



GLADE DRILLING PROGNOSIS
PRECISION 580



ZERO IN™

Drilling Prognosis GLADE

GLADE WEST API# 05-123-52915
GLADE EAST API# 05-123-52916

Rev. 1

CONFIDENTIAL

SHL: 40.253073° N, 104.739141° W
2324' FSL & 1223' FEL, Section 2

Section 2, T3N, R66W

This program should be considered a guide to follow as long as actual well conditions allow. When actual well conditions deviate from pre-drill predictions, the Drill Site Manager (DSM) will make decisions adhering to our MOC methodology and standard. When possible, the Field Drilling Superintendent (FDS) and Drilling Engineer (DE) should be consulted prior to program deviations. If errors are found in the program, contact the drilling engineer so they may be corrected.



Contents

1.0 WELL INFORMATION 5

1.1 Objective of Proposed Work 5

1.2 Pad Directions 5

1.3 General Overview of Operations..... 6

1.4 Wellbore Diagram 8

1.5 Well Plans 8

1.6 Projected Days Vs. Depth.....11

1.7 Projected Cost Vs. Depth12

2.0 CONDUCTOR AND CELLAR PROGRAM13

2.1 Notifications13

2.2 Design Details and Dimensions.....13

3.0 SURFACE HOLE PROGRAM (VERTICAL)14

3.1 Notifications14

3.2 Site Evaluation and Preparation.....14

3.3 Surface Hole Procedure15

4.0 INTERMEDIATE HOLE PROGRAM (NEAR VERTICAL).....24

4.1 Overview24

4.2 Intermediate Hole Procedure24

5.0 PRODUCTION HOLE PROGRAM (BASEMENT INTERVAL).....40

5.1 Overview40

5.2 Production Hole Procedure.....40

6.0 RANGING AND INTERCEPT OPERATIONS52

6.1 Overview52

6.2 Procedure.....52

7.0 WRAP UP OPERATIONS57

7.1 Overview57

7.2 Procedure.....57

APPENDICES59

A – CONTACT LIST60

B – Subsurface Prognosis and Logging Program64

C – Well Control Monitoring, Mitigation and Procedures65

D – Spec Sheets72

E – Supplemental Drilling Procedures85

F – Newpark Fluids Program.....89

G – StreamFlo Geothermal Wellhead.....91

H – SLB Logging Procedures.....92

I – Halliburton Ranging Procedure.....93



J – APD	95
L – Emergency Action Plan.....	96



NOTE: Always confirm latest revision of Drilling Program is used. A printed version may be out of date. See revision table below for changes that have been made to the program.

Version Number	Revisions to Program	Date
1.0	Initial Release	3/28/2025

BU APPROVALS / NOTIFICATIONS			
TITLE	SIGNATURE / DATE	TITLE	SIGNATURE / DATE
Project / Drilling Engineer (Initiator)	Redacted	Drilling Manager	Redacted
Drilling Engineering Supervisor	Redacted	Director Drilling & Completions	
Drilling Superintendent	Redacted	Drilling Engineer	

ADDITIONAL APPROVALS / NOTIFICATIONS			
TITLE	SIGNATURE / DATE	TITLE	SIGNATURE / DATE
VP – World Wide D&C	Redacted		



1.0 WELL INFORMATION

Geothermal Limitless Approach to Drilling Efficiencies (GLADE) is a partially funded U.S. Department of Energy project to demonstrate drilling technology in a Geothermal application.

1.1 Objective of Proposed Work

The objective of this project is to reduce overall cycle time, from spud to total depth, of drilling hard, hot, basement rock in twin geothermal wellbores. The proposed design provides an opportunity to drill thousands of feet of granitic basement rock to demonstrate advancements in rate of penetration and cycle times. The primary goals to achieve this objective are:

- 1. Improve instantaneous drilling rate of penetration by trialing novel downhole tools and technologies.
- 2. Increase footage drilled between failures to reduce overall non-productive time on the well.
- 3. Apply rig performance metrics from oil and gas operations to reduce off-bottom time.

Secondary goals for Oxy Rockies Development are as follows:

- 1. Define temperature gradient in the basement granitic section.
- 2. Connect the two wellbores in a loop to evaluate production capabilities and surface equipment.
- 3. Evaluate deep sedimentary section for alternative geothermal applications.

1.2 Pad Directions

This location has a designated haul route that must be followed by all personnel entering and leaving the GLADE location. From the intersection of Weld County Road (WCR) 32 and WCR 35 travel north approximately 2.4 miles (past WCR 36) to the site lease access road. Turn left and travel west on the site lease access road approximately 500 feet to pad.





1.3 General Overview of Operations

Batch drilling two twin wellbores.

DRL Order	West	East
	Target	Intercept
Surface 1		x
Surface 2	x	
Intermediate 1	x	
Intermediate 2		x
Production 1	x	
Production 2		x



Cellar and Conductor

- Install 8' dia cellar ring
- Set 20" dia (0.375" well). conductor approx. 80' below ground level
 - Cut conductor 41.5" below ground level
- Preinstall 14" x 80' mousehole adjacent to each conductor
 - Ensure alignment matches rig orientation

Note: Operation will be coordinated by the Construction Team and executed by Melvin Geib.

Surface Hole

- Drill 17.5" hole to $\pm 2,350'$ TVD with freshwater mud
- Run 13-3/8" 54.5 ppf L-80 Type 1 BTC surface casing
- Land out StreamFlo Casing Head assembly (A Section) on 20" conductor pipe
- Cement surface casing with TOC at surface
- Skid rig and repeat

Intermediate Hole

- NU and test 13-5/8" x 10,000 psi BOP and RU RCD
- Swap drilling fluids from Freshwater to SBM
- Drill 10' of new formation with 12-1/4" bit and perform FIT to 18.0 ppg equivalent
- Drill down to a final depth of $\pm 10,800'$ MD (Base of the Sedimentary Formations)
- TOOH, RU Logging equipment and log intermediate
- Run 9-5/8" 47 ppf P-110 IC ER intermediate casing (Shoe set 50ft into Granite)
- Pump single stage cement job with TOC to surface
- Install and test packoff
- Install StreamFlo Intermediate head assembly (B section) and blind flange



- Skid rig and repeat
- Offline – RU Wireline and obtain CBL and Gyro log

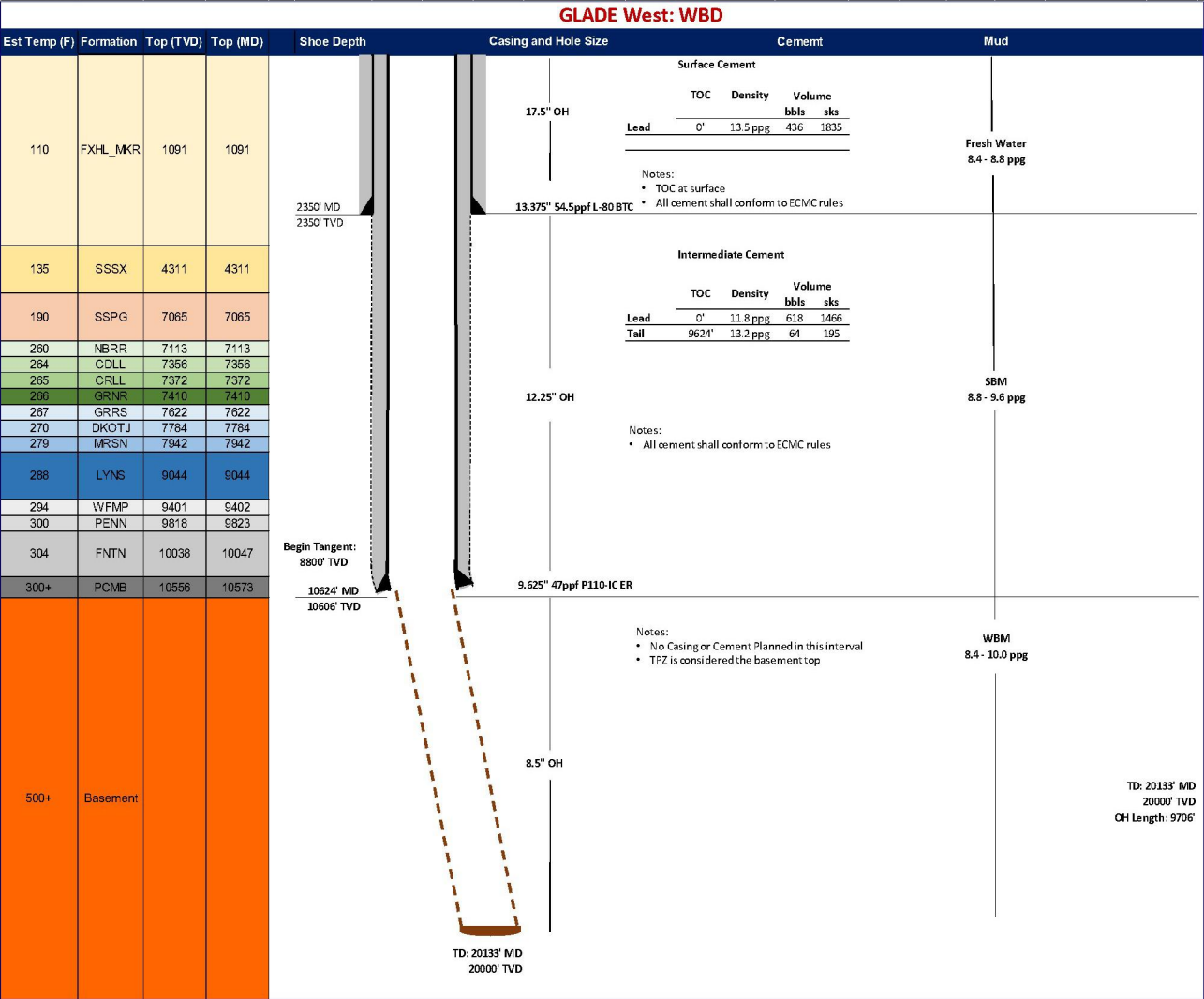
Production Hole

- Swap drilling fluids from SBM to WBM
- NU on GLADE **West** (Target Well) and test 13-5/8" x 10,000 psi BOP and RU full MPD
- Drill 10' of new formation with 8-1/2" bit and perform FIT to 16.2 ppg equivalent
- Drill to a TD depth of approximately 20,000' TVD
- TOOH, RU logging BHA, execute logging runs
- TOOH and install 5-1/2" 17# P110-ICY TPN ranging string
- Install and test pack off and install back pressure valve
- ND BOP, skid rig, and install adapter and master valve. ,
- NU on GLADE **East** (Intercept Well) and test 13-5/8" x 10,000 psi BOP and RU full MPD
- Drill 10' of new formation with 8-1/2" bit and perform FIT to 16.2 ppg equivalent
- Complete first ranging run using AC MGT System to verify target wellbore position.
- Drill to an approximate depth of 16,000' MD
- Execute ranging plan to a well intercept depth of approximately 19,500' MD
 - This plan will use a combination of MGT, WellSpot and/or RMRS ranging techniques from Halliburton
- Confirm well intercept has been completed and TOOH
- RU Thrubit BHA, TIH and log production hole
- Install and test pack off and install back pressure valve
- ND BOP, skid rig and install adapter and master valve
- Skid back to GLADE West and NU and test BOPs. Pull previously installed 5 1/2" casing
- Install and test pack off and install back pressure valve
- ND BOP and re-install adapter and master valve
- Prepare for rig DEMOB



1.4 Wellbore Diagram

The diagram below illustrates the overall design for the planned GLADE geothermal wells. This should only be used as a general reference guide and not for determining final hole depths, casing set points, or cement volumes – That information should be obtained from the final well plan and cement programs (and verified with the DE).



1.5 Well Plans

The well path is designed to minimize casing and drillpipe wear as well as prevent buckling while drilling the production hole section by maintaining vertical orientation as long as possible but still allowing the initial build section to be completed prior to entering the granitic section. The well orientation maximizes AC from offset wells and helps mitigate risk of encountering downhole structure. It is CRITICAL to minimize DLS while drilling the Surface and Intermediate section. The DLS target in these sections will be < 1 Deg/100ft and the build will be planned on a DLS of 1 deg/100ft. Pre-job modeling has indicated that any shallow doglegs will hinder our ability to meet objectives in the production hole section. If BHA has a significant drift tendency, please notify DS/DES/DE to discuss path forward.

Regularly verify that the directional drillers are working to the latest well plan revision and contact the DE/DES/DS immediately if deviations from the plan are required.



Project: WELD-NAD83-UTMFT13N
Site: 3N-66W-02 GLADE Geothermal Pad
Well: GLADE EAST
Wellbore: Plan A
Design: Permit Rev-2

US ROCKIES WATTENBERG PLANNING

CASING DETAILS

TVD	MD	Name	Size
1637.00	1637.00	13-3/8"	13-3/8"
10606.00	10608.21	9 5/8"	9-5/8"
20000.00	20162.38	5-1/2"	5-1/2"

SHL
2134' FSL
1146' FEL

TPZ
2137' FSL
1188' FEL

BHL
2287' FSL
2376' FEL



SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSecl
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	9850.00	0.00	0.00	9850.00	0.00	0.00	0.00	0.00	0.00
3	10800.00	9.50	275.00	10795.65	8.85	-78.28	1.00	275.00	78.58
4	15400.00	9.50	275.00	15392.57	73.02	-834.81	0.00	0.00	837.80
5	15600.00	11.50	275.00	15529.21	76.20	-870.92	1.00	0.00	874.24
6	20162.38	11.50	275.00	20000.00	155.47	-1777.05	0.00	0.00	1783.83

WELLBORE TARGET DETAILS (LAT/LONG)

Name	TVD	Northing	Easting	Latitude	Longitude
GLADE EAST_SHL	0.00	14618806.85	1713249.34	40.252551	-104.738987
GLADE EAST_TPZ	10556.00	14618810.53	1713205.83	40.252562	-104.739122
GLADE EAST_BHL	20000.00	14618957.09	1711471.84	40.252978	-104.745336

WELL DETAILS: GLADE EAST

GL = 4900'

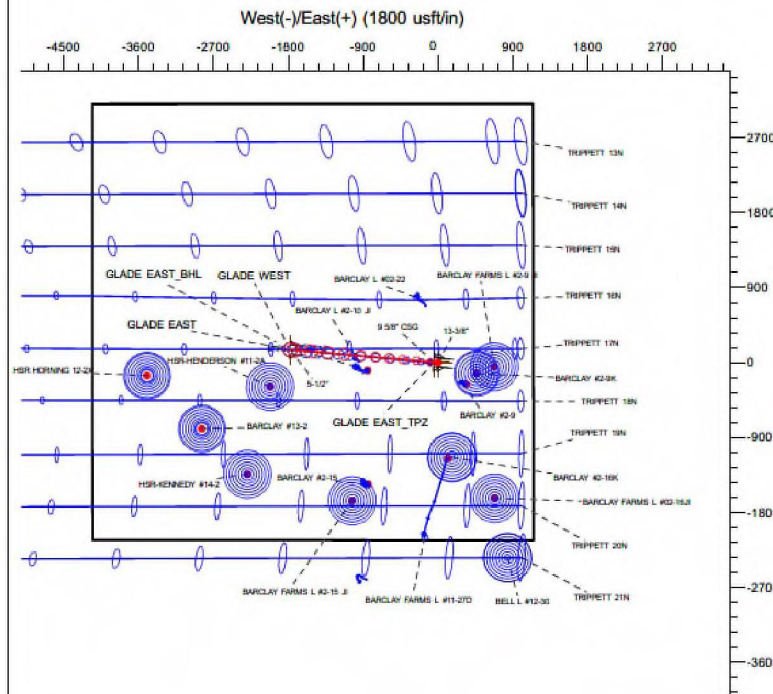
RKB = 17' @ 4917.00usft (RIG)

Plan: Permit Rev-2 (GLADE EAST/Plan A)

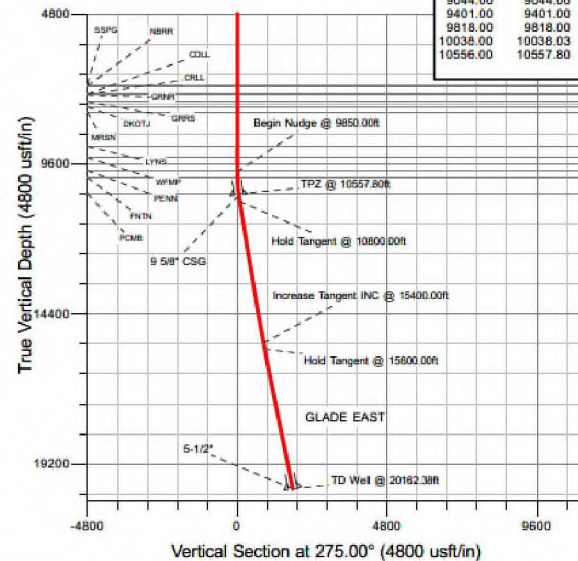
Date: 12/17/2024

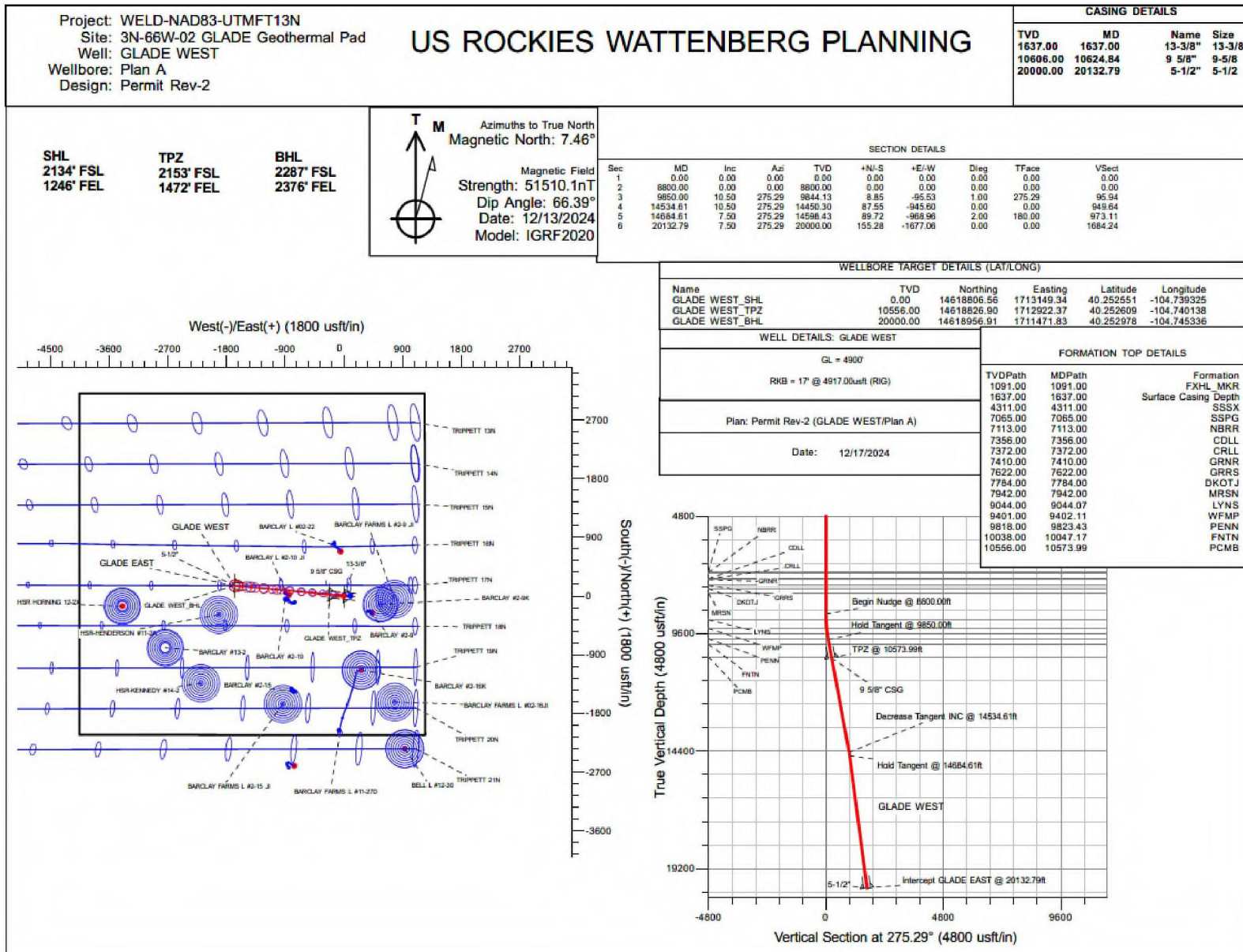
FORMATION TOP DETAILS

TVDPath	MDPath	Formation
1091.00	1091.00	FXHL MKR
1637.00	1637.00	Surface Casing
4311.00	4311.00	SSSX
7065.00	7065.00	SSPG
7113.00	7113.00	NBRR
7356.00	7356.00	CDLL
7372.00	7372.00	CRLL
7410.00	7410.00	GRNR
7622.00	7622.00	GRRS
7784.00	7784.00	DKOTJ
7942.00	7942.00	MRSN
9044.00	9044.00	LYNS
9401.00	9401.00	WFMP
9818.00	9818.00	PENN
10036.00	10036.00	FNTN
10556.00	10557.80	PCMB



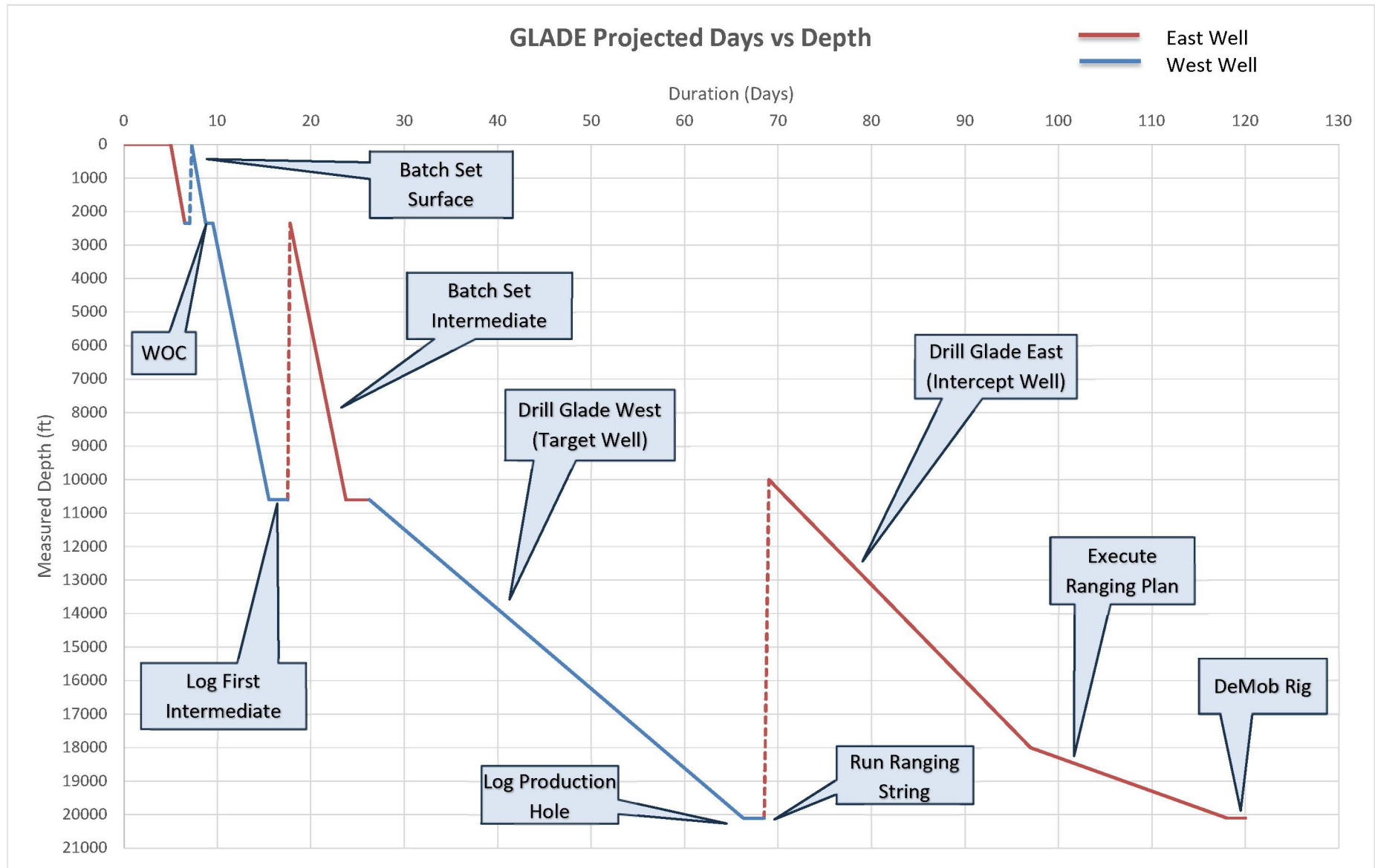
South(-)/North(+) (1800 usft/in)







1.6 Projected Days Vs. Depth





1.7 Projected Cost Vs. Depth

Protected Data



2.0 CONDUCTOR AND CELLAR PROGRAM

Note: Operation will be coordinated by the Construction team and executed by Melvin Geib vendor.

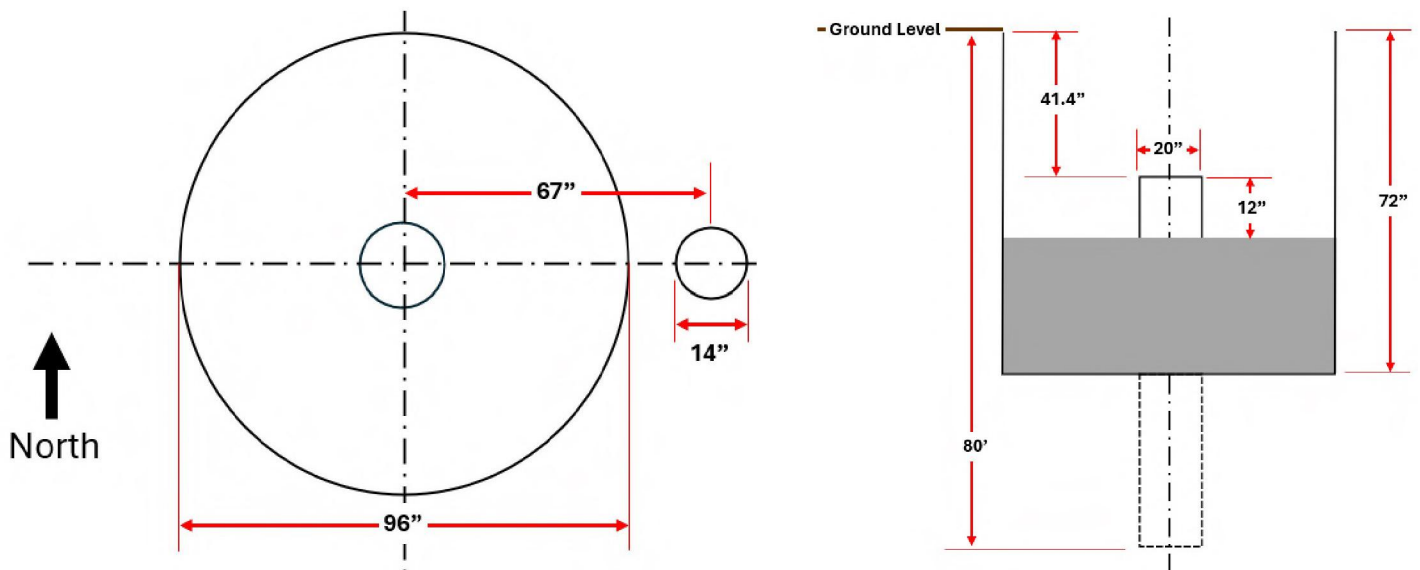
2.1 Notifications

- Notify the ECMC at least 24 hours prior to spud by using the well's API number and provide the following info:
 - Casing size
 - Time/date of spud
 - The 24/7 rig phone number
 - If spud happens to occur on a weekend, call the Thursday or Friday prior to that weekend and give the anticipated spud date.

2.2 Design Details and Dimensions

- Cellar Information
 - 8' diameter with permanent aluminum cellar ring (culvert)
 - Cement in bottom of cellar leaving 12" of conductor
 - 6' deep from ground level (cellar top) to cement floor (cellar floor)
- Conductor Information
 - 20" diameter
 - ASTM A53 Grade B, 3/8" wall thickness
 - Cut off conductor 41.4" from top of conductor to ground level
 - Set conductor at ~80'. Ensure the bottom of conductor is set in at least 5' of competent rock

NOTE: Ensure a mousehole is drilled next to each conductor (Qty 2 total).





3.0 SURFACE HOLE PROGRAM (VERTICAL)

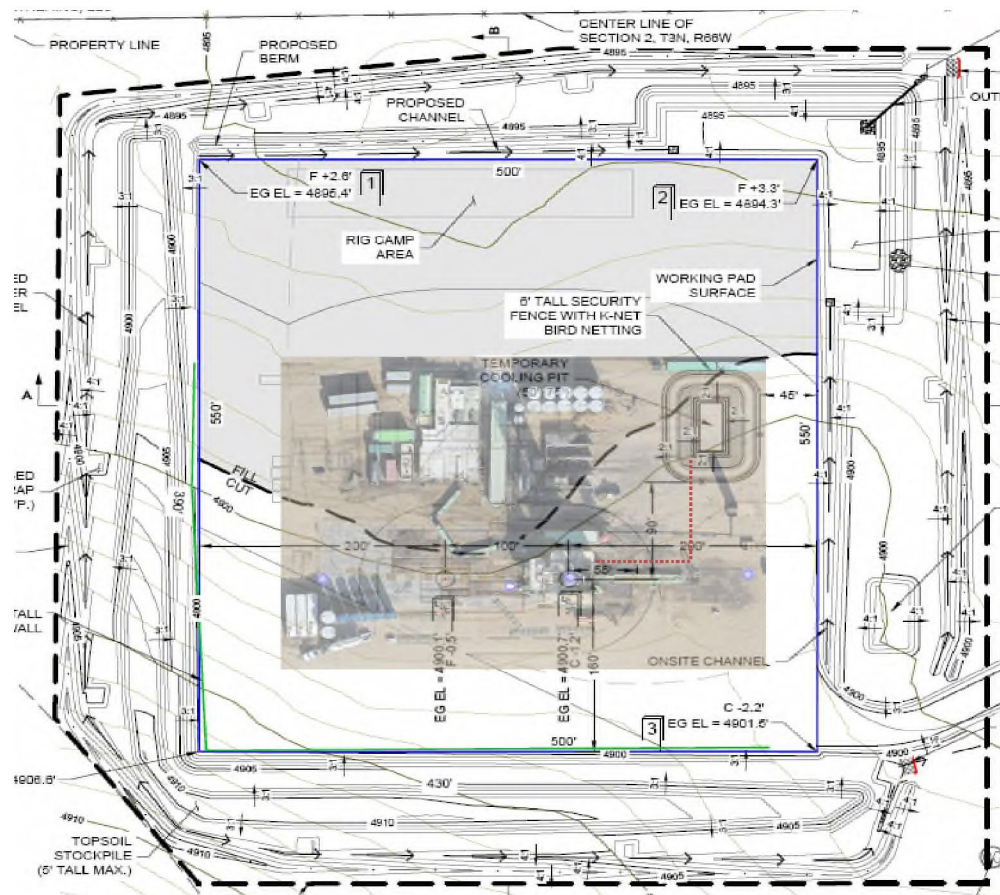
3.1 Notifications

- Notify StreamFlo field representative prior to spudding surface – **Redacted**
- Ensure that one-calls have been submitted 48 business hours in advance of moving the rig onto location

3.2 Site Evaluation and Preparation

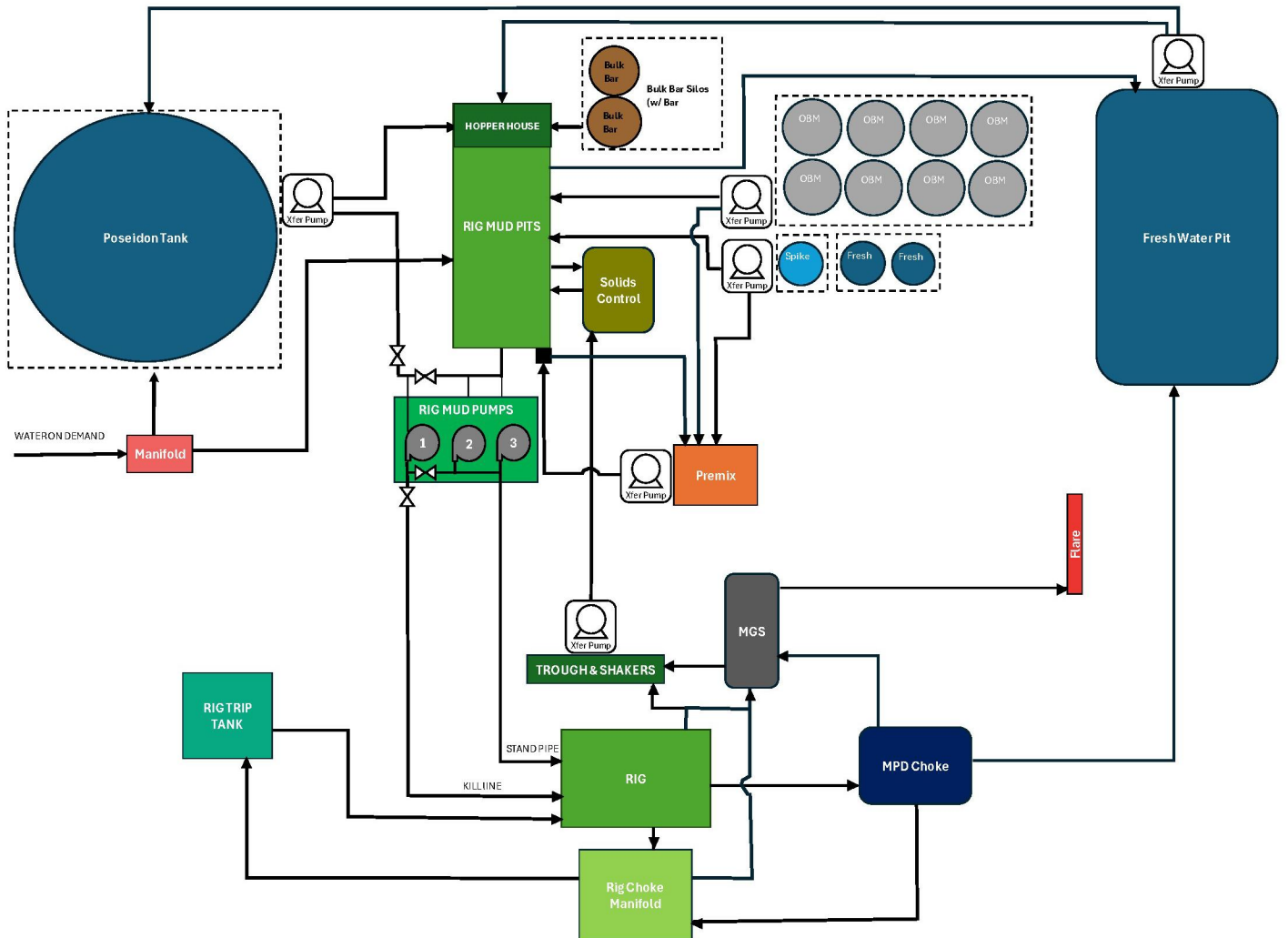
- Prior to the rig move, OXY Wellsite Consultant and rig manager shall ensure the GLADE location is ready and safe to accept the rig
- Ensure the following equipment and tanks have arrived on location and are properly arranged:
 - QTY (1) premix tank
 - QTY (1) 10,000 bbl Poseidon Tank for H₂O Storage
 - QTY (3) 400 bbl Frac Tanks
 - QTY (3) 400 bbl tanks for H₂O storage
 - QTY (5) 500 bbl tanks for SBM storage
 - QTY (2) bulk bar silos with bar blower
 - QTY (6) transfer pumps
 - QTY (1) pond pump

NOTE: Extra tanks will likely be necessary for temporary mud storage during pit cleanout operations.





- Tank farm plumbing schematic below (simplified for clarity) - Final arrangement is at the discretion of the FDS and DSMs, but shall be validated by the drilling fluids provider, solids control provider, DE & DS.
- The pad also includes a 3,000 bbl capacity lined pit in the east side of location. A hard line shall be installed and anchored to route steam and liquid returns to that pit from the MPD choke.



3.3 Surface Hole Procedure

- 1) MIRU over staked Glade **EAST** well location for the first Wellbore – Verify the rig is centered over the conductor and is level.
- 2) Complete Pre-Spud Checklist for setting surface.



<u>DRILLER & LEAD HAND INITIALS</u>	<u>DESCRIPTION OF SYSTEM CHECK</u>	<u>DRILLER CHECK OFF BOX</u>	<u>LEAD HAND CHECK OFF BOX</u>
	RIGGED UP ON THE CORRECT WELL AND CORRECT PAD		
	WELL READY TO DRILL (RTD) AND IS THE AFE APPROVED		
	CENTERED OVER THE WELL LOCATION PROPERLY		
	HAVE THE DIRECTIONAL DRILLER, COMPANY MAN, DRILLER AND TOOLPUSHER DISCUSSED THE WELL PLAN		
	RIG HAS HOSES HAMMERED UP & WHIP CHECKS IN PLACE		
	SAFETY RAILS UP		
	CONFIRM CONDUCTOR HEIGHT IS APPROPRIATE – TOP OF CONDUCTOR SHOULD BE 41.2” IN BELOW GROUND LEVEL		
	ALL VALVES ARE IN PROPER POSITION TO START OPERATIONS		
	MUD SYSTEM HAS BEEN FULLY CLEANED PREVIOUSLY AND IS ALL READY FOR WBM		
	MUD PITS ARE FULL OF WATER AND MUD IS PRETREATED		
	HIGHLINE POWER IS HOOKED UP PROPERLY & WIRED CORRECTLY AND RUNNING, GENERATORS ARE READY TO USE AS BACKUP		
	CELLAR PUMP IS SET IN PLACE AND WORKING		
	SAFETY CABLES ARE ON AND SECURED		
	SHAKERS & SCREENS ARE IN GOOD WORKING ORDER AND RUNNING WITH API 80's INSTALLED		
	SOLIDS CONTROL HAS DEWATERING UNIT AND CENTRIFUGE IN GOOD WORKING ORDER AND RUNNING		
	LINE OF COMMUNICATION BETWEEN RIG AND SOLIDS CONTROL COMPANY ARE IN PLACE TO AVOID SPILLS		
	RIG HAND IS MONITORING CELLAR TO PREVENT SPILLS		
	DIRT BERM IN PLACE IN FRONT OF CUTTINGS CATCH TANK		
	MUD PUMPS ARE EQUIPPED TO REACH 1100 GPM		

NOTE: Verify with MWD hand that tool has been programmed to transmit continuous INC and AZI prior to picking up tools.



3) Pick up the following BHA (BHA #1) to spud. Pick up 5" delta 527 DP using mousehole:

OXY	GLADE PROJECT	PD 580			Bit: TK69-B11	Guage = 4 in	Nozzle Sizes: 6x14	HSI = 2.307
#	Description	OD (in)	ID (in)	Cnx Up	Cnx Dn	Length (Usft)	Total Length (Usft)	Comments
1	17.5" PDC	17.5		7-5/8 REG		1.5	1.5	
2	14" Vertical Scout	14	2.25	7-5/8 REG	7-5/8 REG	23.5	25	Pad @ 5/6 ft
3	9-5/8"x8", 7/8, 5.9, 0.155 rev/gal	9.625	2.25	6-5/8 Reg	7-5/8 REG	40	65	
4	NM Integral Blade Stabilizer	17.4375	3.25	6-5/8 Reg	6-5/8 Reg	6	71	Stab @ 68 ft
5	8 NM Pony Collar	8	3.25	6-5/8 Reg	6-5/8 Reg	15	86	
6	Gap Sub	8	3.25	6-5/8 Reg	6-5/8 Reg	5	91	EM Survey @ 79 ft
7	NM Integral Blade Stabilizer	17.375	3.25	6-5/8 Reg	6-5/8 Reg	6	97	Stab @ 94 ft
8	NM DC	8	3.25	6-5/8 Reg	6-5/8 Reg	30	127	
9	8" Shock Sub	8	2.75	6-5/8 Reg	6-5/8 Reg	15	142	
10	8" DC	8	3.5	6-5/8 Reg	6-5/8 Reg	90	232	
11	Crossover SUB	6.5	2.875	4 1/2 IF	6-5/8 Reg	5	237	
12	6 1/2" Drill Collars	6.5	2.875	4 1/2 IF	4 1/2 IF	180	417	
13	Crossover SUB	6.5	2.875	Delta 527	4 1/2 IF	5	422	
14	5" HWDP	5	3	Delta 527	Delta 527	540	962	
15	5" Drill Pipe	5	4.276	Delta 527	Delta 527	1,388	2,350	

NOTE: Plan to PU an 8" NOV Shock Sub (supplied by Scout) to mitigate vibrations and shock loads.

NOTE: Verify piston force required with onsite Vertical Scout Rep prior to picking up BHA. The total backpressure target will be 800psi with a minimum pressure drop required of 700psi. The maximum pressure drop across the bit is 1000psi. Please refer to Vertical scout spec sheet in appendix. A restrictor plate will be run to achieve additional backpressure if pressure is not exceeded with the bit jetting.

NOTE: Stabilizer OD size and placement are critical for proper BHA tracking. The above BHA is a proposal with estimated component lengths. Please confirm component lengths onsite with Scout representative. Discuss with DS/FDS/DE if stabilizer placement deviates significantly from proposed BHA.

- 4) Pretreat the freshwater mud system using the following guidelines:
- Section off mud pits to limit mud system to 650-750 bbl, not full rig capacity
 - Add Gypsum/Calcium Sulfate to achieve a hardness of >1500 mg/L
 - Calcium Ammonium Nitrate can be added for additional hardness



- c) Add a sack of SAPP and a five-gallon bucket of drilling detergent per 400 bbl mud
- 5) Below is the recommended liner configuration for the F-1600 (12" stroke) mud pumps to attain 1000 gpm.
 - a) QTY (3) pumps with 6" liners (~1350 gpm flow rate capability @ 95% efficiency)

NOTE: Do not exceed the maximum stroke rate of 108 strokes/min.

NOTE: Maintain at least 850 GPM (w/ proposed Bit TFA and no restrictor nozzle) while drilling ahead to ensure the Vertical Scout tool is operating above the minimum back pressure requirement. Verify operating flow window with DE after surface BHA has been finalized during execution.

- 6) Returns will be transferred out of the cellar to shakers using Godwin/Fisher pump (1,450 gpm capacity).
 - a) Ensure that a backup is available in case the primary becomes plugged or additional pump is required to keep up with returns.
 - b) Always have a person near the cellar monitoring with a radio to make sure cellar does not overflow
- 7) Mud system should be maintained as follows during drilling operations:
 - a) Add one (1) SAPP sticks and two (2) soap sticks on every connection
 - b) Pump 30 bbl high vis sweep every 200' or as needed
 - i) 80 bbls of freshwater
 - ii) 1 sk soda ash
 - iii) 10 ppb NewGel HY
 - iv) 0.25 – 1 ppb NexVis
 - v) 1 sk Walnut M
 - c) New PHPA sweeps may be pumped for additional hole cleaning
 - d) DynaDet may be added to break up bit balling and mud rings
 - e) In the event we encounter losses or water flow, add Sawdust and fiber Seal or NewCarb and DynaFiber directly to the suction tank. For more aggressive losses, add larger fibers (e.g. walnut shells, etc...)
 - i) Seepage Losses (85-99% Returns)
 - (1) 3-5 ppb NerCarb
 - (2) 3-5 ppb Sawdust
 - (3) 2-4 ppb DynaFiber
 - ii) Partial Losses (35-84% Returns)
 - (1) 6-10 ppb NewCarb C
 - (2) 5-7 ppb FiberFluid/DynaFiber
 - (3) 4-6 ppb Phenoseal
 - (4) 24 ppb Vanguard
 - iii) Severe Losses (0-34% Returns)
 - (1) 6-10 ppb NewCarb C
 - (2) 5-7 ppb FiberFluid/DynaFiber
 - (3) 4-6 ppb Phenoseal
 - (4) 24 ppb Vanguard
 - (5) 20 ppb X-Prima

NOTE: Please refer to Scout LCM guidance in appendix for maximum concentration for MWD tools.

- f) Maintain the following mud properties:

Water-Based Mud Properties – Surface Hole					
Density (ppg)	Funnel Vis.*	PV	YP	pH	Hardness (mg/l)
8.4 – 8.9	28 - 34	2-6	2-10	8 - 9	>1,000

*Viscosity should be on the higher end of the range to maximize hole cleaning efficiency.

- 8) Drill per Scout's directional plan to achieve a minimum 13-3/8" set depth of 2,350' TVD
 - a) **CRITICAL:** Maintain DLS <1.0° to casing point at 2,350' TVD



- b) Adjust section TD for casing measurements while allowing for a 10' rat hole
- c) EM-MWD will be used
- i) Monitor MWD continuous INC and AZI to look for any early indications of deviating from planned trajectory. Critical to report any deviations from immediately for discussion with DSM, FDS, and DE.
- d) Rotate down past ~200 ft MD to get sensor away from conductor
- e) Surveys should be taken every connection
- f) Typical drilling parameters (may be varied to optimize ROP and controllability):
- | Weight On Bit | Differential Pressure | Flow Rate | Rotary Speed |
|---------------|-----------------------|---------------|--------------|
| 15-25 kips | 500 – 700 psi | 1000–1200 gpm | 50 - 60 rpm |
- g) The vertical scout tool does not have any limitation on backreaming. Back ream full stands or as needed to maintain wellbore quality, ream doglegs, and clean up any potential ledges.
- 9) At surface TD, circulate two final high viscosity / LCM (as required) sweeps (60 bbls each) and continue circulating until shakers clean up prior to pulling out to run casing (2x BU minimum with full BU after sweeps are out of hole)
- a) POOH & rack back BHA - If tight spots are encountered, work the spot, washing and reaming
- i) If tight spots are encountered trip back to bottom and circulate BU
- NOTE: DO NOT PULL MORE THAN 30 KIPS INTO A TIGHT SPOT**
- b) If no tight spots are encountered, rack back drill string.
- NOTE:** Stabilizer OD is critical for proper BHA tracking. Confirm bottom stabilizer is still 1/16" UG and top stabilizer is 1/8" UG prior to racking back BHA. If stabilizers are worn, replace for second well.
- 10) Check all 13-3/8" casing equipment for correct sizes and connections as they arrive on location and drift casing per API drift.
- a) Ensure pup joints are available to adjust the casing tally as needed.

NOTE: Ensure casing running company has CRT available prior to casing run.

- 11) RU equipment to run 13-3/8" 54.5 ppf L-80 Type 1 BTC casing using CRT.

13-3/8", 54.4 ppf, L-80 Type 1 Surface Casing								
Casing Properties (Rated at 100%)								
ID (in)	Drift (in)	Collapse (psi)	Burst (psi)	Tensile (kips)	Threads	*Torque (ft.-lbs)		
						Min	Opt	Max
12.615	12.459	1,140	3,980	1241	BTC	N/A	N/A	N/A

*API buttress connection is designed to be made up to a final position, there is no final torque specified – Minimum make up is one full thread turn before triangle base and maximum is to triangle apex. To determine make up torque for the string, record the torque required to reach the center of the triangle for the first 15 joints. Use the average torque as your running torque and ±10% as the minimum and maximum make-up torques. Visually check with a frequency of at least 1 in 10 joints that the field end coupling face is within the acceptable position after make-up for the remainder of the casing run.

NOTE: Refer to Surface Casing Spec sheet in Appendix.

- 12) Run 13-3/8" 54.5 ppf L-80 Type 1 BTC casing
- a) Leave 10' of rat hole
- b) Keep casing full while tripping in the hole (Fill casing and break circulation every 10 joints or sooner)
- i) Break circulation slowly then increase up to 6-8 bpm as the hole conditions allow
- ii) Circulate for 5-10 minutes to allow pressures to stabilize prior to continuing in the hole



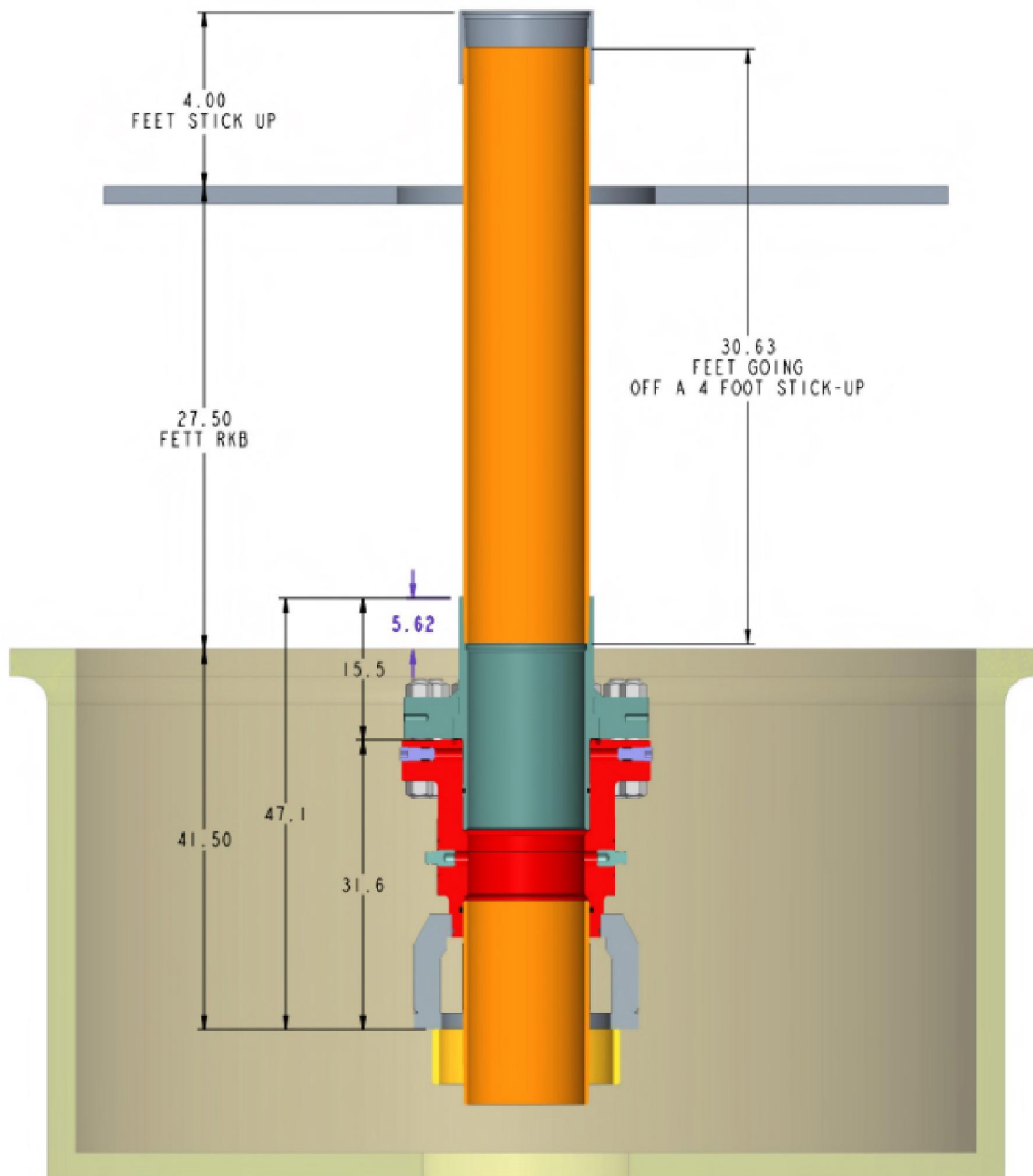
NOTE: A trip sheet must be filled out during the casing run. Record mud displacement volumes. Reduce running speeds if fluid is being pushed away. Stop and monitor for flow if excess fluid volume is returned.

13-3/8" Casing Setting Details & Centralization								
Interval	Length	Weight	Grade	I.D.	Drift	Conn	Description	Vendor
0' - 6'	6'	54.5	L-80 TYPE 1	12.615	12.459	BTC	Hanger w/ 6ft Pup	StreamFlo
6' - 2,268'	2,262'	54.5	L-80 TYPE 1	12.615	12.459	BTC	+/- 53 joints	Tenaris
2,268' - 2308'	40'	54.5	L-80 TYPE 1	12.615	12.459	BTC	Pre-Bucked with Collar on Pin End	Tenaris
2,308' - 2,309'	1'	NA	L-80 TYPE 1			BTC	Float Collar	HAL
2,309' - 2,349'	40'	54.5	L-80 TYPE 1	12.615	12.459	BTC	Shoe Track Jt.	Tenaris
2,349' - 2,350'	1'	NA	L-80 TYPE 1			BTC	Float Shoe	HAL
Cement Plugs will be supplied by HAL and run prior to cement (bottom plug) and displacement (top plug). Install solid body and single piece bow spring centralizers as follows:								
- One solid body above the float shoe and one solid body above the float collar supplied by HAL. - Single piece bow spring installed on the 2nd and 3rd joints, then a centralizer every 3rd joint, to surface supplied by HAL. - We will need approximately 22 centralizers. - Place 2 ridged welded centralizers in conductor to help centralize casing (One on each of the last two joints) supplied by HAL.								

- 13) Pick up Casing Head (Section A) assembly and slowly lower the wellhead assembly through the rotary table and land the baseplate flush on top of the 20" conductor pipe. After landing the wellhead assembly, perform the cement job, then the StreamFlo hand will finish the installation.
- a) Make up Casing Head components on pipe rack prior to picking up.
 - i) First portion is made up of casing head and pup joint that is pre-bucked and welded
 - ii) Second portion is the torque tool and landing joint.
 - b) Ensure that all the wellhead valves are removed and replaced with flush plugs so that the assembly will fit through the rotary table (**37.5" opening for PD 580 rotary table**) – Verify wellhead valve configuration with StreamFlo Hand prior to lowering through rotary table
 - c) Casing valves should be pointing North when installed.
 - d) Rig hand should be near cellar with radio for quick communication
 - e) Wash assembly down if needed.
 - f) Slack off so wellhead is sitting on conductor and set slips in the rotary table.

NOTE: The GLADE wells are using a different wellhead design than is typical in the DJ Basin; the StreamFlo System (13-5/8" 10,000 psi). It is crucial to review the running/operating procedure for this system prior to installation and ensure that the StreamFlo Field Hand is well versed in this wellhead configuration/installation procedure. Contact Josh DeForest or Jason Sarrafian with any issues or concerns related to personnel. Reference Wellhead installation procedure in appendix.

NOTE: Please refer to following diagram for casing head landing assembly.



- 14) Rig up cementing equipment and test lines to 2,500 psi. Circulate at least 2 casing volumes (~725 bbls) at 15-20 bpm (or maximum pump rate). Keep circulating until shakers are clean and the well is stabilized.
 - a) Verify water sample test has been performed on cement mix water to ensure there are no contamination issues associated with the source water
 - b) **Notify Halliburton two days prior to the cement job.** The notification will include the timing of the job and the cement job screen shot shown below.
 - c) **Call the Halliburton dispatch number in the contacts section one day prior to the cement job.**
 - d) **Call the Halliburton dispatch and provide eight hours' notice of the time to be on location.**



- e) Dry cement and mix water to be used must be checked in the lab for properties before mixing prior to rig up. Wet, dry and water field samples are required and should be set aside until such time as the job outcome is known.
- f) Do not over-displace the volume between the float shoe & float collar.
- g) Note amount of cement returns, lift, and bump pressures on morning report. Also mention any other losses during casing circulation, displacement, etc.
- h) Be prepared to do a top job if the cement in the annulus falls below ground level

NOTE: The maximum flow rate for the Halliburton float equipment with the 4-1/4" valve is 25 BPM for 24 hrs.

NOTE: There is potential to have cement to surface after the first stage cement based on the excess volumes. Ensure we have vac trucks lined out to treat high volumes at surface if needed (sugar as well). Send treated cement to the cuttings collection area.

Surface Cement Program							
Spacer	40 bbls of Fresh Water @ 8.32 ppg						
Tail	13.5 ppg, SBM CEM VARICEM						
Top-out	14.2 ppg, Class G						
Slurry	Density, ppg	Yield, ft³/sk	Mix Water, gal/sk	Top	Volume		
					bbls	sacks	Excess
Tail	13.5	1.34	6.91	0' - 2350'	509	2133	75%
Top-out	14.2	1.50	7.64	0'			
Comments	Check volumes with HAL prior to pumping cement job. Make sure there is cement and other LCM products on location that can be pumped on the fly if needed.						

- 15) All cementing stages are designed for a minimum pump rate of 4 bpm. Ideally the well will allow pump rates of at least 6 bpm. Pump spacer at 6-8 bpm, drop bottom plug, pump lead cement at 6-8 bpm, and chase cement with top plug. Displace cement at 6-10 bpm with fresh water. Stop pumping 25 bbls prior to plug bump for hesitation squeeze procedure. The following steps are to be used as a general guideline.
- a) Stage the final 25 bbls of displacement, shutting down at 5 bbl intervals for 5-10 mins (20 bbls, 15 bbls, 10 bbls, and 5 bbls short of displacement each).
 - b) Watch cement fall and make decision for each stage based on how fast/far it falls each time. If pressure is seen during staging, continue displacement to ensure plug bump.
 - c) After plug bump increase pressure 500 psi over lift pressure to ensure plug is seated, hold for 5 minutes.
 - d) Release pressure and check floats. If floats leak, pressure back up to final displacement pressure and hold until cement slurry has achieved 50 psi compressive strength, (est. WOC duration of 4 hours). Verify WOC duration with FDS and DE. In no event should more than 1.0 bbls of displacement fluid be allowed to flow back before the well is shut in.
 - e) If necessary, pump a top job with Standard – Class G cement at 14.2 ppg.

NOTE: It is crucial that a thorough PJSM has been conducted so everyone involved on the cementing operation is familiar with the plan and what to look out for during the job.

NOTE: It is permissible to allow the cement to enter and slightly fill the cellar, and consequently “backfill” the 13-3/8” X 20” annulus to aid with any cement fall-back that may occur.

NOTE: DO NOT EXCEED 2,786 PSI FOR 13-3/8” AT ANY TIME (70% OF BURST)

- 16) Estimate the amount of cement returns and record pressures.



-
- 17) R/D cementers and remove the landing joint from the casinghead.
- 18) Remove Torque tool and laydown landing joint. Verify StreamFlo has prepared the wellhead by removing the flush plugs and installing the correct fittings and API flange.
- a) Outlet #1:
 - i) VR Plug
 - ii) Companion Flange
 - iii) 2" LP Bull plug
 - iv) Grease Fitting
 - b) Outlet #2
 - i) Flanged Valve 2-1/16 API 5000
 - ii) Companion flange x 2 LP
 - iii) Bull Plug 2 LP x 1/2 LP RWP
 - iv) Grease Fitting, Needle valve, and pressure gauge

NOTE: At this point the wellhead is considered a 5K rated system.

- 19) After completing the Glade **EAST** well, prepare to skid to Glade **WEST** (2nd) surface hole and repeat steps 1-18.
- 20) After successfully completing Glade **WEST** (2nd Well), WOC for 500 psi compressive strength to drill out surface shoe and continue to Intermediate hole program (est. time of 8hrs). Verify with FDS and DE.





4.0 INTERMEDIATE HOLE PROGRAM (NEAR VERTICAL)

4.1 Overview

This section will be drilled with SBM. All aquifer zones have been covered by surface casing. This section will penetrate through all historical producing zones and TD at the top of the basement granitic section. The goal of this section is to maintain a vertical wellbore down to the initial build section. Then build and maintain a low angle tangent until TD. Minimizing DLS in this section is critical to the success of the project. The goal is to maintain <1 Deg/100ft DLS in the vertical section and build the tangent on 1 Deg/100ft DLS. To achieve this goal, the primary plan will be a two BHA strategy that's optimized for each portion of the intermediate hole. The Vertical scout tool will be utilized to maintain vertical down to the build section. An Orbit RSS tool will be utilized for the build portion to TD.

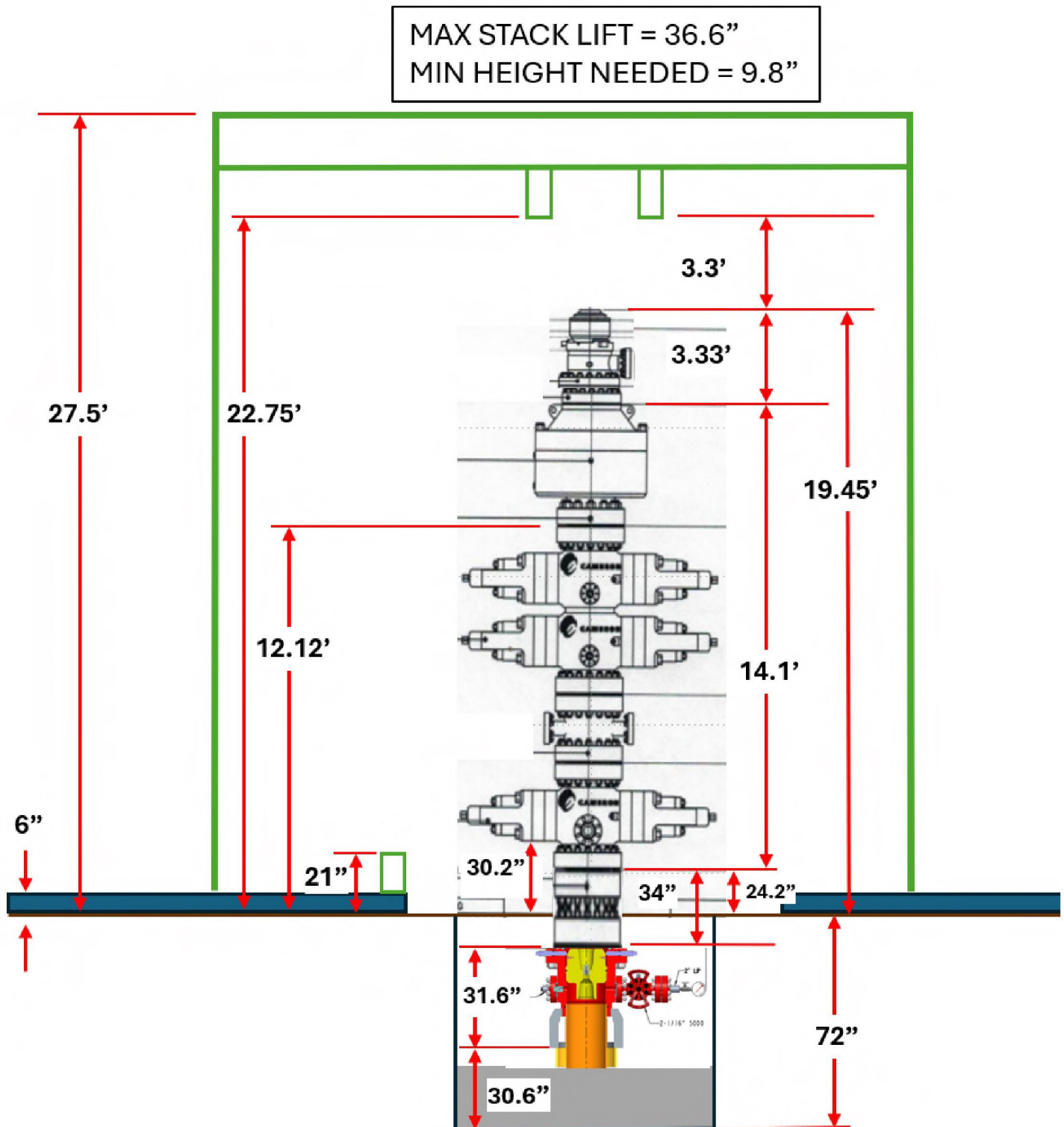
4.2 Intermediate Hole Procedure

- 1) Swap liners to 4.75" liners on all three mud pumps. Clean pits, mud lines, and tank farm in preparation for filling with synthetic base fluid mud.
 - a) QTY (3) pumps with 4.75" liners (~850 gpm flow rate capability @ 95% efficiency)
- 2) Install 34" tall 13-5/8" x 10,000 psi BOP spacer spool.
- 3) Nipple up the 13-5/8" x 10,000 psi BOP onto the StreamFlo Wellhead System
 - a) Allow enough time to achieve a 500 psi (estimated 8 hr) compressive strength prior to lowering BOP onto well head – This will save the conductor from supporting additional weight
 - b) Ensure the correct height 13-5/8" x 13-5/8" spacer spool is installed between the wellhead and lower pipe rams to achieve the right elevation for the flow line
 - c) Take the extra time to ensure the BOP is rigged up properly prior to proceeding
- 4) Install bell nipple and flow line
- 5) Install the Pruitt 1509 Rotating Control Device (RCD) with orbit valve. This will be used throughout the duration of the well to divert drilling fluids.

CRITICAL: Personal Gas monitors WILL be required for all personnel on location during the execution of the GLADE project starting on the first intermediate hole section to TD of the final production hole. Permanent gas monitors are installed in the sub, rig floor, and shakers as well. Please review monitor testing requirements and muster locations with the crew.

- 6) Mudlogging will be performed while drilling this interval. Services will include cuttings sample collection, examination, description, and packaging, gas monitoring, daily morning and evening reports, and production of geologic logs and a final well report.
 - a) Cuttings will be collected at 90' intervals from surface drillout to the Niobrara.
 - b) Cuttings will be collected at 30' intervals from the top of the Niobrara to section TD (Basement top).

7) BOP stack-up while drawing while drilling intermediate hole:





- 8) Test all BOP's and BOPE to **250 psi for the low-pressure test for 5 minutes**. Pressure test blind and pipe rams and BOPE to **5,000 psi for high pressure test for 10 minutes**. Test the annular preventer to **70% of working pressure (3 ,500 psi) for 10 minutes**.
- a) Ensure the **casing valve below the test plug is open to prevent over-pressure of the 13-3/8" casing** if the test plug leaks.
 - b) Ensure that the test plug is the proper size and that the plug is landed in the proper position.
 - c) The pipe rams are to be operationally checked each 24 hours. Blind rams will be function tested each time pipe is pulled out of the hole; however, if a previous trip has been made within last 24 hours a second test is not necessary. A pit level drill shall be conducted weekly for each drilling crew. All BOP function tests and pit drills shall be properly noted in the IADC tour sheets as they are performed.
 - d) **A full open safety valve (FOSV) must be available on the floor for all pipe connections as well as a dart valve** to be placed above FOSV so we have the ability to strip in the hole. The FOSV will be set in the open position and readily available on the rig floor at all times.
 - e) Ensure that the testing is recorded on a chart. **Keep a copy and send one to the office.**
 - f) Test surface casing during the BOP test, 1500psi for 30 minutes. If pressure declines more than 10% in 30 minutes, contact DS and DE to discuss remedial actions.

NOTE: Make sure that ditch magnets are utilized by the rig and cleaned once per tour. Adjust frequency as needed as conditions dictate.

NOTE: Install the wear bushing per StreamFlo procedure prior to picking up BHA.

NOTE: Ensure all rig components, tanks, and ancillary equipment are properly grounded.

NOTE: Ensure MWD is programmed to transmit continuous INC & AZI, and Shock & Vibration data to surface prior to picking up tools.

- 9) Pick up BHA #2 (Vertical Only) and pick up 5" delta 527 DP:

OXY	GLADE PROJECT	PD 580			Bit: TK66-AA1	Guage = 4 in	Nozzles: 9x12	TF = 0.994; HSI = 2.244
#	Description	OD (in)	ID (in)	Cnx Up	Cnx Dn	Length (Usft)	Total Length (Usft)	Comments
1	12.25" PDC	12.25		6-5/8 Reg		1	1	Restrictor Plate = 400psi
2	962 Vertical Scout	12.25		6-5/8 Reg	6-5/8 Reg	20.5	21.5	Pad @ 4/5 ft
3	9-5/8"x8", 7/8, 5.9, 0.155 rev/gal	9.625		6-5/8 Reg	6-5/8 Reg	40	61.5	
4	NM Integral Blade Stabilizer	12.188	3.25	6-5/8 Reg	6-5/8 Reg	6	67.5	Stab @ 64.5 ft
5	8 NM Pony Collar	8	3.25	6-5/8 Reg	6-5/8 Reg	15	82.5	EM Survey @ ~75 ft
6	GAP SUB	8	3.25	6-5/8 Reg	6-5/8 Reg	5	87.5	
7	NM Integral Blade Stabilizer	8	3.25	6-5/8 Reg	6-5/8 Reg	6	93.5	Stab @ 90.5 ft
8	8 NMDC	8	3.25	6-5/8 Reg	6-5/8 Reg	30	123.5	
9	8" Shock Sub	9.625	3.25	6-5/8 Reg	6-5/8 Reg	15	138.5	
10	8" DC	12.125	2.7	6-5/8 Reg	6-5/8 Reg	180	318.5	
11	Crossover SUB	8	3.875	4 1/2 IF	6-5/8 Reg	5	323.5	
12	6 1/2" Drill Collars	6.5	3.875	4 1/2 IF	4 1/2 IF	360	683.5	
13	Crossover SUB	6.5	2.875	Delta 527	4 1/2 IF	5	688.5	
14	5" HWDP	5	3.0	Delta 527	Delta 527	540	1228.5	
15	5" Drill Pipe	5	4.276	Delta 527	Delta 527	7571.5	8800	



NOTE: Verify piston force required with onsite Vertical Scout Rep prior to picking up BHA. The total backpressure target will be 800psi with a minimum pressure drop required of 700psi and maximum pressure drop across Bit is 1000psi. Please refer to Vertical scout spec sheet in appendix. A restrictor plate will be run to achieve additional backpressure. The proposed BHA will require an additional 400 psi of backpressure, verify with Scout Rep and DE prior to execution after BHA has been finalized.

NOTE: Stabilizer OD size and placement are critical for proper BHA tracking. The above BHA is a proposal with estimated component lengths. Please confirm component lengths onsite with Scout representative. Discuss with DS/FDS/DE if stabilizer placement deviates significantly from proposed BHA.

- 10) Plan to drill out of the surface casing using a **9.0-9.4 ppg 70:30 SBM**. Refer to mud program for specifics.
- a) Ensure pits and lines are clean prior to filling with SBM.
 - b) Displacement and Drill out
 - i) Pretreat system with 2 drums of TeroCoat – Prevent shaker sticking
 - ii) Pretreat system with 1 drum of TeroMul HP to pretreat any water taken upon displacement
 - c) Mud Maintenance
 - i) Maintain emulsion stability with TeroMul HP (Emulsifier) and Lime.
 - ii) For proper oil wetting of solids add TeroCoat (Wetting Agent).
 - iii) HTHP fluid loss will be controlled with OptiTrol-L (HTHP Control).
 - iv) Rheology will be achieved primarily from invert emulsion.
(1) OptiVis (Rheology), TeroVis CF, and TeroMod may be added to achieve additional rheology
 - v) Maintain Volume with additions of NeoFlo and Brine/Water
 - vi) Treat the system with Calcium Chloride for WPS.

NOTE: While volume is being transferred (especially when the fluid system is swapped), it is important to have adequate personnel in place to spot any leaks/spills, monitor volumes, etc...

NOTE: Offset disposal wells drilled down to the basement rock in DJ have not shown H2S. However, Pennsylvanian rock formations can potentially be sources of hydrogen sulfide gas, **Excess Lime** will be maintained in the system and H2S testing will be conducted by Newpark while drilling Pennsylvanian formations. Permanent H2S monitors are currently installed in the sub, rig floor, and shakers.

- 11) H2S testing while drilling Pennsylvanian rock formations will be as follows:
- a) Test 1: Hach Test performed Daily – Results show H2S presence but not concentration.
 - b) Test 2: Garret Gas Train Test performed if Hach test is positive – Results will determine concentration.

Intermediate Mud Properties – Synthetic Based Mud

Interval	MW (ppg)	FV	PV	YP	Fluid Loss	WPS	ES (mV)	Excess Lime	%LGS
2,350'- 10,600' TVD	8.6-10	38-60	10-20	6-12	<15	200-280k	400-700	4 ppb	< 8%

- 12) TIH and drill out the shoe track using conservative drilling parameters (5K WOB, 10-15 RPM, 300 GPM) Drill 10' of new formation. Close annular and perform a formation integrity test (FIT) with the rig pumps to an **18.0 ppge** as follows:

$$FIT = (18.0 - MW) * TVD * 0.052 \approx (18.0 - 9.0) * 2,350 * 0.052 \approx 1100 \text{ psi applied at surface}$$

Adjust variables (MW & TVD) in the equation to reflect actual conditions. Record initial and final pressures after 10 minutes in OpenWells and IADC report. **Contact the DS/DE if we are unable to get a successful FIT.**

- 13) Drill to ±9,850' TVD, start of the build section.
- a) **CRITICAL:** Maintain DLS <1.0° to build point



- b) EM-MWD will be used
 - i) Monitor MWD continuous INC and AZI to look for any early indications of deviating from planned trajectory. It is critical to report any deviations from plan immediately for discussion with DSM, FDS, and DE.
 - ii) Monitor shock, vibration, and MSE to optimize drilling parameters.
- c) The goal is to reduce overall cycle time for the well, however, if BHA has a drift tendency, we will sacrifice ROP to improve BHA tracking.
- d) Formations are expected to get more abrasive, and ROP will slow as we reach the sedimentary formations near the basement. Parameters down to the build section are as follows:

Weight On Bit	Differential Pressure	Flow Rate	Rotary Speed
30-50 kips	600 – 800 psi	700–800 gpm	60 - 100 rpm

- e) The vertical scout tool does not have any limitation on backreaming. Back ream every other stand or as needed maintain wellbore quality. If a survey is seen with a DLS greater than 1.0 in this portion of the intermediate, wash and ream through multiple times. Discuss next steps with DS/FDS/DE.

- 14) At end of vertical section (±9,850' TVD) circulate 1 bottoms up and verify shakers are clean. Pump additional volume as needed to clean the hole. TOO H for 2nd BHA.
- a) Rack back 5" HWDP, 6.75" DC, and 8" DC for use with the 2nd BHA
 - b) Laydown vertical scout tools and inspect for re-run on 2nd Intermediate Wellbore (GLADE East)

NOTE: Ensure 90ft of vertical hole is left prior to KOP to downlink the RSS in the Build BHA.

- 15) Pick up the following BHA (BHA #3) for the build and hold to interval TD.

OXY	GLADE PROJECT	PD 580			Bit: V507X	Gauge = 6 in	Nozzles: 5x12, 5x11	TF = 1.016; HSI = 2.147
#	Description	OD (in)	ID (in)	Cnx Up	Cnx Dn	Length (Usft)	Total Length (Usft)	Comments
1	12.25" PDC	12.25		6-5/8 Reg		1.5	1.5	
2	Orbit 900 Powerdrive RSS	9	3.25	6-5/8 Reg	6-5/8 Reg	14	15.5	Pad @ 3/4 ft
3	OrbitLink Carrier w/ 12-1/8" NM Stab	12.125	3	6-5/8 Reg	6-5/8 Reg	16	31.5	Orbit Comms & Stab at 18 ft
4	Filter Sub	8	3.25	6-5/8 Reg	6-5/8 Reg	5	36.5	
5	Cougar Thruster (Stiff)	8	3.25	6-5/8 Reg	6-5/8 Reg	25	61.5	WOB Range 50-80klbs
6	NM Oxytrac stab	12.125	2.7	6-5/8 Reg	6-5/8 Reg	6	67.5	Stab @ 64.5 ft
7	9-5/8"x8", 7/8, 5.9, 0.155 rev/gal	9.625		6-5/8 Reg	6-5/8 Reg	40	107.5	
8	8 NM Pony	8	3.25	6-5/8 Reg	6-5/8 Reg	14	121.5	
9	Oxytrac stab	12.125	2.7	6-5/8 Reg	6-5/8 Reg	6	127.5	Stab @ 124.5 ft
10	Velocity MWD Carrier	8	3.5	6-5/8 Reg	6-5/8 Reg	15	142.5	Dual Telemetry
11	8 NMDC	8	3.25	6-5/8 Reg	6-5/8 Reg	30	172.5	
12	8 DC	8	3.25	6-5/8 Reg	6-5/8 Reg	180	352.5	
13	Crossover SUB	8	2.875	4 1/2 IF	6-5/8 Reg	5	357.5	
14	6 1/2" Drill Collars	6.5	2.875	4 1/2 IF	4 1/2 IF	360	717.5	
15	Crossover SUB	6.5	2.875	Delta 527	4 1/2 IF	5	722.5	
16	5" HWDP	5	3	Delta 527	Delta 527	540	1262.5	
17	5" Drill Pipe	5	4.276	Delta 527	Delta 527	9,338	10,600	

- 16) Begin build section and drill to Intermediate TD.



- a) It is critical to minimize DLS when kicking off the build. Minimize RSS pad force to minimize DLS. It is better to fall “behind” the planned line rather than get ahead with a significant dogleg at the top of the build.
 - i) Orbit tool should be downlinked with a target Toolface and minimum pad force.
 - ii) Downlinking with GPM while on bottom is the preferred method.
- b) Downlinking best practices for Orbit are as follows:
 - i) Surface WOB should be held constant through downlink (DL) duration. Target 30-35 klbs & drilling RPM
 - ii) Start downlinking early in stand to ensure enough time to finish prior to end of stand
 - iii) Start downlinking for builds early to allow for downlink over multiple stands.
 - iv) Reduce surface RPM if downlink WOB cannot be maintained (50% of drilling RPM)
- c) It is critical to monitor shock and vibration for RSS longevity as we drill the harder abrasive formations near TD. Optimize drilling parameters to minimize MSE, shock, and vibration outputs.

Weight On Bit	Differential Pressure	Flow Rate	Rotary Speed
40-70 kips	600 – 800 psi	700–800 gpm	60 - 100 rpm

- d) Intermediate TD is planned to be at least 50ft into the granite top as determined by the GEO team. Markers that BHA is entering competent basement granite are an increase Gamma, a steady Gamma reading, and a reduction of ROP. It has been identified that the top layer of basement rock may be fractured, weathered, and broken up. To ensure the target FIT is reached for the production hole section, it is critical to set the casing shoe in competent formation. Steady drilling parameters may be indicative of homogenous competent formation. The most reliable data to confirm granite top will be cuttings collection from the onsite Mudloggers. Consult with GEO/DS/DE prior to calling TD.



NOTE: The table below is Scout's guidance for monitoring shock and vibration.

The table below is Scout's guidance to be used by personnel in charge of monitoring drilling in general.
Preventative actions include changes to weight on bit, flow rate and RPM. Sometimes it might be necessary to fully stop the drill string for several minutes to halt harmonics from propagating over the BHA.

	DIRECTION	SHOCKS (g)	VIBRATION (gRMS)	SSI (%)	Duration (minutes)
LOW	Lateral	10	3	0.25 (25%)	Unlimited
	Axial	5	1		
	3 Axes	10	3		
MEDIUM	Lateral	25	5	0.75 (75%)	2,880
	Axial	10	3		
	3 Axes	25	5		
HIGH	Lateral	50	11	1.5 (150%)	120
	Axial	25	8		
	3 Axes	50	11		
SEVERE	Lateral	> 50	> 11	> 1.5 (> 150%)	30
	Axial	> 25	> 8		
	3 Axes	> 50	> 11		

Depending on observed levels, follow this escalation matrix:

- 1- Parameter **Low** or **Medium** => Continue monitoring.
if **Medium** document on Daily.
- 2- Parameter **High** longer than 15 mins => Inform(*) Customer, DD and Driller.
Emphasize need to mitigate.
Document on Daily.
- 3- Parameter **High** longer than 30 mins => Keep customer informed(*) of progress.
Inform(*) Coordinator.
Document on Daily.
- 4- Parameter **Severe** longer than 5 mins => Inform(*) Customer, Coordinator, DD and Driller.
Emphasize need to mitigate.
Document on Daily.

- 17) **At interval TD**, circulate until shakers are clean in preparation for two SLB wireline logging runs. Minimum of 3 bottoms up.
- 18) Perform open hole FIT to maximum ECD expected during cement job.

a) Close MPD RCD and apply pressure equal to maximum expected ECD at the shoe during cement.

b) It is critical to discuss test pressure with DS/FDS/DE prior to execution to adjust for actual parameters at the time of the test.

c) Additional open hole FIT tests may be performed at shallower depths to confirm formation strength. Coordinate with DE if additional tests are required.

NOTE: Verify applied pressure plus hydrostatic does not exceed Sussex FG prior to test. Discuss increasing MW if necessary, to lower test pressure at the Sussex.

NOTE: If seepage is experienced during the test, stop immediately and discuss plan forward with DS/FDS/DE. A wellbore strengthening plan or 2 stage cementing plan may be evaluated pending results of the test.

- 19) Pull out of hole.

a) If tight spots are encountered, pull up to the 13-3/8" casing shoe, and then trip back to interval TD for further conditioning.

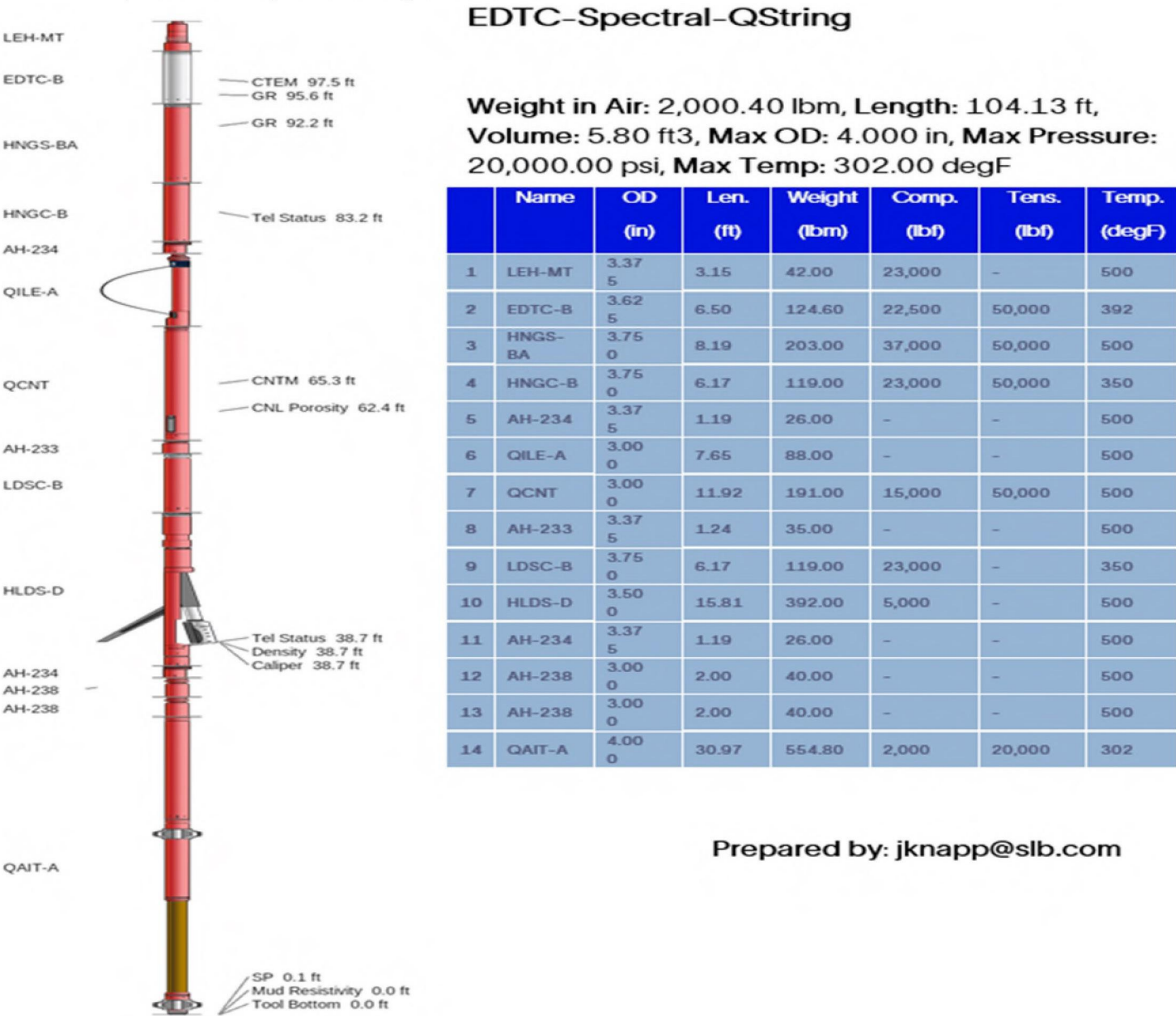
NOTE: Wireline logging operations are only planned on the first intermediate hole, Glade WEST.



NOTE: Rig to provide 48 hour and 24hr notification to SLB wireline dispatch.

NOTE: Ensure well is dead, prior to proceeding with wireline operations. As long as well is dead, no wireline pressure control is necessary.

- 20) RU SLB wireline and logging equipment. Pick up logging tool string and run in hole to TD. Begin logging trip out of hole.
- a) Rig up wireline.
 - b) Pick up the following wireline logging tool string for the first Run
 - i) Run 1A – Spectral Qstring TCOM w/ AIT



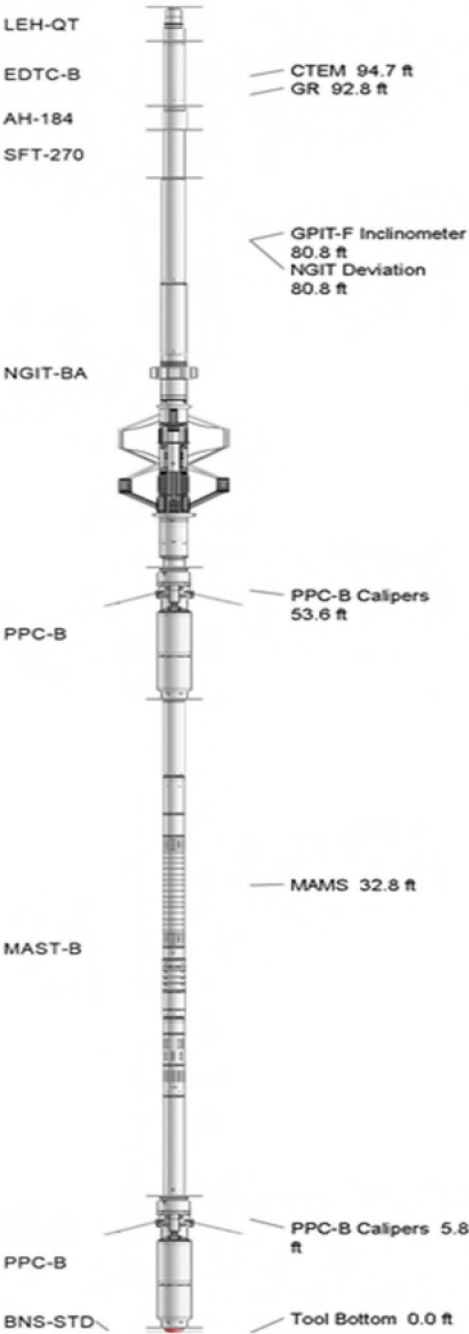
Prepared by: jknapp@slb.com

- c) Perform logging per procedure provided by SLB. (Procedure in Appendix for reference)
 - i) Max logging speed of 1,800 fph, estimated logging duration of 4.5 hrs for Run 1A.
 - ii) Logging depth from TD to surface casing shoe.



- d) At surface laydown the 1A logging string.
- e) Confirm data download from logging string.
- f) Pick up the following logging tool string for the second logging Run
 - i) Run 1B – GR-PPC-Sonic PnS/ANI/MP-PPC-NGI

NGI-SS



Weight in Air: 2160.24 lbm, Length: 101.69 ft, Volume: 8.49 ft3, Max OD: 6.500 in, Max Pressure: 20000.00 psi, Max Temp: 347.00 degF

	Name	OD (in)	Rigid OD (in)	Len. (ft)	Weight (lbm)	Comp. (lbf)	Tens. (lbf)	Temp. (degF)
1	LEH-QT	3.375	3.375	3.49	33.00	23000		350
2	EDTC-B	3.625	3.625	6.50	124.60	22500	50000	392
3	AH-184	3.375	3.375	2.00	35.30	23000	50000	350
4	SFT-270	3.375	3.375	4.00	80.00			350
5	NGIT-BA	6.500	6.500	30.91	697.42	8000	12000	347
6	PPC-B	4.300	4.300	6.52	169.76	10000	50000	347
7	MAST-B	3.622	3.622	41.30	837.40	3000	35000	350
8	PPC-B	4.300	4.300	6.52	169.76	10000	50000	347
9	BNS-STD	3.375	3.375	0.46	13.00			500

Prepared by: Keele Venable

SLR-Private



- g) Perform logging per procedure provided by SLB. (Procedure in Appendix for reference)
 - i) Max logging speed of 1,200 fph, estimated logging duration of 7 hrs for Run 1B.
 - ii) Logging depth from TD to 6400ft MD.
- h) At surface breakdown/laydown the 1B logging string.
 - i) Confirm data download from 1B logging string.
 - j) Rig down wireline.

NOTE: Prior to running casing discuss with FDS/DE if cleanout run is necessary. Although not currently planned, a cleanout run may be performed if hole conditions dictate.

- 21) Prepare to run 9-5/8" casing. Check all 9-5/8" casing equipment for correct sizes and connections as they arrive on location and drift casing per API drift.
- a) Review the ER running guidelines and casing spec sheet prior to casing run.
 - b) Run standard Elevators to pick up casing. Confirm CRT availability in the event rotation is needed
 - c) This connection has an optimal make-up torque rating with a make-up loss (MUL) indicator to confirm full makeup position.

NOTE: When POOH on the 2nd intermediate well (Glade East, Intercept well) we will lay down 5" DP in preparation for picking up 5-1/2" DP for the production holes.

9-5/8” Casing Design									
Interval		Size	Weight	Grade	Thread	ID	Drift	Cplg OD	
Surface – 10,600’ MD		9-5/8"	47 ppf	P-110 IC	ER	8.681”	8.525"	10.626"	
P-110 IC Casing Specs									
Size	Collapse (psi)	Burst (psi)	Tension (lbs)			Make-up Torque, ft-lb, <u>0.9</u> FF Dope			
			Body	Joint	Max @ 1.6 SF	Thread	Min	Opt	Max
9-5/8"	7,100	9,440	1,493,000	1,493,000	933,125	ER	11,943	13,266	14,589

NOTE: The Tenaris ER connection is a rotatable thread, with an operating Torque of 33,590 ft-lbs. Discuss with FDS/DE prior to rotating casing. Excessive rotating will wear down the polymer centralizers and decrease the placement efficiency of the cement job.

NOTE: Initiate connection make-up with low RPM (≤ 5 RPM). Do not exceed maximum RPM of **15** when spinning up connections at surface. Apply power tong at low RPM (≤ 5 RPM) for final make up.

- 22) Pull wear bushing.

- 23) Run the 9-5/8" Intermediate casing to TD
- a) RIH at a rate of 200 ft/min or as fast as hole conditions allow
 - b) Contact FDS/DE if excess drag is seen while running Casing to discuss plan forward
 - c) Call out and pick up CRT to wash joints down if hole conditions dictate.
 - i) Start with 5 bpm and stage up to 8 bpm as hole conditions allow
 - d) Rotate joints down if hole conditions dictate.
 - i) Target 10-20 RPM with max torque value of 33,590 ft-lbs. Set torque limit at 80% (26,800 ft-lbs).
 - e) Continue casing run to Intermediate TD by filling on the fly. Stop and fill casing when casing run starts to slow or as needed. Filling more frequently will allow for allow us to monitor hookload / hole conditions during the casing run.

NOTE: A trip sheet must be filled out during the casing run. Record mud displacement volumes. Reduce running speeds if fluid is being pushed away. Stop and monitor for flow if excess fluid volume is returned.



9-5/8" Casing Static Load Summary							
Interval	Description	Wt/Ft	Length	MW	Air Weight	Buoyed Weight	Total Weight
				(ppg)	(lbs)	(lbs)	(lbs)
Intermediate	47 ppf, P110-IC, ER	47 ppf	10,600'	9	498,200	429,745	429,745

9-5/8" Casing Setting Details & Centralization								
Interval	Length	Weight	Grade	I.D.	Drift	Conn	Description	Vendor
0' – 10,498'	10,498'	47	P110-IC	8.681"	8.525"	ER	Casing +/- 262 joints	Tenaris
10,498' - 10,518'	20	47	P110-IC	8.681"	8.525"	ER x BTC	Shoetrack Crossover	Tenaris
10,518' – 10,519'	1'	47	P110-IC	8.681"	n/a	BTC	Float Collar pre-bucked to box end	HAL
10,519' – 10,599'	80'	47	P110-IC	8.681"	8.525"	BTC	80ft Shoe track	Tenaris
10,599' – 10,600'	1'	47	P110-IC	8.681"	n/a	BTC	Float Shoe pre-bucked to pin end	HAL

Cement Plugs will be supplied by HAL and run prior to cement (bottom plug) and displacement (top plug).
Install polymer Slip-n-slide centralizers as follows:

- One polymer above the float shoe and one polymer above the float collar supplied by ARSENAL.
- Polymer centralizers installed 1:1 from shoe track to surface supplied by ARSENAL.
- We will need approximately 265 centralizers.

- 24) Set last joint of casing in slips at rig floor. Pick up StreamFlo casing hanger running assembly. The running assembly consists of the following components.
- a) The landing joint will be pre-bucked to the top connection of the torque/running tool.
 - b) Thread the casing hanger onto the running tool appx 10-11 turns. Please refer to StreamFlo procedure in appendix.
 - c) After testing running tool seals, install sliders and shear pins to transfer torque through the casing hanger.
 - d) These steps will be performed on the rack prior to picking up assembly.

NOTE: Max torque rating of the running tool is 51,000 ft-lbs. Max operating torque of casing threads is 33,590 ft-lbs.

- 25) Make up the StreamFlo Mandrel Hanger to the last joint of casing (Mandrel Hanger will have an ER pin down connection).
- 26) Slowly and carefully lower the hanger & casing string through the BOP and run in to 3' – 4' above the casing head. The mandrel hanger will be positioned at this point for the cement job, to allow for e-slips to be placed if cement does not reach surface. The casing tally should be planned such that there will be 10' of rathole after the hanger has landed in the casing head.

NOTE: Verify landing joint and running tool threads prior to rotation. Rotate only if needed to land casing string. Ensure hanger is lifted above landing profile at least 55" prior to rotating to prevent damage to the hanger and/or sealing surface of the wellhead housing.

- 27) At TD break circulation slowly and then increase up to 10-15 bpm. Circulate a minimum of 1.5 bottoms up at a maximum of 10-15 bpm to ensure hole is in good condition. Circulate until shakers are clean and hole is properly conditioned. Reduce flowrate if necessary, depending on hole conditions.
- 28) Rig up cementing equipment and test lines to 5,000 psi.



- a) Notify Halliburton two days prior to the cement job.
- b) Ensure that the water has been tested and approved for use
- c) Call Halliburton at the dispatch number one day prior to the cement job.
- d) Call Halliburton and provide eight hours' notice to be on location.

NOTE: The Sussex is not estimated to be weak in this area; however, we may encounter losses during the cement job, so please ensure that the thickening time on the cement is long enough to allow for us to pump at a reduced rate (4-5 bpm) to keep the ECD's in line with what is needed to avoid breaking down the formation.

- 29) Pump cement job per Halliburton's 9-5/8" Intermediate Casing Cement Program. The plan below is based on a single stage job. If losses are experienced while drilling or performing FIT tests, a two-stage cement job may be pumped. Confirm final cementing plan with DE/DES.
- a) Mix water must be checked in the lab to verify compatibility with dry cement – This should be performed well in advance of the cement job.
 - b) Pump time and compressive strengths should be tested and communicated to DE. Wet, dry and water samples are required and should be held until the job status has been determined.
 - c) Utilize a top and bottom wiper plug for the cement job.
 - d) Pump cement at 6 bpm (reduce rate if losses become an issue).
 - e) Displace the cement slurry with 8.34 ppg freshwater at 6-8 bpm per Halliburton's pump schedule.
 - f) Shoe integrity is critical for the production hole. Do not over-displace.

Intermediate Cement Program							
Spacer	60 bbls Tuned Prime Spacer @ 10.5 ppg						
Lead	11.5 ppg SBM CEM EXTENDACEM Cement						
Tail	12.5 ppg CEM ECONOCEM Cement						
Slurry	Density, ppg	Yield, ft³/sk	Mix Water, gal/sk	Top (MD)	Volume		
					bbls	sacks	Excess
Lead	11.5	2.63	12.49	0' – 9,600'	618	1321	15%
Tail	12.5	1.97	10.06	9,600' – 10,600'	64	183	15%
Comments	Check volumes with HAL prior to pumping cement job. The final spacer design, cement recipe, and pump schedule is subject to change based on actual hole conditions. Consider thickening times when finalizing pump schedule.						

NOTE: Cement head limit of 5,000 psi. Casing Triaxial SF (1.25) limit of 6,000 PSI while cementing with a full column of cement inside casing and 9.4 MW in Annulus.

NOTE: Document final lift pressure. In following steps, the casing will be tested to 500psi over lift pressure and the packoff seals to be tested to 500psi less than final lift pressure.

- 30) When plug bumps, if cement returns are at surface, immediately slack off to land mandrel hanger in casing head. If cement returns are not at surface, wait on cement to achieve 500 psi compressive strength and prepare to set e-slips.
- 31) After landing mandrel hanger, or determining to WOC for e-slips, increase pressure to 500 psi over lift pressure. Hold pressure for 15 minutes and ensure pressure does not decay more than 10%. Release pressure and check floats.
- a) Flush stack with fresh water to remove any residual cement.
- 32) When cementing is complete, remove the landing joint and running tool per StreamFlo procedure.
- a) Apply counterclockwise torque to shear the shear pins.
 - b) Continue to rotate counterclockwise 11-12 turns to disengage.



33) Examine the Pack-off Bushing and running tool. Verify the following:

- a) Bore is clean and free of debris
- b) All elastomer seals are in place and undamaged
- c) All threads are clean and undamaged

NOTE: The Pack-off running tool will make up to the 9-5/8" casing running tool and landing joint.

34) Run Packoff, test seals, engage Lockring, and retrieve Running Tool per StreamFlo procedure.

- a) It may take up to 20,000 lbs of weight to land packoff bushing properly.
- b) Engage Lockdown screws and verify torque measurements.
- c) Rotate the running tool 4 turns counterclockwise to disengage.
- d) Test Packoff seals to 500 psi less than final lift pressure for 15 minutes.
 - i) Close blind ram
 - ii) Open 2-1/16" 5k Annular valve
 - iii) Increase pressure to 500 psi less than final lift pressure
 - iv) Hold pressure for 15 minutes. Ensure pressure doesn't decrease more than 10%
 - (1) Verify Annular valve is reading zero during test
 - v) Bleed off pressure and open rams.

35) Prepare to ND BOP and skid rig to 2nd intermediate hole, Glade EAST (Intercept) and repeat steps 2-33.

NOTE: 12" of clearance is required to lift the stack above the hanger neck and GL to skid the rig off the well.

36) The following steps will be performed offline after rig has skidded off the 1st wellbore (Glade WEST).

- a) Install Intermediate head (B Section) with loader
 - i) Place the 9-5/8" bottom ring and ring seal over the casing hanger neck so it sits flat on top of the casing head.
 - ii) Pick up intermediate head and lower over hanger neck. The intermediate head will be pre-assembled and bench tested in StreamFlo's shop.
 - (1) Outlet #1 – VR Plug x Blind flange
 - (2) Outlet #2 – 3-1/8" 10k valve x companion flange x 1/2 LP x 1/2 NPT Grease fitting x needle valve x pressure gauge
 - iii) Locate test port labeled "*FLG TEST PORT 1/2 LP*", test to 5000 psi for 15 minutes. This test validates the flange ring gasket, packoff seals, 9-5/8" metal seal and LDS packing.
 - iv) Locate test port labeled "*DR1 TEST PORT 1/2 LP*", TEST TO 5000 PSI FOR 15 minutes. This test validates 9-5/8" metal seal and 9-5/8" FS seal.
- b) Install the following temporary 1502 snorkel piping on the casing head valve (2-1/16") to monitor bradenhead pressure while drilling the production hole.
 - i) 2-1/16" 5M
 - ii) 1502 XO flange
 - iii) 1502 90deg
 - iv) 1502 pup
 - v) 1502 plug valve
 - vi) Pason 5k Pressure transducer

NOTE: Utilize BOP Testers to Pressure test to 5000 psi for 10 min. Pressure testers will tie into the 1502 plug valve and pressure test against closed 2-1/16" valve.

NOTE: Ensure all valves are open to continuously monitor annulus pressure utilizing Pason's pressure transducer and rig EDR.

- vii) Ensure valves are open and transducer is functional for continuous monitoring.



- c) Install StreamFlo's 11" 10,000psi blind flange.

NOTE: At this point the wellhead is considered a 10k rated system.

- 37) Offline log the first intermediate (Glade WEST) with a CBL/VDL log and gyro to confirm wellbore position and cement competence prior to drilling out production.
- Contact The Wireline Group as the primary vendor and Bighorn Wireline as the secondary.
 - Ensure adequate time has passed for the cement to reach compressive strength. Verify with DE prior to running log.
 - The gyro provider will be Scientific Drilling or Gyrodata. Confirm with DE prior to logging ops.

NOTE: To get the best log response as possible with a lightweight cement, wait as long as possible for the cement to set up prior to logging.

- 38) After successfully executing the Glade EAST well (2nd wellbore, Intercept) prepare to ND BOP, lift stack, and skid rig to the Glade WEST (Target) well for the 1st production hole.

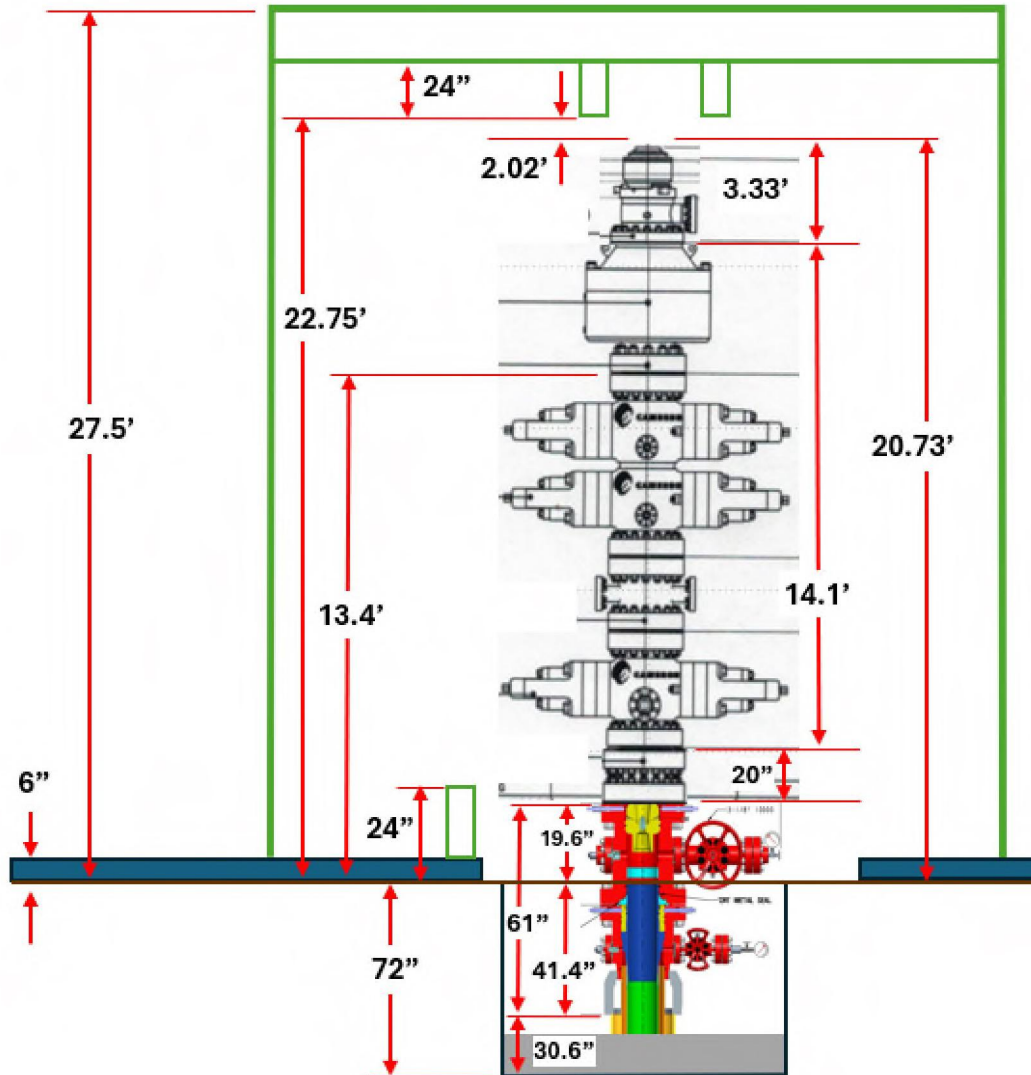
- 39) The following steps will be performed offline after rig has skidded off the 2nd wellbore (Glade EAST).
- Install Intermediate head (B Section) with loader
 - Place the 9-5/8" bottom ring and ring seal over the casing hanger neck so it sits flat on top of the casing head.



- ii) Pick up intermediate head and lower over hanger neck. The intermediate head will be pre-assembled and bench tested in StreamFlo's shop.
 - (1) Outlet #1 – VR Plug x Blind flange
 - (2) Outlet #2 – 3-1/8" 10k valve x companion flange x 1/2 LP x 1/2 NPT Grease fitting x needle valve x pressure gauge
 - iii) Locate test port labeled "*FLG TEST PORT 1/2 LP*", test to 5000 psi for 15 minutes. This test validates the flange ring gasket, packoff seals, 9-5/8" metal seal and LDS packing.
 - iv) Locate test port labeled "*DR1 TEST PORT 1/2 LP*", TEST TO 5000 PSI FOR 15 minutes. This test validates 9-5/8" metal seal and 9-5/8" FS seal.
- b) Install the following temporary 1502 snorkel piping on the casing head valve (2-1/16") to monitor bradenhead pressure while drilling the production hole.
- i) 2-1/16" 5M
 - ii) 1502 XO flange
 - iii) 1502 90deg
 - iv) 1502 pup
 - v) 1502 plug valve
 - vi) Pason 5k Pressure transducer
- NOTE:** Utilize BOP Testers to Pressure test to 5000 psi for 10 min. Pressure testers will tie into the 1502 plug valve and pressure test against closed 2-1/16" valve.
- NOTE:** Ensure all valves are open to continuously monitor annulus pressure utilizing Pason's pressure transducer and rig EDR.
- c) Install StreamFlo's 11" 10,000psi blind flange.
- 40) Offline log the second intermediate (Glade EAST) with a CBL/VDL log and gyro to confirm wellbore position and cement competence prior to drilling out production.
- a) Contact The Wireline Group as the primary vendor and Bighorn Wireline as the secondary.
 - b) Ensure adequate time has passed for the cement to reach compressive strength. Verify with DE prior to running log.
 - c) The gyro provider will be Scientific Drilling or Gyrodata. Confirm with DE prior to logging ops.

41) BOP Schematic in preparation to drill Production Hole:

NOTE: The BOP stack will require an adapter spool (11" 10000psi x 13-5/8" 10000psi) while drilling the production hole. Contact Steve Smith with Weatherford for 20" adapter spool.





5.0 PRODUCTION HOLE PROGRAM (BASEMENT INTERVAL)

5.1 Overview

The production interval of the well will consist of drilling granitic basement rock from drillout to the planned interval TD of 20,000' TVD. This interval will present multiple challenges, known and unknown. The purpose of this section is to define the primary plan to execute drilling this interval efficiently and safely. All perceived challenges have been considered, and plans are outlined to address them. These challenges include, but are not limited to, the following:

- Drilling high compressive strength formations (>30kpsi)
- Drilling interbedded formations in which rock strength may vary significantly over short distances
- Encountering hot hole conditions in excess of 500 deg F rock temperatures
- Drilling into a total loss zone with large, vugular, pore space
- Taking a kick with any of the following fluids: Hydrocarbons, water, steam, non-hydrocarbon gases such as helium, hydrogen, CO2 or H2S
- Managing high temperature returns at surface
- Mitigating damage to BHA components as a result of high temperature drilling fluids

NOTE: There is an elevated risk of high temperature fluid returns at surface that present an HSE hazard. Proper precautions should be taken to avoid exposure when personnel are near the shakers or pits.

5.2 Production Hole Procedure

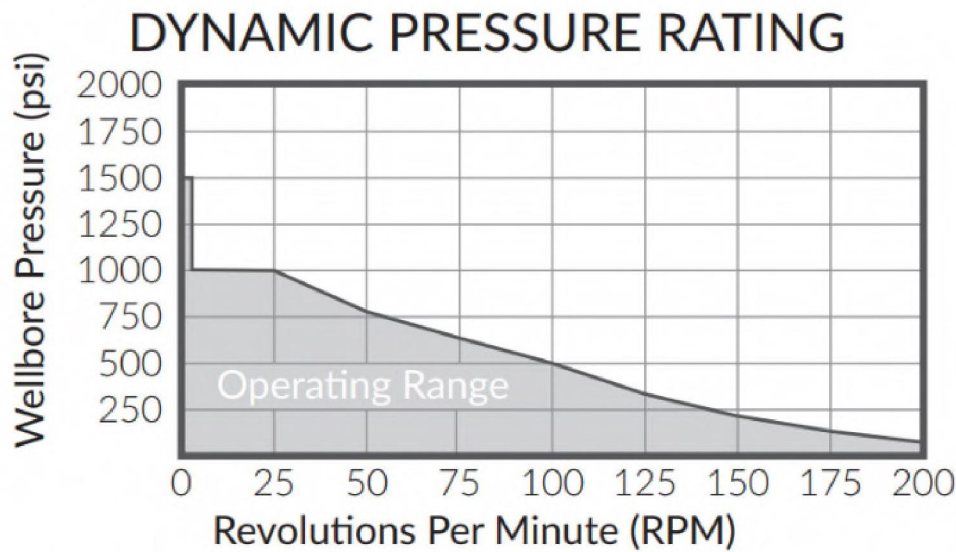
- 1) Clean mud pits in preparation for swap from SBM to WBM.
 - a) Ensure that Qty 2 DrillCool mud coolers are rigged up and operable.
 - i) Mud coolers will be rigged up in parallel with each mud cooler having separate inlet and outlet lines.
 - ii) Inlet lines should be plumbed from the tank in the active pit system that receives fluid from the shaker transfer tank.
 - iii) Outlet lines should discharge into the active pit system.
 - b) The site will have a Water On Demand (WOD) line rigged up to supply a constant supply of water. Using that line, ensure that Poseidon tank is full prior to drilling out.
 - c) Ensure ditch magnets are installed on possum belly to catch metal shavings. Material caught by ditch magnets shall be removed and weighed daily. Increasing amounts may indicate an increase in casing wear. Report daily weights in OpenWells for review by DE.
- 2) Mud loggers from TerraGuidance are planned for this hole interval, working 2-man tours.
 - a) Services will include cuttings sample collection, examination, description, and packaging, gas monitoring, daily morning and evening reports, and production of geologic logs and a final well report.
 - b) Samples will be collected every 30' from drillout to TD.
- 3) NU BOP on Glade WEST (Target Well) and test as follows:
 - a) Ensure that high temperature BOP components are installed prior to testing.
 - b) Ensure that top and bottom VBRs have been replaced with 5.5" pipe rams.



- c) Test all BOP's and BOPE to **250 psi for the low-pressure test for 5 minutes**. Pressure test blind and pipe rams and BOPE to **10,000 psi for high pressure test for 10 minutes**. Test the annular preventer to **70% of working pressure (3,500 psi) for 10 minutes**.
 - d) The pipe rams are to be operationally checked each 24 hours. Blind rams will be function tested each time pipe is pulled out of the hole; however, if a previous trip has been made within last 24 hours a second test is not necessary. A pit level drill shall be conducted weekly for each drilling crew. All BOP function tests and pit drills shall be properly noted in the IADC tour sheets as they are performed.
 - e) Ensure that the testing is recorded on a chart. **Keep a copy and send one to the office.**
 - f) Pressure test intermediate casing to 6,800 psi for 30 minutes. If pressure declines more than 10% in 30 minutes, consult with office for remedial actions to be taken.
 - g) Ensure well control crossovers are available and tested for all drill pipe sizes.
 - h) BOP tests must be performed every 30 days. Ensure that a BOP test is planned accordingly to conform to this requirement.
 - i) If a BOP test is required while the well is still being drilled, trip the BHA into casing and hang off a storm packer.
 - ii) Set storm packer per vendor procedure.
 - iii) Perform BOP test per the procedure above.
 - iv) Retrieve storm packer and trip back into well to continue drilling.
- 4) Mud pumps shall be rigged up to be able to pump through the standpipe and the kill line simultaneously.
- a) Ensure that 4 ¾" liners are installed in all 3 pumps.
 - b) Install valving such that one pump can be lined up on the kill line while the other two can pump down the standpipe.
 - i) All three pumps should have 7500 psi pop-offs for drill out.
 - ii) If circulation down the kill line and standpipe is required, the pop-off pressure value for the pump rigged up to pump down the kill line shall be reduced to the lowest pressure rating of the surface lines that will be circulated through. For the rotating head this value is 1500 psi. If circulating with the annular or pipe rams closed, the pop-off shall be set to 2000 psi.
 - c) Confirm ability to circulate from cold reserve tank (Poseidon tank) to suction for all three mud pumps. This provides the ability to cool return fluid before reaching the flow line or choke.
- 5) Rig up and test MPD setup.
- a) Ensure that all equipment is rigged up per the Pruitt P&ID diagram in the appendix.
 - i) The setup shall include a diverter line downstream of the choke and upstream of the MGS that can route steam and liquid returns to the 3000 bbl open pit. All steam diverter lines shall be hard piped and anchored.
 - b) Ensure that flow can be diverted to either the MGS or the diverter pit downstream of the choke.
 - i) Confirm that 4 gas monitors are installed at the following locations (Monitors shall be Drager Polytron IR or equivalent):
 - (1) Near outlet of diverter line entering open pit.
 - (2) Near shale shakers
 - (3) Additional fixed 4-gas monitors shall be installed per the Oxy respiratory protection program waiver, under the drilling substructure near the flowline/rotating head and on the rig floor.
 - ii) All personnel shall also wear personal H2S monitors while drilling the production interval.
 - iii) **Note: Ensure that all lines running from the choke to the pit are adequately constrained in the event of a rapid energy release.**
 - c) Confirm that temperatures sensors have been installed near the BOP on the rig choke and MPD choke lines, and that those temperatures can be monitored remotely, and alarms can be set based on their values.



d) Confirm PRCD 1509 rotating head is installed.



e) Ensure High temp Polyurethane RCD seal elements are used.

HIGH PRESSURE SEAL ELEMENT TEMPERATURE LIMITS (FAHRENHEIT)				
	NATURAL RUBBER	NITRILE	POLYURETHANE	HIGH TEMP POLYURETHANE
LOWER LIMIT (°F)	-60	40	-50	-50
UPPER LIMIT (°F)	220	180	185	250
TEMPERATURE SPIKE LIMIT (°F)	N/A	250	200	300

- 6) Prepare fluids system as follows:
- a) Plan will be to drill with a freshwater system in this interval. Target a mud weight of 8.4 ppg water at drill out.
 - b) Target the fluid specifications listed in the first row of the table below.
 - c) Plan to pump sweeps as needed based on ROP and hole conditions. Sweep frequency may change as well conditions dictate.
 - i) 20 bbls of 14-20 YP, 10-18 PV fluid, viscosified with Salt Gel (attapulgitite) and Xanthan Gum.



Water / TerraTherm™

Hole Size (in)	MD (ft)	Mud Weight (ppg)	Plastic Viscosity (cp)	Yield Point (lb/100ft²)	HTHP Fluid Loss (ml/30min)	3 RPM	6 RPM	Lubricant	KCl %	pH	10s / 10m gel	LGS (%)
8 1/2"	ICP—TD	8.4—8.8	2—4	2—4	N/C	N/C	N/C	2—4%	0-3 TBD	N/C	N/C	< 3
High Temperature Viscosified Fluid												
8 1/2"	Surface Build	8.4—10.0	80	106	N/C	13	20	N/C	0-3 TBD	10.0—11.0	14 / 23	< 3
8 1/2"	Down Hole	8.4—10.0	8	9	N/C	1	1	N/C	0-3 TBD	10.0—11.0	1 / 12	< 3
Kill Pill												
8 1/2"	Surface Build	14.0	80	106	N/C	13	20	N/C	0-3 TBD	10.0—11.0	14 / 23	< 3
8 1/2"	Down Hole	14.0	8	9	N/C	1	1	N/C	0-3 TBD	10.0—11.0	1 / 12	< 3

7) PU 8 1/2" Drilling assembly. Assembly includes PDC bit, bent housing mud motor, mud pulse MWD tool, stabilizers and shock mitigation tool. See BHA below.

#	Description	OD [in]	ID [in]	Cnx Up / Cnx Dn	Length [ft]	Total Length [ft]	Notes
1	8.5 PDC	8.5	2	4 1/2 REG	1	1	TFA 1.0-1.3
2	7in 1.25 CAM w/8 1/8	7.125		4 1/2 IF / 4 1/2 REG	37	38	7/8 8.5, .24 rev/gal, mid body IBS 1/8" UG, .015-.025 fit
3	8.25 Stabilizer	8.125	2.25	4 1/2 IF / 4 1/2 IF	8	46	1/4" UG, DTI FixedBlade
4	6.5 NM UBHO	6.5	2.875	4 1/2 IF / 4 1/2 IF	3.5	49.5	
5	6.5 NMDC (MWD CARRIER)	6.75	3.25	4 1/2 IF / 4 1/2 IF	30	79.5	Scout Tracker
6	6.5 NMDC	6.5	3.25	4 1/2 IF / 4 1/2 IF	30	109.5	
7	8.25 Stabilizer	8.125	2.25	4 1/2 IF / 4 1/2 IF	8	117.5	1/4" UG, DTI FixedBlade
8	Anti Stick Slip Tool	6.5		4 1/2 IF / 4 1/2 IF	17	126.5	Cougar Thruster, setup for 50k-80k WOB
9	6.5 Filter Sub	6.5	3.25	4 1/2 IF / 4 1/2 IF	4	130.5	
10	6 3/4 Collars	6.75	2.875	4 1/2 IF / 4 1/2 IF	500	630.5	
11	Xover SUB	6.5	2.875	Delta 544 / 4 1/2 IF	3.5	634	
12	5.5 HWDP	5.5	3.25	Delta 544	400	1034	
13	5.5 Drill Pipe	5.5	4.778	Delta 544	To Surf	20000	



Multiple BHAs are expected to be needed to drill this hole interval. Several bit, motor, MWD, and shock mitigation tools will be evaluated and selected for subsequent runs. BHA designs will be confirmed as needed during operations.

- 8) Run in hole while picking up 5 ½" Delta 544 Insulated Drill Pipe.
 - a) Using 1.0 FF pipe dope, make up connections to standard make up torque, 50,300 ft-lbs.
 - b) Operating torque shall be 80% of make up, or 40,200 ft-lbs.
 - c) Inspect and ensure hard-banding on IDP is casing-friendly. Casing comes with Duraband NC hardbanding installed and Duraband NC should be used for any re-applications.
- 9) Prior to drilling out, perform a steam kick drill as follows.
 - a) Shut in the well using RCD. Ensure choke is closed.
 - b) Line up pump one to pump down kill line. Ensure pop off is adjusted to match the rating of the RCD. This should be 1,500 psi, but should be confirmed.
 - c) Line up pumps two and three to pump down standpipe.
 - d) Begin pumping through kill line at 100 gpm while opening choke and maintaining 200 psi of back pressure. Ensure returns are flowing to MGS.
 - e) Bring on pumps on standpipe at a rate of 100 gpm while adjusting choke to maintain 200 psi of back pressure. Ensure returns are mixing as indicated by total flow rate out of 200 gpm as measured by MPD Coriolis.
 - f) Monitor temperature on MPD flowline downstream of BOP during entire operation to simulate requirement to reduce temp in a real scenario.
 - g) Kill pumps on standpipe first, followed by kill line, then close choke.
- 10) Drill out shoe track and 10' of new hole at 5k-15k WOB, 500 GPM, and 20-30 RPM. Perform LOT. Do not exceed EMW of 16.2 ppg.
 - a) Circulate BU, verify MW in/out, and pull back into shoe prior to performing LOT.
 - b) Perform LOT using rig pumps at a rate of 0.25 BPM max. If pressure increase deviates from linear trend, shut down pumps immediately. This is the leak off point.
 - c) Report FIT/LOT results to office. MASP and MAASP will be determined based on break down pressure and mud weight (likely 8.4 ppg for water).
 - d) If leak off test result is below a 12.3 PPG EMW, do not drill ahead. Discuss shoe remediation plan with DS/FDS/DES/DE.
- 11) The following best practices shall be used while drilling ahead in this section.
 - a) Always ensure that the hole is full. If the fluid level falls below surface, continually fill the backside during connections. This reduces the risk of fluid flashing to steam at surface.
 - b) Always monitor return fluid temperature. Return temps should gradually increase as we drill deeper in the well. In the event return temperatures exceed 180 deg F, shut in the well and line up to mix fluid in the returns through the kill line. Additional details for this operation can be found in the Well Control Appendix.
 - c) Always line up to drill through the MPD choke and MGS. This allows for monitoring of bbl in/bbl out as well as the ability to make rapid adjustments to EMW. This also ensures that any encountered gas is routed through the MGS and flare.



- d) In the event gas or steam is seen at the shakers, pick up, kill pumps, and shut in the well. Identify if a kick has been taken or super-heated returns are at surface. Ensure mud leg of MGS is full. Follow steps in well control appendix to eliminate gas or steam.

NOTE: If returns are taken to the diverter pit, ensure that buffers are maintained for personnel and vehicles. It is possible that entrained gas could be released in this area.

- e) If liquid water is seen at the flare, pick up, kill pumps, and shut in the well. It is possible that super heated returns are flashing to steam in the flare line. Check return temperatures and ensure MGS is full. Identify if there is an indication of a kick and follow well control procedures as needed.

NOTE: Transfer tank and shakers shall be clear of all personnel during tripping operations when pumps are on. There is an elevated risk of superheated fluid returns at surface that present an HSE risk.

- 12) Drill ahead targeting ~50klbs WOB. Ensure that limits for torque and differential pressure are not exceeded.
- a) Mechanical Specific Energy (MSE) is a surface measurement that can aid in determining dysfunction at the bit. The goal is to have as low an MSE as possible. High MSE will be the result of increased torque, diff pressure, or reduced ROP and WOB. Monitor MSE in the data stream and adjust drilling parameters if MSE begins to increase or rapidly fluctuate.
 - b) Fluctuations in torque, surface RPMs, or WOB are an indicators of dysfunction. Monitor these readings and adjust WOB and/or RPMs to mitigate dysfunction.
 - c) Closely monitor MWD data for indications of high shock and vibration. These indications should correlate to increased MSE. Modify drilling parameters to reduce MSE and MWD data should follow. Refer to the Table and corrective actions outlined below.



The table below is Scout’s guidance to be used by personnel in charge of monitoring drilling in general. Preventative actions include changes to weight on bit, flow rate and RPM. Sometimes it might be necessary to fully stop the drill string for several minutes to halt harmonics from propagating over the BHA.

	DIRECTION	SHOCKS (g)	VIBRATION (gRMS)	SSI (%)	Duration (minutes)
LOW	Lateral	10	3	0.25 (25%)	Unlimited
	Axial	5	1		
	3 Axes	10	3		
MEDIUM	Lateral	25	5	0.75 (75%)	2,880
	Axial	10	3		
	3 Axes	25	5		
HIGH	Lateral	50	11	1.5 (150%)	120
	Axial	25	8		
	3 Axes	50	11		
SEVERE	Lateral	> 50	> 11	> 1.5 (> 150%)	30
	Axial	> 25	> 8		
	3 Axes	> 50	> 11		

Depending on observed levels, follow this escalation matrix:

- 1- Parameter **Low** or **Medium**

=>

Continue monitoring.
if **Medium** document on Daily.
- 2- Parameter **High** longer than 15 mins

=>

Inform(*) Customer, DD and Driller.
Emphasize need to mitigate.
Document on Daily.
- 3- Parameter **High** longer than 30 mins

=>

Keep customer informed(*) of progress.
Inform(*) Coordinator.
Document on Daily.
- 4- Parameter **Severe** longer than 5 mins

=>

Inform(*) Customer, Coordinator, DD and Driller.
Emphasize need to mitigate.
Document on Daily.

- 13) After first stand is drilled, perform step test to identify optimal parameters to limit MSE. Perform step test per the following steps.

a) Ensure correct hole size and motor specification are entered in Pason before beginning test.

b) Drill ahead varying the parameters as described in the Step Test Appendix. Perform each test for approximately 3-5 minutes each. Record average Differential Pressure and MSE for each test.

i) **Note: The test matrix calls for varying WOB and rotary RPMs. Ensure that differential pressure and torque ratings of the motor are not exceeded at any time.**

ii) The optimal parameters are those which result in the lowest MSE. If multiple tests have equally low MSE, select the parameters with the highest ROP. Drill ahead at optimal parameters.

iii) Ensure that shock and vibe data is within Scout recommended limits at lowest MSE drilling parameters.

c) If a drilling break is encountered, maintain drilling parameters with autodriller, including WOB, diff, ROP and torque. Be prepared for a transition back to a harder formation which presents a risk of a diff spike.

14) Make connections per the following procedure:

a) Drill previous stand down noting full drilling parameters (Hookload, WOB, SPP, Diff, Torque, and RPMs)

b) When stand reaches bottom, allow WOB to drill off to half of full operating weight. Do not exceed 45 seconds of drill off.

c) Pick up off bottom until hookload breaks over, indicating bit is off bottom.
- DETAILED DRILLING PROGRAM

PAGE 46

2 APRIL 2025
- Contains Business Sensitive, Trade
Secrets, Proprietary or Otherwise
Confidential Information Exempt from
Public Disclosure
- GDP047



- d) Kill rotary and kill Pumps
- e) Position drillstring for connection and set slips.
- f) Make connection.
- g) Pick up and remove slips
- h) Stage pumps up to full drilling rate and confirm flow.
- i) Engage rotary to 50% of drilling RPMs.
- j) Slack off back to bottom at rate approximately half of previous ROP. WOB and differential pressure should be zeroed at this time.
- k) Watch for an increase in WOB, indicating the bit is back on bottom.
- l) Smoothly bring RPMS back to full drilling rate while continuing to increase WOB back to full amount from previous stand. From tagging bottom to reaching full WOB and RPMs should occur within 15-20 seconds.
- i) **This is the critical action to avoid bit damage due to whirl. A smooth and rapid return to drilling parameters is the best way to avoid bit damage.**

NOTE: Monitor shock, vibration, and stick slip data from MWD tool while transitioning on and off bottom. If high or severe values are seen, discuss with DE and DFS. Changes to these steps may be warranted.

- 15) Transition from rotate to slide using the following procedure.
- a) Drill to slide point and stop drilling ahead.
 - b) Maintain full drilling RPMs and pump rates and allow WOB to drill off to half of full amount.
 - c) Pick up and ensure that weight breaks over, indicating the bit is off bottom.
 - d) Kill rotary.
 - e) Bring pumps to full rate if not already there.
 - f) Start drill pipe oscillator.
 - g) Slack off to bottom at 5-10 ft/min, watching for weight increase.
 - h) When weight increase is seen, slowly bring weight up to 30k lbs.
 - i) Orient tool face as required for slide.
 - j) Bring weight up to full amount, ~60k lbs, adjusting string to maintain toolface orientation.
 - k) Drill to end of slide interval.
 - l) Allow to drill off for 30 seconds at full pump rate and with oscillator running.
 - m) Pick up until weight breaks over, indicating bit is off bottom, then stop oscillator.
 - n) Return to bottom in rotary mode using same procedure as above.
- 16) Always monitor the well for losses. Be prepared to fill the backside with cold water or WBM to mitigate risk of wellbore fluid flashing to steam.
- a) If partial losses occur, refer to LCM plan and begin implementing LCM in fluids.
 - b) If severe losses occur, line up RCD fill-up line to pump down backside while drilling ahead.
 - i) Pump down backside to attempt to maintain hole fill.
 - ii) Incorporate LCM into mud according to Newpark drilling program and continue drilling ahead. Cuttings and LCM are expected to heal losses. Refer to decision tree in Newpark fluids program to define LCM recipe to treat losses.
 - iii) **Monitor closely for high temperature steam or fluid to surface during this operation. If steam is identified, shut in the well and line up for a steam kill per the procedure in the Appendix.**
 - iv) **In the event of drilling blind with total losses, refer to the appendix regarding hazards and mitigations.**



-
- 17) Monitor Torque and Drag and MWD temperature and compare to pre-drill models. Engineering will project ahead to ensure that drillstring can be safely removed from well at TD.
- a) Coordinate with engineering regarding slide efficiency and ability to follow well plan. Well plan and drilling window may be adjusted to improve drilling performance.
- 18) In the event of a tool failure or trip for ROP, circulate a bottoms up, incorporating a high viscosity sweep, and trip out of hole. Pick up a new BHA and begin trip in hole. Tripping presents a higher risk of exposing BHA components to temperatures above their design limits, as well as a higher risk of circulating high temperature fluid to surface. Ensure the following guidelines are followed any time a trip is performed:
- a) On fill ups in open hole, ensure to circulate at MWD/motor minimum for long enough to record temperature.
- b) MWD tools should be set up for tripping to provide frequent temperature measurements in the data stream.
- c) If temperature over 250 deg F is observed, begin staging in the hole as follows:
- i) Circulate at minimum GPM for MWD to turn on (400 GPM).
- ii) Move the string down slowly, while staging. Downhole subs have shown less lateral vibration with pipe movement. **Do not rotate.**
- iii) Circulate for minimum of 30 minutes, or a maximum of 60 minutes until a temperature below 250 deg F at the tools is recorded.
- iv) Begin tripping again and repeat every 30 minutes or 10 stands, whatever comes first.
- v) When temperature exceeds 250 deg F after 60 minutes of circulating, switch to washing in.
- d) A downlink can be performed once the trip is complete to return to the data stream preferred while drilling.
- e) When stopping to circulate, monitor return temperature at surface on Pruitt sensors. If temperature exceeds 180 deg F, **stop and shut in the well on the MPD choke.** Rig up to simultaneously circulate fluid through the kill line while pumping down the drill pipe. Refer to the well control appendix for further details.



Water boils at ~200 deg F at the GLADE location. Always ensure that returns will not exceed 180 deg F when circulating hot fluid. Refer to the tables below for recommended pump rates to ensure temperature limit is not exceeded. If return temperature exceeds 250 deg F, it is recommended to pump from the Poseidon tank to reduce ratio of kill line fluid to standpipe. Always maintain 200 psi back pressure when circulating to maintain drilling fluid in liquid phase.

Measured Stack Temperature (F)	Kill Line Pump Rate (GPM)	Standpipe Pump Rate (GPM)
180	100	200
190	200	200
200	200	200
225	200	100
250	200	100
275	N/A	N/A
300	N/A	N/A
350	N/A	N/A

Table 1. Pump Rates assuming 150 deg F Suction

Measured Stack Temperature (F)	Kill Line Pump Rate (GPM)	Standpipe Pump Rate (GPM)
180	50	200
190	100	200
200	100	200
225	200	200
250	200	200
275	200	100
300	200	100
350	200	100

Table 2. Pump Rates assuming 80 deg F Suction

- 19) Drill to the total measured depth of the well plan. Circulate wellbore clean and trip out of hole for logging runs.
- 20) Rig up SLB thru bit logging equipment. Pick up 8.5” thru bit BHA and run in hole to TD. Circulate according to logging procedure to precondition the wellbore temperature. Deploy logging tool and begin logging trip out of hole.
- a) Rig up packoff, swivel, and pump in sub to circulate
 - b) Perform logging per procedure provided by SLB. (Procedure in Appendix for reference)
 - c) Ensure 2 3/8” rabbit is run prior to deploying tools to confirm drift. Rabbit must be Teflon or plastic, not metal.
 - d) Circulate at a maximum rate of 270 GPM with wireline tools in the well. Ensure that tools are reading 280 deg F or lower when deployed, prior to disengaging wireline.
 - e) Disengage wireline and begin tripping out at max speed according to logging plan.
 - f) At intermediate casing shoe trip speed may be increased to 200-300 fpm.
 - g) Once string is at surface, lay down wireline tools and confirm data quality with SLB.
- 21) Rig up to run 5 ½” casing string. This casing string is being placed in the wellbore to aid in ranging and intercept operations to be performed while drilling the production interval of the second well.
- a) Ensure wear bushing is pulled prior to beginning casing run.
 - b) Refer to the casing tally below. No centralizers are planned to be run, and this string will not be cemented.
 - c) Ensure that shoe collar is installed on end of string to guide casing in open hole. Confirm that shoe collar does not have a valve installed.

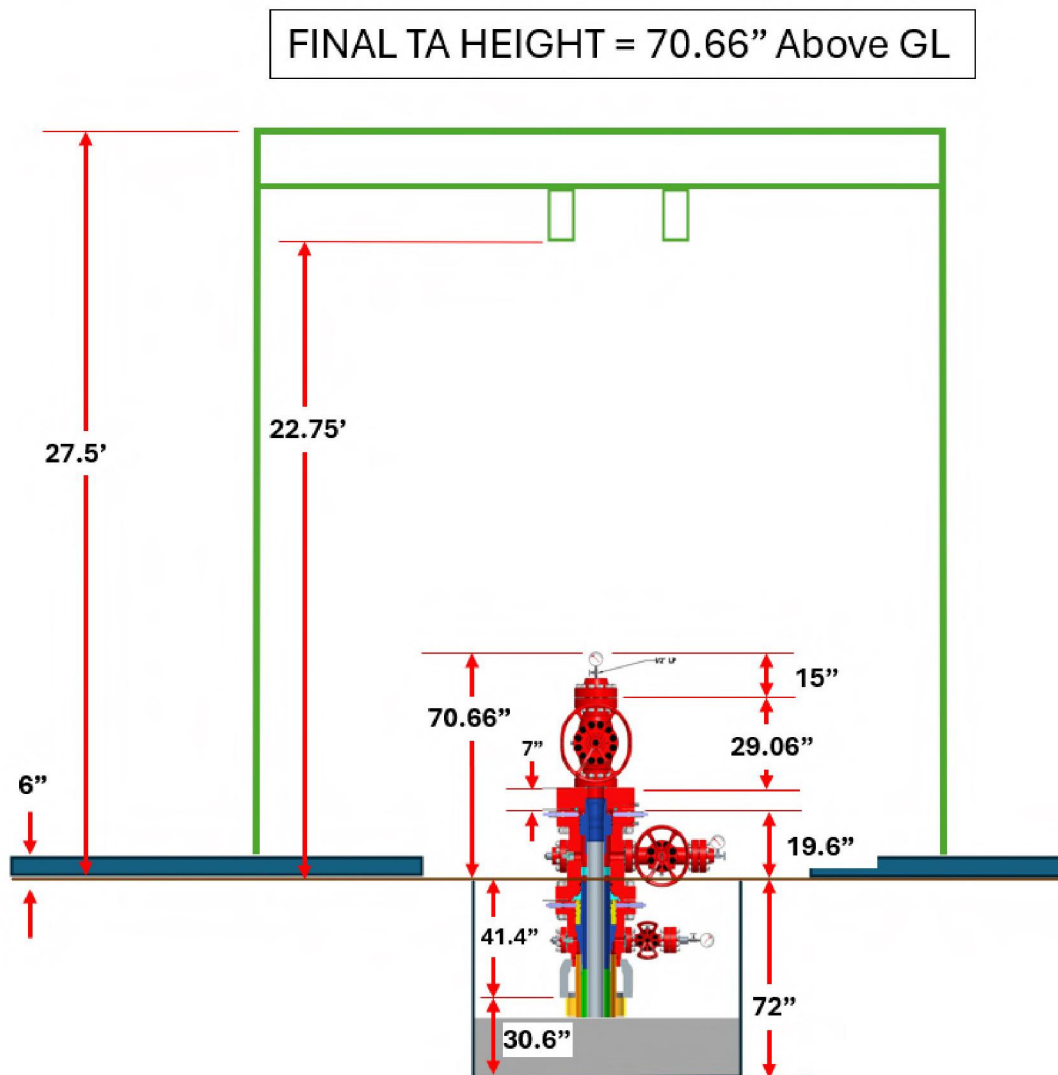
NOTE: There are no floats installed in the casing string. A x-over to a FOSV and dart valve must be available on the rig floor until the casing is landed and BPV is installed.



5 1/2" Casing Design									
Interval		Size	Weight	Grade	Thread	ID	Drift	Cplg OD	
Surface – 20200' TMD		5 1/2"	17 ppf	P-110 ICY	TPN	4.892"	4.767"	6.300"	
P-110 IC Casing Specs									
Size	Collapse (psi)	Burst (psi)	Tension (lbs)			Make-up Torque, ft-lb			
			Body	Joint	Max @ 1.6 SF	Thread	Min	Opt	Max
5 1/2"	8,610	12,090	620,000	620,000	387,500	TPN	11,700	13,000	14,300

- 22) Land casing string in wellhead on 5 1/2" casing hanger. Test hanger seals to 10,000 psi.
- Casing Hanger will be pre-bucked with a 4ft pup.
 - Make up casing hanger to the last joint of casing
 - Make up Landing joint to the top box connection of the casing hanger. Ensure tongs are not used on sealing surfaces and applied only to the designated area of the hanger.
 - Lower the casing hanger through floor.
 - Land and tighten the lockdown screws.
 - Locate test port labeled "**SEAL TEST PORT**" and test to 10,000psi for 10 minutes.
 - This test validates seals between 5-1/2" casing hanger and intermediate head.
- 23) Circulate 1.5 bottoms up through casing to ensure clear flow path and clean column of mud in wellbore.
- Confirm that well is dead with mud weight in well.
 - Treat fluid with 5 gallons of Avacide (Biocide) per 225 bbls of fluid.
 - Treat with corrosion inhibitor as follows:
 - For temps <320 deg F, add 55 gallons of C335P per 500 bbls to be treated.
 - For temps >320 deg F add 5 gallons of ZC1500 per 75 bbls of fluid to be treated.
- 24) Set BPV, remove landing joint and ND BOP. Once rig is moved off the well, call StreamFlo to install adapter and master valve on wellhead.
- Install tubing head adapter per StreamFlo procedure
 - Remove protector sleeve from hanger neck.
 - Clean, inspect, lubricate, and install ring gasket
 - Lower tubing head adapter and make up flange.
 - Locate test port labeled "**FLG TEST PORT**" and test to 10,000psi for 10 minutes.
 - This test validates seals on the following: top of 5-1/2" casing hanger, lockdown screws, tubing head adapter flange, 5-1/2" hanger neck seal with adapter.
 - Install master valve immediately after BOP is removed.
 - Test Master Valve per StreamFlo procedure using H21 BPV and test dart.
 - Ensure that outlet valves are installed on A-Section and B-section of the wellhead with pressure gauges to measure the two wellbore annuli.
- 25) Skid to Glade EAST (Intercept well) and perform the same drilling procedure, with the exception of the steps outlined in the Ranging and Intercept Procedure.

26) Wellhead diagram below post rig release:





6.0 RANGING AND INTERCEPT OPERATIONS

6.1 Overview

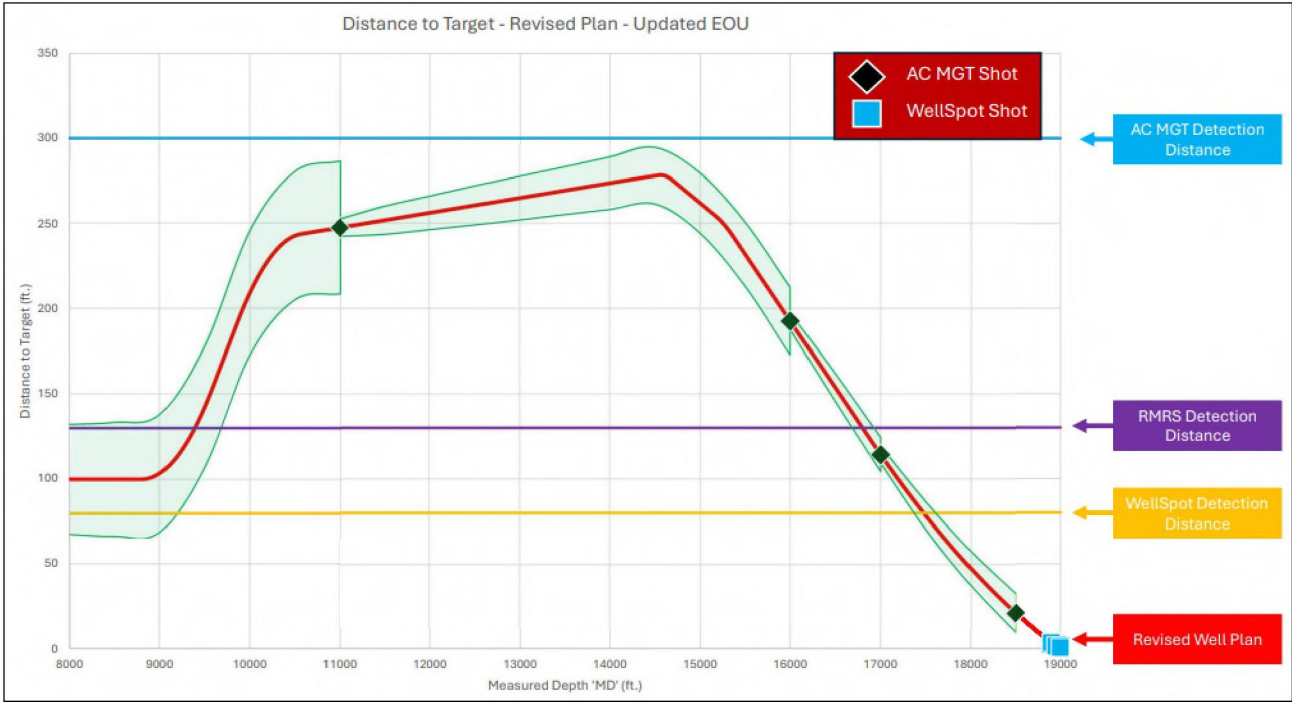
This section focuses on the required steps to execute a ranging and intercept between the well being actively drilled (Glade EAST, Intercept well) and the previously drilled target well (Glade WEST). Intercepting and connecting the two wellbores is a critical part of creating a closed loop geothermal system. There are multiple challenges associated with this operation including the following:

- Managing high temperatures in the target and active wellbores
- Ability to steer in the active well
- Wellbore position uncertainty
- Temperature lifespan of sensitive electronics

Halliburton Ranging Services has provided several ranging technologies to this project which will be used based on wellbore conditions at the time of drilling. The wells are designed to be intercepted at a planned MD of 19,500', providing 500' of "runway" to allow for well plan revisions and a second run if needed. The following provides a summary of the preliminary plan identified for GLADE. Based on drilling conditions and the thermal gradient identified while drilling the first production interval, this plan may change. A final Ranging procedure will be provided prior to entering ranging operations.

6.2 Procedure

- 1) The image below shows the various ranging technologies to be employed and the planned depth for each ranging run. This graph also shows the detection limits for each ranging option. This plan is subject to change depending on wellbore conditions encountered while drilling.





- 2) Perform first ranging run upon production hole drillout. This will use the AC MGT ranging technique.
- a) Drill out with BHA below that includes a Sperry BaseStar MWD tool that is designed to measure a signal that will be generated from the previously drilled wellbore (target well).

Description	OD [in]	ID [in]	Cnx Up / Cnx Dn	Wt[lb/ft] / Comp Wt[klbs] / Tot Wt[klbs]	Length [Usft]	Total Length [Usft]	Notes
8.5 PDC	8.5	2	4 1/2 REG		1	1	TFA 1.0-1.3
7in 1.25 CAM w/8 1/8	7.125		4 1/2 IF / 4 1/2 REG		37	38	7/8 8.5, .24 rev/gal, mid body IBS 1/8" UG, .015-.025 fit
8.125 Stabilizer	8.125	2.25	4 1/2 IF / 4 1/2 IF		8	46	1/8" UG, DTI FixedBlade
6.5 NM UBHO	6.5	2.875	4 1/2 IF / 4 1/2 IF		3.5	49.5	
6.5 NMDC (MWD CARRIER)	6.75	3.25	4 1/2 IF / 4 1/2 IF		30	79.5	Sperry Base Star
6.5 NMDC	6.5	3.25	4 1/2 IF / 4 1/2 IF		30	109.5	
8.125 Stabilizer	8.125	2.25	4 1/2 IF / 4 1/2 IF		8	117.5	1/8" UG, DTI FixedBlade
Anti Stick Slip Tool	6.5		4 1/2 IF / 4 1/2 IF		17	126.5	Tomax or similar
6.5 Filter Sub	6.5	3.25	4 1/2 IF / 4 1/2 IF		4	130.5	
6 3/4 Collars	6.75	2.875	4 1/2 IF / 4 1/2 IF	101.0	500	630.5	
Crossover SUB	6.5	2.875	Delta 544 / 4 1/2 IF		3.5	634	
5.5 HWDP	5.5	3.25	Delta 544	57.4	400	1034	
5.5 Drill Pipe	5.5	4.778	Delta 544	21.9	To Surface	20000	

- b) Rig up wireline on the target well and run in hole with MGT coil.
- c) Perform MGT shot at 11,000 ft MD.
- d) Confirm MGT ranging shot was successful and remove MGT from target well.
- e) With wireline rigged up on the target well, perform a gyro and temperature logging run to total MD.
- f) Rig down wireline and secure target well.
- 3) Drill ahead per the drilling procedure outlined in the Production Drilling section.
- a) Ensure that surveys are closely monitored and are always within acceptance criteria.
- b) Send surveys to Halliburton ranging team to ensure that the active well is tracking the target well.
- c) Wellplan modifications may be made based on BHA tendencies to ensure the wells are staying within range of each other.
- 4) After 17,000' MD and before 18,000' MD, prepare to perform a ranging run with the AC MGT System.
- a) Trip out to install Sperry BaseStar MWD if not already in string.
- b) With BHA near bottom of well, deploy MGT coil in target well. Monitor MGT coil temp and retrieve tool if temperature exceeds 500 deg F.
- c) Perform ranging run when back on bottom.
- 5) Drill ahead until wells are expected to be within 80' of each other.
- 6) Continue drilling to 18,500 ft MD and perform a WellSpot run.



a) Pick up drilling BHA which includes the isolation subs and landing collar required for the WellSpot tool. The table below shows a sample WellSpot ranging BHA required for this operation.

#	Description	OD [in]	ID [in]	Cnx Up / Cnx Dn	Wt[lb/ft] / Comp Wt[klbs] / Tot Wt[klbs]	Length [Usft]	Total Length [Usft]	Notes
1	8.5 PDC	8.5	2	4 1/2 REG		1	1	TFA 1.0-1.3
2	7in 1.25 CAM w/8 1/8	7.125		4 1/2 IF / 4 1/2 REG		37	38	7/8 8.5, .24 rev/gal, mid body IBS 1/8" UG, .015-.025 fit
3	8.25 Stabilizer	8.25	2.25	B 4 1/2" IF		8	46	1/4" UG, DTI FixedBlade
4	6.5 NM UBHO	6.5	2.875	B 4 1/2" IF		3.5	49.5	
5	6.5 NMDC (MWD CARRIER)	6.75	3.25			30	79.5	
				B 4 1/2" IF				
6	6.5 NMDC	6.5	3.25	B 4 1/2" IF		30	109.5	
7	8.25 Stabilizer	8.25	2.25	B 4 1/2" IF		8	117.5	1/4" UG, DTI FixedBlade
8	Anti Stick Slip Tool	6.5		B 4 1/2" IF		17	134.5	Cougar Thruster
9	Gap Sub w/ Baffle Plate	6.5	3.25	B 4 1/2" IF	84.82	3.2	137.7	
10	NMDC	6.5	3	B 4 1/2" IF	89	60	197.7	
11	6 3/4 Collar	6.75	2.81	B 4 1/2" IF	99.35	120	317.7	
12	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	320.9	
13	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	324.1	
14	HWDC	6.75	2.81	B 4 1/2" IF	99.35	60	384.1	
15	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	387.3	
16	HWDC	6.75	2.81	B 4 1/2" IF	99.35	120	507.3	
17	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	510.5	
18	6.5 Filter Sub	6.5	3.25	4 1/2 IF / 4 1/2 IF		4	514.5	
19	6 3/4 Collars	6.75	2.875	4 1/2 IF / 4 1/2 IF	101.0	320	834.5	
20	Crossover SUB	6.5	2.875	Delta 544 / 4 1/2 IF		3.5	838	
21	5.5 HWDP	5.5	3.25	Delta 544	57.4	400	1238	
22	5.5 Drill Pipe	5.5	4.778	Delta 544	21.9	To Surface	20000	

- b) This ranging run will be performed with a Thru Pipe Logging (TPL) wireline and a side entry sub.
- c) Trip back to bottom and circulate to condition the wellbore until BHA temperatures are below 300 deg F.
- d) Deploy the WellSpot tool through the side entry sub and take a ranging shot. Continue circulating while pumping the WellSpot tool in place. Pump at 500-700 gpm while monitoring tension in the wireline to ensure limits are not exceeded. The tool has an external temperature rating of 392 deg F and an internal rating of 250 deg F. Monitor temperature while running tool and retrieve if temperature limit is being approached.
- i) In addition to WellSpot temp monitoring, ensure that MWD temperature is monitored during this operation and does not exceed operating limits.
- e) Stop pumps and perform ranging shot. Confirm data is acquired.
- f) Remove the WellSpot tool while continuing to circulate at 700 gpm, continuing to monitor wireline tension is within acceptable limits.



- g) Once WellSpot tool is removed, rig down side entry sub and continue drilling ahead.
- 7) Continue performing ranging shots per the ranging procedure, until the estimated distance from the target wellbore is 1-3 ft.
- 8) POOH and pickup ranging specific BHA.
- a) Pickup BHA as follows:

#	Description	OD [in]	ID [in]	Cnx Up / Cnx Dn	Wt[lb/ft] / Comp Wt[klbs] / Tot Wt[klbs]	Length [Usft]	Total Length [Usft]	Notes
1	8.5 PDC	8.5	2	4 1/2 REG		1	1	TFA 1.0-1.3
2	Stabilizer	8.25	2.25	B 4 1/2" IF		3.9	4.9	Stab with float
3	Gap Sub w/ Baffle Plate	6.5	3.25	B 4 1/2" IF	84.82	3.2	8.1	
4	NMDC	6.5	3	B 4 1/2" IF	89	60	68.1	
5	6 3/4 Collar	6.75	2.81	B 4 1/2" IF	99.35	120	188.1	
6	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	191.3	
7	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	194.5	
8	HWDC	6.75	2.81	B 4 1/2" IF	99.35	60	254.5	
9	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	257.7	
10	HWDC	6.75	2.81	B 4 1/2" IF	99.35	120	377.7	
11	Gap Sub	6.5	3.25	B 4 1/2" IF	84.82	3.2	380.9	
12	6.5 Filter Sub	6.5	3.25	4 1/2 IF / 4 1/2 IF		4	384.9	
13	6 3/4 Collars	6.75	2.875	4 1/2 IF / 4 1/2 IF	101.0	320	704.9	
14	Crossover SUB	6.5	2.875	Delta 544 / 4 1/2 IF		3.5	708.4	
15	5.5 HWDP	5.5	3.25	Delta 544	57.4	400	1108.4	
16	5.5 Drill Pipe	5.5	4.778	Delta 544	21.9	To Surface	20000	

- b) Deploy the WellSpot ranging tool on wireline using the same procedure as before.
- c) Perform ranging shot and determine exact distance and direction to target well.
- d) This measurement is taken very close to the bit and provides the required telemetry to perform the final intercept run.
- e) Remove the WellSpot tool while continuing to circulate.
- 9) Pickup drilling BHA
- a) Drill to intercept point.
- b) Additional ranging runs may be required at this time, per the procedure in step 7, to zero in on the target well.
- c) Once the target wellbore is within 5-10 ft, pick up a roller cone bit for the final intercept run.
- d) Monitor drilling parameters for an indication that the target wellbore has been intercepted. The following may indicate the wellbores have been intercepted:
- i) Erratic ROP and torque spikes indicating casing is hit.
- ii) Potential losses into the target wellbore.
- iii) Pressure measured on the gauge installed on the target well.



-
- iv) Returns with metal shavings from casing in target well.
- 10) Confirm wells are intercepted by shutting in on the drilling well and applying pressure to the wellbore. This pressure should be measured on the 9 5/8" x 5 1/2" casing annulus on the target well. A pressure increase indicates the wellbores have been intercepted.
- a) Drill an additional 3-4 ft to ensure that a large connection is made between the two wellbores.
- 11) In the event that the wellbores are not intercepted through drilling, but are within 1-2 ft of each other, an attempt to join the two wells using perforations or sand jetting may be performed. Refer to specific plan for detailed procedure.
- 12) TOOH and lay down entire drillstring and BHA.
- 13) Install dummy hanger for 5 1/2" casing. Test hanger seals to 10,000psi. Install 5 1/2" BPV in dummy hanger and ND BOP.
- a) Refer to StreamFlo procedure for setting 5-1/2" dummy hanger.
- i) Make up Landing joint to the top box connection of the casing hanger. Ensure tongs are not used on sealing surfaces and applied only to the designated area of the hanger.
- ii) Lower the casing hanger through floor.
- iii) Land hanger and tighten the lockdown screws.
- iv) Locate test port labeled "SEAL TEST PORT" and test to 10,000psi for 10 minutes.
- (1) This test validates seals between 5-1/2" casing hanger and intermediate head.
- b) Install 5-1/2" BPV per StreamFlo procedure.
- 14) After rig has moved off the well, install tubing head adapter and master valve per StreamFlo procedure.
- a) Refer to StreamFlo procedure for installing tubing head adapter.
- i) Remove protector sleeve from hanger neck.
- ii) Clean, inspect, lubricate, and install ring gasket
- iii) Lower tubing head adapter and make up flange.
- iv) Locate test port labeled "FLG TEST PORT" and test to 10,000psi for 10 minutes.
- (1) This test validates seals on the following: top of 5-1/2" casing hanger, lockdown screws, tubing head adapter flange, 5-1/2" hanger neck seal with adapter.
- b) Refer to StreamFlo procedure for installing the master valve.
- c) Test Master Valve per StreamFlo procedure using H21 BPV and test dart. Test to 10,000 psi for 10 minutes.
- d) Ensure that outlet valves are installed on A-Section and B-section of the wellhead with pressure gauges to measure the two wellbore annuli.
- 15) Prepare to skid rig back to Glade WEST.





7.0 WRAP UP OPERATIONS

7.1 Overview

This section covers all steps remaining to be completed on location prior to RDMO. The rig will be skidded back to the target well to remove the 5 ½" casing string that was previously installed to aid in the ranging process. This pipe will be re-used, so care must be taken in handling this pipe. The target well will also be secured at this time and equipment will be RDMO.

7.2 Procedure

- 1) Prior to skidding back to Glade WEST (Target Well), remove master valve per the following steps:
 - a) Lubricate in and install BPV in 5 ½" casing profile.
 - b) ND lubricator
 - c) Remove StreamFlo master valve using loader.
- 2) Skid rig back to Glade WEST (Target Well) and NU and Test BOP.
 - a) Verify well is dead by checking pressure on B-section outlet valve gauge.
 - b) Equalize pressure and then remove previously installed BPV.

NOTE: The BOP stack will require an adapter spool (11" 10000psi x 13-5/8" 10000psi).

- 3) Make up landing joint to the top of the casing hanger.
- 4) Confirm well is dead with fluid in the well. Plan to displace well with KWM if necessary.
 - a) If displacing well with new fluid, include biocide and corrosion inhibitor.
 - b) Treat fluid with 5 gallons of Avancide (Biocide) per 225 bbls of fluid.
 - c) Treat with corrosion inhibitor as follows:
 - i) For temps <320 deg F, add 55 gallons of C335P per 500 bbls to be treated.
 - ii) For temps >320 deg F add 5 gallons of ZC1500 per 75 bbls of fluid to be treated.
- 5) Rig up casing crew to remove 5 ½" casing string. Do not exceed overpull limit of 100,000 lbs.
- 6) Begin pulling casing from wellbore and laying down.
 - a) Maintain hole fill while tripping pipe and monitor trip sheet for proper hole fill.
 - b) Exercise caution breaking out connections and handling pipe, as this pipe will be reused.
 - c) Ensure thread protectors are installed on rig floor prior to sending pipe down PDS.
 - d) In the event casing becomes too hot to handle, install a swedge and circulate 1-2 bottoms up to cool the pipe. Monitor return temps during this operation. If temps exceed 180 deg F, rig up to pump fluid across the stack using the modified drillers method. When temperatures stabilize below 180 deg F, continue tripping pipe, ensuring it is safe to handle.
 - e) Return casing to local Tenaris yard for inspection.
- 7) Once all casing has been laid down, reinstall 5-1/2" Casing hanger and BPV in the 9 5/8" intermediate head profile. Test seals to 10,000 psi for 10 min.
 - a) Refer to StreamFlo procedure for setting 5-1/2" dummy hanger.
 - i) Make up landing joint to the top box connection of the casing hanger. Ensure tongs are not used on sealing surfaces and applied only to the designated area of the hanger.
 - ii) Lower the casing hanger through floor.



-
- iii) Land hanger and tighten the lockdown screws.
 - iv) Locate test port labeled "SEAL TEST PORT" and test to 10,000psi for 10 minutes.
 - (1) This test validates seals between 5-1/2" casing hanger and intermediate head.
 - v) Install 5-1/2" BPV per StreamFlo procedure.
- 8) ND BOP, install tubing head adapter, install master valve, and begin RDMO.
- a) Refer to StreamFlow procedure for installing tubing head adapter.
 - i) Remove protector sleeve from hanger neck.
 - ii) Clean, inspect, lubricate, and install ring gasket
 - iii) Lower tubing head adapter and make up flange.
 - iv) Locate test port labeled "FLG TEST PORT" and test to 10,000psi for 10 minutes.
 - (1) This test validates seals on the following: top of 5-1/2" casing hanger, lockdown screws, tubing head adapter flange, 5-1/2" hanger neck seal with adapter.
 - b) Refer to StreamFlo procedure for installing the master valve.
 - c) Test Master Valve per StreamFlo procedure using H21 BPV and test dart. Test to 10,000 psi for 10 minutes.
 - d) Ensure that outlet valves are installed on A-Section and B-section of the wellhead with pressure gauges to measure the two wellbore annuli.
- 9) When rig has moved off, reinstall master valve on wellhead.



A – CONTACT LIST

Primary Contacts

Service Providers	Name
Stream Flow Wellhead	Redacted
Stream Flow Wellhead	
Pruitt MPD	
Pruitt MPD	
Halliburton Cement	
Newpark Drilling Fluids	
Fluid PR Solids Control	
Scout Directional	
Schlumberger Wireline	
Ultrerra Bits	
Schlumberger (Smith) Bits	
NOV (REED) Bits	
Baker Hughes Bits	
Halliburton Ranging	
Cool Drill	
Cool Drill	



	Redacted
Stallion	
WES Latham Gas Plant	

Additional Contacts

Service Providers	Name		
3 corner OFS- Water Hauling	Redacted		
AI Driller			
Bentley Welding (BWI)			
BluePrint			
Brand-X			
Childers trucking			
Drovo			
Freedom			
HCI -High Country Industrial			
Hillspoint			
Innovative Solution			
Jamm Power			
Mathena (SPM)			
Montrose			
Noble			
Norco			
NOV / MD Totco			



Full Throttle	Redacted
Pason	
Pathfinder	
Premium	
Red Desert	
Select	
Select	
Select / Peak	
TRK	
Vertical tank	
Walker	
Waste Connection	
Weatherford	
Well Water Solutions	
Wisco Trucking	
Zeco	
OAK CREEK CONSULTING	

Contingency Procedure Contacts

Service Providers	Name
Redacted	



WWT International	Redacted
Weatherford Fishing	
GO Wireline	
KLX Energy	
Gyrodata	



B – Subsurface Prognosis and Logging Program



GLADE Subsurface Prognosis and Logging Program

GEOHERMAL LIMITLESS APPROACH TO DRILLING EFFICIENCIES

Prepared by:

Allison Kimbrough

Jess Puyear

Amber Peterson

Contents

1. Geologic Background
 - a. Temperature
 - b. Stratigraphy
 - c. Basement Lithology
 - d. Seismic/Structure
 - e. Regional Stress
 - f. PPFG
2. Subsurface Goals
3. Mudlogging (TerraGuidance)
4. Wireline Logging (SLB)
5. Appendix

1. Geologic Background

The GLADE (Geothermal Limitless Approach to Drilling Efficiencies) project is a partially DOE-funded pilot to demonstrate drilling technology in a high temperature, hard rock geothermal application. The GLADE wells will be a parallel set of wells drilled to 20,000' TVD and intersected at the toe to create a closed loop in crystalline basement with temperatures up to 560° F.

a. Temperature

GLADE is targeting a temperature anomaly within the DJ Basin. The “Hot Spot” is at the core of the Wattenberg field and has an elevated geothermal gradient of up to 50 C/km, making this a favorable site for oil & gas development and to test geothermal resource potential. Bottomhole temperature estimates for GLADE use corrected DFIT and BHT data from offset wells down to the top of basement (Figure 1). GLADE estimates account for the uncertainty of the geothermal gradient in the basement where there is no data due to a lack of deep wells. The range of expected bottomhole temperatures is between 425-575° F given a measured temperature of 300° F at the top of basement in the offset UPRR PAN AM 39-1 well (3 miles east of GLADE) and potential geothermal gradients of 25 C/km to 50 C/km. This range considers potential thermal conductivity in the basement of 3-4 W/mK. Average estimates from literature for granite and gneiss thermal conductivities are closer to 3 W/mK, which would result in BHT closer to the high end of the range. However, thermal conductivity of metals associated with the Colorado Mineral Belt have orders of magnitude higher thermal conductivity, which could increase the basement average if present even in small quantities.

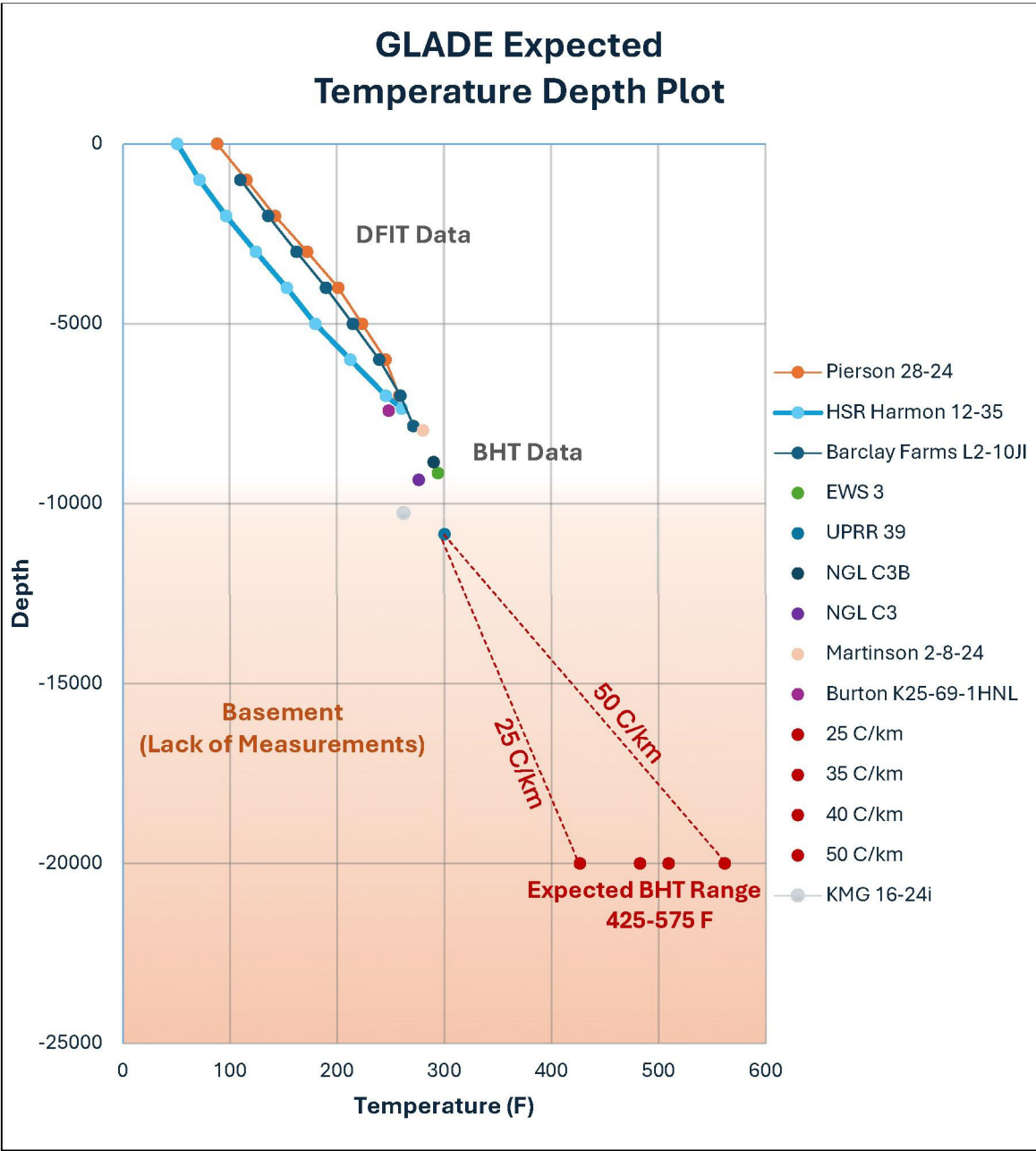


Figure 1. Expected temperature vs depth plot used to estimate a range of GLADE bottomhole temperatures using well data from the sedimentary section and a range of possible gradients in the basement section.

b. Stratigraphy

The DJ Basin is an asymmetrical, Laramide-aged basin with a steeply dipping western flank and a gently dipping eastern flank. The Wattenberg field is in the axis of the basin and is the source of decades of historical oil & gas production in Cretaceous sedimentary reservoirs. The interval from surface to approximately 7000' TVD is expected to be drilled with high ROP in line with typical DJ Basin drilling operations.

The Lyons and Fountain Formations are Paleozoic clastic reservoirs beneath the hydrocarbon-bearing zones that have been historically used for saltwater disposal. This interval comprises harder rocks that are not penetrated by typical DJ wells, and therefore, is expected to be drilled with lower ROP. These reservoirs, and the Lyons in particular, are of interest as additional future geothermal targets for EGS (Enhanced Geothermal Systems) development. Sampling and logging in the GLADE wells will be conducted across this interval with that future potential in mind.

The top of Pre-Cambrian basement is at approximately 10,500' TVD in the GLADE location. The expected tops for GLADE were derived from log and seismic correlation to sufficiently deep offset wells (Figure 2). The top of basement is an unconformity and therefore is expected to be weathered due to subaerial exposure in the Paleozoic before Fountain Formation sediments were deposited. This transition is best observed in the M B LEHL-A1 well (Figure 3).

GLADE SUBSURFACE PROGNOSIS AND LOGGING PROGRAM

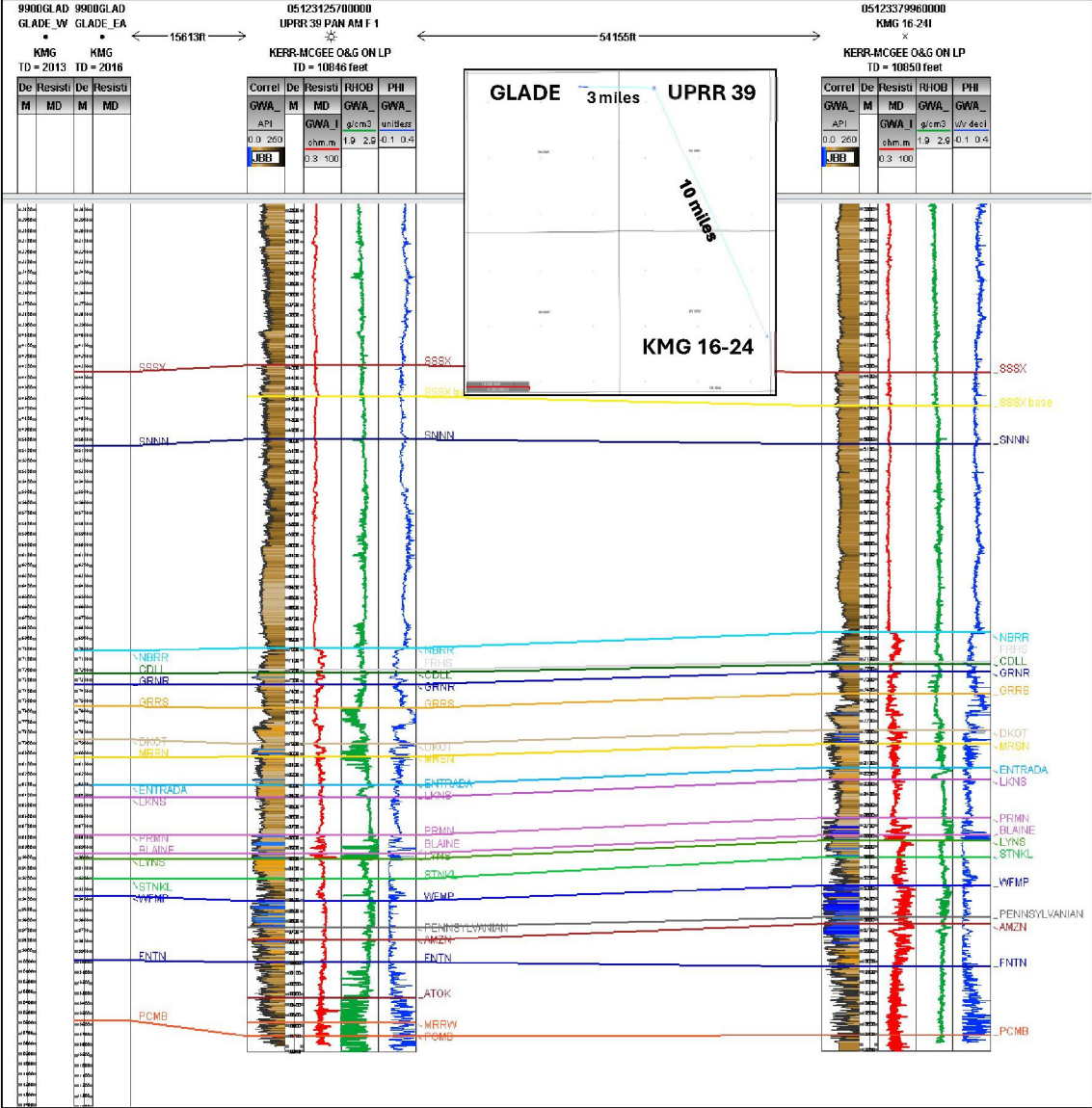


Figure 2. Correlation section through the intermediate hole section of GLADE to offset wells UPRR 39 PAN AM F1 and KMG 16-24I. Well log and seismic correlations were used to generate the GLADE expected tops. *Formation Tables and Lithologic Cross Section attached in Appendix.*

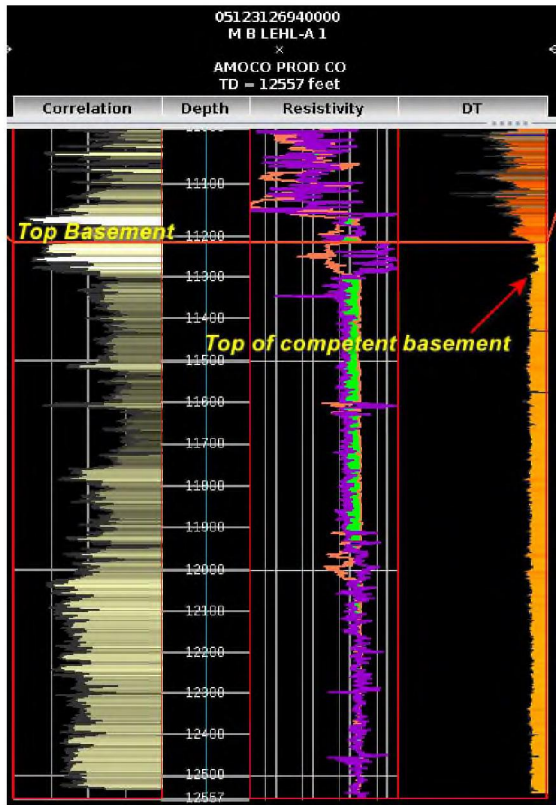


Figure 3. Logs across the top of basement in the M B LEHL-A1 well showing the transition from Paleozoic sedimentary rocks to weathered basement to competent basement.

c. Basement Lithology

We expect to encounter igneous and metamorphic rocks, primarily granite and gneiss, in the basement (Figure 4).

Protected Data

Figure 4. Magnetic Basement Domains as defined by the USGS using magnetics data signature from outcrop to estimate basement lithology within the basin. (USGS; Tweto, 1979)

Geomechanical tests were conducted by Los Alamos National Lab (LANL) on local surface samples that were collected from outcrop in the Front Range. The results of the UCS tests show that gneiss samples are denser, stiffer, and stronger than granite samples (Figure 5). Additionally, field observations suggest that the basement is likely to be fractured at a sub-seismic scale and additional igneous and metamorphic lithologies may be encountered.



GTU samples (Granite UCS tests)

GNU samples (Gneiss UCS tests)

Granite Samples	GTU-01	GTU-02	GTU-03
UCS (MPa)	132.9	119.3	80.8
Young's modulus (GPa)	47.827.21	40.244.26	37.719.60
Poisson's ratio	0.290.04	0.160.02	0.130.03
Density (g/cc)	2.688	2.695	2.693

Gneiss Samples	GNU-01	GNU-02	GNU-03
UCS (MPa)	167.7	199.8	157.9
Young's modulus (GPa)	47.227.06	61.757.60	55.125.01
Poisson's ratio	0.110.02	0.180.02	0.170.01
Density (g/cc)	2.929	2.957	2.940

Figure 5. Geomechanical results of uniaxial stress tests performed by Los Alamos National Lab. The plugs for testing were taken from outcrop samples collected by Oxy in the Front Range in analogous formations to the DJ Basin Pre-Cambrian basement.

The temperature anomaly that GLADE targets is associated with the Colorado Mineral Belt (Figure 6). The Colorado Mineral Belt (COMB) is a northeast-trending, 500 km long, 20-25 km wide, belt of late Cretaceous to Paleogene aged plutons and ore deposits across the state (Chapin, 2012). Ore deposits in the COMB include molybdenum, gold, silver, copper, lead, and zinc. There are potential COMB-related assemblages in the basement and that the GLADE wells may encounter younger igneous intrusions and/or ore mineralization. These constituents could have a significant positive impact on thermal conductivity.



Figure 6. Map showing the alignment of Colorado Mineral Belt (red outline) where it is mapped in outcrop with GLADE location (black square) in the basin.

Non-hydrocarbon gases may be present in open fractures in the basement. A lack of deep penetrations in the area creates significant uncertainty, but based on the depth, lithologies, and association with the COMB the following gases are considered possible. H₂S (Hydrogen Sulfide) is common in geothermal systems including in hot spring systems in Colorado. He (Helium) in Colorado is formed by U-Pb decay of zircons in basement rocks and migrates into overlying reservoirs via basement faulting. Less likely gases are H (Hydrogen), which may be formed by radioactive decay in basement rocks through serpentinization at high temperatures where H₂O interacts with iron-rich rocks, and CO₂ (Carbon Dioxide), which is naturally occurring in other basins on the Colorado Plateau in association with deep igneous rocks but has not been identified in the DJ basin.

d. Seismic/Structure

Reprocessed 3D seismic that is focused on basement imaging was used for structural interpretation and well path optimization. Structural interpretation confirms that GLADE is not located within one of the major SW-NE trending shear zones that are present to the north and south within the basin, but there are mapped faults that extend close to the GLADE location (Figure 7).



Figure7. Basement map of the main shear faults in the DJ basin. Zoom in on the top of basement structure at the GLADE wellsite.

Additionally, a high amplitude feature is recognized in the basement that the GLADE wells will penetrate at ~14,000' TVD (Figure 8). Our hypotheses are that this feature may be a basement fault or a boundary between basement rock types including a possible intrusive body. Cuttings and image log data will help us determine the lithology and characteristics of any fault that may be encountered.

Protected Data

Figure 8. Seismic Line going through the GLADE wells showing the basement feature the wells will encounter.

e. Regional Stress

Regional Shmax estimations can be derived from image logs and microseismic data. These datasets exist in the Sussex, Niobrara, Codell, Greenhorn, and Dakota formations, however we do not have any basement stress datasets. The estimated maximum stress range is ~100-130 degrees with 0 degrees being north. This is based on the range of sedimentary section Shmax azimuths from the nearby Ludwig 13-1 microseismic and image log datasets (Figure 9). There is a possibility of the basement stresses being decoupled from the sedimentary section. If this is the case, we will be able to define our maximum and minimum stresses using the dipole sonic and image logs collected in competent basement rock.

Protected Data

Figure 9. Orientation of maximum stresses in the DJ Basin as measured by image log and microseismic datasets. The Ludwig 13-1 well, 1 mile to the east of the GLADE wells has microseismic and image log datasets.

f. Pore Pressure/Fracture Gradient

Pore pressure and minimum stress and tensile failure gradient estimates were generated using industry standard log-based methodologies including modified Eaton (Eaton, 1975) and Bowers (Bower, 1995)) models as implemented in the commercially available RokDoc software. Two wells in proximity to the GLADE site and with deep coverage and required logs (density and sonic) extending to the top of the Precambrian basement were used for modeling (UPRR 39 Pan Am F1 and KMG 16-24). All available calibration data were incorporated including DFITs from the Sussex, Niobrara and Codell formations and step-rate test data from the KMG 16-24. These data served to constrain values of pore pressure and minimum stress and model-based solutions were used to interpolate between calibration points. The zone of greatest uncertainty is the majority of the Precambrian basement where log coverage was not available. The log-based model is extrapolated from its deepest point to the anticipated TD of the GLADE wells and represents our best estimate of the pore pressure, minimum stress and tensile failure limit (Figure 10.

Zone	Depth (ft TVD)		Pore Pressure (psi)				Shmin (psi)				Tensile Failure (psi)			
	Top	Bottom	Min	Mean	Max	S.D.	Min	Mean	Max	S.D.	Min	Mean	Max	S.D.
J0_WI	0	5500	8.0	9.0	9.8	0.7	13.2	14.4	15.5	0.8	17.6	19.8	21.8	1.5
J1_WI	5500	6950	9.1	9.9	11.1	0.7	12.9	13.9	14.5	1.1	17.0	18.7	19.6	2.3
J2_WI	6950	7750	10.8	12.3	14.6	1.5	13.7	14.9	16.3	1.0	17.6	19.1	20.7	1.2
J3_WI	7750	10000	8.3	8.3	8.3	0.4	12.0	13.1	15.4	1.2	15.8	17.6	21.9	2.2
J4_WI	10000	10200	6.0	7.1	7.9	0.7	11.8	12.0	12.5	0.3	15.9	16.5	17.7	0.7

GLADE SUBSURFACE PROGNOSIS AND LOGGING PROGRAM

J5_WI	10200	10425	8.0	8.6	9.1	0.4	11.7	11.8	12.0	0.1	15.6	15.8	15.9	0.1
J6_WI	10425	10750	9.3	9.9	10.3	0.4	12.0	12.3	12.6	0.2	15.9	16.2	16.7	0.3
pC Basement	10825	25000	8.3	9.8	11.3	1.2	12.3	12.3	12.3	na	16.2	16.2	16.2	na

Figure 10. Table summarizing pore pressure, minimum horizontal stress, and tensile failure at blocked depths from surface to TD using a stress model based on offset UPRR PAN AM F1 and KMG 16-24 wells.

2. Subsurface Goals

The goal of the geologic program for GLADE is to build a comprehensive dataset that allows us to evaluate the geothermal development potential in the DJ Basin. We are primarily interested in the Pre-Cambrian basement and the Paleozoic sedimentary section. The mudlogging and wireline logging programs aim to achieve the following:

- To define the temperature gradient
- To evaluate the range of lithologies; this includes mineralogy, rock fabrics, and degree of heterogeneity
- To assess structural features including faults and fractures and principal stresses
- To determine the presence of geothermal fluids and/or gases

3. Mudlogging

Vendor: TerraGuidance

Mudlogging will be conducted from surface casing point to TD on both GLADE wells. Services will include cuttings sample collection, examination, description, and packaging, gas monitoring, daily morning and evening reports, and production of geologic logs and a final well report. There will be a 4-man crew with pairs working 12-hour shifts.

- Cuttings will be collected between 30-90 ft intervals according to the depths in the table below.
 - Additional samples may be collected through critical intervals as ROP allows.
- Sample Sets:
 - 2 washed & dried sets (15 grams minimum)
 - 1 large volume wet set (250 grams minimum)

Hole Section	Depth	Sample Interval
Intermediate (OBM) 2,350’-10,789’ TVD	2,350’-7113’ (Top Niobrara)	90’
	7113’ (Top Niobrara)-10,789’ (Base of Intermediate)	30’
Production (WBM) 10,789’-20,000’ TVD	Entire Basement Section	30’

Gas Monitoring

TerraGuidance will use a portable quadrupole mass spectrometer provided by One Geo for onsite gas analysis. The mass spectrometer is used to differentiate between organic and inorganic gases in geothermal systems. It helps interpret fluid sources, chemistry, and processes by analyzing organic compounds and inorganic gases.

Major gas species that occur in geothermal fluids generally include CO2, He, H2, N2, NH3, CH4, Ar, and H2S. These analyses support the interpretation of porous/permeable zones including faults and fractures, geothermometry, monitoring of bit wear, and detection of hazardous gases.

The mass spectrometer deploys like conventional gas detection equipment, weighs 45 lbs, and requires a gas extractor, power (100-240 V, 1 A), sample flow system, ambient temperature (65-75 F), and internet/WITS.

4. Wireline Logging

Vendor: SLB

Wireline logging will be performed to acquire detailed subsurface data, essential for lithology and fracture characterization. The wireline logging plan has been optimized to capture the most critical data time and cost efficiently.

The program will focus most of the logging in the first well, with a subset of the same program in the production section of the second well. The intermediate logs will consist of two runs on wireline in open hole. The production hole section will utilize SLB’s ThruBit logging tools. The production hole logs will be combined into one run.

Hole Section	First Well (WEST)	Second Well (EAST)
Intermediate 2,350’-10,789’ TVD SBM	<u>WL Run 1: 1800 fph (10-11 hr)</u> Spectral GR Resistivity Density Neutron <u>WL Run 2: 1000-1200 fph (13-14 hr)</u> Sonic Scanner Quanta Geo Image Log	No logging
Production 10,789’-20,000’ TVD WBM	<u>ThruBit Run 1: 900 fph</u> Spectral GR Resistivity Density Neutron Dipole Sonic 3D Far Field FMI (Image Log)	<u>ThruBit Run 1: 900 fph</u> Spectral GR Resistivity Density Neutron Dipole Sonic 3D Far Field

5. Appendix

5.1 GLADE Formation Tables

GLADE EAST	Formation	Top SSTVD	Top MD	Top TVD	Base SSTVD	Base MD	Base TVD	Zone Type	TDS (mg/L)
3N66W2 Barclay 2-9 05123161220000 GL = 4900' RKB = 17' Datum = 4917'	Fox Hills and Shallower	Surface	17	17	4445	472	472	Groundwater	501-1000
	Pierre Shale	4444	473	473	4246	671	671	Confining Layer	
	Upper Pierre Aquifer	4245	672	672	3340	1577	1577	Groundwater	501-1000
	Pierre Shale	3339	1578	1578	608	4309	4309	Confining Layer	
	Sussex	607	4310	4310	308	4609	4609	Hydrocarbon	
	Pierre Shale	307	4610	4610	-2195	7112	7112	Confining Layer	
	Niobrara	-2196	7113	7113	-2438	7355	7355	Hydrocarbon	
	Codell	-2439	7356	7356	-2419	7336	7336	Hydrocarbon	
	Greenhorn	-2420	7337	7337	-2625	7542	7542	Hydrocarbon	
	Graneros Shale	-2626	7543	7543	-2940	7857	7857	Confining Layer	
	Dakota	-2941	7858	7858	-3117	8034	8034	Hydrocarbon	
	Morrison	-3118	8035	8035	-3381	8298	8298	Confining Layer	
	Entrada	-3382	8299	8299	-3506	8423	8423	Groundwater	>10000
	Lykins	-3507	8424	8424	-4041	8958	8958	Confining Layer	
	Blaine	-4042	8959	8959	-4087	9004	9004	Confining Layer	
	Lyons	-4088	9005	9005	-4279	9196	9196	Groundwater	>10000
	Lower Satanka	-4280	9197	9197	-4445	9362	9362	Groundwater	>10000
	Wolfcamp	-4446	9363	9363	-5057	9974.01	9974	Groundwater	>10000
	Fountain	-5058	9975.01	9975	-5638	10556.79	10555	Groundwater	>10000
	Precambrian Basment	-5639	10557.8	10556	TD	20162.38	20000	Confining Layer	

GLADE WEST	Formation	Top SSTVD	Top MD	Top TVD	Base SSTVD	Base MD	Base TVD	Zone Type	TDS (mg/L)
3N66W2 Barclay 2-9 05123161220000 GL = 4900' RKB = 17' Datum = 4917'	Fox Hills and Shallower	Surface	17	17	4445	472	472	Groundwater	501-1000
	Pierre Shale	4444	473	473	4246	671	671	Confining Layer	
	Upper Pierre Aquifer	4245	672	672	3340	1577	1577	Groundwater	501-1000
	Pierre Shale	3339	1578	1578	608	4309	4309	Confining Layer	
	Sussex	607	4310	4310	308	4609	4609	Hydrocarbon	
	Pierre Shale	307	4610	4610	-2195	7112	7112	Confining Layer	
	Niobrara	-2196	7113	7113	-2438	7355	7355	Hydrocarbon	

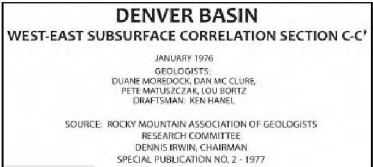
GLADE SUBSURFACE PROGNOSIS AND LOGGING PROGRAM

	Codell	-2439	7356	7356	-2419	7336	7336	Hydrocarbon	
	Greenhorn	-2420	7337	7337	-2625	7542	7542	Hydrocarbon	
	Graneros Shale	-2626	7543	7543	-2940	7857	7857	Confining Layer	
	Dakota	-2941	7858	7858	-3117	8034	8034	Hydrocarbon	
	Morrison	-3118	8035	8035	-3381	8298	8298	Confining Layer	
	Entrada	-3382	8299	8299	-3506	8423	8423	Groundwater	>10000
	Lykins	-3507	8424	8424	-4041	8958.02	8958	Confining Layer	
	Blaine	-4042	8959.02	8959	-4087	9004.04	9004	Confining Layer	
	Lyons	-4088	9005.04	9005	-4279	9196.32	9196	Groundwater	>10000
	Lower Satanka	-4280	9197.32	9197	-4445	9362.91	9362	Groundwater	>10000
	Wolfcamp	-4446	9363.91	9363	-5057	9982.08	9974	Groundwater	>10000
	Fountain	-5058	9983.1	9975	-5638	10572.97	10555	Groundwater	>10000
	Precambrian Basement	-5639	10573.99	10556	TD	20132.79	20000	Confining Layer	

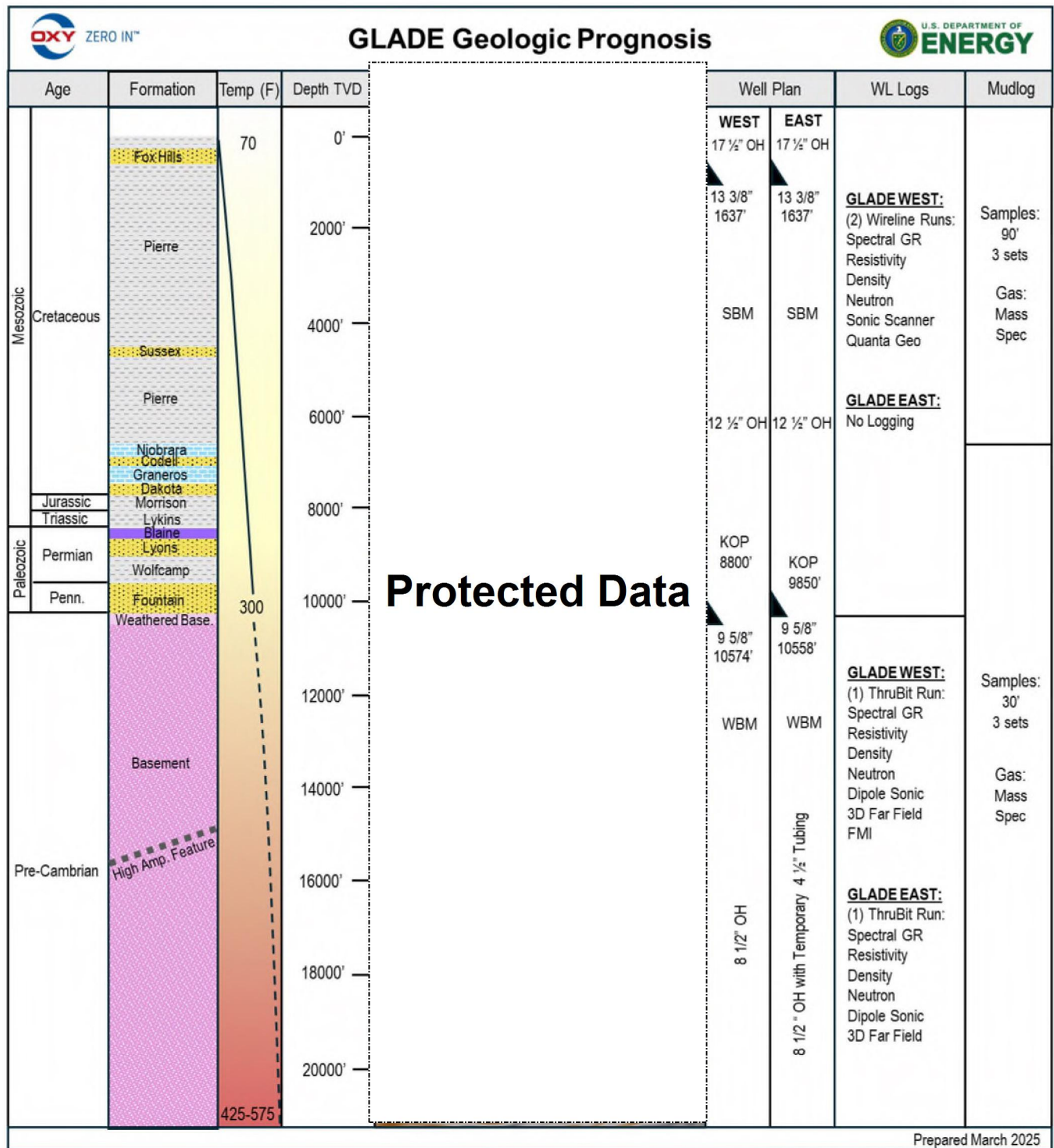
5.2 Regional Lithology Correlation

CALCO UPRR Ferch is nearest offset to GLADE.

GLADE SUBSURFACE PROGNOSIS AND LOGGING PROGRAM



5.3 Summary Geologic Prognosis Figure





C – Well Control Monitoring, Mitigation and Procedures

The following section describes the type of well control events that may be encountered, how to monitor the well to identify when a kick is being taken, and steps to kill the well depending on the kick type. The well control procedures are meant to address the following kick types; gas, steam, and gas/steam mixture. **When a kick type is unknown, always assume it is gas.** The procedures described in this appendix will always ensure that circulated gas is directed to the flare stack, and that any superheated fluids being circulated to surface are cooled below boiling point before flowing through the choke.

Monitoring

Typical kick indicators for gas kicks will be used at all times. These include the following:

1. Pit Gain – A pit gain can be an indication that steam or gas has entered the wellbore. If a pit gain is taken, the well must be shut in quickly to limit the gas influx (kick volume) allowed into the wellbore. Following shut in, determine next steps as described in the procedures below.
2. Return Flow Rate – A rapid increase in return flow can indicate that gas is rapidly expanding at surface and increasing return flow. Return flow is measured by the Coriolis when circulating through the MPD choke.
3. Pump Pressure Drop – A pump pressure drop while drilling can indicate that gas has entered the wellbore and is forcing its way to surface.
4. Drilling Break – A drilling break can sometimes lead to an increase in gas or steam in the wellbore. Other indicators should be closely monitored if a drilling break is encountered.
5. Gas Detection – Gas detectors on the rig can indicate small amounts of gas are entrained in the drilling fluid. There is normally a constant level of “background” gas in the mud. In the event the gas detectors indicate a fast rise in detected gas units, other indicators should be closely monitored.
6. Utilize MPD - Use MPD to monitor bbl in / bbl out conditions. In the event the pump rate into the well is not matching the return flow, gas or steam may be entering the well, or losses may have been encountered.

In addition to monitoring these items, due to the potential for steam at surface the following additional indicators must be monitored:

1. Return Temperature – The BOP stack will have redundant temperature sensors installed. These sensors should be monitored while drilling. The return temperature is expected to slowly increase while drilling. In the event of a rapid increase in temperature, exceeding 180 deg F, well control actions described below must be taken.
2. Downhole Losses – Downhole losses can be a leading indicator that steam, or hotter fluid is entering the wellbore. Return temperatures should be monitored closely in the event of losses.
3. Steam Sounds at Surface – When superhot water returns to surface and is exposed to atmospheric pressure, it rapidly flashes to steam and makes hissing or boiling sounds. This should be considered a last indicator and would result from previous indicators failing to be recognized.

Mitigation

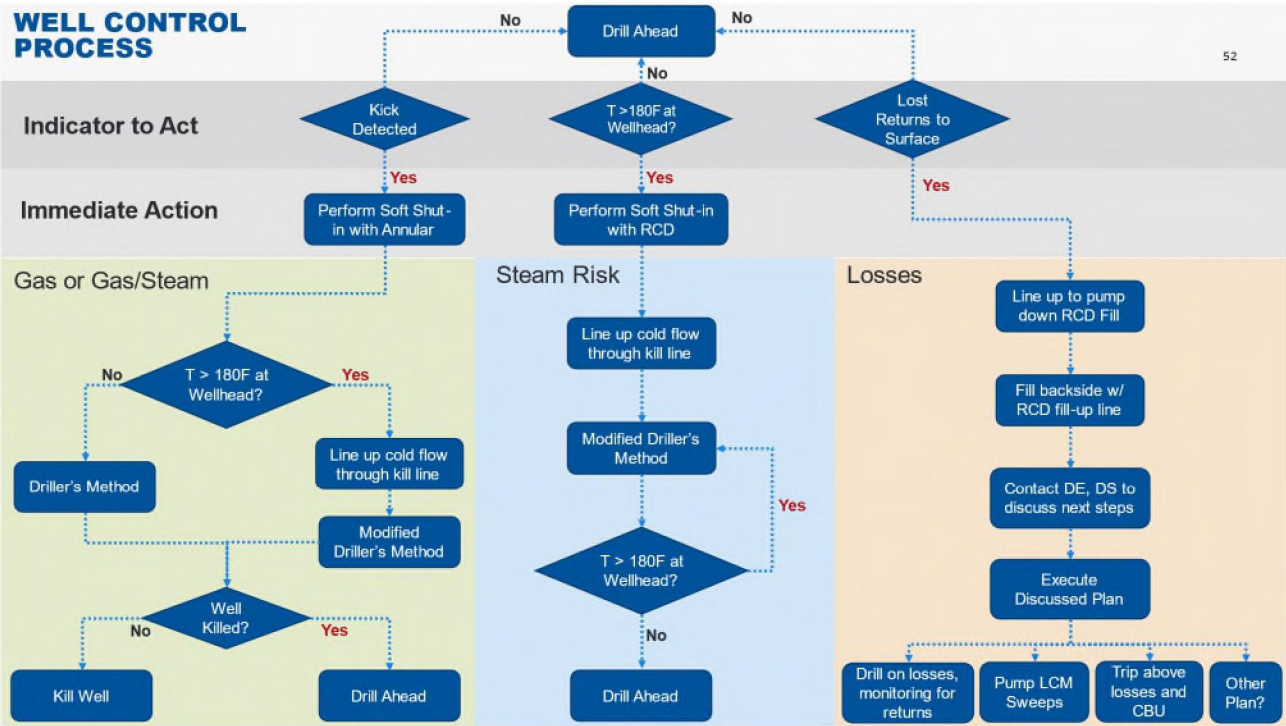
There are several mitigations in place to avoid gas or steam kicks from entering the wellbore in the first place. The following list describes actions that should be taken to mitigate the risk of a kick:

1. Maintain hole fill – In the event of losses, hydrostatic pressure is reduced in the wellbore, this can result in an underbalanced situation which may allow gas into the wellbore, or fluid flashing to steam in the wellbore.
2. MPD Back Pressure – Use MPD to add back pressure to increase EMW. in the event that an underbalanced drilling scenario is encountered.
3. Cooling system – Ensure surface cooling equipment is functioning to reduce suction temperature. Outlet temperature from coolers should be 10-15 deg F lower than inlet. This helps maintain lower temperatures in the wellbore and reduces the risk of steam kick.



Procedures

The decision tree below is meant to aid in determining well control steps based on a series of measurements that can be monitored at surface.

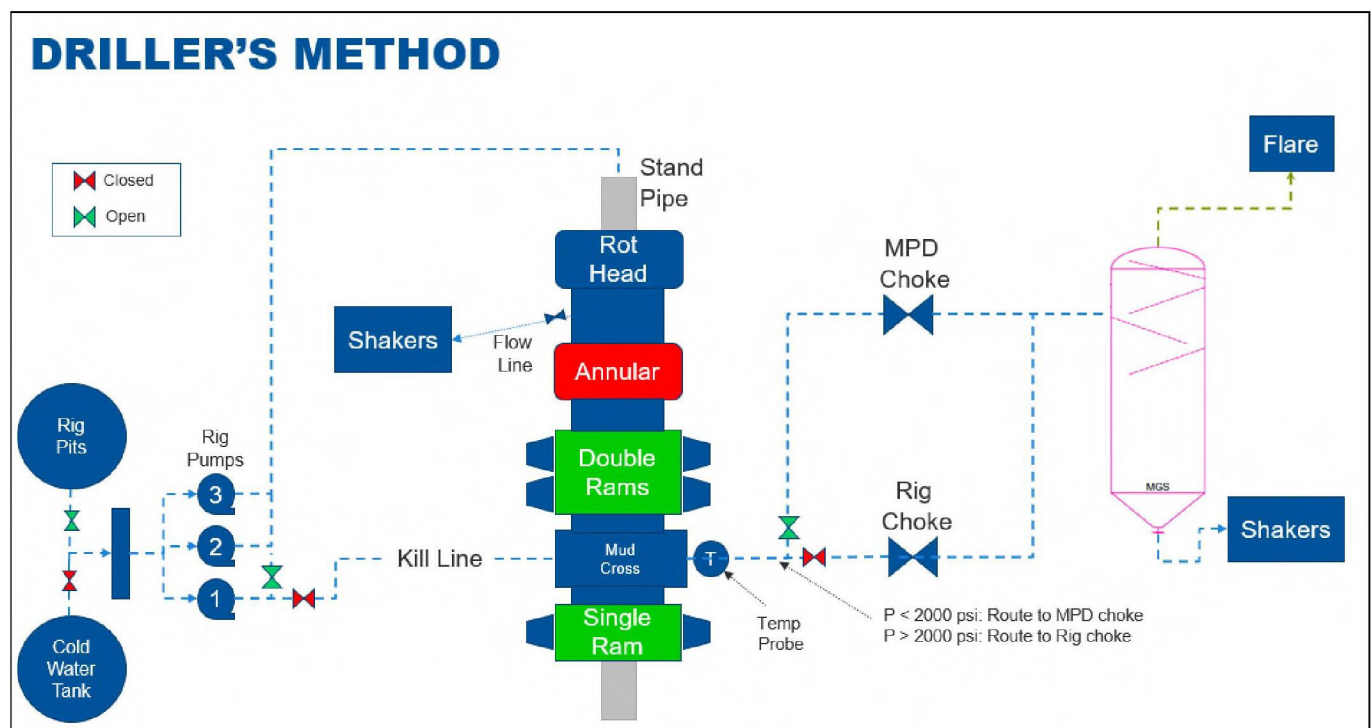


Each well control procedure below has an accompanying diagram indicating the appropriate line up of suction, pumps, and returns. The driller's method for steam will not be a primary well control technique, and would only be considered in the event an operational event precludes the use of other kill methods.

Gas kick

Driller's Method

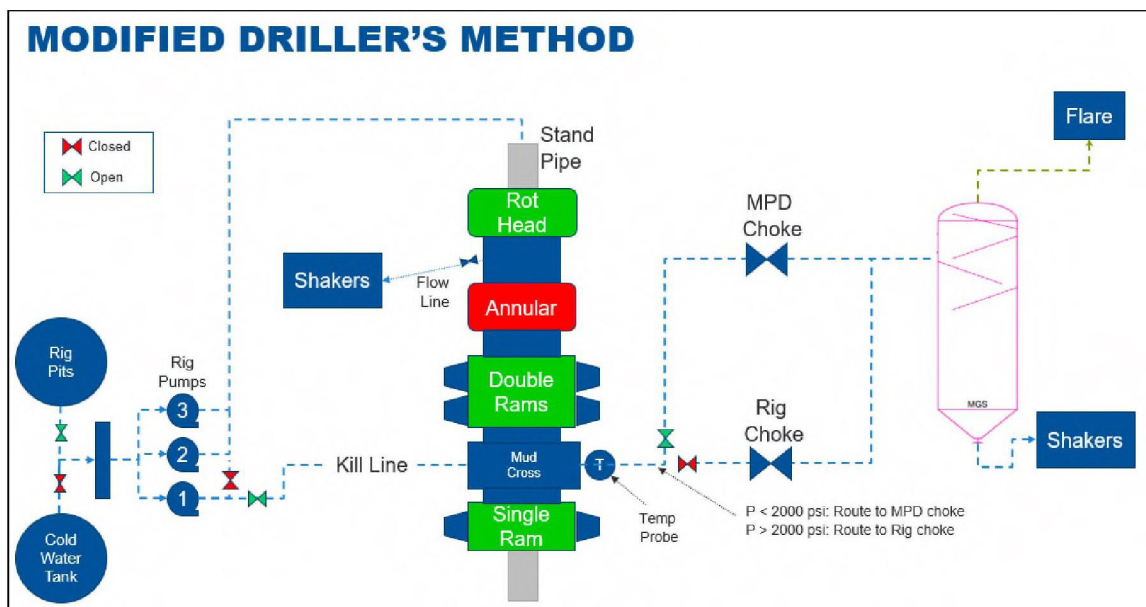
1. Perform soft shut in. Shut in with annular or pipe rams and then close HCR.
2. Double check wellhead temperature is below 180 deg F. If it is above 180 deg F, refer to modified driller's method.
3. Record SIDPP and SICP
4. Line up to take all flow through MGS. Line up to circulate kick out through HCR to MPD choke for pressures up to 2000 psi. If pressure exceeds 2000 psi, circulate kick through rig choke.
5. Pump down drillpipe ensuring outlet temp remains below 180 deg F.
6. Adjust choke to maintain constant drillpipe pressure while circulating out gas.
7. Circulate until entire influx has been removed.
 1. It is possible that the gas influx will be a small, finite amount and will not require a mud weight increase.
8. Shut in and check casing and drillpipe pressures.
9. Discuss drilling ahead underbalanced, using the MPD system to maintain equivalent bottom hole pressure while drilling and making connections.
10. In the event a mud weight increase is decided, perform the second circulation of the driller's method to maintain bottom hole pressure while swapping to a higher mud weight.



Gas/Steam Mixture

Modified Driller's Method

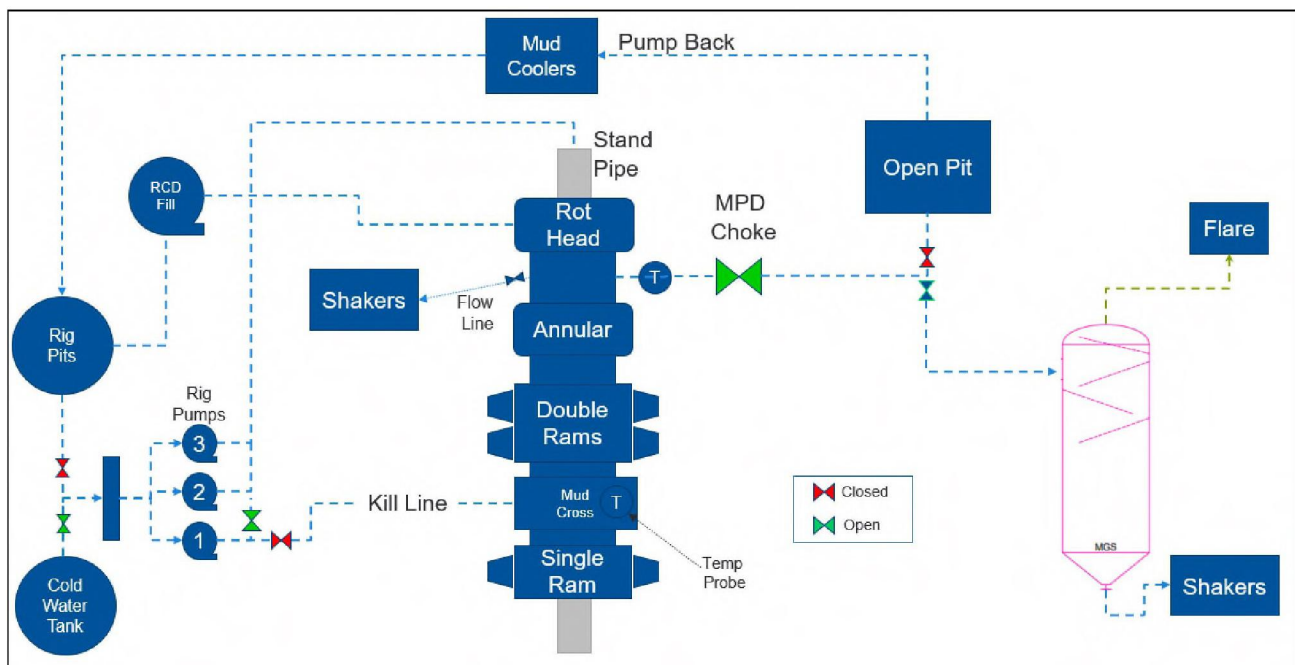
1. Perform soft shut in. Shut in with annular or pipe rams and then close HCR.
2. Wellhead temperatures are rapidly increasing, or have exceeded 180 deg F, or there is liquid water and steam coming out of the flare.
3. Line up pumps as follows:
 1. Pump 1 to circulate through kill line
 2. Pumps 2 and 3 to circulate down standpipe.
 3. Suction from rig pits
4. Line up to take all flow through the MPD choke and circulate through MGS.
5. Open HCR and bring pump 1 online to 200 GPM, maintaining constant casing pressure while staging pumps on. Apply additional 200 psi back pressure to wellbore while bringing pumps on and at steady state circulation.
6. Monitor wellhead temperature. It should reduce quickly and stabilize at the pit temperature.
7. Bring on pumps 2 and 3 to begin circulating out kick.
 1. Maintain constant drill pipe pressure once pump rates are stable.
 2. Monitor return temperature and ensure it remains below 180 deg F. If temperatures require excessive amount of kill line fluid, swap to pumping from Poseidon tank for kill line.
 3. If temperature begins to exceed 180 deg F, reduce standpipe flow rate to increase ratio of colder fluid mixing at the mud cross. Always maintain constant casing pressure when adjusting flow rates.
8. If MPD choke pressure exceeds 2000 psi, stop circulation, shut in, and line up to pump through rig choke.
9. Circulate until all gas has been removed from the well and return temps reduce to 160 F to 170 F.
10. Continue circulating while reducing the kill line pump rate.
 1. Monitor return temperature during this operation.
 2. Continue reducing pump rate until no flow is entering through kill line.
11. Shut in and check casing and drillpipe pressures. Discuss plan forward with DE and DFS based on results.



Steam

Annular Fill Procedure

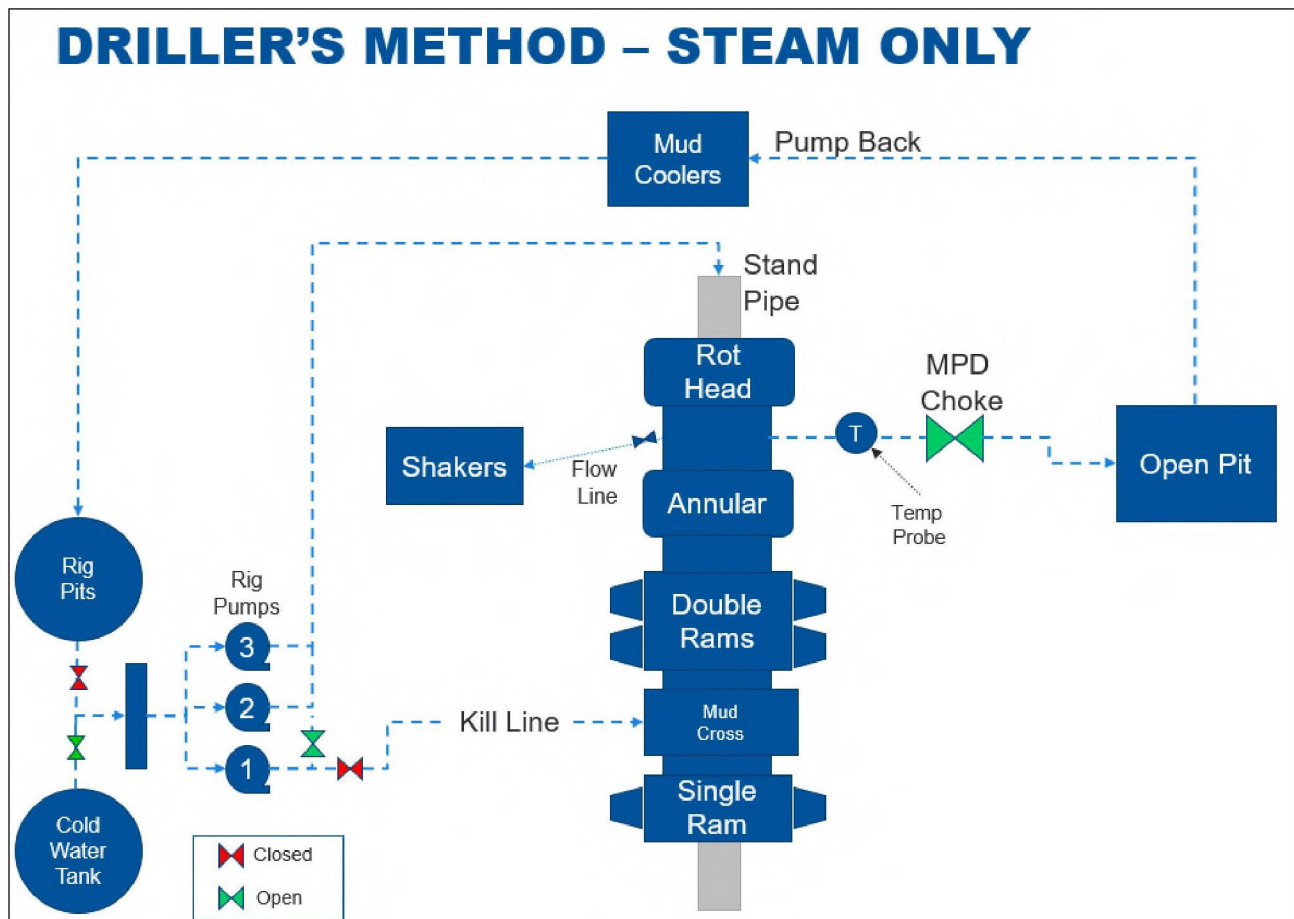
1. In the event of total losses and signs of increasing temperature at surface, shut in the well.
2. Line up to pump down the backside using the RCD fill up line.
3. Pump down backside at 300 gpm while monitoring pressure.
4. When pressure begins to climb, the hole is full, kill pumps and shut in the well.
5. If hole cannot be filled, continue pumping down backside to prevent steam flashing.
 1. Contact DE & FDS to discuss next steps which may include drilling blind, pumping LCM, short tripping, or other strategy.
6. If returns are established, drill ahead while closely monitoring return temperatures.
 1. It is possible that super-heated fluid may reach surface at this time.
 2. If temperatures exceed 180 deg F at the wellhead, refer to modified drillers method to cool returns.
 3. If lined up to pump fluid from the Poseidon tank, ensure that returns will be routed to the diverter pit to avoid overfilling rig pits.



Driller's Method (for steam)

Note: This is a contingency method only to be used in the event the MGS is plugged or cold flow to kill line is not available.

1. Perform soft shut in. Shut in with annular or pipe rams and then close HCR.
2. Line up to pump down drillpipe from coldest tank (Poseidon tank).
3. Line up to take returns through MPD choke, to diverter pit. Max pit volume is 3,000 bbls.
4. **Fluid will transition from liquid phase to gas as it expands across the choke, releasing a large amount of energy. Ensure personnel are aware of the risk and that all diverter lines are secured. Enforce buffer zones around all lines and pit.**
5. Bring pumps on slowly, holding choke pressure at 300 psi, and circulating fluid and/or steam to the pit
 1. Monitor for any gas in returns.
6. Bring rate up to 300 gpm and monitor return temperature.
7. Monitor returns until temp is below 180 deg F.
8. Shut in and re-route returns to shakers.
9. Drill ahead monitoring return temperatures.





D – Spec Sheets



337-278-4105 | 337-298-2528
208 E. AMADEE STREET, SCOTT, LA 70583

HOME ABOUT PRODUCTS CONTACT



"YOU'LL NEVER DRILL WITHOUT IT."

MISSION
TO BE AN INNOVATOR, FOSTERING
EFFICIENT, SAFE, AND COST-EFFECTIVE
METHODS OF DOWNHOLE DRILLING.

FLOAT VALVES
DrillGuard Systems' float valves are designed to perform. They are ideal for horizontal wells, and for drilling in the high-pressure and high-temperature zones of Wyoming, Pennsylvania, Ohio, North and South Dakota, north Louisiana (Haynesville Shale), and south Louisiana. Our floats are made of 8620 steel alloy, heat treated to a Rockwell hardness of 55, then carburized and nickel-plated to prevent corrosion from H2S gas and drilling chemicals.

DISTINCTIVE DESIGN
What makes them truly unique is their design, which includes the patented Delta Shaft. This three-quarter-inch triangular shaft adds strength and enables drilling fluids, such as LCM and drilling beads, to pass through, eliminating float failures and jamming caused by these materials. We reduced the beveled angle of the dart — from 44 to 22 ½ degrees — to increase the sealing area with a metal-to-metal seal that eliminates rubber sealants. The spring shield also provides several advantages. When the dart is compressed, the shield lowers over the Iconel spring and protects it from the "washing" effect caused by high-pressure fluids flowing past the spring. In the compressed position, the shield also acts as a stop, preventing spring distortion from over compression. And when the spring closes over the shaft guide bore, it prevents many of the mud-borne solids from entering the bore.

Available sizes:

- 1R
- 2F3R
- 3 ½ IF
- 4R
- 5F6R



Contact Information:
Thanks
Bob LeJeune
DrillGuard Systems, LLC
Power Rig Rental Tools, Inc.
337-278-4105
RJLejeune@msn.com



13-3/8" 54.5ppf L80 BTC

Printed on: 11-18-2024



API BTC

Coupling	Pipe Body
Grade: L80 Type 1	Grade: L80 Type 1
Body: Red	1st Band: Red
1st Band: Brown	2nd Band: Brown
2nd Band: -	3rd Band: -
3rd Band: -	4th Band: -

Outside Diameter	13.375 in.	Wall Thickness	0.380 in.	Grade	L80 Type 1
Min. Wall Thickness	87.50 %	Pipe Body Drift	API Standard	Type	Casing
Connection OD Option	Regular				

Pipe Body Data

Geometry		Performance	
Nominal OD	13.375 in.	Drift	12.459 in.
Wall Thickness	0.380 in.	Plain End Weight	52.79 lb/ft
Nominal Weight	54.500 lb/ft	OD Tolerance	API
Nominal ID	12.615 in.		
		SMYS	80,000 psi
		Min UTS	95,000 psi
		Body Yield Strength	1241 x1000 lb
		Min. Internal Yield Pressure	3980 psi
		Collapse Pressure	1140 psi
		Max. Allowed Bending	27 °/100 ft

Connection Data

Geometry		Performance	
Thread per In	5	Joint Strength	1232 x1000 lb
Connection OD	14.375 in.	Coupling Face Load	1114 x1000 lb
Hand Tight Stand Off	1 in.	Internal Pressure Capacity	3980 psi

Notes

For products according to API Standards 5CT & 5B; Performance calculated considering API Technical Report 5C3 (Sections 9 & 10) equations.
For geometrical and steel grades combinations not considered in the API Standards 5CT and/or 5B; Performance calculations indirectly derived from API Technical Report 5C3 (Sections 9 & 10) equations.
Couplings OD are shown according to current API 5CT 10th Edition.
Tenaris has issued this document for general information only and the information in this document, including, without limitation, any pictures, drawings or designs ("Information") is not intended to constitute professional or any other type of advice or recommendation and is provided on an "as is" basis. No warranty is given. Tenaris has not independently verified any information – if any – provided by the user in connection with, or for the purpose of, the Information contained hereunder. The use of the Information is at user's own risk and Tenaris does not assume any responsibility or liability of any kind for any loss, damage or injury resulting from, or in connection with any Information contained hereunder or any use thereof. The Information in this document is subject to change or modification without notice. Tenaris's products and services are subject to Tenaris's standard terms and conditions or otherwise to the terms resulting from the respective contracts of sale or services, as the case may be, between petitioner and Tenaris. For more complete information please contact a Tenaris's representative or visit our website at www.tenaris.com. ©Tenaris 2024. All rights reserved.



9-5/8" 47ppf P110-IC Tenaris ER

Printed on: 11-22-2024



TenarisHydril ER™



Coupling	Pipe Body
Grade: P110-4C	Grade: P110-4C
Body: White	1st Band: White
1st Band: -	2nd Band: Pale Green
2nd Band: -	3rd Band: -
3rd Band: -	4th Band: -
	5th Band: -
	6th Band: -

Customer	OXYUSA INC	Wall Thickness	0.472 in.	Grade	P110-10
Outside Diameter	9.625 in.	Pipe Body Drift	API Standard	Type	Casing
Min. Wall Thickness	87.50 %				
Connection OD Option	REGULAR				

Pipe Body Data

Geometry				Performance	
Nominal OD	9.625 in.	Wall Thickness	0.472 in.	Body Yield Strength	1493 x1000 lb
Nominal Weight	47.00 lb/ft	Plain End Weight	46.18 lb/ft	Min. Internal Yield Pressure	9440 psi
Drift	8.525 in.	OD Tolerance	API	SMYS	110,000 psi
Nominal ID	8.681 in.			Collapse Pressure	7100 psi

Connection Data

Geometry		Performance		Make-Up Torques	
Connection OD	10.626 in.	Tension Efficiency	100 %	Minimum	13,270 ft-lb
Coupling Length	10.626 in.	Joint Yield Strength	1493 x1000 lb	Optimum	14,740 ft-lb
Connection ID	8.807 in.	Internal Pressure Capacity	9440 psi	Maximum	16,210 ft-lb
Make-up Loss	4.724 in.	Compression Efficiency	100 %	Shoulder Torques	
Threads per inch	4	Compression Strength	1493 x1000 lb	Minimum	2210 ft-lb
Connection OD Option	Regular	Max. Allowable Bending	52 °/100 ft	Maximum	11,790 ft-lb
		External Pressure Capacity	7100 psi	Operation Limit Torques	
		Coupling Face Load	1,005,000 lb	Operating Torque	33,590 ft-lb
				Yield Torque	51,670 ft-lb

Notes

This connection is fully interchangeable with:
ER™ -9.625 in. -0.352 (36.00) / 0.395 (40.00) / 0.435 (43.50) / 0.545 (53.50) / 0.595 (58.40) / 0.609 (59.40) / 0.625 (61.10) / 0.672 (64.90) in. (lb/ft)
Connections with Dopeless® Technology are fully compatible with the same connection in its doped version

For the latest performance data, always visit our website: www.tenaris.com
For further information on concepts indicated in this datasheet, download the Datasheet Manual from www.tenaris.com

Tenaris has issued this document for general information only and the information in this document, including, without limitation, any pictures, drawings or designs ("Information") is not intended to constitute professional or any other type of advice or recommendation and is provided on an "as is" basis. No warranty is given. Tenaris has not independently verified any information - If any provided by the user in connection with, or for the purpose of, the Information contained hereunder. The use of the Information is at user's own risk and Tenaris does not assume any responsibility or liability of any kind for any loss, damage or injury resulting from, or in connection with any Information contained hereunder or any use thereof. The Information in this document is subject to change or modification without notice. Tenaris's products and services are subject to Tenaris's standard terms and conditions or otherwise to the terms resulting from the respective contracts of sale or services, as the case may be, between petitioner and Tenaris. For more complete information please contact a Tenaris's representative or visit our website at www.tenaris.com. ©Tenaris 2024. All rights reserved.

PII-0/CII-0



5-1/2” 17ppf P110-ICY Tenaris TPN

Printed on: 03-27-2025



TPN™



Coupling	Pipe Body
Grade: P110-ICY	Grade: P110-ICY
Body: White	1st Band: White
1st Band: Pale Green	2nd Band: Pale Green
2nd Band: -	3rd Band: Pale Green
3rd Band: -	4th Band: -
	5th Band: -
	6th Band: -

Outside Diameter	5.500 in.	Wall Thickness	0.304 in.	Grade	P110-ICY
Min. Wall Thickness	87.50 %	Pipe Body Drift	API Standard	Type	Casing
Connection OD Option	REGULAR				

Pipe Body Data

Geometry				Performance	
Nominal OD	5.500 in.	Wall Thickness	0.304 in.	Body Yield Strength	620 x1000 lb
Nominal Weight	17.00 lb/ft	Plain End Weight	16.89 lb/ft	Min. Internal Yield Pressure	12,090 psi
Drift	4.767 in.	OD Tolerance	API	SMYS	125,000 psi
Nominal ID	4.892 in.			Collapse Pressure	8610 psi

Connection Data

Geometry		Performance		Make-Up Torques	
Connection OD	6.300 in.	Tension Efficiency	100 %	Minimum	11,700 ft-lb
Coupling Length	8.408 in.	Joint Yield Strength	620 x1000 lb	Optimum	13,000 ft-lb
Connection ID	4.892 in.	Internal Pressure Capacity	12,090 psi	Maximum	14,300 ft-lb
Make-up Loss	4.204 in.	Compression Efficiency	100 %	Operation Limit Torques	
Threads per inch	5	Compression Strength	620 x1000 lb		
Connection OD Option	Regular	Max. Allowable Bending	104 °/100 ft		
		External Pressure Capacity	8610 psi	Operating Torque	21,630 ft-lb
		Coupling Face Load	577,000 lb	Yield Torque	24,040 ft-lb

Notes

This connection is fully interchangeable with:
TPN™ - 5.5 in. - 0.361 (20.00) / 0.415 (23.00) / 0.476 (26.00) in. (lb/ft)
Connections with Dopeless® Technology are fully compatible with the same connection in its doped version
Connection performance values are related to structural capabilities. For sealability-related performance information, request the Connection Service Envelope from your local Tenaris Representative.

For the latest performance data, always visit our website: www.tenaris.com
For further information on concepts indicated in this datasheet, download the Datasheet Manual from www.tenaris.com

Tenaris has issued this document for general information only and the information in this document, including, without limitation, any pictures, drawings or designs ("Information") is not intended to constitute professional or any other type of advice or recommendation and is provided on an "as is" basis. No warranty is given. Tenaris has not independently verified any information -if any- provided by the user in connection with, or for the purpose of, the Information contained hereunder. The use of the Information is at user's own risk and Tenaris does not assume any responsibility or liability of any kind for any loss, damage or injury resulting from, or in connection with any information contained hereunder or any use thereof. The Information in this document is subject to change or modification without notice. Tenaris's products and services are subject to Tenaris's standard terms and conditions or otherwise to the terms resulting from the respective contracts of sale or services, as the case may be, between petitioner and Tenaris. For more complete information please contact a Tenaris's representative or visit our website at www.tenaris.com . ©Tenaris 2025. All rights reserved.



5" 19.5ppf S135 DELTA527 SPECS

Drill Pipe Performance Sheet

Grant Prideco | NOV Wellbore Technologies

Pipe Body Specification

Pipe Body OD	in	5.0
Pipe Body Wall Thickness - Nominal Weight		0.362 in - 19.5 lb/ft
Pipe Body Grade		S135
Drill Pipe Length		Range 3
- Max	ft	45.0
- Min	ft	44.5
Type of Upset		IEU
Max Upset OD	in	5.125
Tong Length includes handbanding if applicable		

Pipe Body Performance

		Nominal	API Premium 80% Inspection Class
Burst Pressure *	psi	17,100	15,600
Collapse Pressure *	psi	15,670	10,030
Slip Crushing Capacity *	lbs	572,100	453,500
- Assumed Slip Length	in	16.5	
- Assumed Transverse Load Factor (K)		2.6	
Adjusted Weight **	lbs/ft	22.03	
Fluid Displacement **	US gal/ft	0.34	
	Bbls/ft	0.008	
Fluid Capacity **	US gal/ft	0.71	
	Bbls/ft	0.017	

* With no bending or axial load in the string as applicable

** Best estimate with coating

Note: Oil field barrel equivalent to 42 US gal

Note: Nominal burst calculated at 87.5% RBW per API

Tool Joint Specification

Connection Type and Size	Delta™ 527
Benchmark	Xmark™ +
SmoothEdge™ Height per side	in 0.09375
Tool Joint SMYS	psi 130,000
Connection OD	in 6.5
Connection ID	in 3.75
Pin Tong Length	in 10.0
Box Tong Length	in 15.0
Thread Compound Friction Factor (FF)	1.0

Tool Joint Performance

Max Make-Up Torque (Recommended)	ft-lbs	49,800
Min Make-Up Torque	ft-lbs	41,500
Min TJ OD (API Premium)	in	6.065
Min TJ OD for Counterbore	in	6.065
Drift Size	in	3.625

The maximum make-up torque should be applied when possible.
To maximize connection operational tensile, a MUT (T4) = 41,600 should be applied.

Advisories and Warnings for Drill Pipe

Advisories:

Warnings:



5-1/2" 21.9ppf S135 DELTA544 SPECS

 A PARKER WELLBORE COMPANY		Drill Pipe Specification & Performance Data Sheet 5-1/2", 21.90#, 0.361", S135, IEU, R2 Delta544 - 6.625" x 4.000"				QT Item #: 10654
Tube / Pipe Body Specification			Tubular Assembly		Tube / Pipe Body Performance	
OD:	5.500	in	Adjusted Weight:	25.84	lbs/ft	Inspection Class: Premium Class 80%
ID:	4.778	in	Length (approximate):	30 - 32	ft	Remaining Body Wall: 0.289 in
Wall Thickness:	0.361	in	Box TJ Length (nominal):	17	in	Tube Tensile: 620,600 lbs
Weight (nominal):	21.90	lbs/ft	Pin TJ Length (nominal):	12	in	Torsional Strength: 71,750 ft-lbs
Grade:	S135		Fluid Displacement:	0.0094	bbbls/ft	Burst Capacity: 14,180 psi
Range:	R2		Fluid Capacity w/ IPC:	0.0211	bbbls/ft	Collapse Capacity: 7,500 psi
Type of Upset:	IEU	An oilfield barrel equals 42 US gallons.				
Maximum Upset OD:	5.600	in				
Notes: -Dimensions, wall thickness, and tool joint lengths shown above are nominal if not otherwise stated. -Values shown may vary with actual values due to OEM tolerances, rounding, and other factors. -Capacity, Displacement, & Adjusted Weight are best estimates from the OEM and are based on pipe purchased at 95% RBW with longer than standard tool joints. Nominal thickness of IPC is .009" when applied. Notes: -Tube / Pipe body properties are calculated based on uniform OD and wall thickness.						
Connection / Tool Joint Specification			Connection Performance			
Connection:	Delta544		Thread Compound Friction Factor (FF):	1.0 FF	1.15 FF	
OD:	6.625	in	Extended Make-Up Torque ¹ :	58,700	67,505	ft-lbs
ID:	4.000	in	Tension at Extended Make-Up Torque:	727,700	727,700	lbs
SMYS:	130	ksi	Standard Max Make-Up Torque ¹ : (Recommended)	50,300	57,845	ft-lbs
Drift Size:	3.875	in	Tension at Standard Make-Up Torque:	970,300	970,300	lbs
Elevator Taper:	18"		Minimum Make-Up Torque:	41,900	48,185	ft-lbs
Notes: -Above dimensions are nominal. -The following are registered trademarks of NOV-Grant Prideco™: Delta™ -There is no published pressure rating for this connection.			Tension at Minimum Make-Up Torque:	1,211,480	1,211,480	lbs
			Torsional Strength:	83,800	96,370	ft-lbs
			The Standard Max Make-Up Torque based on the appropriate thread compound friction factor (FF) is recommended. MUTs lower than standard max should only be applied when MUT is limited by rig equipment or connection tensile capacity. MUT values lower than Minimum MUT should never be used.			
			See OEM NOV-Grant Prideco™ bulletin on Extended MUTs (Standard Max MUT is 60% of connection torsional whereas Extended MUT is 70%).			
			Adjust MUT values per the applied thread compound's FF greater than 1.0, without exceeding 1.15. Above values tabulated at 1.0 and 1.15 FF.			
Elevator Shoulder Capacity			The Extended MUT is recommended when downhole torque and/or backoff is a concern due to string dynamics (stick-slip, rocking, etc.) and other conditions associated with long laterals, providing it is not limited by connection tensile capacity reduction due to higher preload or rig equipment.			
-Refer to the attached OEM page(s) for capacities with wear prior to using. -Only Quail Tools' slimhole elevators should be used with this pipe.						
For combined loading of drill pipe, connection wear table, & elevator capacity figures, please see the attached page(s) provided by NOV-Grant Prideco™.						
			www.quailtools.com			
Visit our website or download the Quail Tools Tubular & BOP Specification App for the latest updates and specifications!						
The technical information contained herein, including the product Specification / Performance sheets and other attached documents, have been generated from material provided by the manufacturer where available. It is for reference only and should not be construed as a recommendation. The user is fully responsible for the accuracy and suitability of use of all technical information. Quail Tools cannot assume responsibility for the results obtained through the use of this material. No expressed or implied warranty is intended. Assembly properties are based on uniform OD and wall thickness. No safety factor is applied. The information provided for various wear conditions (remaining body wall) is for information only and does not represent or imply acceptable operating limits. It is the responsibility of the customer and/or user to determine the appropriate performance ratings, acceptable use of the product, maintain safe operational practices, and to apply a prudent safety factor suitable for the application. The user should consider all field conditions along with combined factors which may affect the final string design used in the field. For API connections that have different pin and box (D) & tool joint (D) ratios to the pin (D). For the UAC drilling manual, it is recommended that drilling torque should not exceed 80% of MUT.						
New Iberia, LA (337) 385-8154		Victoria, TX (361) 579-0244		Odessa, TX (432) 366-1491		Evanston, WY (307) 789-5860
Texarkana, TX (903) 838-1034		Williston, ND (701) 774-2280		Morgantown, WV (304) 212-5121		
Houston, TX (281) 445-1777		Denver, CO (303) 534-1873		Ok. City/Tulsa, OK (918) 994-4898		Dallas, TX (972) 681-1443
				San Antonio, TX (210) 822-4801		Pittsburgh, PA (724) 916-4643



VERTICAL SCOUT®

SPECIFICATIONS



	5 inch	6-1/4 inch	7-1/8 inch	8 inch	9-5/8 inch	14 inch
Hole Size Range	5" - 6-3/4" 152 mm - 171 mm	7-7/8" / 200 mm	8-3/8" - 8 3/4" / 213 mm - 222 mm	9-7/8" - 11", / 251 mm - 279 mm	12-1/4" - 14-3/4" / 311 mm - 375 mm	17-1/2" to 28" / 445 mm, 711 mm
Maximum Control Housing OD (Activated)	6", 6-1/8", 6-1/4", 6-1/2", 6-3/4" 152 mm, 156 mm, 159 mm, 165 mm, 171 mm	7-7/8" / 200 mm	8-3/8", 8-1/2, 8-3/4" 213 mm, 216 mm, 222 mm	9-7/8", 10-5/8", 11" 251 mm, 270 mm, 279 mm	12-1/4", 14", 14-1/2", 14-3/4", 311 mm, 356 mm, 368 mm, 375 mm	17-1/2", 20", 26", 28", 445mm, 508 mm, 660 mm, 711 mm
Maximum Control Housing OD (Deactivated)	5.65", 5.77", 5.90", 6.15", 6.40", 143 mm, 147 mm, 150 mm, 156 mm, 163 mm	7.45" / 189 mm	7.95", 8.07", 8.32" / 202 mm, 205 mm, 211 mm	9.38", 10.10", 10.48" 238 mm, 257 mm, 266 mm	11.43", 13.18", 13.68", 13.93" 290 mm, 335 mm, 348 mm, 354 mm	16.27", 18.77", 24.28", 26.28" 413 mm, 477 mm, 617 mm, 668 mm
Inside Diameter (D)	1-1/8" / 29 mm	1-5/8" / 41 mm	1-7/8" / 48 mm	2" / 51 mm	2-3/4" / 70 mm	3" / 76 mm
Tool Length	17.6' / 5.36 m	19.8' / 6.04 m	20' / 6.10 m	20.7' / 6.3 m	19.9' / 6.07 m	21.7' / 6.61 m
Tool Weight	1,147 lbs / 520 kg	2,168 lbs / 983 kg	2,430 lbs / 1102 kg	3,546 lbs / 1608 kg	4,860 lbs / 2204 kg	8,750 lbs / 3969 kg
Upper Connection	3-1/2" Reg Box	4-1/2", XH Box, 4-1/2" IF Box, 4-1/2" Reg Pin		6-5/8" Reg Box or Pin	6-5/8" Reg Box or Pin 7-5/8" Reg Box or Pin	7-5/8" Reg Box or Pin
Bit Connections	3-1/2" Reg Box	4-1/2" Reg Box		6-5/8" Reg Box	6-5/8" Reg Box 7-5/8" Reg Box	7-5/8" Reg Box
General Data						
Optimal Pressure Drop Across Bit	500 - 550 psi / 3.45- 3.79 MPa					
Maximum Pressure Drop Across Bit	700 psi / 4.83 MPa			600 psi / 4.14 MPa	850 psi / 5.86 MPa	1,000 psi / 6.89 MPa
Minimum Piston Pad Force	2,525 lbf / 1123 daN	2,513 lbf / 1118 daN	3,181 lbf / 1415 daN	5,346 lbf / 2378 daN	6,637 lbf / 2952 daN	<20' HS 10,053 lbf / 4472 daN >20" HS 14,313 lbf / 6367 daN
Maximum Piston Pad Force	5,052 lbf / 2247 daN	4,396 lbf. / 1995 daN	5,566 lbf / 2476 daN	10,692 lbf / 4756 daN	14,103 lbf / 6273 daN	<20", HS 25, 120 lbf / 11 173 daN > 20" HS 35,785 lbf / 15 918 daN
Drilling Performance Data						
Maximum Weight-on-Bit	PDC Bit: 20,000 lbf / 8869 daN TC Bit: 27,000 lbf / 12 010 daN	PDC Bit: 28,000 lbf / 12 455 daN TC Bit: 45,000 lbf / 20 017 daN	PDC Bit: 32,000 lbf / 14 234 daN TC Bit: 50,000 lbf / 22 243 daN	PDC Bit: 37,000 lbf / 16 458 daN TC Bit: 55,000 lbf / 24 465 daN	PDC Bit: 42,000 lbf / 18 683 daN TC Bit: 60,000 lbf / 26 689 daN	PDC Bit: 75,000 lbf / 33 362 daN TC Bit: 75,000 lbf / 33 362 daN
Maximum RPM	Unlimited					
Maximum Operating Torque	10,000 ft-lb / 1356 daN.m	15,000 ft-lb / 2034 daN.m	16,000 lbf-ft / 2170 daN.m	32,000 lbf-ft / 4337 daN.m	35,000 lbf-ft / 4745 daN.m	50,000 lbf-ft / 6780 daN.m
Maximum Mass Flow Rate	4,000 lbm/min 1814 kg/min	6,000 lbm/min 2721 lbm/min	6,500 lbm/min 2721 lbm/min	12,000 lbm/min 5443 kg/min		15,000 lbm/min 6804 kg/
Flow Range	150 gpm - 400 gpm 568 lpm - 1515 lpm	300 gpm - 600 gpm 1136 lpm - 2270 lpm	350 gpm - 650 gpm 1325 lpm - 2461 lpm	600 gpm - 1,200 gpm 2271 lpm - 4542 lpm	500 gpm - 1,200 gpm 1893 lpm - 4542 lpm	700 gpm - 1,500 gpm 2650 lpm - 5678 lpm
Maximum Temperature	392°F / 200°C					
High-Temperature Option	450°F / 232°C					
Maximum Pressure	20,000 psi / 137.9 MPa					
Typical Pressure Loss Across Tool Using 10-ppg Mud	135 psi @ 250 gpm	130 psi @ 400 gpm	75 psi @ 600 gpm	75 psi @ 250 gpm	25 psi @ 900 gpm	15 psi @ 1,200 gpm
Maximum Sand Content	5% by volume					
Maximum Loss Control Material (Medium Nut Plug)	50 lbm/bbl / 143 kg/m³					
Ultimate Loading						
Maximum Overpull Run	144,000 lbf / 64 054 daN	340,000 lbf / 151 240 daN	410,000 lbf / 182 377 daN	560,000 lbf / 249 100 daN	750,000 lbf / 333 617 daN	1,050,000 lbf / 467 063 daN
Absolute Overpull	360,000 lbf / 160 136 daN	850,000 lbf / 378 099 daN	980,000 lbf / 435 926 daN	1,325,000 lbf / 589 389 daN	1,760,000 lbf / 782 887 daN	2,600,000 lbf / 156 538 daN



LCM Guide (Lost Circulation Material)

The effects of LCM on MWD systems can vary greatly. In general these effects do not pose the risk of damaging equipment.

The greatest risk of LCM is to possibly affect mud pulse telemetry up to total cessation of operation of the pulser, yielding to undesired Non Productive Time (NPT).

This guide is provided in an effort to help mitigate possible NPT events associated with the use of LCM, and does not constitute or provide any guarantees of operation.

LCM Recommended Limits:

SDT Retrievable Pulser:		
Maximum Ball Passable Through Tool:		5/8"
Maximum Fine Nut Plug <u>Well Mixed</u> :		40 lbs/bbl
Maximum Medium Glass Beads:		40 lbs/bbl
Maximum Amount QuickSeal/UltraSeal:		40 lbs/bbl
Maximum Amount of Wood Fibers:		4 lbs/bbl
Maximum Amount Medium Nut Plug <u>Well Mixed</u> :		8 lbs/bbl
SDT Top Mounted Pulser:		
Maximum Amount Medium Nut Plug <u>Well Mixed</u> :		40 lbs/bbl

Properly mixed LCM sweeps are critical to mitigate possible plugging of tool, most particularly Retrievable Pulsers.

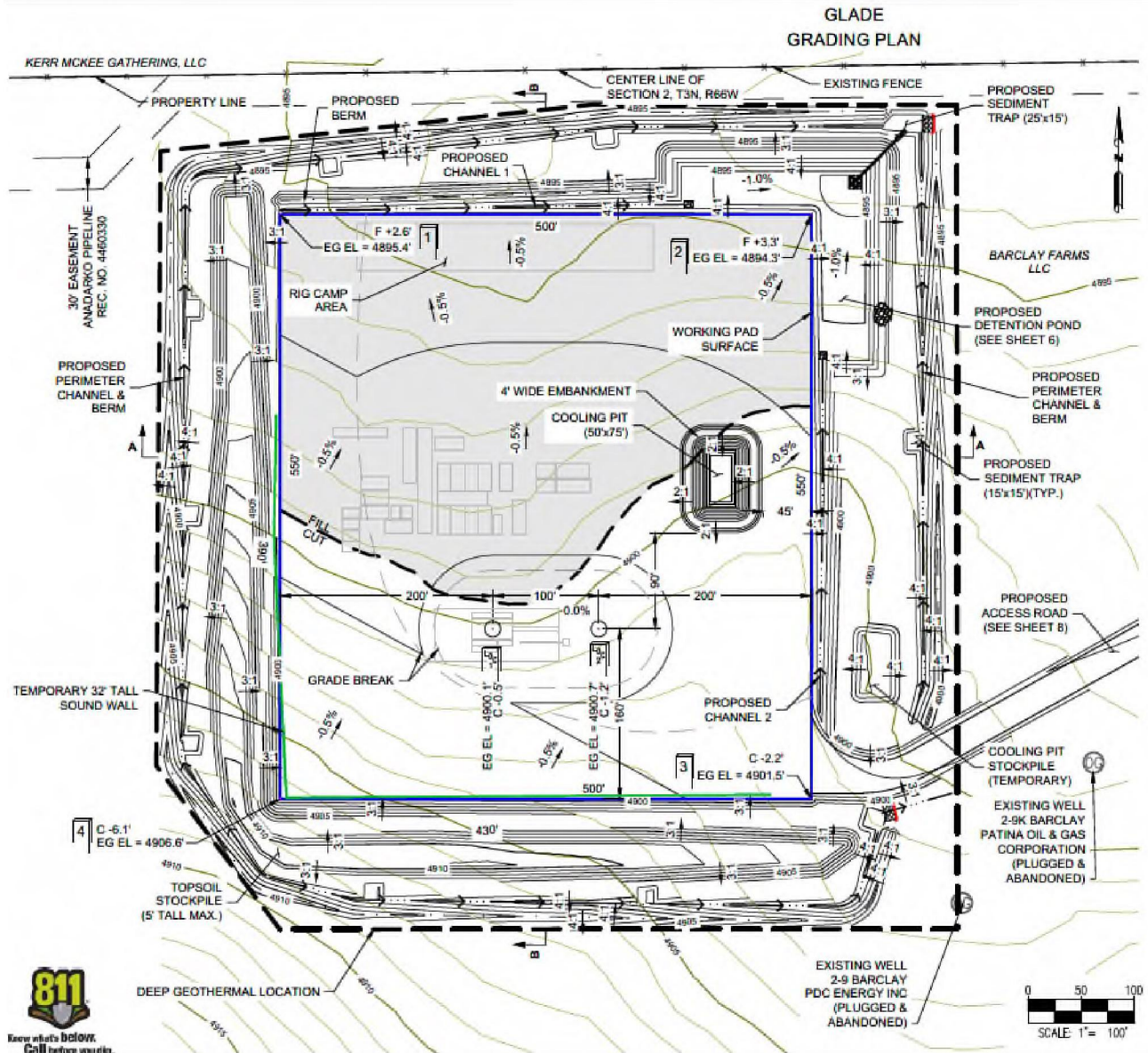
Maximum recommended quantities for LCM pills of combined materials need to be calculated as a weighted average (i.e. 10 lbs/bbl of Fine Nut Plug => 4 lbs/bbl Medium Nut Plug for Retrievable Pulser).

Companies use different standards when referring to sizes for coarse, medium, and fine. Samples should be collected so they can be reviewed before mixing LCM into the active system. Pictures using a reference for size (e.g. a coin), should be provided to gauge impact of LCM on tools

Scout Drilling Technologies gives no guarantees of Pulser performance due to effects of LCM



Grading Plan

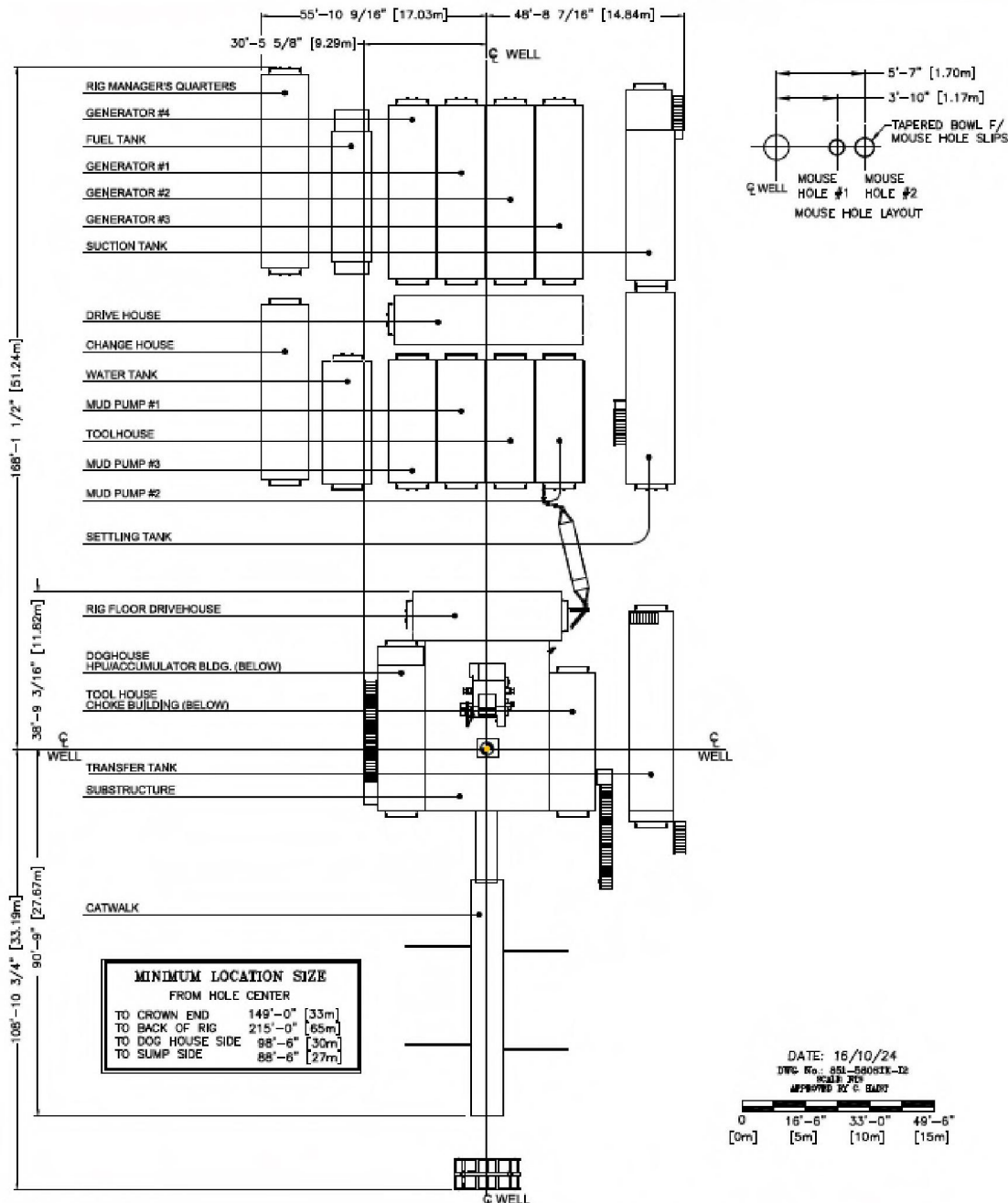




PD 580 Rig Layout

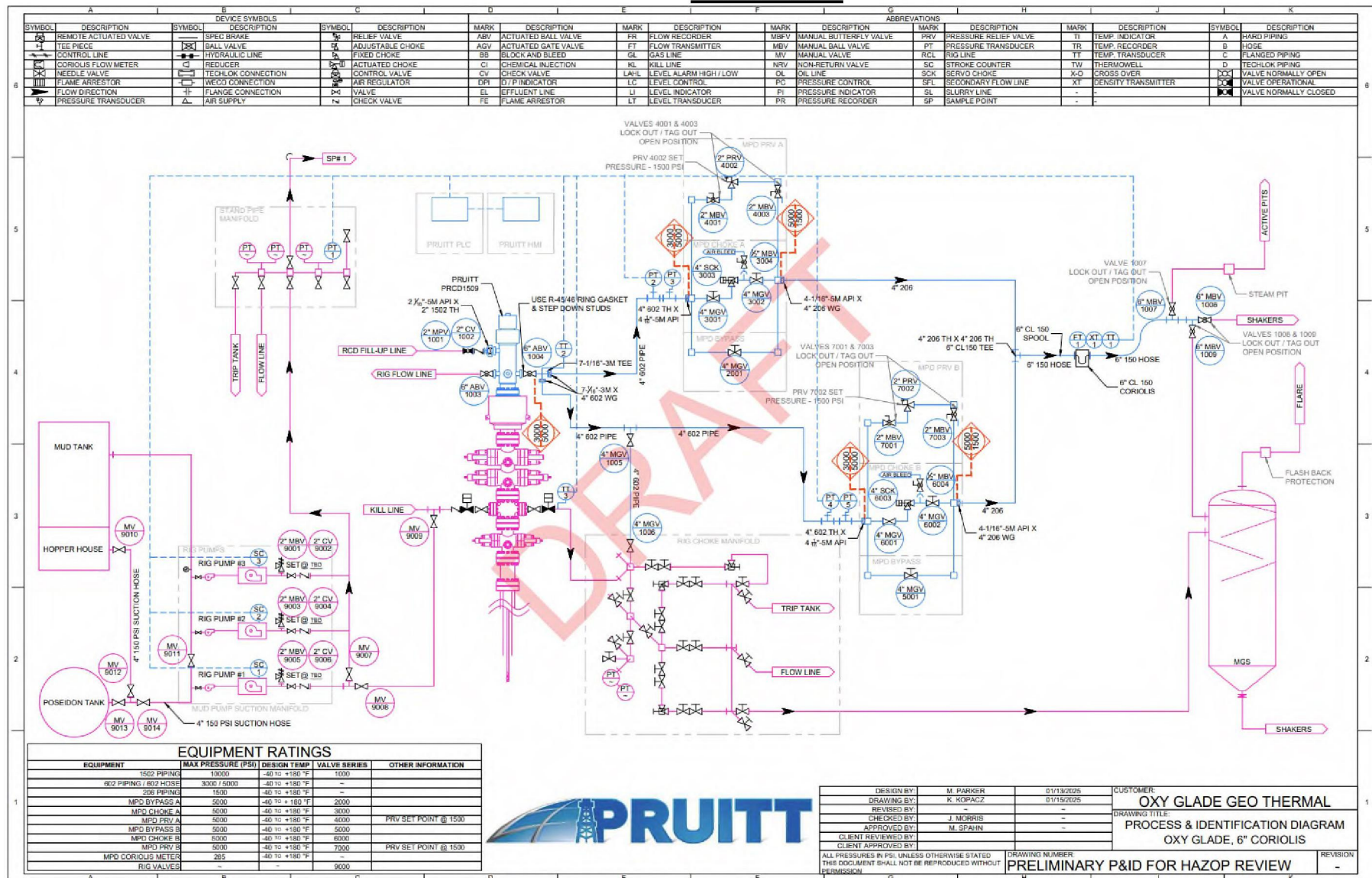
RIG LAYOUT

RIG 580ST



PRECISION DRILLING

Pruitt P&ID





Pruitt PRCD 1509 Technical Specs

	PRCD 3016	PRCD 3000	PRCD 2000	PRCD 1509	PRCD 1509D	PRCD 500
Single/Dual Element	Single	Dual	Single	Single	Dual	Single
Maximum Tested RPM	200 RPM	200 RPM	200 RPM	200 RPM	200 RPM	200 RPM
Maximum Tested Static PSI Rating	3,000 PSI	3,000 PSI	2,000 PSI	1,500 PSI	1,500 PSI	500 PSI
Maximum Dynamic PSI Rating	2,000 PSI	2,000 PSI	2,000 PSI	1,000 PSI	1,000 PSI	250 PSI
Pass-Thru Diameter with Bearing	7.0 inches	7.0 inches	7.0 inches	9.0 inches	9.0 inches	8.2 inches
Diameter without Bearing	13.625 inches	13.625 inches	13.625 inches	13.625 inches	13.625 inches	13.625 inches
Height Range Installed in Bowl	50.1 to 59.8 inches	65.1 to 74.7 inches	50.1 to 59.8 inches	47.8 to 55.2 inches	66.1 to 73.4 inches	Customizable
Recommended Applications	Managed Pressure Drilling (MPD) and high pressure		MPD and intermediate pressure	MPD and intermediate pressure applications that utilize larger drill pipe, smaller casing sizes, and/or other drill string components		Low pressure and surface drilling applications
Additional Features	API 16RCD Monogram		- Swivel Bottom Mount Flange Available - Multiple Outlet Sizes - Forged and Welded Bowl Options with Multiple Outlets - Pruitt Fluid Containment System (LP Bowls only) - HP Bowls compatible with all PRCD Bearing Assemblies - Hydraulic Clamps with Check Valve System			





Managed Pressure Drilling & RCD Solutions
sales@pruitt.com





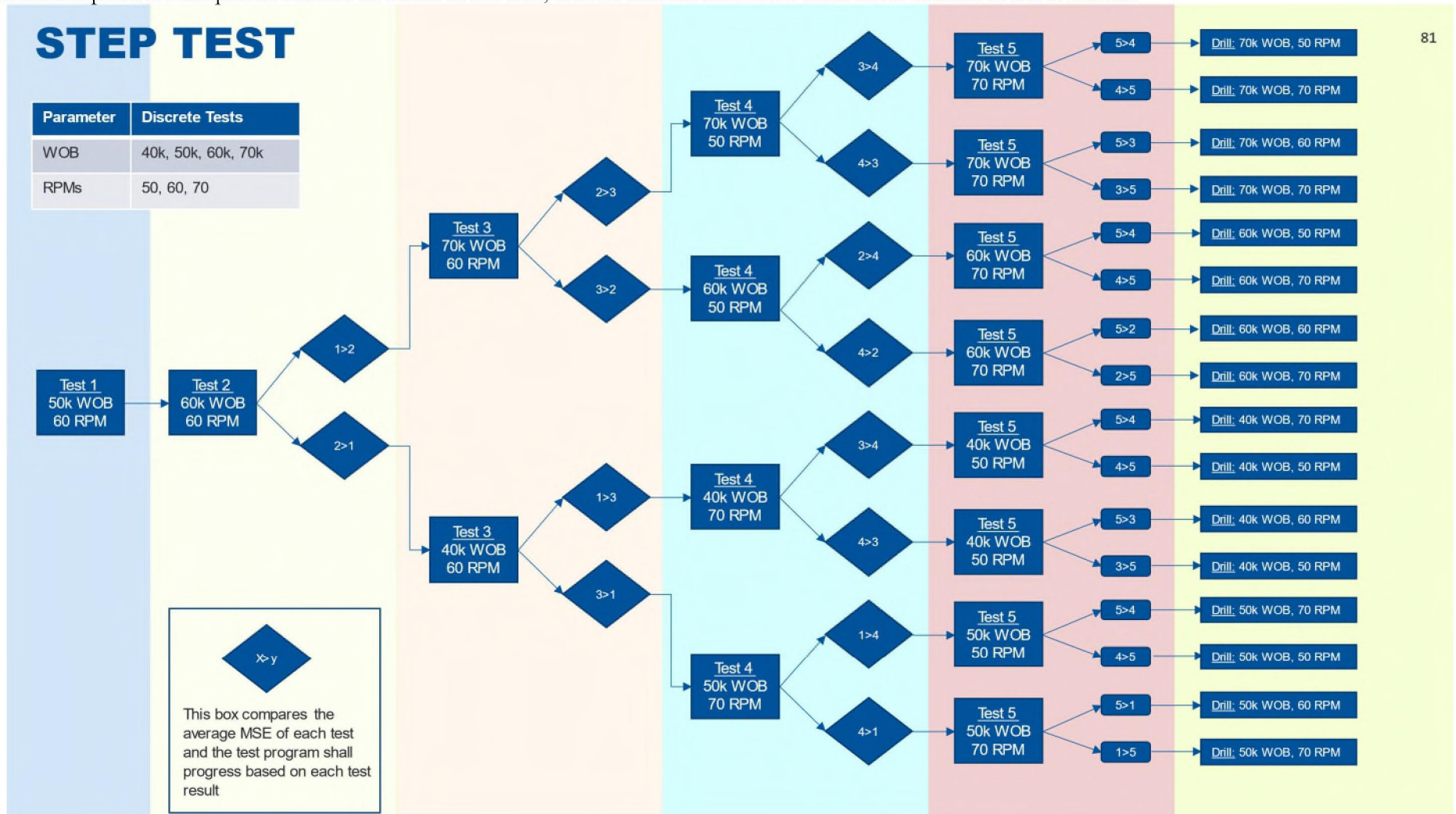
E – Supplemental Drilling Procedures



Step Test Description

The test matrix below outlines a structured sequence for optimizing drilling parameters to extend bit and BHA life. It serves as a template to help streamline testing, minimizing unnecessary trials that could damage the BHA while efficiently identifying the most effective drilling parameters. Collaborate with the DE and field engineer to adjust the test matrix as needed to achieve optimal results. Modifications may include increasing WOB or evaluating rotary settings at different intervals.

Each diamond represents a comparison between the results of two tests, with the next test determined based on the outcome of that evaluation.





Drilling Blind Guidelines

The following section outlines best practices for drilling blind. While this approach carries an increased risk of sticking the BHA, it has been proven effective in mitigating losses and reducing NPT associated with loss circulation treatment. Before proceeding with blind drilling, always consult the DLT (FDS, DE, and DS) to ensure proper planning and risk management.

1. If the well goes on losses due to weak formation:
 - a) Stop drilling once losses are witnessed
 - b) Work pipe while circulating a full BU to clear annulus of cuttings and establish loss zone
 - c) Receive DLT approval to drill ahead
2. Drill ahead with controlled ROP - Team will agree upon drilling rate.
 - a) Start off with low RPM (30-40) to maintain WOB while control drilling
 - b) Drilling blind creates a hazardous environment for drilling tools. Parameter optimization is critical. After torque and drag trends are established while control drilling, a minimum WOB as specified below will be applied to limit lateral vibrations. FDS must grant approval to increase/remove ROP limit.
 - i) 8.5" Hole: 30-40 klbs, 40-50 rpm
 - c) Tag bottom with 20 rpms
 - d) When off bottom, reduce flow (75-80% of drilling rate) and rotary (0-20 rpm) if hole conditions allow
 - e) **Hole conditions take precedent over BHA shock and vibe. Increase rotary and gpm as needed to clean the hole**
3. Monitor T&D on every connection.
 - a) Ensure the driller is breaking over hook load prior to setting slips and keeping a close eye on his trend sheets.
 - b) Consider back reaming or down reaming 1 joint at the bottom of the stand prior to making a connection.
 - c) Watch for increasing P/U, S/O and off bottom torque
 - d) Monitor pump pressure and torque while drilling - watch for trends that indicate a change in hole conditions.
 - e) Pump 30 bbl high visc (60 s/q) sweeps every 1-2 connections.
4. If T&D trends are showing deteriorating hole conditions:
 - a) Circulate around a high visc sweep (60 sec/q+) while working pipe with rotary and ensure trends have returned to normal before continuing to drill ahead or making a connection.
 - b) Notify FDS of hole conditions and obtain approval to drill ahead.
 - c) Ensure a minimum of 1 BU is pumped prior to resuming drilling ops.
5. Minimize all still pipe time. Keep pipe moving if possible.
 - a) If having issues with directional tools (i.e. recycling for surveys) — work the pipe several times and ensure good hole conditions prior to cycling
 - i) If recycling is a reoccurring issue, notify DE. We may drill ahead for several stands without acquiring a survey attempting to re-establish circulation.
 - b) Directional does not make any decisions without consulting the DSM first
 - c) If needing to troubleshoot tools, discuss tripping to put BHA above troubled zone or back into the previous casing shoe
 - i) Pay attention to the entire BHA (not just bit depth). Ensure collars aren't across previously identified trouble zones
6. After performing clean up cycles, perform a 1000' wiper trip to ensure hole is in good shape
 - a) Clean up any tight spots and circulate an additional bottoms-up equivalent if reaming is required
 - b) Ensure you can trip through spots on elevators with minimal drag after cleaning up (<10 klbs overpull)
7. After wiper trip, spot a 150 bbl low water loss (WL<20 cc's), high viscosity (80 visc and 20 YP) pill



- a) Consult with DE and mud engineer to ensure that pill is suited for the temperature environment downhole.
- 8. During trips, discuss with the team if precautionary back reaming should be executed across known troubled zones. At the very least, limit block speed to 50 fpm when pulling across zones with potential issues.
 - a) Reference Oxy Tripping Guidelines for overpull limits and reaming parameters if back reaming is necessary
- 9. If tripping back in hole into a known loss zone, consider adding jars to the string.
 - a) Consult with DE on the placement of jars.
- 10. **REMEMBER — If you get stuck or pull tight coming up, the next movement should be down. If pipe gets stuck, discuss with FDS on max working parameters IMMEDIATELY. The next few minutes after getting stuck are the most important**



F – Newpark Fluids Program



GLADE—Technical Proposal
DJ Basin Colorado
Revised—March 27, 2025

Technical Fluids Program

Newpark Fluids Systems
5990 Greenwood Plaza Blvd, Bldg 2 Suite 205
Greenwood Village, CO 80111
(303) 623-2205 (720) 904-7970 Fax

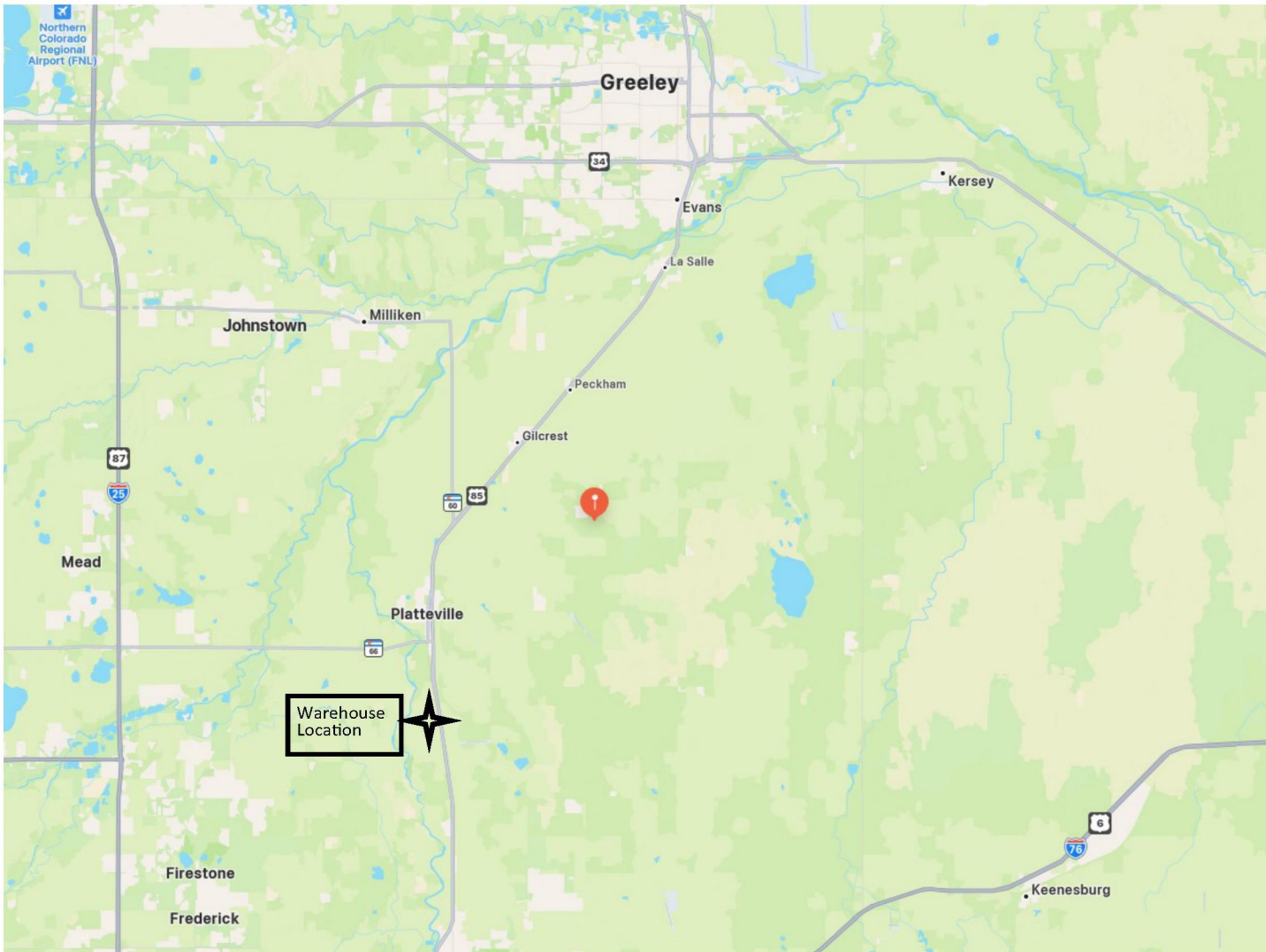
GDP106

Contains Business Sensitive, Trade
Secrets, Proprietary or Otherwise
Confidential Information Exempt from
Public Disclosure

Redacted



Project Summary DJ GLADE—LOCATION



Warehouse for DJ Basin:

- The primary warehouse used for DJ basin drilling fluids material storage is located in Ft. Lupton, CO
- The location of the GLADE drilling project is approximately 10 miles from the warehouse.
- Our Bulk Barite Rail storage location is approximately 50 miles from the GLADE location.
- Our Liquid Oil Based Mud Plant is 193 miles North (3 hours) from the GLADE location.



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Project Summary
DJ GLADE—DRILLING FLUID

Hole	Casing	TVD	Interval Comments	Mud Properties
17 1/2" Hole			Water with High Viscosity sweeps - Drill with water utilizing the dewatering unit to surface TD. Mud up only if necessary. - Maintain calcium levels using Gypsum/Calcium Sulfate for 1200—1400 mg/l hardness. - Add 1/2 SAPP Stick and 1/2 Soap Stick each connection to prevent and clean up bit balling. - Build High Vis sweeps for hole cleaning and pump 10 bbls every 500'. SAPP/Soap and Walnut sweeps can be build and pumped if needed to break up mud rings and clean bit balling.	Fluid Properties Vis (sec/qt): 28—32 Weight (ppg): 8.4—8.9 PV: 2—10 YP: 2—10 Ca++: 1200—1400 LGS: < 4%
13 3/8" Casing		FXHL-1079' SCP-2350'	If losses occur, sweeps of NewCarb and DynaFiber or Fiber Seal and Sawdust should be pumped. If losses are severe it may be necessary to increase LCM in total system.	
12 1/4" Hole		SSSX-4299'	70:30—80:20 Teros™ SBM - Displace fluid in casing with 9.2—9.6 ppg Synthetic Based Drilling Fluid - Ensure pits and mud lines are clean and dry, drip pans installed, and all gates are sealed prior to filling mud pits with NAF. Follow displacement procedures. - Maintain emulsion stability with additions of TeroMul HP (Emulsifier) and Lime. - For proper oil wetting of solids make additions of TeroCoat (Wetting Agent). - The HTHP fluid loss will be controlled with additions of OptiTrol-L (HTHP Control) - Rheology will be achieved primarily from the invert emulsion, additional rheology will be achieved with additions of TeroVis CF and TeroMod (Rheology Modifier). - Maintain Volume with additions of NeoFlo 4633 and Brine/Water, treat the system with Calcium Chloride for WPS. Seepage/Lost Circulation - Pretreat: 8—10 ppb PreFix and 8—10 ppg ProppFix (LCM) - Primary LCM recipe: 5—6 ppb Phenoseal (LCM), 7 ppb DynaFiber (LCM) C, 5—6 ppb NewCarb (LCM) - Secondary LCM Recipe: 5—7 ppb PROPPFIX (LCM), 5—7 ppb DynaFiber (LCM) C, 5—7 ppb New X-prima (LCM). - If losses continue, consider adding 30—40 ppb of LCM to the circulating system (check directional tool tolerance prior to increasing LCM additions) Pennsylvanian rock formations can be sources of hydrogen sulfide gas, Excess Lime will be maintained in the system and H₂S testing will be conducted while drilling Pennsylvanian strata, a qualitative H₂S test will indicate if H₂S is present, if detected a garret gas train will determine treatment levels needed. ZC1500 scavenger - 0.5 ppb will treat 50 — 80 ppm sulfide. (Upon contact with chelated zinc the sulfide in the system will instantly have a one way reaction to form a stable zinc sulfide. Lime treatment will be continued until Garret Gas Train confirmation that sulfide neutralization has occurred)	Fluid Properties Vis (sec/qt): 38—60 MW: 8.6—10.0 3 RPM: 3—5 6 RPM: 4—8 PV: 10—20 YP: 10—16 WPS: 230—280k HTHP: < 15 O:W: 70:30—80:20 ES (mV): 400—700 Excess Lime: 4 ppb+ LGS%: <8
9 5/8" Casing		SSPG-7053' NBRR-7101' CDLL-7344' CRLL-7360' GRNR-7398' GRRS-7610' DKOTJ-7772' MRSN-7930' LYNS-9032' WFMP-9389' PENN-9806' FNTN-10026' PCMB-10727' ICP-10785'		
8 1/2" Hole			Water / TerraTherm Geothermal Fluid - Drilling with water is recommended as this will be the most efficient fluid for the required temperatures. A recommended mud up formulation is being lab tested and stressed as an option for increased fluid density if needed, the formulation can be used to build a low sag kill pill as well. While Drilling: Salt Gel (Attapulgate) and NewZan weeps should be pumped for hole cleaning. EvoLube G or NeoFlo 4633 are options for increasing the lubricity of the fluid. Lubricant can be added to the system or as sweeps. The duration for efficacy will be reduced due to temperature. Graphite can be added to the system for a high temperature lubricant as well. NDFT 424 and NewEase 487 are viable lubricants when not left in the hole. Corrosion Inhibitor (CP-335P): should be added to the system 25 gallons initial treatment and 5 gallons per day while drilling, this product is only able to provide protection at circulation temperatures < 320F. For high temp corrosion inhibition ZC1500 scavenger may be an option. Mud up to TerraTherm and for Kill Pills (3-7-2025—current formulation) NaOH: Add at 0.5 ppb Salt Gel (Attapulgate): Add at 8—12 ppb NewStabil (high temp fluid stabilizer): 1.0 ppb TerraTrol HY (High temp polymer): 2.0—4.0 ppb - Treat foaming with a Aluminum Stearate and NoFoam A (Defoamer). - Run Solids Control and De-Watering Equipment when possible to maintain LGS below 3%. Seepage/Lost Circulation - Prior to adding LCM to fluid increase the rheology of the fluid using sweep procedure. - Treat losses with 15—25 ppb lcm pills containing; NewCarb (Sized Calcium Carbonate) and Mica. For high rates of loss, add New X-prima™ (Specialty LCM Field tested up to 750F) at 15—45 ppb LCM pills for losses. - Information on LCM is included in this technical program. Displacement Fluid Treatment Corrosion Inhibitor (ZC1500 scavenger): 1 pail per 75 bbls of fluid to be treated. Biocide (Avancide): 5 gallons per 250 bbls of fluid to be treated. 10 ppg NaCl brine will be used if weighted fluid is required for displacement.	Fluid Properties Vis (sec/qt): 28—32 Mud wt: 8.4—8.8 PV: 2—4 YP: 2—4 FL (cc/30 min): N/C Lubricant (%): 2—4 TerraTherm Properties Vis (sec/qt): 38—50 MW: 8.4—14.0 PV (Surf/450°): 25 / ? YP (Surf/450°): 65 / ? FL (cc/30 min): N/C Lubricant (%): 2—4 Mud weight is just an estimate. Actual hole conditions should dictate the mud weight necessary for control of formation pressures.
Open Hole		TD-20000'		



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



DRILLING FLUID PROPERTIES

Surface Interval
Calcium Treated Water with NewPHPA Sweeps

Hole Size (in)	TVD (ft)	Mud Weight (ppg)	Plastic Viscosity (cp)	Yield Point (lb/100ft²)	Ca++ (mg/l)	Fluid Loss (ml/30min)	pH Range	LGS (%)
17 1/2"	0—SCP	8.4—8.9	2—10	2—10	1,200—1400	N/C	8.5—9.5	< 4

Intermediate Interval
Teros™ OBM

Hole Size (in)	MD (ft)	Mud Weight (ppg)	Plastic Viscosity (cp)	Yield Point (lb/100ft²)	HTHP Fluid Loss (ml/30min)	3 RPM	6 RPM	WPS (ppm)	E.S. (mV)	Oil:Water	Lime (ppb)	LGS (%)
12 1/4"	SCP—ICP	8.6—10.0	10—20	10—16	< 15	3—5	4—8	230—280K	400—700	70:30—80:20	4+	< 8

Production Interval
Water / TerraTherm™

Hole Size (in)	MD (ft)	Mud Weight (ppg)	Plastic Viscosity (cp)	Yield Point (lb/100ft²)	HTHP Fluid Loss (ml/30min)	3 RPM	6 RPM	Lubricant	pH	10s / 10m gel	LGS (%)
8 1/2"	ICP—TD	8.4—8.8	2—4	2—4	N/C	N/C	N/C	0—4%	9.5—10.5	N/C	< 4
High Temperature Viscosified Fluid and Kill Pill											
8 1/2"	Surface Build	10.0	25	65	N/C	22	20	0—4%	10.0—11.0	23/36	< 6
8 1/2"	350° Rheology	10.0	20	63	N/C	33	34	0—4%	10.0—11.0	34/36	< 6
8 1/2"	550° Rheology	10.0			N/C			0—4%	10.0—11.0		< 6

- Drilling fluid properties are guidelines only. Available rig equipment and/or equipment additions will dictate fluid properties. Range for rheology correlates with solids control equipment efficiency.
- Mud weights for guidelines only, allow hole conditions to dictate actual mud weights.
- Filter cake qualities should be closely monitored and product mix adjusted accordingly.



Newpark Fluids Systems, LLC
5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



17 1/2” Hole Section
Surface Interval

System	TVD (ft)	Mud Weight (ppg)	Plastic Viscosity (cp)	Yield Point (lb/100ft ²)	Ca++ (mg/l)	Fluid Loss (ml/30min)	pH Range	LGS (%) ange
Water	0—SCP	8.4—8.9	2—10	2—10	1,200—1400	N/C	8.5—9.5	< 4

Challenges:	Best Practice: <i>Water with High Vis Sweeps</i>
Hole Cleaning	- Drill with water, add Gypsum to reach 1200—1400 mg/L calcium for inhibition. - Maintain pump rates necessary to clean 17 1/4” hole, ROP and pump rate models are on the following page. - Using the High Vis Sweeps recipe, build and pump sweeps very 500’ or more frequently if required. - If ROP exceeds hole cleaning capabilities control drilling to prevent excessive annular loading.
Swelling / Bit Balling	- Maintain recommended calcium levels with additions of Gypsum/Calcium Sulfate to prevent accretion and clay swelling. Calcium will also aid in dewatering efficiency. - If hole is tight it is helpful to ream down each joint of pipe before making connections. - Maintain a clean fluid by dewatering, this will allow higher annular velocities and reduce clay sticking to the BHA. - Run sweeps of SAPP and DynaDet to break up bit ball balling and mud rings. Walnut can be added to create an abrasive solid that has been useful in breaking up bit balls.
Seepage/Lost Circulation	- If seepage losses are to be controlled, pump LCM sweeps with 5—10 ppb NewCarb and 5—10 ppb DynaFiber should every 250’—300’. - To control larger losses, sweeps of 10—15% coarse materials such as Fiber Seal and Saw-dust can be used. For losses follow the lost circulation flow chart.
Casing Safely to Bottom	- At TD pump high vis sweeps, build 80 pumpable bbls using high vis sweep recipe, add 4 sacks of Walnut to the sweep. - Pump 20 bbls sweeps and monitor shaker load to ensure the well is clear of cuttings before TOOH. 3 sweeps minimum should be pumped before coming out of the hole. - Check wellbore integrity with short trip, ream tight spots before running casing.

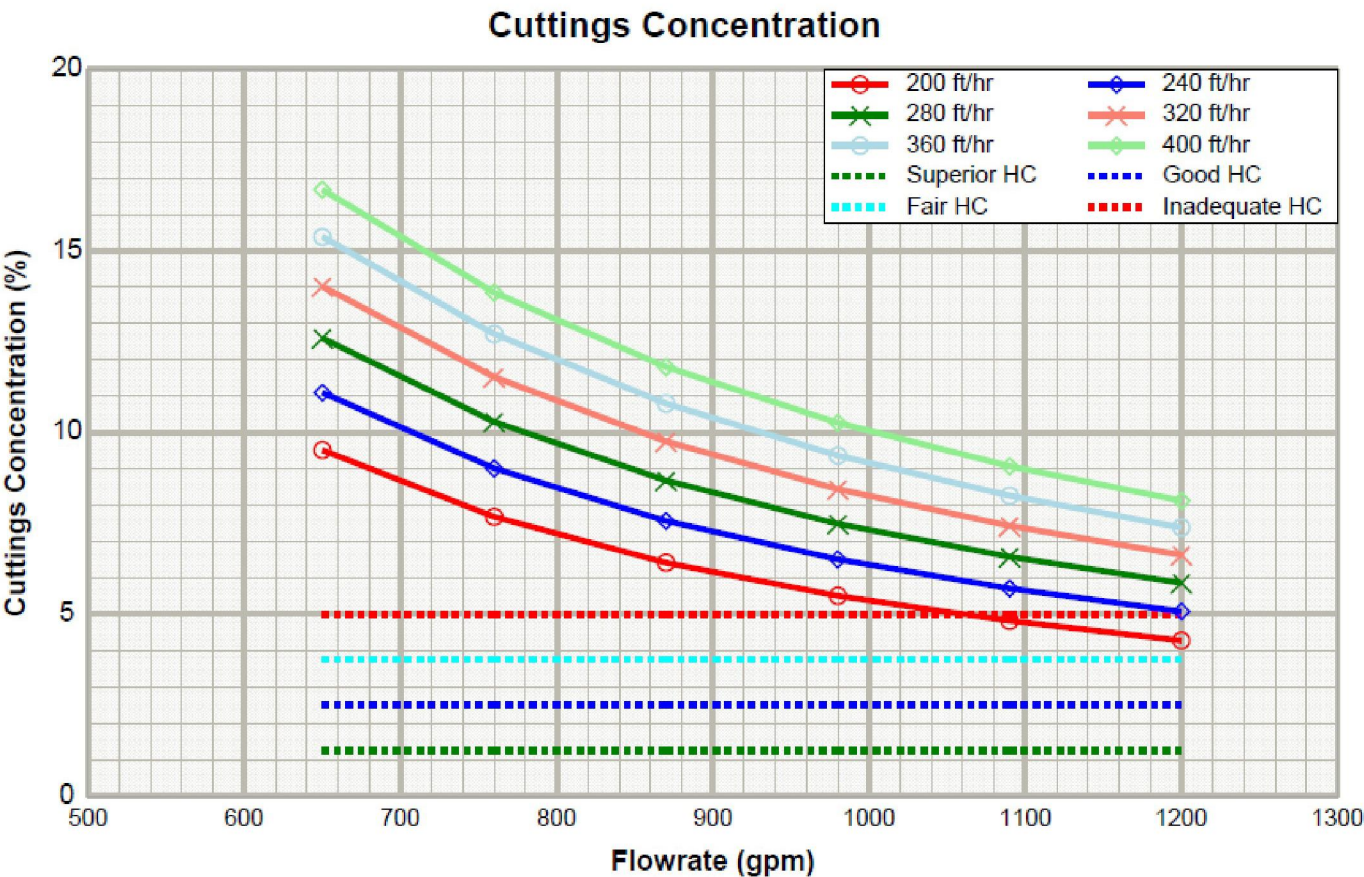
Procedure	Implementation:
Bit Balling sweeps	Maintenance: - To prevent and clean up bit balling add 1/2 SAPP Stick and 1/2 Soap Stick down drill pipe on each connection. Sweeps: - If bit balling occurs and Soap Sticks / Sapp Sticks are ineffective, build a sweep with 0.25—0.5 ppb SAPP to 50 bbls in the pill tank. - To help the sweep break up bit balls 0.25—0.5 ppb NewZan can be added for rheology and 2—4 ppb Walnut M can be added to the sweep.
High Vis Sweep	Pill tank: - Bring 100 bbls of freshwater into the sweep tank to build the high viscosity sweep. - Add 1/2 sack of Soda Ash to kill any hardness and increase alkalinity to help gel yield. - Add 15—25 ppb of NewGel HY to the sweep to achieve 50+ sec / qt funnel viscosity. Pump Sweep: - Monitor torque and drag and monitor the shakers for indications of poor hole cleaning. - Pump ~10 bbls of the sweep every ~500’, or more frequently if needed. Always ensure sweep has returned to surface before shutting pumps off.
Mud Up ONLY IF NEEDED	If a mud up is necessary even with high calcium levels in the system, NewZan D can be added to gain rheology in the system using 1.5—2.5 ppb and will provide adequate YP, concentrations should be adjusted based on field test results.



Newpark Fluids Systems, LLC
5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



17 1/2" Hole Section
Surface Interval



Challenges:

Best Practice: Hole Cleaning

Cuttings Loading

- A YP of 22 was modeled as different pump rates and ROP's.
- Results show 1000—1200 GPM will allow <5% cuttings load, higher ROP's will required longer circulation times to remove cuttings from the wellbore.
- Modeling different scenarios can be done while drilling to model hole cleaning efficiency.



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



12 1/4” Hole Section
Intermediate Interval

System	MD (ft)	MW (ppg)	PV (cp)	YP (lb/100ft ²)	HTHP (ml/30min)	6 RPM	6 RPM	WPS (ppm)	E.S. (mV)	Oil:Water	Lime (ppb)	LGS (%)
Teros™	SCP—ICP	8.6—10.0	10—20	10—16	< 15	3—5	4—8	230—280K	400—700	70:30—80:20	4+	< 8

Challenges: Best Practice: Teros™ NAF—NeoFlo

Hole Cleaning	- Maximize pump rates for hole cleaning in the 12 1/4” hole. - Perform a cleanup cycle if a spread in P/U and S/O or torque increase is noticed. - Maintain low end rheology as recommended.
Possibility of H ₂ S in Pennsylvanian Rock	Pennsylvanian rock formations can be sources of hydrogen sulfide gas, Excess Lime will be maintained in the system and H2S testing will be conducted while drilling Pennsylvanian strata, a qualitative H2S test will indicate if H2S is present, if detected a garret gas train will determine treatment levels needed. ZC1500 scavenger - 0.5 ppb will treat 50 – 80 ppm sulfide. (Upon contact with chelated zinc the sulfide in the system will instantly have a one way reaction to form a stable zinc sulfide. Lime treatment will be continued until Garret Gas Train confirmation that sulfide neutralization has occurred)
Seepage/Lost Circulation	- Avoid trip speeds that cause surge/swab. - When breaking circulation bring pump pressure up slowly to avoid breaking down formation. - Pretreat; 8—10 ppb PreFix and 8—10 ppg ProppFix - Primary LCM recipe; 5—6 ppb Phenoseal, 7 ppb DynaFiber C, 5—6 ppb NewCarb. - Secondary LCM Recipe; 5—7 ppb PROPPFIX, 5—7 ppb DynaFiber C, 5—7 ppb New X-prima. - If losses continue, consider adding 30—40 ppb of LCM to the circulating system (check directional tool tolerance prior to increasing LCM additions) For losses follow the conventional lost circulation flow chart.
Casing Safely to Bottom	Circulate hole clean at TD and check wellbore integrity with short trip. Clean up any tight hole before running casing.

Procedure Implementation:

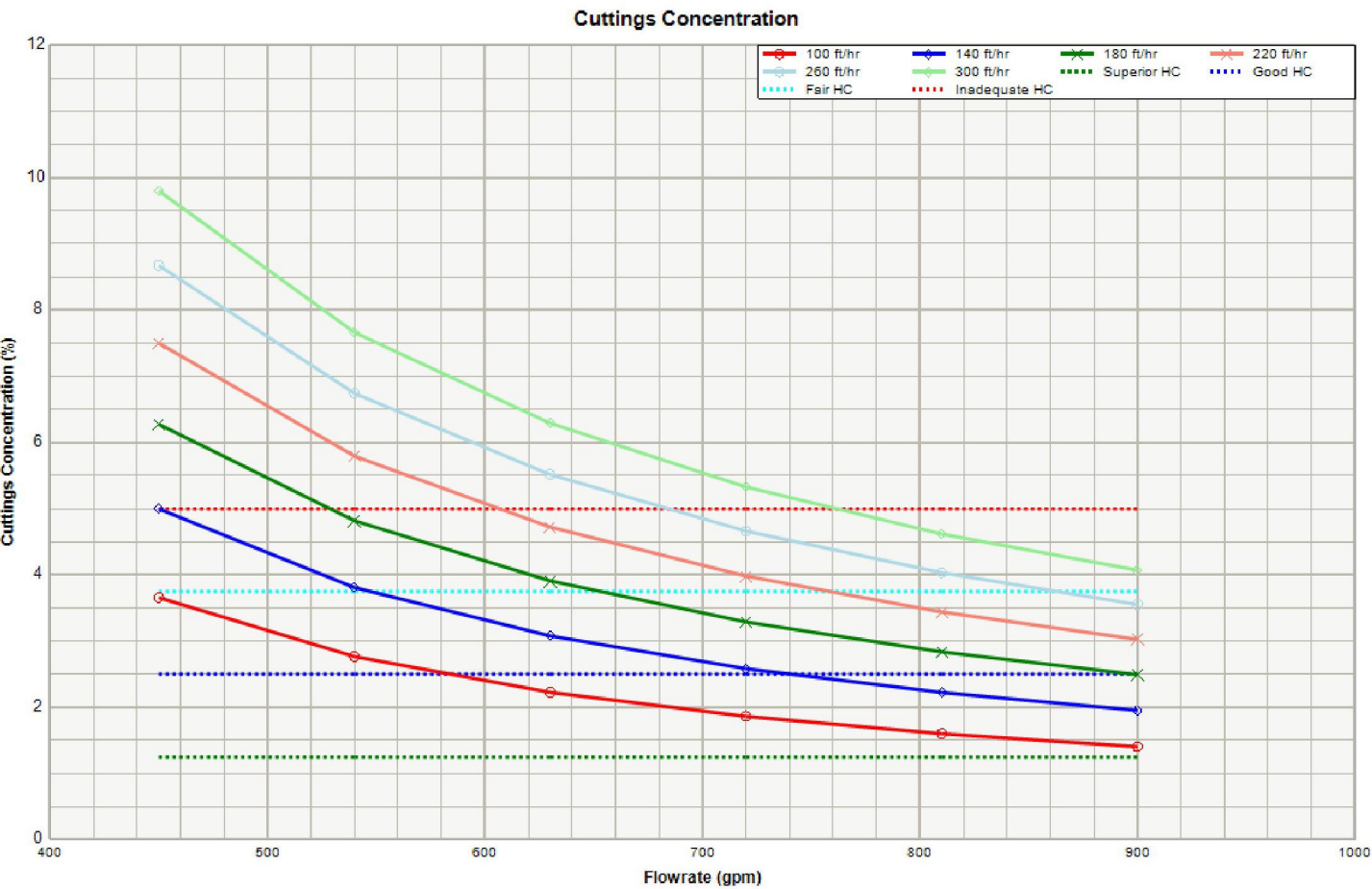
Displacement and Drill out	- Displace the hole with NAF and capture water to be used for makeup additions. - Prior to drill out of surface casing, pretreat the system with 2 drums of TeroCoat to prevent shaker sticking. Additions of TeroCoat may be needed while drilling the first 3,000—5,000 feet of hole. - Add 1 drum of TeroMul HP prior to drill out to pretreat any water taken upon displacement of water from surface casing.
OBM Preparations	- Ensure an adequate volume of Teros™ / NeoFlo is on location prior to drilling the interval. - Clean out all water in pits or tanks before transferring Teros™ in, remove all nonessential water lines from pits. - Install floor pans and drip pans to catch NAF leaks. - Plumb in a base NAF tank for maintaining the drilling fluid. - A mud bucket with a hose back to the pits should be installed.
Maintenance	- Maintain emulsion stability with additions of TeroMul HP (5—8 ppb). - Run 4+ ppb Excess Lime in the system. - For proper oil wetting of solids make additions of TeroCoat (0.5—1.0). - The HTHP fluid loss will be controlled with additions of OptiTrol-L (0.2—0.4 ppb) - Rheology will be achieved primarily from the invert emulsion, additional rheology will be achieved with additions of TeroVis CF (0.25—0.5 ppb) and TeroMod (0.1—0.2 ppb). - Maintain volume and O:W ratio with additions of NeoFlo 4633 and Water, treat the system with CaCl₂ powder for WPS. - Mud weight will be controlled with additions of ExWATE. Field Testing will be used to determine changes to the fluid formulation.
Kill Pills	- Calculate ECD and build a weighted pill to statically reflect ECD. - After trips divert kill pill into an isolated tank and transfer back into a premix to be treat, weighted up and reused.



Newpark Fluids Systems, LLC
5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



12 1/4" Hole Section Intermediate Interval



Challenges:

Cuttings Loading

Best Practice: Hole Cleaning

- A YP of 13 was modeled as different pump rates and ROP's.
- Results show in most scenarios flow rates above 675 GPM will allow <5% cuttings load, higher ROP's and lower flow rates required longer circulation times to remove cuttings from the wellbore.
- Modeling different scenarios can be done while drilling to model hole cleaning efficiency.



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



8 1/2" Hole Section Production Interval

System	MD	MW	PV	YP	HTHP	3 RPM	6 RPM	Lubricant	pH	10s / 10m	LGS
Water	ICP—TD	8.4—8.8	2—4	2—4	N/C	N/C	N/C	2—4%	9.5—10.5	N/C	< 4
High Temperature Fluid and Kill Pill											
TerraTherm	Surface Build	10.0	25	65	N/C	22	20	2—4%	10.0—11.0	23/36	< 6
TerraTherm	350° Rheology	10.0	20	63	N/C	33	34	2—4%	10.0—11.0	34/36	< 6
TerraTherm	550° Rheology	10.0			N/C			2—4%	10.0—11.0		< 6

Challenges:

Best Practice: *Water / TerraTherm™ Geothermal Fluid*

Hole Cleaning

- Maximize pump rates for hole cleaning.
- Build high vis pill with **Salt Gel** (attapulgitite) and **NewZan** to sweep the hole as needed.
- Mud up to the system if needed for hole cleaning.

High Temperature

- Utilize water for drilling fluid during the hot rock drilling.
- Use high viscosity sweeps for hole cleaning.
- IF MUD IS REQUIRED the formulations for high temperature fluid built and tested in the lab should be used to ensure the fluid will provide carrying capacity for cuttings and Barite suspension.
- **Current geothermal fluid formulation has been tested changes to the formulation may be necessary to address specific challenges of this project.**

Lubricity

- Pump sweeps of 4% **EvoLube G** (lubricant) for lubricity and incorporate into the system for 2—4%. (At the anticipated temperatures liquid lubricants will degrade and will required continuous additions to maintain torque parameters).
- **NeoFlo 4633** has been tested as a lubricant and will provide lubricity at high temperatures.
- Additional lubricants **NDFT-424** and **NewEase 487** have been tested and should be used for lubricity while drilling, these lubricants shouldn't be used for spotting at >300°F.
- **Graphite** can be added to high vis sweeps as a temperature stabile mechanical lubricant using 4—6 ppb as a starting point for torque reduction.

Seepage/Lost Circulation

- **Prior to adding LCM to fluid increase the viscosity of the fluid using the sweeps procedure.**
- Treat losses with 15—25 ppb lcm pills containing; **NewCarb** (Sized Calcium Carbonate) and **Mica**. For high rates of loss, add **New X-prima™** (Specialty LCM Field tested up to 750F) at 15—45 ppb LCM pills for losses.
- **For losses follow the geothermal lost circulation flow chart.**

Procedure

Implementation:

Sweeps

HIGH VISCOSITY

- Use the pill tank to build and hold a high viscosity sweep and pump 20 bbls as needed for hole cleaning.
- Make additions of 8—12 ppb **Salt Gel** (Attapulgitite) and 0.5—1.0 ppb **NewZan** to the pill tank and allow 20 minutes to shear prior to pumping for hole cleaning.

LUBRICITY

- Make additions of 4% lubricant to the high vis sweep and pump to increase lubricity of the fluid. The lubricant will remain in the system, however the duration of efficacy will be reduced as the product breaks down due to temperature.
- 6—8 ppb of **Graphite** can be added to a viscous sweep to increase lubricity.

Drilling Fluid or Kill Pill Mud Up

To main drill water in active system

- Make additions of 0.5—1.0 ppb **Caustic Soda** (5 min mix)
- Add 8—12 ppb **Salt Gel** (Attapulgitite) (20 min mix)
- Add 1.0 ppb **Newstabil** (pH Stabilizer) (5 min mix)
- Add 2.0—4.0 ppb **TerraTrol HY** (High temp polymer) (5 min mix)
- Weight up the system with **NewWate** (barite) to required density
- Treat foaming with a **Aluminum Stearate** or **NoFoam A** (Defoamer).

Corrosion Inhibitor

To main drill water in active system

- Add 25 gallons of C335P for system initial treatment.
- Add 5 gallons per day while drilling, this product is only able to provide protection at circulation temperatures < 320F.
- For high temp corrosion inhibition ZC1500 scavenger may be an option.



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



8 1/2” Hole Section Displacement Fluid

System	MD	MW
Displacement	Surface—TD	8.4—8.8 Fresh Water or 10.0 ppg brine

DISPLACEMENT SETUP

Tank Preparation—confirm setup at least 1 day prior to displacement

- Assign storage tanks with an adequate volume to fully displace hole volume .
- The purpose of the biocide treatment is to shock kill prior to pumping.
- The **C335-P** oxygen scavenger and filming amine corrosion inhibitor is intended to prevent corrosion up to ~320° F.
- H2S scavenger (**ZC1500**) has a secondary function of corrosion inhibition and can be used at higher temperatures.

Mixing—build fluid as close to displacement timing as possible

- The tank will be filled with fresh water or 10 ppg NaCl brine prior to mixing the chemicals.
- The mud engineer or other authorized personnel will wear the recommended proper PPE listed in the SDS prior to handling the Biocide and corrosion inhibitor (see exposure controls section on SDS sheets)
 - Chemical Resistant Gloves
 - Organic Vapor Respirator
 - Splash Goggles
 - Face Shield
 - Chemical Resistant Clothing
- Add the required amount of product for total displacement volume.
 - 5 gallon of Avacide 75 (Biocide) per 225 bbls. (Biocide will degrade quickly and treatment is intended to shock kill bacteria in the water only)
 - **FOR TEMPS <320°F add 55 gallons of C335P (amine and O2 Scavenger) per 500 bbls to be treated**
 - **FOR TEMPS >320°F add 5 gallons of ZC1500 per 75 bbls of fluid to be treated**
- Inform crews of the location and function of the displacement fluid.



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Geothermal Fluid
Lab Test Results Formulation 1

Mixing Volume	350 ml	FORMULATION 1							
Mixer	Multimixer								
Composition	Function	Concentrations							
Water	Continuous Phase	0.832 bbls							
Soda Ash	Alkalinity	0.5 ppb							
Sodium Hydroxide	Alkalinity	0.5 ppb							
TerraLig HT	Fluid Loss	10 ppb							
TerraThin, HT	Rheology Control	5 ppb							
NanoFix	Pore Plugging	10 ppb							
NewStabil	Alkalinity	1 ppb							
Salt Gel	Viscosifier	2 ppb							
NewCarb 5	Pore Plugging	15 ppb							
NewCarb 10	Pore Plugging	15 ppb							
NewCarb 25	Pore Plugging	15 ppb							
NewSeal Sigma, fine	Pore Plugging	20 ppb							
NewBar, 4.2sg	Weighting Agent	30.8 ppb							
TerraTrol HT	Rheology + Fluid Loss	4 ppb							
Properties	Unit	Temp 120 Pressure 0 psi	Temp 250 Pressure 2500 psi	Temp 250 Pressure 5000 psi	Temp 350 Pressure 5000 psi	Temp 350 Pressure 7500 psi	Temp 450 Pressure 7500 psi	Temp 450 Pressure 10000 psi	Temp 550 Pressure 10000 psi / Static Age 48 hr
Mud Weight	ppg	10	10	10	10	10	10	10	10 /10
600 RPM	Dial Reading	35	45	45	33	33	27	27	13 / 7
300 RPM	Dial Reading	22	31	32	23	22	18	18	9 / 7
200 RPM	Dial Reading	17	23	25	22	18	13	13	8 / 7
100 RPM	Dial Reading	10	18	17	13	12	10	10	8 / 7
6 RPM	Dial Reading	1	8	8	5	6	7	8	8 / 7
3 RPM	Dial Reading	1	8	8	5	5	7	8	8 / 7
PV	cP	13	14	13	10	11	9	9	4 / 3
YP	lb/100ft ²	9	17	19	13	11	9	9	5 / 4
Gel Strength (10s)	lb/100ft ²	1	7	5	5	5	7	8	8 / 7
Gel Strength (10m)	lb/100ft ²	1	6	5	5	4	7	8	7 / 7



Newpark Fluids Systems, LLC
5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Geothermal Fluid
Lab Test Results Formulation 2

Mixing Volume	350 ml	FORMULATION 2							
Mixer	Multimixer								
Composition	Function	Concentrations							
Water	Continuous Phase	0.919 bbls							
Sodium Hydroxide	Alkalinity	0.5 ppb							
NewStabil	Alkalinity	1 ppb							
Salt Gel	Viscosifier	12 ppb							
NewBar, 4.2sg	Weighting Agent	80.8 ppb							
TerraTrol HT	Rheology + Fluid Loss	4 ppb							
Properties	Unit	Temp 120 Pressure 0 psi	Temp 250 Pressure 2500 psi	Temp 250 Pressure 5000 psi	Temp 350 Pressure 5000 psi	Temp 350 Pressure 7500 psi	Temp 450 Pressure 7500 psi	Temp 450 Pressure 10000 psi	Temp 550 Pressure 10000 psi / Static Age 48 hr
Mud Weight	ppg	10	10	10	10	10	10	10	10
600 RPM	Dial Reading	115	114	116	103	103			
300 RPM	Dial Reading	90	94	92	82	83			
200 RPM	Dial Reading	77	80	80	73	72			
100 RPM	Dial Reading	60	67	66	60	57			
6 RPM	Dial Reading	22	36	35	34	33			
3 RPM	Dial Reading	20	36	35	34	34			
PV	cP	25	20	24	21	20	0	0	0
YP	lb/100ft ²	65	74	68	61	63	0	0	0
Gel Strength (10s)	lb/100ft ²	23	32	32	34	34			
Gel Strength (10m)	lb/100ft ²	36	34	34	39	39			

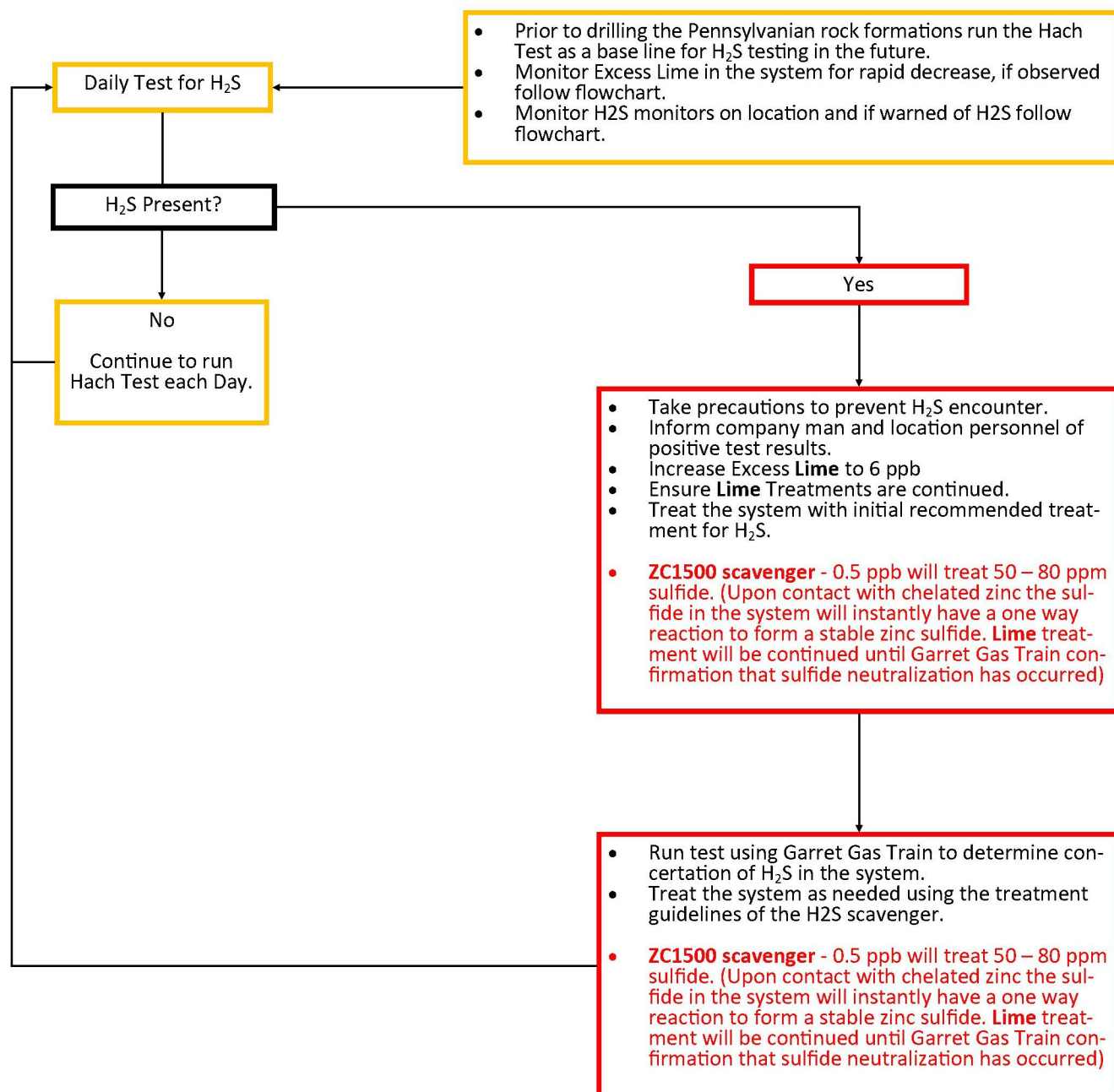


Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Additional Procedures H₂S management



This procedure is for treatment of fluid and is not a substitute or replacement for and protocols related to H₂S management and H₂S training



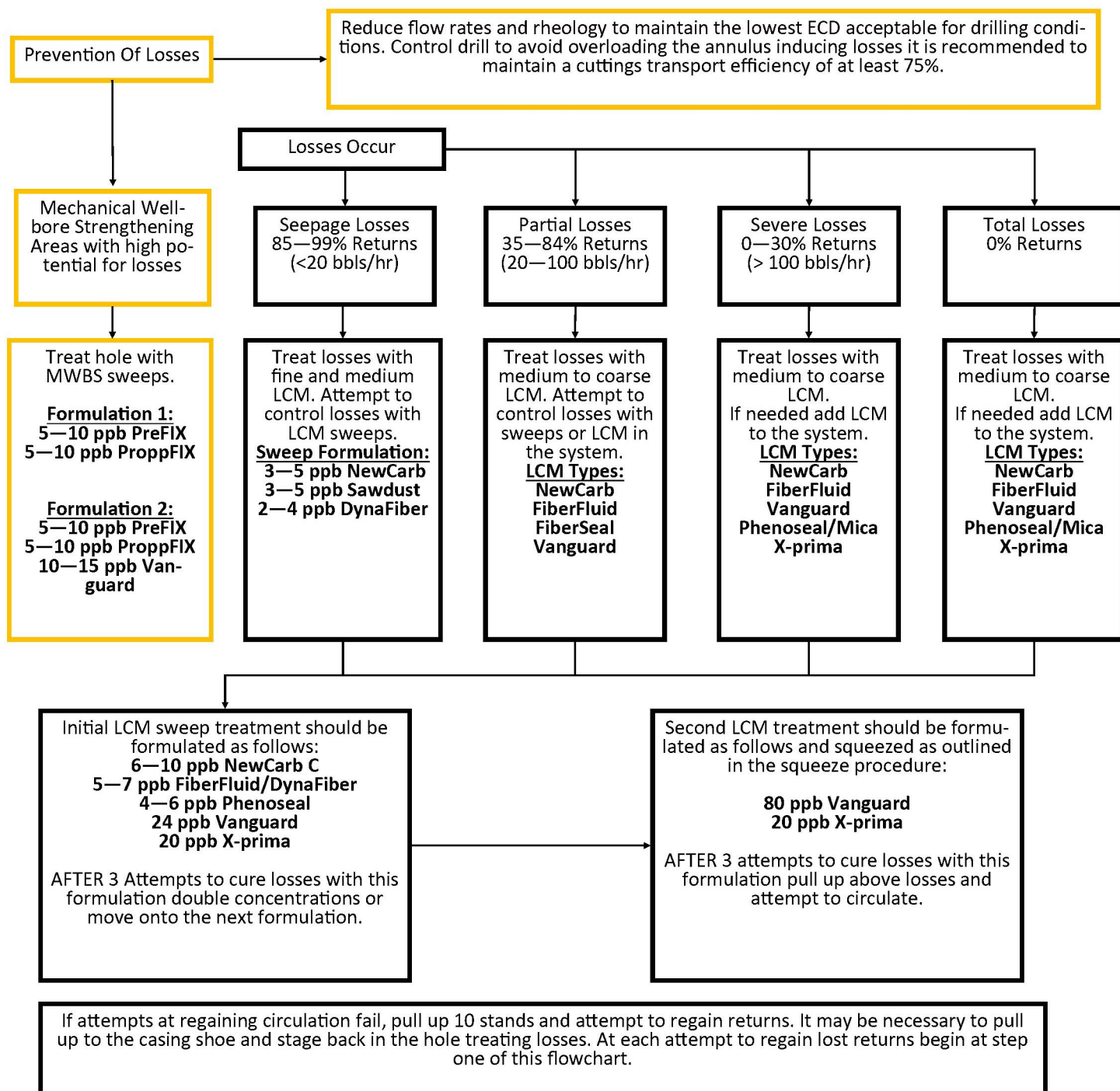
Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Additional Procedures Conventional LCM Flow Chart & Recommendations Up to 350F

Treat losses by following the LCM flowchart. At each attempt to regain lost returns begin at step one of this flowchart. Check with MWD hands for tool tolerance. Pulse vs. EM tool is critical to the amount of LCM allowed.
Prior to adding LCM to fluid increase the viscosity of the fluid using sweep procedures.



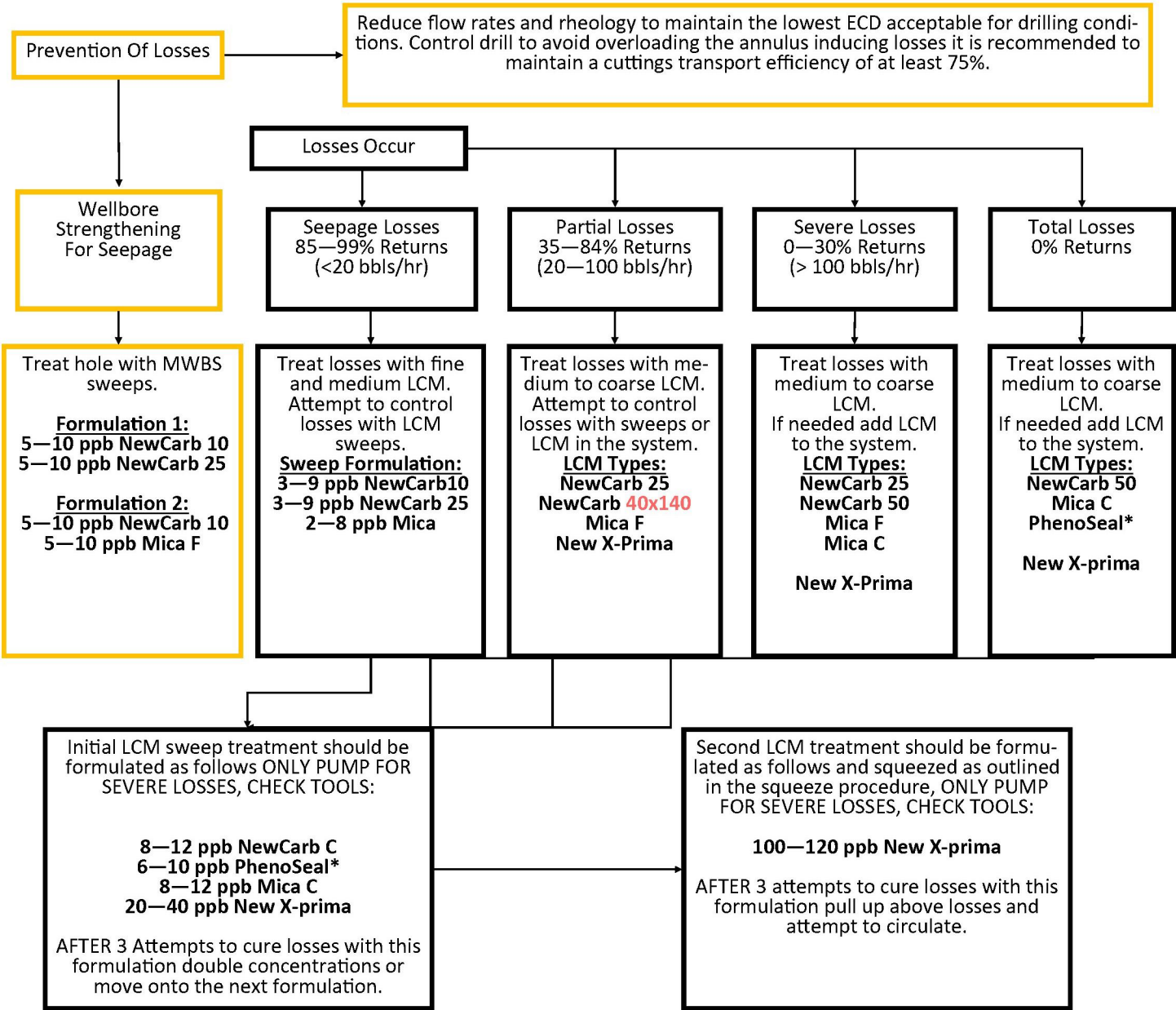
Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Additional Procedures Geothermal
LCM Flow Chart & Recommendations
Above 350F

Treat losses by following the LCM flowchart. At each attempt to regain lost returns begin at step one of this flowchart. Check with MWD hands for tool tolerance. Pulse vs. EM tool is critical to the amount of LCM allowed.
The LCM selected will not degrade at the anticipated temperatures of 500F. New X-Prima has been successfully used on geothermal wells with 750F bottom hole temperatures.
Prior to adding LCM to fluid increase the viscosity of the fluid using sweep procedures.



*product is suitable up to 500F, for temperatures exceeding 500F testing will be required



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Material Consumption
Estimate

2398 bbls Surface Hole Section (WBM - 8.4 - 8.9 ppg)					
Material/Additive/Chemical	Commercial Name	UoM (bbls/lbs/sxs/gal)	Concentration of UoM/bbl	Total Units of Measure	Total Consumption in UoM
Fluid Phase	WATER	bbls	0.99	2374.02	2374.02
Thinner / Dispersant	SAPP STICK	EA	0.025	60	60
Surfactant	SOAPSTICKS	EA	0.025	60	60
Polymer	NEWPHPA	pail	0.004761905	12	12
Shale Inhibitor	GYPSUM	sxs	0.08	192	192
Rheology Modifier	NEWZAN	sxs	0.04	96	96
1500 bbls whole mud and 1230 bbls dilution - Intermediate Hole Section (SBM 10.0 ppg)					
Material/Additive/Chemical	Commercial Name	UoM (bbls/lbs/sxs/gal)	Concentration of UoM/bbl	Total Units of Measure	Total Consumption in UoM
Synthetic Fluid Phase	NEOFLO 4633	bbls	0.64	787.2	787.2
Water Phase	WATER	bbls	0.22	270.6	270.6
Fluid Alkalinity	LIME HYDRATED	sxs	0.1200	148	148
Rheology Modifier	TEROIVIS	pail	0.0150	19	19
Weighting Agent	EXWATE BULK	tons	0.0575	71	71
Water Phase Salinity	CALCIUM CHLORIDE POWDER	sxs	0.1600	197	197
Fluid Loss Control	OPTITROL L	pail	0.0400	50	50
Rheology Modifier	TEROMOD	gal	0.0974	120	120
Emulsifier	TEROMUL HP	gal	0.80834	995	995
Wetting Agent	TEROCOAT	gal	0.19984	246	246
2293 bbls Production Hole Section (Water - 8.4 - 8.8 ppg)					
Material/Additive/Chemical	Commercial Name	UoM (bbls/lbs/sxs/gal)	Concentration of UoM/bbl	Total Units of Measure	Total Consumption in UoM
Fluid Phase	WATER	bbls	0.97	2224.21	2224.21
Friction Reducer	EVOLUBE G TOTE	gal	0.97799511	2243	2243
Friction Reducer	GRAPHITE	sxs	0.018	42	42
Viscosifier	SALT GEL	sxs	0.026	60	60
Rheology Modifier	NEWZAN	sxs	0.01	23	23



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



Material Consumption
Estimate

2293 bbls Production Hole Section (WBM - 10.0 ppg)					
Material/Additive/Chemical	Commercial Name	UoM (bbls/lbs/sxs/gal)	Concentration of UoM/bbl	Total Units of Measure	Total Consumption in UoM
Fluid Phase	WATER	bbls	0.919	2107.267	2107.267
Friction Reducer	EVOLUBE G TOTE	gal	0.97799511	2243	2243
Friction Reducer	GRAPHITE	sxs	0.08	184	184
Weighting Agent	EXWATE BULK	tons	0.0405	93	93
Viscosifier	SALT GEL	sxs	0.24	551	551
Mud Alkalinity Control	SODIUM HYDROXIDE	sxs	0.009090909	21	21
Mud Temperature Stabilizer	NEWSTABIL	gal	0.171232877	393	393
Rheology + Fluid Loss	TERRATROL HT	sxs	0.08	184	184

400 bbls Production Hole Section (Kill Pill - 14.0 ppg)					
Material/Additive/Chemical	Commercial Name	UoM (bbls/lbs/sxs/gal)	Concentration of UoM/bbl	Total Units of Measure	Total Consumption in UoM
Fluid Phase	WATER	bbls	0.73	292	292
Weighting Agent	EXWATE BULK	tons	0.224	90	90
Viscosifier	SALT GEL	sxs	0.24	96	96
Mud Alkalinity Control	SODIUM HYDROXIDE	sxs	0.009090909	4	4
Mud Temperature Stabilizer	NEWSTABIL	gal	0.171232877	69	69
Rheology + Fluid Loss	TERRATROL HT	sxs	0.08	32	32



Newpark Fluids Systems, LLC

5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



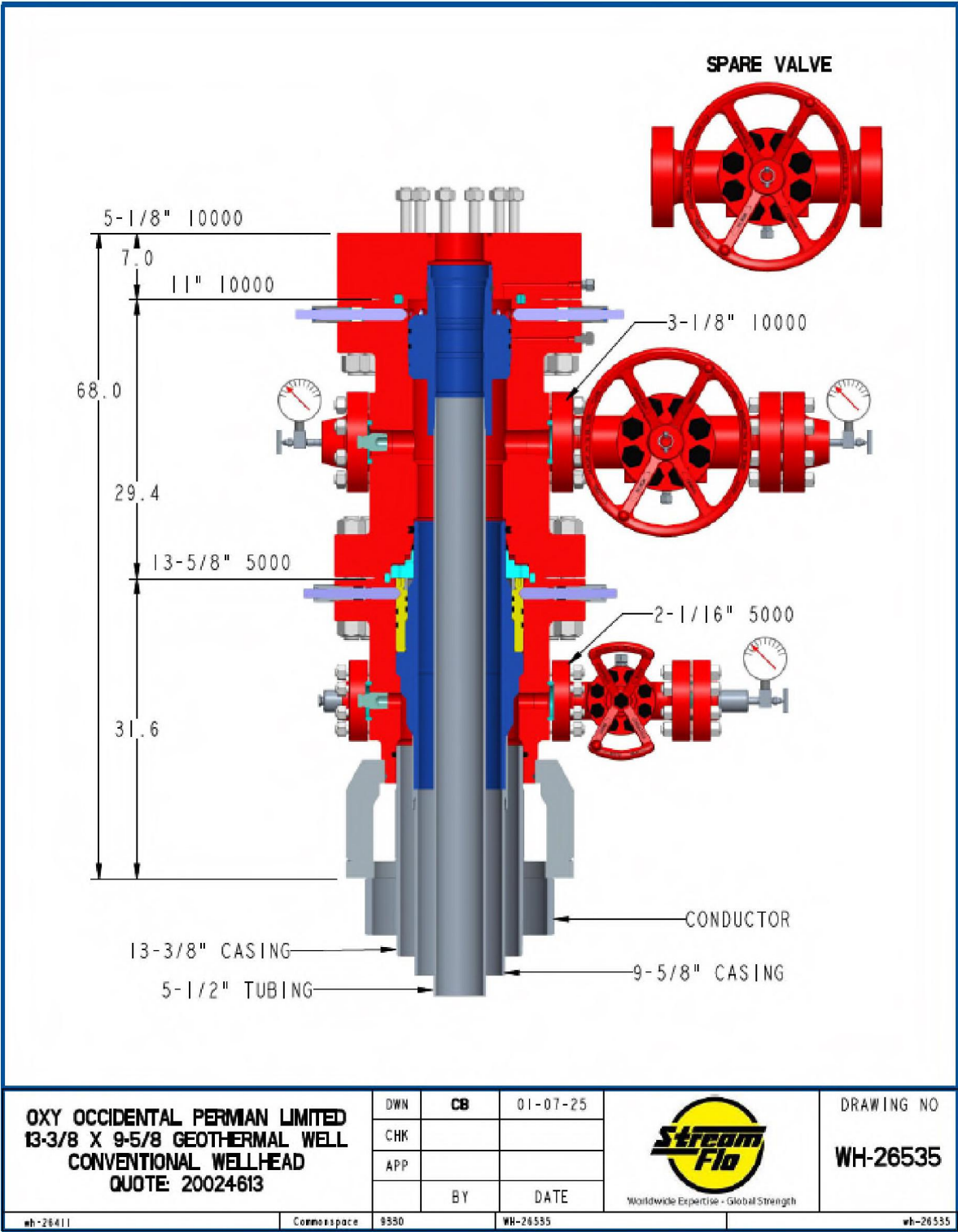
CONTACT	TITLE	PHONE	EMAIL
Redacted			

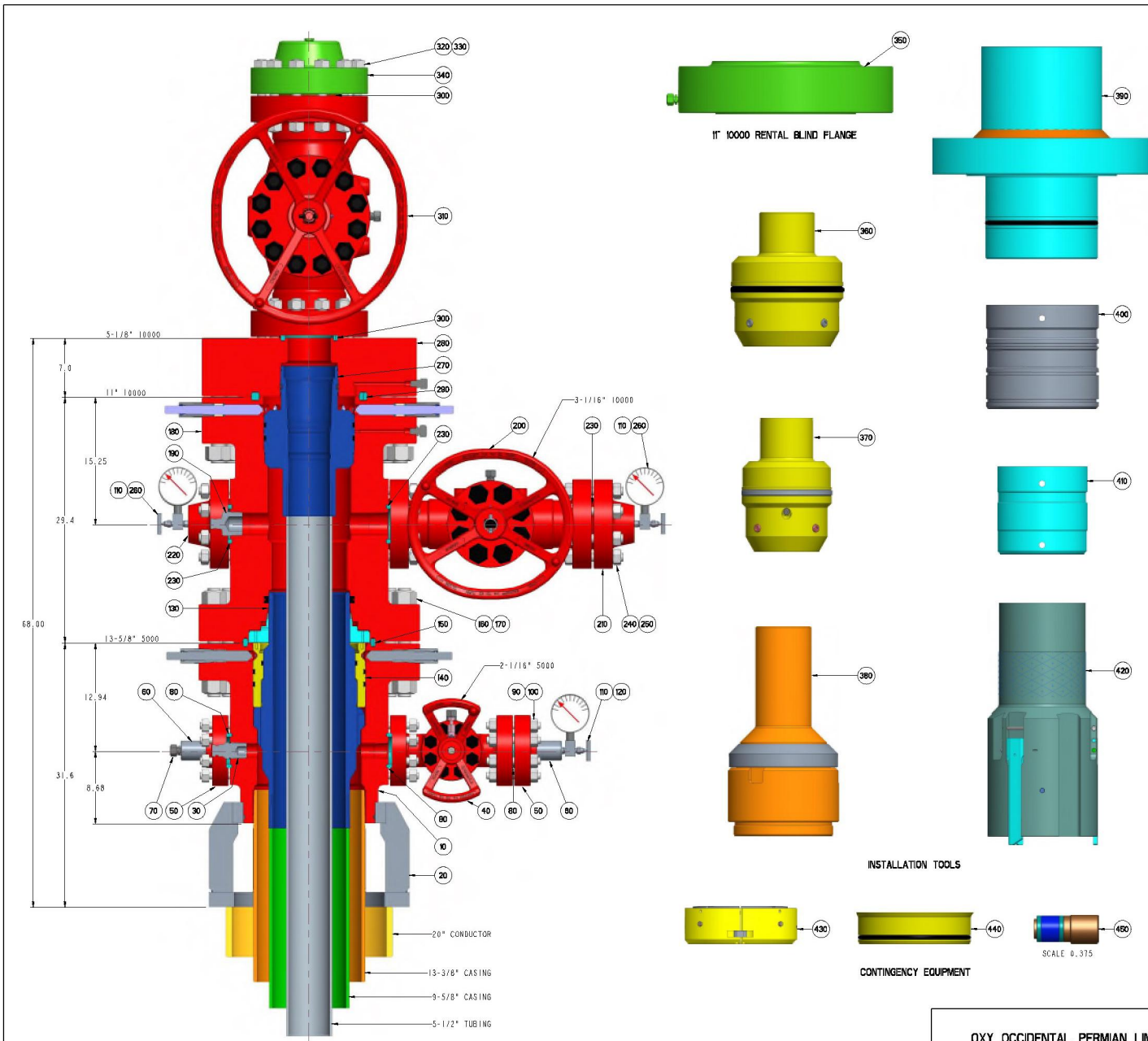


Newpark Fluids Systems, LLC
5990 Greenwood Plaza Blvd, Bldg. 2 Suite 205
Greenwood Village, CO 80111
Phone: (303) 623-2205 Fax: (720) 904-7970



G – StreamFlo Geothermal Wellhead





BILL OF MATERIALS			
ITEM	PART NUMBER	DESCRIPTION	QTY
10	3020844	STREAM-FLO CROWN CASING HEAD CC-21K 13-5/8 5000 FLANGE TOP X 13-3/8 SLIP ON WELD BOTTOM SIXTEEN 2-1/16 5000 STUDDED SIDE OUTLETS WITH 1.000 VR THREAD SIXTEEN TYPE P-121 LOCKDOWNS SPECIAL FBD TOLERANCES 15.75 OUTSIDE DIAMETER X 2.50 LONG HUB PREPARATION FOR LANDING BASE 12.50 BORE 21.62 LONG NON-EXPOSED (B7/2H) BOLTING API 6A PXXD PSL-2 PR2	1
20	30020773	STREAM-FLO CROWN LANDING BASE ASSEMBLY FA ATTACHABLE TO CASING HEAD 24.00 OD X 18.00 ID X 1.75 THICK BOTTOM PLATE WITH SIX RIBS 15.81 ID SUPPORT RING FOR CASING HEAD WITH 13.75 DIAMETER X 2.50 LONG HUB FOR 20 CONDUCTOR WITH FIVE SET SCREWS FOR RETENTION MAX LOAD 50000 lbf	1
30	30022083	VALVE REMOVAL PLUG FOR 2-1/16 2000 TO 10000 psi OUTLETS 1.900 SHARP-V THREAD X 1-1/4 HEX END API 6A MONOGRAMMED DD	1
40	30001461	STREAM-FLO CROWN GATE VALVE MODEL A-2 1-1/16 API 5000 FLANGED ENDS T-25 TRIM API 6A PUEE-0.5 PSL-2 PR2F	1
50	30008994	COMPANION FLANGE 2-1/16 5000 X 2 LP LUDD/EE PSL-2	2
60	10003555	BULLPLUG 2 LP X 1/2 LP XIX CARBON STEEL 5000 psi RWP COATED WITH DRY FILM LUBRICANT	2
70	10006178	GREASE FITTING 1/2 NPT AISI 4140 BODY VENTED CAP WITH GIANT BUTTON HEAD ZINC-COBALT PLATED NACE	1
80	10011734	RING GASKET OVAL R-24 316 STAINLESS STEEL 3316-4 API 6A	3
90	10013790	STUD 7/8 9UNRC X 8-1/4 FULL THREAD MINIMUM 16-1/2 OVERALL LENGTH MAXIMUM ASTM A193 GRADE B7M SOUR SERVICE ZINC PLATED API 6A BSL	8
100	10007740	NUT 7/8 9UN ASTM A194 GRADE 2H SOUR SERVICE ZINC PLATED API 6A BSL-1	16
110	10008357	NEEDLE VALVE ANGLE 1/2 NPT MALE X FEMALE 10000 psi RWP 316 STAINLESS STEEL	3
120	10006157	PRESSURE GAUGE 0-5000 psi DUAL SCALE 1/2 NPT LOWER MOUNT 316SS CONNECTION 4 FACE SILICONE FILLED NACE MRO175	1
130	30206648	STREAM-FLO CROWN CASING HANGER MANDREL CFBED 13-5/8 NOMINAL X BLANK PREPARATION FOR 9-5/8 TENARISHYDRIL ER (47.00 18/11) PIN BOTTOM X 11.500-4 STUB ACME RH LIFT THREAD 11.00 PACKOFF SEALING DIAMETER 9.10 DIAMETER X 6.00 EFFECTIVE LENGTH SLICK EXTENDED NECK SIX FLUTES 12.51 OD LANDING CENTRALIZER 6.61 BORE 26.25 LONG 11.0 ksi MINIMUM YIELD MATERIAL API 6A PXXD PSL-2 PR1 MAX LOAD 600000 lbf RUNNING TOOL 30208649	1
140	30206647	STREAM-FLO CROWN PRIMARY PACKOFF CFBED 13-5/8 NOMINAL FOR USE WITH CFBED FLUTED CASING HANGER WITH 11.00 DIAMETER SLICK EXTENDED NECK TWO DOVETAIL SEALS ON OD AND ONE S-SEAL ON ID 11.875-4 STUB ACME-20 RH LIFTING THREAD RETAINED BY LOCKSCREWS (BX GASKET ONLY) 7.69 LONG LONG 120 ksi MINIMUM YIELD MATERIAL API 6A PXXD PSL-2 PR1	1
150	10011701	RING GASKET BX-160 316 STAINLESS STEEL 3316-4 API 6A	1
160	10013501	STUD 1-5/8 9UNR X 12-1/2 FULL THREAD MINIMUM 113 OVERALL LENGTH MAXIMUM ASTM A193 GRADE B7M SOUR SERVICE ZINC PLATED API 6A BSL-1	16
170	10007656	NUT 1-5/8 9UN ASTM A194 GRADE 2H SOUR SERVICE ZINC PLATED API 6A BSL-1	32
180	30206651	STREAM-FLO CROWN INTERMEDIATE HEAD CMB 13-5/8 5000 11.0000 FLANGE TOP TWO 3-1/16 10000 STUDDED SIDE OUTLETS WITH 2-7/8 VR THREAD SIXTEEN TYPE P-121 LOCKDOWNS BUILT-IN 9-5/8 DR SECONDARY SEAL AND ONE 9-5/8 FS SEAL FOR 1.10 DIAMETER X 6.00 EFFECTIVE LENGTH SLICK EXTENDED NECK HANGER CMC COATED BODY 9.00 BORE 26.38 LONG NON-EXPOSED (B7/2H) BOLTING 7150 psi RWP API 6A PXXD PSL-2 PR2	1
190	30228800	STREAM-FLO CROWN VALVE REMOVAL PLUG FOR 3-1/16 AND 3-1/8 2000 TO 10000 psi OUTLETS 2-7/8 SHARP-V THREAD X 1-1/4 HEX END API 6A DD	1
200	30024297	STREAM-FLO CROWN GATE VALVE MODEL SL-3 3-1/16 API 10000 FLANGED ENDS T-25N TRIM ALLOY 718 STEM PAINTED WITH TWO-COAT EPOXY SYSTEM API 6A XEE-160 PSL-3 PR2F	1
210	30205155	STREAM-FLO CROWN BLIND FLANGE 3-1/16 10000 X 1/2 LP WITH 3.00 DIAMETER X 2.75 DEEP COUNTERBORE FOR 2-7/8 VR PLUS API 6A LUDD/EE PSL-2	1
220	30208665	RING GASKET BX-154 316 STAINLESS STEEL 3316-4 API 6A	3
230	10011682	STUD 1 8UNRC X 7 FULL THREAD MINIMUM 17-3/8 OVERALL LENGTH MAXIMUM ASTM A193 GRADE B7M SOUR SERVICE ZINC PLATED API 6A BSL-1	8
240	10013601	NUT 1 8UN ASTM A194 GRADE 2H SOUR SERVICE ZINC PLATED API 6A BSL-1	16
250	10007553	PRESSURE GAUGE 0-10000 psi DUAL SCALE 1/2 LP LOWER MOUNT 316SS CONNECTION 4 FACE SILICONE FILLED NACE MRO175	2
260	30208664	STREAM-FLO CROWN CASING HANGER CMBEN 11 NOMINAL X 5-1/2 TENARISHYDRIL TPN (17.00 18/11) BOX BOTTOM X 5-1/2 API BUTTRESS CASING THREAD BOX TOP 5 TYPE B BPV THREAD 1.00 DIAMETER X 3.62 EFFECTIVE LENGTH EXTENDED NECK TYPE CMB PRIMARY METAL SEAL AND TWO S-SEAL SECONDARY SEALS ON BODY CMB PRIMARY METAL SEAL AND ONE S-SEAL SECONDARY SEAL ON EXTENDED NECK 4.86 BORE 18.00 LONG 125 ksi MINIMUM YIELD MATERIAL DRY FILM LUBRICANT COATED METAL SEAL SURFACES 10000 psi RWP (47ES psi RWP 0-3500) API 6A LXX PSL-2 PR1	1
280	30208668	STREAM-FLO CROWN TUBING HEAD ADAPTER CMC 11 10000 STUDDED BOTTOM X 5-1/8 10000 STUDDED TOP 7.00 DIAMETER TWO STEP POCKET AND 0.875 DIAMETER TAPERED POCKET X 3.62 EFFECTIVE LENGTH EXTENDED NECK HANGER PREPARATION 5.12 BORE 7.00 LONG DRY FILM LUBRICANT COATED CMC METAL SEAL SURFACES NON-EXPOSED (B7/2H) BOLTING 9530 psi RWP API 6A PXXD PSL-2 PR1	1
290	10011696	RING GASKET BX-150 316 STAINLESS STEEL 3316-4 API 6A	1
300	10011713	RING GASKET BX-165 316 STAINLESS STEEL 3316-4 API 6A	2
310	10029012	GATE VALVE 5-1/8 API 10000 FLANGED ENDS T-25N TRIM BALL SCREW OPERATED HARDFACED SLAB GATE AND SEATS ALLOY 718 STEM API 6A MONOGRAMMED PXXE PSL-2 PR2	1
320	10203421	STUD 1-1/8 9UNR X 8-3/4 FULL THREAD MINIMUM 10-1/8 OVERALL LENGTH MAXIMUM ASTM A193 GRADE B7M SOUR SERVICE API 6A BSL-1	12
330	10007555	NUT 1-1/8 9UN ASTM A194 GRADE 2H SOUR SERVICE API 6A BSL-1	24
340	30000118	RENTAL FLANGE BLIND 5-1/8 10000 X 1/2 NPT	1
350	30005555	RENTAL BLIND FLANGE 11 10000 WITH 1/2 LP ON FLANGE OUTSIDE DIAMETER API 6A LUDD PSL-1	1
INSTALLATION TOOLS			
360	30208012	STREAM-FLO CROWN COMBINATION TEST PLUG AND RUNNING TOOL CMB 13-5/8 NOMINAL X NC50 14-1/2 (F) BOX X BOX ONE 1.900 VR PLUS ONE DOVETAIL SEAL ON OUTSIDE DIAMETER 1.64 BORE 16.00 LONG NITRIDE HARDENED	1
370	30007713	STREAM-FLO CROWN BORE PROTECTOR CC-22-BP SPECIAL 13-5/8 NOMINAL X 12.53 ID WITH WELDED LUG AND O-RINGS TO FIT CC-22 CC-29 OR CU HEADS 12.38 LONG	1
380	30205525	STREAM-FLO CROWN PRIMARY PACKOFF RUNNING / RETRIEVING TOOL FBD 13-5/8 NOMINAL X 11.875-4 STUB ACME-20 RH PIN BOTTOM X 11.500-4 STUB ACME-20 RH THREAD PIN TOP X NC50 14-1/2 (F) BOX TOP WITH THREE MILDLED SLOTS FOR RUNNING TOOL SLIDER KNURLED 12.93 LONG LONGING NECK 3.75 BORE 25.60 LONG NITRIDE HARDENED B SERVICE (0 TO 250 DEGREES F)	1
390	30208667	STREAM-FLO CROWN COMBINATION TEST PLUG AND RUNNING/RETRIEVING TOOL CMB 11 NOMINAL X NC50 14-1/2 (F) BOX X BOX ONE 1.900 VR PLUS ONE DOVETAIL SEAL ON OUTSIDE DIAMETER 1.64 BORE 16.00 LONG NITRIDE HARDENED	1
400	30208690	STREAM-FLO CROWN BORE PROTECTOR CMB 11 NOMINAL FOR CMB BOWL PROFILE WITH WELDED LUG 9.00 BORE 16.44 LONG	1
410	30208649	STREAM-FLO CROWN RUNNING/TORQUING TOOL FBD 13-5/8 NOMINAL X 11.500-4 STUB ACME-20 RH BOX BOTTOM X BLANK PREPARATION FOR 9-5/8 TENARISHYDRIL (47.00 18/11) BOX TOP FOR USE WITH CFBED CASING HANGER WITH 11.00 PACKOFF SEALING DIAMETER AND 9.10 DIAMETER X 6.00 EFFECTIVE LENGTH SLICK EXTENDED NECK TWO O-RING SEALS THREE TORQUE SLIDERS ONE 1/4 LP TEST PORT THREE FLUTES PARTIALLY KNURLED 12.19 LONG LONGING NECK 13.38 OD 8.68 BORE 28.90 LONG NITRIDE HARDENED U SERVICE (0 TO 250 DEGREES F) MAX TEST PRESSURE 5000 psi MAX TORQUE 51000 ft-lbf MAXIMUM TORQUE 1270-1950 ft-lbf MAX TEST PRESSURE 5000 psi MAX TORQUE 51000 ft-lbf MAXIMUM TORQUE 1270-1950 ft-lbf	1
420	30205597	STREAM-FLO CROWN TORQUE PLATE 13-5/8 5000 FLANGE BOTTOM (NO RING GASKET) X 13-3/8 BC BOX TOP WITH BUILT-IN ISOLATION COUPLER FOR 13-5/8 NOMINAL CC-29 HEAD 12.50 BORE 26.38 LONG 2000 psi RWP 45000 lbf LOAD RATING AT 0 psi INTERNAL PRESSURE	1
CONTINGENCY EQUIPMENT			
430	30008840	STREAM-FLO CROWN CASING SLIP HANGER CC-21K 13 5/8 NOMINAL X 9-5/8 MANUAL API 6A LUDD PSL-1 PR2	1
440	30006698	STREAM-FLO CROWN PRIMARY PACKOFF CC-21K 13-5/8 NOMINAL X 9-5/8 CASING WITH ELBOWED PORT AND O-RING SEALS TO FIT CC-29L OR CC-29BP HEAD WITH CC-22 HANGER AND R/BX GASKET ONLY 5000 psi RWP API 6A LUDD PSL-2 PR2	1
450	30020824	TYPE P-157 LOCKSCREW PLUG 1.625-8 UN EXTERNAL THREAD 0.75 INTERNAL HEX FOR 15000 psi AND LOWER RWP LOCKSCREW PREPS LUDD SERVICE	16

OXY OCCIDENTAL PERMIAN LIMITED
13-3/8 X 9-5/8 GEOTHERMAL WELL
CONVENTIONAL WELLHEAD
QUOTE: 20024613

DWN	SZS	03-19-25
CHK	RM	03-19-25
APP		
BY	DATE	



DRAWING NO
WH-26635
REV. 1

REF: _____ CONWSPACE _____ PROJ: 0330 _____ MODEL: 4330-FR2-WH-26635 _____ JWB: 1330-FR2-WH-26635 _____



Running Procedure

Geothermal Well

13-3/8" X 9-5/8" X 5-1/2" Casing

Oxy Occidental Permian Limited

Project 9330, WH-26411, Quote 20024613

RP-0619

Revision 1

Contents

Section 1	Safety & Environment.	1
	General.....	1
	Vented Cap Body Grease Fitting Safety	1
	Lockscrew Safety.....	2
Section 2	Introduction	3
Section 3	Installing the Casing Head with Landing Base	4
Section 4	Testing the 13-5/8" 5000 BOP Stack.....	8
Section 5	Installing Wellhead Bore Protector.....	10
Section 6	Retrieving Wellhead Bore Protector	12
Section 7	Installing the Fluted Mandrel Intermediate Casing Hanger	13
	Pre-Installation	13
	Installing the Fluted Mandrel Casing Hanger	15
Section 8	Installing the Packoff.....	18
	Preparation.....	18
	Installation	19
Section 9	Installing the Contingency Casing Slip Hanger	21
Section 10	Installing the Contingency Packoff.....	23
	Installation	23
Section 11	Installing CMB Intermediate Head with DR1 Metal Seal.....	25
Section 12	Testing the 11" 10000 BOP Stack	28
Section 13	Installing Wellhead Bore Protector.....	30
Section 14	Retrieving Wellhead Bore Protector	32
Section 15	Installing the 11" x 5-1/2" CMBEN Casing Hanger	33
Section 16	Installing the Tubing Head Adapter with Master Valve and Blind Flange	37
Section 17	Testing Additional Christmas Tree Components	40
Section 18	11" x 5-1/2" CMBEN Casing Hanger Retrieval.....	40
Section 19	Reference.....	41
	About Corrosion	41
	General Corrosion	41
	Pitting Corrosion	42
	Cracking Corrosion	42
	Spalling/Flaking Corrosion.....	43
	Working with Hangers and Landing Joints.....	44
	Measuring the Wellhead-to-RKB Distance	47
	Measurement Standards	47
	Index.....	49



External Documents Referenced

EB 01-024	Welding Guidelines and Recommendations for Slip-on Connections
EB 13-010	API 6A Flange Overview and Assembly
EB 13-014	Recommended Flange Bolt Torque for API 6A Flanges
EB 16-002	Operating Instructions for Stream-Flo Lubricator for use with Threaded Back Pressure Valves and Two-Way Checks
EB 18-005	Operational Procedure for Type 'P' Lockscrews
EB 33-005	Field Pressure Testing

Document Approval

Revision	Created By	Date	Approved By	Date
Redacted				



Section 1 Safety & Environment

General

- Obey all applicable national, provincial/state, and local laws and regulations regarding hazardous work environments as required.
- Always wear Personal Protective Equipment (PPE) appropriate to the job/site. The customer may have their own PPE requirements. The customer may require PPE from the point of dispatch.
- Upon arrival at the site, check in with the company representative.
- Check tools, equipment, personal protective and safety equipment for hazards before using.
- All company operations are conducted with safety as top priority, and with the objective to safeguard the environment.
- All worn or damaged parts to be disposed of in an environmentally-conscious manner.
- Before you begin work, familiarize yourself with the site and any hazards that may exist.

Vented Cap Body Grease Fitting Safety

Warning! Fitting assemblies can be under extreme pressure, which is not visible from the outside. Fittings can be ejected at high velocity if backed out under pressure, resulting in possible property damage, injury, or death. DO NOT remove fittings while they are under pressure.

Vented-cap body grease fittings are assemblies, not solid pieces, and they have multiple sets of threads. The vent cap can be removed from the fitting while under pressure.

When removing the vent cap from the fitting body, it is critical that only the vent cap is rotated. The body must be held still and kept from rotating. Failure to keep the body from turning can result in the release of pressure or the ejection of the fitting body.

Do not use a single wrench to remove a vent cap, as nothing prevents the fitting body from loosening.

Once the vent cap is removed, a pressure relief tool can be installed to bleed pressure through the fitting.



Figure 1

1. Never stand in the potential line of fire of a fitting while operating it.
2. Never assume there is no pressure behind a fitting.
3. Place the first wrench on the wrench hex of the fitting body (see Figure 1). Use this wrench to ensure the assembly body does not rotate.
4. Place the second wrench on the fitting vent cap (see Figure 1).
Rotate the fitting vent cap as required to loosen or tighten.



Lockscrew Safety

The following precautions **must** be taken to prevent damage to components or personal injuries:

- Warning!** BE EXTREMELY CAREFUL when operating lockdown assemblies under pressure. The lockdown assembly is retained in the head by the bushing threads.
- Warning!** Adequate thread engagement is required AT ALL TIMES. The bushing standoff dimensions 'Br' are the maximum safe distance the bushing can be retracted with adequate thread engagement.
- Warning!** DO NOT retract the lockscrew or bushing further than the 'Sr' (Retracted Lockscrew) and 'Br' (Retracted Bushing) dimensions given.
- Warning!** DO NOT stand, or allow others to be in potential line-of-fire the lockdown assembly that is being operated.
- Warning!** Whenever possible, bleed all pressure from the annulus, Christmas tree, or flange test port before operating the lockdown assemblies.

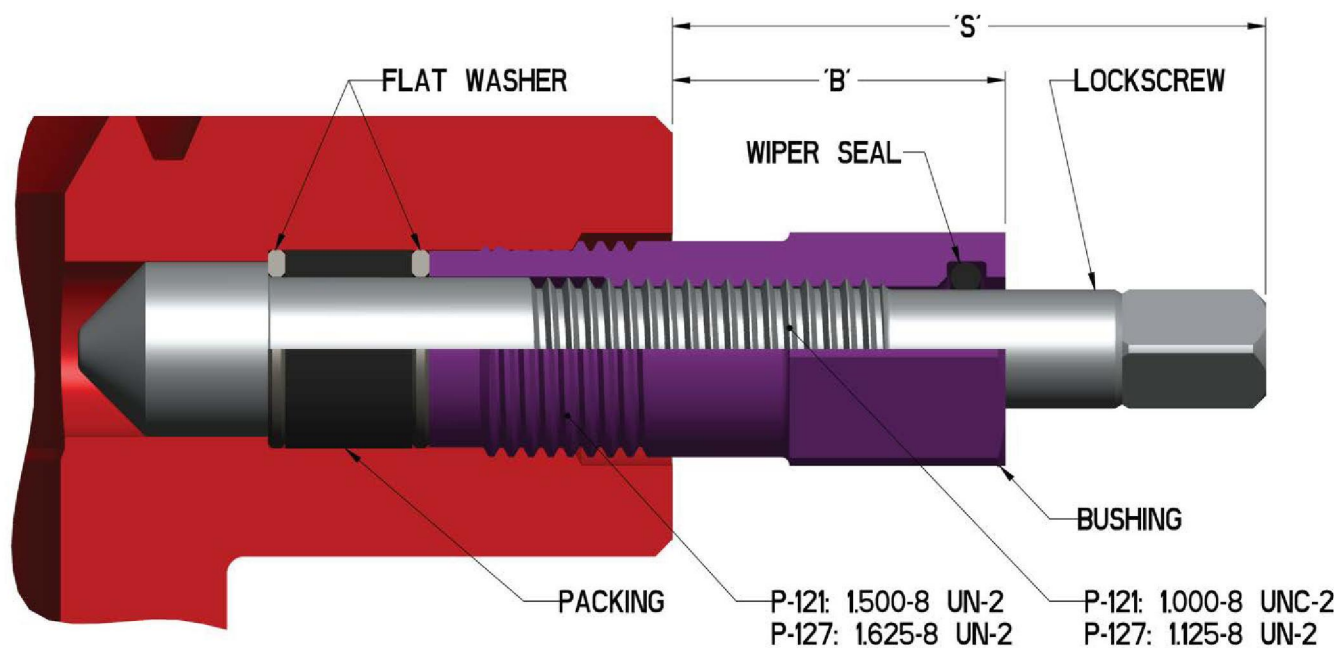


Table 1 TYPE P-127 Lockdown Assembly						
NOMINAL FLANGE SIZE	BUSHING RETRACTED B_r (+/- 0.12) INCHES	BUSHING ENGAGED B_e (+/- 0.12) INCHES	LOCKSCREW RETRACTED S_r (MIN) INCHES	LOCKSCREW ENGAGED S_e (MAX) INCHES	LOCKSCREW TORQUE (MIN - MAX) ft - lbf	BUSHING TORQUE (MIN - MAX) ft - lbf
11" 10,000	2.75	2.50	4.47	3.81	300 - 475	250 - 500
13-5/8" 5,000	2.19	1.94	3.78	3.25	300 - 475	250 - 500

Note for bore protector: Use lockscrew torque range 65 to 85 ft-lbf. The engaged lockscrew dimensions 'Se' will be 0.25" MORE than the values in the tables (e.g. "Se" + 0.25").



Section 2 Introduction

The Stream-Flo conventional wellhead system for this Oxy geothermal well is a 3-string system. This procedure covers the installation of the equipment for the 13-3/8" casing, 9-5/8" casing, and 5-1/2" casing. The casing head is landed on the conductor pipe and welded to the 13-3/8" surface casing with a slip-on weld (SOW) connection.

The 9-5/8" casing string is landed with a mandrel casing hanger and running tool which has torque through capabilities. Once the hanger is landed, a primary packoff is installed using an adapter tool and the same running tool as the mandrel hanger.

A metal seal is installed on the OD of the 9-5/8" mandrel hanger neck and the metal seal is energized by tightening the intermediate head bolts when making it up to the casing head.

The 5-1/2" string is landed with a mandrel hanger. Once the hanger is landed, a tubing head adapter is installed.

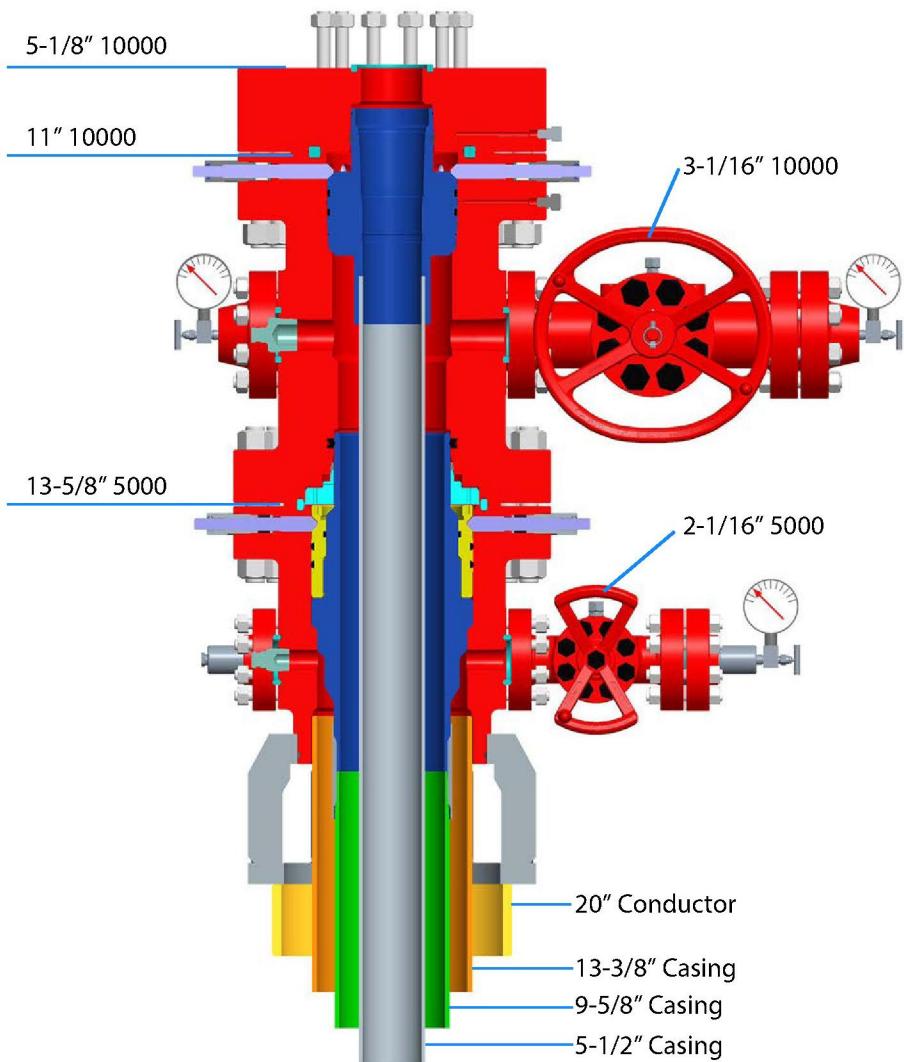


Figure 2
Wellhead Assembly



Section 3 Installing the Casing Head with Landing Base

- Casing Head Material Number: 30208444
Landing Base Material Number: 30020773
Torque Plate Material Number: 30205597
Valve Removal Plug Material Number: 30022883
Lockscrew Plug Material Number: 30020824
- The casing head comes with a 13-3/8" L80 54.5# API buttress pup joint factory welded into the bottom.
1. Inspect all component stamping to ensure compatibility.
 2. Ensure the conductor casing is cut flat and square to the well-bore.
 3. Remove the attached valves, studs and nuts from the side outlets and thread 1.9" SV plugs in, stop at finger/hand tight (approximately 8 to 9 turns). Gradually tighten the plugs approximately 1.3 to 2.5 turns past the finger/hand-tight point. This will be approximately 200 to 225 ft-lbf.
 4. Remove lockscrews and install Lockscrew Plugs (LP). Apply a light coat of Jet-Lube Kopr-Kote to the entire plug prior to installation.
 5. Torque the LP to 250 ft-lbs.
 6. Set the casing head in the landing base. Engage the landing base set screws to secure the casing head to the landing base.

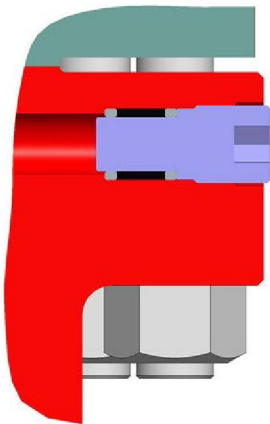


Figure 3
Lockscrew Plug

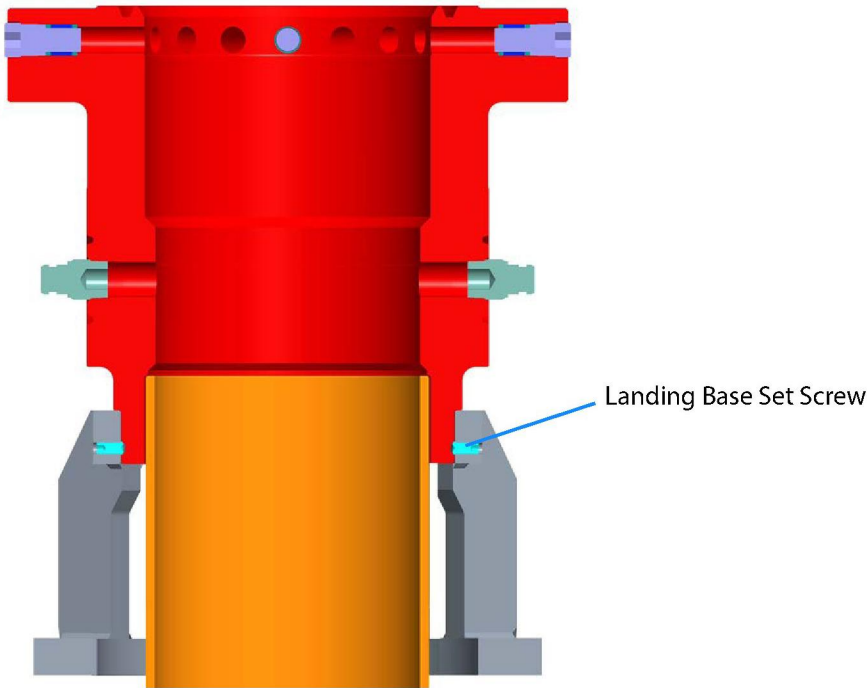


Figure 4
Landed Casing Head



7. Make up a landing joint to the torque plate.
8. Grease the o-ring seal on the torque plate and the bore of the casing head.
9. Install the torque plate into the casing head using the 13-5/8" 5000 bolt circle.
Note: Do not install a ring gasket. Assemble the torque plate face-to-face with the casing head. Ensure that the running tool goes on straight so that the o-ring seal is not damaged. Lubricate and torque the nuts to approximately 250 ft-lbs.
10. Run the 13-3/8" surface casing to the target depth and set the last joint of casing in the slips at the rig floor.
11. Pick up the casing head with the torque tool and landing joint and thread the casing head into the surface casing string. Torque to spec.
12. Run the casing head and surface casing string through the rig floor and land the landing base on the conductor pipe. Ensure the outlets are aligned in the desired orientation.
13. Cement through the landing joint and torque plate. Cement returns will be taken through slots in the landing base.
14. Once cementing is complete, remove the studs and nuts from the torque plate and casing head. Lift the torque plate and set it aside. Inspect casing head for damage.



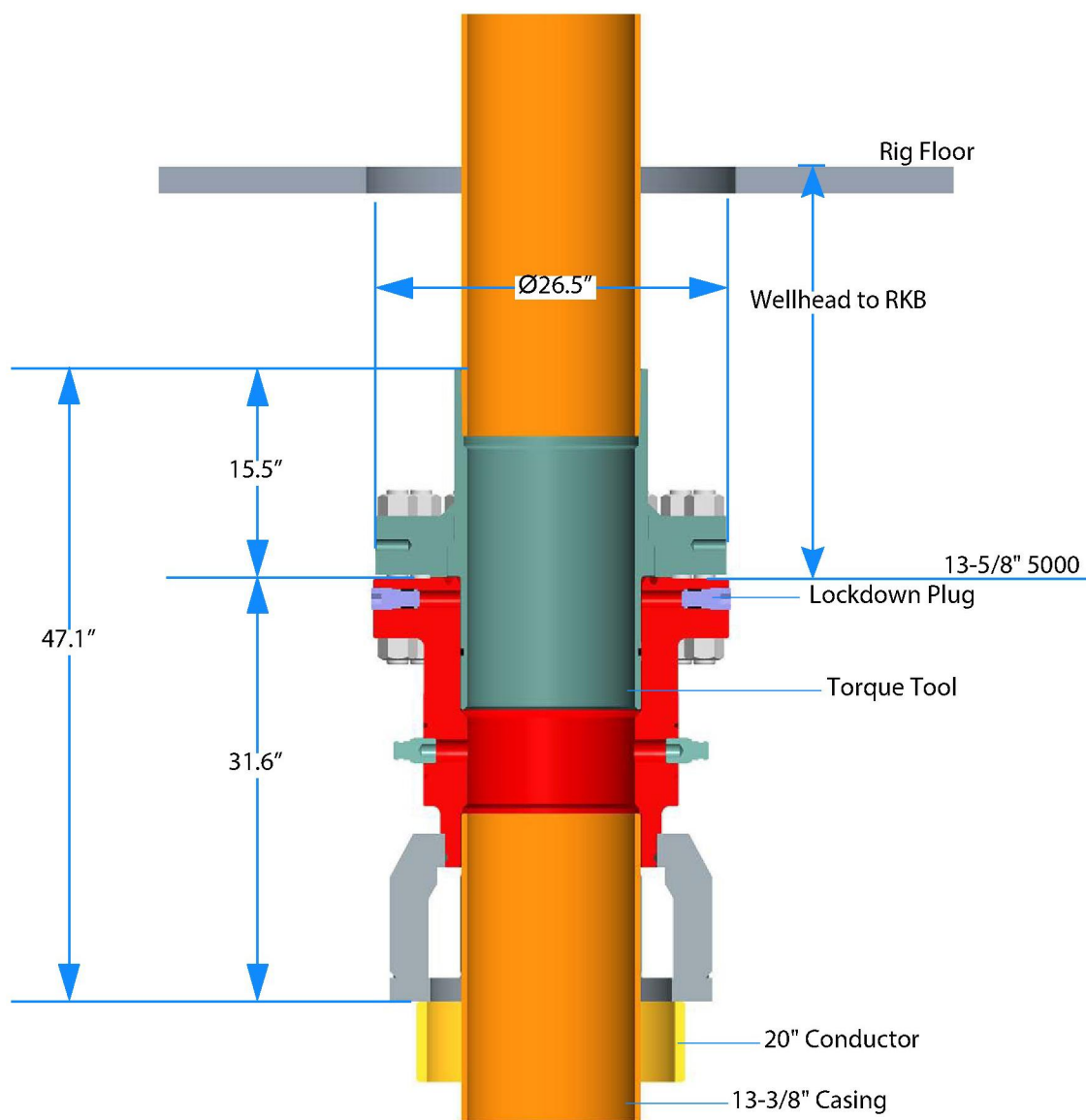


Figure 5
Casing Head Installed



15. Remove lockscrew plug and valve removal plug. Clean the bore of the casing head and side outlets, ensuring that no scratches, nicks, or dirt are present in the casing head bore or ring grooves that will affect sealing.
16. Install valve removal plug, companion flange, annulus valve, and lockscrew assembly per Figure 6. The lockscrew torque is 300 - 475 ft-lbf and the bushing torque is 250 - 500 ft-lbf. The torque for a 2-1/16" 5000 studded connection is 188-319 ft-lbf.
17. Measure the distance from the top face of the casing head to the rig floor. This measurement shall be referred to as 'Wellhead to RKB'.
18. Install the BOP stack.

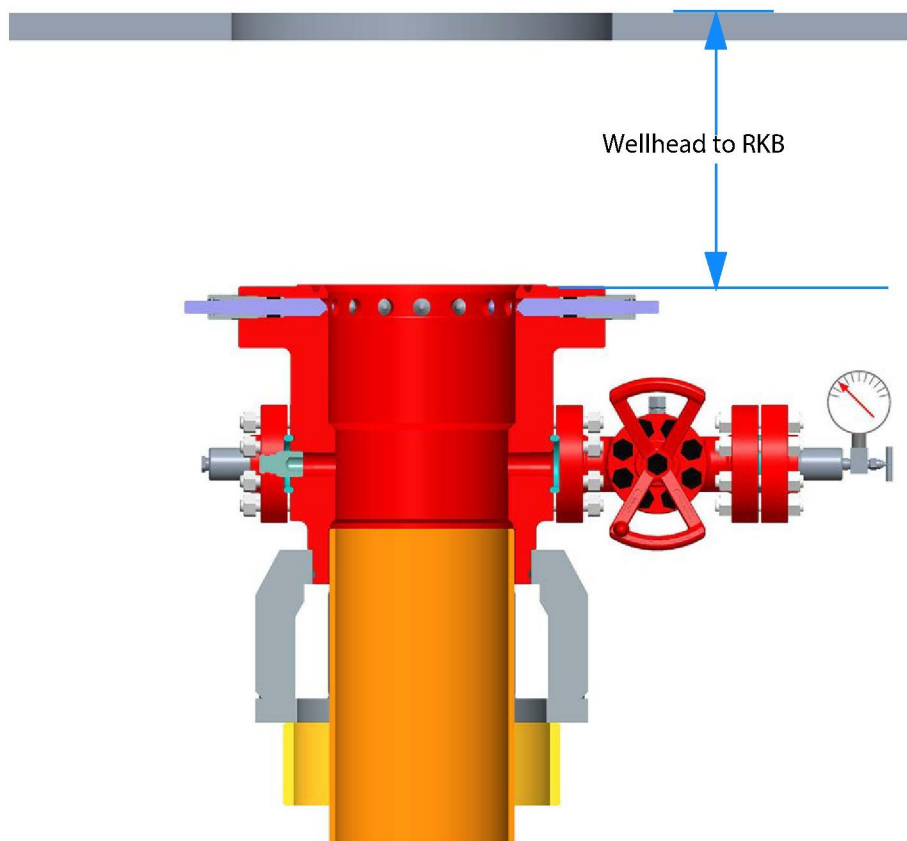


Figure 6
Wellhead to RKB



Section 4 Testing the 13-5/8" 5000 BOP Stack

Combination Running Tool Material Number: 30208012

The combination running tool (CRT) is used to test the BOP stack to 5,000 psi. This tool serves as both the BOP test plug and the running/retrieving tool for the bore protector.

1. Open the casing head side outlets valves to drain any fluid out of the BOP stack and head.
2. Leave the casing side outlets valves in the open position to allow for seal leak monitoring.

Warning! The side outlet valve must be open for seal leak monitoring to avoid over pressuring the casing and intermediate head side outlets

3. Verify the stamping of the CRT is correct. Inspect the test plug seal and check that central plug is installed. Check the weeping holes: if the lower BOP rams are to be tested through the drill pipe, remove the plugs; otherwise they must be fully made-up.
4. Check that all lockscrew in the intermediate head are fully backed off. Refer to SFI engineering bulletin EB 18-005.
5. Calculate the distance from the rig floor to the CRT seated position in the wellhead. Note the calculation on the service report.

Distance = Wellhead to RKB + 10"

6. Make up the CRT to a joint of drill pipe.
7. Mark the landing point on the drill pipe. The drill pipe should be marked a distance of Wellhead to RKB + 10" from the tapered shoulder of the CRT.

Note: The four lugs must be above the seal (i.e., the tonging neck end should be facing down).

8. Apply clean grease to the elastomer seal on the CRT.
9. Slowly lower and measure the CRT through the fully opened BOP into the wellhead and land it.
10. Confirm the landing distance traveled: when the CRT is properly landed, the mark on the drill pipe made in Step 6 will be flush with the rig floor.
11. Test to the desired pressure as per rig operator's procedure. Do not exceed the pressure rating of the wellhead flange connections. See SFI Engineering Bulletin EB 33-005: Field Pressure Testing.

Note: Any leakage past the CRT seal may be observed at the open intermediate head side outlet valves.

12. After the test has been completed, release pressure. Remove as much fluid from the BOP stack as possible.

Important: Verify all pressure is relieved.

13. Retrieve the CRT slowly to avoid damaging components or rolling out the seal

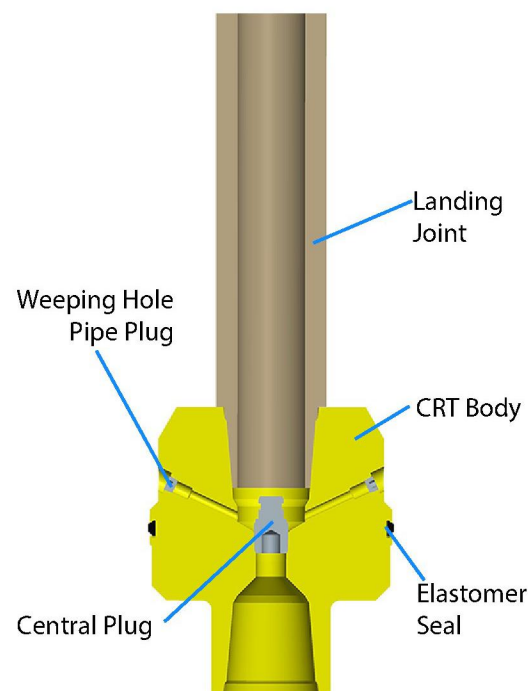


Figure 7
Combination Running Tool



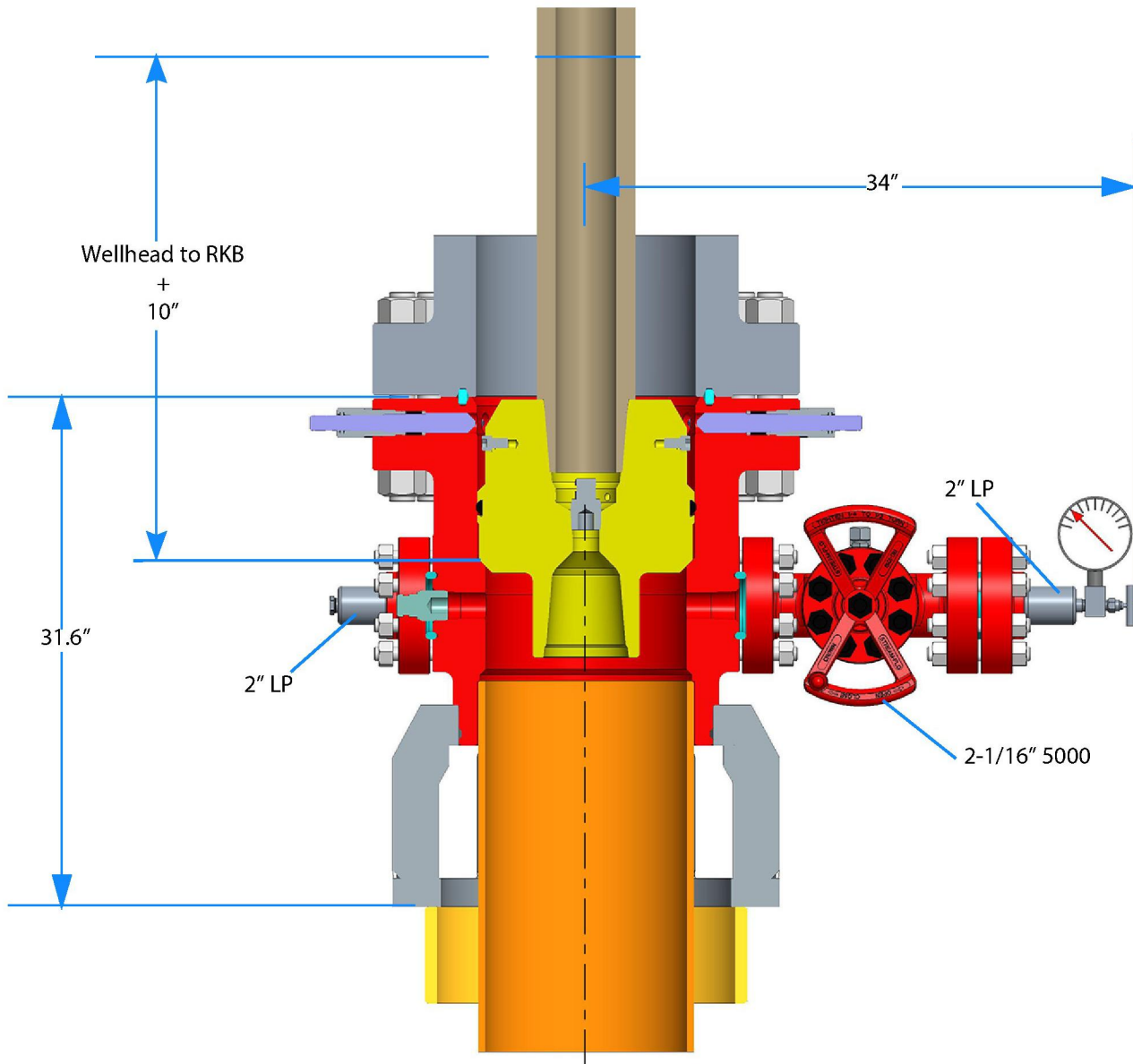


Figure 8
Casing Head BOP Test



Section 5 Installing Wellhead Bore Protector

Bore Protector Material Number: 30007713

When drilling through the wellhead, a bore protector must be used to protect critical sealing surfaces and landing shoulders from wear and damage by the drill bit, drill pipe, and the installation of downhole tools.

1. Inspect the bore protector and running tool and verify the type and size. Verify:
- The lugs are installed in the CRT.

Measure the inside diameter of the bore protector to ensure it will drift all equipment that will run through it.

Central plug and elastomer seal ring should be removed if possible.
2. Attach the CRT to a joint of drill pipe.

Important: The elastomer seal groove must be above the four lugs.

3. Align the CRT lugs with bore protector J-slots, and then carefully lower the into the protector until it stops.

Warning! Pinch Point - watch hand placement as the running tool is being lowered.

4. Rotate the CRT clockwise 80 degrees until it stops to completely engage the J-slots with the lugs.
5. Calculate the distance from the rig floor to the bore protector seat position in the wellhead. Note the calculation on the service report.
- Distance = Wellhead to RKB + 10"
6. Mark the landing point on the drill pipe. The drill pipe should be marked a distance of Wellhead to RKB + 10" from the tapered shoulder of the bore protector.
7. Slowly lower and measure the tool and bore protector assembly through the BOP stack and into the wellhead until lands on the landing shoulder.
8. Confirm the measured distance matches the calculated distance to validate the proper seating of the bore protector. When properly landed, the mark on the drill pipe will be flush with the rig floor.
9. Remove the tool from the bore protector by rotating the drill pipe counterclockwise 90 degrees and then lifting straight up.
10. Remove the tool from the drill pipe. Clean, inspect, and store the tool.
11. Drill for the next casing string.

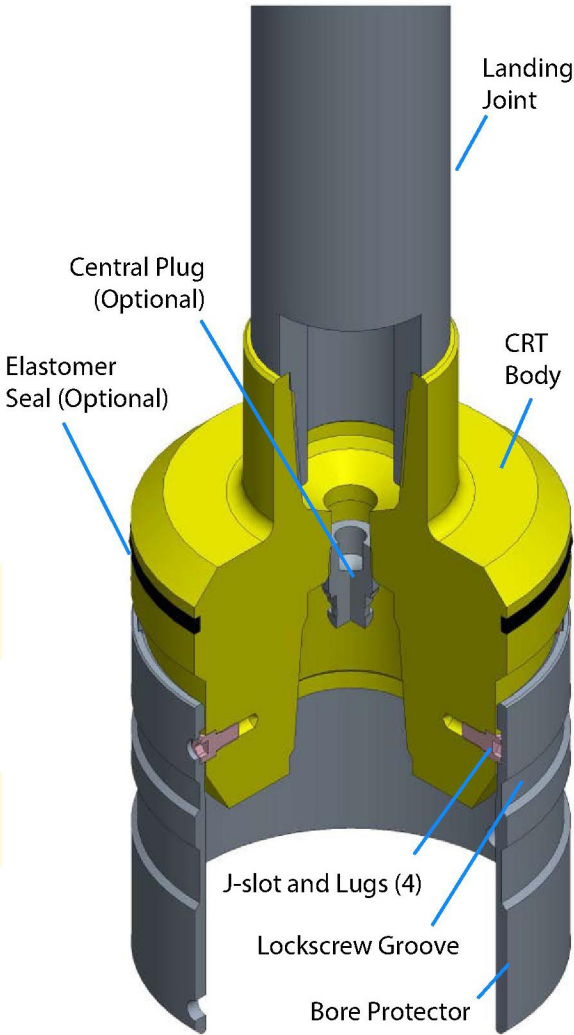


Figure 9
Bore Protector with CRT



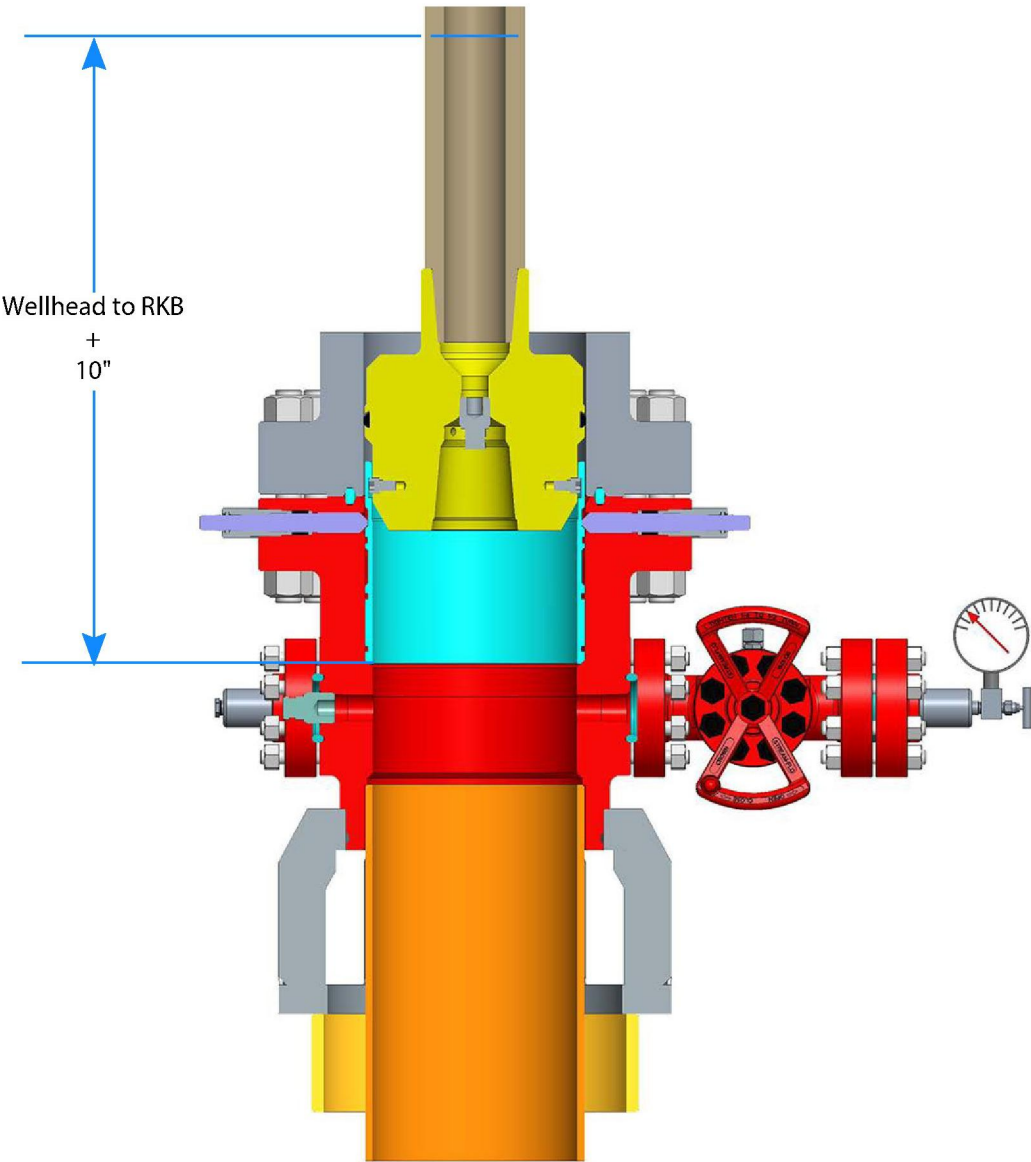


Figure 10
Casing Head Bore Protector



Section 6 Retrieving Wellhead Bore Protector

After drilling has been completed and before the casing is run, the bore protector must be retrieved.

- 1. Inspect the running tool lugs. Central plug and elastomer seal ring should be removed if possible.
- 2. Attach the CRT to a joint of drill pipe.
Note: The elastomer seal groove must be above the four lugs.
- 3. Calculate the distance from the rig floor to the CRT bottom face. Note the calculation on the service report.

Distance = Wellhead to RKB + 2-3/8"

- 4. Mark the landing point on the drill pipe. The drill pipe should be marked a distance of Wellhead to RKB + 2-3/8" from the bottom face of the CRT.
- 5. Slowly lower and measure the tool through the BOP stack and into the bore protector. The mark on the drill pipe will be flush with the rig floor when the running tool is in the J-slot groove. If necessary, rotate the drill pipe clockwise until the lugs drop into the J-slots. When the lugs have reached the bottom of the J-slot in the bore protector, rotate the drill pipe clockwise 80 degrees.

Note: Never release string weight onto the bore protector.

- 6. Pull up and remove the tool and bore protector.
- 7. Remove the bore protector from the CRT.
- 8. Remove the CRT from the drill pipe.
- 9. Inspect the bore protector and replace if required, or store for use later.
- 10. Washout the inside of the wellhead housing.

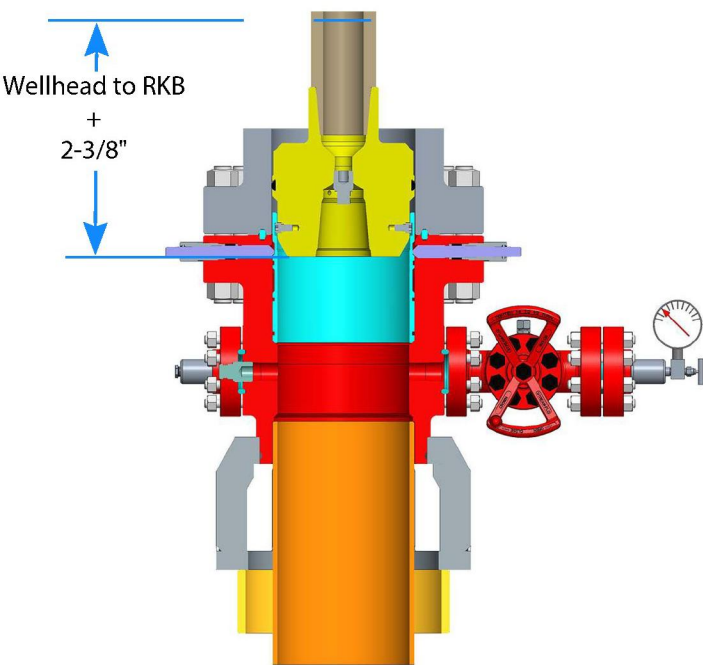


Figure 11
Casing Head Bore Protector Retrieval



Section 7 Installing the Fluted Mandrel Intermediate Casing Hanger

- Casing Hanger Material Number: 30208648
- Casing Hanger Running Tool Material Number: 30208649
- Running Tool Torque Slider Material Number: 20211612
- Running Tool O-ring Material Number: 10202638
- Shear Pin Material Number: 20020586

The fluted mandrel casing hanger has milled slots to allow for fluid bypass when the casing is set. The mandrel hanger has a casing thread pin bottom connector with a tonging neck and a male acme thread top for use with a running tool. The mandrel casing hanger also has a slick neck top for sealing against the pack-off bushing.

The casing hanger is run with the running and torquing tool. The running tool uses sliders to transfer torque from the landing joint to the casing hanger, allowing the hanger to be torqued into the casing string using a top drive. The running tool allows clockwise rotation of the casing string and reciprocation when landing horizontal casing strings. The running tool is equipped with shear pins to allow limited torque in the counter-clockwise direction

Note: Running tool sliders are rated to transfer up to 51,000 ft-lbs to the casing hanger. The actual torque rating may be limited by the casing threads.

Note: Running Tool Max Load: 600,000 lbs

Pre-Installation

1. Inspect the fluted mandrel casing hanger and verify:
 - Ensure material numbers on the component match the running procedure.
 - Internal bore is clean and in good condition.
 - Inspect ACME threads are in good condition. Dress with emery cloth if required.
 - Inspect suspension threads are in good condition.
 - Load and pressure ratings.
 - Required casing thread make up torque.
 - Slick extended neck is free of damage. Dress with emery cloth as required. Handle with care.
2. Inspect the casing hanger running tool and verify:
 - Ensure material numbers on the component match the running procedure.
 - Internal bore is clean and in good condition.
 - Inspect ACME threads are in good condition. Dress with emery cloth if required.
 - Inspect lifting threads are in good condition.
 - Load and pressure ratings are known.
 - Internal elastomer seals are in place and in good condi-

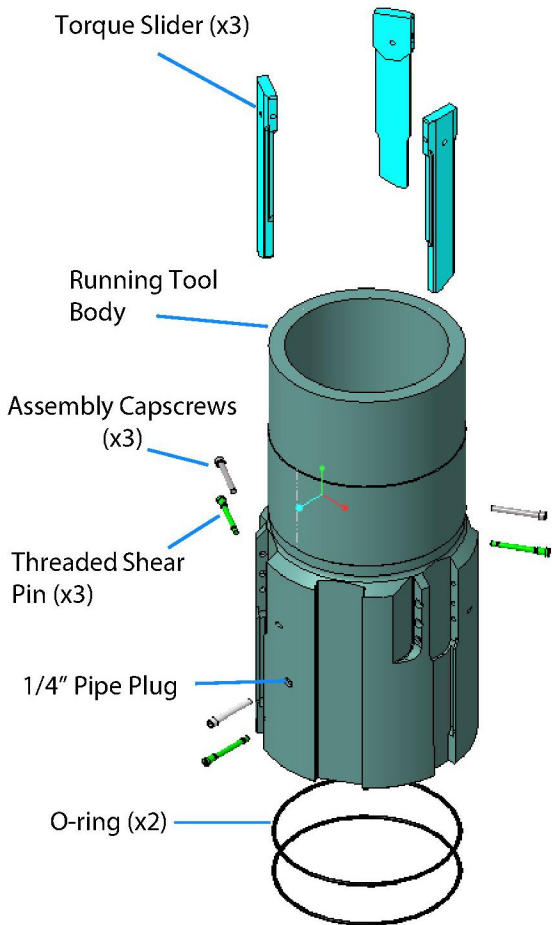


Figure 12
Fluted Mandrel Casing Hanger



- tion. Replace if necessary.
- Sliders are in place orientated correctly (tapered flat facing counter-clockwise orientation).
 - Threaded shear pin and assembly cap screws are present.
 - 1/4" pipe plug is present, functional, and is not protruding outside of the tool body.
 - Required casing thread make-up torque
3. Remove the 3/8" hex head assembly cap screws from the running tool body and install into slider. Remove the threaded shear pin with a flat head screw driver. Lift the sliders so the bottom of the slider sits above or flush with the bottom of the running tool body (see Figure 13. Tighten the assembly cap screw to keep the sliders in the raised position.
4. Ensure that the pipe plug is installed in the test port on the torque/running tool and that it is not protruding outside of the tool body.
5. If necessary, make up a landing joint to the top connection of the torque/running tool.
6. Using a clean brush, apply a light coat of Jet-Lube KoprKote (or equivalent) to the ACME threads on the torque/ running tool and the casing hanger. **DO NOT USE PIPE DOPE.**
7. Apply light grease to the running tool seals and the slick extended neck on the mandrel casing hanger.
8. Align the running tool to the casing hanger and make up the connection. To ensure proper thread alignment, turn the tool counter-clockwise until a thread 'bump' is felt.
9. Mark a vertical line on the casing hanger and on the running tool after the thread 'bump' is felt.
10. Rotate the hanger clockwise, using the vertical line as a guide, approximately 10-1/2 to 11 turns until the running tool is threaded onto the hanger and contacts the top of the casing hanger neck.
- Note:** There will be a 3/16" (5mm) gap between the bottom of the running tool and the casing hanger when fully made up.
11. Write the number of turns on the running tool for future reference when removing the running tool.
12. Make note of the position of the sliders relative to the hanger flutes. If the slider is not initially positioned above a flute, rotate the running tool counterclockwise so that the sliders line up with the next flute.
13. Locate and remove the 1/4" internal hex pipe plug on the running tool stamped "TEST PORT 1/4 LP" and install grease fitting. Remove grease fitting cap.
14. Gradually increase the pressure to 200-300 psi to remove trapped air. Check for leaks.

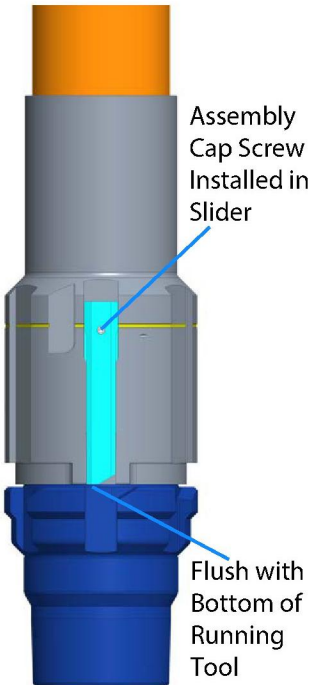


Figure 13
Running Tool

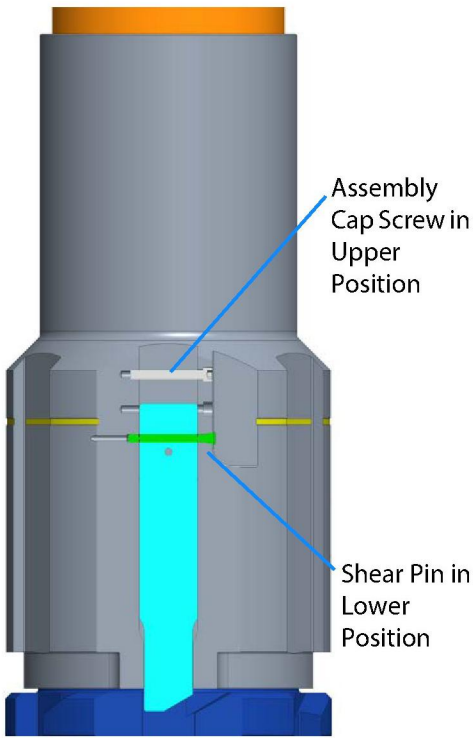


Figure 14
Running Tool Installed



15. If no leaks identified, pressure slowly in 500 psi increments. The maximum test pressure is 2,000 psi
16. At a minimum, hold pressure for 15 minutes of stable pressure readings, unless directed differently by the end-user.
17. If the pressure test is passed, proceed to the next steps. If the pressure test failed, disassemble and redress the seals.
18. Once the testing is complete bleed off the pressure in a controlled manner.
19. Drain and recover the test fluid for safe disposal.
20. Remove the grease fitting from the running tool body and re-install the internal hex pipe plug.
21. Loosen the assembly cap screws and lower the sliders down into the flutes.
22. Install the assembly cap screws back into the upper holes on the running tool body. See Figure 13.
23. Install the shear pin through the lower hole on the running tool and through the slider. Hand tighten the shear pin until the head is flush against the body. DO NOT torque the shear pin or the pin will stretch and fail.
24. Rotate the running tool clockwise so that the sliders are contacting the flutes in the casing hanger.

- Installing the Fluted Mandrel Casing Hanger
1. Ensure that the bore protector has been removed from the wellhead.
 2. Run 9-5/8" casing to target depth and suspend the last casing joint in slips at the rig floor with the collar accessible.
 3. Make up a landing joint to the casing hanger running tool.
 4. Pick up the casing hanger and running tool assembly and center it over the casing string.
 5. Thread the casing hanger onto the last joint of the casing to be run and torque the connection to the required make up torque. Torque to be applied through the hanger running/torquing tool.
Note: Do not exceed the running tool torque rating 51000 ft*lb when making the casing hanger up into the casing string. The actual torque rating may be limited by the casing threads.
 6. Calculate the distance from the rig floor to the mandrel hanger seated position in the wellhead housing.
Note the calculation on the service report.
$$\text{Landing Distance} = \text{'Wellhead to RKB'} + 10''$$
 7. If not done already mark the landing point on the landing joint. The landing joint should be marked a distance of 'Wellhead to RKB' + 10" from the tapered shoulder of the casing hanger (see Figure 15).

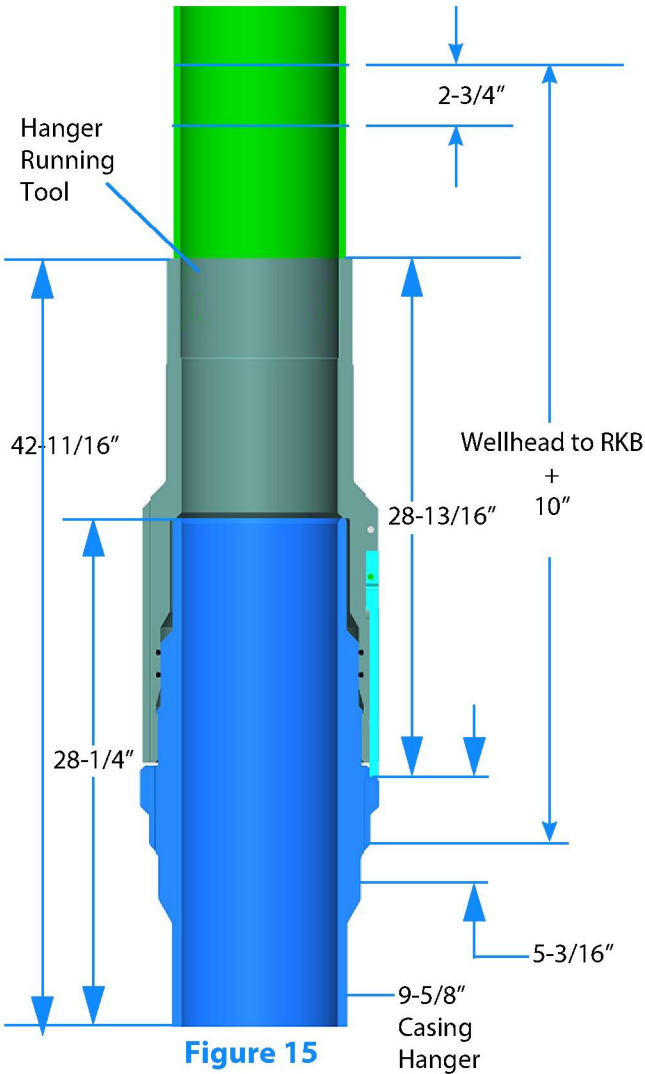


Figure 15
Assembled Hanger



8. Mark another horizontal line 2-3/4" below the landing point
9. Slowly lower the casing hanger and through the fully open BOP stack into the wellhead housing and land it. Slack off all weight on the casing.
10. When properly landed, the landing point on the landing joint will be flush with the rig floor.

Note: It is important to get the mandrel hanger landed on the load shoulder or contingency operations will be necessary. See Section 9 "Installing the Contingency Casing Slip Hanger" on page 21.

11. Cement as required. Returns may be taken through the milled flutes of the mandrel hanger.

Note: While it is possible to reciprocate the casing while cementing, it is important to ensure the mandrel casing hanger will land in the wellhead housing or contingency operations will be necessary. See Section 9 "Installing the Contingency Casing Slip Hanger" on page 21.

Important: If reciprocation is required during cementing, it is advisable to re-land the mandrel hanger immediately if resistance is felt at any time.

Important: Do not reciprocate the mandrel casing hanger inside the wellhead housing as vertical movement may damage the sealing surfaces of the wellhead housing. Raise the casing such that the upper painted landing distance line on the landing joint is at least 55" above the rig floor.

12. Using a marker, place a vertical line on the landing joint so you can count the number of turns.
13. After the casing has been cemented, apply counter-clockwise torque to the landing joint and running tool assembly to shear the shear pins.

Note: The torque required to shear the shear pin in the running tool will be between 1270 to 1950 ft-lb
14. Once the shear pins have sheared, continue to rotate the running tool counter-clockwise noting when the running tool was made up or until you feel a thread 'bump'. The running tool will require approximately 11-12 turns to disengage and the mark on the landing joint should raise around 2-3/4" from the rig floor (see Figure 16). The lower mark on the landing joint will be flush with the rig floor.
15. Lift the running tool assembly. Watch the weight indicator to make sure the tool is released from the casing hanger.
16. Set the landing joint and running tool down.
17. Thoroughly wash the OD of the landed mandrel casing hanger and running/torquing tool to prevent any cement build-up.
18. Clean and inspect the casing hanger running tool. Remove the sheared shear pins. The shear pins will require to be replaced prior to future use.
19. Coat the running tool with grease or other rust inhibitor to prevent corrosion while in storage. An appropriate thread protector may be installed, if available.



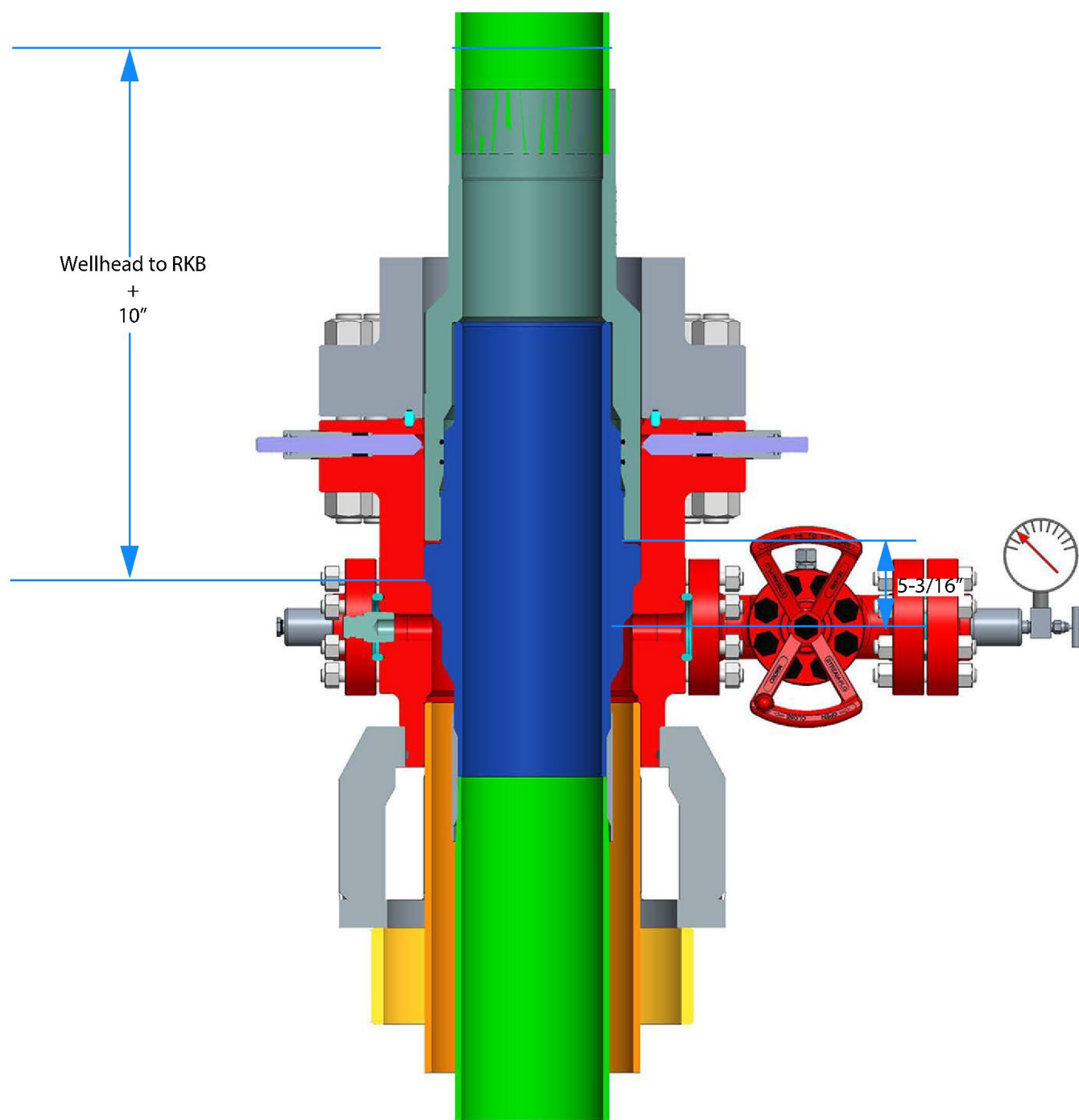


Figure 16
Fluted Mandrel Casing Hanger Installed



Section 8 Installing the Packoff

Packoff Material Number: 30208647
Packoff Running Tool Material Number:30205525
Hanger Running Tool Material Number: 30208649

1. Inspect the packoff bushing:
- Ensure material numbers on the component match the running procedure.
 - All elastomer seals are in place and in good condition. Replace as necessary.
 - Stub ACME threads are clean and undamaged. Dress with emery cloth if required.
2. Inspect the packoff running tool:
- Ensure material numbers on the component match the running procedure.
 - Remove guide ring. Inspect ACME thread to be clean and undamaged. Re-install.
 - Check top and bottom threads are clean and undamaged.

- Preparation**
1. Ensure landing joint is fully made up to the casing hanger running tool.
2. Remove the 3/8" hex head assembly cap screws from the running tool body and install into sliders.
3. Remove the threaded shear pin with a flat head screw driver and set it aside for future use.
4. Lift the sliders so the bottom of the slider sits above or flush with the bottom of the running tool body. Tighten the 3/8" hex head assembly cap screws to keep the sliders in the raised position.
5. Remove the guide ring from the packoff bushing running/ retrieving tool.
6. Using a clean brush, apply a light coat of Jet-Lube KoprKote (or equivalent) to the ACME threads on the casing hanger torque/running tool and the packoff bushing running tool. **DO NOT USE PIPE DOPE.**
7. Align the casing hanger running/torquing tool to the packoff bushing running/retrieving tool and make up the connection. To ensure proper thread alignment, turn the tool counterclockwise until a thread 'bump' is felt.
8. Rotate the casing hanger running/torquing tool clockwise until the tool bottoms out on the packoff bushing tool shoulder. The running tool requires 5 turns after the thread bump to be fully made up.

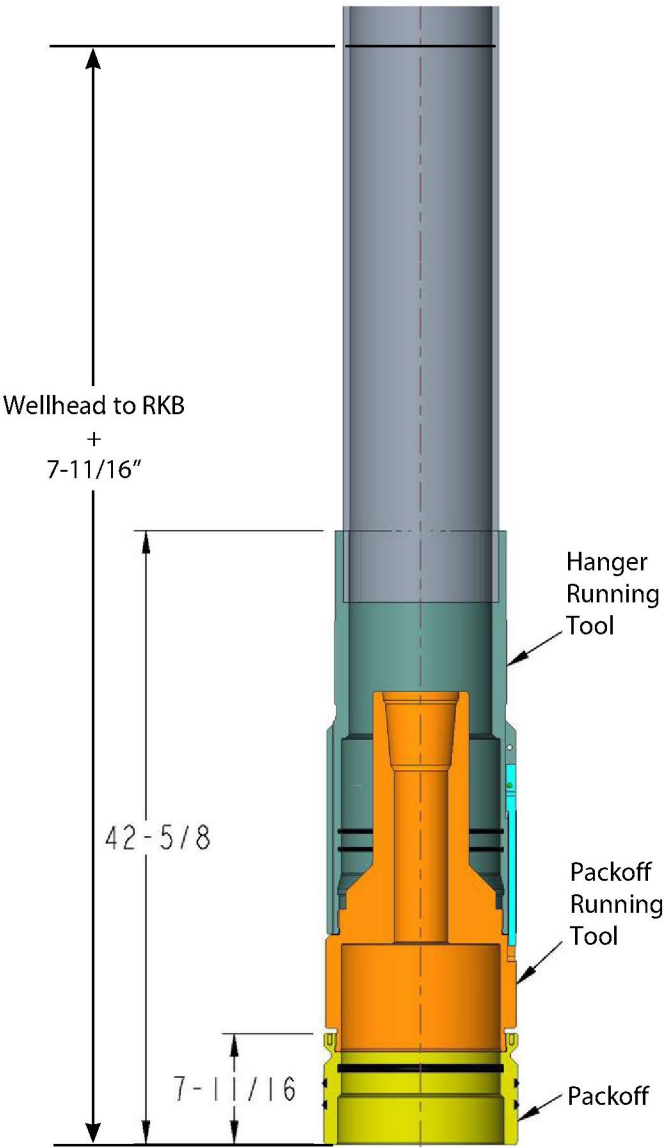
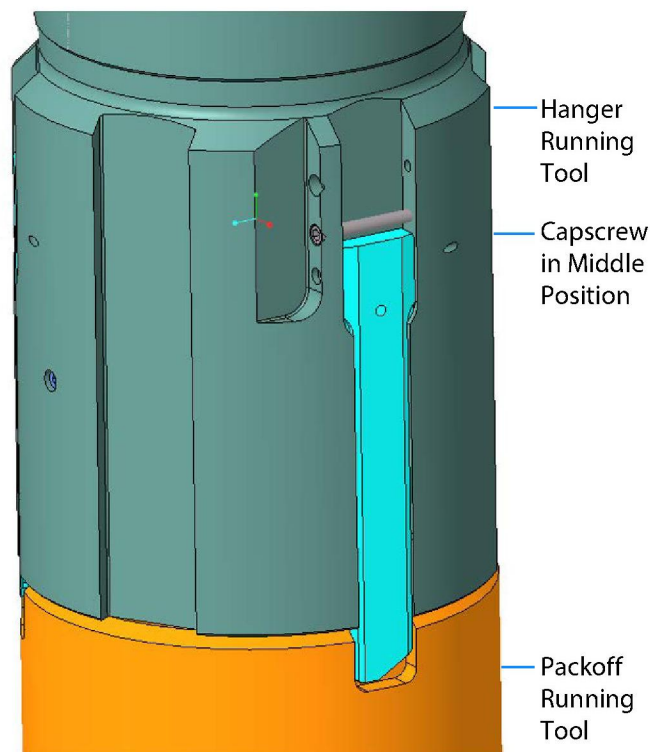


Figure 17
Packoff Assembled



9. Make note of the position of the sliders relative to the two slider preps on the packoff bushing tool. Rotate the hanger running/torquing tool counterclockwise so that the sliders line up with the two milled slots.
10. Loosen the 3/8" hex head assembly cap screws from Step 4 and lower the sliders down into the milled prep.
11. Install the assembly cap screws into the middle holes on the running tool body to hold the sliders firmly in the lower position.
12. Using a clean brush, apply a light coat of Jet-Lube Kopr-Kote (or equivalent) to the ACME threads on the packoff hanger running tool and the packoff bushing. **DO NOT USE PIPE DOPE.**
13. Align the tool assembly with the packoff bushing and start to make up the STUB ACME connection. To ensure proper thread alignment, turn the running tool counterclockwise until a thread 'bump' is felt.
14. Mark a vertical line on the running tool and count the number of turns.
15. The running tool requires 3 to 3-1/2 turns after the thread bump to be made up. There will be a 3/8" gap between the packoff bushing and the packoff bushing running tool.
16. Mark a line on the landing joint a distance of 'Well-head to RKB' + 7-11/16" from the bottom of the packoff. This line will be used to ensure the packoff is properly landed.

**Figure 18**

Running Tool Assembled

Installation

1. Verify the lower side outlets valves of casing head are fully open and that all fluid is drained from the BOP.

Important: The valves are to remain open while landing the packoff bushing. Fluid in the wellhead housing may prevent the packoff bushing from landing properly.

Note: If unable to drain the BOP, and "compression" or "circulation" lines are connected to the lower side outlets valves of casing head, physically verify that all plug valves and gate valves in the lines running from the lower side outlets valves of casing head and connecting into the BOP are fully open to allow fluid to be displaced while landing. Failure to do so may result in damage to the equipment.

2. Rinse the BOP with clean fluid.
3. Apply grease to the OD and ID packoff bushing elastomers.
4. Center the landing joint over the BOP
5. Lower the packoff bushing to the top of the bell nipple.
6. Pour 1-2 gallons of hydraulic oil on the packoff bushing, coating the entire OD of the packoff bushing and ID of the BOP.
7. Slowly lower and measure the packoff bushing through the BOP until it lands on the flutes of the casing hanger mandrel.



Important: Take extreme caution when lowering the packoff bushing into the well. The landing joint must be centralized when entering the casing hanger.

- Note:** It may take up to 20,000 lbs of weight to land the packoff bushing properly.
- 8. Verify the pack-off bushing is properly landed by comparing the measured landing distance with the calculated distance. When properly landed, the lower mark on the landing joint will be flush with the rig floor.
 - 9. Engage the lockdown screws on the casing head in an alternating start pattern.
 - 10. Verify the lockdown screw and lockdown bushing stand off values and torque measurements match the values listed in Table 1. Bushing engaged standoff is 1.94", lockscrew engaged standoff is 3.25", lockscrew torque is 300-475 ft-lbf, and bushing torque is 250-500 ft-lbf.
 - 11. Rotate the running tool 4 turns counterclockwise to fully disengage the running tool from the packoff bushing.
 - 12. Slowly lift the running tool out of the BOP. Watch the weight indicator to make sure the running tool is released from the packoff bushing.
 - 13. Disassemble the running tool assembly. Clean, inspect, and store the running tool. Coat the running tool with grease or other rust inhibitor to prevent corrosion while in storage.
 - 14. Close BOP blind rams and pressure test the packoff seals against the cement. Test pressure to be confirmed by field representative but is recommended to be approximately 500psi less than final lift pressure. Up to a maximum of 5000psi.

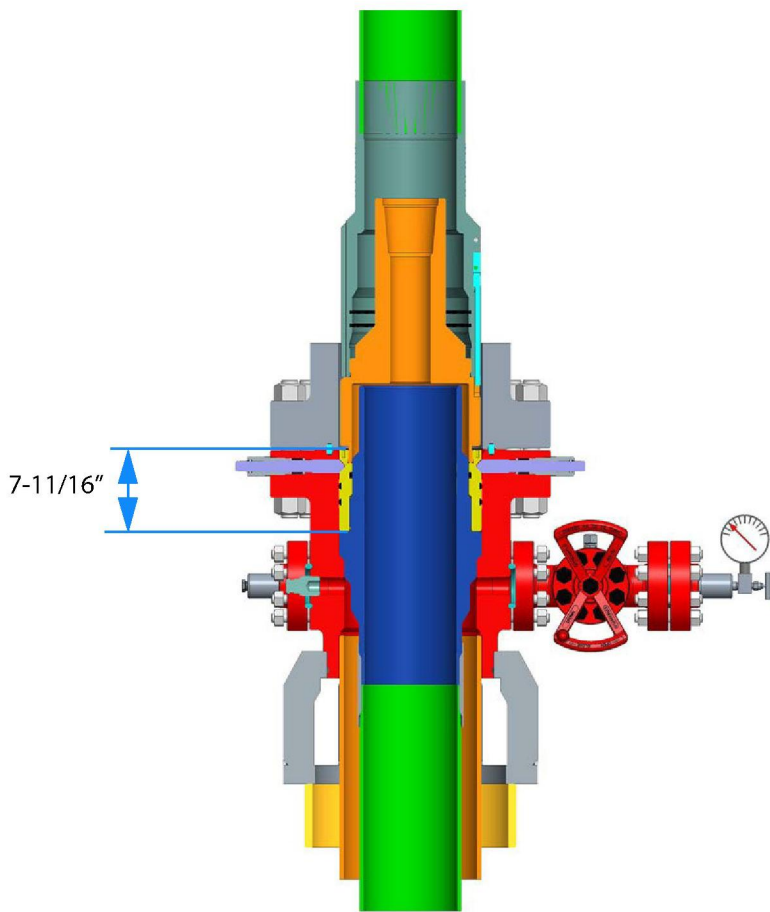


Figure 19
Packoff Installed



Section 9 Installing the Contingency Casing Slip Hanger

Contingency Casing Slip Hanger Material Number: 30008940

Once the casing string is landed and cemented a C-21N casing slip hanger is used. A primary packoff will then be installed to provide the annulus seal.

1. Run and cement the 9-5/8" casing as required.
2. After the cement has set, drain the drilling fluids from the wellhead using the side outlets.
3. Raise the BOP stack to allow for installation of the casing slip hanger.

Warning! Warning Heavy Lifting/Working Under a Suspended Load

4. Wash out the casing head bore as required.
5. Inspect the 9-5/8" casing dimensions and ensure that the outside diameter is within API tolerances. Check roundness and surface condition.
6. Place two boards on top of the casing head, against the casing.
7. Remove the hinge screw and open the casing slip hanger housing.
8. Place the casing slip hanger assembly around the casing, using the boards for support, and reinsert the hinge screw.
9. Grease the OD of the casing slip hanger.
10. Pull tension on the 9-5/8" intermediate casing as specified in the casing plan.
11. Center the 9-5/8" casing as much as possible.
12. Remove the four cap screws used to retain the slip segments.
13. Remove the boards evenly to allow the casing slip hanger to be lowered into the casing head.
14. Ensure the hanger travels to the landing shoulder. Check the hanger is seated by hammering down on the slip housing.
15. Engage the slip segments by tapping on the top of the segments with a soft bar.
16. Horizontally mark the casing at the top of the casing head. This is to give a visual indication of when the slip segments are engaged.
17. Record the casing slip setting weight on the service report.
18. Release the tension to load the casing weight slowly onto the casing slips.
19. Rough cut the casing 12" above the casing head top face.
20. Move the excess casing and BOP out of the way.
21. Place a protective plate over the casing stub to protect the ring groove and sealing surfaces.

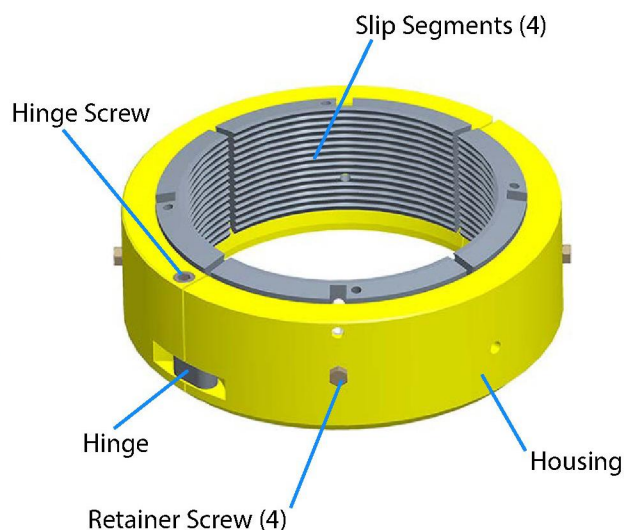


Figure 20

Type C-21N Casing Slip Hanger



22. Final cut the casing 6" above the casing head top face.
23. Bevel the casing OD and ID per Figure 21.
24. Inspect the casing stub; make sure it is clean and chamfered.
25. Remove the protective plate from the casing head.
26. Re-install the BOP stack.

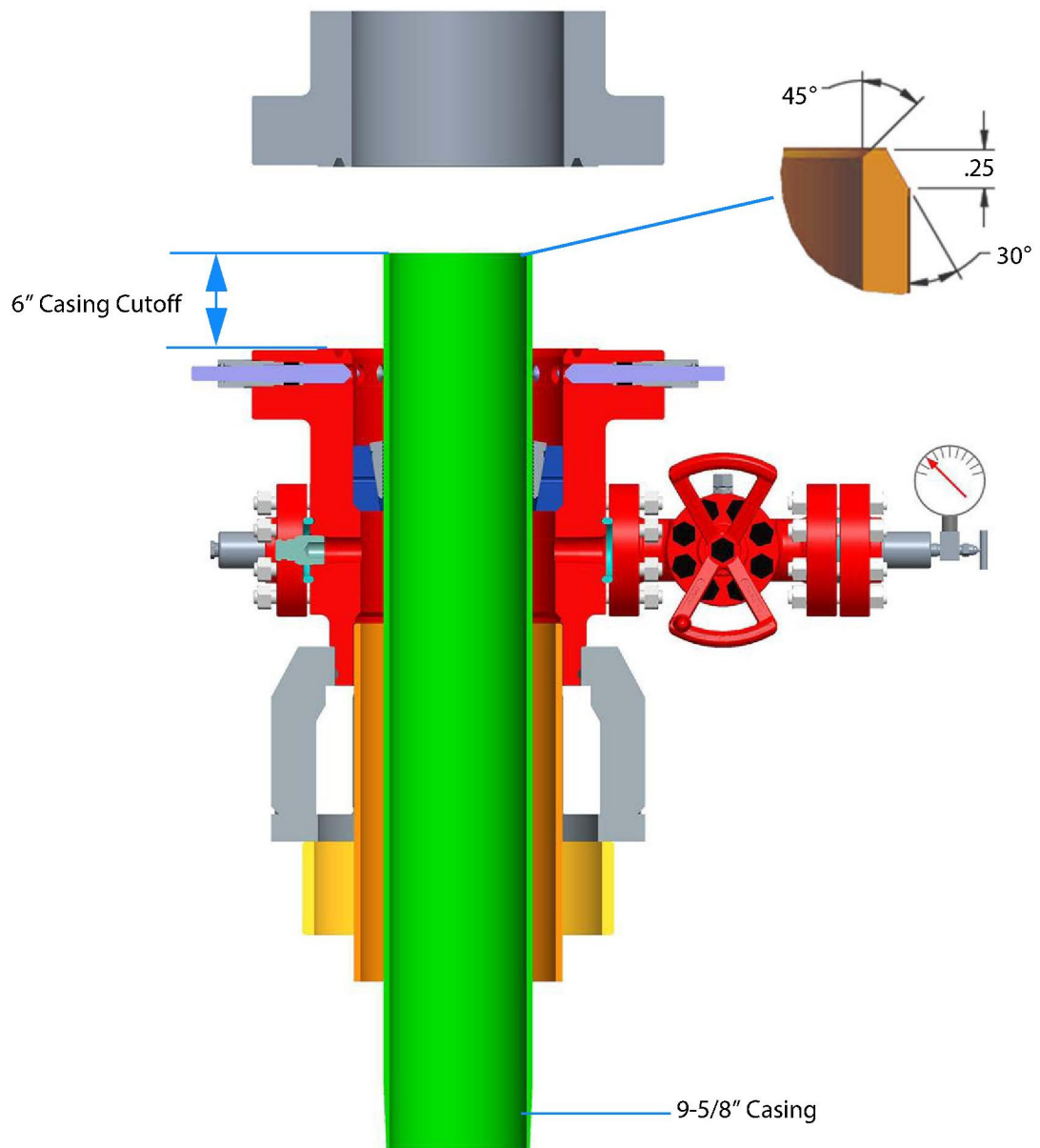


Figure 21
Casing Slip Hanger Installed



Section 10 Installing the Contingency Packoff

Contingency Packoff Material Number: 30008698

The CC-21-L primary packoff is a pressure isolation seal with o-ring type body seals for up to 5000 psi pressure ratings. It is designed to fit into the CC-29-L casing head above the CC-21 casing hanger. The casing head has lockscrews.

This packoff provides an annulus seal, and isolates the slips from the top flange test pressure.

A bleeder port is provided in the CC-21-L primary packoff when it is to be installed into a casing head that has a primary seal, or casing hanger with an integral seal installed below it. It may also be used when retrieving the packoff.

The CC-21-L primary packoff is designed with specific stand-off, allowing it to be retained by an upper spool. For this functionality, the packoff is used with the appropriate type BX ring gasket in the top flange of the casing head.

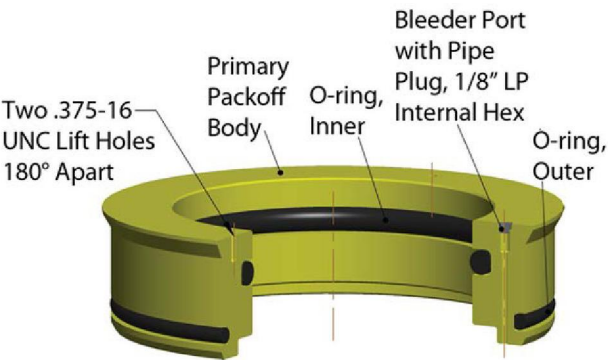


Figure 22
Contingency Packoff

Installation

1. The CC-21-L primary packoff should be installed after the casing hanger is set and the casing stub is cut (see Figure 23).
2. Inspect the casing stub, make sure it is clean and chamfered. Visually inspect the inner and outer o-rings of the primary packoff; replace if damaged.
3. Check space in the head and thickness of the primary. The top of the casing hanger housing should be at least 3.88" below the top face of the casing head.
4. Verify that the casing head annulus valve(s) are open and that all fluids are drained from the wellhead.
Note: The valve must remain open while landing the packoff bushing.
Note: If wellbore fluids are flowing when installing the primary packoff both outlets must remain open to prevent pressure from building up below the casing hanger and primary packoff.
5. Confirm the flange ring gasket type is compatible with the packoff.
6. Apply grease to the outside of the casing stub. Apply grease to the OD and ID of the primary packoff.
7. Slide the primary packoff over the casing and push into place.
8. If air cushion does not allow the packoff to go down, remove the 1/8" line pipe bleeder plug. Slide the primary packoff over the casing and push into place. Replace the bleeder plug after the packoff is installed.
9. Do not engage the lockscrews on the upper flange of the casing head.



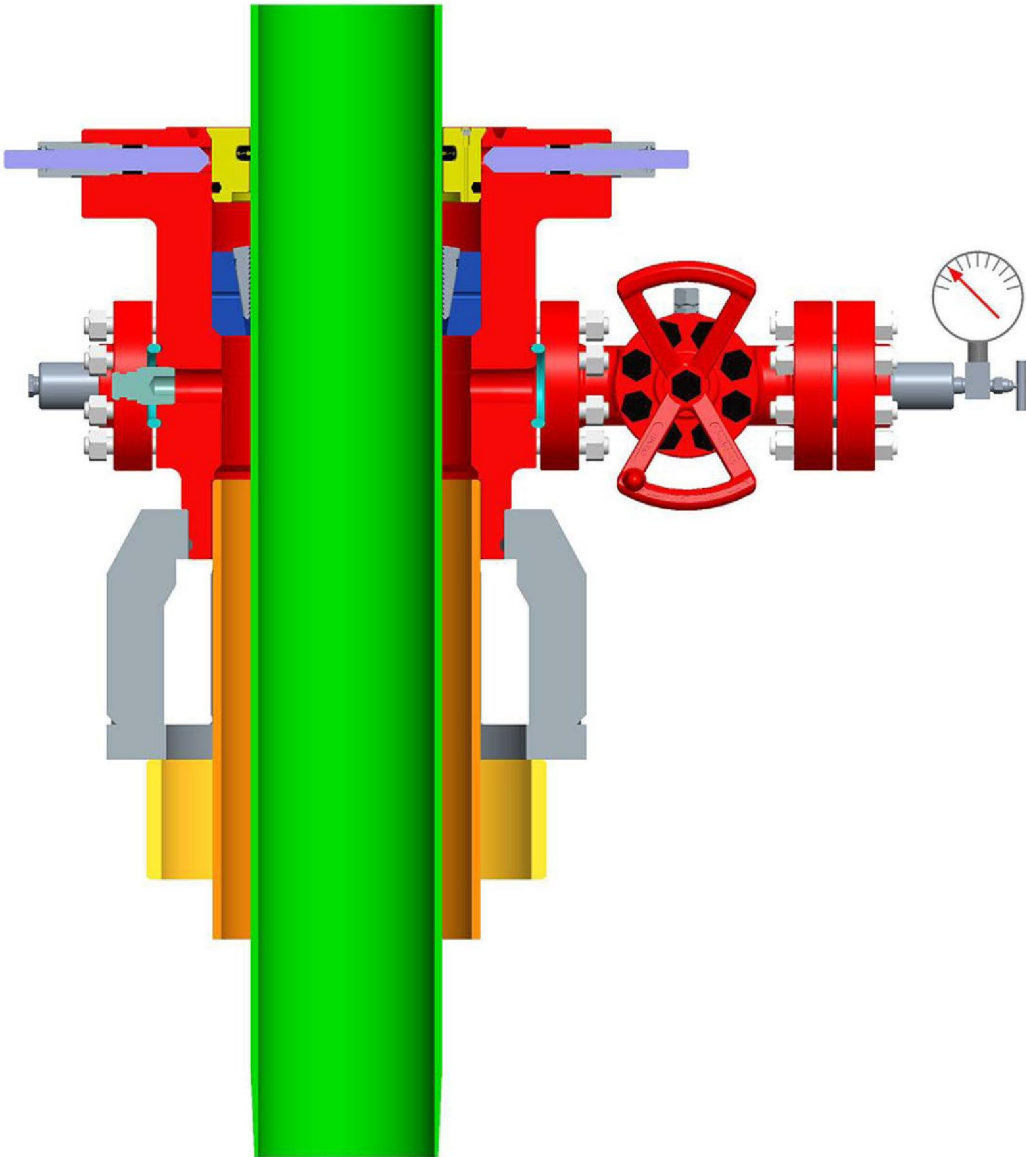


Figure 23
Packoff Installed



Section 11 Installing CMB Intermediate Head with DR1 Metal Seal

- Intermediate Head Material Number: 30208651
- The intermediate head with DR1 metal seal and FS seal is designed to seal onto the mandrel hanger extended neck and comes with two 3-1/8" 3000 studded side outlets with 2-7/8" VR thread.
1. Inspect the intermediate head and verify:
 - Inspect all component stamping to ensure compatibility.
 - All ring grooves are clean and free of damage.
 - All fittings are in place and functioning.
 - FS-Seals are in place and are in good condition.
 - Tapered metal seal area is clean and undamaged.

2. Verify the 9-5/8" hanger extended neck is in good condition. If necessary, dress the outside diameter with emery cloth to remove any scratches and smooth out any imperfections.

3. Grease the outside diameter of the 9-5/8" hanger extended neck and intermediate head FS secondary seals.

4. Clean and dress the ring gasket groove of the casing head flange and install a new ring gasket.

5. Place the 9-5/8" bottom ring over the hanger extended neck so sits flat on top of casing head.

6. Place the 9-5/8" metal seal ring over the extended neck so that it rests on the bottom ring with the tapered smaller end up.

Note: If running the contingency hanger and packoff, begin by attempting to use the smallest size of ring first (#1) and then progress to the next largest until the seal ring fits.

Important: Do not force the seal ring down. if it will not fit, attempt to use the next largest size until it slides over the casing without assistance.

7. Pick up the intermediate head. Orient as required, then carefully lower it over the hanger extended neck.

8. Install the flange nuts and make-up the flange connection. See the following SFI Engineering Bulletins for proper flange make-up instructions:
 - EB 13-010: API 6A Flange Overview and Assembly.
 - EB 13-014: Recommended Flange Bolt Torque for API 6A Flanges.

9. Locate the grease fitting on the intermediate head stamped 'FLG TEST PORT 1/2 LP' and remove cap.

Warning! Check for pressure before opening. Failure to check for pressure could result in injury.

10. Attach a hydraulic pump to the fitting stamped FLG TEST PORT 1/2 LP' and pump up with test fluid several times to remove air.

Warning! Over-pressuring the casing during the seal test could result in a restriction below the minimum through-bore or casing collapse.

Figure 24
Metal Seal

Section 11 • Installing CMB Intermediate Head with DR1 Metal Seal • Page 25

GDP154

Contains Business Sensitive, Trade
Secrets, Proprietary or Otherwise
Confidential Information Exempt from
Public Disclosure

11. Apply test pressure and hold for a minimum 15 minutes of stable pressure readings, unless directed differently by the end-user. The maximum test pressure is 5,000 psi limited by flange connection pressure rating. This test validates the flange ring gasket, packoff seals, 9-5/8" metal seal and LDS packing.
12. Release pressure in a controlled manner and collect as much test fluid as possible.

Important: Verify all pressure is relieved.

13. Reinstall cap on the fitting.
14. Locate the grease fitting on the intermediate head stamped 'DR1 TEST PORT 1/2 LP' and remove cap.

Warning! Check for pressure before opening. Failure to check for pressure could result in injury.

15. Attach a hydraulic pump to the fitting stamped 'DR1 TEST PORT 1/2 LP' and pump up with test fluid several times to remove air.

Warning! Over-pressuring the casing during the seal test could result in a restriction below the minimum through-bore or casing collapse.

16. Apply test pressure and hold for a minimum 15 minutes of stable pressure readings, unless directed differently by the end-user. The maximum test pressure is 5,000 psi limited by the mandrel hanger extended neck collapse resistance. This test validates the 9-5/8" metal seal and 9-5/8" FS seal.
17. Release pressure in a controlled manner and collect as much test fluid as possible.

Important: Verify all pressure is relieved.

18. Reinstall cap on the fitting.
19. Install 11" 10000 psi blind flange (night cap) if not already done. Rig can be skidded to the next well.



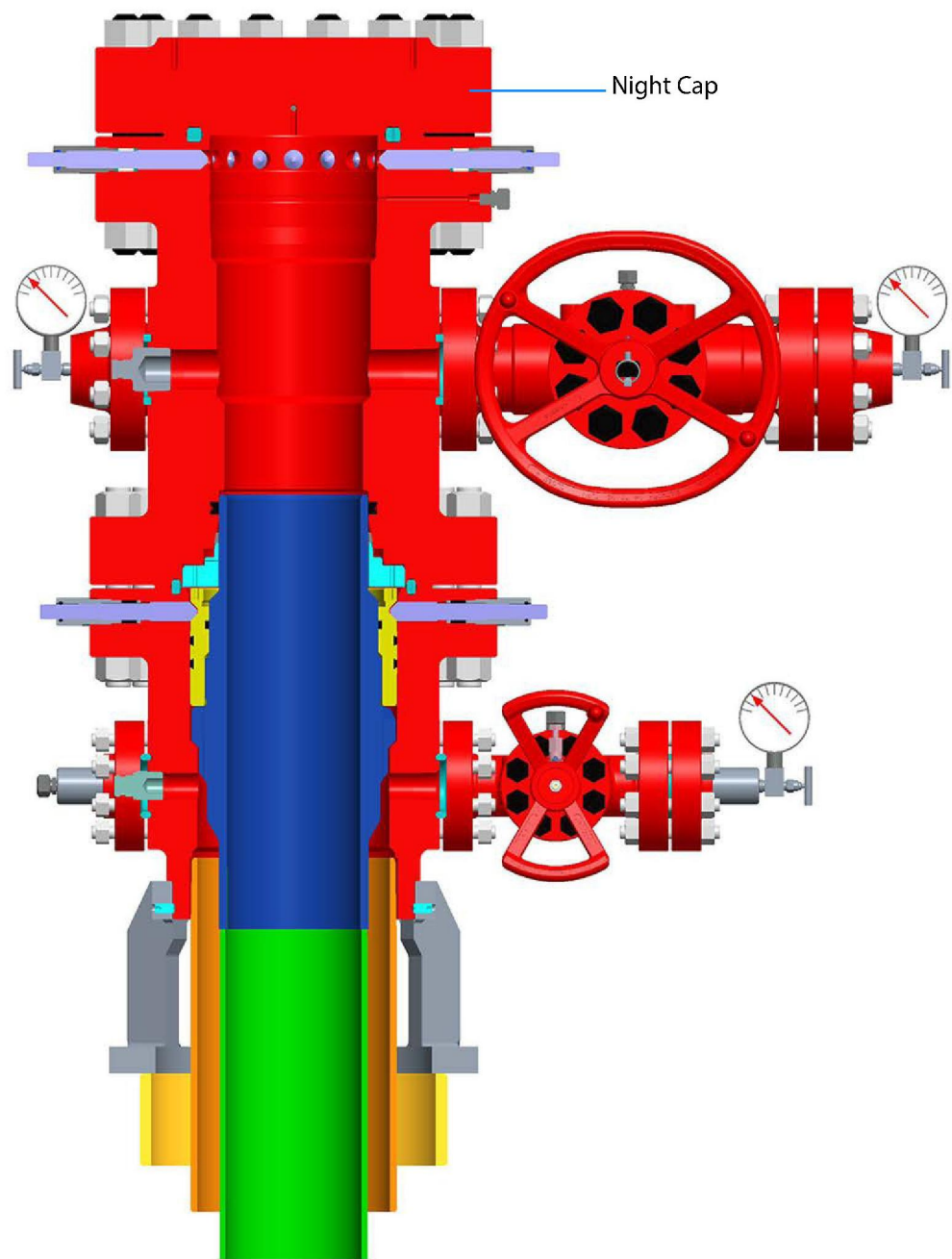


Figure 25
Landing the Intermediate Head with the DR1 Metal Seal Installed



Section 12 Testing the 11" 10000 BOP Stack

Combination Running Tool Material Number: 30208667

The combination running tool (CRT) is used to test the BOP stack to 10,000 psi. This tool serves as both the BOP test plug and the running/retrieving tool for the bore protector.

1. Open the intermediate head side outlets valves to drain any fluid out of the BOP stack and head.
2. Leave the casing side outlets valves in the open position to allow for seal leak monitoring.

Warning! The side outlet valve must be open for seal leak monitoring to avoid over pressuring the casing and intermediate head side outlets

3. Verify the stamping of the CRT is correct. Inspect the test plug seal and check that central plug is installed. Check the weeping holes: if the lower BOP rams are to be tested through the drill pipe, remove the plugs; otherwise they must be fully made-up.
4. Check that all lockscrew in the intermediate head are fully backed off. Refer to SFI engineering bulletin EB 18-005.
5. Calculate the distance from the rig floor to the CRT seated position in the wellhead. Note the calculation on the service report.
Distance = Wellhead to RKB + 8"
6. Make up the CRT to a joint of drill pipe.
7. Mark the landing point on the drill pipe. The drill pipe should be marked a distance of Wellhead to RKB + 8" from the tapered shoulder of the CRT.

Note: The four lugs must be above the seal (i.e., the tonging neck end should be facing down).

8. Apply clean grease to the elastomer seal on the CRT.
9. Slowly lower and measure the CRT through the fully opened BOP into the wellhead and land it.
10. Confirm the landing distance traveled: when the CRT is properly landed, the mark on the drill pipe made in Step 6 will be flush with the rig floor.
11. Test to 10000 psi pressure as per rig operator's procedure. Do not exceed the pressure rating of the well-head flange connections. See SFI Engineering Bulletin EB 33-005: Field Pressure Testing.

Note: Any leakage past the CRT seal may be observed at the open intermediate head side outlet valves.

12. After the test has been completed, release pressure. Remove as much fluid from the BOP stack as possible.

Important: Verify all pressure is relieved.

13. Retrieve the CRT slowly to avoid damaging components or rolling out the seal.
14. After the CRT has been removed, perform casing pressure test per operator drilling program (less than 10000 psi).

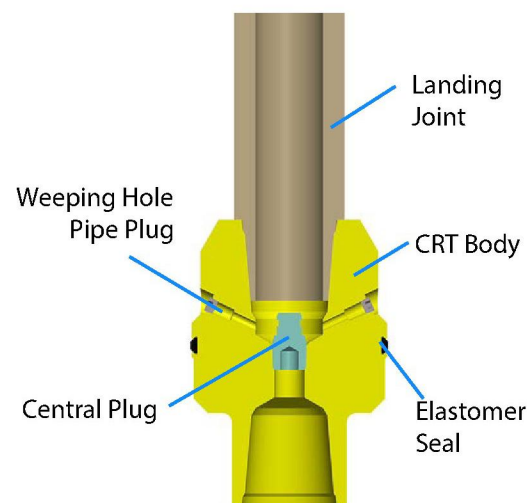


Figure 26

Combination Running Tool



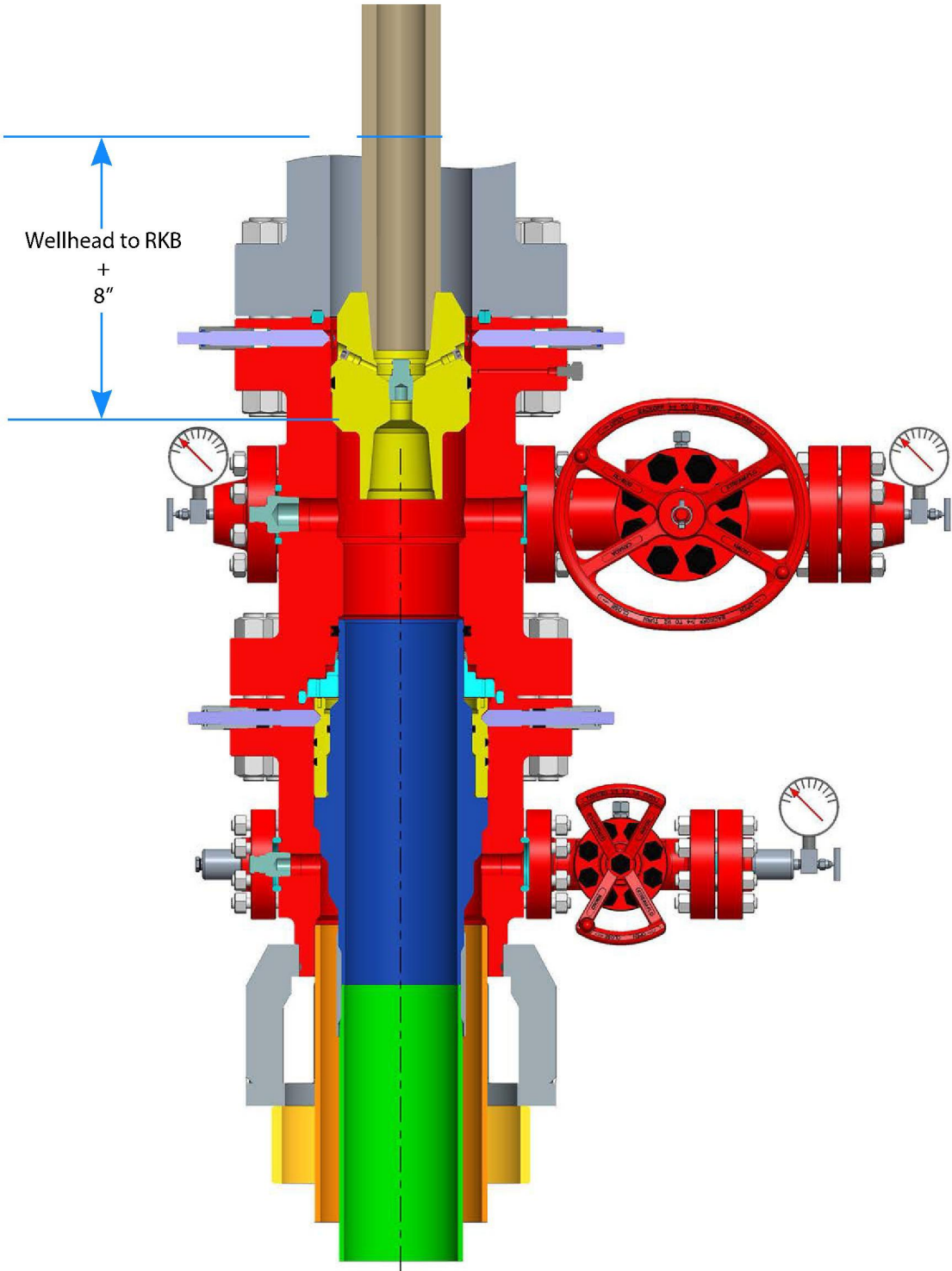


Figure 27
Intermediate Head BOP Test



Section 13 Installing Wellhead Bore Protector

Bore Protector Material Number: 30208690

When drilling through the wellhead, a bore protector must be used to protect critical sealing surfaces and landing shoulders from wear and damage by the drill bit, drill pipe, and the installation of downhole tools.

1. Inspect the bore protector and running tool and verify the type and size. Verify:
 - The lugs are installed in the CRT.
 - Measure the inside diameter of the bore protector to ensure it will drift all equipment that will run through it.
 - Central plug and elastomer seal ring should be removed if possible.
2. Attach the CRT to a joint of drill pipe.

Important: The elastomer seal groove must be above the four lugs.

3. Align the CRT lugs with bore protector J-slots, and then carefully lower the into the protector until it stops.

Warning! Pinch Point - watch hand placement as the running tool is being lowered.

4. Rotate the CRT clockwise 80 degrees until it stops to completely engage the J-slots with the lugs.
5. Calculate the distance from the rig floor to the bore protector seat position in the wellhead. Note the calculation on the service report.
 $\text{Distance} = \text{Wellhead to RKB} + 8"$
6. Mark the landing point on the drill pipe. The drill pipe should be marked a distance of Wellhead to RKB + 8" from the tapered shoulder of the bore protector.
7. Slowly lower and measure the tool and bore protector assembly through the BOP stack and into the wellhead until lands on the landing shoulder.
8. Confirm the measured distance matches the calculated distance to validate the proper seating of the bore protector. When properly landed, the mark on the drill pipe will be flush with the rig floor.
9. Gently engage two opposite lockscrews on the 11" 10000 intermediate head according to SFI Engineering Bulletin EB 18-005: Operational Procedure for 'Type P' Lockscrews. Do not deform bore protector.
Note: Over-tightening the lockscrews will deform the bore protector.
10. Remove the tool from the bore protector by rotating the drill pipe counterclockwise 90 degrees and then lifting straight up.
11. Remove the tool from the drill pipe. Clean, inspect, and store the tool.
12. Drill for the next casing string.

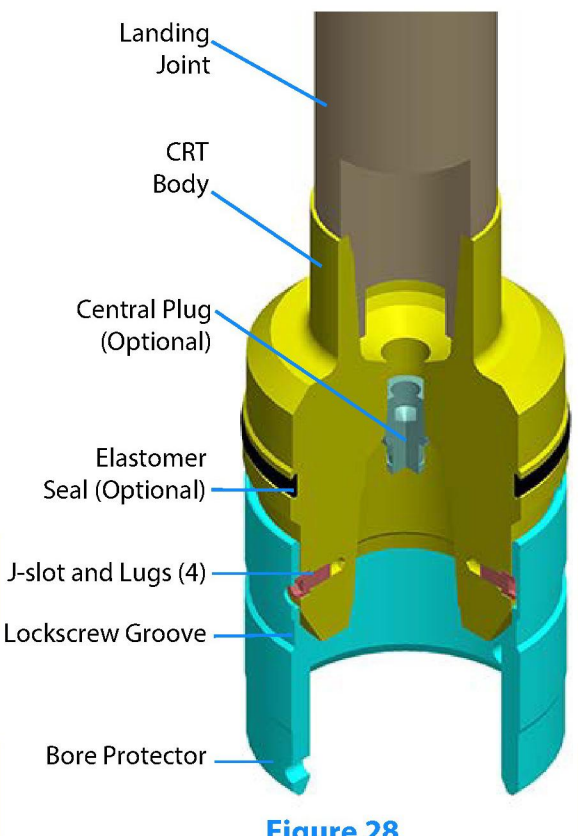


Figure 28

Bore Protector with CRT



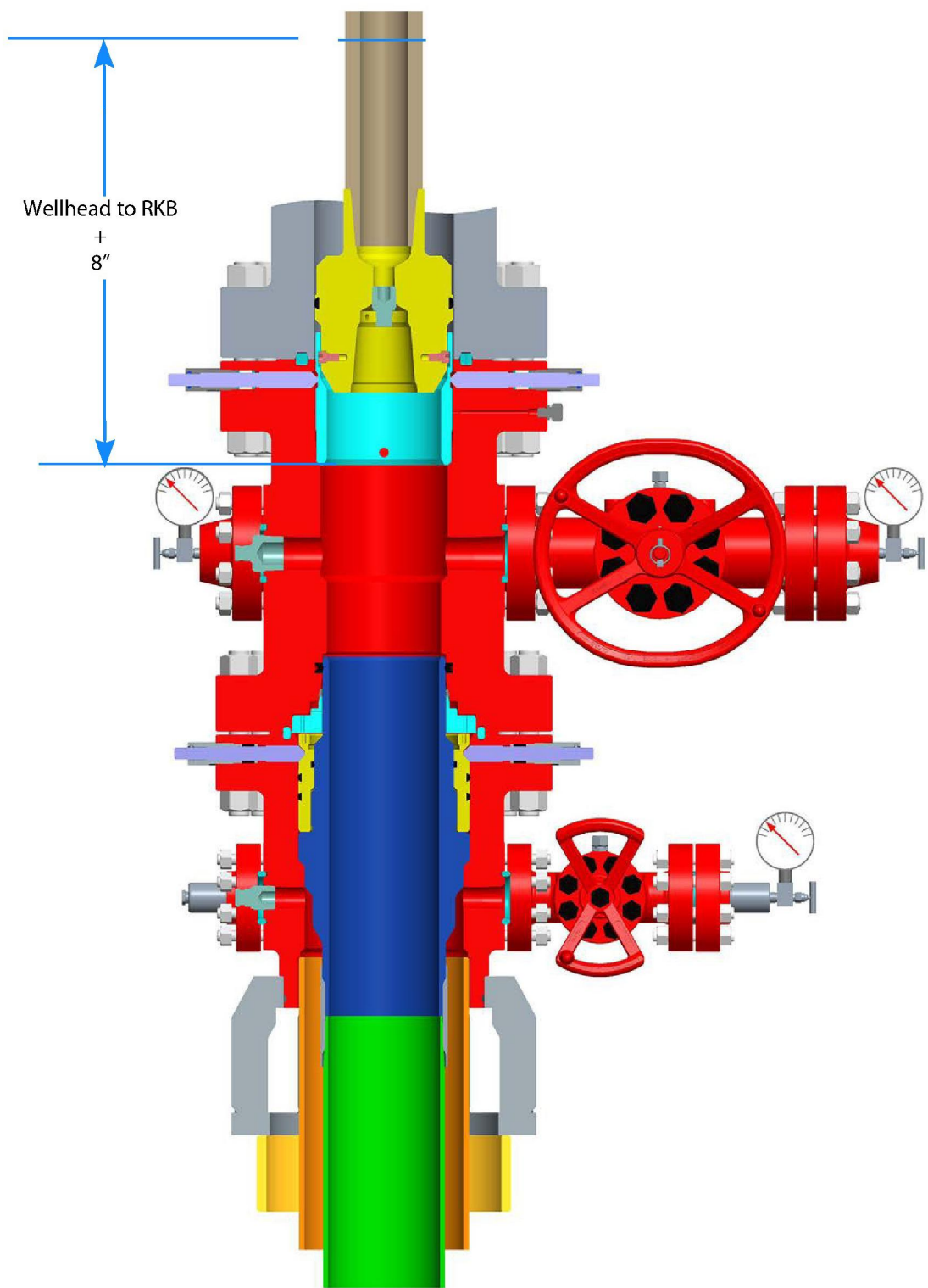


Figure 29
Intermediate Head Bore Protector



Section 14 Retrieving Wellhead Bore Protector

After drilling has been completed and before the casing is run, the bore protector must be retrieved.

1. Inspect the running tool lugs. Central plug and elastomer seal ring should be removed if possible.
2. Attach the CRT to a joint of drill pipe.
Note: The elastomer seal groove must be above the four lugs.
3. Calculate the distance from the rig floor to the CRT bottom face. Note the calculation on the service report.

- Distance = Wellhead Head to RKB - 2-1/2"
4. Mark the landing point on the drill pipe.
The drill pipe should be marked a distance of Wellhead Head to RKB - 2-1/2" from the bottom face of the CRT.

5. Slowly lower and measure the tool through the BOP stack and into the bore protector. The mark on the drill pipe will be flush with the rig floor when the running tool is in the J-slot groove. If necessary, rotate the drill pipe clockwise until the lugs drop into the J-slots. When the lugs have reached the bottom of the J-slot in the bore protector, rotate the drill pipe clockwise 80 degrees.
Note: Never release string weight onto the bore protector.

6. Fully back off the lockscrews in the 11" 10000 intermediate head top flange.
7. Pull up and remove the tool and bore protector.
8. Remove the bore protector from the CRT.
9. Remove the CRT from the drill pipe.
10. Inspect the bore protector and replace if required, or store for use later.

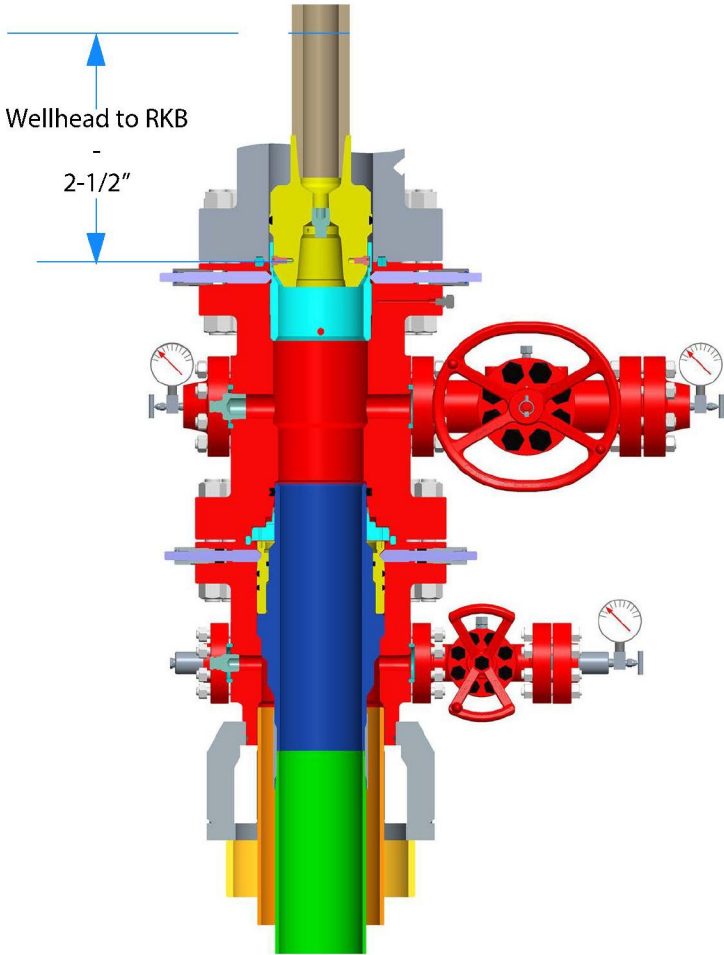


Figure 30
Intermediate Head Bore Protector Retrieval



Section 15 Installing the 11" x 5-1/2" CMBEN Casing Hanger

Casing Hanger Material Number: 30208684

The CMBEN casing hanger contains suspension, lifting, and type H BPV threads on the inside bore. It is designed for critical service including Natural Gas, CO₂, and Hydrogen to 10000 psi rated working pressure. The assembly comes with a combination of Elastomer and metal-to-metal annular seals.

Casing weight, along with the lockdown screws on the tubing head, push down on the casing hanger body which creates an interference metal-to-metal seal on the tapered seal area. The hydraulic packing prevents galling of the sealing surface during installation.

The redundant elastomer seals are a robust design which are manufactured with molded anti-extrusion rings and made from RGD (rapid gas decompression) resistant materials. The combination of metal-to-metal and elastomer seals make this hanger reliable for gas production or storage.

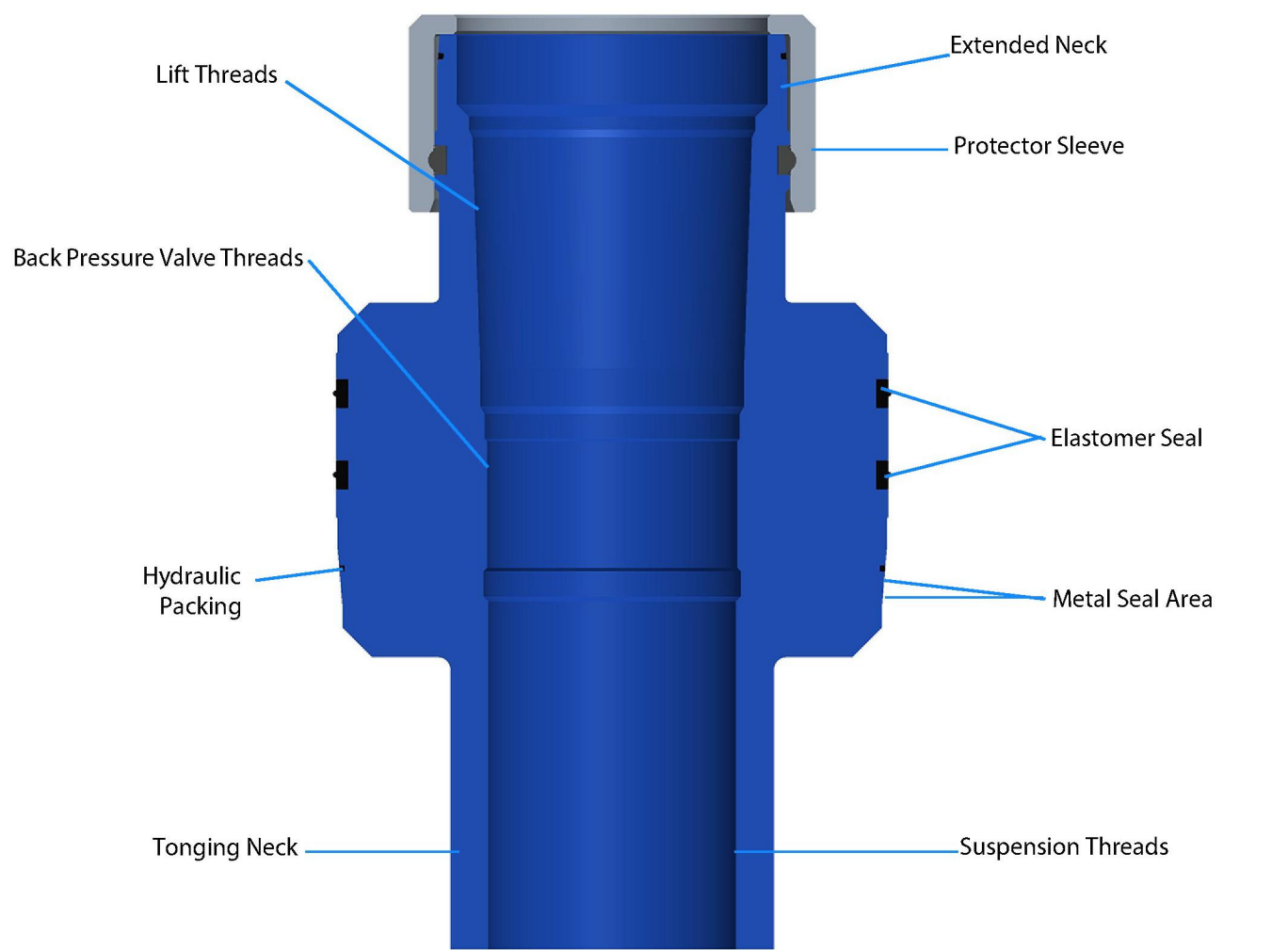


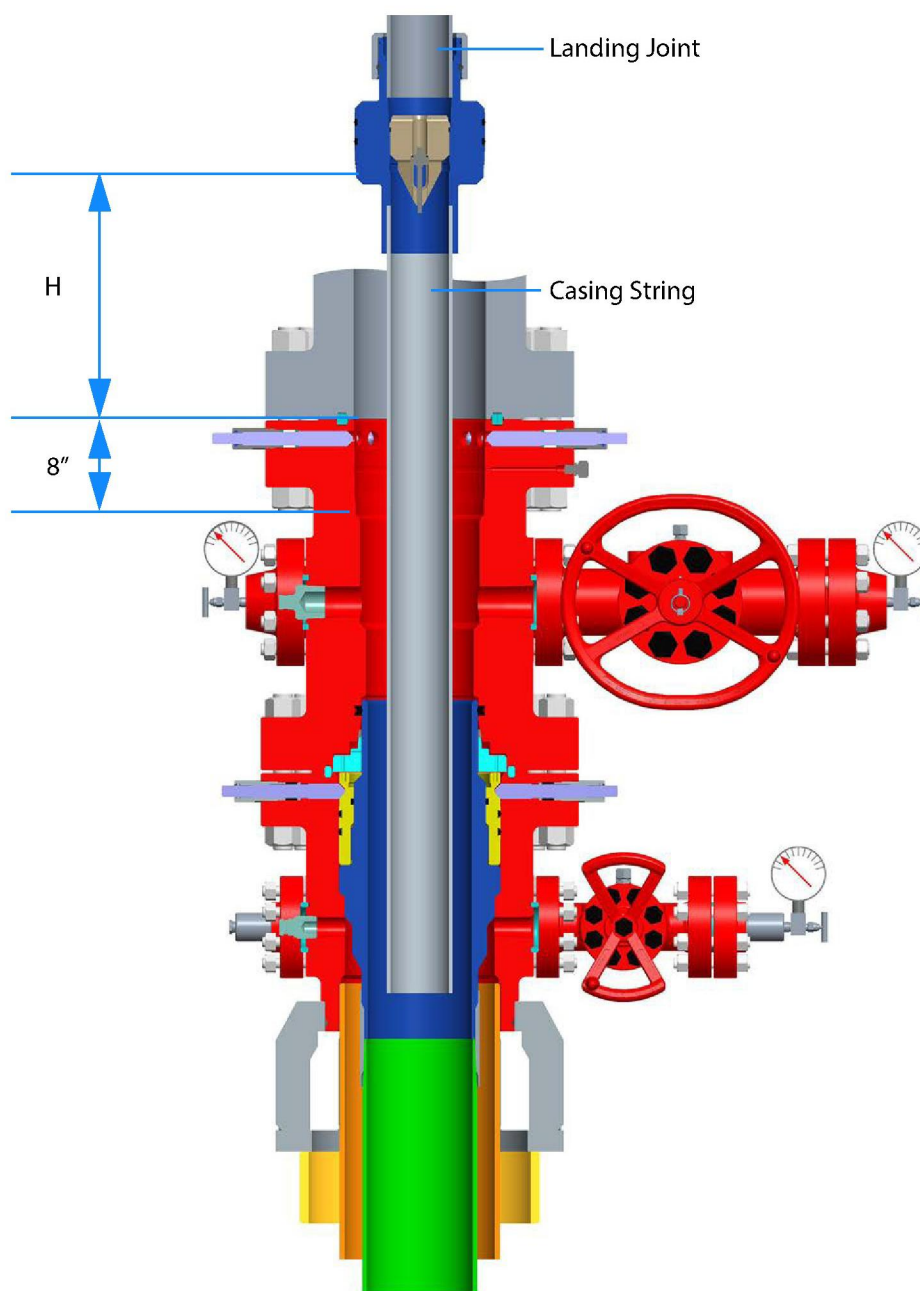
Figure 31
CMBEN Hanger Assembly



Note: It is the end users' responsibility to ensure proper well control is in place during ALL operations.

1. Inspection:
 - Inspect the casing hanger sealing surfaces, including the tapered metal-to-metal seal area (minor nicks or scratches can be polished).
 - Inspect the elastomer seals to ensure they are in good condition and fully seated in the grooves.
 - Inspect the internal threads for any burrs or noticeable damage. Remove burrs if necessary.
2. Ensure that the lockscrews in the intermediate head operate freely and are fully retracted from the bore.
3. Verify the internal diameter through stamping on the tubing head.
4. Ensure the protector sleeve is installed on the hanger extended neck.
5. Run the casing string, establishing the desired space-out.
6. Make up the casing hanger to the last joint of casing. Apply tongs to the hanger only in the tonging area as shown in Figure 31. Clean and lubricate the threads per the manufacturer's specifications. Torque to the manufacturer's specifications.
7. Make up the landing joint to the casing hanger. Keep the tongs away from the sealing surfaces. Apply the tongs to the hanger only in the tonging neck area as shown in Figure 31. Take care not to damage the tapered metal-to-metal sealing surface. The landing joint does not need to be torqued to full casing spec. Snug with a pipe wrench is sufficient.
8. Grease the landing shoulder, the outside diameter, the lockdown shoulder, and the seals of the hanger with a metallic anti-seize compound (such as Jet-Lube Kopr-Kote).
9. Measure the distance 'H' from the load shoulder surface of the hanger to the top face of the intermediate head as shown in Figure 32.



**Figure 32**

Installing the 'CMBEN' Hanger

10. Lower the casing hanger through the fully opened BOP stack into the intermediate head. The casing hanger should travel a distance of $H + 8.00"$ (Figure 32).
11. Tighten the intermediate head lockdown screws as described in Engineering Bulletin EB 18-005.
Optimal torque on the lockdown screw is 350 ft-lbs and 400 ft-lbs on the lockdown bushing.
12. Perform any down-hole operations through the casing string as required.
13. Install a back pressure valve (BPV) into the casing hanger body (left hand threads).
14. Locate the grease fitting port on the flange stamped "SEAL TEST PORT" and remove its cap.
15. Attach the hydraulic pump and pump several times to remove the air.



16. Test the connection to the rated working pressure of 10000 psi. Refer to SFI Engineering Bulletin EB 33-005: Field Pressure Testing, for proper field pressure testing instructions.
17. Release the pressure in a controlled manner and collect as much test fluid as possible.
18. Remove the hydraulic pump and reinstall the cap.
19. Remove the landing joint and the BOP stack.

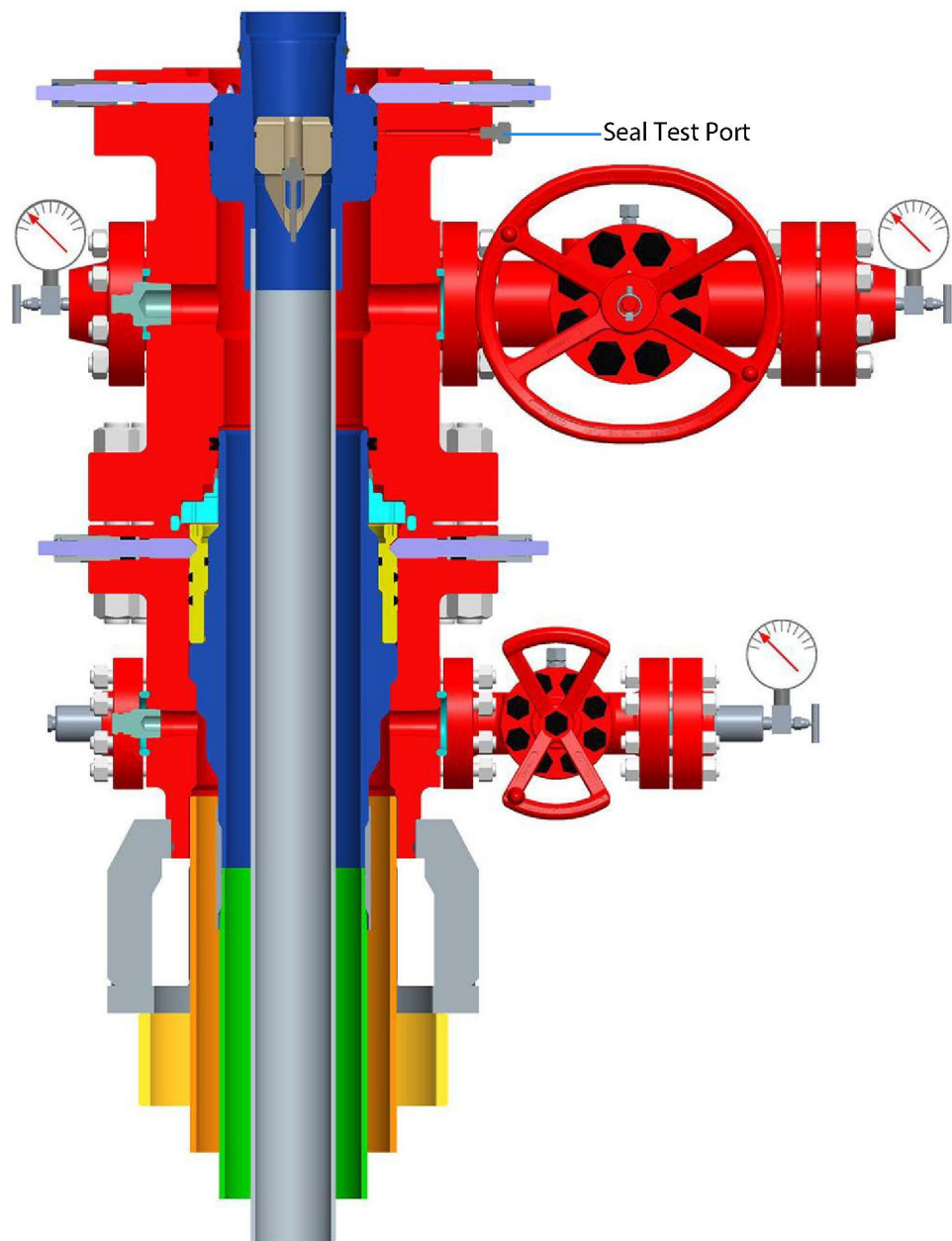


Figure 33

11" x 5-1/2" CMBEN Casing Hanger Installed



Section 16 Installing the Tubing Head Adapter with Master Valve and Blind Flange

Tubing Head Adapter Material Number: 30208668

Note: The tubing head adapter, and master valve is fully tested to 10000 psi in the shop before going out to the field.

1. Remove the nylon protector sleeve from the hanger extended neck. The protector sleeve is held in place by friction on the o-ring and can be removed by rocking back and forth or rotating slightly while applying slight upward force.
2. Clean and examine the extended neck sealing surface of the hanger to ensure there is no damage.
3. Clean the ring gasket groove on the tubing head and the tubing head adapter. If necessary, dress the surface with emery cloth to restore smoothness.
4. Install a new ring gasket.
5. Clean the extended neck pocket in the tubing head adapter down to the dry film lubricant/ dry moly spray.
6. Lubricate the isolation seal on the hanger extended neck with light oil. Do not lubricate the hydraulic packing or the CMC tapered metal seal region.
7. Fully coat the FS seals with light oil or a metallic anti-seize compound such as Kopr-Kote.
8. Slowly lower the tubing head adapter and Christmas tree (consisting of one master valve and blind flange) over the casing hanger extended neck while keeping the tubing head adapter square to the tubing head. See Figure 36 for the completed assembly.

Warning! POTENTIAL PINCH POINT. Keep hands and fingers clear.

9. Make up the flange connection as described in Engineering Bulletins EB 13-010 and EB 13-014.
10. Locate the grease fitting port on the flange stamped "FLG TEST PORT" and remove its cap.
11. Attach the hydraulic pump and pump several times to remove the air.
12. Test the connection to the rated working pressure of 10000 psi. Refer to SFI Engineering Bulletin EB 33-005: Field Pressure Testing, for proper field pressure testing instructions.
13. Release the pressure in a controlled manner and collect as much test fluid as possible.
14. Remove the hydraulic pump and reinstall the cap.
15. Retrieve the BPV from the casing hanger.
16. If a lubricator is required, refer to Engineering Bulletin EB 16-002 for proper operating instructions for a Stream-Flo lubricator.

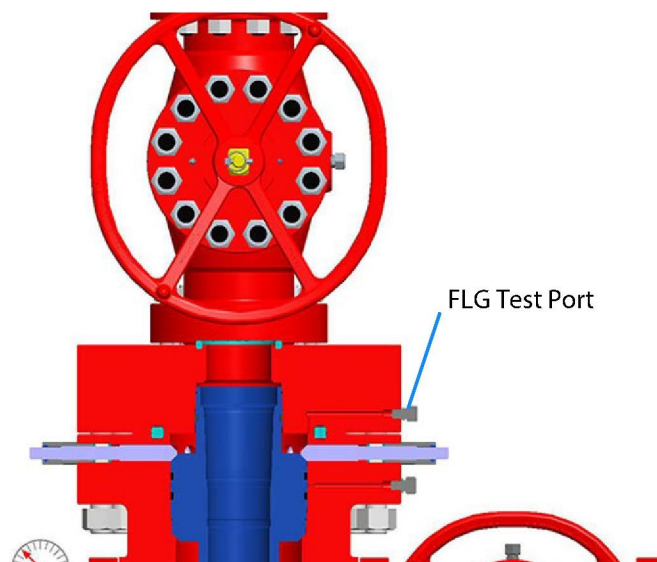


Figure 34
Pressure Testing



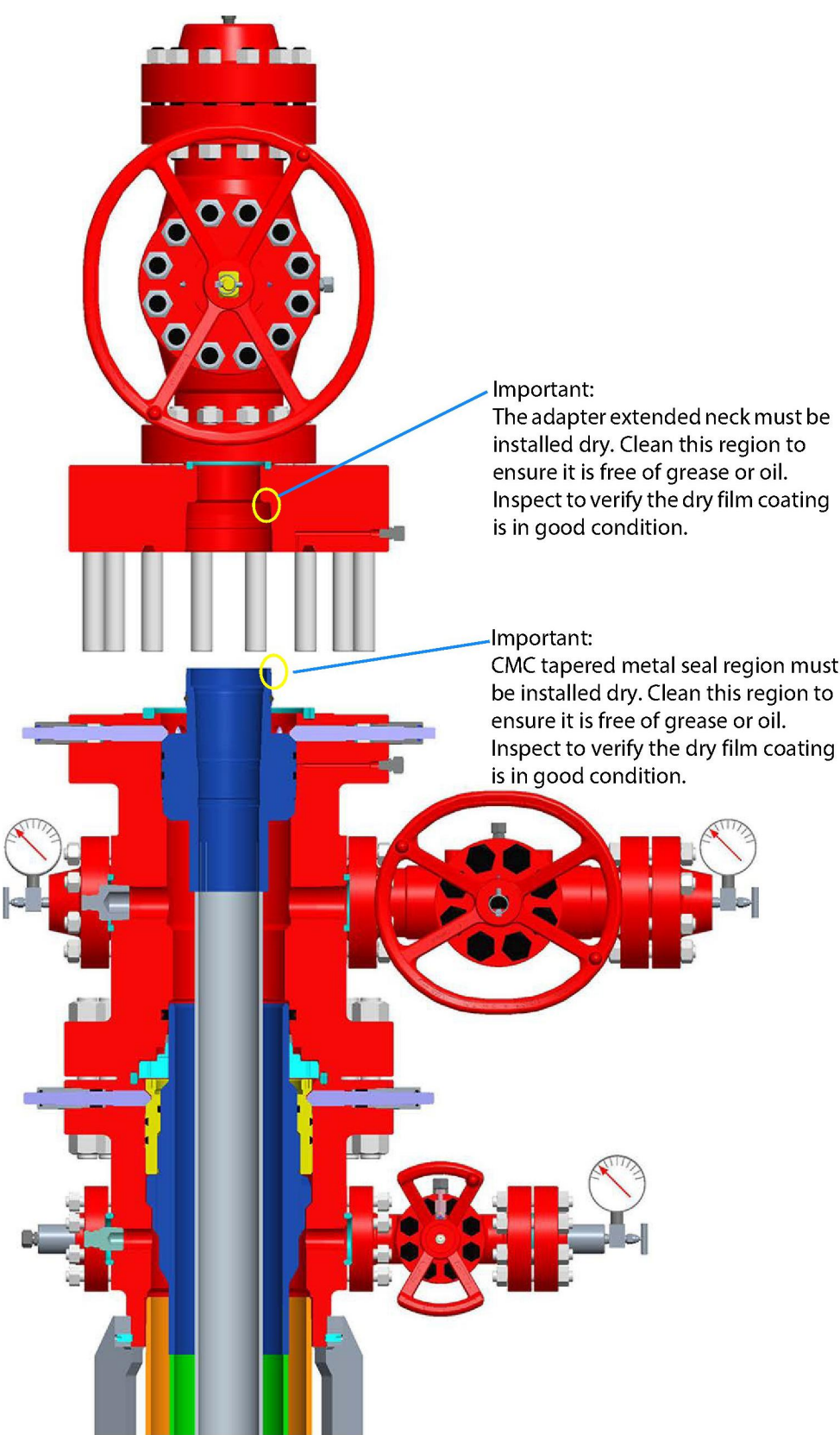


Figure 35
Landing the Tubing Head Adapter



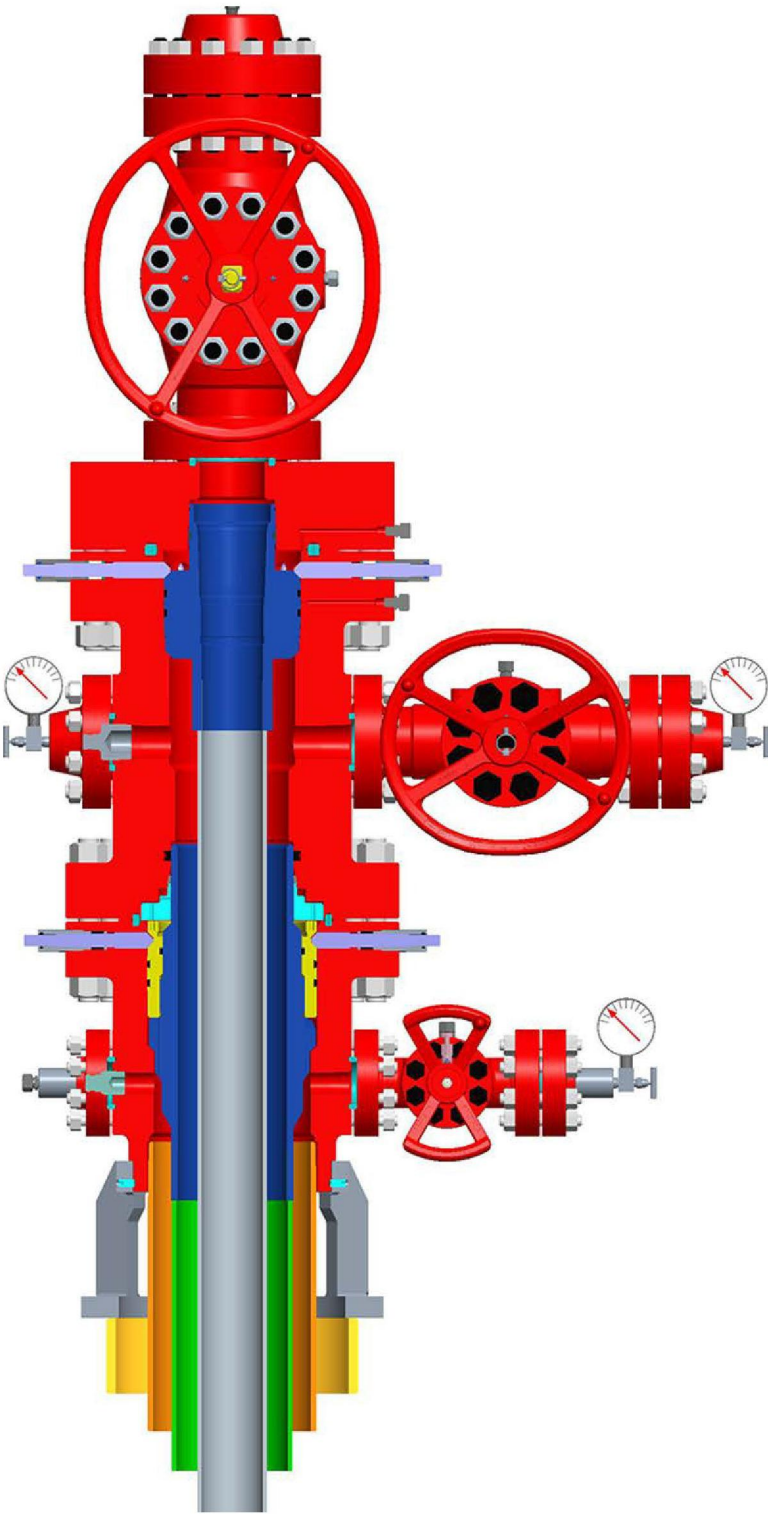


Figure 36
Finished Assembly



Section 17 Testing Additional Christmas Tree Components

1. Before stimulating the well, additional Christmas tree equipment will need to be installed.
2. Close the Lower Master Valve (LMV).
3. Install additional Christmas tree equipment.
4. Pressure test the additional Christmas tree equipment to 10000psi against the LMV.
5. Bleed pressure and remove the test fluid.
6. Be sure to re-open the LMV before stimulating the well.

Section 18 11" x 5-1/2" CMBEN Casing Hanger Retrieval

1. Bleed off all pressure from the Christmas tree and annulus.
2. If required, install a BPV plug (if no BPV is installed, another form of well control should be used). If required, use a lubricator as per SFI lubricator engineering bulletin EB 16-002.
3. Verify that all tubing head lockscrews are fully engaged. Refer to the engineering bulletin EB 18-005 for proper operating procedures.
4. Check all tubing head adapter ports to ensure that no pressure exists between the adapter and the casing hanger.
5. Remove the Christmas tree.
6. Install hanger extended neck protector.
7. Install the BOP stack.
8. Make up the landing joint to the top of the casing hanger.
9. Retract the lockscrews in the tubing head. Refer to the Engineering Bulletin EB 18-005 for proper operating procedures.
10. Lift the casing hanger until it clears the BOP stack and suspend the casing string.
11. Break the casing hanger from the casing string. Apply tongs to the hanger only in the tonging neck area as shown in Figure 31.

Important: Keep the tongs away from the sealing surfaces.

12. Retrieve the remainder of the casing string as required.



Section 19 Reference

About Corrosion

Throughout this procedure, you will be required to inspect equipment, to ensure things are intact and undamaged. When you are inspecting equipment, make sure there is no corrosion, which could compromise sealing surfaces.

Detailed below is a list of the different types of corrosion that can be found on the equipment used in this procedure, what the corrosion looks like, and why it is important to find and report this corrosion.

General Corrosion

The material loss happens at a uniform rate over time. Rust and orange/brown/black discolouration may be present.

If it has progressed enough to affect the shape of a sealing surface and possibly compromise the seal, it should be reported. If it is relatively light and on non-sealing surfaces (IE. the wall of the valve), it is generally not critical.

Corroded or damaged seal prep can cause installation failure.
Contact the Service Manager.



Figure 37
General Corrosion of Ring Groove



Pitting Corrosion

Metal has a dimpled appearance, with small pits and divots.

Pitting is rapid corrosion at concentrated points (pits), it can compromise the integrity of a part faster than general corrosion. Pits can be deep enough to cause cracking. Parts are designed to avoid pitting corrosion, so if it is present, that means something is wrong (IE. an acid, caustic, etc. has been introduced to the system). Pitting should especially be noted if it is on a sealing surface.

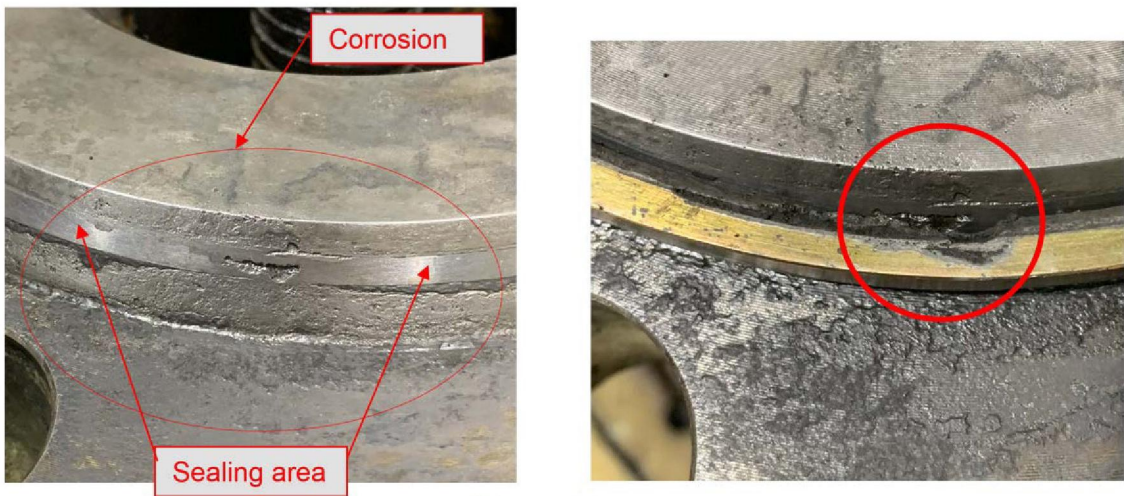


Figure 38
Pitting Corrosion of Ring Groove

Cracking Corrosion

Similar in appearance to cracking in concrete, glass, ice, etc. The material is fractured.

The material is fractured, and the depth of the crack is unknown. If the part is cracked through the wall, or is now weakened, it could cause a leak even if other kinds of corrosion are not present. Cracking should always be reported, especially if it is on a sealing surface.



Figure 39
Cracking Corrosion of Valve Body



Spalling/Flaking Corrosion

A version of cracking where the cracks run just under the material's surface, causing flakes of the material to break off. A typical example would be the stellite overlay on gates flaking off.

If the flakes of material are coming off a sealing surface, leakage could occur. Depending on the size of the flakes, the resulting debris could cause problems for other components downstream. Flaking/spalling should especially be reported if it is on a sealing surface.



Figure 40

Spalling/Flaking Corrosion of Gate

Contact the Service Manager if extensive corrosion is found.



Working with Hangers and Landing Joints

Inspection of hangers and landing joints is critical immediately upon arrival on customer location.

1. Record in your Tally Book and on the Service Ticket/Field Service Order (FSO):
 - Hanger Description
 - Part Number
 - Serial Number
 - Heat Number

Important: Recording these items is crucial for anything being run in the hole and left. It will help out in troubleshooting any problems that may occur on the job or in the future.

2. Verify hanger is the correct size and type for the wellhead system being run and casing size.
3. Verify hanger threads are compatible with casing being run. If not verify with Company Man that he has the proper cross-over joint on location.
4. Measure RKB to Top Flange of Wellhead and determine RKB to Load Shoulder / Land Off Point.

See "Measuring the Wellhead-to-RKB Distance" on page 47

Important: the 5' marks and the RKB to Load Shoulder must always be marked on the landing joint before picking it up to the rig floor.



Figure 41

5. Secure strapping tape to hanger load shoulder.
6. Stretch the tape out the length of the hanger ensuring that your end did not move from the land off point.
7. Mark the pipe in 5' increments up to your land off point.
 - Try to make your mark 1/2 way around the pipe with your numbers marked on top of the line.
 - Ensure markings are clear and visible for the driller to see.



Figure 42



8. Mark the RKB to Load Shoulder distance with a clear and accurate line (see the 28.18' in Figure 43).
9. Mark the RKB to Top Flange of the Wellhead Dimension. This will give you and indication when you are entering the restricted bore of the wellhead in the case of any hang ups or excessive drag (see WH27.14' in Figure 43).
10. Measure your landing joint from the land off point to the bottom of the collar to ensure you have enough stick up for the elevators to fit. Also notify the company man of this stick up so he can make proper arrangements with the cementers (if applicable).
11. Place a vertical line across the hanger and running tool to reference while on the rig floor. In the case that either your running tool over torques or begins to back out of your hanger.
12. Thoroughly wrap and protect all sealing surfaces with duct tape and rags to ensure no damage occurs as the hanger is brought to the rig floor. Remove the duct tape and rags prior to running the hanger into the wellhead.



Figure 44

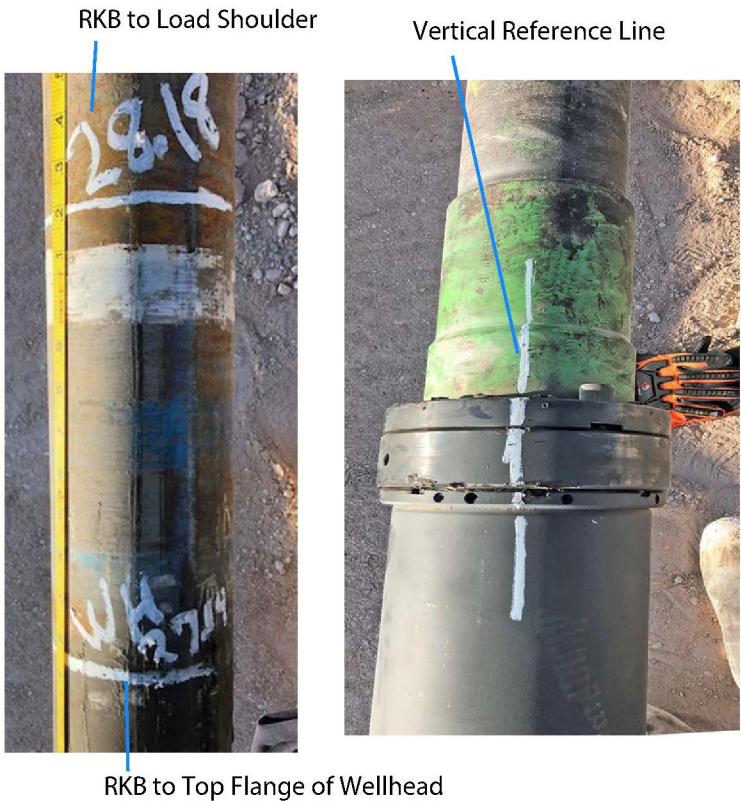


Figure 43



13. Upon land out, the 5' stick is laid across the hole and used to mark your landing joint, so revolutions and any travel up or down can be monitored.

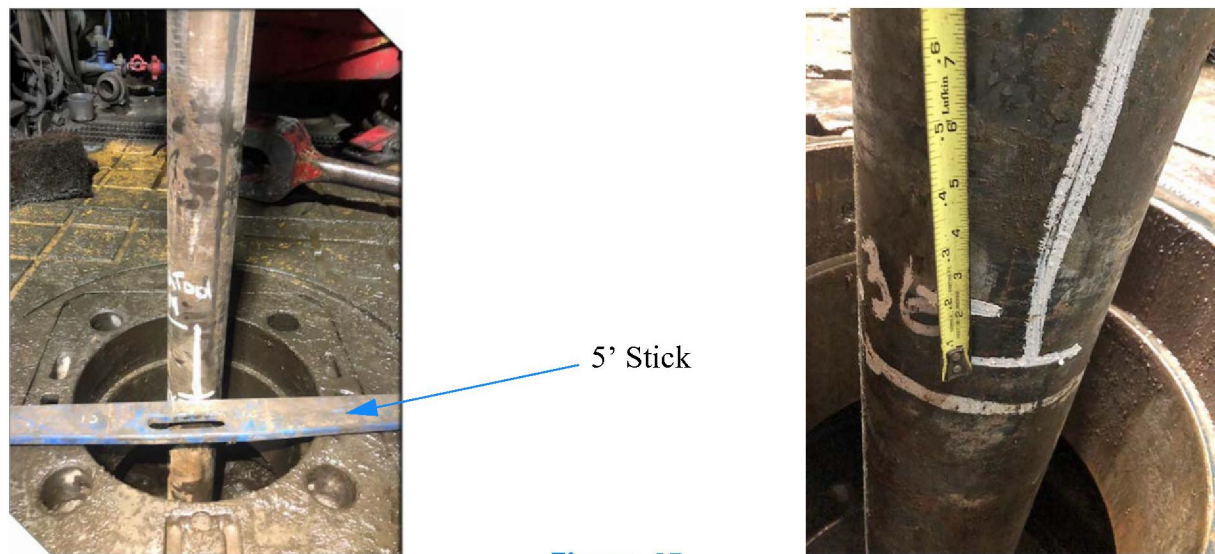


Figure 45

14. Always mark landing joint with proper direction to back out and number of turns required to do so.



Figure 46



Measuring the Wellhead-to-RKB Distance

Knowing where we are at all times when running any of our tools in or out of the hole is crucial for proper installation and well control.

This includes:

- Hangers,
- Packoffs,
- Test Plugs,
- Wear Bushings,
- Back Pressure Valves.

Measurement Standards

Industry standard for measurements is in **feet-tenths**.

Take care when converting measurements from inches to feet tenths. This can be done with the use of a engineers x inches tape or by simply dividing the inches by 12 and rounding to the second decimal place. For example 32 1/2" = 2.71'

Table 2:Fractions to Decimal

1/32	0.03125		7/16	0.4375
1/16	0.0625		1/2	0.500
3/32	0.09375		9/16	0.5625
1/8	0.1250		5/8	0.625
5/32	0.15625		3/4	0.750
3/16	0.1875		13/16	0.8125
1/4	0.250		7/8	0.875
5/16	0.3125		15/16	0.9375
3/8	0.375		31/32	0.96875
13/32	0.40625		1	1.00



Important: Measure twice and mark once.

RKB - “Rotary Kelly Bushing” is the measurement from a defined point to the rig floor.

- 1. Select a location of the substructure or matting boards that allow you access to the thinnest part of the rig floor. Usually on the outward edges of the rig floor. The area around rotary table is reinforced and multiple layers thick with heavy beams.

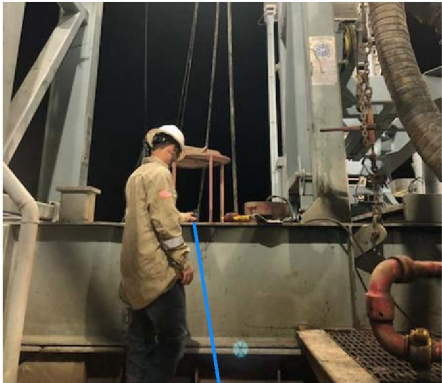
Note: You must be able to stretch a string line across the cellar unobstructed from this elevation point. Main substructure beams work well.

- 2. Record **Measurement “A”: Beam to underside of rig floor.**
- 3. Tightly stretch string line across cellar from same elevation point in step 1

String line needs to be as close to the wellhead as possible without contacting any obstacles.

Ensure there is no “sag” in the line.

- 4. Measure down to the Top Flange of the Wellhead.
- 5. Record **Measurement “B”: Beam to TOP of Wellhead.**
- 6. Combine dimensions:
 $A+B= \text{RKB to Wellhead (Dimension C)}$
- 7. Record dimension C on the FSO.



Laser Mark

Figure 47



Figure 48



Index

Numerics

- 10202638 • 13
- 20020586 • 13
- 20211612 • 13
- 30007713 • 10
- 30008698 • 23
- 30008940 • 21
- 30020773 • 4
- 30020824 • 4
- 30022883 • 4
- 30205525 • 18
- 30205597 • 4
- 30208012 • 8
- 30208444 • 4
- 30208647 • 18
- 30208648 • 13
- 30208649 • 13, 18
- 30208651 • 25
- 30208667 • 28
- 30208668 • 37
- 30208684 • 33

B

- Bore Protector Material Number • 10, 30

C

- Casing Hanger Material Number • 13, 33
- Casing Hanger Running Tool Material Number • 13
- Casing Head Material Number • 4
- Combination Running Tool Material Number • 8, 28
- Contingency Casing Slip Hanger Material Number • 21
- Contingency Packoff Material Number • 23

H

- Hanger Running Tool Material Number • 18

I

- Intermediate Head Material Number • 25

L

- Landing Base Material Number • 4
- Lockscrew Plug Material Number • 4

P

- Packoff Material Number • 18
- Packoff Running Tool Material Number • 18

R

- Running Tool O-ring Material Number • 13
- Running Tool Torque Slider Material Number • 13

S

- Shear Pin Material Number • 13

T

- Torque Plate Material Number • 4
- Tubing Head Adapter Material Number • 37

V

- Valve Removal Plug Material Number • 4





H – SLB Logging Procedures



Geothermal Limitless Approach to Drilling Efficiencies (GLADE)
General Logging Requirements – Trip 1

Revision 2 – 03/012/2025

Operator:	OXY USA, INC	API:	05-123-52915-00
Well:	Glade West	Permit #:	
Field:	Wildcat	Rig:	
County/Parish:	Weld, CO		
Expected Logging Date:	4/15		

Revision #	Changes
1	Updated logging scope with NGI reduced interval and Sonic objectives
2	Updated well details, InterACT

- Section 1 – Contacts
- Section 2 – Scope of Work
- Section 3 – Well Details
- Section 4 – General Notes
- Section 5 – Run Details
- Section 6 – General Logging Instructions
- Section 7 – Data Delivery
- Section 8 – A/I Requirements
- Section 9 – Appendix B - Explanations

SECTION 1: CONTACTS

PRIMARY	Name	Position	Email	Phone Number
SLB	Redacted			
Drilling				
Logging				

SECONDARY - Operations	Name	Position	Email	Phone Number
SLB		FE/WSS		
		ROE		
		ROE		

SECTION 2: SCOPE OF WORK

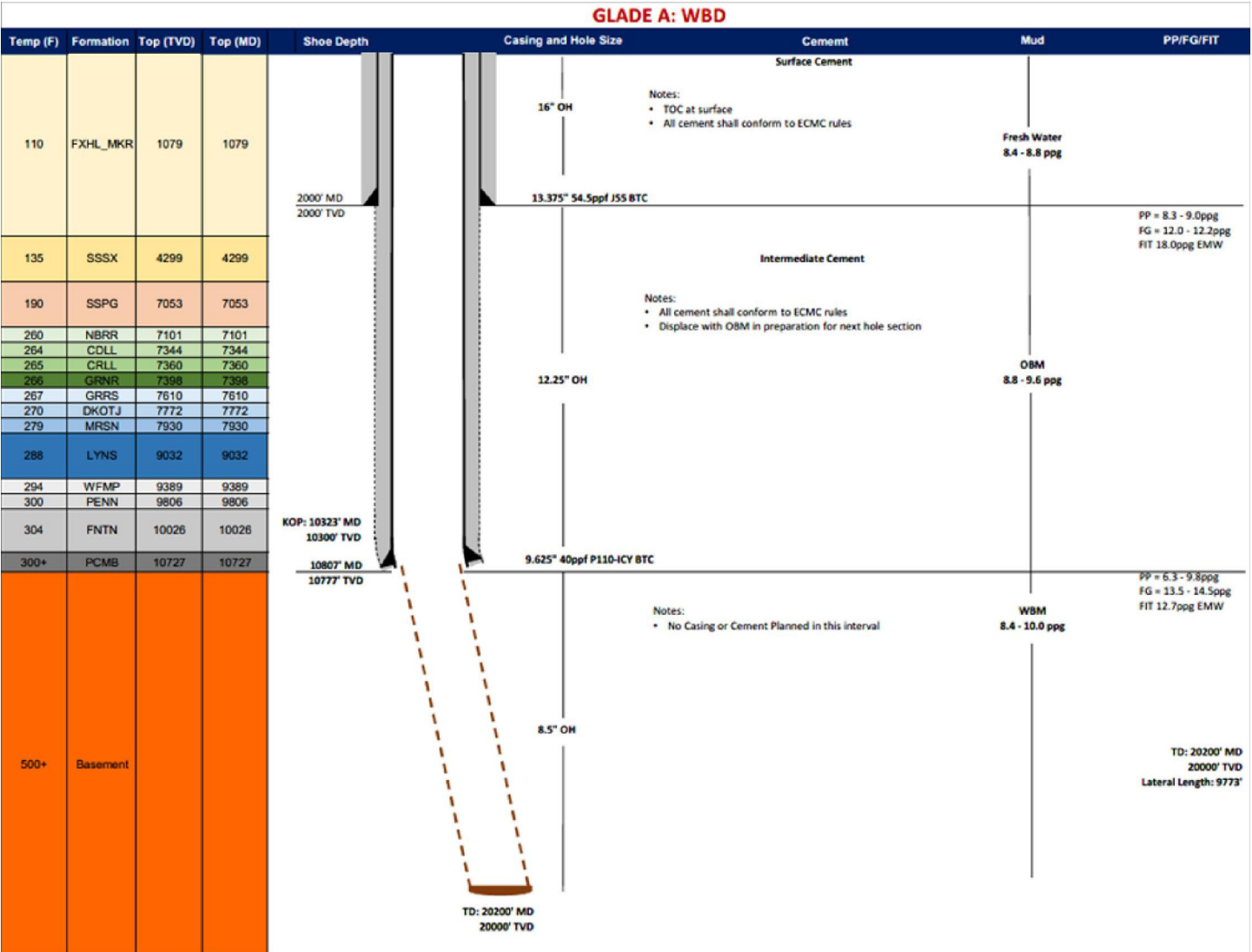
Run	Service	Run Times*
1A	Spectral Qstring TCOM w/ AIT	10-11hr
2B	GR-PPC-Sonic PnS-PPC- NGI	13-14hrs

Domain	Service/Explanation	Interval	Quantity
Petrophysics: - PEX – AIT - PEX – HRLA - Qstring TCOM	- GR-Neutron-Density-MCFL-Caliper-Resistivity Note: No MCFL in OBM - GR-Neutron-Density-MCFL-Caliper-Laterolog - GR-Neutron-Denisty – Caliper -Resistivity	2000-10807	
- Spectral - NMR - Spectroscopy - Triaxial Induction - Dielectric Scanner - Qstring TCOM - PNL – Pulse Neutron Log	- HNGS – K, U, Th - CMR Plus - CMR MagniPhi(T1T2) - ECS-Mineralogy - LithoScanner (NEXT) - Advanced Mineralogy - TOC -Total Organic Carbon - Salinity - RT Scanner (Induction, Rv/Rh, Dips, LSA) - Level 1 – Induction, Rv/Rh - Level 2 – Induction, Rv/Rh, Dips - Level 3 – Induction, Rv/Rh, Dips, LSA - ADT – Water filled porosity - RST - Sigma - Carbon Oxygen - Pulsar	2000-10807	

	○ Sigma/FNXS ○ CHFE – Sigma/FNXS/Spectroscopy ○ Carbon Oxygen		
Acoustics: • Sonic Scanner • ASLT • DSLT • QSLT	• TRA – Vertical (PnS/ANI/MP/CP) • TRA – Horizontal (PnS/ANI/MP) • Geophysics Ready (PnS/ANI/GEO) • Geomechanics Ready (PnS/ANI/CP/SA/MP) • Fracture Ready (PnS/ANI/FRAC/FAM) • BHC – DT/Porosity • PnS – Monopole / Dipole • ANI – Dipole Shear Anisotropy Analysis • MP – Mechanical Properties • 3D Far Field • CBL-VDL	2000-10807	
Geology: • Imaging	• FMI – WBM • Quanta Geo/NGI – OBM (>7.5” BS) • Slim Quant Geo - OBM • OBMI – OBM ○ Dual OBMI • UBI	6404-10807	
Geology: • Coring	• MSCT – 0.92” Diameter Core • XL Rock – 1.5” Diameter Core • CST – Percussion Cores		
Reservoir: • Pressures/Sampling • Stress Testing/Mini-Frac • Mini-DST	• XPT – Pressures Only • MDT-SP / Saturn ○ Pressures ○ Samples • MDT Dual Packer ○ Stress Test/Mini-Frac ○ Mini-DST		
Geophysics: • Seismic	• Checkshot • VSP		
Other Open Hole: • Inclinometry Survey • Calipers • Third Party Gyro • Temperature	• IS Survey – GPIT • PPC – Powered Calipers- 4 arm • PBMS • GyroData/SD	2000-10807	
Well Integrity • CBL-VDL • Cement Evaluation • Corrosion Evaluation	• CBL-VDL • SCMT (Radial, CBL-VDL) • USIT ○ Cement ○ Corrosion • Isolation Scanner ○ Cement ○ Corrosion ○ Cut and Pull Advisor • UCI – Corrosion only • EMIT • Caliper		

SECTION 3: WELL DETAILS

Expected TD	10807ft
Bit Size (BS)	12 ¼
Drill Pipe size/Connection (ThruBit)	NA
BHT	<350
BHP	5395psi
Mud Type	OBM
Mud Weight	8.8-9.6#
Casing Depth	13 3/8, 54.5# @ 2000ft
Future Casing Size	9 5/8, 40#
Well Geometry	Directional with 10deg tangent at bottom
Formation	See schematic
Logging Parameters (SS, LST, DOL)	LST, 2.71g/cc



SECTION 4: GENERAL NOTES

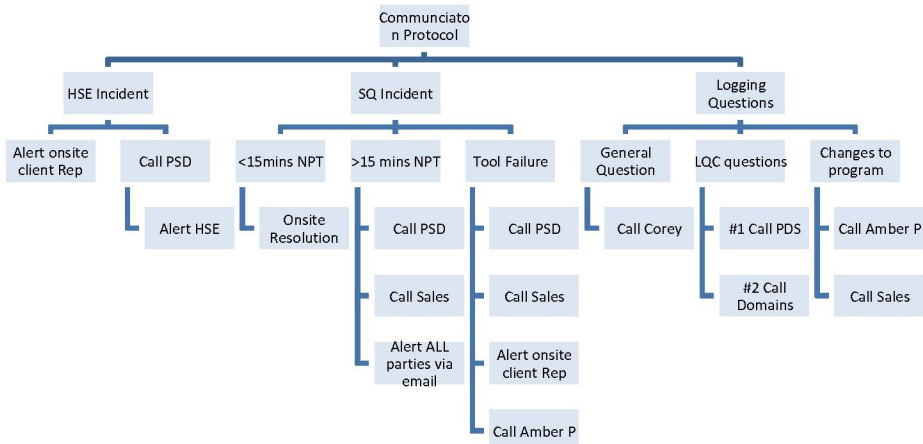
General Notes:

- Upon arrival to wellsite, check in Company Rep.
- Perform JSA upon arrival/before rig up
- STOP the JOB authority is crucial and expected.
 - Communicate any concerns about HSE/SQ as needed to onsite representatives and SLB
- Ensure that all files are being pushed to InterACT and TransACT.
- TEAMS meeting during ALL operations
 - Send invite to **Redacted**
- Any operational changes and/or logging changes need to be communicated to **Redacted** **Redacted** before proceeding
- This document is for high level communication/planning and does not supersede SLB’s standard SWI(Standard Work Instructions) for the applicable services

Pre-Job Communication:

- Sales to alert operations, dispatch, A&I
 - Send Logging SOP, contact details, timing
- Sales to email Oxy with Logging SOP
 - LWOP completed 1-2 weeks before logging
- Dispatch to initiate daily calls to the rig to get updates
 - Start 10 days prior to estimated logging date
- Rig to provide a 48 hour notice to dispatch/district
- Rig to provide a 24hr final time to dispatch/district

Onsite Communication Workflow:



SECTION 5: RUN DETAILS

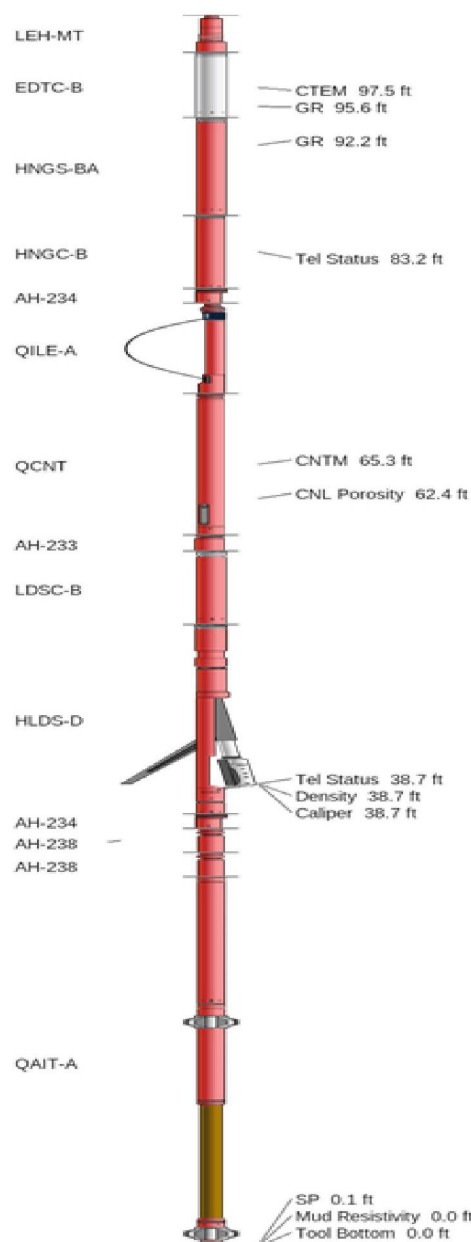
Run	Service	Run Times*
1A	Spectral Qstring TCOM w/ AIT	10-11hr
1B	GR-PPC-Sonic PnS-PPC- NGI	13-14hrs

*Rig up/Rig Down Estimates-->Does not factor in wiper trips

Run 1A: ECRD Spectral Qstring TCOM w/ QAIT

- Confirm on surface that the caliper open/closes as per normal
- Run ALL services from TD to shoe
 - Acquire full downlog @ 10kfph
 - Complete 200ft repeat at TD unless hole conditions dictate otherwise
 - POOH logging @ 1800fph
 - Display RHOB and Neutron Porosity, not density porosity.
- Communicate changes to Amber P/Allison K

EDTC-Spectral-QString



**Weight in Air: 2,000.40 lbm, Length: 104.13 ft,
Volume: 5.80 ft³, Max OD: 4.000 in, Max Pressure:
20,000.00 psi, Max Temp: 302.00 degF**

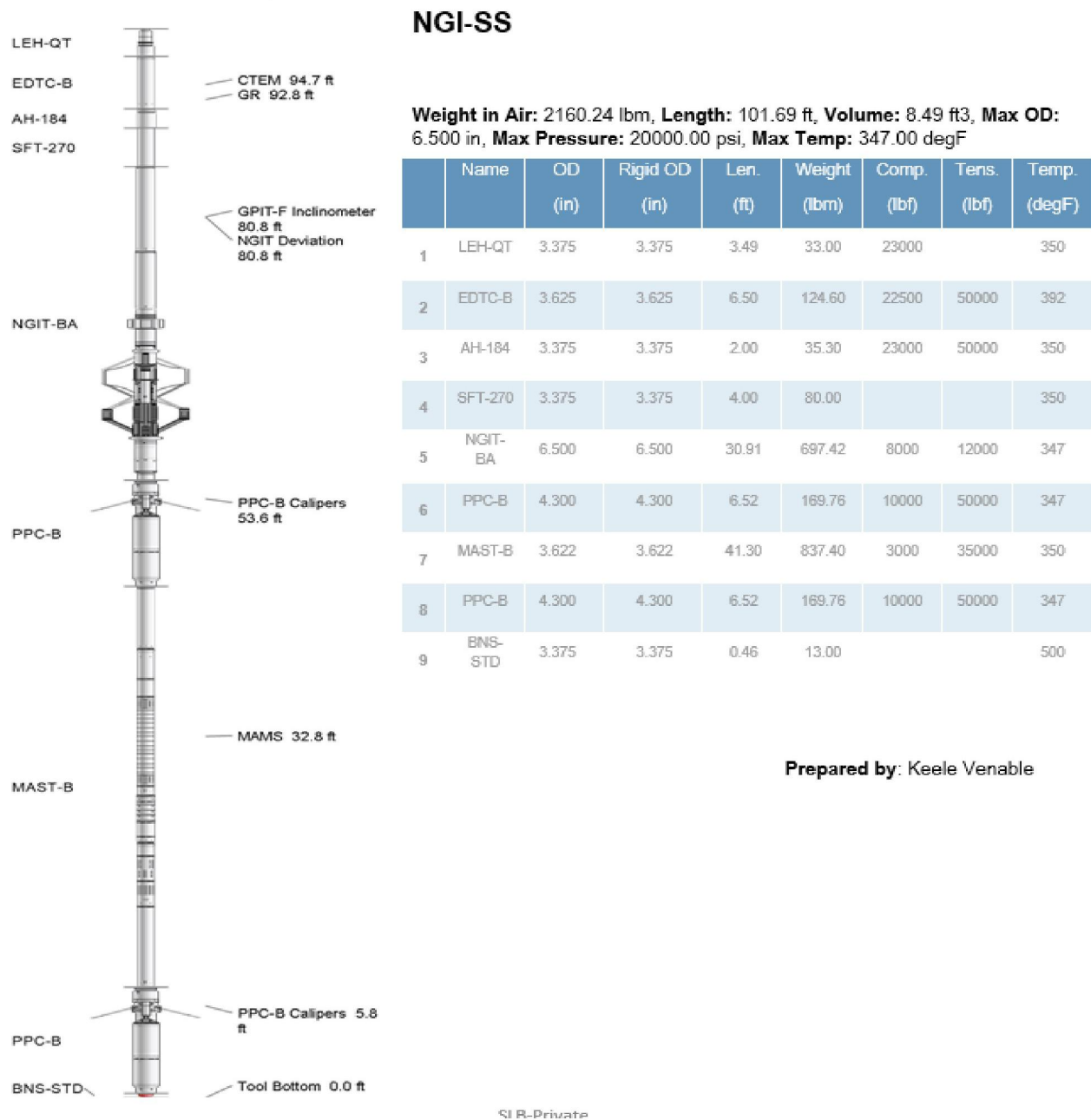
	Name	OD (in)	Len. (ft)	Weight (lbm)	Comp. (lbf)	Tens. (lbf)	Temp. (degF)
1	LEH-MT	3.37 5	3.15	42.00	23,000	-	500
2	EDTC-B	3.62 5	6.50	124.60	22,500	50,000	392
3	HNGS-BA	3.75 0	8.19	203.00	37,000	50,000	500
4	HNGC-B	3.75 0	6.17	119.00	23,000	50,000	350
5	AH-234	3.37 5	1.19	26.00	-	-	500
6	QILE-A	3.00 0	7.65	88.00	-	-	500
7	QCNT	3.00 0	11.92	191.00	15,000	50,000	500
8	AH-233	3.37 5	1.24	35.00	-	-	500
9	LDSC-B	3.75 0	6.17	119.00	23,000	-	350
10	HLDS-D	3.50 0	15.81	392.00	5,000	-	500
11	AH-234	3.37 5	1.19	26.00	-	-	500
12	AH-238	3.00 0	2.00	40.00	-	-	500
13	AH-238	3.00 0	2.00	40.00	-	-	500
14	QAIT-A	4.00 0	30.97	554.80	2,000	20,000	302

Prepared by: jknapp@slb.com

Run 1B: ECRD - GR – PPC – Sonic PnS – PPC – NGI

- Confirm on surface that all calipers open/close as per normal
- Run GR-Sonic service from TD to shoe
 - Run NGI from TD to 6404ft
 - Acquire downlog and correlate to Run 1A – Qstring TCOM
 - Complete 200ft repeat at TD unless hole conditions dictate otherwise
 - Communicate changes to Amber P/Allison K
 - Acquire Sonic Scanner in Std Mode with acquisition of all waveforms
 - Processing requirements:
 - Sonic = PnS only deliverables to Oxy no SLB processing
 - NGI = TBD
 - Log @ 1000-1200fph
- Set PPC arm power to level 1 and adjust according to hole conditions

- Start with 30 on pad pressure
- Watch for stick-slip and adjust accordingly
- Apply speed correction to final data set
- Use PPC for borehole profile and volumes



SECTION 6: GENERAL LOGGING INSTRUCTIONS

E-logging Instructions for logging engineer: (add/remove as required per well)

Pre-job:

- Sales to initiate and maintain Email communication linking SLB FE/JDL, Oxy team, A&I/Domain team
 - Email to alert all on:
 - Arrival to location
 - RIH to TD

SLB-Private

- Main pass completed
 - Files uploaded...
- FE to contact **Amber P** upon arrival on location to update Oxy team on logging timing and to reconfirm logging program.
 - Discuss planned logging parameters, speeds and tension pull maximum limits
 - SS matrix/MDEN
 - LST
 - DOL
 - If oil base mud use fluid density of 0.90, water base mud use fluid density of 1.0
- Discuss with driller/drilling eng on any hole condition concerns that need attention while RIH/POOH
- REMARKS:
 - Add in all relevant logging parameter, well parameter under header remarks section
 - Include all changes to the operation, ie splice, downlog
 - Add in depth to which Run 1 was correlated back to

General Running Procedures/Communication:

- Confirm on surface that all calipers open/close as per normal
- Confirm SP acquisition, reposition fish if required
- RIH perform downlog @ 8000-10000fph
- Tag TD, open calipers and run main pass
 - Complete 200ft repeat at TD unless hole conditions dictate otherwise
 - Communicate changes to Amber P/Allison K
- **Adhere to SLB depth control procedures**
- Communicate to Drilling/Geology contact if any of the following occurs:
 - If unable to reach TD during logging run
 - For a tool failure
 - If tools become stuck
 - If logging job is altered in any way by someone other than Primary or Secondary Geosciences Contact
 - Any significant changes in tension/pulls >1000 lbf
 - Pull through time spot and continue to log out AND/OR
 - Close caliper, reopen when safe to do so and continue to log out
- Do not leave location until confirming with **Amber P and SLB Domains** that all information has been transferred, and no additional data or service is required

SLB-Private

GDP188

SECTION 7: DATA DELIVERY

ALL Digital and Graphical Files to be made immediately available on **InterACT** from the field and reverse pushed to TransACT.

General Requirements

- InterACT organization: Oxy – USL-Rockies

Oxy-USL-Rockies.....Wildcat.....Glade East.....Trip 1 Intermediate Hole

Top OXY-USL-Rockies Wildcat Glade East Trip 1 - Intermediate Hole				
Details WTSML View Subscribe Upload More				
Section Level 2/2 Available Items 100 per page Activity: Display All Cate				
Single file or folder actions: Edit Details Multiple file actions: Download				
#		Category	Name	Creation Date
1.	☐	(0 Items) Sub Section	Run 2 - Sonic NGL	12-Mar-25 16:12
2.	☐	(0 Items) Sub Section	Run 1 - Spectral TCOM	12-Mar-25 16:11

- **ROE/FE will upload directly to the appropriate run folder and reverse push to TransACT**
- TEAMS meeting during ALL operations
 - Send invite to

Redacted
- PDF for every measurement required.
- TIFF required of every PDF in color
- LAS should only display curves listed on the graphical files
 - Include both LST and SS matrices in the LAS file ONLY
- Post full DLIS to InterACT including all curves in Customer format
- All digital data should be referenced to measured depth (MD).

Prepare, present, and deliver the following field & processed logs:

Field deliverables (if applicable):

- TCOM (2in and 5in)
- Borehole Profile (2in and 5in)-->PPC
- Sonic PnS(2in and 5in)
- Spectral (5in)
- Lithoscanner (5in)
- CMR Plus(5in)
- MDT Pretests and Sampling
- MDT Stress testing
- XL Rock coring summary
- FMI-HD (5in and 40in)
- If there are revisions to ANY field logs, v2...v3 should be used in the naming convention

SLB-Private

Processed deliverables (if applicable):

- Multi-Mineral ELAN(PEX/CMR/Litho)
- LithoScanner Mineralogy
- Sonic PnS/Anisotropic Analysis
- Sonic Mechanical Properties
- Sonic Mechanical Earth Model
- FMI static/dynamic images and interpretation
 - Advanced Fracture Analysis, Sandtex
- MDT Stress Test Report

Processed Data

- Any processed data should be furnished in digital form. The file name should clearly indicate that the file contains Processed Data. Header should specify data is from computing center
- If there are revisions to ANY processed logs, v2...v3 should be used in the naming convention

SECTION 8: A/I REQUIREMENTS (Analysis & Interpretation)

- Sonic Scanner = SLB to deliver PnS data only(DLIS and LAS), Oxy to process data
- NGI = TBD

Requirements to be provided by client:

Hydrocarbon type	NA
Pore Pressure	
Rw	
API	NA
GOR	NA
m, n values(otherwise default 2, 1 will be used)	

- Formation Tops
- Deviation Survey
- Drilling Reports (For Mechanical Earth Model)

Turnaround Time Requirements: NOTE: from time of delivery to A/I team

Service/Domain	Standard TAT(business days)	Rush TAT
Petrophysics	3 - 5	36 hrs*
Acoustics • PnS/ANI/MP • MEM	5 - 7 14 - 21	TBD**
Geology	10 - 14	24hrs***

SLB-Private

Reservoir – Stress Test Report	14 - 21	TBD
--------------------------------	---------	-----

*Includes Shale ELAN/RPI/T1T2 Maps/LithoScanner Spectroscopy if applicable

**Dependent on sonic objectives

*** To be discussed based on level of interpretation and total interval to be processed

SLB-Private

SECTION 9: APPENDIX B - EXPLANATIONS

- PEX AIT= Triple Combo, Gamma Ray, Neutron, Density, MCFL, Single Arm Caliper, Induction/SP
- PEX HRLA = Triple Combo, Gamma Ray, Neutron, Density, MCFL, Single Arm Caliper, Laterolog
- Qstring = Slim Extreme TCOM (GR, Neutron, Density, Induction)
- CMR plus = Nuclear Magnetic Resonance --> T2 acquisition
- CMR MagniPHI = Nuclear Magnetic Resonance-->T1/T2 acquisition
- ECS = Elemental Capture Spectroscopy
- LithoScanner = Elemental Capture Spectroscopy--> Spectrolith lithology outputs, matrix properties, rock classification
 - TOC = Total Organic Carbon
 - Advanced Mineralogy = 15 dry weight elemental analysis
 - Salinity = Based on formation Chlorine and porosity
 - May be influenced by WBM invasion
- ADT = Dielectric Express--> Water volume and Rxo, Archie's m, n adjustments
- RT Scanner = Triaxial Induction
 - Level 1 = Induction, Rv/Rh
 - Level 2 = Induction, Rv/Rh, Dips
 - Level 3 = Induction, Rv/Rh, Dips, LSA (Laminated Sand Analysis)
- HGNS = Spectral Gamma Ray (U, K, Th)
- Pulsar = 3-Detector Pulse Neutron Tool
- RST = Reservoir Saturation Tool
- SSCAN = Sonic Scanner
 - PnS = Monopole Compressional and Dipole Shear acquisition
 - ANI = Anisotropic Analysis
 - Fast and slow shear from dispersion-based anisotropy analysis of shear waveforms
 - MP = Mechanical Properties
 - Dynamic Poisson's ratio and Young's modulus are estimated from slownesses (isotropic or anisotropic) and formation density
 - ISA = Integrated Stress Analysis
 - Estimation of the maximum and minimum horizontal stress magnitudes using a combination of pore pressure, overburden stress and data derived from the shear radial profiles and 3 shear moduli
 - CP = Completion Plus
 - Radial profiles for the Stoneley shear and the dipole fast and slow shear slownesses
 - FRAC = Stoneley Fracture Analysis
 - FAM = Fracture Anisotropy Analysis
 - GEO = Polar Anisotropy Parameters
 - MEM = 1D Mechanical Earth Model
 - 3D FF = 3D Far Field Analysis
 - SSCAN Geomechanics = PnS, ANI, MP, SA, CP and MEM

SLB-Private

- SSCAN Fracture = PnS, ANI, FRAC, FAM
- SSCAN Geophysics = PnS, ANI, GEO
- ASLT/DSLT = Monopole compressional sonic only, BHC, CBL-VDL
- FMI-HD = Formation MicroImager for water-based muds
- NGI = QuantaGeo Imager for oil-based muds
- OBMI = Oil-based mud Imager
- UBI = Ultrasonic Borehole Imager
- MSCT = Mechanical Sidewall Coring Tool-->0.92in diameter cores
- XL Rock = Xtra Large Sidewall Coring Tool-->1.5in diameter cores
- CST = Percussion Sidewall Cores
- XPT = Pressure Express-->Pressure only tool
- MDT = Modular Dynamics Tester
 - MDT-SP = Single Probe Module for pressures/sampling
 - Saturn = Radial Probe for pressures/sampling
 - HY = Hydraulics Module
 - PC = Power Cartridge
 - PO = Pumpout Module
 - HPDU = High Pressure Displacement Unit
 - XHPU = XHigh Pressure Displacement Unit
 - LFA = Live Fluid Analyzer
 - IFA = Insitu Fluid Analyzer
 - MS = Multi-Sampler-->6 x 450cc bottles
 - SC = Sample Chamber-->1 G up to 2.75 G
 - PA = Dual Packer for stress testing/mini-frac and mini-DST
- GPIT = General Purpose Inclinometry Tool
- PPC = Powered Positioning Caliper-->4 arm caliper
- ILE = Inline Eccentralizer Tool
- CBL-VDL = Cement Bond Log/Variable Density Log
 - Sonic Scanner
 - DSLT/ASLT = Digital Sonic Logging Tool
- USI = Ultrasonic Imager
- UCI = Ultrasonic Corrosion Imager
- IBC = Isolation Scanner
- EMIT = Electromagnetic Imager
- Caliper = 24, 40 or 56 finger multi-finger caliper
- ECRD = Electrically Controlled Release Device

SLB-Private

GDP193



Geothermal Limitless Approach to Drilling Efficiencies (GLADE)
General Logging Requirements – Trip 2

Revision 2 – 03/12/2025

Operator:	OXY USA, INC	API:	05-123-52915-00
Well:	Glade West	Permit #:	
Field:	Wildcat	Rig:	
County/Parish:	Weld, CO		
Expected Logging Date:	5/30		

Revision #	Changes
1	Updated contact details, operations notes, well details, tool sketch
2	Updated well details and tool sketch, removed Pulsar,InterACT

- Section 1 – Contacts
- Section 2 – Scope of Work
- Section 3 – Well Details
- Section 4 – General Notes
- Section 5 – Run Details
- Section 6 – General Logging Instructions
- Section 7 – Data Delivery
- Section 8 – A/I Requirements
- Section 9 – Appendix B - Explanations

SECTION 1: CONTACTS

PRIMARY	Name	Position	Email	Phone Number
SLB	Redacted			
Drilling				
Logging				

SECONDARY - Operations	Name	Position	Email	Phone Number
SLB		FE/WSS		
		ROE		
		ROE		

SECTION 2: SCOPE OF WORK

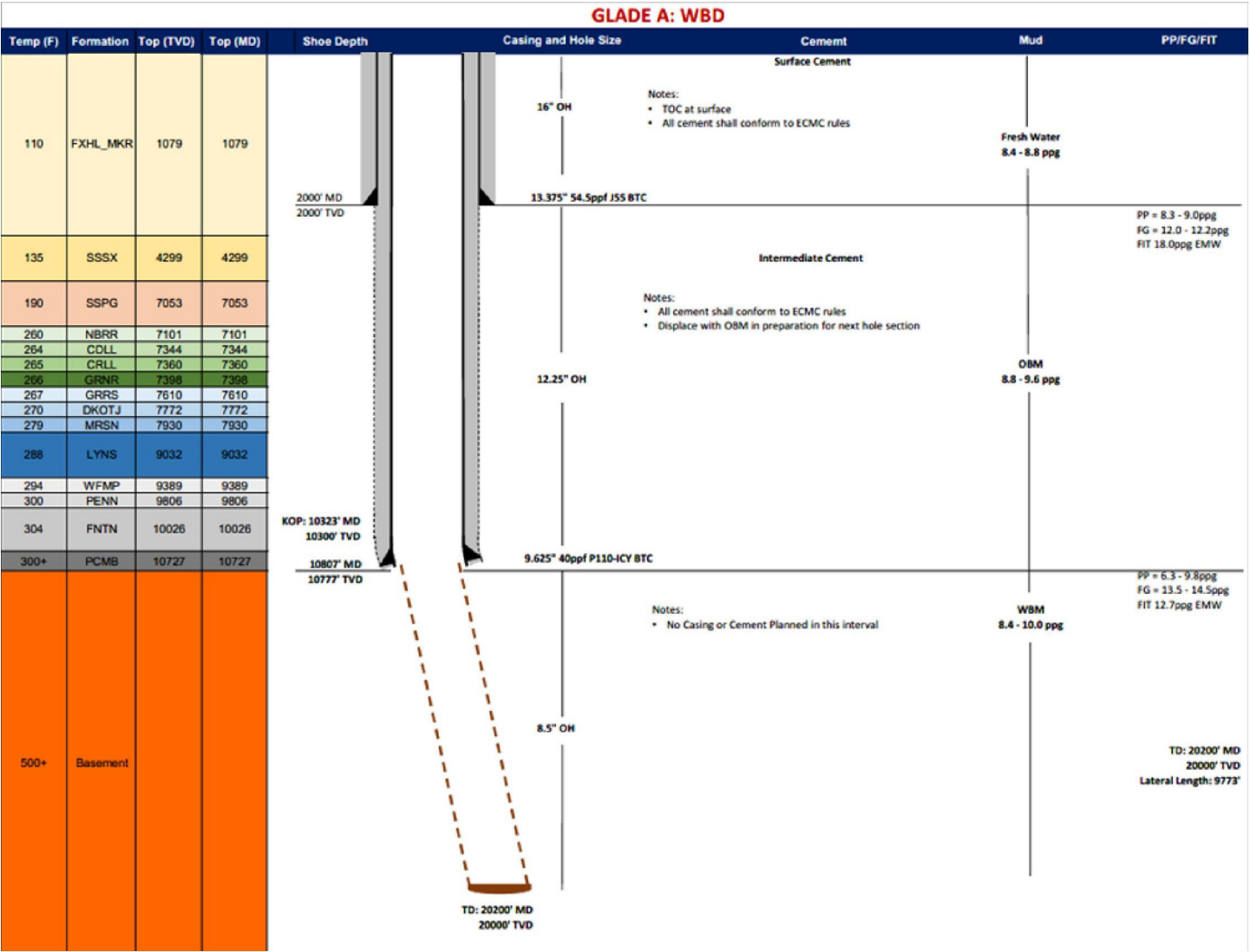
Run	Service	Run Times
2A	TB Level 3 Spectral – TCOM w/AIT - Dipole – Depth Resolver - Imager	TBD

Domain	Service/Explanation	Interval	Quantity
Petrophysics: • PEX – AIT • PEX – HRLA • Qstring TCOM	• GR-Neutron-Density-MCFL-Caliper-Resistivity Note: No MCFL in OBM • GR-Neutron-Density-MCFL-Caliper-Laterolog	10807-20200	
• Spectral • NMR • Spectroscopy • Triaxial Induction • Dielectric Scanner • Qstring TCOM • PNL – Pulse Neutron Log	• HNGS – K, U, Th • CMR Plus • CMR MagniPhi(T1T2) • ECS-Mineralogy • LithoScanner (NEXT) ◦ Advanced Mineralogy ◦ TOC -Total Organic Carbon ◦ Salinity • RT Scanner (Induction, Rv/Rh, Dips, LSA) ◦ Level 1 – Induction, Rv/Rh ◦ Level 2 – Induction, Rv/Rh, Dips ◦ Level 3 – Induction, Rv/Rh, Dips, LSA • ADT – Water filled porosity • RST ◦ Sigma ◦ Carbon Oxygen • Pulsar ◦ Sigma/FNXS	10807-20200	

	○ CHFE – Sigma/FNXS/Spectroscopy ○ Carbon Oxygen		
Acoustics: • Sonic Scanner • ASLT • DSLT • QSLT	• TRA – Vertical (PnS/ANI/MP/CP) • TRA – Horizontal (PnS/ANI/MP) • Geophysics Ready (PnS/ANI/GEO) • Geomechanics Ready (PnS/ANI/CP/SA/MP) • Fracture Ready (PnS/ANI/FRAC/FAM) • BHC – DT/Porosity • PnS – Monopole / Dipole • ANI – Dipole Shear Anisotropy Analysis • MP – Mechanical Properties • 3D Far Field • CBL-VDL	10807-20200 10807-20200 10807-20200	
Geology: • Imaging	• FMI – WBM • Quanta Geo/NGI – OBM (>7.5” BS) • Slim Quant Geo - OBM • OBMI – OBM ○ Dual OBMI • UBI	10807-20200	
Geology: • Coring	• MSCT – 0.92” Diameter Core • XL Rock – 1.5” Diameter Core • CST – Percussion Cores		
Reservoir: • Pressures/Sampling • Stress Testing/Mini-Frac • Mini-DST	• XPT – Pressures Only • MDT-SP / Saturn ○ Pressures ○ Samples • MDT Dual Packer ○ Stress Test/Mini-Frac ○ Mini-DST		
Geophysics: • Seismic	• Checkshot • VSP		
Other Open Hole: • Inclinometry Survey • Calipers • Third Party Gyro • Temperature	• IS Survey – GPIT • PPC – Powered Calipers- 4 arm • PBMS • GyroData/SD		
Well Integrity • CBL-VDL • Cement Evaluation • Corrosion Evaluation	• CBL-VDL • SCMT (Radial, CBL-VDL) • USIT ○ Cement ○ Corrosion • Isolation Scanner ○ Cement ○ Corrosion ○ Cut and Pull Advisor • UCI – Corrosion only • EMIT • Caliper		

SECTION 3: WELL DETAILS

Expected TD	20200ft
Bit Size (BS)	8.5
Drill Pipe size/Connection (ThruBit)	5.5", 21.9#, Connection Delta 544 **Need 2 3/8" drift on all drill string components**, 4.5IF connection available
Rig depth system	Pason – 1 sec interval
BHT	350-560degF-->static before cooling down - 280 expected prior to rig up
BHP	10504psi
Mud Type	WBM
Mud Weight	8.4-10#
Casing Depth	9 5/8, 40# @ 10807ft
Future Casing Size	NA
Well Geometry	Directional
Formation	See schematic
Logging Parameters (SS, LST, DOL)	LST, 2.71g/cc



SECTION 4: GENERAL NOTES

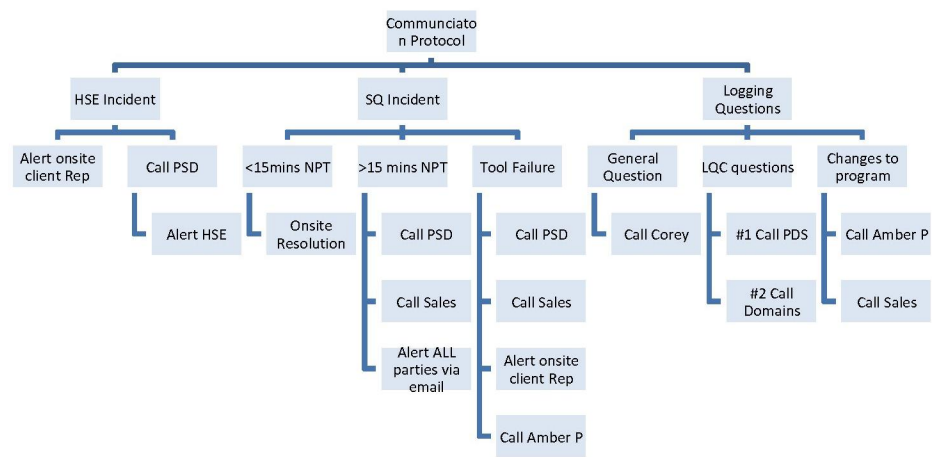
General Notes:

- Upon arrival to wellsite, check in Company Rep.
- Mud chillers/circulation to lower temperature to approx 280degF prior to rigging up ThruBit tools
- Perform JSA upon arrival/before rig up
- STOP the JOB authority is crucial and expected.
 - Communicate any concerns about HSE/SQ as needed to onsite representatives and SLB
- Ensure that all files are being pushed to InterACT and TransACT.
- TEAMS meeting during ALL operations
 - Send invite to Amber Peterson - amber.peterson@oxy.com
- Any operational changes and/or logging changes need to be communicated to Amber P/Allison K and Corey Schrader before proceeding
- **This document is for high level communication/planning and does not supersede SLB’s standard SWI(Standard Work Instructions) for the applicable services**

Pre-Job Communication:

- Sales to alert operations, dispatch, A&I
 - Send Logging SOP, contact details, timing
- Sales to email Oxy with Logging SOP
 - LWOP completed 1-2 weeks before logging
- Dispatch to initiate daily calls to the rig to get updates
 - Start 10 days prior to estimated logging date
- Rig to provide a 48 hour notice to dispatch/district
- Rig to provide a 24hr final time to dispatch/district

Onsite Communication Workflow:



SECTION 5: THRUBIT BHA/RIG PREPARATION

- Mobilize to the rig minimum 48hrs before truck/crew
 - Portal bit
 - Hang off sub
 - Float
 - DP Xovers
 - 2 3/8" rabbit
 - Schematic with part SN/labels and order of connections
- Confirm drilling rig depth system
 - Totco
 - Pason-->confirmed with Ryan R
 - Rig Sense
 - Confirm that the system can deliver 1 sec intervals(preferred)

SECTION 6: RUN DETAILS

Run	Service	Run Times
2A	TB Level 3 Spectral – TCOM w/AIT - Dipole – Depth Resolver - Imager	TBD

Run 2A: Level 3 TB – Spectral (TBSG) – TCOM- (TBIT) - Dipole (TBDS) – Imager (TBEI / TBDR)

- Drillers to follow SLB provided “ThruBit Safety Placard and Driller Rules”
- Rig to pull 3 stands in preparation for rig up and deployment
- Rig up surface PCE
 - Packoff, swivel and pump-in T sub
- Rig up TB tools for deployment and perform tool tests
- RIH between 8000-12000fph, slowing down (50fpm) for landing
 - Once tools are in the hole, no rotation or movement of the drill pipe
 - Confirm BHT prior to releasing from tools
 - Perform downhole function test of tools
- Activate drop off tool, monitor line tension and POOH
- Rig down equipment and rig proceeds to trip out of hole @ 900fph
- Run ALL services from TD to 500ft into casing for GR-CNL correlation to Trip 1 PEX
 - Rig up surface PCE and retrieving tool
 - RIH and retrieve tools at the shoe
 - Confirm data acquisition and process for deliverables
 - Sonic = PnS/ANI to be processed by Oxy
 - Sonic = 3D Far Field to be processed by SLB upon receipt of results from Oxy
 - Image = post job processing only by SLB; Oxy to provide interpretation
 - Depth matching
 - Static and dynamic images
 - Oriented to North if well <30deg and Top of Hole if well >30deg

-
- Diagram illustrating the tool joint assembly with depth markers (ft) on the right side:
- CCL 180.2 ft
 - Gamma-Ray 132.7 ft
 - Status 127.4 ft
 - SGR Det 1 125.6 ft
 - SGR Det 2 124.8 ft
 - Neutron Porosity 114.8 ft
 - Density LS 103.8 ft
 - Caliper 103.6 ft
 - Density SS 103.4 ft
 - Section 3 Buttons 60 ft
 - Section 3, Pad AC Bottom Row 60.4 ft
 - Status 51.0 ft
 - RX Array 39.9 ft
 - Mono TX 32.2 ft
 - Dipole TX 31.6 ft
 - Induction Array 14.4 ft
 - Tool Bottom 0.0 ft

Item #	Part Name	Weight (lb)	Length (ft)	Price (\$)	Stock
1	PEH-EFA	1.375	2.64	9.40	350
	Description: Perforating Equipment Head				
2	AH-317-TB	2.125	1.06	22.60	302
	Description: ThruBit Adapter Head PEH-EHF to TB Head 2-1/8 in. - 10 pin.				
3	TBCCCL-A	2.125	1.71	3.95	302
	Description: ThruBit CASING COLLAR LOCATOR Tool				
4	TILE-AB	2.125	4.50	70.00	302
	Description: ThruBit Slim Eccentralizer - 2-1/8 in. - 10 pin.				
5	TILE-AB	2.125	4.50	70.00	302
	Description: ThruBit Slim Eccentralizer - 2-1/8 in. - 10 pin.				
6	TBDOT-BA	2.125	3.49	30.00	300
	Description: ThruBit Drop-Off Tool with ThruBit End Connections - Version BA - 2-1/8 in. - 10 pin.				
7	TBHO-BA	2.125	5.94	31.50	302
	Description: ThruBit Hang Off Weight Bar - Version BA - 2-1/8 in. - 10 pin.				
8	SAH-TB	2.125	2.34	22.60	302
	Description: ThruBit Swivel Head 2-1/8 in. - 10 pin.				
9	KAH-TB	2.125	1.42	15.00	302
	Description: ThruBit Knuckle Joint - 2-1/8 in. - 10 pin.				
10	TBSB-BA	2.125	6.12	5.00	302
	Description: ThruBit Smart Battery Tool				
11	TBSB-BA	2.125	6.12	5.00	302
	Description: ThruBit Smart Battery Tool				
12	TBSB-BA	2.125	6.12	5.00	302
	Description: ThruBit Smart Battery Tool				
13	TBSB-BA	2.125	6.12	5.00	302
	Description: ThruBit Smart Battery Tool				
14	TMG-A	2.125	6.13	45.00	302
	Description: ThruBit Telemetry Memory Gamma				
15	TBSG-A	2.125	5.81	45.00	302
	Description: ThruBit Spectral GR Tool				
16	TILE-AB	2.125	4.50	70.00	302
	Description: ThruBit Slim Eccentralizer - 2-1/8 in. - 10 pin.				
17	TBN-B	2.125	4.76	35.00	302
	Description: ThruBit Neutron Tool				
18	TBD-B	2.125	10.48	91.00	302
	Description: ThruBit Density Tool				
19	TBDR-AA	2.130	15.50	30.00	350
20	TCME-BA	2.125	4.08	20.00	350
	Description: ThruBit Staggered Centralizer				

SECTION 7: GENERAL LOGGING INSTRUCTIONS

E-logging Instructions for logging engineer: (add/remove as required per well)

Pre-job:

- Sales to initiate and maintain Email communication linking SLB FE/JDL, Oxy team, A&I/Domain team

- Email to alert all on:
 - Arrival to location
 - RIH to TD
 - Main pass completed
 - Files uploaded...
- FE to contact **Amber P** upon arrival on location to update Oxy team on logging timing and to reconfirm logging program.
 - Discuss planned logging parameters, speeds and tension pull maximum limits
 - SS matrix/MDEN
 - LST
 - DOL
 - If oil base mud use fluid density of 0.90, water base mud use fluid density of 1.0
- Discuss with driller/drilling eng on any hole condition concerns that need attention while RIH/POOH
- REMARKS:
 - Add in all relevant logging parameter, well parameter under header remarks section
 - Include all changes to the operation, ie splice, downlog
 - Add in depth to which Run 1 was correlated back to

General Running Procedures/Communication:

- **Adhere to SLB depth control procedures**
- Communicate to Drilling/Geology contact if any of the following occurs:
 - If unable to land tools
 - For a tool failure
 - If tools become stuck
 - If logging job is altered in any way by someone other than Primary or Secondary Geosciences Contact
 - Watch carefully for overpulls, note depth of all overpulls. Max allowed overpull is 10,000 lbs.
 - If required, circulate slowly while logging
 - Hang-Off Sub (with tools deployed) TFA = 2.36 sq.in (4.62 sq. in. also available)
 - If required, pipe can be rotated to back ream – do not rotate faster than 15 rpm.
 - If drill pipe becomes stuck, stop operation and consult Company Representative and Tool pusher
 - Slips are to be set manually – damage may occur to density caliper arm if drill pipe is moved downhole whilst tripping or setting slips.
- Do not leave location until confirming with **Amber P/Allison K and SLB Domains** that all information has been transferred and no additional data or service is required

SLB-Private

GDP201

SECTION 8: DATA DELIVERY

ALL Digital and Graphical Files to be made immediately available on InterACT from the field and pushed to TransACT.

General Requirements

- InterACT organization: Oxy – USL-Rockies
- Oxy-USL-Rockies.....Wildcat.....Glade East.....Trip 2 Production Hole



- *ROE/FE will upload directly to the appropriate run folder and reverse push to TransACT*
- TEAMS meeting during ALL operations
 - Send invite to Redacted
- PDF for every measurement required.
- TIFF required of every PDF in color
- LAS should only display curves listed on the graphical files
 - Include both LST and SS matrices in the LAS file ONLY
- Post full DLIS to InterACT including all curves in Customer format
- All digital data should be referenced to measured depth (MD).

Prepare, present, and deliver the following field & processed logs:

Field deliverables (if applicable):

- TCOM (2in and 5in)
- Borehole Profile (2in and 5in)-->PPC
- Sonic PnS(2in and 5in)
- Spectral (5in)
- Lithoscanner (5in)
- CMR Plus(5in)
- MDT Pretests and Sampling
- MDT Stress testing
- XL Rock coring summary
- FMI-HD (5in and 40in)
- If there are revisions to ANY field logs, v2...v3 should be used in the naming convention

SLB-Private

Processed deliverables (if applicable):

- Multi-Mineral ELAN(PEX/CMR/Litho)
- LithoScanner Mineralogy
- Sonic PnS/Anisotropic Analysis
- Sonic Mechanical Properties
- Sonic Mechanical Earth Model
- FMI static/dynamic images and interpretation
 - Advanced Fracture Analysis, Sandtex
- MDT Stress Test Report

Processed Data

- Any processed data should be furnished in digital form. The file name should clearly indicate that the file contains Processed Data. Header should specify data is from computing center
- If there are revisions to ANY processed logs, v2...v3 should be used in the naming convention

SECTION 9: A/I REQUIREMENTS (Analysis & Interpretation)

- Sonic = SLB will deliver PnS/ANI raw data only, PnS/ANI to be processed by Oxy
- Sonic = 3D Far Field to be processed by SLB upon receipt of results from Oxy
 - TAT 2 days
- Image = post job processing only by SLB; Oxy to provide interpretation
 - Depth matching
 - Static and dynamic images
 - Oriented to North if well <30deg and Top of Hole if well >30deg
 - SLB will provide a processed pdf, dlis and xml(if required)

Requirements to be provided by client:

Hydrocarbon type	NA
Pore Pressure	
Rw	
API	NA
GOR	NA
m, n values(otherwise default 2, 1 will be used)	

- Formation Tops
- Deviation Survey
- Drilling Reports (For Mechanical Earth Model)

Turnaround Time Requirements: **NOTE: from time of delivery to A/I team**

SLB-Private

Service/Domain	Standard TAT(business days)	Rush TAT
Petrophysics	3 - 5	36 hrs*
Acoustics - PnS/ANI/MP - MEM	5 - 7 14 - 21	TBD**
Geology	10 - 14	24hrs***
Reservoir – Stress Test Report	14 - 21	TBD

*Includes Shale ELAN/RPI/T1T2 Maps/LithoScanner Spectroscopy if applicable

**Dependent on sonic objectives

*** To be discussed based on level of interpretation and total interval to be processed

SECTION 10: APPENDIX B - EXPLANATIONS

- PEX AIT= Triple Combo, Gamma Ray, Neutron, Density, MCFL, Single Arm Caliper, Induction/SP
- PEX HRLA = Triple Combo, Gamma Ray, Neutron, Density, MCFL, Single Arm Caliper, Laterolog
- Qstring = Slim Extreme TCOM (GR, Neutron, Density, Induction)
- CMR plus = Nuclear Magnetic Resonance --> T2 acquisition
- CMR MagniPHI = Nuclear Magnetic Resonance-->T1/T2 acquisition
- ECS = Elemental Capture Spectroscopy
- LithoScanner = Elemental Capture Spectroscopy--> Spectrolith lithology outputs, matrix properties, rock classification
 - TOC = Total Organic Carbon
 - Advanced Mineralogy = 15 dry weight elemental analysis
 - Salinity = Based on formation Chlorine and porosity
 - May be influenced by WBM invasion
- ADT = Dielectric Express--> Water volume and Rxo, Archie's m, n adjustments
- RT Scanner = Triaxial Induction
 - Level 1 = Induction, Rv/Rh
 - Level 2 = Induction, Rv/Rh, Dips
 - Level 3 = Induction, Rv/Rh, Dips, LSA (Laminated Sand Analysis)
- HGNS = Spectral Gamma Ray (U, K, Th)
- Pulsar = 3-Detector Pulse Neutron Tool
- RST = Reservoir Saturation Tool
- SSCAN = Sonic Scanner
 - PnS = Monopole Compressional and Dipole Shear acquisition
 - ANI = Anisotropic Analysis

SLB-Private

- Fast and slow shear from dispersion-based anisotropy analysis of shear waveforms
- MP = Mechanical Properties
 - Dynamic Poisson's ratio and Young's modulus are estimated from slownesses (isotropic or anisotropic) and formation density
- ISA = Integrated Stress Analysis
 - Estimation of the maximum and minimum horizontal stress magnitudes using a combination of pore pressure, overburden stress and data derived from the shear radial profiles and 3 shear moduli
- CP = Completion Plus
 - Radial profiles for the Stoneley shear and the dipole fast and slow shear slownesses
- FRAC = Stoneley Fracture Analysis
- FAM = Fracture Anisotropy Analysis
- GEO = Polar Anisotropy Parameters
- MEM = 1D Mechanical Earth Model
- 3D FF = 3D Far Field Analysis
- SSCAN Geomechanics = PnS, ANI, MP, SA, CP and MEM
- SSCAN Fracture = PnS, ANI, FRAC, FAM
- SSCAN Geophysics = PnS, ANI, GEO
- ASLT/DSLT = Monopole compressional sonic only, BHC, CBL-VDL
- FMI-HD = Formation MicroImager for water-based muds
- NGI = QuantaGeo Imager for oil-based muds
- OBMI = Oil-based mud Imager
- UBI = Ultrasonic Borehole Imager
- MSCT = Mechanical Sidewall Coring Tool-->0.92in diameter cores
- XL Rock = Xtra Large Sidewall Coring Tool-->1.5in diameter cores
- CST = Percussion Sidewall Cores
- XPT = Pressure Express-->Pressure only tool
- MDT = Modular Dynamics Tester
 - MDT-SP = Single Probe Module for pressures/sampling
 - Saturn = Radial Probe for pressures/sampling
 - HY = Hydraulics Module
 - PC = Power Cartridge
 - PO = Pumpout Module
 - HPDU = High Pressure Displacement Unit
 - XHPU = XHigh Pressure Displacement Unit
 - LFA = Live Fluid Analyzer
 - IFA = Insitu Fluid Analyzer
 - MS = Multi-Sampler-->6 x 450cc bottles
 - SC = Sample Chamber-->1 G up to 2.75 G
 - PA = Dual Packer for stress testing/mini-frac and mini-DST
- GPIT = General Purpose Inclinometry Tool
- PPC = Powered Positioning Caliper-->4 arm caliper
SLB-Private

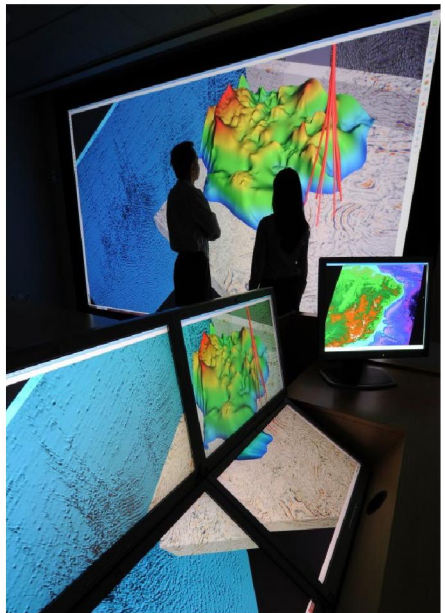
- ILE = Inline Eccentralizer Tool
- CBL-VDL = Cement Bond Log/Variable Density Log
 - Sonic Scanner
 - DSLT/ASLT = Digital Sonic Logging Tool
- USI = Ultrasonic Imager
- UCI = Ultrasonic Corrosion Imager
- IBC = Isolation Scanner
- EMIT = Electromagnetic Imager
- Caliper = 24, 40 or 56 finger multi-finger caliper
- ECRD = Electrically Controlled Release Device

SLB-Private

GDP206



I – Halliburton Ranging Procedure



© 2025 Halliburton. All rights reserved.



Magnetic Ranging Plan

GLADE Intercept Wells OXY

Target Well:	WEST
Interception Well:	EAST
Country:	USA
Date Submitted:	February 13, 2025
Revision:	1



HALLIBURTON

1. Table of Contents

2. Release Information3

3. Introduction4

4. Summary of Service.....4

5. Temperature Analysis6

6. Suggested Options - Rig Work Specifics8

Option A: AC MGT w/ WellSpot9

Option B: DC MGT w/ WellSpot10

Option C: AC MGT w/ RMRS11

Option D: RMRS13

7. WellSpot™ Deployment in Ranging BHA14

8. Estimate Time Ranging Operations.....15

9. Services Required.....16

Sperry Drilling:16

Directional Drilling Provider:16

OXY16

10. Glossary.....17

Rig Work Specifics17

List of Figures19

2. Release Information

Customer Information			
Customer:	Oxy	Country:	USA
Customer Representative:	Redacted	Position:	Drilling Engineer
Target Well Name:	WEST	Intercept Well Name:	EAST
Sperry PR&I Information			
Author:	Redacted	Date Submitted:	Feb 13, 2025
Reviewed by:		Revision #:	1
Disclaimer			
Because of the uncertainty of variable well conditions the necessity of relying on facts and supporting services furnished by others, Halliburton is unable to guarantee the effectiveness of the products, supplies or materials, nor the results of any treatment or service, nor the accuracy of any chart interpretation, research analysis, job recommendation or other data furnished by Halliburton. Halliburton personnel will use their best efforts in gathering such information and their best judgment in interpreting it, but customer agrees that Halliburton shall not be liable for and customer shall release, defend and indemnify Halliburton against any damages or liability arising from the use of such information even if such damages are contributed to or caused by the negligence, fault or strict liability of Halliburton			
Report Distribution			
Company	Name	Position	Email Address
Oxy	Redacted	Drilling Engineer	Redacted
Sperry Contacts			
Name	Position	Phone #	Email Address
Redacted	Technical Advisor	Redacted	
	Service Coordinator		
	Operations Leader		

3. Introduction

The GLADE wellbore intercept project is geothermal loop which involves the complexity of a wellbore interception with the challenges of mitigating downhole temperatures.

Multiple ranging techniques have been evaluated; this plan is intended to provide an actionable start point for future planning purposes for four prospective options.

Each option has advantages or disadvantages depending on which aspect of the intercept is prioritized. The goal of these four options is to provide an actionable plan for today, as well as potential optimizations for future planning use if certain challenges can be mitigated.

4. Summary of Service

In development for each of these actionable plans, the largest contributing factor is downhole temperature mitigation combined with risk tolerances from EOU at depth. Each of the proposed ranging service has different temperature limitations with different detection ranges. By combining these services, we can utilize the strengths of each independent service

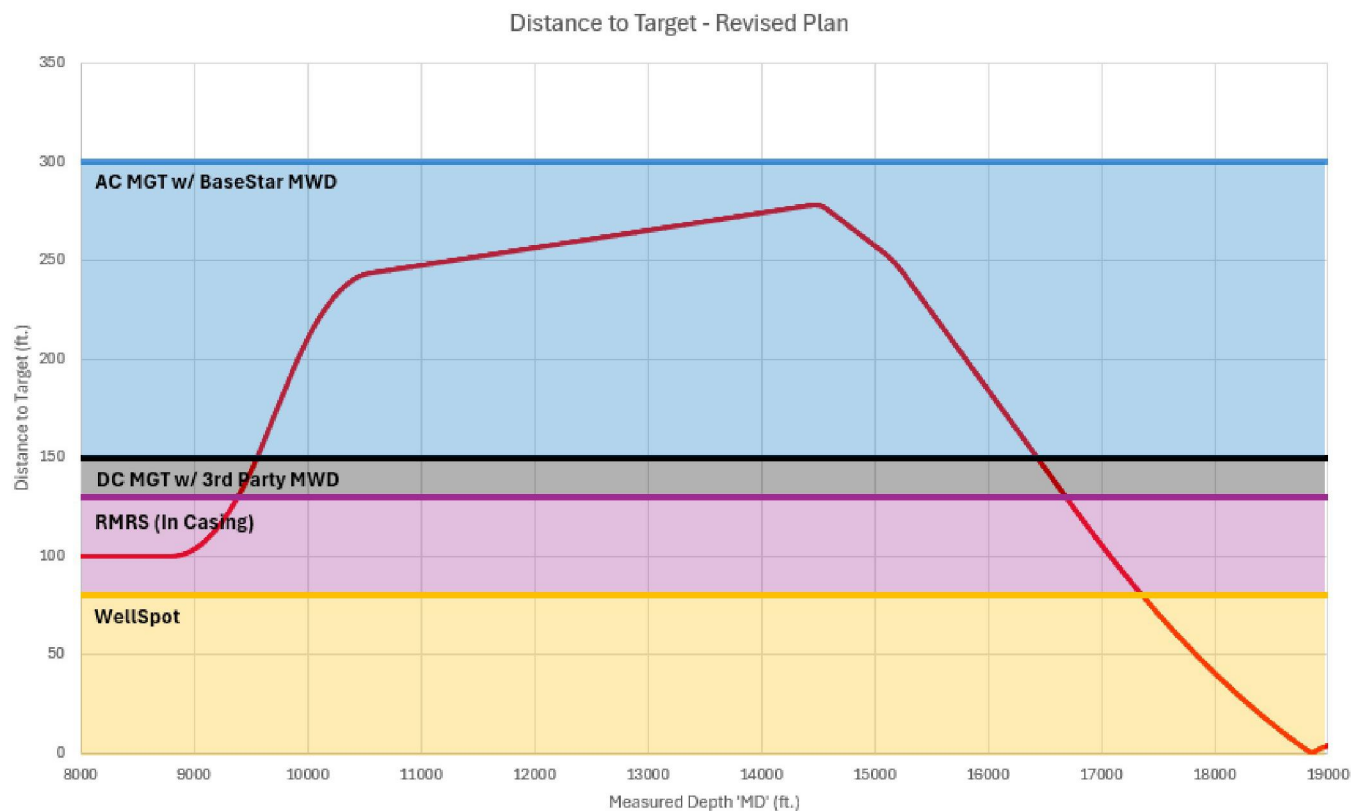


Figure 1 - Distance to Target of Various Ranging Systems

Analyzing the EOU from 8,000 ft. MD to 19,000 ft. MD shows a gross error which can potentially put the target well outside of specific tools detection ranges:

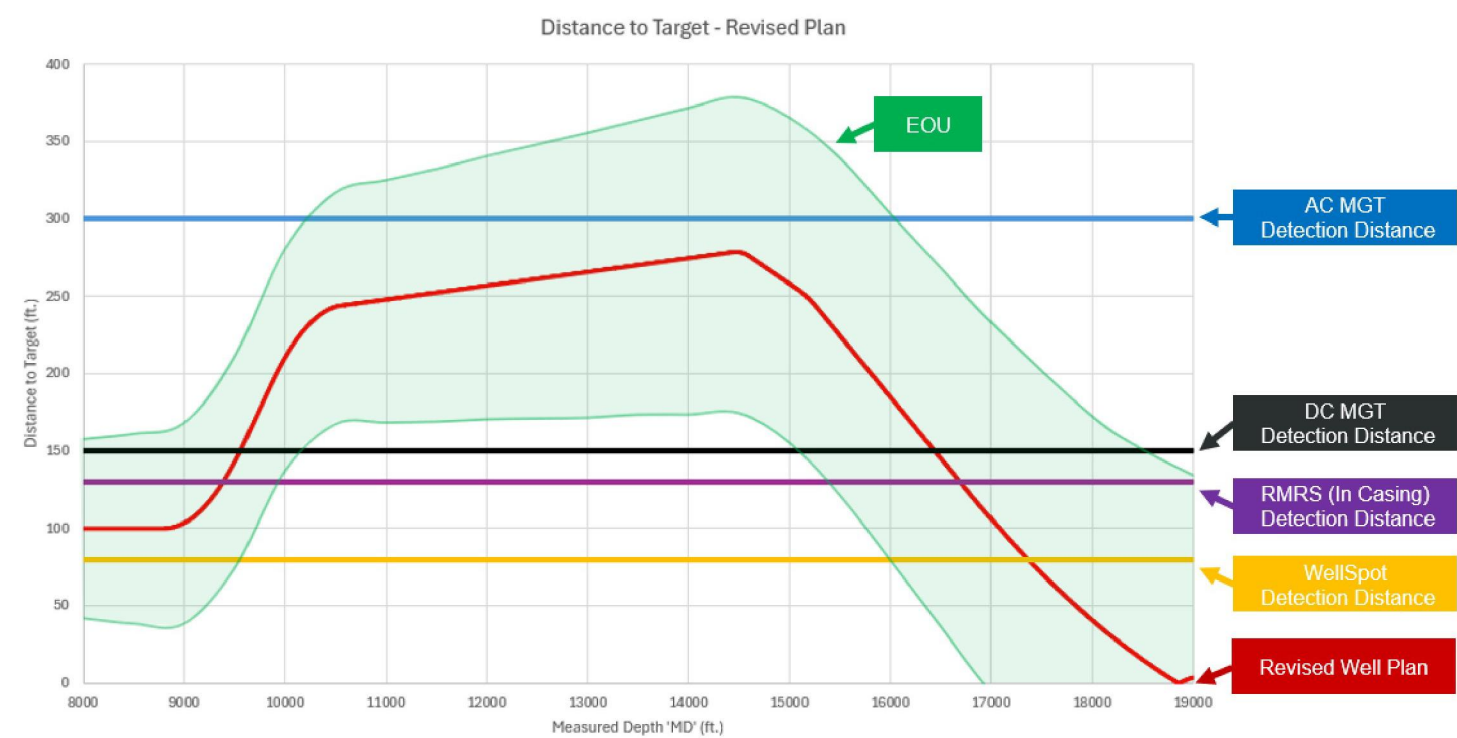


Figure 2 - EOU Analysis of 'Revised Plan'

The EOU will provide a risk tolerance that can either be mitigated through running different tools or relying on surveys alone. By not mitigating the uncertainty during earlier drilling sections we potentially put the drilling well in spot which may require a deeper interception point, or more complex direction drilling work to be completed.

From error uncertainty aside, the largest factor to determine tool selection would be the expected wellbore temperature. If the temperature in the target well can be managed, we can run the RMRS system and improve drilling efficiency. If the temperatures cannot be managed, we are able to run the WellSpot system behind the BHA.

The suggested four options are as follows:

- Option A: AC MGT (w/BaseStar MWD) and WellSpot
- Option B: DC MGT and WellSpot
- Option C: AC MGT (w/BaseStar MWD) and RMRS
- Option D: RMRS

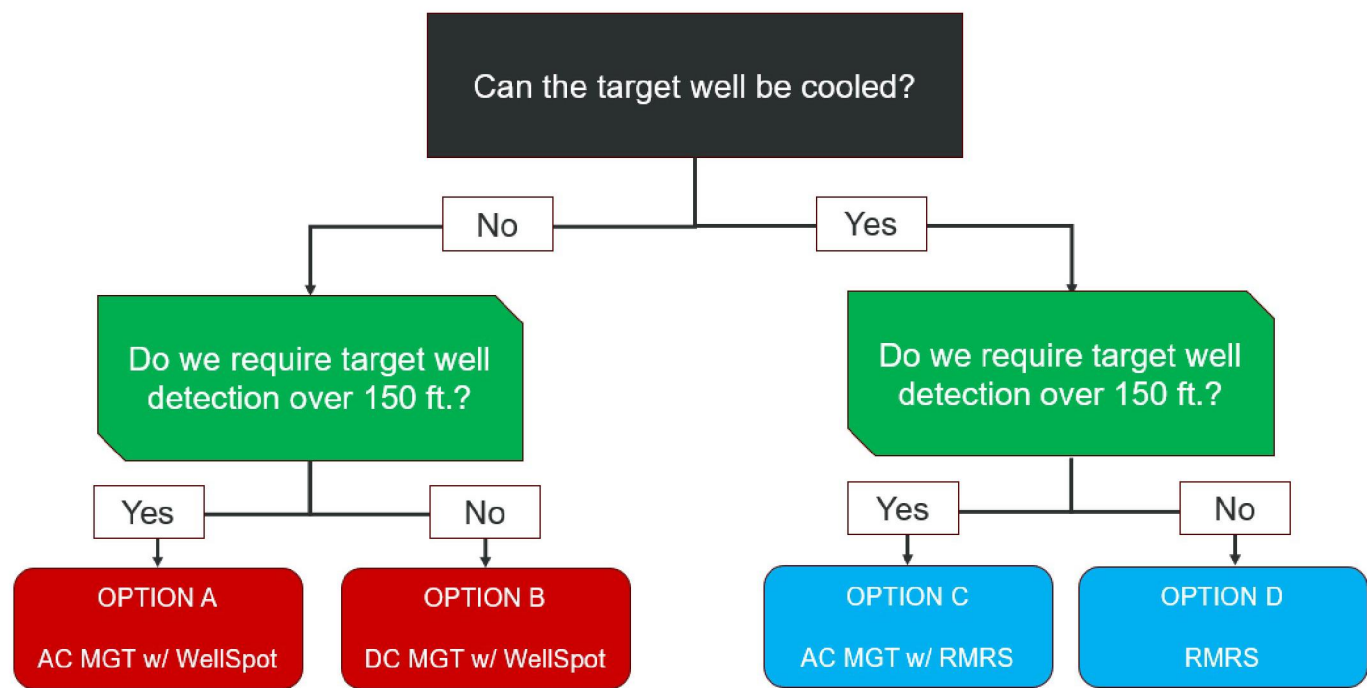


Figure 3 - Ranging Options Flow Chart

5. Temperature Analysis

Defining temperature ratings of the different ranging systems is complex due the nature of how heat shields (flasks) work. Electronic components have maximum internal temperatures in which they will fail if exceed. ‘Flasking’ electronics will provide shielding in the form of delaying the external temperature from heating up the electronics, however also providing a greenhouse effect for the electronics gradually heating up over time, causing the maximum external temperature to be related to time rather than a distinct temperature. Some tools (such as the WellSpot system) have flaked and unflaked components, each with individual temperature ratings.

Ranging System	Internal Temperature Limit (°F)	External Temperature Limit (°F)
MGT	500° F	500° F
RMRS w/o Flask	248° F	248° F
RMRS w/ Flask	248° F	Time Based
WellSpot	248° F	392° F

Figure 4 - Temperature Ratings of Various Ranging Systems

Plotting these ranging systems against expected downhole temperatures provides us the following survivability limits:

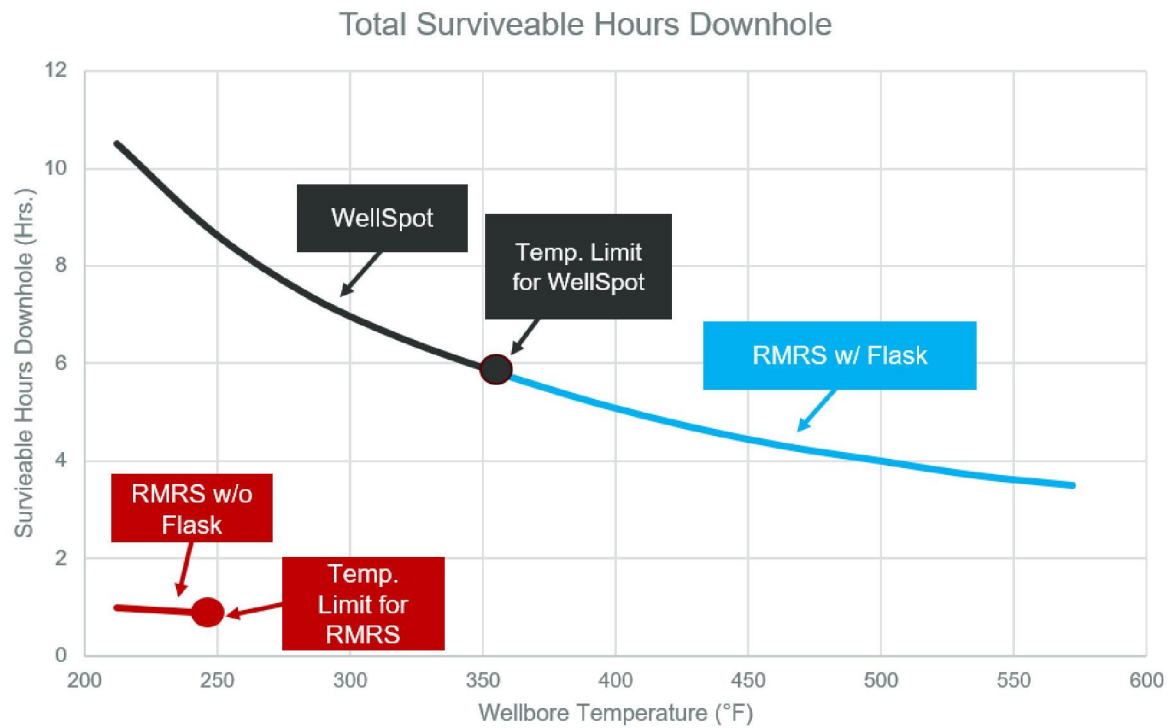


Figure 5 - Survivability of Tools Downhole

Considering the wireline logging operations for 19,000 ft., we will require a ~4.2 hours for RIH and POOH (150 ft./min winch speed). The wells temperature gradient will likely provide some heating relief as the entire well is not 575°F, however its recommended to plan cautiously incase of wireline issues during operations (unit power failure, hydraulic failure, tools stuck etc.).

Planning to cool the tools downhole is not recommended, the flaked systems shield the heat from dissipating. The base cooling rate is ~0.11° F/min if the external temperature is colder than the internal temperature. Plotting the cooling rates of a flaked tool that was inside a 356° F well, shows that if left in 68° F conditions, it will take ~27.5 hours to reach 68° F.

Due to the time required to cool flaked tools, it is not recommended to rely solely on wellbore temperature gradients to try and extend survivability.

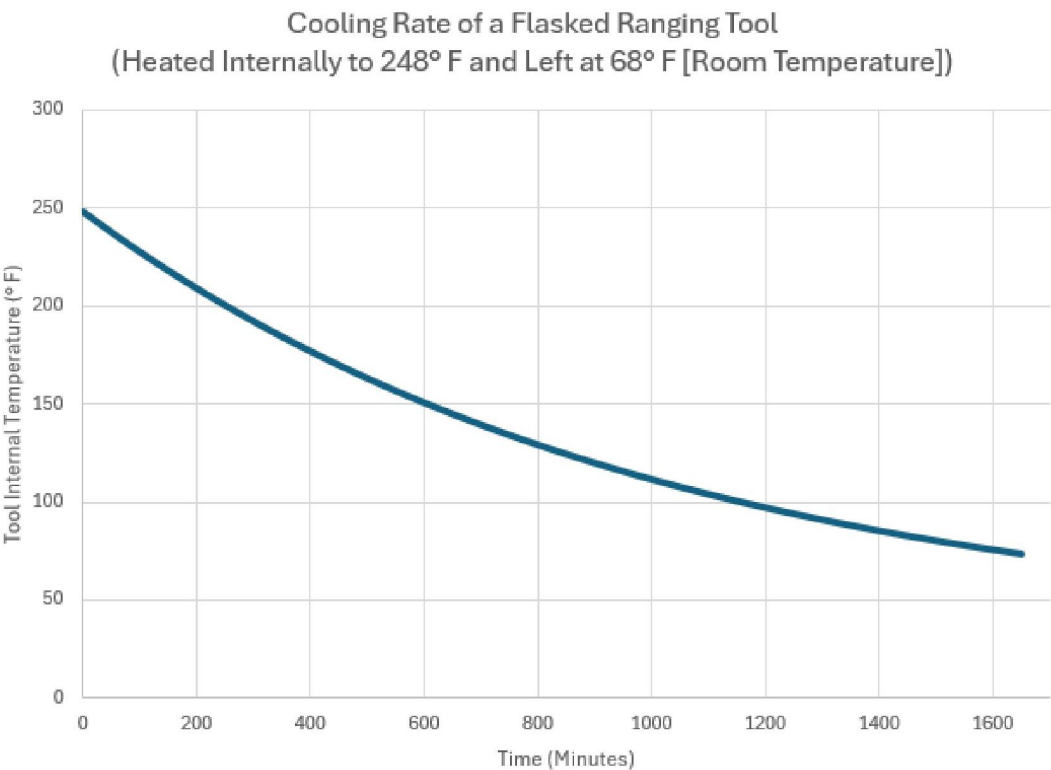


Figure 6 - Cooling Rate of Flasked Ranging Tools

6. Suggested Options - Rig Work Specifics

The rig work specifics for the four suggested options are to follow, with a table view found in the glossary. Please note that these ranging runs / shots are estimates, magnetic ranging plans are dynamic based on ranging results and trajectory.

- Option A: AC MGT (w/BaseStar MWD) and WellSpot
- Option B: DC MGT and WellSpot
- Option C: AC MGT (w/BaseStar MWD) and RMRS
- Option D: RMRS

Option A: AC MGT w/ WellSpot

Rig Work Instruction Summary

1. Drill WEST well to TD following revised plan
2. Run 5 ½" Casing to TD in WEST well
3. Recommended – Run wireline gyro inside casing to provide definitive target well survey for WEST.
4. Rig move to EAST SHL – drill from surface to 9,000 ft. MD.
5. Pick up and RIH BaseStar MWD system with ranging BHA (isolation subs) drilling well, pickup and RIH MGT coil with AC power supply via either OH wireline (with whip), or mono-conductor wireline with rated wireline, and GO-A connection
6. Drill out in EAST well – taking AC MGT shots every at least every 1,000 ft.
 - a. **MGT Shot 1** – 9,000 ft. MD
 - b. **MGT Shot 2** – 10,000 ft. MD
 - c. **MGT Shot 3** – 11,000 ft. MD
7. If drilling is ahead or on schedule it is recommended to continue ranging every 1,000 ft., however, to increase efficiency POOH MGT coil – continue drilling with BaseStar MWD system until 16,000 ft. MD
8. Pick up and RIH MGT with either OH wireline (with whip), or mono-conductor wireline with rated wireline, and GO-A connection
9. Continue drilling out in EAST – taking AC MGT shots at least every 1,000 ft.
 - a. **MGT Shot 4** – 16,000 ft. MD
 - b. **MGT Shot 5** – 17,000 ft. MD
10. Based on the ranging results at 17,000 ft. MD: (**WellSpot Shot 1**)
 - a. If the wells are trending and expected to be within 80 ft. distance to target at 17,500 ft. MD, remove MGT coil from well, prepare for WellSpot TPL run at 17,500 ft. MD behind current BHA (inside ranging BHA).
 - b. If wells are expected to be farther away than 80 ft. distance to target at 17,500 ft. MD, complete one more MGT shot at 17,500 ft. MD, then POOH and prepare for a WellSpot TPL run at 18,000 ft. MD
11. Continue drilling to 18,500 ft. MD, conduct WellSpot TPL run.
 - a. **WellSpot Shot 2** – 18,500 ft. MD
12. Continue drilling to 18,750 ft. MD. POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 3** – 18,750 ft. MD
13. POOH ranging BHA and pickup drilling BHA.
14. Continue drilling to 18,900 ft. MD. POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 4** – 18,900 ft. MD
15. POOH ranging BHA and pickup drilling BHA
16. Continue drilling to ~1-3 ft. distance to target from expected interception depth (~18,997 ft. MD). POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 5** – 18,997 ft. MD
17. POOH ranging BHA and pickup drilling BHA
18. Drill to interception point.

Option B: DC MGT w/ WellSpot

Rig Work Instruction Summary

1. Drill WEST well to TD following revised plan
2. Run 5 ½" Casing to TD in WEST well
3. Recommended – Run wireline gyro inside casing to provide definitive target well survey for WEST.
4. Rig move to EAST SHL – drill from surface to 9,000 ft. MD.
5. Pickup and RIH BHA with ranging BHA (isolation subs) drilling well, pickup and RIH MGT coil with DC power supply via either OH wireline (with whip), or mono-conductor wireline with rated wireline, and GO-A connection
6. Drill out in EAST well – taking DC MGT shots every at least every 500 ft.
 - a. **MGT Shot 1** – 9,000 ft. MD
 - b. **MGT Shot 2** – 9,500 ft. MD
7. After 9,500 ft. MD, POOH MGT coil and continue drilling out in EAST until 16,500 ft.
8. Pickup DC MGT coil
 - a. **MGT Shot 3** – 16,500 ft. MD
 - b. **MGT Shot 4** – 17,000 ft. MD
9. Based on the ranging results at 17,000 ft. MD: (**WellSpot Shot 1**)
 - a. If the wells are trending and expected to be within 80 ft. distance to target at 17,500 ft. MD, remove MGT coil from well, prepare for WellSpot TPL run at 17,500 ft. MD behind current BHA (inside ranging BHA).
 - b. If wells are expected to be farther away than 80 ft. distance to target at 17,500 ft. MD, complete one more MGT shot at 17,500 ft. MD, then POOH and prepare for a WellSpot TPL run at 18,000 ft. MD
10. Continue drilling to 18,500 ft. MD, conduct WellSpot TPL run.
 - a. **WellSpot Shot 2** – 18,500 ft. MD
11. Continue drilling to 18,750 ft. MD. POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 3** – 18,750 ft. MD
12. POOH ranging BHA and pickup drilling BHA.
13. Continue drilling to 18,900 ft. MD. POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 4** – 18,900 ft. MD
14. POOH ranging BHA and pickup drilling BHA
15. Continue drilling to ~1-3 ft. distance to target from expected interception depth (~18,997 ft. MD). POOH current BHA. Pickup and RIH dedicated ranging BHA. Complete WellSpot TPL run
 - a. **WellSpot Shot 5** – 18,997 ft. MD
16. POOH ranging BHA and pickup drilling BHA
17. Drill to interception point.

Option C: AC MGT w/ RMRS

Rig Work Instruction Summary w

1. Drill WEST well to TD following revised plan
2. Run 5 ½" Casing to TD in WEST well
3. Recommended – Run wireline gyro inside casing to provide definitive target well survey for WEST.
4. Rig move to EAST SHL – drill from surface to 9,000 ft. MD.
5. Pick up and RIH BaseStar MWD system with RMRS sub in drilling well, pickup and RIH MGT coil with AC power supply via either OH wireline (with whip), or mono-conductor wireline with rated wireline, and GO-A connection
6. Drill out in EAST well – taking AC MGT shots every at least every 1,000 ft.
 - a. **MGT Shot 1** – 9,000 ft. MD
 - b. **MGT Shot 2** – 10,000 ft. MD
 - c. **MGT Shot 3** – 11,000 ft. MD
7. If drilling is ahead or on schedule it is recommended to continue ranging every 1,000 ft., however, to increase efficiency POOH MGT coil – continue drilling with BaseStar MWD system until 16,000 ft. MD
8. Pick up and RIH MGT with either OH wireline (with whip), or mono-conductor wireline with rated wireline, and GO-A connection
9. Continue drilling out in EAST – taking AC MGT shot at 16,000 ft. MD.
 - a. **MGT Shot 4** – 16,000 ft. MD
10. Based on the ranging results at 16,500 ft. MD: (**RMRS Shot 1**)
 - a. If the wells are trending and expected to be within 160 ft. distance to target at 16,500 ft. MD, remove MGT coil from well, prepare for RIH with the RMRS probe. Conduct first RMRS shot at 16,500 ft. MD
 - b. If wells are expected to be farther away than 160 ft. distance to target at 16,500 ft. MD, complete one more MGT shot a 16,500 ft. MD, then POOH and prepare for an RMRS shot at 17,000 ft. MD
11. Continue drilling from 17,000 ft. MD to 18,000 ft. taking RMRS shots every 500 ft.
 - a. **RMRS Shot 2** – 17,000 ft.
 - b. **RMRS Shot 3** – 17,500 ft.
 - c. **RMRS Shot 4** – 18,000 ft.
12. Continue drilling from 18,000 ft. MD increasing shots to every 100 ft. For the last 100 ft. prior to intercept take shots every 30 ft.
 - a. **RMRS Shot 5** - 18,100 ft.
 - b. **RMRS Shot 6** -18,200 ft.
 - c. **RMRS Shot 7** - 18,300 ft.
 - d. **RMRS Shot 8** -18,400 ft.
 - e. **RMRS Shot 9** -18,500 ft.
 - f. **RMRS Shot 10** -18,600 ft.
 - g. **RMRS Shot 11** - 18,700 ft.
 - h. **RMRS Shot 12** - 18,800 ft.
 - i. **RMRS Shot 13** -18,900 ft.
 - j. **RMRS Shots 14** – 18,930 ft.
 - k. **RMRS Shot 15** - 18,960 ft.
 - l. **RMRS Shot 16** - 18,990 ft.

13. Drill to interception point.

Option D: RMRS

Rig Work Instruction Summary

1. Drill WEST well to TD following revised plan
2. Run 5 ½" Casing to TD in WEST well
3. Recommended – Run wireline gyro inside casing to provide definitive target well survey for WEST.
4. Rig move to EAST SHL – drill from surface to 9,000 ft. MD.
5. Pickup RMRS sub and drill from 9,000 ft. MD - 16,500 ft. MD: Pick up RMRS probe into target well (**RMRS Shot 1**)
6. Continue drilling from 17,000 ft. MD to 18,000 ft. taking RMRS shots every 500 ft.
 - a. **RMRS Shot 2** – 17,000 ft.
 - b. **RMRS Shot 3** – 17,500 ft.
 - c. **RMRS Shot 4** – 18,000 ft.
7. Continue drilling from 18,000 ft. MD increasing shots to every 100 ft. For the last 100 ft. prior to intercept take shots every 30 ft.
 - a. **RMRS Shot 5** - 18,100 ft.
 - b. **RMRS Shot 6** -18,200 ft.
 - c. **RMRS Shot 7** - 18,300 ft.
 - d. **RMRS Shot 8** -18,400 ft.
 - e. **RMRS Shot 9** -18,500 ft.
 - f. **RMRS Shot 10** -18,600 ft.
 - g. **RMRS Shot 11** - 18,700 ft.
 - h. **RMRS Shot 12** - 18,800 ft.
 - i. **RMRS Shot 13** -18,900 ft.
 - j. **RMRS Shots 14** – 18,930 ft.
 - k. **RMRS Shot 15** - 18,960 ft.
 - l. **RMRS Shot 16** - 18,990 ft.
8. Drill to interception point.

7. WellSpot™ Deployment in Ranging BHA

Based on the intercept plan for the GLADE intercept, the WellSpot™ tool will be deployed in a modified drilling assembly, acquiring ranging data without the need for a BHA trip. The following is an overview of the procedure for running a dedicated ranging BHA:

- A section of non-magnetic pipe is required for the bottom section of the BHA where the WellSpot™ tool will be seated
- Isolation subs are used throughout the BHA to isolate the WellSpot™ tool from the excitation section of the WellSpot™ assembly.
- The ranging BHA is deployed to within a couple of joint lengths of TD and the tool is inserted into the pipe thru the side entry sub.
- The BHA is lowered to TD and the tool is put into position.
- The bottom hole section is logged with the tool seated into the non-magnetic BHA.
- Upper sections of the hole may be logged by repositioning the ranging assembly in the BHA and/or repositioning the BHA.

The following table is a sample WellSpot ranging BHA configuration. Note that this BHA will start immediately above the drilling BHA.

Component
Drilling BHA
Isolation Sub #1
NM Flex Collar
NM Flex Pony Collar
Isolation Sub #2
Isolation Sub #3
HWDP
Isolation Sub #4
Isolation Sub #5
4 X HWDP
Isolation Sub #6
Isolation Sub #7
Drill String

Figure 7 - Components of DH Ranging BHA

8. Estimate Time Ranging Operations

Under normal operating conditions the WellSpot data collection plan will require high data density for the deeper sections of the ranging interval. This data will typically be taken at 1 ft. intervals for the bottom 10 ft. and increased to 5 – 10 ft. intervals up to 50 ft. off bottom. This data will be analyzed by the ranging specialist and any infill data will be taken on a 2nd descent if required, or temperature permitting

MGT data collection happens at individual depths that the coil is deployed to and picked up by the MWD survey probe. Ranging data is taken during the survey and sent to surface as a component of the transmitted downhole data.

RMRS data collection happens at individual depths that the sensor is deployed to. Once the sensor is set to a depth, with pumps on the BHA is slowly wiped back, causing the magnetic bit sub to spin. The BHA wipes take 10-20 minutes depending on proximity.

The estimated ranging run time for WellSpot using a ranging BHA:

Event	Time
Pull off bottom required number of stands	Rig Dependent
Rig up TPL	3 hr.
WL TIH 150 ft/min	2 hr.
Logging 50 ft. data	1 hr.
WL POOH 150 ft/min	2 hr.
Rig Down TPL	3 hr.
Total	~11 hr.

Figure 8 - Estimated Time Per Ranging Run Using Ranging BHA

The estimated ranging run time for MGT:

Event	Time
Waiting on survey and analysis	5-10 minutes
Analysis	15 minutes
Total	~0.5 hr.

Figure 9 - Estimated Time Per Ranging Shot Using MGT

The estimated ranging run time for RMRS:

Event	Time
BHA Wipe	10 – 20 minutes
Analysis	15
Total	~0.5 hr.

Figure 10 - Estimated Time Per Ranging Shot Using RMRS

9. Services Required

The following services are required for this intercept:

Sperry Drilling:

- A) Options 1 & 2: WellSpot™ Kit w/ isolation subs
- B) Options 1,2 & 3: MGT Kit w/ DC or AC Power supply
- C) Options 1 & 3: BaseStar MWD service
- D) Options 3 & 4: RMRS system with high temperature probes and magnets

Directional Drilling Provider:

- A) MWD specs to see if DC MGT option is available

OXY

- A) Gyro – Recommended wireline gyro in target well after TD
- B) Casing for target well
- C) Wireline – Must be rated for downhole temperatures.
 - a. MGT and RMRS require GO-A mono-conductor cased hole wire
 - b. WellSpot requires 7-conductor open-hole wire

10. Glossary

Rig Work Specifics

Please note that these ranging runs / shots are estimates, magnetic ranging plans are dynamic based on ranging results and trajectory.

Measured Depth (MD) [ft.]	Expected C2C [ft.]	Option A		Option B		Option C		Option D	
		Tool Type	Shot #	Tool Type	Shot #	Tool Type	Shot #	Tool Type	Shot #
9,000.0	103.6	AC MGT	1	DC MGT	1	AC MGT	1		
9,100.0	107.9								
9,200.0	114.0								
9,300.0	121.9								
9,400.0	131.5								
9,500.0	142.8			DC MGT	2				
9,600.0	156.2								
9,700.0	170.1								
9,800.0	184.2								
9,900.0	198.1								
10,000.0	210.2	AC MGT	2			AC MGT	2		
10,100.0	220.5								
10,200.0	228.8								
10,300.0	235.4								
10,400.0	240.1								
10,500.0	242.9								
10,600.0	244.1								
10,700.0	244.9								
10,800.0	245.8								
10,900.0	246.7								
11,000.0	247.6	AC MGT	3			AC MGT	3		
11,100.0	248.5								
11,200.0	249.4								
11,300.0	250.2								
11,400.0	251.1								
11,500.0	252.0								
11,600.0	252.9								
11,700.0	253.8								
11,800.0	254.7								
11,900.0	255.5								
12,000.0	256.4								
12,100.0	257.3								
12,200.0	258.2								
12,300.0	259.1								
12,400.0	260.0								
12,500.0	260.9								

12,600.0	261.7								
12,700.0	262.6								
12,800.0	263.5								
12,900.0	264.4								
13,000.0	265.3								
13,100.0	266.2								
13,200.0	267.0								
13,300.0	267.9								
13,400.0	268.8								
13,500.0	269.7								
13,600.0	270.6								
13,700.0	271.5								
13,800.0	272.4								
13,900.0	273.2								
14,000.0	274.1								
14,100.0	275.0								
14,200.0	275.9								
14,300.0	276.8								
14,400.0	277.7								
14,500.0	278.1								
14,600.0	275.3								
14,700.0	271.0								
14,800.0	266.6								
14,900.0	262.2								
15,000.0	257.8								
15,100.0	253.3								
15,200.0	247.7								
15,300.0	240.1								
15,400.0	232.3								
15,500.0	224.4								
15,600.0	216.4								
15,700.0	208.6								
15,800.0	200.6								
15,900.0	192.7								
16,000.0	184.7	AC MGT	4			AC MGT	4		
16,100.0	176.9								
16,200.0	169.0								
16,300.0	161.0								
16,400.0	153.2								
16,500.0	145.2			DC MGT	3				
16,600.0	137.3								
16,700.0	129.3								
16,800.0	121.5								
16,900.0	113.7								
17,000.0	106.2	AC MGT	5	DC MGT	4	RMRS	5	RMRS	1
17,100.0	98.9								

17,200.0	91.6								
17,300.0	84.7								
17,400.0	77.8								
17,500.0	71.2	WellSpot	6	WellSpot	5	RMRS	6	RMRS	2
17,600.0	64.7								
17,700.0	58.5								
17,800.0	52.5								
17,900.0	46.6								
18,000.0	41.0					RMRS	7	RMRS	3
18,100.0	35.5					RMRS	8	RMRS	4
18,200.0	30.2					RMRS	9	RMRS	5
18,300.0	25.1					RMRS	10	RMRS	6
18,400.0	20.2					RMRS	11	RMRS	7
18,500.0	15.5	WellSpot	7	WellSpot	6	RMRS	12	RMRS	8
18,600.0	10.9					RMRS	13	RMRS	9
18,700.0	6.6	WellSpot	8	WellSpot	7	RMRS	14	RMRS	10
18,800.0	2.4					RMRS	15	RMRS	11
18,900.0	1.3	WellSpot	9	WellSpot	8	RMRS	16	RMRS	12
19,000.0	3.7	WellSpot	10	WellSpot	9	RMRS	17-20	RMRS	13-16
19,100.0	0.0								
19,200.0	0.0								

Figure 11 - Rig Work Instructions Per Option

List of Figures

Figure 1 - Distance to Target of Various Ranging Systems	4
Figure 2 - EOU Analysis of 'Revised Plan'	5
Figure 3 - Ranging Options Flow Chart.....	6
Figure 4 - Temperature Ratings of Various Ranging Systems	6
Figure 5 - Survivability of Tools Downhole	7
Figure 6 - Cooling Rate of Flashed Ranging Tools	8
Figure 7 - Components of DH Ranging BHA.....	14
Figure 8 - Estimated Time Per Ranging Run Using Ranging BHA.....	15
Figure 9 - Estimated Time Per Ranging Shot Using MGT	15
Figure 10 - Estimated Time Per Ranging Shot Using RMRS	15
Figure 11 - Rig Work Instructions Per Option.....	19



HALLIBURTON

Disclaimer

Because of the uncertainty of variable well conditions the necessity of relying on facts and supporting services furnished by others, Halliburton IS UNABLE TO GUARANTEE THE EFFECTIVENESS OF THE PRODUCTS, SUPPLIES OR MATERIALS, NOR THE RESULTS OF ANY TREATMENT OR SERVICE, NOR THE ACCURACY OF ANY CHART INTERPRETATION, RESEARCH ANALYSIS, JOB RECOMMENDATION OR OTHER DATA FURNISHED BY Halliburton. Halliburton personnel will use their best efforts in gathering such information and their best judgment in interpreting it, but Customer agrees that Halliburton shall not be liable for and Customer SHALL RELEASE, DEFEND AND INDEMNIFY Halliburton against any damages or liability arising from the use of such information even if such damages are contributed to or caused by the negligence, fault or strict liability of Halliburton.





J – APD

FORM 2A Rev 05/22	State of Colorado Energy & Carbon Management Commission 1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone: (303) 894-2100 Fax: (303) 894-2109	 	Document Number: 403656949						
	Oil and Gas Location Assessment		Date Received: 04/25/2024						
This Oil and Gas Location Assessment is to be submitted to the ECMC for approval prior to any ground disturbance activity associated with oil and gas operations. Approval of this Oil and Gas Location Assessment will allow for the construction of the below specified Location; however, it does not supersede any land use rules applied by the local land use authority. Please see the ECMC website at https://ecmc.state.co.us/ for all accompanying information pertinent this Oil and Gas Location Assessment.			Location ID: 487829 OGDP ID: Expiration Date: 09/11/2027						
☒ New Location ☐ Refile ☐ Amend Existing Location # _____ If this Location assessment is a component of an Oil and Gas Development Plan (OGDP) application, enter the OGDP docket number(s). <table border="1"><thead><tr><th>Docket Number</th><th>OGDP ID</th><th>OGDP Name</th></tr></thead><tbody><tr><td>299999998</td><td></td><td></td></tr></tbody></table> If this Location assessment is part of an approved Oil and Gas Development Plan, enter the OGDP ID number(s). <No existing OGDP number provided>				Docket Number	OGDP ID	OGDP Name	299999998		
Docket Number	OGDP ID	OGDP Name							
299999998									
CONSULTATION ☐ This location is included in a Comprehensive Area Plan (CAP). CAP ID # _____ ☐ This Location or its associated new access road, utility, or Pipeline corridor meets Rule 309.e.(2).A, B, or C. ☐ This Location is within 2,640 feet of a GUDI or Type III Well per Rule 411.b.(4). ☐ This Location includes a Rule 309.e.(2).E variance request. ☐ This location includes a Rule 309.f.(1).A.ii. variance request.									
Operator Operator Number: <u>66561</u> Name: <u>OXY USA INC</u> Address: <u>PO BOX 173779</u> City: <u>DENVER</u> State: <u>CO</u> Zip: <u>80217-3779</u>		Contact Information Name: <u>Matt Wells</u> Phone: <u>(720) 929-3403</u> Fax: <u>()</u> email: <u>Matt_wells@oxy.com</u>							
FINANCIAL ASSURANCE FOR THIS LOCATION (check all that apply) ☒ Plugging, Abandonment, and Reclamation <u>20010124</u> ☐ Centralized E&P Waste Management Facility _____ ☐ Gas Gathering, Gas Processing, and Underground Gas Storage Facilities _____ ☐ Surface Owner Protection Bond. _____									
Federal Financial Assurance ☐ In checking this box, the Operator certifies that it has provided or will provide at least this amount of Financial Assurance to the federal government for one or more Wells on this Location. Amount of Federal Financial Assurance \$ _____									
LOCATION IDENTIFICATION Name: <u>GLADE</u> Number: _____									

FORM 2 Rev 10/24	State of Colorado Energy & Carbon Management Commission 1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone: (303) 894-2100 Fax: (303) 894-2109	Document Number: 404023428 Date Received: 12/31/2024
APPLICATION FOR PERMIT TO		
☒ Drill ☐ Deepen ☐ Re-enter ☐ Recomplete and Operate Amend ☐ TYPE OF WELL OIL ☐ GAS ☐ COALBE ☐ ☒ GEO THERMAL ☐ OTHER: _____ ZONE TYPE SINGLE ZONE ☒ MULTIPLE ZONES ☐ COMMINGLE ZONES ☐ Refile ☐ Sidetrack ☐		
Well Name: <u>GLADE</u> Well Number: <u>EAST</u> Name of Operator: <u>OXY USA INC</u> ECMC Operator Number: <u>66561</u> Address: <u>PO BOX 173779</u> City: <u>DENVER</u> State: <u>CO</u> Zip: <u>80217-3779</u> Contact Name: <u>Loryn Spady</u> Phone: <u>(720)9293504</u> Fax: <u>()</u> Email: <u>Loryn_Spady@oxy.com</u>		
FINANCIAL ASSURANCE FOR PLUGGING, ABANDONMENT, AND RECLAMATION		
ECMC Financial Assurance ☒ The Operator has provided or will provide Financial Assurance to the ECMC for this Well. Surety ID Number (if applicable): <u>20230087</u>		
Federal Financial Assurance ☐ In checking this box, the Operator certifies that it has provided or will provide at least this amount of Financial Assurance to the federal government for this Well. (Per Rule702.a.) Amount of Federal Financial Assurance \$ _____		
WELL LOCATION INFORMATION		
Surface Location QtrQtr: <u>NESE</u> Sec: <u>2</u> Twp: <u>3N</u> Rng: <u>66W</u> Meridian: <u>6</u> Footage at Surface: <u>2134</u> Feet FNL/FSL <u>FSL</u> <u>1146</u> Feet FEL/FWL <u>FEL</u> Latitude: <u>40.252551</u> Longitude: <u>-104.738967</u> GPS Data: _____ GPS Quality Value: <u>1.3</u> Type of GPS Quality Value: <u>PDOP</u> Date of Measurement: <u>12/03/2024</u> Ground Elevation: <u>4901</u> Field Name: _____ Field Number: _____ Well Plan: is ☒ Directional ☐ Horizontal (highly deviated) ☐ Vertical If Well plan is Directional or Horizontal attach Deviated Drilling Plan and Directional Data.		
Subsurface Locations Top of Productive Zone (TPZ) Sec: <u>2</u> Twp: <u>3N</u> Rng: <u>66W</u> Footage at TPZ: <u>2137</u> FSL <u>1188</u> FEL Measured Depth of TPZ: <u>10558</u> True Vertical Depth of TPZ: <u>10556</u> FNL/FSL FEL/FWL		

Base of Productive Zone (BPZ)

Sec: 2Twp: 3NRng: 66WFootage at BPZ: 2287FSL 2376FWL
Measured Depth of BPZ: 20162True Vertical Depth of BPZ: 20000FNL/FSLFEL/FWL

Bottom Hole Location (BHL)

Sec: 2Twp: 3NRng: 66WFootage at BHL: 2287FSL 2376FWL
FNL/FSLFEL/FWL

LOCAL GOVERNMENT PERMITTING INFORMATION

County: WELDMunicipality: N/A

Is the Surface Location of this Well in an area designated as one of State interest and subject to the requirements of § 24-65.1-108 C.R.S.? Yes

Per §34-60-106(1)(f)(I)(A) C.R.S and §37-90.5-107(2)(b)(I) C.R.S, the following questions pertain to the Relevant Local Government approval of the siting of the proposed Oil and Gas or Deep Geothermal Locations.

The Energy and Carbon Management Act and the Geothermal Resources Act provide that when “applying for a permit to drill,” operators must include proof that they sought a local government siting permit and the disposition of that permit application, or that the local government does not have siting regulations.

Does the Relevant Local Government regulate the siting of Oil and Gas and Deep Geothermal Locations, with respect to this Location?

☒ Yes☐ No

☒ If yes, in checking this box, I hereby certify that an application has been filed with the local government with jurisdiction to approve the siting of the proposed oil and gas location.

The disposition of the application filed with the Relevant Local Government is: ApprovedDate of Final Disposition: 12/11/2024

Comments: GLADE Pilot Project

GEOTHERMAL

Well Overview

The following questions determine informational requirements based on Well type:

Which type of Geothermal Well is this? Select one of the following: Science Well

Will this well be constructed using cementing methodologies other than those listed in Rule 408.f? No

If Yes, what method will be used:

Please describe the cementing method to be used in detail:

Surface: Casing will be cemented using a pump and plug method with a 13.5 ppg lead cement and a 14.8 ppg tail cement. A water-based spacer will be pumped ahead of lead cement. Lead/tail interface is planned for 1850 ft MD. Cement will be pumped with excess to ensure cement to surface.

Intermediate: Casing will be cemented using a pump and plug method with a 12.5 ppg lead cement and a 13.2 ppg tail cement. A water-based spacer will be pumped ahead of lead cement. Lead/tail interface is planned for 7100 ft MD. Cement will be pumped with excess to ensure cement to surface. Additives will be used in the slurries to mitigate bradenhead pressure risks.

Science Well Information

Please describe the timing, duration, and types of tests that may be run in the wellbore for scientific purposes:

The first well is currently planned for spud in early April 2025. All phases of drilling are expected to take 60 days per well, for a total planned duration of 120 days on the pad. This duration also includes the time required to perform an intercept between the two wellbores at their toes.

Upon completion of drilling and wellbore interception, testing may be conducted to evaluate the thermal potential and heat extraction capabilities. These tests could include running thermal logs to measure in-situ temperatures or setting up surface equipment to circulate fluid through the wellbores. Data collected during these tests, such as flow rates, temperatures, and heat extraction metrics, will be analyzed at the surface to assess the system's performance.

Please describe the reason for the scientific well and its potential future use:

Oxy aims to surpass the limits of current geothermal drilling technology by safely drilling two adjacent high-temperature geothermal wells (i.e., twin wells) at the GLADE location. These wells are part of a project funded under a Funding Opportunity Announcement (FOA) issued by the Department of Energy (DOE). The primary objective is to demonstrate the capability to penetrate deep into granitic basement rock at drilling rates and cycle times that could support economic viability for future geothermal projects.

Located in the Denver-Julesburg Basin, the wells are planned to be drilled to a target true vertical depth (TVD) of 20,000 feet, with downhole temperatures potentially approaching 572 °F. By integrating existing and novel drilling technologies, we aim to achieve a significant increase in daily drilling rates, surpassing 25%, well over well.

To achieve these objectives, we will deploy cutting-edge high-temperature downhole tools, implement advanced cloud-based real-time drilling optimization, and leverage technologies to reduce non-productive time, all while prioritizing operational safety. The twin-well design enables a robust comparative analysis of drilling performance both within and between wells, providing reliable insights into geothermal drilling equipment and best practices.

The future use of these wells remains uncertain. If the wells are successfully intercepted to create a closed-loop system, flow testing may be conducted using a small surface test facility. The twin-well design also provides flexibility for future applications, potentially supporting either enhanced geothermal systems (EGS) or advanced geothermal systems (AGS). However, any future use will depend on the results obtained during drilling and the availability of funding to support subsequent phases.

SURFACE AND MINERAL OWNERSHIP AT WELL'S OIL & GAS OR DEEP GEOTHERMAL LOCATION

Surface Owner of the land at this Well's Oil and Gas Or Deep Geothermal Location: ☒ Fee ☐ State ☐ Federal ☐ Indian

Mineral Owner beneath this Well's Oil and Gas Or Deep Geothermal Location: ☒ Fee ☐ State ☐ Federal ☐ Indian

Surface Owner Protection Bond (if applicable): _____ Surety ID Number (if applicable): _____

MINERALS DEVELOPED BY WELL

The ownership of all the minerals that will be developed by this Well is (check all that apply):

- ☐ Fee
- ☐ State
- ☐ Federal
- ☐ Indian
- ☒ N/A

LEASE INFORMATION

Using standard QtrQtr, Section, Township, Range format describe one entire mineral lease as follows:
* If this Well is within a unit, describe a lease that will be developed by the Well.
* If this Well is not subject to a unit, describe the lease that will be produced by the Well.
(Attach a Lease Map or Lease Description or Lease if necessary.)

Total Acres in Described Lease: Described Mineral Lease is: ☐ Fee ☐ State ☐ Federal ☐ Indian
Federal or State Lease # _____

SAFETY SETBACK INFORMATION

Distance from Well to nearest:

Building: 1109 Feet
Building Unit: 1834 Feet
Public Road: 1142 Feet
Above Ground Utility: 1730 Feet
Railroad: 5280 Feet
Property Line: 527 Feet

INSTRUCTIONS:
- Specify all distances per Rule 308.b.(1).
- Enter 5280 for distance greater than 1 mile.
- Building - nearest building of any type. If nearest Building is a Building Unit, enter same distance for both.
- Building Unit – as defined in 100 Series Rules.

OBJECTIVE FORMATIONS

Objective Formation(s)	Formation Code	Spacing Order Number(s)	Unit Acreage Assigned to Well	Unit Configuration (N/2, SE/4, etc.)
PRECAMBRIAN	PCMB			

Federal or State Unit Name (if appl): Unit Number: _____

SUBSURFACE MINERAL SETBACKS

Enter 5280 for distance greater than 1 mile.

Is this Well within a unit? _____

If YES:

Enter the minimum distance from the Completed Zone of this Well to the Unit Boundary: Feet
Enter the minimum distance from the Completed Zone of this Well to the Completed Zone of an offset Well within the same unit permitted or completed in the same formation: Feet

If NO:

Enter the minimum distance from the Completed Zone of this Well to the Lease Line of the described lease: Feet
Enter the minimum distance from the Completed Zone of this Well to the Completed Zone of an offset Well producing from the same lease and permitted or completed in the same formation: Feet

Exception Location

☐ If this Well requires the approval of a Rule 401.c Exception Location, enter the Rule or spacing order number and attach the Exception Location Request and Waivers. _____

SPACING & FORMATIONS COMMENTS

DRILLING PROGRAM

Proposed Total Measured Depth: 20162 Feet TVD at Proposed Total Measured Depth 20000 Feet

Distance from the proposed wellbore to nearest existing or proposed wellbore belonging to another operator, including plugged wells:

Enter distance if less than or equal to 1,500 feet: 156 Feet ☐ No well belonging to another operator within 1,500 feet

Will a closed-loop drilling system be used? Yes

Is H2S gas reasonably expected to be encountered during drilling operations at concentrations greater than or equal to 100 ppm? No If yes, attach an H2S Drilling Plan unless a plan was already submitted with the Form 2A per Rule 304.c.(10).

Will there be hydraulic fracture treatment at a depth less than 2,000 feet in this well? No

Will salt sections be encountered during drilling? No

Will salt based (>15,000 ppm Cl) drilling fluids be used? Yes

Will oil based drilling fluids be used? Yes

BOP Equipment Type: ☒ Annular Preventor ☒ Double Ram ☒ Rotating Head ☐ None

Beneficial reuse or land application plan submitted? No

Reuse Facility ID: or Document Number:

CASING PROGRAM

Casing Type	Size of Hole	Size of Casing	Grade	Wt/Ft	Csg/Liner Top	Setting Depth	Sacks Cmt	Cmt Btm	Cmt Top
CONDUCTOR	26	20	A53B	79	0	80	60	80	0
SURF	17+1/2	13+3/8	L80	54.5	0	2350	770	2350	0
1ST	12+1/4	9+5/8	P110IC	47	0	10608	1700	10608	0
OPEN HOLE	8+1/2				10608	20162			

☐ Conductor Casing is NOT planned

POTENTIAL FLOW AND CONFINING FORMATIONS

Zone Type	Formation /Hazard	Top M.D.	Top T.V.D.	Bottom M.D.	Bottom T.V.D.	TDS (mg/L)	Data Source	Comment
Groundwater	Fox Hills and Shallower	17	17	472	472	501-1000	USGS	Depth from DWR
Confining Layer	Pierre Shale	473	473	671	671			
Groundwater	Upper Pierre Aquifer	672	672	1577	1577	501-1000	Electric Log Calculation	Controlled by samples
Confining Layer	Pierre Shale	1578	1578	4309	4309			
Hydrocarbon	Sussex	4310	4310	4609	4609			Productive
Confining Layer	Pierre Shale	4610	4610	7112	7112			
Hydrocarbon	Niobrara	7113	7113	7355	7355			
Hydrocarbon	Codell	7356	7356	7371	7371			
Confining Layer	Carlile	7372	7372	7409	7409			
Hydrocarbon	Greenhorn	7410	7410	7596	7596			
Confining Layer	Graneros Shale	7597	7597	7857	7857			
Hydrocarbon	Dakota	7858	7858	8034	8034			
Confining Layer	Morrison	8035	8035	8298	8298			
Groundwater	Entrada	8299	8299	8423	8423	>10000	USGS	
Confining Layer	Lykins	8424	8424	8958	8958			
Confining Layer	Blaine	8959	8959	9004	9004			Anhydrite
Groundwater	Lyons	9005	9005	9196	9196	>10000	USGS	
Groundwater	Lower Satanka	9197	9197	9362	9362	>10000	USGS	
Groundwater	Wolfcamp	9363	9363	9974	9974	>10000	USGS	
Groundwater	Fountain	9975	9975	10557	10555	>10000	USGS	
Geothermal	Precambrian Basement	10558	10556	20162	20000			Igneous/Metamorphic; *base MD/TVD is BHL per ECMC

OPERATOR COMMENTS AND SUBMITTAL

Comments

PLEASE ENSURE ALL CORRESPONDENCE ASSOCIATED WITH THIS PERMIT GOES TO ANALYST AND DJREGULATORY EMAIL ADDRESSES, AS LISTED ON THIS PERMIT.

Offset well buffer description for the subject well has been included on this permit for review as an attachment labeled "Other."

Surface user agreement is in the Form 2A (Doc-403656949) under attachment number 403765166

Base of Productive Zone is the same as Bottom Hole Location.

The nearest offset wellbore permitted or completed in the same formation is GLADE WEST, DOC ID: 404023513.

Project Overview:
The GLADE project is a groundbreaking initiative to drill a first-of-its-kind, deep geothermal well pair in the Denver-Julesburg (DJ) Basin. These wells are part of a project funded under a Funding Opportunity Announcement (FOA) issued by the Department of Energy (DOE). The primary objective is to demonstrate the ability to penetrate deep into granitic basement rock at economically viable drilling rates, paving the way for the next generation of geothermal energy systems.

Currently, most geothermal projects worldwide focus on utilizing existing hydrothermal systems, where hot water is extracted from naturally occurring reservoirs. However, a new frontier of geothermal development is emerging with enhanced geothermal systems (EGS) and advanced geothermal systems (AGS). EGS involves creating artificial reservoirs by fracturing hot, dry rock and circulating fluid to extract heat, while AGS leverages conduction from hot rock to transfer heat without the need for a fluid reservoir. These systems are particularly well-suited for high-temperature, hard basement rock, but the high cost of drilling in such conditions has been a major barrier to widespread adoption.

The GLADE project aims to overcome this limitation by demonstrating the use of modern oilfield drilling technologies, combined with innovative wellbore cooling techniques, to significantly enhance rates of penetration (ROP) and extend time between equipment failures. By achieving these advancements, the project seeks to make deep geothermal systems more economically viable, enabling broader deployment in the renewable energy sector.

The project involves drilling two deep geothermal wells to a target true vertical depth (TVD) of 20,000 feet, with approximately 9,500 feet of drilling through granitic basement rock. Downhole temperatures may reach as high as 572 °F, presenting a significant technical challenge. The wells are designed with a spacing of approximately 300 feet in the granitic section to minimize thermal interaction during circulation and ensure efficient heat transfer. At the surface, the wellheads are positioned 100 feet apart to allow simultaneous operations, such as drilling one well while using the other for ranging and interception support.

To optimize drilling efficiency, the well paths will maintain a vertical trajectory to a depth of approximately 9,000 feet, minimizing torque and drag, side forces, and drill pipe fatigue. This design ensures mechanical stability and enhances the overall performance of drilling operations. The drilling program is scheduled to commence in April 2024, with a total planned duration of 120 days on location. This timeline includes the completion of both wells and the integration of ranging and intercept operations to connect the well toes. Establishing this connection between the wells will create a closed loop (AGS) system.

Through this ambitious effort, the GLADE project seeks to demonstrate the feasibility of drilling cost-effective, high-performance geothermal wells in challenging conditions, thereby contributing to the advancement of renewable energy technologies and the development of sustainable energy solutions for the future.

This application is in a Comprehensive Area Plan

No

CAP #:

Oil and Gas Development Plan Name

OGDP ID#:

Location ID:

487829

I hereby certify all statements made in this form are, to the best of my knowledge, true, correct, and complete.

Signed:

Print Name:

Loryn Spady

Title:

Regulatory Analyst

Date:

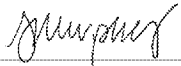
12/31/2024

Email:

DJRegulatory@oxy.com

Operator must have a valid water right or permit allowing for industrial use or purchased water from a seller that has a valid water right or permit allowing for industrial use, otherwise an application for a change in type of use is required under Colorado law. Operator must also use the water in the location set forth in the water right decree or well permit, otherwise an application for a change in place of use is required under Colorado law. Section 37-92-103(5), C.R.S. (2011).

Based on the information provided herein, this Application for Permit-to-Drill complies with ECMC Rules, applicable orders, and SB 19-181 and is hereby approved.

ECMC Approved: 

Director of ECMC

Date: 2/10/2025

Expiration Date: 02/09/2028

API NUMBER

05 123 52916 00

CONDITIONS OF APPROVAL, IF ANY LIST

All representations, stipulations and conditions of approval stated in the Form 2A for this location shall constitute representations, stipulations and conditions of approval for this Form 2 Permit-to-Drill and are enforceable to the same extent as all other representations, stipulations and conditions of approval stated in this Permit-to-Drill.

COA Type	Description
Drilling/Completion Operations	Bradenhead tests shall be performed according to the following schedule and Form 17 submitted within 10 days of each test: 1) Within 60 days of rig release. 2) Annually as required by Rule 419.c.
Drilling/Completion Operations	1) Submit Form 42 electronically to ECMC 2 business days prior to MIRU (spud notice) for the first well activity with a rig on the pad and provide 2 business day spud notice via Form 42 for all subsequent wells drilled on the pad. 2) Comply with Rule 408.j. and provide cement coverage from TD to a minimum of 500' above Sussex. Verify coverage with a cement bond log. 3) Oil based drilling fluid can only be used after all groundwater has been isolated.
Drilling/Completion Operations	In accordance with Rule 1314.b.(1), Operator will run a pipe analysis log or caliper log in conjunction with any other logging requirements of Rule 408.r.
Drilling/Completion Operations	Operator will Submit a Form 4-Notice of Intent requesting approval of any circulation of fluid in the production hole section for testing reasons prior to such operations.
Drilling/Completion Operations	Significant lost circulation encountered during drilling will be reported as soon as practicable to the ECMC. Such notice will be provided on a Form 42, Field Operations Notice – Notice of Significant Lost Circulation. For instances of lost circulation encountered during drilling, tour sheets or drilling operations logs covering the time interval(s) where lost circulation was encountered will be attached to the Form 5 – Drilling Completion Report.
5 COAs	

Operator Best Management Practices		
No	BMP/COA Type	Description
1	Drilling/Completion Operations	Anti-Collision: Kerr-McGee will perform an anti-collision evaluation of all active (producing, shut in, or temporarily abandoned) offset wellbores that have the potential of being within one hundred fifty (150) feet of a proposed well prior to drilling operations for the proposed well. Notice shall be given to all offset operators within one hundred fifty (150) feet prior to drilling.
2	Drilling/Completion Operations	In one of the two GLADE wells, Oxy plans to run CBL, Gamma Ray, Resistivity, Density, Neutron, and Sonic logs through the entire intermediate hole section, and an Image Log across the deepest 3000' of the intermediate hole section. Additionally, Oxy plans to run Gamma Ray, Resistivity, Density, Neutron, Dipole Sonic, Image Log, and Spectroscopy logs through the entire production hole section. In the other GLADE well, Oxy plans to run CBL, Gamma Ray, Resistivity, Density, and Neutron logs in the intermediate section and Gamma Ray, Resistivity, Density, and Neutron logs in the production hole section. This logging program is subject to changes based on vendor and tool availability and hole conditions that may exceed logging tool limitations.

Total: 2 comment(s)

ATTACHMENT LIST

Att Doc Num	Name
2168656	WELLBORE DIAGRAM
2168658	WELL LOCATION PLAT
404023428	FORM 2 SUBMITTED
404032061	OTHER
404033078	DEVIATED DRILLING PLAN
404033082	DIRECTIONAL DATA
404087438	OFFSET WELL EVALUATION

Total Attach: 7 Files

General Comments

User Group	Comment	Comment Date
Permit	Final Review Complete.	02/07/2025
Permit	-Uploaded updated well location plat from the operator -Passed Permit Review	01/22/2025
Permit	-Removed field name since it's not needed since permit is for a geothermal well -Selected the minerals owner beneath this location to fee as per ECMC GIS maps -Deleted surface lease information in the lease information text box since that information is on the 2A -Added logging BMP from the operator -Updated casing grade as per operator -Uploaded wellbore diagram from the operator -Requesting corrected well location plats from the operator	01/16/2025
OGLA	The Location associated with this Form 2 was conditionally approved administratively pursuant to Order 1-326 on September 12, 2024. OGLA task passed.	01/08/2025
OGLA	Added Location ID #487829.	01/03/2025

Total: 5 comment(s)

FORM 2 Rev 10/24	State of Colorado Energy & Carbon Management Commission 1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone: (303) 894-2100 Fax: (303) 894-2109	Document Number: 404023513 Date Received: 12/31/2024
APPLICATION FOR PERMIT TO		
☒ Drill ☐ Deepen ☐ Re-enter ☐ Recomplete and Operate Amend ☐ TYPE OF WELL OIL ☐ GAS ☐ COALBE ☐ ☒ GEOTHERMAL ☐ OTHER: _____ Refile ☐ ZONE TYPE SINGLE ZONE ☒ MULTIPLE ZONES ☐ COMMINGLE ZONES ☐ Sidetrack ☐ Well Name: <u>GLADE</u> Well Number: <u>WEST</u> Name of Operator: <u>OXY USA INC</u> ECMC Operator Number: <u>66561</u> Address: <u>PO BOX 173779</u> City: <u>DENVER</u> State: <u>CO</u> Zip: <u>80217-3779</u> Contact Name: <u>Loryn Spady</u> Phone: <u>(720)9293504</u> Fax: <u>()</u> Email: <u>Loryn_Spady@oxy.com</u>		
FINANCIAL ASSURANCE FOR PLUGGING, ABANDONMENT, AND RECLAMATION		
ECMC Financial Assurance ☒ The Operator has provided or will provide Financial Assurance to the ECMC for this Well. Surety ID Number (if applicable): <u>20230087</u>		
Federal Financial Assurance ☐ In checking this box, the Operator certifies that it has provided or will provide at least this amount of Financial Assurance to the federal government for this Well. (Per Rule702.a.) Amount of Federal Financial Assurance \$ _____		
WELL LOCATION INFORMATION		
Surface Location QtrQtr: <u>NESE</u> Sec: <u>2</u> Twp: <u>3N</u> Rng: <u>66W</u> Meridian: <u>6</u> Footage at Surface: <u>2134</u> Feet FNL/FSL <u>FSL</u> <u>1246</u> Feet FEL/FWL <u>FEL</u> Latitude: <u>40.252552</u> Longitude: <u>-104.739325</u> GPS Data: GPS Quality Value: <u>1.3</u> Type of GPS Quality Value: <u>PDOP</u> Date of Measurement: <u>12/03/2024</u> Ground Elevation: <u>4900</u> Field Name: _____ Field Number: _____ Well Plan: is ☒ Directional ☐ Horizontal (highly deviated) ☐ Vertical If Well plan is Directional or Horizontal attach Deviated Drilling Plan and Directional Data. Subsurface Locations Top of Productive Zone (TPZ) Sec: <u>2</u> Twp: <u>3N</u> Rng: <u>66W</u> Footage at TPZ: <u>2153</u> <u>FSL</u> <u>1472</u> <u>FEL</u> Measured Depth of TPZ: <u>10574</u> True Vertical Depth of TPZ: <u>10556</u> FNL/FSL FEL/FWL		

Base of Productive Zone (BPZ)

Sec: 2Twp: 3NRng: 66WFootage at BPZ: 2287FSL 2376FWL
Measured Depth of BPZ: 20133True Vertical Depth of BPZ: 20000FNL/FSLFEL/FWL

Bottom Hole Location (BHL)

Sec: 2Twp: 3NRng: 66WFootage at BHL: 2287FSL 2376FWL
FNL/FSLFEL/FWL

LOCAL GOVERNMENT PERMITTING INFORMATION

County: WELDMunicipality: N/A

Is the Surface Location of this Well in an area designated as one of State interest and subject to the requirements of § 24-65.1-108 C.R.S.? Yes

Per §34-60-106(1)(f)(I)(A) C.R.S and §37-90.5-107(2)(b)(I) C.R.S, the following questions pertain to the Relevant Local Government approval of the siting of the proposed Oil and Gas or Deep Geothermal Locations.
The Energy and Carbon Management Act and the Geothermal Resources Act provide that when “applying for a permit to drill,” operators must include proof that they sought a local government siting permit and the disposition of that permit application, or that the local government does not have siting regulations.

Does the Relevant Local Government regulate the siting of Oil and Gas and Deep Geothermal Locations, with respect to this Location?

☒ Yes☐ No

☒ If yes, in checking this box, I hereby certify that an application has been filed with the local government with jurisdiction to approve the siting of the proposed oil and gas location.

The disposition of the application filed with the Relevant Local Government is: ApprovedDate of Final Disposition: 12/11/2024

Comments: GLADE Pilot Project

GEOTHERMAL

Well Overview

The following questions determine informational requirements based on Well type:
Which type of Geothermal Well is this? Select one of the following: Science Well
Will this well be constructed using cementing methodologies other than those listed in Rule 408.f? No
If Yes, what method will be used:
Please describe the cementing method to be used in detail:

Surface: Casing will be cemented using a pump and plug method with a 13.5 ppg lead cement and a 14.8 ppg tail cement. A water-based spacer will be pumped ahead of lead cement. Lead/tail interface is planned for 1850 ft MD. Cement will be pumped with excess to ensure cement to surface.
Intermediate: Casing will be cemented using a pump and plug method with a 12.5 ppg lead cement and a 13.2 ppg tail cement. A water-based spacer will be pumped ahead of lead cement. Lead/tail interface is planned for 7100 ft MD. Cement will be pumped with excess to ensure cement to surface. Additives will be used in the slurries to mitigate bradenhead pressure risks.

Science Well Information

Please describe the timing, duration, and types of tests that may be run in the wellbore for scientific purposes:

The first well is currently planned for spud in early April 2025. All phases of drilling are expected to take 60 days per well, for a total planned duration of 120 days on the pad. This duration also includes the time required to perform an intercept between the two wellbores at their toes.

Upon completion of drilling and wellbore interception, testing may be conducted to evaluate the thermal potential and heat extraction capabilities. These tests could include running thermal logs to measure in-situ temperatures or setting up surface equipment to circulate fluid through the wellbores. Data collected during these tests, such as flow rates, temperatures, and heat extraction metrics, will be analyzed at the surface to assess the system's performance.

Please describe the reason for the scientific well and its potential future use:

Oxy aims to surpass the limits of current geothermal drilling technology by safely drilling two adjacent high-temperature geothermal wells (i.e., twin wells) at the GLADE location. These wells are part of a project funded under a Funding Opportunity Announcement (FOA) issued by the Department of Energy (DOE). The primary objective is to demonstrate the capability to penetrate deep into granitic basement rock at drilling rates and cycle times that could support economic viability for future geothermal projects.

Located in the Denver-Julesburg Basin, the wells are planned to be drilled to a target true vertical depth (TVD) of 20,000 feet, with downhole temperatures potentially approaching 572 °F. By integrating existing and novel drilling technologies, we aim to achieve a significant increase in daily drilling rates, surpassing 25%, well over well.

To achieve these objectives, we will deploy cutting-edge high-temperature downhole tools, implement advanced cloud-based real-time drilling optimization, and leverage technologies to reduce non-productive time, all while prioritizing operational safety. The twin-well design enables a robust comparative analysis of drilling performance both within and between wells, providing reliable insights into geothermal drilling equipment and best practices.

The future use of these wells remains uncertain. If the wells are successfully intercepted to create a closed-loop system, flow testing may be conducted using a small surface test facility. The twin-well design also provides flexibility for future applications, potentially supporting either enhanced geothermal systems (EGS) or advanced geothermal systems (AGS). However, any future use will depend on the results obtained during drilling and the availability of funding to support subsequent phases.

SURFACE AND MINERAL OWNERSHIP AT WELL'S OIL & GAS OR DEEP GEOTHERMAL LOCATION

Surface Owner of the land at this Well's Oil and Gas Or Deep Geothermal Location: ☒ Fee ☐ State ☐ Federal ☐ Indian

Mineral Owner beneath this Well's Oil and Gas Or Deep Geothermal Location: ☒ Fee ☐ State ☐ Federal ☐ Indian

Surface Owner Protection Bond (if applicable): _____ Surety ID Number (if applicable): _____

MINERALS DEVELOPED BY WELL

The ownership of all the minerals that will be developed by this Well is (check all that apply):

- ☐ Fee
- ☐ State
- ☐ Federal
- ☐ Indian
- ☒ N/A

LEASE INFORMATION

Using standard QtrQtr, Section, Township, Range format describe one entire mineral lease as follows:

- * If this Well is within a unit, describe a lease that will be developed by the Well.
 - * If this Well is not subject to a unit, describe the lease that will be produced by the Well.
- (Attach a Lease Map or Lease Description or Lease if necessary.)

Total Acres in Described Lease: _____ Described Mineral Lease is: ☐ Fee ☐ State ☐ Federal ☐ Indian
Federal or State Lease # _____

SAFETY SETBACK INFORMATION

Distance from Well to nearest:

Building: 1178 Feet
Building Unit: 1779 Feet
Public Road: 1242 Feet
Above Ground Utility: 1774 Feet
Railroad: 5280 Feet
Property Line: 525 Feet

INSTRUCTIONS:
- Specify all distances per Rule 308.b.(1).
- Enter 5280 for distance greater than 1 mile.
- Building - nearest building of any type. If nearest Building is a Building Unit, enter same distance for both.
- Building Unit – as defined in 100 Series Rules.

OBJECTIVE FORMATIONS

Objective Formation(s)	Formation Code	Spacing Order Number(s)	Unit Acreage Assigned to Well	Unit Configuration (N/2, SE/4, etc.)
PRECAMBRIAN	PCMB			

Federal or State Unit Name (if appl): _____ Unit Number: _____

SUBSURFACE MINERAL SETBACKS

Enter 5280 for distance greater than 1 mile.

Is this Well within a unit? _____

If YES:

Enter the minimum distance from the Completed Zone of this Well to the Unit Boundary: _____ Feet
Enter the minimum distance from the Completed Zone of this Well to the Completed Zone of an offset Well within the same unit permitted or completed in the same formation: _____ Feet

If NO:

Enter the minimum distance from the Completed Zone of this Well to the Lease Line of the described lease: _____ Feet
Enter the minimum distance from the Completed Zone of this Well to the Completed Zone of an offset Well producing from the same lease and permitted or completed in the same formation: _____ Feet

Exception Location

☐ If this Well requires the approval of a Rule 401.c Exception Location, enter the Rule or spacing order number and attach the Exception Location Request and Waivers. _____

SPACING & FORMATIONS COMMENTS

DRILLING PROGRAM

Proposed Total Measured Depth: 20133 FeetTVD at Proposed Total Measured Depth 20000 Feet

Distance from the proposed wellbore to nearest existing or proposed wellbore belonging to another operator, including plugged wells:

Enter distance if less than or equal to 1,500 feet: 155 Feet☐ No well belonging to another operator within 1,500 feet

Will a closed-loop drilling system be used? Yes

Is H2S gas reasonably expected to be encountered during drilling operations at concentrations greater than or equal to 100 ppm? NoIf yes, attach an H2S Drilling Plan unless a plan was already submitted with the Form 2A per Rule 304.c.(10).

Will there be hydraulic fracture treatment at a depth less than 2,000 feet in this well? No

Will salt sections be encountered during drilling? No

Will salt based (>15,000 ppm Cl) drilling fluids be used? Yes

Will oil based drilling fluids be used? Yes

BOP Equipment Type: ☒ Annular Preventor☒ Double Ram☒ Rotating Head☐ None

Beneficial reuse or land application plan submitted? No

Reuse Facility ID: or Document Number:

CASING PROGRAM

Casing Type	Size of Hole	Size of Casing	Grade	Wt/Ft	Csg/Liner Top	Setting Depth	Sacks Cmt	Cmt Btm	Cmt Top
CONDUCTOR	26	20	A53B	79	0	80	60	80	0
SURF	17+1/2	13+3/8	L80	54.5	0	2350	770	2350	0
1ST	12+1/4	9+5/8	P110IC	47	0	10624	1700	10624	0
OPEN HOLE	8+1/2				10624	20133			

☐ Conductor Casing is NOT planned

POTENTIAL FLOW AND CONFINING FORMATIONS

Zone Type	Formation /Hazard	Top M.D.	Top T.V.D.	Bottom M.D.	Bottom T.V.D.	TDS (mg/L)	Data Source	Comment
Groundwater	Fox Hills and Shallower	17	17	472	472	501-1000	USGS	Depth from DWR
Confining Layer	Pierre Shale	473	473	671	671			
Groundwater	Upper Pierre Aquifer	672	672	1577	1577	501-1000	Electric Log Calculation	Controlled by samples
Confining Layer	Pierre Shale	1578	1578	4309	4309			
Hydrocarbon	Sussex	4310	4310	4609	4609			Productive
Confining Layer	Pierre Shale	4610	4610	7112	7112			
Hydrocarbon	Niobrara	7113	7113	7355	7355			
Hydrocarbon	Codell	7356	7356	7371	7371			
Confining Layer	Carlile	7372	7372	7409	7409			
Hydrocarbon	Greenhorn	7410	7410	7596	7596			
Confining Layer	Graneros Shale	7597	7597	7857	7857			
Hydrocarbon	Dakota	7858	7858	8034	8034			
Confining Layer	Morrison	8035	8035	8298	8298			
Groundwater	Entrada	8299	8299	8423	8423	>10000	USGS	
Confining Layer	Lykins	8424	8424	8958	8958			
Confining Layer	Blaine	8959	8959	9004	9004			Anhydrite
Groundwater	Lyons	9005	9005	9196	9196	>10000	USGS	
Groundwater	Lower Satanka	9197	9197	9363	9362	>10000	USGS	
Groundwater	Wolfcamp	9364	9363	9982	9974	>10000	USGS	
Groundwater	Fountain	9983	9975	10573	10555	>10000	USGS	
Geothermal	Precambrian Basement	10574	10556	20133	20000			Igneous/Metamorphic; *base MD/TVD is BHL per ECMC

OPERATOR COMMENTS AND SUBMITTAL

Comments

PLEASE ENSURE ALL CORRESPONDENCE ASSOCIATED WITH THIS PERMIT GOES TO ANALYST AND DJREGULATORY EMAIL ADDRESSES, AS LISTED ON THIS PERMIT.

Offset well buffer description for the subject well has been included on this permit for review as an attachment labeled "Other."

Surface user agreement is in the Form 2A (Doc-403656949) under attachment number 403765166

Base of Productive Zone is the same as Bottom Hole Location.

The nearest offset wellbore permitted or completed in the same formation is GLADE EAST, DOC ID: 404023428.

Project Overview:
The GLADE project is a groundbreaking initiative to drill a first-of-its-kind, deep geothermal well pair in the Denver-Julesburg (DJ) Basin. These wells are part of a project funded under a Funding Opportunity Announcement (FOA) issued by the Department of Energy (DOE). The primary objective is to demonstrate the ability to penetrate deep into granitic basement rock at economically viable drilling rates, paving the way for the next generation of geothermal energy systems.

Currently, most geothermal projects worldwide focus on utilizing existing hydrothermal systems, where hot water is extracted from naturally occurring reservoirs. However, a new frontier of geothermal development is emerging with enhanced geothermal systems (EGS) and advanced geothermal systems (AGS). EGS involves creating artificial reservoirs by fracturing hot, dry rock and circulating fluid to extract heat, while AGS leverages conduction from hot rock to transfer heat without the need for a fluid reservoir. These systems are particularly well-suited for high-temperature, hard basement rock, but the high cost of drilling in such conditions has been a major barrier to widespread adoption.

The GLADE project aims to overcome this limitation by demonstrating the use of modern oilfield drilling technologies, combined with innovative wellbore cooling techniques, to significantly enhance rates of penetration (ROP) and extend time between equipment failures. By achieving these advancements, the project seeks to make deep geothermal systems more economically viable, enabling broader deployment in the renewable energy sector.

The project involves drilling two deep geothermal wells to a target true vertical depth (TVD) of 20,000 feet, with approximately 9,500 feet of drilling through granitic basement rock. Downhole temperatures may reach as high as 572 °F, presenting a significant technical challenge. The wells are designed with a spacing of approximately 300 feet in the granitic section to minimize thermal interaction during circulation and ensure efficient heat transfer. At the surface, the wellheads are positioned 100 feet apart to allow simultaneous operations, such as drilling one well while using the other for ranging and interception support.

To optimize drilling efficiency, the well paths will maintain a vertical trajectory to a depth of approximately 9,000 feet, minimizing torque and drag, side forces, and drill pipe fatigue. This design ensures mechanical stability and enhances the overall performance of drilling operations. The drilling program is scheduled to commence in April 2024, with a total planned duration of 120 days on location. This timeline includes the completion of both wells and the integration of ranging and intercept operations to connect the well toes. Establishing this connection between the wells will create a closed loop (AGS) system.

Through this ambitious effort, the GLADE project seeks to demonstrate the feasibility of drilling cost-effective, high-performance geothermal wells in challenging conditions, thereby contributing to the advancement of renewable energy technologies and the development of sustainable energy solutions for the future.

This application is in a Comprehensive Area Plan

No

CAP #:

Oil and Gas Development Plan Name

OGDP ID#:

Location ID:

487829

I hereby certify all statements made in this form are, to the best of my knowledge, true, correct, and complete.

Signed:

Print Name:

Loryn Spady

Title:

Regulatory Analyst

Date:

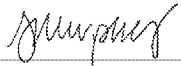
12/31/2024

Email:

DJRegulatory@oxy.com

Operator must have a valid water right or permit allowing for industrial use or purchased water from a seller that has a valid water right or permit allowing for industrial use, otherwise an application for a change in type of use is required under Colorado law. Operator must also use the water in the location set forth in the water right decree or well permit, otherwise an application for a change in place of use is required under Colorado law. Section 37-92-103(5), C.R.S. (2011).

Based on the information provided herein, this Application for Permit-to-Drill complies with ECMC Rules, applicable orders, and SB 19-181 and is hereby approved.

ECMC Approved: 

Director of ECMC

Date: 2/10/2025

Expiration Date: 02/09/2028

API NUMBER

05 123 52915 00

CONDITIONS OF APPROVAL, IF ANY LIST

All representations, stipulations and conditions of approval stated in the Form 2A for this location shall constitute representations, stipulations and conditions of approval for this Form 2 Permit-to-Drill and are enforceable to the same extent as all other representations, stipulations and conditions of approval stated in this Permit-to-Drill.

COA Type	Description
Drilling/Completion Operations	Bradenhead tests shall be performed according to the following schedule and Form 17 submitted within 10 days of each test: 1) Within 60 days of rig release. 2) Annually as required by Rule 419.c.
Drilling/Completion Operations	1) Submit Form 42 electronically to ECMC 2 business days prior to MIRU (spud notice) for the first well activity with a rig on the pad and provide 2 business day spud notice via Form 42 for all subsequent wells drilled on the pad. 2) Comply with Rule 408.j. and provide cement coverage from TD to a minimum of 500' above Sussex. Verify coverage with a cement bond log. 3) Oil based drilling fluid can only be used after all groundwater has been isolated.
Drilling/Completion Operations	In accordance with Rule 1314.b.(1), Operator will run a pipe analysis log or caliper log in conjunction with any other logging requirements of Rule 408.r.
Drilling/Completion Operations	Operator will Submit a Form 4-Notice of Intent requesting approval of any circulation of fluid in the production hole section for testing reasons prior to such operations.
Drilling/Completion Operations	Significant lost circulation encountered during drilling will be reported as soon as practicable to the ECMC. Such notice will be provided on a Form 42, Field Operations Notice – Notice of Significant Lost Circulation. For instances of lost circulation encountered during drilling, four sheets or drilling operations logs covering the time interval(s) where lost circulation was encountered will be attached to the Form 5 – Drilling Completion Report.
5 COAs	

Operator Best Management Practices		
No	BMP/COA Type	Description
1	Drilling/Completion Operations	Anti-Collision: Kerr-McGee will perform an anti-collision evaluation of all active (producing, shut in, or temporarily abandoned) offset wellbores that have the potential of being within one hundred fifty (150) feet of a proposed well prior to drilling operations for the proposed well. Notice shall be given to all offset operators within one hundred fifty (150) feet prior to drilling.
2	Drilling/Completion Operations	In one of the two GLADE wells, Oxy plans to run CBL, Gamma Ray, Resistivity, Density, Neutron, and Sonic logs through the entire intermediate hole section, and an Image Log across the deepest 3000' of the intermediate hole section. Additionally, Oxy plans to run Gamma Ray, Resistivity, Density, Neutron, Dipole Sonic, Image Log, and Spectroscopy logs through the entire production hole section. In the other GLADE well, Oxy plans to run CBL, Gamma Ray, Resistivity, Density, and Neutron logs in the intermediate section and Gamma Ray, Resistivity, Density, and Neutron logs in the production hole section. This logging program is subject to changes based on vendor and tool availability and hole conditions that may exceed logging tool limitations.

Total: 2 comment(s)

ATTACHMENT LIST

Att Doc Num	Name
1802989	WELLBORE DIAGRAM
2168659	WELL LOCATION PLAT
404023513	FORM 2 SUBMITTED
404032060	OTHER
404033079	DEVIATED DRILLING PLAN
404033080	DIRECTIONAL DATA
404087421	OFFSET WELL EVALUATION

Total Attach: 7 Files

General Comments

User Group	Comment	Comment Date
Permit	Final Review Complete.	02/07/2025
Permit	-Uploaded updated well location plat from the operator -Passed Permit Review	01/22/2025
Permit	-Removed field name since it's not needed since permit is for a geothermal well -Selected the minerals owner beneath this location to fee as per ECMC GIS maps -Deleted surface lease information in the lease information text box since that information is on the 2A -Added logging BMP from the operator -Updated casing grade as per operator -Uploaded wellbore diagram from the operator -Requesting corrected well location plats from the operator	01/16/2025
OGLA	The Location associated with this Form 2 was conditionally approved administratively pursuant to Order 1-326 on September 12, 2024. OGLA task passed.	01/08/2025
OGLA	Added Location ID #487829.	01/03/2025

Total: 5 comment(s)



ECMC Conditions of Approval (COA) & Best Management Practices (BMP)

Best Management Practices		
No	BMP/COA Type	Description
1	General Housekeeping	The Pit will not be utilized longer than three years, unless otherwise approved of by ECMC."
2	Wildlife	A wildlife exclusion fence and netting (or a CPW-approved wildlife exclusion device) will be installed around and over the Pit, pursuant to Rule 1202.a.(4)."
3	Storm Water/Erosion Control	Some of the soil from the pit will be used to construct the perimeter berms. The internal slope faces will be protected by the HDPE liner. And external berm face will be track packed and consolidated to prevent erosion. The excess pit soil will be stockpiled on east side of well pad and will be stabilized by straw crimping. The cooling pit soil stockpile will be included in Oxy Stormwater Management program and will be inspected with CDPHE construction stormwater frequency."
4	Material Handling and Spill Prevention	There will be a report of any unauthorized Release of Fluids from a Pit pursuant to Rule 912."
5	Construction	The Pit will be constructed, lined, operated, and maintained pursuant to Rules 909 and 910. All manufacture's specifications on constructing, installation, and maintenance activities will be followed as well as good engineering practices. Testing results and repair documentation and dates will be maintained and available for inspection, as requested."
6	Construction	A 147'x238' (exterior dimensions) earthen Pit, 6.5 feet deep (minimum) will be constructed with a synthetic 40 MIL liner that also allows for 2' of freeboard. The 2' freeboard will be maintained and monitored through the life of the Pit. The foundation of the liner will not have any sharp debris and will have a minimum thickness of 12 inches after compaction."
7	Odor mitigation	The Pit will be maintained hydrocarbon free and of any other oil and gas liquids."
8	Final Reclamation	The Pit will be sampled to ensure that any soil left in place meets the cleanup concentrations listed in Table 915-1. A sufficient number of representative samples from locations beneath the Pit will be collected that demonstrate that no leakage of managed fluids has occurred. Once laboratory analysis is back, results will be submitted via Supplemental Form 27 with a request for a final approval for pit closure and reclamation."
9	Final Reclamation	Interim/Final grading and recontour of the entire location and access road will be completed once the Pit has been closed and seeded (with an approved seed mix) and storm water stabilization will follow after re-spreading of topsoil. The closed pit will not be re-disturbed during the interim or final reclamation phases."
10	Final Reclamation	At time of closure, the Pit will be graded to the contour of the well pad and backfilled and compacted with clean fill generated in the construction of the well/pit location. The fence and netting will be removed."
11	Final Reclamation	The constructed soil liner will be either removed for treatment and disposal, or, if left in place the material will be ripped and mixed with native soils in a manner to alleviate compaction and prevent an impermeable barrier to infiltration and groundwater flow."
12	Final Reclamation	The synthetic liner will be removed and disposed of pursuant to all state and federal requirements for Solid Waste Disposal."
Total: 12 comment(s)		
CONDITIONS OF APPROVAL, IF ANY LIST		
COA Type		Description
		With the 27-Initial Operator shall provide a waste characterization sample and/or an SDS for materials that were contained in the pit. In addition to the SDS, Operator shall provide a proposed list of potential contaminants of concern.
		At time of construction, Operator shall conduct background sampling from a minimum of five separate locations as an initial characterization and should be obtained from representative depths and soil horizons or lithologic materials. Samples shall be analyzed for 915-1 metals and soil suitability parameters.
2 COAs		

SITE SAFETY AND EMERGENCY ACTION PLAN



**OXY USA Inc. (OXY)
1099 18th Street, Suite 700
Denver, Colorado 80202**

Geothermal Limitless Approach to Drilling Efficiencies (GLADE) Project

NE/4 SE/4 Section 2, T3N R66W, 6th P.M.

17419 Weld County Road 36

Weld County, Colorado

April 2024

GDP249

TABLE OF CONTENTS

SECTION 1 – APPROVAL SIGNATURES 1

SECTION 2 – SITE ADDRESS AND DIRECTIONS 2

 a) Directions:..... 2

 b) Ingress and egress information: 2

 c) Physical Address and GPS coordinates 2

 d) Emergency Evacuation/Muster Assembly point(s) 2

SECTION 3 – LIST OF EMERGENCY CONTACTS..... 3

 a) OXY USA Inc. **Error! Bookmark not defined.**

 b) First Responders (Fire, EMS, HazMat) 3

 c) Local, State, and Federal Contacts..... 3

 d) Medical Facilities (*Nearest locations to site*) 3

 e) Spill Response Organization (*Contracted*) 3

 f) Loss of Well Control..... 4

 g) Railroad Emergency Response (*if applicable*)..... 4

 h) Mutual-Aid 4

SECTION – 4 SITE SPECIFIC INFORMATION 5

 a) Site Description..... 5

 b) Nearby Schools, High Occupancy Buildings, Waterways..... 5

 c) Site Safety Requirements and General Safety Information..... 5

 d) Safety Data Sheets (SDS) 5

 e) Equipment List 6

 f) Chemicals stored on-site (BBLs and Gallons)..... 6

SECTION 5 – MAPS AND DRAWINGS 6

 a) Project Area Map..... 7

 b) Project Location Access Map and Muster Point..... 7

 c) Haul Route Map..... 9

 d) 2,500 Foot Buffer Area Map 10

SECTION 6 – SPILL RESPONSE AND CLEAN-UP 11

 a) Spill Response 11

 b) Spill Reporting..... 11

SECTION 7 – REPORTABLE QUANTITIES..... 11

 a) Reportable Quantities 11

 b. Reportable Requirements..... 12

SECTION 8 – EVACUATION INFORMATION..... 12

 a. Evacuation Plan Procedures (public) 12

SECTION – 9 TRAINING AND EXERCISES 12

SECTION – 10 COORDINATION WITH FIRST RESPONDERS 13

SECTION – 11 PLAN REVIEW AND UPDATE PROCEDURES..... 13

SECTION 1 – APPROVAL SIGNATURES

OXY USA inc.			
Name	Signature	Title	Date
Redacted	Redacted	Rockies Asset Director	4/2/2024
Platteville Gilcrest Fire Protection District			
Name	Signature	Title	Date
Redacted		Fire Chief	

Weld County Office of Emergency Management
Digitally Signed



SECTION 2 – SITE ADDRESS AND DIRECTIONS

NOTE: This is not an oil and gas location. This is a geothermal pilot project. No hydrocarbons are being explored, produced, or stored at this location.

a) Directions:

From the intersection of Weld County Road (WCR) 32 and WCR 35 travel north approximately 2.4 miles (past WCR 36) to the site lease access road. Turn left and travel west on the site lease access road approximately 500 feet to pad.

b) Ingress and egress information:

All traffic into and out of the geothermal location will check-in and check-out with security. All ingress and egress routes will be clearly identified and kept clear from parked/staged vehicles at all times.

c) Physical Address and GPS coordinates

- **API#** – Pending ECMC Permit Approval
- **Legal Description** – NE/4 SE/4 of Section 2, Township 3 North, Range 66 West
- **Address** - * Address Pending (*Weld OEM will provide physical address for 911 dispatching*)
- **Town, CO, Zip** – Weld County, Colorado 80561
- **Lat/Long:** 40.253073, -104.739141

d) Emergency Evacuation/Muster Assembly Point(s)

For incidents, where remaining in a particular area could pose a hazard to personnel onsite, such as a fire or hazardous material release, evacuation may be required to ensure the safety of onsite personnel. In the event of an emergency, site personnel will initially be evacuated to pre-designated muster assembly points.

- The Muster Assembly Points are identified in Section 5.b. of this plan, and noted in the site-specific TRP, and identified during all site safety briefings for visitors, employees, and contract personnel.
- **Sign-In Sheets:** During drilling activities all employees and approved visitors to the geothermal test location will be required to enter through a manned security checkpoint. Upon checking in, employees and visitors will be provided a detailed safety briefing of current operations, all safety precautions that must be adhered to, and the site emergency evacuation plan. In addition, all personnel who enter the location must sign-out upon their departure. Security or Supervisory personnel are required to account for all persons entering or leaving during active operations and in the event of an incident.
- Once drilling activities are finalized, the site will transition to the evaluation phase and no unauthorized personnel will be allowed on location without first contacting a company representative.

SECTION 3 – LIST OF EMERGENCY CONTACTS

a) OXY USA Inc.

Name	Office Phone	Emergency/Cell
OXY USA Inc. 1099 18 th Ave. Denver, CO 80202	Redacted	
OXY USA Inc. Integrated Operations Center (IOC) 501 N. Division Blvd. Platteville, CO 80651		
OXY USA Inc. HSE on-call Emergency Number		
HSE–Supervisor & Safety – Redacted		
HSE – Environmental – Redacted		

b) First Responders (Fire, EMS, HazMat)

Name	Emergency Number	Non-Emergency Number
*All emergency notifications require notification to 911 first		
Platteville Gilcrest Fire Protection District	911	970-785-2232
Weld County Sheriff	911	970-356-4015
Colorado State Patrol	911	970-506-4999

c) Local, State, and Federal Contacts

Name	Emergency Number	Non-Emergency Number
Weld County Oil and Gas Energy Department	none	970-400-3580
Weld County Office of Emergency Management	911	970-304-6540
Energy & Carbon Management Commission (ECMC)	none	303-894-2100
Colorado Department of Public Health and Environment (CDPHE)	none	877-518-5608
Colorado Parks & Wildlife	none	303-291-7227
National Response Center	800-424-8802	none

d) Medical Facilities

Name	Office Phone
Northern Colorado Medical Center	970-352-4121
Medical Center of the Rockies	970-624-2500
UCHealth Greeley Hospital	970-652-2000

e) Contracted Spill Response Organization

Name	24/7 Emergency Number	Non-Emergency Number
EnviroServe	720-450-1316	800-488-0910
HSE-Environmental HAZMAT Services	303-525-3111	720-225-9252

f) Loss of Well Control

Name	24/7 Emergency Number	Non-Emergency Number
Wild Well Control, Inc.	281-353-5481	281-784-4700
Cudd Pressure Control	307-382-6650 and 713-849-2769	800-990-2833

g) Railroad Emergency Response

Name	24/7 Emergency Number
Union Pacific Railroad	888-877-7267
BNSF	800-832-5452
Great Western Railway	800-533-9416 (Office 303-398-4500)

h) Mutual-Aid

All mutual-aid coordination within Weld County will be in accordance with the current Weld County Fire Chiefs Association Mutual-Aid Agreement. In addition, due to the size of Weld County and the large number of Fire Departments that make up the Weld County Fire Chiefs Association’s, Mutual-Aid may be a mixture of full-time, combination, and volunteer FD resources responding to an incident at this oil and gas location.

SECTION – 4 SITE SPECIFIC INFORMATION

a) Site Description

The GLADE project is an OXY geothermal test site that will consist of two (2) Deep Geothermal wells (DGW).

As part of the Weld County 1041 WOGLA permit process, the following sections of County Code address site layout, site drawings, and identify any sensitive areas and discuss any mitigation measures needed.

- Sec. 21-5-312 – Comprehensive Development Plans (CDPs)
- Section 21-5-320 – Application requirements for 1041 WOGLA Permit

b) Nearby Schools, High Occupancy Buildings, Waterways (measured from the Disturbance Area)

- Schools - None within 5,280 feet of location
- High Occupancy Buildings - None within 5,280 feet of location
- Waterways – Irrigation Ditch: 935 feet east of pad

c) Site Safety Requirements and General Safety Information

The minimum personal protective equipment (PPE) to enter any OXY location includes hard hat, safety glasses, safety toe boots, four gas monitor, and fire-resistant clothing (FRC). All contractors and visitors are responsible for providing their employees with the appropriate training on and use of PPE while on OXY locations. In addition, all contract personnel entering an OXY location to perform work must understand and abide by OXY's contractor expectations relating to environmental, health, and safety requirements.

d) Safety Data Sheets (SDS)

- **SDS:** Depending on the operations taking place on location, chemicals stored on-site may vary. In accordance with 49 CFR 1910.1200, Safety Data Sheets (SDS) will be made available for site personnel performing work and for first responders in a centralized location onsite.

e) Equipment Lists – Evaluation Phase

Item Description	Quantity
Deep Geothermal wells	2
1,000 - barrel freshwater tank	6
Coolers	3
Transformer	1
Communication Tower	1
Panel Rack	1
Organic Rankine Cycle (ORC)	2
Chemical Tank	1
Pump Building	1

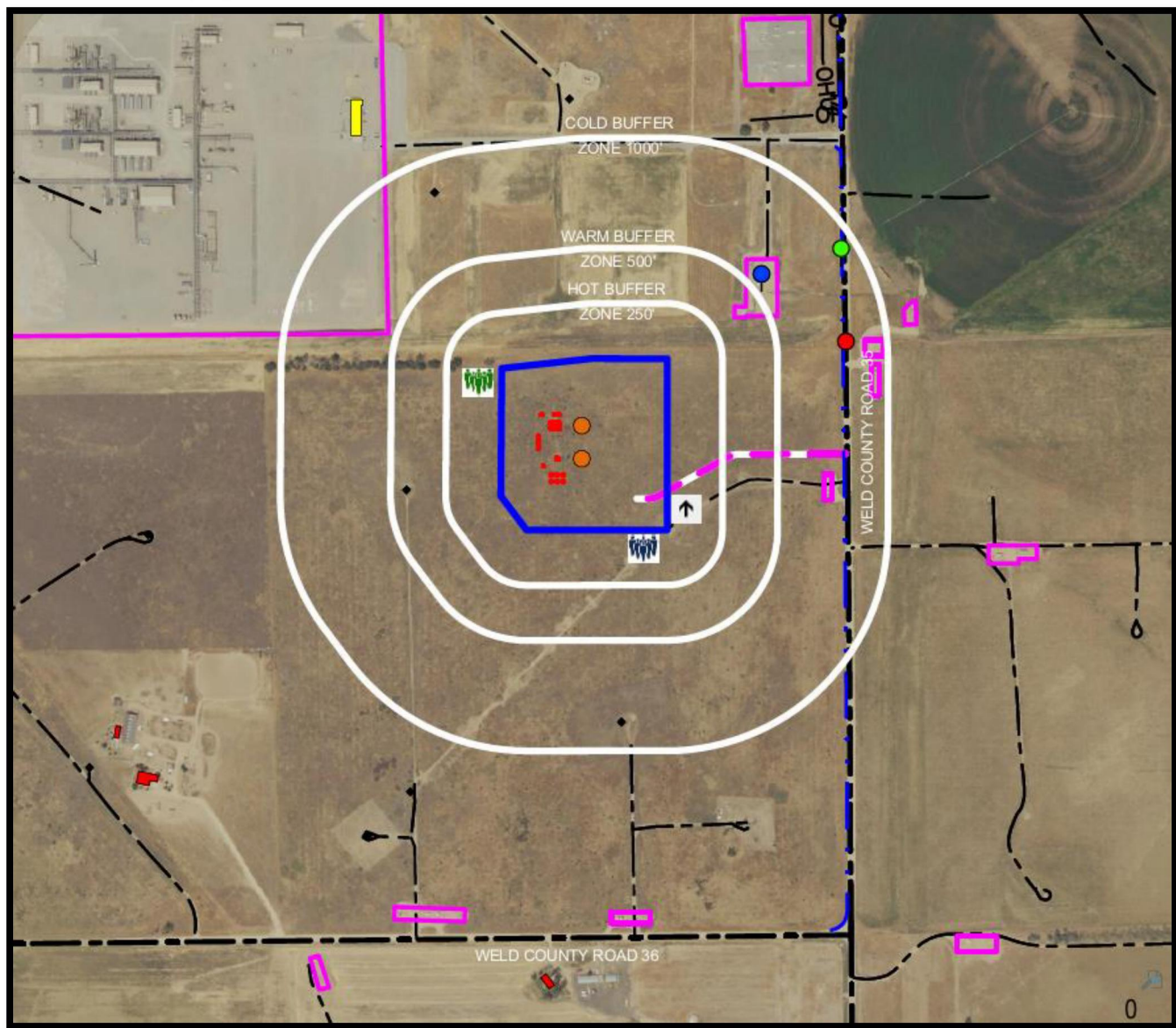
f) Chemicals stored on-site (BBLs and Gallons)

Drilling Phase			
Chemicals (CAPs indicate Product Name vs upper lower case is a generic chemical)	Package Size <u>(Volume)</u>	Quantity	Comments
ADAPTA L	5 gal can	128 cans	
BARAKLEAN	5 gal can	64 cans	
BAROID 41	bulk silo	45 tons	
BAROID 41	100 lb. sacks	400 sacks	
BARO-SEAL CLASSIC	40 lb. sacks	60 sacks	
Calcium Chloride	50 lb. sacks	500-600 sacks	
DRILTREAT	55 gal drum	4 drums	
FORTI-MUL	55 gal drum	16-20 drums	
Diesel	19,000 gal tank	19,000 gals	
Graphite	50 lb. sacks	60 sacks	
Lime	50 lb. sacks	200 sacks	
Odor Armor	275 gal tote	1 tote	
RHEMOD L	55 gal drum	4 drums	
Salt-Driller's Rock	50 lb. sacks	49 sacks	
Sawdust Fine	5.5 cubic foot bag	60 bags	
STOPPIT	50 lb. sacks	80 sacks	
WALL-NUT MEDIUM	50 lb. sacks	48 sacks	
Oil Based Mud (OBM)	150-500 BBL Tanks	1,800-2,200 BBLs	11 Tanks - 3 tank sizes - 150, 350 & 500 BBLs
Biocide	350 Gal Capacity	1	Chemical injection cube (stainless steel tub)
Oxygen scavenger	350 Gal Capacity	1	Chemical injection cube (stainless steel tub)
Evaluation Phase			
Chemicals	Volume	Units/Quantity	Comments
Corrosion/Scale Inhibitor	350 Gal Capacity	1	
ORC Refrigerant	~2,000 Gal	2	

SECTION 5 – MAPS AND DRAWINGS

a) Project Area Map

Showing the following distances: 250 feet (Hot Zone), 500 feet (Warm Zone) and 1,000 feet (Cold Zone) from the Disturbance Area (DA).



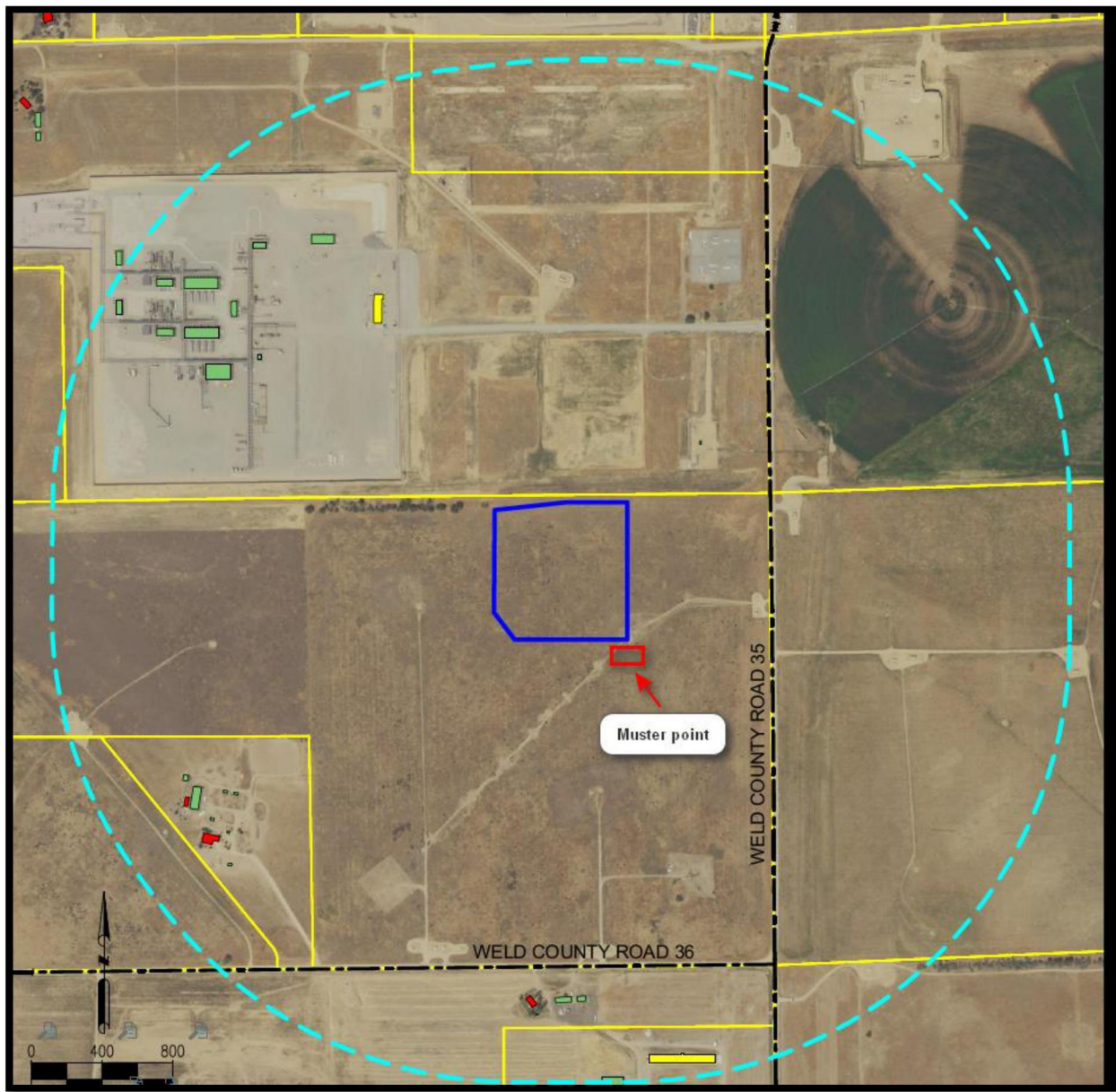
LEGEND

-  = PRIMARY MUSTER POINT
 = SECONDARY MUSTER POINT
 = PRIMARY INGRESS/EGRESS
 = PROPOSED WELL
 = EXISTING WELL
 = CRITICAL RECEPTOR
-  = PROPOSED FACILITIES
 = EXISTING FACILITIES
 = PROPOSED DEEP GEOTHERMAL LOCATION
 = BUILDING UNIT
 = RESIDENTIAL BUILDING UNIT
 = HOT, WARM, & COLD BUFFER ZONES
-  = PROPOSED ACCESS ROAD
 = OVERHEAD UTILITY
 = DITCH
 = PUBLIC ROAD
 = PRIVATE ROAD
- ERG ZONE (800 METERS)

GLADE project EAP
Section 2 T3N R66W
Weld County, Colorado

b) Project Location Access Map and Muster Point

The Primary muster point will be located at the entrance to the location as shown below. The secondary muster point is subject to change depending on the phase of operations occurring at the location.



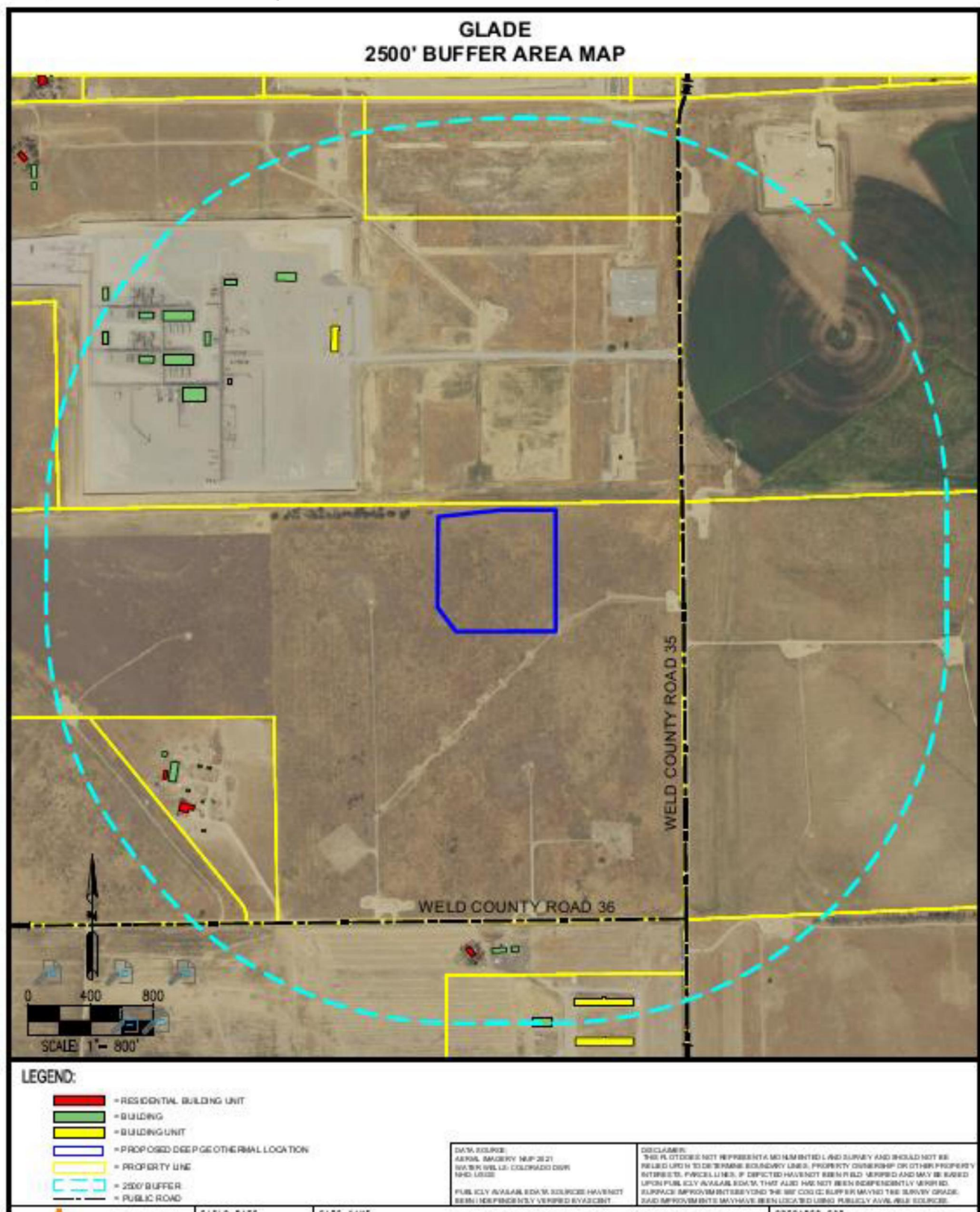
- LEGEND:
- [Red box] = RESIDENTIAL BUILDING UNIT
 - [Green box] = BUILDING
 - [Yellow box] = BUILDING UNIT
 - [Blue box] = PROPOSED DEEP GEOTHERMAL LOCATION
 - [Yellow line] = PROPERTY LINE
 - [Cyan dashed line] = 2500' BUFFER
 - [Black dashed line] = PUBLIC ROAD

c) Haul Route Map



GLADE project EAP
Section 2 T3N R66W
Weld County, Colorado

d) 2,500 Foot Buffer Area Map



GLADE project EAP
Section 2 T3N R66W
Weld County, Colorado

SECTION 6 – SPILL RESPONSE AND CLEAN-UP

a) Spill Response

There are multiple types of chemicals stored onsite which can be released/spilled during operations. If a spill is discovered, it will be mitigated in accordance with Colorado Energy & Carbon Management Commission (ECMC), Colorado Department of Public Health and Environment (CDPHE), and Weld County Local Emergency Planning Committees (LEPC) requirements.

Once a release has been discovered, it will be immediately stopped and contained if possible and is safe to do so. When containing a spill; a combination of sorbent rolls, pads, mats, socks, or containment boom may be deployed, or earthen berms will be constructed around the release to keep spilled material contained and from spreading. These materials will be provided by OXY and the contract company. During a spill, efforts will be made to minimize contact with live vegetation, nearby drainage, rivers, creeks, or streams. If the release is outside of secondary containment or poses a threat to flow off site, or impact environmentally sensitive areas, the spill response contractor should be notified for cleanup assistance, if needed, and for removal and disposal of spilled materials and contaminated areas.

In the event of a large incident requiring outside assistance/cascading resources, OXY has contracted with a several spill response organizations, listed in Section 3 of this EAP. These organizations possess a working knowledge of operations, emergency response and the Incident Command System (ICS). Once notified, personnel can be on location within 6 hours.

b) Spill Reporting

A spill/release will be reported to the ECMC if released meets the ECMC reporting requirements per the 900 series rules. A spill/release will be reported to the CDPHE if released meets the CDPHE reporting requirements.

These regulatory guidelines will be strictly followed by OXY and any contractors operating under OXY guidance during all activities at the GLADE project at NE/4 SE/4 Sec 2 T3N R66W.

SECTION 7 – REPORTABLE QUANTITIES

a) Reportable Quantities

Mandated by Section 312 of the Emergency Planning and Community Right-To-Know Act (EPCRA) – also known as SARA Title III – the Tier II form captures information about the types, quantities, and locations of hazardous chemicals at a given facility. The form also lists contact information for the facility's designated emergency point-of-contact.

- Any facility that is required to maintain MSDSs (or SDSs) under the Occupational Safety and Health Administration (OSHA) 49 CFR 1910.1200 regulations for hazardous chemicals stored or used in the workplace.
- Facilities with chemicals in quantities that equal or exceed the lists of lists thresholds must report.

b) Reportable Requirements

If your facility will meet the requirements under 40 CFR Part 370, you must submit your Tier II report to the State of Colorado every year before March 1st.

These regulatory requirements will be strictly followed by OXY and any contractors operating under OXY during all activities at the GLADE project at NE/4 SE/4 Sec 2 T3N R66W.

SECTION 8 – EVACUATION INFORMATION

a) Evacuation Plan Procedures (public)

The procedure to be used in alerting the public in the event of than incident which could pose a threat to life or property will be arranged and coordinated with first responders and Weld County Emergency Management. In the event of an actual emergency, the following steps will be immediately taken:

- 1. The OXY representative will immediately notify first responders (911), to warn the public of a potential chemical exposure.
- 2. First responders may conduct door to door evacuation notices in addition to reverse 911 and utilizing the Integrated Public Alert and Warning System (IPAWS).
- 3. OXY is responsible for employees and contract personnel will monitor essential and non-essential personnel traffic on or near the incident site.
- 4. General:
 - a. The area included within the radius of exposure is the zone with the maximum potential hazard, per the Emergency Response Guide (ERG). When it is determined that conditions exist which create an additional area (beyond the initial zone of maximum potential hazard) vulnerable to possible hazard, public areas in the additional hazardous area will be evacuated.
 - b. In the event of an incident, after the public areas have been evacuated and traffic stopped, it is expected that local civil authorities will have arrived and within a few hours will have assumed direction of and control of the public, including all public areas.
 - c. OXY will fully cooperate with these authorities and will exert every effort by careful advice to such authorities to prevent panic or rumors.

OXY will dispatch appropriate personnel to the disaster site as soon as possible. The company’s personnel will cooperate with and provide such information to civil authorities as they might require.

SECTION – 9 TRAINING AND EXERCISES

TRAINING: The National Incident Management System (NIMS) guides all levels of government, nongovernmental organizations, and the private sector to work together to prevent, protect against, mitigate, respond to and recover from incidents.

NIMS provides stakeholders across the whole community with the shared vocabulary, systems, and processes to successfully deliver the capabilities described in the National Preparedness System. NIMS defines operational systems that guide how personnel work together during incidents.

OXY plays a vital role in the Incident Management System. OXY has a significant impact on local, regional, and national economic recovery, and is part of the whole community and essential to the function of the Community Lifelines.

To maximize OXY’s impact and willingness to participate in incident operations, OXY will coordinate and integrate with first responders into a Unified Command (UC)—including planning, training, and preparedness exercises. This is done independently and within the emergency response community, such as CPRN. In addition, it is also recommended all OXY employees who will respond to an incident within the incident command structure have

training in ICS 100, ICS 200, and ICS 700 at a minimum, for company and agency emergency response interoperability to manage a response.

EXERCISES: Exercises are an important component to test an organization's response readiness, training and familiarity with various emergency response scenarios, participation, and engagement with local and or state agencies, and to develop lessons learned to improve emergency response capabilities. Per ECMCC guidance number 16, a proposed schedule and type of exercises are provided below:

SECTION – 10 COORDINATION WITH FIRST RESPONDERS

- a) OXY will communicate site construction and drill operations and dates to the Weld County Office of Emergency Management for coordination/communication with local first responders. These start dates will be provided a minimum of 7 business days prior to commencement or change in operations.
- b) In the event of an emergency requiring First Responders, Unified Command will be established between the OXY On-site Incident Command (OSIC) and First Responders present. Unified Command post will be established based on conditions present at time of incident.
- c) OXY EHS representative and first responders identified in this Emergency Action Plan (EAP) and Tactical Response Plan (TRP) have reviewed both documents and have discussed coordination efforts in the event of an emergency requiring first responder assistance.
- d) **Industry Mutual-Aid:** Energy companies operating in Weld County are encouraged to be members of the Colorado Preparedness Response Network (CPRN), to support mutual-aid collaboration between industry and public emergency response organizations to achieve a coordinated and effective response to an all-hazards event. OXY is a member of CPRN.

SECTION – 11 PLAN REVIEW AND UPDATE PROCEDURES

- a) **Multi-year plan review and update:**
The OXY Rockies Emergency Response Plan (ERP) is reviewed at a minimum over five years, but usually every year. Reviews include updating contacts, contractors, and procedures. **Post incident plan review and update:**
Post incidents that required response personnel, an after-action review (AAR) is completed with all response participants. If during the AAR it is identified that changes or updates are needed to the ERP they are done so as a corrective action within the AAR.



GLADE

ADDRESS: 17419 Weld County Road 36

FACILITY LOCATION: 40.25307 °N, -104.73914 °W

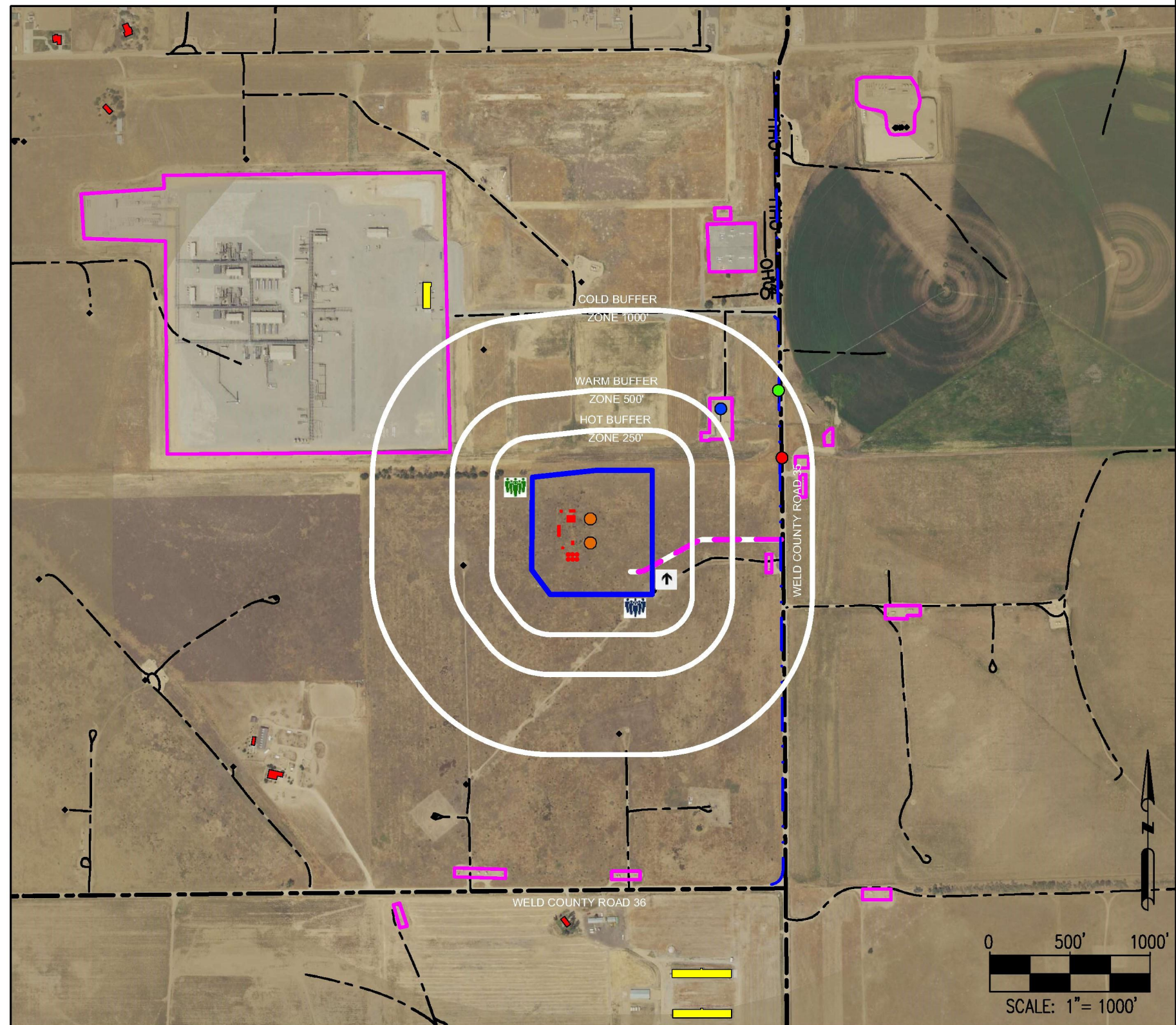
ACCESS LOCATION: 40.25269 °N, -104.73487 °W

NOTIFICATIONS

1. OXY USA INC 24-Hour Hotline
970-515-1500
720-929-6000
2. Platteville-Gilcrest Fire Protection District
911 & 970-785-2232 (NON-EMERGENCY)
3. Weld County OEM
970-350-9600
4. Weld County Sheriff
970-356-4015
5. Colorado Highway State Patrol
303-239-4501
6. Weld County O&G Energy Department
970-400-3580
7. Colorado Oil & Gas Commission
303-894-2100
8. Colorado Department of Public Health & Environment
877-518-5608
9. Colorado Parks & Wildlife
303-291-7227
10. National Response Center
800-424-8802

CRITICAL RECEPTORS

1. WELD COUNTY 35
2. DITCH
3. EXISTING FACILITIES



SITE NAME:
GLADE
SURFACE LOCATION:
NE 1/4 SE 1/4 SEC. 2, T3N, R66W, 6TH P.M.
WELD COUNTY, COLORADO



FIELD DATE:
12-03-23
DRAWING DATE:
02-01-24

BY:
HJL

CHECKED BY:
CSG

LEGEND

- PRIMARY MUSTER POINT
- SECONDARY MUSTER POINT
- PRIMARY INGRESS/EGRESS
- PROPOSED WELL
- EXISTING WELL
- CRITICAL RECEPTOR
- PROPOSED FACILITIES
- EXISTING FACILITIES
- PROPOSED DEEP GEOTHERMAL LOCATION
- BUILDING UNIT
- RESIDENTIAL BUILDING UNIT
- HOT, WARM, & COLD BUFFER ZONES
- ERG ZONE (800 METERS)
- PROPOSED ACCESS ROAD
- OVERHEAD UTILITY
- DITCH
- PUBLIC ROAD
- PRIVATE ROAD

Note: This Tactical Response Card is a reference tool and is intended to provide guidance during an actual event or exercise. Placement of resources may need to be adjusted according to environmental variables. It is the responsibility of emergency response personnel to be trained in response and to be able to make adjustments to the card as needed.

DATA SOURCES:
-AERIAL IMAGERY: NAIP 2021
-HYDROLOGY: NHD

PUBLICLY AVAILABLE DATA SOURCES HAVE NOT BEEN INDEPENDENTLY VERIFIED BY ASCENT.

FIRE DEPARTMENT RESPONSE GUIDELINES	INDUSTRY RESPONSE OBJECTIVES	GEO THERMAL FACILITY INFORMATION																									
Command FIRE DEPARTMENT RESPONSE GUIDELINES COMMAND - Establish initial command post near the location entrance. - Position should provide a clear view of the entire scene - Advise responding units and resources to stage near the location entrance. - Locate operator lease sign on location (located at the entrance /site access) - If industry personnel are not on location, call the 24-Hour Emergency Contact number located on the sign. - Establish unified command with operator on-site liaison - Develop incident action plan with the operator to mitigate incident - Strategy - <u>Always defensive unless a life safety need is identified!</u> INCIDENT STABILIZATION - Implement Hazardous Materials response protocols - All personnel operating in hazard zones should be in appropriate PPE, to include a personal mobile air monitoring device - Establish Hot, Warm, Cold Zones, and ERG zones - Exposure Concerns --- Equipment, nearby structures, neighborhoods, roadways, etc. - Monitor weather conditions, especially wind direction - Air monitoring for vulnerable areas and locations around the incident. - Conduct evacuations of citizens, bystanders, and resources at risk. - Identify and address any water supply and/or foam requirements necessary to mitigate the incident SPECIAL CONSIDERATIONS - If evacuations are needed, coordinate with Weld County OEM before ordering an evacuation to establish evacuation routes, shelters, shelter in-place and to utilize IPAWS (reverse 9-1-1). - Request mutual aid apparatus and equipment asap to minimize operational delays - Consider and address any potential impacts to critical receptors identified near the location. - Consider requesting a HazMat Team if needed to assist with mitigation. - Consider requiring a fire investigation for any fire and/or explosion. - Keep the public and stakeholders informed of response activities. - Notify FAA if air Traffic restrictions are needed (requested through OEM) <i>(very large incident)</i>	Ensure safety of the public, first responders, employees, and contractors. Minimize impact to the environment and local community. The following response objectives checklist shall be followed: SAFETY – PROTECT LIFE - Evaluate and account for all personnel - Isolate all potential ignition sources - Establish site control (safe perimeter and evacuation routes) - Contact emergency services as needed (911, Fire, LEPC) - Identify hazard(s) of emitted material (obtain SDS) - Implement air monitoring around impacted area - Continually assess site hazards/risks RESPONSE – INCIDENT STABILIZATION - Notify internal personnel and agencies - Assign on-site liaison to the incident commander - Establish a unified command post and field communications - Establish Hot, Warm, Cold Zones, and ERG zone - Identify and establish staging areas to support response operations - Activate emergency shutdown procedures (ESD) - Activate response action contractors for equipment and manpower as needed (e.g, Well Control, spill/HazMat clean-up, etc.) ENVIRONMENTAL – PROTECT THE ENVIRONMENT - Identify, prioritize, and protect environmentally sensitive areas - Verify if water has been impacted - Implement waste handling, disposal and decontamination procedures as needed - Contain and recover spilled materials - Notify appropriate agencies SPECIAL CONSIDERATIONS - Keep the public and stakeholders informed of response activities.	Note: This is not an oil and gas site Production Facility Storage: - Oil (BBL) – 0 - Condensate Tanks – 0 - Produced Water (BBL) –0 - Fresh Water tanks – 6 tanks each holds 1,000 bbl. Specific Facility Hazardous Conditions: (chemicals stored on site) <table><tr><td rowspan="5">Drilling</td><td>Diesel</td><td>19,000 Gal (1 Tank)</td></tr><tr><td>Oil Based Mud (OBM)</td><td>2,200 BBLs (11 Tanks)</td></tr><tr><td>FORTI-MUL</td><td>20 – 55 Gal Drum</td></tr><tr><td>ADAPTA L</td><td>1280 – 5 Gal Cans</td></tr><tr><td>BARAKLEAN</td><td>64 – 5 Gal Cans</td></tr><tr><td colspan="3">Additional chemicals are stored on location for drilling, see Emergency Action Plan</td></tr><tr><td>Evaluation</td><td>Corrosion/Scale Inhibitor</td><td>500 Gal x 1 Totes</td></tr><tr><td colspan="3"></td></tr><tr><td colspan="3"></td></tr></table> Is Water Supply Available on Location? No <table><tr><td>Fire hydrants: None</td></tr><tr><td>Water Storage Tanks: None</td></tr></table>	Drilling	Diesel	19,000 Gal (1 Tank)	Oil Based Mud (OBM)	2,200 BBLs (11 Tanks)	FORTI-MUL	20 – 55 Gal Drum	ADAPTA L	1280 – 5 Gal Cans	BARAKLEAN	64 – 5 Gal Cans	Additional chemicals are stored on location for drilling, see Emergency Action Plan			Evaluation	Corrosion/Scale Inhibitor	500 Gal x 1 Totes							Fire hydrants: None	Water Storage Tanks: None
Drilling	Diesel	19,000 Gal (1 Tank)																									
	Oil Based Mud (OBM)	2,200 BBLs (11 Tanks)																									
	FORTI-MUL	20 – 55 Gal Drum																									
	ADAPTA L	1280 – 5 Gal Cans																									
	BARAKLEAN	64 – 5 Gal Cans																									
Additional chemicals are stored on location for drilling, see Emergency Action Plan																											
Evaluation	Corrosion/Scale Inhibitor	500 Gal x 1 Totes																									
Fire hydrants: None																											
Water Storage Tanks: None																											

