NM OIL CONSERVATION
ARTESIA DISTRICT
OCT 02 2019
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Form 3160-3
(June 2015)

FORM APPROVED
OMB No. 1004-0137
Expires: January 31, 2018

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

APPLICATION FOR PERMIT TO DRILL OR REENTER

5. Lease Serial No.
NMNM0002425

6. If Indian, Allotee or Tribe Name

1a. Type of work: ☑ DRILL ☐ REENTER

1b. Type of Well: ☑ Oil Well ☐ Gas Well ☐ Other

1c. Type of Completion: ☐ Hydraulic Fracturing ☐ Single Zone ☑ Multiple Zone

7. If Unit or CA Agreement, Name and No.

8. Lease Name and Well No.
THUNDERBIRD DEVELOPMENT UNIT
2H 326054

2. Name of Operator
APACHE CORPORATION

9. API Well No.
30-015-46328

3a. Address	3b. Phone No. *(include area code)*	10. Field and Pool, or Exploratory
303 Veterans Airpark Lane #1000 Midland TX 79705	(432)818-1000	YESO / LOCO HILLS; GLORIETA-YESO

4. Location of Well *(Report location clearly and in accordance with any State requirements.*)*

At surface SENE / 2411 FNL / 1050 FEL / LAT 32.8786638 / LONG -103.9717835

At proposed prod. zone SESE / 100 FSL / 792 FEL / LAT 32.8565637 / LONG -103.9709382

11. Sec., T. R. M. or Blk. and Survey or Area
SEC 33 / T16S / R30E / NMP

14. Distance in miles and direction from nearest town or post office*	12. County or Parish	13. State
5.4 miles	EDDY	NM

15. Distance from proposed* location to nearest property or lease line, ft. (Also to nearest drig. unit line, if any)	16. No of acres in lease	17. Spacing Unit dedicated to this well
100 feet	599.35	279.74
18. Distance from proposed location* to nearest well, drilling, completed, applied for, on this lease, ft.	19. Proposed Depth	20. BLM/BIA Bond No. in file
40 feet	5146 feet / 12933 feet	FED: NMB000736

21. Elevations (Show whether DF, KDB, RT, GL, etc.)	22. Approximate date work will start*	23. Estimated duration
3738 feet	07/15/2019	20 days

24. Attachments

The following, completed in accordance with the requirements of Onshore Oil and Gas Order No. 1, and the Hydraulic Fracturing rule per 43 CFR 3162.3-3 (as applicable)

1. Well plat certified by a registered surveyor.
2. A Drilling Plan.
3. A Surface Use Plan (if the location is on National Forest System Lands, the SUPO must be filed with the appropriate Forest Service Office).
4. Bond to cover the operations unless covered by an existing bond on file (see Item 20 above).
5. Operator certification.
6. Such other site specific information and/or plans as may be requested by the BLM.

25. Signature	Name *(Printed/Typed)*	Date
(Electronic Submission)	Sorina Flores / Ph: (432)818-1167	02/07/2019
Title: Supv of Drilling Services		
Approved by *(Signature)* (Electronic Submission)	Name *(Printed/Typed)* Cody Layton / Ph: (575)234-5959	Date 09/27/2019
Title: Assistant Field Manager Lands & Minerals	Office: CARLSBAD	

Application approval does not warrant or certify that the applicant holds legal or equitable title to those rights in the subject lease which would entitle the applicant to conduct operations thereon.
Conditions of approval, if any, are attached.

Title 18 U.S.C. Section 1001 and Title 43 U.S.C. Section 1212, make it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

APPROVED WITH CONDITIONS

RWP 10-3-19

(Continued on page 2)

*(Instructions on page 2)

Approval Date: 09/27/2019

Need GCP

INSTRUCTIONS

GENERAL: This form is designed for submitting proposals to perform certain well operations, as indicated on Federal and Indian lands and leases for action by appropriate Federal agencies, pursuant to applicable Federal laws and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from local Federal offices.

ITEM I: If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations. Consult applicable Federal regulations concerning subsequent work proposals or reports on the well.

ITEM 4: Locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local Federal offices for specific instructions.

ITEM 14: Needed only when location of well cannot readily be found by road from the land or lease description. A plat, or plats, separate or on the reverse side, showing the roads to, and the surveyed location of, the wen, and any other required information, should be furnished when required by Federal agency offices.

ITEMS 15 AND 18: If well is to be, or has been directionany drilled, give distances for subsurface location of hole in any present or objective productive zone.

ITEM 22: Consult applicable Federal regulations, or appropriate officials, concerning approval of the proposal before operations are started.

ITEM 24: If the proposal will involve hydraulic fracturing operations, you must comply with 43 CFR 3162.3-3, including providing information about the protection of usable water. Operators should provide the best available information about all formations containing water and their depths. This information could include data and interpretation of resistivity logs run on nearby wells. Information may also be obtained from state or tribal regulatory agencies and from local BLM offices.

NOTICES

The Privacy Act of 1974 and regulation in 43 CFR 2.48(d) provide that you be furnished the following information in connection with information required by this application.

AUTHORITY: 30 U.S.C. 181 et seq., 25 U.S.C. 396; 43 CFR 3160

PRINCIPAL PURPOSES: The information will be used to: (1) process and evaluate your application for a permit to drill a new oil, gas, or service wen or to reenter a plugged and abandoned well; and (2) document, for administrative use, information for the management, disposal and use of National Resource Lands and resources including (a) analyzing your proposal to discover and extract the Federal or Indian resources encountered; (b) reviewing procedures and equipment and the projected impact on the land involved; and (c) evaluating the effects of the proposed operation on the surface and subsurface water and other environmental impacts.

ROUTINE USE: Information from the record and/or the record win be transferred to appropriate Federal, State, and local or foreign agencies, when relevant to civil, criminal or regulatory investigations or prosecution, in connection with congressional inquiries and for regulatory responsibilities.

EFFECT OE NOT PROVIDING INFORMATION: Filing of this application and disclosure of the information is mandatory only if you elect to initiate a drilling or reentry operation on an oil and gas lease.

The Paperwork Reduction Act of 1995 requires us to inform you that:

The BLM conects this information to anow evaluation of the technical, safety, and environmental factors involved with drilling for oil and/or gas on Federal and Indian oil and gas leases. This information will be used to analyze and approve applications. Response to this request is mandatory only if the operator elects to initiate drilling or reentry operations on an oil and gas lease. The BLM would like you to know that you do not have to respond to this or any other Federal agency-sponsored information collection unless it displays a currently valid OMB control number.

BURDEN HOURS STATEMENT: Public reporting burden for this form is estimated to average 8 hours per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding the burden estimate or any other aspect of this form to U.S. Department of the Interior, Bureau of Land Management (1004-0137), Bureau Information Conection Clearance Officer (WO-630), 1849 C Street, N.W., Mail Stop 401 LS, Washington, D.C. 20240.

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Additional Operator Remarks

Location of Well

1. SHL: SENE / 2411 FNL / 1050 FEL / TWSP: 16S / RANGE: 30E / SECTION: 33 / LAT: 32.8786638 / LONG: -103.9717835 (TVD: 0 feet, MD: 0 feet)
   PPP: NESE / 2443 FSL / 868 FEL / TWSP: 16S / RANGE: 30E / SECTION: 33 / LAT: 32.877482 / LONG: -103.9711921 (TVD: 5042 feet, MD: 5315 feet)
   BHL: SESE / 100 FSL / 792 FEL / TWSP: 16S / RANGE: 30E / SECTION: 4 / LAT: 32.8565637 / LONG: -103.9709382 (TVD: 5146 feet, MD: 12933 feet)

BLM Point of Contact

Name: Ciji Methola
Title: GIS Support - Adjudicator
Phone: 5752345924
Email: cmethola@blm.gov

Review and Appeal Rights

A person contesting a decision shall request a State Director review. This request must be filed within 20 working days of receipt of the Notice with the appropriate State Director (see 43 CFR 3165.3). The State Director review decision may be appealed to the Interior Board of Land Appeals, 801 North Quincy Street, Suite 300, Arlington, VA 22203 (see 43 CFR 3165.4). Contact the above listed Bureau of Land Management office for further information.

PECOS DISTRICT
DRILLING CONDITIONS OF APPROVAL

OPERATOR'S NAME:	**Apache Corporation**
LEASE NO.:	**NMNM0002425**
WELL NAME & NO.:	Thunderbird Development Unit 2H
SURFACE HOLE FOOTAGE:	2411'/N & 1050'/E
BOTTOM HOLE FOOTAGE	100'/S & 792'/E
LOCATION:	Section 33, T.16 S., R.30 E., NMPM
COUNTY:	Eddy County, New Mexico

COA

H2S	◉ Yes	○ No	
Potash	◉ None	○ Secretary	○ R-111-P
Cave/Karst Potential	◉ Low	○ Medium	○ High
Variance	○ None	◉ Flex Hose	○ Other
Wellhead	○ Conventional	○ Multibowl	◉ Both
Other	☐ 4 String Area	☐ Capitan Reef	☐ WIPP
Other	☐ Fluid Filled	☐ Cement Squeeze	☐ Pilot Hole
Special Requirements	☐ Water Disposal	☐ COM	☑ Unit

A. HYDROGEN SULFIDE

A Hydrogen Sulfide (H2S) Drilling Plan shall be activated 500 feet prior to drilling into the **Yates, Tansill, and Queen** formation. As a result, the Hydrogen Sulfide area must meet Onshore Order 6 requirements, which includes equipment and personnel/public protection items. If Hydrogen Sulfide is encountered, please provide measured values and formations to the BLM.

B. CASING

1. The **13-3/8** inch surface casing shall be set at approximately **400 feet** (a minimum of **70 feet (Eddy County)** into the Rustler Anhydrite and above the salt) and cemented to the surface.

    a. If cement does not circulate to the surface, the appropriate BLM office shall be notified and a temperature survey utilizing an electronic type temperature survey with surface log readout will be used or a cement bond log shall be run to verify the top of the cement. Temperature survey will be run a minimum of six hours after pumping cement and ideally between 8-10 hours after completing the cement job.
    b. Wait on cement (WOC) time for a primary cement job will be a minimum of **8 hours** or 500 pounds compressive strength, whichever is greater. (This is to

include the lead cement)

c. Wait on cement (WOC) time for a remedial job will be a minimum of 4 hours after bringing cement to surface or 500 pounds compressive strength, whichever is greater.
d. If cement falls back, remedial cementing will be done prior to drilling out that string.

2. The minimum required fill of cement behind the **9-5/8** inch intermediate casing shall be set at approximately **3200 feet** is:

Option 1 (Single Stage):

- Cement to surface. If cement does not circulate see B.1.a, c-d above.

Option 2:

Operator has proposed a DV tool, the depth may be adjusted as long as the cement is changed proportionally. The DV tool may be cancelled if cement circulates to surface on the first stage.

a. First stage to DV tool: Cement to circulate. If cement does not circulate off the DV tool, contact the appropriate BLM office before proceeding with second stage cement job.

b. Second stage above DV tool:

- Cement to surface. If cement does not circulate, contact the appropriate BLM office.

3. The minimum required fill of cement behind the production casing is:

- Cement should tie-back at least **200 feet** into previous casing string. Operator shall provide method of verification.

C. PRESSURE CONTROL

1. Variance approved to use flex line from BOP to choke manifold. Manufacturer's specification to be readily available. No external damage to flex line. Flex line to be installed as straight as possible (no hard bends).'

2.

Option 1:

a. Minimum working pressure of the blowout preventer (BOP) and related equipment (BOPE) required for drilling below the surface casing shoe shall be **2000 (2M)** psi.

b. Minimum working pressure of the blowout preventer (BOP) and related equipment (BOPE) required for drilling below the intermediate casing shoe shall be **2000 (2M)** psi.

Option 2:

1. Operator has proposed a multi-bowl wellhead assembly. This assembly will only be tested when installed on the surface casing. Minimum working pressure of the blowout preventer (BOP) and related equipment (BOPE) required for drilling below the surface casing shoe shall be **2000 (2M)** psi.

    a. Wellhead shall be installed by manufacturer's representatives, submit documentation with subsequent sundry.
    b. If the welding is performed by a third party, the manufacturer's representative shall monitor the temperature to verify that it does not exceed the maximum temperature of the seal.
    c. Manufacturer representative shall install the test plug for the initial BOP test.
    d. If the cement does not circulate and one inch operations would have been possible with a standard wellhead, the well head shall be cut off, cementing operations performed and another wellhead installed.
    e. Whenever any seal subject to test pressure is broken, all the tests in OOGO2.III.A.2.i must be followed.

D. SPECIAL REQUIREMENT (S)

Unit Wells

The well sign for a unit well shall include the unit number in addition to the surface and bottom hole lease numbers. This also applies to participating area numbers. If a participating area has not been established, the operator can use the general unit

designation, but will replace the unit number with the participating area number when the sign is replaced.

Commercial Well Determination

A commercial well determination shall be submitted after production has been established for at least six months.

GENERAL REQUIREMENTS

The BLM is to be notified in advance for a representative to witness:

a. Spudding well (minimum of 24 hours)
b. Setting and/or Cementing of all casing strings (minimum of 4 hours)
c. BOPE tests (minimum of 4 hours)

☒ Eddy County
Call the Carlsbad Field Office, 620 East Greene St., Carlsbad, NM 88220, (575) 361-2822

☒ Lea County
Call the Hobbs Field Station, 414 West Taylor, Hobbs NM 88240, (575) 393-3612

1. Unless the production casing has been run and cemented or the well has been properly plugged, the drilling rig shall not be removed from over the hole without prior approval.

   a. In the event the operator has proposed to drill multiple wells utilizing a skid/walking rig. Operator shall secure the wellbore on the current well, after installing and testing the wellhead, by installing a blind flange of like pressure rating to the wellhead and a pressure gauge that can be monitored while drilling is performed on the other well(s).
   b. When the operator proposes to set surface casing with Spudder Rig
      - Notify the BLM when moving in and removing the Spudder Rig.
      - Notify the BLM when moving in the 2nd Rig. Rig to be moved in within 90 days of notification that Spudder Rig has left the location.
      - BOP/BOPE test to be conducted per Onshore Oil and Gas Order No. 2 as soon as 2nd Rig is rigged up on well.

2. Floor controls are required for 3M or Greater systems. These controls will be on the rig floor, unobstructed, readily accessible to the driller and will be operational at all times during drilling and/or completion activities. Rig floor is defined as the area immediately around the rotary table; the area immediately above the substructure on which the draw works are located, this does not include the dog house or stairway area.

3. The record of the drilling rate along with the GR/N well log run from TD to surface (horizontal well – vertical portion of hole) shall be submitted to the BLM office as well as all other logs run on the borehole 30 days from completion. If available, a digital copy of the logs is to be submitted in addition to the paper copies. The Rustler top and top and bottom of Salt are to be recorded on the Completion Report.

A. CASING

1. Changes to the approved APD casing program need prior approval if the items substituted are of lesser grade or different casing size or are Non-API. The Operator can exchange the components of the proposal with that of superior strength (i.e. changing from J-55 to N-80, or from 36# to 40#). Changes to the approved cement program need prior approval if the altered cement plan has less volume or strength or if the changes are substantial (i.e. Multistage tool, ECP, etc.). The initial wellhead installed on the well will remain on the well with spools used as needed.

2. Wait on cement (WOC) for Potash Areas: After cementing but before commencing any tests, the casing string shall stand cemented under pressure until both of the following conditions have been met: 1) cement reaches a minimum compressive strength of 500 psi for all cement blends, 2) until cement has been in place at least 24 hours. WOC time will be recorded in the driller's log. The casing intergrity test can be done (prior to the cement setting up) immediately after bumping the plug.

3. Wait on cement (WOC) for Water Basin: After cementing but before commencing any tests, the casing string shall stand cemented under pressure until both of the following conditions have been met: 1) cement reaches a minimum compressive strength of 500 psi at the shoe, 2) until cement has been in place at least 8 hours. WOC time will be recorded in the driller's log. See individual casing strings for details regarding lead cement slurry requirements. The casing intergrity test can be done (prior to the cement setting up) immediately after bumping the plug.

4. Provide compressive strengths including hours to reach required 500 pounds compressive strength prior to cementing each casing string. Have well specific cement details onsite prior to pumping the cement for each casing string.

5. No pea gravel permitted for remedial or fall back remedial without prior authorization from the BLM engineer.

6. On that portion of any well approved for a 5M BOPE system or greater, a pressure integrity test of each casing shoe shall be performed. Formation at the shoe shall be tested to a minimum of the mud weight equivalent anticipated to control the formation pressure to the next casing depth or at total depth of the well. This test shall be performed before drilling more than 20 feet of new hole.

7. If hardband drill pipe is rotated inside casing, returns will be monitored for metal. If metal is found in samples, drill pipe will be pulled and rubber protectors which have a larger diameter than the tool joints of the drill pipe will be installed prior to continuing drilling operations.
8. Whenever a casing string is cemented in the R-111-P potash area, the NMOCD requirements shall be followed.

B. PRESSURE CONTROL

1. All blowout preventer (BOP) and related equipment (BOPE) shall comply with well control requirements as described in Onshore Oil and Gas Order No. 2 and API RP 53 Sec. 17.

2. If a variance is approved for a flexible hose to be installed from the BOP to the choke manifold, the following requirements apply: Check condition of flexible line from BOP to choke manifold, replace if exterior is damaged or if line fails test. Line to be as straight as possible with no hard bends and is to be anchored according to Manufacturer's requirements. The flexible hose can be exchanged with a hose of equal size and equal or greater pressure rating. Anchor requirements, specification sheet and hydrostatic pressure test certification matching the hose in service, to be onsite for review. These documents shall be posted in the company man's trailer and on the rig floor.

3. 5M or higher system requires an HCR valve, remote kill line and annular to match. The remote kill line is to be installed prior to testing the system and tested to stack pressure.

4. If the operator has proposed a multi-bowl wellhead assembly in the APD. The following requirements must be met:

    a. Wellhead shall be installed by manufacturer's representatives, submit documentation with subsequent sundry.
    b. If the welding is performed by a third party, the manufacturer's representative shall monitor the temperature to verify that it does not exceed the maximum temperature of the seal.
    c. Manufacturer representative shall install the test plug for the initial BOP test.
    d. Whenever any seal subject to test pressure is broken, all the tests in OOGO2.III.A.2.i must be followed.
    e. If the cement does not circulate and one inch operations would have been possible with a standard wellhead, the well head shall be cut off, cementing operations performed and another wellhead installed.

5. The appropriate BLM office shall be notified a minimum of 4 hours in advance for a representative to witness the tests.

    a. In a water basin, for all casing strings utilizing slips, these are to be set as soon as the crew and rig are ready and any fallback cement remediation has been done. The casing cut-off and BOP installation can be initiated four hours after installing the slips, which will be approximately six hours after bumping the plug. For those casing strings not using slips, the minimum wait time before cut-off is eight hours after bumping the plug. BOP/BOPE testing can begin after cut-off or once cement reaches 500 psi compressive strength (including lead when specified), whichever is greater. However, if the float does not

hold, cut-off cannot be initiated until cement reaches 500 psi compressive strength (including lead when specified).

b. In potash areas, for all casing strings utilizing slips, these are to be set as soon as the crew and rig are ready and any fallback cement remediation has been done. For all casing strings, casing cut-off and BOP installation can be initiated at twelve hours after bumping the plug. However, **no tests** shall commence until the cement has had a minimum of 24 hours setup time, except the casing pressure test can be initiated immediately after bumping the plug (only applies to single stage cement jobs).

c. The tests shall be done by an independent service company utilizing a test plug not a cup or J-packer. The operator also has the option of utilizing an independent tester to test without a plug (i.e. against the casing) pursuant to Onshore Order 2 with the pressure not to exceed 70% of the burst rating for the casing. Any test against the casing must meet the WOC time for water basin (8 hours) or potash (24 hours) or 500 pounds compressive strength, whichever is greater, prior to initiating the test (see casing segment as lead cement may be critical item).

d. The test shall be run on a 5000 psi chart for a 2-3M BOP/BOP, on a 10000 psi chart for a 5M BOP/BOPE and on a 15000 psi chart for a 10M BOP/BOPE. If a linear chart is used, it shall be a one hour chart. A circular chart shall have a maximum 2 hour clock. If a twelve hour or twenty-four hour chart is used, tester shall make a notation that it is run with a two hour clock.

e. The results of the test shall be reported to the appropriate BLM office.

f. All tests are required to be recorded on a calibrated test chart. A copy of the BOP/BOPE test chart and a copy of independent service company test will be submitted to the appropriate BLM office.

g. The BOP/BOPE test shall include a low pressure test from 250 to 300 psi. The test will be held for a minimum of 10 minutes if test is done with a test plug and 30 minutes without a test plug. This test shall be performed prior to the test at full stack pressure.

h. BOP/BOPE must be tested by an independent service company within 500 feet of the top of the Wolfcamp formation if the time between the setting of the intermediate casing and reaching this depth exceeds 20 days. This test does not exclude the test prior to drilling out the casing shoe as per Onshore Order No. 2.

C. DRILLING MUD

Mud system monitoring equipment, with derrick floor indicators and visual and audio alarms, shall be operating before drilling into the Wolfcamp formation, and shall be used until production casing is run and cemented.

D. WASTE MATERIAL AND FLUIDS

All waste (i.e. drilling fluids, trash, salts, chemicals, sewage, gray water, etc.) created as a result of drilling operations and completion operations shall be safely contained and disposed of properly at a waste disposal facility. No waste material or fluid shall be disposed of on the well location or surrounding area.

Porto-johns and trash containers will be on-location during fracturing operations or any other crew-intensive operations.

PECOS DISTRICT
SURFACE USE
CONDITIONS OF APPROVAL

OPERATOR'S NAME:	Apache Corporation
WELL NAME & NO.:	Thunderbird Development Unit 2H
SURFACE HOLE FOOTAGE:	2411'/N & 1050'/E
BOTTOM HOLE FOOTAGE	100'/S & 792'/E
LOCATION:	Section 33, T.16 S., R.30 E., NMPM
COUNTY:	Eddy County, New Mexico

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Standard Conditions of Approval (COA) apply to this APD. If any deviations to these standards exist or special COAs are required, the section with the deviation or requirement will be checked below.

I. GENERAL PROVISIONS

The approval of the Application For Permit To Drill (APD) is in compliance with all applicable laws and regulations: 43 Code of Federal Regulations 3160, the lease terms, Onshore Oil and Gas Orders, Notices To Lessees, New Mexico Oil Conservation Division (NMOCD) Rules, National Historical Preservation Act As Amended, and instructions and orders of the Authorized Officer. Any request for a variance shall be submitted to the Authorized Officer on Form 3160-5, Sundry Notices and Report on Wells.

II. PERMIT EXPIRATION

If the permit terminates prior to drilling and drilling cannot be commenced within 60 days after expiration, an operator is required to submit Form 3160-5, Sundry Notices and Reports on Wells, requesting surface reclamation requirements for any surface disturbance. However, if the operator will be able to initiate drilling within 60 days after the expiration of the permit, the operator must have set the conductor pipe in order to allow for an extension of 60 days beyond the expiration date of the APD. (Filing of a Sundry Notice is required for this 60 day extension.)

III. ARCHAEOLOGICAL, PALEONTOLOGY & HISTORICAL SITES

Any cultural and/or paleontological resource discovered by the operator or by any person working on the operator's behalf shall immediately report such findings to the Authorized Officer. The operator is fully accountable for the actions of their contractors and subcontractors. The operator shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Authorized Officer. An evaluation of the discovery shall be made by the Authorized Officer to determine the appropriate actions that shall be required to prevent the loss of significant cultural or scientific values of the discovery. The operator shall be held responsible for the cost of the proper mitigation measures that the Authorized Officer assesses after consultation with the operator on the evaluation and decisions of the discovery. Any unauthorized collection or disturbance of cultural or paleontological resources may result in a shutdown order by the Authorized Officer.

IV. NOXIOUS WEEDS

The operator shall be held responsible if noxious weeds become established within the areas of operations. Weed control shall be required on the disturbed land where noxious weeds exist, which includes the roads, pads, associated pipeline corridor, and adjacent land affected by the establishment of weeds due to this action. The operator shall consult with the Authorized Officer for acceptable weed control methods, which include following EPA and BLM requirements and policies.

V. SPECIAL REQUIREMENT(S)

Timing Limitation Stipulation / Condition of Approval for lesser prairie-chicken: Oil and gas activities including 3-D geophysical exploration, and drilling will not be allowed in lesser prairie-chicken habitat during the period from March 1st through June 15th annually. During that period, other activities that produce noise or involve human activity, such as the maintenance of oil and gas facilities, pipeline, road, and well pad construction, will be allowed except between 3:00 am and 9:00 am. The 3:00 am to 9:00 am restriction will not apply to normal, around-the-clock operations, such as venting, flaring, or pumping, which do not require a human presence during this period. Additionally, no new drilling will be allowed within up to 200 meters of leks known at the time of permitting. Normal vehicle use on existing roads will not be restricted. Exhaust noise from pump jack engines must be muffled or otherwise controlled so as not to exceed 75 db measured at 30 feet from the source of the noise.

Ground-level Abandoned Well Marker to avoid raptor perching: Upon the plugging and subsequent abandonment of the well, the well marker will be installed at ground level on a plate containing the pertinent information for the plugged well. For more installation details, contact the Carlsbad Field Office at 575-234-5972.

Timing Limitation Exceptions:
The Carlsbad Field Office will publish an annual map of where the LPC timing and noise stipulations and conditions of approval (Limitations) will apply for the identified year (between March 1 and June 15) based on the latest survey information. The LPC Timing Area map will identify areas which are Habitat Areas (HA), Isolated Population Area (IPA), and Primary Population Area (PPA). The LPC Timing Area map will also have an area in red crosshatch. The red crosshatch area is the only area where an operator is required to submit a request for exception to the LPC Limitations. If an operator is operating outside the red crosshatch area, the LPC Limitations do not apply for that year and an exception to LPC Limitations is not required.

Dunes Sagebrush Lizard Trenching Stipulation

- Pre-construction contact with a BLM wildlife biologist is required 5 days prior to any ground disturbing activities associated with the project occurs.

- Successful completion of the BLM Trench Stipulation Workshop is required for a non-agency person to be approved as a monitor.

- Any trench left open for (8) hours or less is not required to have escape ramps; however, before the trench is backfilled, an agency approved monitor shall walk the entire length of the open trench and remove all trapped vertebrates. The bottom surface of the trench will be disturbed a minimum of 2 inches in order to

arouse any buried vertebrates. All vertebrates will be released a minimum of 100 yards from the trench.

- For trenches left open for eight (8) hours or more the following requirements apply:

    - Earthen escape ramps and/or structures (built at no more than a 30 degree slope and spaced no more than 500 feet apart) shall be placed in the trench. Metal structures will not be authorized. Options will be discussed in detail at the required Trench Stipulation Workshop.
    - One approved monitor shall be required to survey up to three miles of trench between the hours of 11 AM-2 PM. A daily report (consolidate if there is more than one monitor) on the vertebrates found and removed from the trench shall be provided to the BLM (email/fax is acceptable) the following morning.
    - Prior to backfilling of the trench all structures used as escape ramps will be removed and the bottom surface of the trench will be disturbed a minimum of 2 inches in order to arouse any buried vertebrates. All vertebrates will be released a minimum of 100 yards from the trench.

- This stipulation shall apply to the entire length of the project in the DSL habitat polygon regardless of land ownership or CCA/CCAA enrollment status.

- A project closeout will be required within three business days of the completion of the project.

Hydrology

The entire well pad will be bermed to prevent oil, salt, and other chemical contaminants from leaving the well pad. The compacted berm shall be constructed at a minimum of 12 inches with impermeable mineral material (e.g. caliche). Topsoil shall not be used to construct the berm. No water flow from the uphill side(s) of the pad shall be allowed to enter the well pad. The integrity of the berm shall be maintained around the surfaced pad throughout the life of the well and around the downsized pad after interim reclamation has been completed. Any water erosion that may occur due to the construction of the well pad during the life of the well will be quickly corrected and proper measures will be taken to prevent future erosion. Stockpiling of topsoil is required. The top soil shall be stockpiled in an appropriate location to prevent loss of soil due to water or wind erosion and not used for berming or erosion control. If fluid collects within the bermed area, the

fluid must be vacuumed into a safe container and disposed of properly at a state approved facility.

When crossing ephemeral drainages the pipeline will be buried to a minimum depth of 48 inches from the top of pipe to ground level. Erosion control methods such as gabions and/or rock aprons should be placed on both up and downstream sides of the pipeline crossing. In addition, curled (weed free) wood/straw fiber wattles/logs and/or silt fences should be placed on the downstream side for sediment control during construction and maintained until soils and vegetation have stabilized. Water bars should be placed within the ROW to divert and dissipate surface runoff. A pipeline access road is not permitted to cross these ephemeral drainages. Traffic should be diverted to a preexisting route. Additional seeding may be required in floodplains and drainages to restore energy dissipating vegetation.

Tank battery locations will be lined and bermed. A 20 mil permanent liner will be installed with a 4 oz. felt backing to prevent tears or punctures. Tank battery berms must be large enough to contain 1 ½ times the content of the largest tank or 24 hour production, whichever is greater. Automatic shut off, check valves, or similar systems will be installed for tanks to minimize the effects of catastrophic line failures used in production or drilling.

A leak detection plan will be submitted to the BLM Carlsbad Field Office for approval prior to pipeline installation. The method could incorporate gauges to detect pressure drops, situating valves and lines so they can be visually inspected periodically or installing electronic sensors to alarm when a leak is present. The leak detection plan will incorporate an automatic shut off system that will be installed for proposed pipelines to minimize the effects of an undesirable event.

Any water erosion that may occur due to the construction of overhead electric line and during the life of the power line will be quickly corrected and proper measures will be taken to prevent future erosion. A power pole should not be placed in drainages, playas, wetlands, riparian areas, or floodplains and must span across the features at a distance away that would not promote further erosion.

VI. CONSTRUCTION

A. NOTIFICATION

The BLM shall administer compliance and monitor construction of the access road and well pad. Notify the Carlsbad Field Office at (575) 234-5909 at least 3 working days prior to commencing construction of the access road and/or well pad.

When construction operations are being conducted on this well, the operator shall have the approved APD and Conditions of Approval (COA) on the well site and they shall be made available upon request by the Authorized Officer.

B. TOPSOIL

The operator shall strip the top portion of the soil (root zone) from the entire well pad area and stockpile the topsoil along the edge of the well pad as depicted in the APD. The root zone is typically six (6) inches in depth. All the stockpiled topsoil will be redistributed over the interim reclamation areas. Topsoil shall not be used for berming the pad or facilities. For final reclamation, the topsoil shall be spread over the entire pad area for seeding preparation.

Other subsoil (below six inches) stockpiles must be completely segregated from the topsoil stockpile. Large rocks or subsoil clods (not evident in the surrounding terrain) must be buried within the approved area for interim and final reclamation.

C. CLOSED LOOP SYSTEM

Tanks are required for drilling operations: No Pits.

The operator shall properly dispose of drilling contents at an authorized disposal site.

D. FEDERAL MINERAL MATERIALS PIT

Payment shall be made to the BLM prior to removal of any federal mineral materials. Call the Carlsbad Field Office at (575) 234-5972.

E. WELL PAD SURFACING

Surfacing of the well pad is not required.

If the operator elects to surface the well pad, the surfacing material may be required to be removed at the time of reclamation. The well pad shall be constructed in a manner which creates the smallest possible surface disturbance, consistent with safety and operational needs.

F. EXCLOSURE FENCING (CELLARS & PITS)

Exclosure Fencing
The operator will install and maintain exclosure fencing for all open well cellars to prevent access to public, livestock, and large forms of wildlife before and after drilling operations until the pit is free of fluids and the operator initiates backfilling. (For examples of exclosure fencing design, refer to BLM's Oil and Gas Gold Book, Exclosure Fence Illustrations, Figure 1, Page 18.)

G. ON LEASE ACCESS ROADS

Road Width
The access road shall have a driving surface that creates the smallest possible surface disturbance and does not exceed fourteen (14) feet in width. The maximum width of surface disturbance, when constructing the access road, shall not exceed twenty-five (25) feet.

Surfacing
Surfacing material is not required on the new access road driving surface. If the operator elects to surface the new access road or pad, the surfacing material may be required to be removed at the time of reclamation.

Where possible, no improvements should be made on the unsurfaced access road other than to remove vegetation as necessary, road irregularities, safety issues, or to fill low areas that may sustain standing water.

The Authorized Officer reserves the right to require surfacing of any portion of the access road at any time deemed necessary. Surfacing may be required in the event the road deteriorates, erodes, road traffic increases, or it is determined to be beneficial for future field development. The surfacing depth and type of material will be determined at the time of notification.

Crowning
Crowning shall be done on the access road driving surface. The road crown shall have a grade of approximately 2% (i.e., a 1" crown on a 14' wide road). The road shall conform to Figure 1; cross section and plans for typical road construction.

Ditching
Ditching shall be required on both sides of the road.

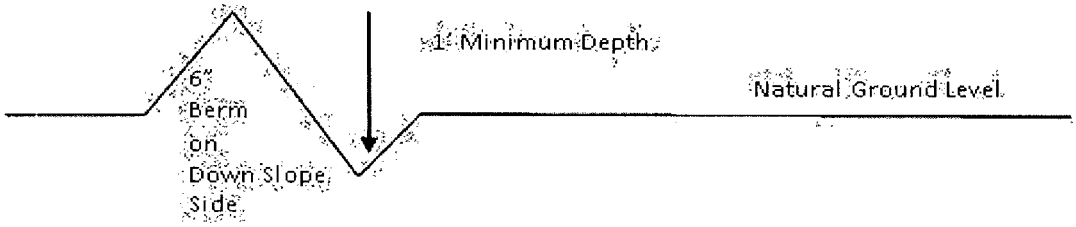
Turnouts
Vehicle turnouts shall be constructed on the road. Turnouts shall be intervisible with interval spacing distance less than 1000 feet. Turnouts shall conform to Figure 1; cross section and plans for typical road construction.

Drainage

Drainage control systems shall be constructed on the entire length of road (e.g. ditches, sidehill outsloping and insloping, lead-off ditches, culvert installation, and low water crossings).

A typical lead-off ditch has a minimum depth of 1 foot below and a berm of 6 inches above natural ground level. The berm shall be on the down-slope side of the lead-off ditch.

Cross Section of a Typical Lead-off Ditch



All lead-off ditches shall be graded to drain water with a 1 percent minimum to 3 percent maximum ditch slope. The spacing interval are variable for lead-off ditches and shall be determined according to the formula for spacing intervals of lead-off ditches, but may be amended depending upon existing soil types and centerline road slope (in %);

Formula for Spacing Interval of Lead-off Ditches

Example - On a 4% road slope that is 400 feet long, the water flow shall drain water into a lead-off ditch. Spacing interval shall be determined by the following formula:

400 foot road with 4% road slope: $\frac{400'}{4\%} + 100' = 200'$ lead-off ditch interval

Cattle guards

An appropriately sized cattle guard sufficient to carry out the project shall be installed and maintained at fence/road crossings. Any existing cattle guards on the access road route shall be repaired or replaced if they are damaged or have deteriorated beyond practical use. The operator shall be responsible for the condition of the existing cattle guards that are in place and are utilized during lease operations.

Fence Requirement

Where entry is granted across a fence line, the fence shall be braced and tied off on both sides of the passageway prior to cutting. The operator shall notify the private surface landowner or the grazing allotment holder prior to crossing any fences.

Public Access

Public access on this road shall not be restricted by the operator without specific written approval granted by the Authorized Officer.

Construction Steps

1. Salvage topsoil
2. Construct road
3. Redistribute topsoil
4. Revegetate slopes

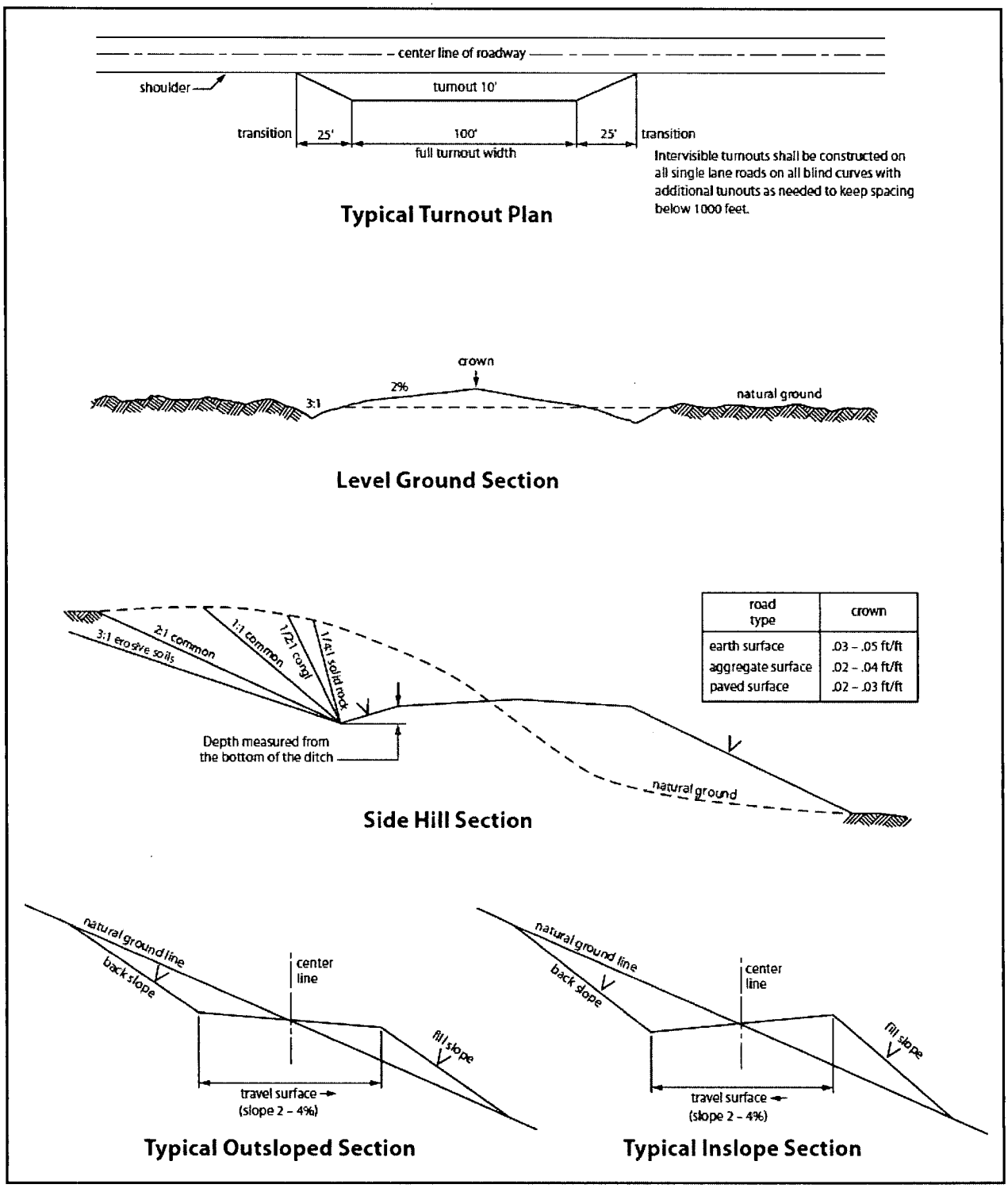


Figure 1. Cross-sections and plans for typical road sections representative of BLM resource or FS local and higher-class roads.

VII. PRODUCTION (POST DRILLING)

A. WELL STRUCTURES & FACILITIES

Placement of Production Facilities
Production facilities should be placed on the well pad to allow for maximum interim recontouring and revegetation of the well location.

Exclosure Netting (Open-top Tanks)
Immediately following active drilling or completion operations, the operator will take actions necessary to prevent wildlife and livestock access, including avian wildlife, to all open-topped tanks that contain or have the potential to contain salinity sufficient to cause harm to wildlife or livestock, hydrocarbons, or Resource Conservation and Recovery Act of 1976-exempt hazardous substances. At a minimum, the operator will net, screen, or cover open-topped tanks to exclude wildlife and livestock and prevent mortality. If the operator uses netting, the operator will cover and secure the open portion of the tank to prevent wildlife entry. The operator will net, screen, or cover the tanks until the operator removes the tanks from the location or the tanks no longer contain substances that could be harmful to wildlife or livestock. Use a maximum netting mesh size of 1 ½ inches. The netting must not be in contact with fluids and must not have holes or gaps.

Chemical and Fuel Secondary Containment and Exclosure Screening
The operator will prevent all hazardous, poisonous, flammable, and toxic substances from coming into contact with soil and water. At a minimum, the operator will install and maintain an impervious secondary containment system for any tank or barrel containing hazardous, poisonous, flammable, or toxic substances sufficient to contain the contents of the tank or barrel and any drips, leaks, and anticipated precipitation. The operator will dispose of fluids within the containment system that do not meet applicable state or U. S. Environmental Protection Agency livestock water standards in accordance with state law; the operator must not drain the fluids to the soil or ground. The operator will design, construct, and maintain all secondary containment systems to prevent wildlife and livestock exposure to harmful substances. At a minimum, the operator will install effective wildlife and livestock exclosure systems such as fencing, netting, expanded metal mesh, lids, and grate covers. Use a maximum netting mesh size of 1 ½ inches.

Open-Vent Exhaust Stack Exclosures
The operator will construct, modify, equip, and maintain all open-vent exhaust stacks on production equipment to prevent birds and bats from entering, and to discourage perching, roosting, and nesting. (*Recommended exclosure structures on open-vent exhaust stacks are in the shape of a cone.*) Production equipment includes, but may not be limited to, tanks, heater-treaters, separators, dehydrators, flare stacks, in-line units, and compressor mufflers.

Containment Structures

Proposed production facilities such as storage tanks and other vessels will have a secondary containment structure that is constructed to hold the capacity of 1.5 times the largest tank, plus freeboard to account for precipitation, unless more stringent protective requirements are deemed necessary.

Painting Requirement
All above-ground structures including meter housing that are not subject to safety requirements shall be painted a flat non-reflective paint color, **Shale Green** from the BLM Standard Environmental Color Chart (CC-001: June 2008).

B. PIPELINES

BURIED PIPELINE STIPULATIONS

A copy of the application (Grant, APD, or Sundry Notice) and attachments, including conditions of approval, survey plat and/or map, will be on location during construction. BLM personnel may request to you a copy of your permit during construction to ensure compliance with all stipulations.

Holder agrees to comply with the following stipulations to the satisfaction of the Authorized Officer:

1. The Holder shall indemnify the United States against any liability for damage to life or property arising from the occupancy or use of public lands under this grant.

2. The Holder shall comply with all applicable Federal laws and regulations existing or hereafter enacted or promulgated. In any event, the holder shall comply with the Toxic Substances Control Act of 1976 as amended, 15 USC 2601 et seq. (1982) with regards to any toxic substances that are used, generated by or stored on the right-of-way or on facilities authorized under this right-of-way grant. (See 40 CFR Part 702-799 and especially, provisions on polychlorinated biphenyls, 40 CFR 761.1-761.193.) Additionally, any release of toxic substances (leaks, spills, etc.) in excess of the reportable quantity established by 40 CFR Part 117 shall be reported as required by the Comprehensive Environmental Response, Compensation, and Liability Act, section 102b. A copy of any report required or requested by any Federal agency or State government as a result of a reportable release or spill of any toxic substances shall be furnished to the authorized officer concurrent with the filing of the reports to the involved Federal agency or State government.

3. The holder agrees to indemnify the United States against any liability arising from the release of any hazardous substance or hazardous waste (as these terms are defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. 9601, et seq. or the Resource Conservation and Recovery Act, 42 U.S.C.6901, et seq.) on the Right-of-Way (unless the release or threatened release is wholly unrelated to the Right-of-Way holder's activity on the Right-of-Way), or resulting from the activity of

the Right-of-Way holder on the Right-of-Way. This agreement applies without regard to whether a release is caused by the holder, its agent, or unrelated third parties.

4. If, during any phase of the construction, operation, maintenance, or termination of the pipeline, any oil or other pollutant should be discharged from the pipeline system, impacting Federal lands, the control and total removal, disposal, and cleaning up of such oil or other pollutant, wherever found, shall be the responsibility of holder, regardless of fault. Upon failure of holder to control, dispose of, or clean up such discharge on or affecting Federal lands, or to repair all damages resulting therefrom, on the Federal lands, the Authorized Officer may take such measures as he deems necessary to control and clean up the discharge and restore the area, including where appropriate, the aquatic environment and fish and wildlife habitats, at the full expense of the holder. Such action by the Authorized Officer shall not relieve holder of any responsibility as provided herein.

5. All construction and maintenance activity will be confined to the authorized right-of-way.

6. The pipeline will be buried with a minimum cover of **36** inches between the top of the pipe and ground level.

7. The maximum allowable disturbance for construction in this right-of-way will be **30** feet:

- Blading of vegetation within the right-of-way will be allowed: maximum width of blading operations will not exceed **20** feet. The trench is included in this area. (*Blading is defined as the complete removal of brush and ground vegetation.*)

- Clearing of brush species within the right-of-way will be allowed: maximum width of clearing operations will not exceed **30** feet. The trench and bladed area are included in this area. (*Clearing is defined as the removal of brush while leaving ground vegetation (grasses, weeds, etc.) intact. Clearing is best accomplished by holding the blade 4 to 6 inches above the ground surface.*)

- The remaining area of the right-of-way (if any) shall only be disturbed by compressing the vegetation. (*Compressing can be caused by vehicle tires, placement of equipment, etc.*)

8. The holder shall stockpile an adequate amount of topsoil where blading is allowed. The topsoil to be stripped is approximately 6 inches in depth. The topsoil will be segregated from other spoil piles from trench construction. The topsoil will be evenly distributed over the bladed area for the preparation of seeding.

9. The holder shall minimize disturbance to existing fences and other improvements on public lands. The holder is required to promptly repair improvements to at least their former state. Functional use of these improvements will be maintained at all times. The holder will contact the owner of any improvements prior to disturbing them. When necessary to pass through a fence line, the fence shall be braced on both sides of the passageway prior to cutting of the fence. No permanent gates will be allowed unless approved by the Authorized Officer.

10. Vegetation, soil, and rocks left as a result of construction or maintenance activity will be randomly scattered on this right-of-way and will not be left in rows, piles, or berms, unless otherwise approved by the Authorized Officer. The entire right-of-way shall be recontoured to match the surrounding landscape. The backfilled soil shall be compacted and a 6 inch berm will be left over the ditch line to allow for settling back to grade.

11. In those areas where erosion control structures are required to stabilize soil conditions, the holder will install such structures as are suitable for the specific soil conditions being encountered and which are in accordance with sound resource management practices.

12. The holder will reseed all disturbed areas. Seeding will be done according to the attached seeding requirements, using the following seed mix.

( ) seed mixture 1 ( ) seed mixture 3

() seed mixture 2 ( ) seed mixture 4

(X) seed mixture 2/LPC ( ) Aplomado Falcon Mixture

13. All above-ground structures not subject to safety requirements shall be painted by the holder to blend with the natural color of the landscape. The paint used shall be color which simulates "Standard Environmental Colors" – **Shale Green**, Munsell Soil Color No. 5Y 4/2.

14. The pipeline will be identified by signs at the point of origin and completion of the right-of-way and at all road crossings. At a minimum, signs will state the holder's name, BLM serial number, and the product being transported. All signs and information thereon will be posted in a permanent, conspicuous manner, and will be maintained in a legible condition for the life of the pipeline.

15. The holder shall not use the pipeline route as a road for purposes other than routine maintenance as determined necessary by the Authorized Officer in consultation with the holder before maintenance begins. The holder will take whatever steps are necessary to ensure that the pipeline route is not used as a roadway. As determined necessary during the life of the pipeline, the Authorized Officer may ask the holder to construct temporary deterrence structures.

16. Any cultural and/or paleontological resources (historic or prehistoric site or object) discovered by the holder, or any person working on his behalf, on public or Federal land shall be immediately reported to the Authorized Officer. Holder shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Authorized Officer. An evaluation of the discovery will be made by the Authorized Officer to determine appropriate actions to prevent the loss of significant cultural or scientific values. The holder will be responsible for the cost of evaluation and any decision as to proper mitigation measures will be made by the Authorized Officer after consulting with the holder.

17. The operator shall be held responsible if noxious weeds become established within the areas of operations. Weed control shall be required on the disturbed land where noxious weeds exist, which includes associated roads, pipeline corridor and adjacent land affected by the establishment of weeds due to this action. The operator shall consult with the Authorized Officer for acceptable weed control methods, which include following EPA and BLM requirements and policies.

18. Escape Ramps - The operator will construct and maintain pipeline/utility trenches [that are not otherwise fenced, screened, or netted] to prevent livestock, wildlife, and humans from becoming entrapped. At a minimum, the operator will construct and maintain escape ramps, ladders, or other methods of avian and terrestrial wildlife escape in the trenches according to the following criteria:

a. Any trench left open for eight (8) hours or less is not required to have escape ramps; however, before the trench is backfilled, the contractor/operator shall inspect the trench for wildlife, remove all trapped wildlife, and release them at least 100 yards from the trench.
b. For trenches left open for eight (8) hours or more, earthen escape ramps (built at no more than a 30 degree slope and spaced no more than 500 feet apart) shall be placed in the trench.

19. Special Stipulations:

Lesser Prairie-Chicken

Oil and gas activities will not be allowed in lesser prairie-chicken habitat during the period from March 1st through June 15th annually. During that period, other activities

that produce noise or involve human activity, such as the maintenance of oil and gas facilities, geophysical exploration other than 3-D operations, and pipeline, road, and well pad construction, will be allowed except between 3:00 am and 9:00 am. The 3:00 am to 9:00 am restriction will not apply to normal, around-the-clock operations, such as venting, flaring, or pumping, which do not require a human presence during this period. Normal vehicle use on existing roads will not be restricted. Exhaust noise from pump jack engines must be muffled or otherwise controlled so as not to exceed 75 db measured at 30 ft. from the source of the noise.

C. ELECTRIC LINES

STANDARD STIPULATIONS FOR OVERHEAD ELECTRIC DISTRIBUTION LINES

A copy of the grant and attachments, including stipulations, survey plat and/or map, will be on location during construction. BLM personnel may request to you a copy of your permit during construction to ensure compliance with all stipulations.

Holder agrees to comply with the following stipulations to the satisfaction of the Authorized Officer:

1. The holder shall indemnify the United States against any liability for damage to life or property arising from the occupancy or use of public lands under this grant.

2. The holder shall comply with all applicable Federal laws and regulations existing or hereafter enacted or promulgated. In any event, the holder shall comply with the Toxic Substances Control Act of 1976 as amended, 15 USC 2601 et seq. (1982) with regards to any toxic substances that are used, generated by or stored on the right-of-way or on facilities authorized under this right-of-way grant. (See 40 CFR, Part 702-799 and especially, provisions on polychlorinated biphenyls, 40 CFR 761.1-761.193.) Additionally, any release of toxic substances (leaks, spills, etc.) in excess of the reportable quantity established by 40 CFR, Part 117 shall be reported as required by the Comprehensive Environmental Response, Compensation, and Liability Act, section 102b. A copy of any report required or requested by any Federal agency or State government as a result of a reportable release or spill of any toxic substances shall be furnished to the authorized officer concurrent with the filing of the reports to the involved Federal agency or State government.

3. The holder agrees to indemnify the United States against any liability arising from the release of any hazardous substance or hazardous waste (as these terms are defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. 9601, et seq. or the Resource Conservation and Recovery Act, 42 U.S.C. 6901, et seq.) on the Right-of-Way (unless the release or threatened release is wholly unrelated to the Right-of-Way holder's activity on the Right-of-Way), or resulting from the activity of the Right-of-Way holder on the Right-of-Way. This agreement applies without regard to whether a release is caused by the holder, its agent, or unrelated third parties.

4. There will be no clearing or blading of the right-of-way unless otherwise agreed to in writing by the Authorized Officer.

5. Power lines shall be constructed and designed in accordance to standards outlined in "Suggested Practices for Avian Protection on Power lines: The State of the Art in 2006" Edison Electric Institute, APLIC, and the California Energy Commission 2006 . The holder shall assume the burden and expense of proving that pole designs not shown in the above publication deter raptor perching, roosting, and nesting. Such proof shall be provided by a raptor expert approved by the Authorized Officer. The BLM reserves the right to require modification or additions to all powerline structures placed on this right-of-way, should they be necessary to ensure the safety of large perching birds. Such modifications and/or additions shall be made by the holder without liability or expense to the United States.

Raptor deterrence will consist of but not limited to the following: triangle perch discouragers shall be placed on each side of the cross arms and a nonconductive perching deterrence shall be placed on all vertical poles that extend past the cross arms.

6. The holder shall minimize disturbance to existing fences and other improvements on public lands. The holder is required to promptly repair improvements to at least their former state. Functional use of these improvements will be maintained at all times. The holder will contact the owner of any improvements prior to disturbing them. When necessary to pass through a fence line, the fence shall be braced on both sides of the passageway prior to cutting the fence. No permanent gates will be allowed unless approved by the Authorized Officer.

7. The BLM serial number assigned to this authorization shall be posted in a permanent, conspicuous manner where the power line crosses roads and at all serviced facilities. Numbers will be at least two inches high and will be affixed to the pole nearest the road crossing and at the facilities served.

8. Upon cancellation, relinquishment, or expiration of this grant, the holder shall comply with those abandonment procedures as prescribed by the Authorized Officer.

9. All surface structures (poles, lines, transformers, etc.) shall be removed within 180 days of abandonment, relinquishment, or termination of use of the serviced facility or facilities or within 180 days of abandonment, relinquishment, cancellation, or expiration of this grant, whichever comes first. This will not apply where the power line extends service to an active, adjoining facility or facilities.

10. Any cultural and/or paleontological resource (historic or prehistoric site or object) discovered by the holder, or any person working on his behalf, on public or Federal land shall be immediately reported to the Authorized Officer. Holder shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Authorized Officer. An evaluation of the discovery will be made by the Authorized Officer to determine appropriate actions to prevent the loss of significant

cultural or scientific values. The holder will be responsible for the cost of evaluation and any decision as to proper mitigation measures will be made by the Authorized Officer after consulting with the holder.

11. Special Stipulations:
    - For reclamation remove poles, lines, transformer, etc. and dispose of properly.
    - Fill in any holes from the poles removed.

Timing Limitation Stipulation/Condition of Approval for Lesser Prairie-Chicken: Oil and gas activities including 3-D geophysical exploration, and drilling will not be allowed in lesser prairie-chicken habitat during the period from March 1st through June 15th annually. During that period, other activities that produce noise or involve human activity, such as the maintenance of oil and gas facilities, geophysical exploration other than 3-D operations, and pipeline, road, and well pad construction, will be allowed except between 3:00 am and 9:00 am. The 3:00 am to 9:00 am restriction will not apply to normal, around-the-clock operations, such as venting, flaring, or pumping, which do not require a human presence during this period. Additionally, no new drilling will be allowed within up to 200 meters of leks known at the time of permitting. Normal vehicle use on existing roads will not be restricted. Exhaust noise from pump jack engines must be muffled or otherwise controlled so as not to exceed 75 db measured at 30 ft. from the source of the noise.

VIII. INTERIM RECLAMATION

During the life of the development, all disturbed areas not needed for active support of production operations should undergo interim reclamation in order to minimize the environmental impacts of development on other resources and uses.

Within six (6) months of well completion, operators should work with BLM surface management specialists (Jim Amos: 575-234-5909) to devise the best strategies to reduce the size of the location. Interim reclamation should allow for remedial well operations, as well as safe and efficient removal of oil and gas.

During reclamation, the removal of caliche is important to increasing the success of revegetating the site. Removed caliche that is free of contaminants may be used for road repairs, fire walls or for building other roads and locations. In order to operate the well or complete workover operations, it may be necessary to drive, park and operate on restored interim vegetation within the previously disturbed area. Disturbing revegetated areas for production or workover operations will be allowed. If there is significant disturbance and loss of vegetation, the area will need to be revegetated. Communicate with the appropriate BLM office for any exceptions/exemptions if needed.

All disturbed areas after they have been satisfactorily prepared need to be reseeded with the seed mixture provided below.

Upon completion of interim reclamation, the operator shall submit a Sundry Notices and Reports on Wells, Subsequent Report of Reclamation (Form 3160-5).

IX. FINAL ABANDONMENT & RECLAMATION

At final abandonment, well locations, production facilities, and access roads must undergo "final" reclamation so that the character and productivity of the land are restored.

Earthwork for final reclamation must be completed within six (6) months of well plugging. All pads, pits, facility locations and roads must be reclaimed to a satisfactory revegetated, safe, and stable condition, unless an agreement is made with the landowner or BLM to keep the road and/or pad intact.

After all disturbed areas have been satisfactorily prepared, these areas need to be revegetated with the seed mixture provided below. Seeding should be accomplished by drilling on the contour whenever practical or by other approved methods. Seeding may need to be repeated until revegetation is successful, as determined by the BLM.

Operators shall contact a BLM surface protection specialist prior to surface abandonment operations for site specific objectives (Jim Amos: 575-234-5909).

Ground-level Abandoned Well Marker to avoid raptor perching: Upon the plugging and subsequent abandonment of the well, the well marker will be installed at ground level on a plate containing the pertinent information for the plugged well.

Seed Mixture for LPC Sand/Shinnery Sites

Holder shall seed all disturbed areas with the seed mixture listed below. The seed mixture shall be planted in the amounts specified in pounds of pure live seed (PLS)* per acre. There shall be no primary or secondary noxious weeds in the seed mixture. Seed will be tested and the viability testing of seed shall be done in accordance with State law(s) and within nine (9) months prior to purchase. Commercial seed shall be either certified or registered seed. The seed container shall be tagged in accordance with State law(s) and available for inspection by the Authorized Officer.

Seed will be planted using a drill equipped with a depth regulator to ensure proper depth of planting where drilling is possible. The seed mixture will be evenly and uniformly planted over the disturbed area (smaller/heavier seeds have a tendency to drop the bottom of the drill and are planted first). Holder shall take appropriate measures to ensure this does not occur. Where drilling is not possible, seed will be broadcast and the area shall be raked or chained to cover the seed. When broadcasting the seed, the pounds per acre are to be doubled. Seeding shall be repeated until a satisfactory stand is established as determined by the Authorized Officer. Evaluation of growth may not be made before completion of at least one full growing season after seeding.

Species to be planted in pounds of pure live seed* per acre:

Species	lb/acre
Plains Bristlegrass	5lbs/A
Sand Bluestem	5lbs/A
Little Bluestem	3lbs/A
Big Bluestem	6lbs/A
Plains Coreopsis	2lbs/A
Sand Dropseed	1lbs/A

*Pounds of pure live seed:

Pounds of seed **x** percent purity **x** percent germination = pounds pure live seed

AFMSS

U.S. Department of the Interior
BUREAU OF LAND MANAGEMENT

Operator Certification Data Report

09/30/2019

Operator Certification

I hereby certify that I, or someone under my direct supervision, have inspected the drill site and access route proposed herein; that I am familiar with the conditions which currently exist; that I have full knowledge of state and Federal laws applicable to this operation; that the statements made in this APD package are, to the best of my knowledge, true and correct; and that the work associated with the operations proposed herein will be performed in conformity with this APD package and the terms and conditions under which it is approved. I also certify that I, or the company I represent, am responsible for the operations conducted under this application. These statements are subject to the provisions of 18 U.S.C. 1001 for the filing of false statements.

NAME: Sorina Flores **Signed on:** 02/07/2019

Title: Supv of Drilling Services

Street Address: 303 Veterans Airpark Ln #1000

City: Midland **State:** TX **Zip:** 79705

Phone: (432)818-1167

Email address: sorina.flores@apachecorp.com

Field Representative

Representative Name:

Street Address:

City: **State:** **Zip:**

Phone:

Email address:

APD ID: 10400038856 **Submission Date:** 02/07/2019

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Well Type: OIL WELL **Well Work Type:** Drill

Highlighted data reflects the most recent changes

Show Final Text

Section 1 - General

APD ID: 10400038856 **Tie to previous NOS?** **Submission Date:** 02/07/2019

BLM Office: CARLSBAD **User:** Sorina Flores **Title:** Supv of Drilling Services

Federal/Indian APD: FED **Is the first lease penetrated for production Federal or Indian?** FED

Lease number: NMNM0002425 **Lease Acres:** 599.35

Surface access agreement in place? **Allotted?** **Reservation:**

Agreement in place? NO **Federal or Indian agreement:**

Agreement number:

Agreement name:

Keep application confidential? YES

Permitting Agent? NO **APD Operator:** APACHE CORPORATION

Operator letter of designation:

Operator Info

Operator Organization Name: APACHE CORPORATION

Operator Address: 303 Veterans Airpark Lane #1000

Zip: 79705

Operator PO Box:

Operator City: Midland **State:** TX

Operator Phone: (432)818-1000

Operator Internet Address:

Section 2 - Well Information

Well in Master Development Plan? NO **Master Development Plan name:**

Well in Master SUPO? NO **Master SUPO name:**

Well in Master Drilling Plan? NO **Master Drilling Plan name:**

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H **Well API Number:**

Field/Pool or Exploratory? Field and Pool **Field Name:** YESO **Pool Name:** LOCO HILLS; GLORIETA-YESO

Is the proposed well in an area containing other mineral resources? USEABLE WATER

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Is the proposed well in an area containing other mineral resources? USEABLE WATER

Is the proposed well in a Helium production area? N **Use Existing Well Pad?** NO **New surface disturbance?**

Type of Well Pad: MULTIPLE WELL **Multiple Well Pad Name:** PAD 1 **Number:** 2H

Well Class: HORIZONTAL **Number of Legs:** 1

Well Work Type: Drill

Well Type: OIL WELL

Describe Well Type:

Well sub-Type: INFILL

Describe sub-type:

Distance to town: 5.4 Miles **Distance to nearest well:** 40 FT **Distance to lease line:** 100 FT

Reservoir well spacing assigned acres Measurement: 279.74 Acres

Well plat: ThunderbirdDevUnit2H_Plat_signed_20190205160028.pdf

Well work start Date: 07/15/2019 **Duration:** 20 DAYS

Section 3 - Well Location Table

Survey Type: RECTANGULAR

Describe Survey Type:

Datum: NAD83 **Vertical Datum:** NAVD88

Survey number: **Reference Datum:**

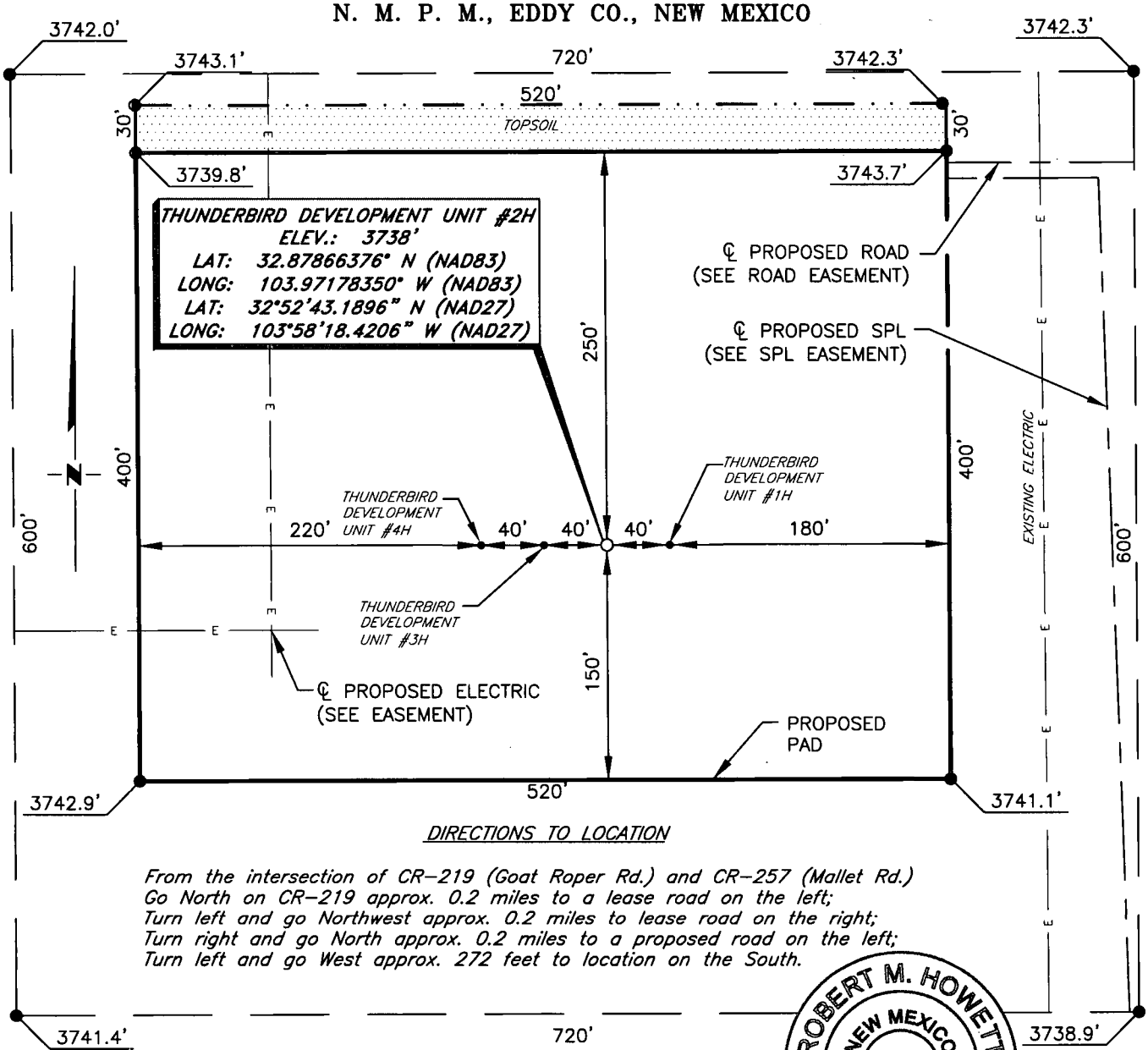
	NS-Foot	NS Indicator	EW-Foot	EW Indicator	Twsp	Range	Section	Aliquot/Lot/Tract	Latitude	Longitude	County	State	Meridian	Lease Type	Lease Number	Elevation	MD	TVD
SHL Leg #1	2411	FNL	1050	FEL	16S	30E	33	Aliquot SENE	32.8786638	-103.9717835	EDDY	NEW MEXICO	NEW MEXICO	F	NMNM 0002425	3738	0	0
KOP Leg #1	2381	FNL	998	FEL	16S	30E	33	Aliquot SENE	32.8787448	-103.9716157	EDDY	NEW MEXICO	NEW MEXICO	F	NMNM 0002425	-826	4565	4564
PPP Leg #1	2443	FSL	868	FEL	16S	30E	33	Aliquot NESE	32.8774882	-103.9711921	EDDY	NEW MEXICO	NEW MEXICO	F	NMLC0 060325	-1304	5315	5042

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

	NS-Foot	NS Indicator	EW-Foot	EW Indicator	Twsp	Range	Section	Aliquot/Lot/Tract	Latitude	Longitude	County	State	Meridian	Lease Type	Lease Number	Elevation	MD	TVD
EXIT Leg #1	100	FSL	792	FEL	16S	30E	4	Aliquot SESE	32.8565637	-103.9709382	EDDY	NEW MEXICO	NEW MEXICO	F	NMLC060325	-1408	12933	5146
BHL Leg #1	100	FSL	792	FEL	16S	30E	4	Aliquot SESE	32.8565637	-103.9709382	EDDY	NEW MEXICO	NEW MEXICO	F	NMLC060325	-1408	12933	5146

APACHE CORPORATION
THUNDERBIRD DEVELOPMENT UNIT #2H
(2411' FNL & 1050' FEL)
SECTION 33, T16S, R30E
N. M. P. M., EDDY CO., NEW MEXICO



DIRECTIONS TO LOCATION

From the intersection of CR-219 (Goat Roper Rd.) and CR-257 (Mallet Rd.)
Go North on CR-219 approx. 0.2 miles to a lease road on the left;
Turn left and go Northwest approx. 0.2 miles to lease road on the right;
Turn right and go North approx. 0.2 miles to a proposed road on the left;
Turn left and go West approx. 272 feet to location on the South.

SCALE: 1" = 100'
0 50 100

BEARINGS ARE NAD 83 GRID - NM EAST
DISTANCES ARE GROUND.

ROBERT M. HOWETT
NEW MEXICO
19680
6/17/16
PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

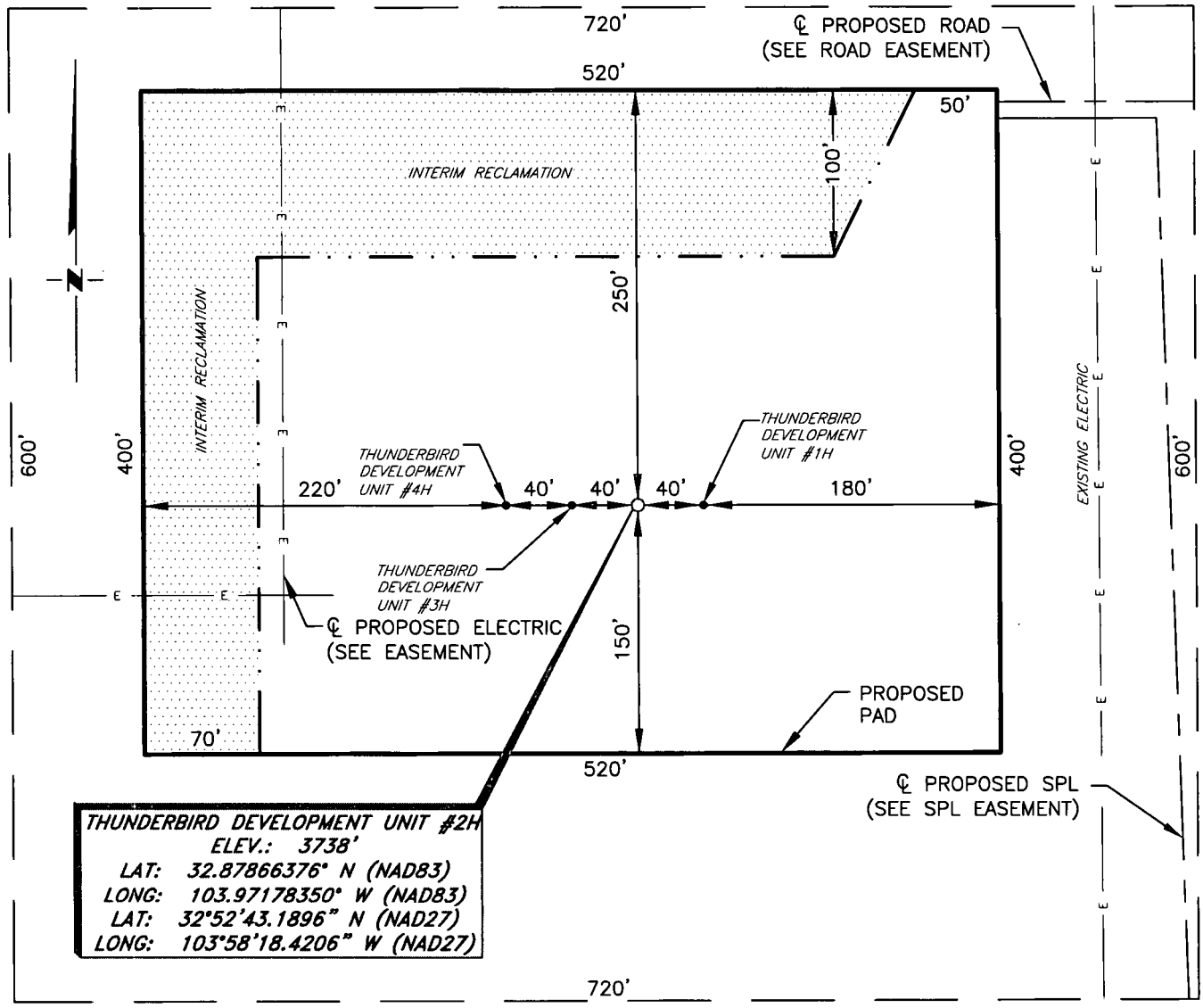
NO.	REVISION	DATE
	WELL NAME	1.30.19
JOB NO.: LS1605192		
DWG. NO.: 1605192PAD		

RRC SURVEYING, LLC

701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 100'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: RMH
APPROVED BY: RMH
SHEET : 1 OF 1

APACHE CORPORATION
INTERIM RECLAMATION
THUNDERBIRD DEVELOPMENT UNIT #2H
(2411' FNL & 1050' FEL)
SECTION 33, T16S, R30E
N. M. P. M., EDDY CO., NEW MEXICO



SCALE: 1" = 100'
0 50 100

BEARINGS ARE
NAD 83 GRID – NM EAST
DISTANCES ARE
GROUND.

DIRECTIONS TO LOCATION

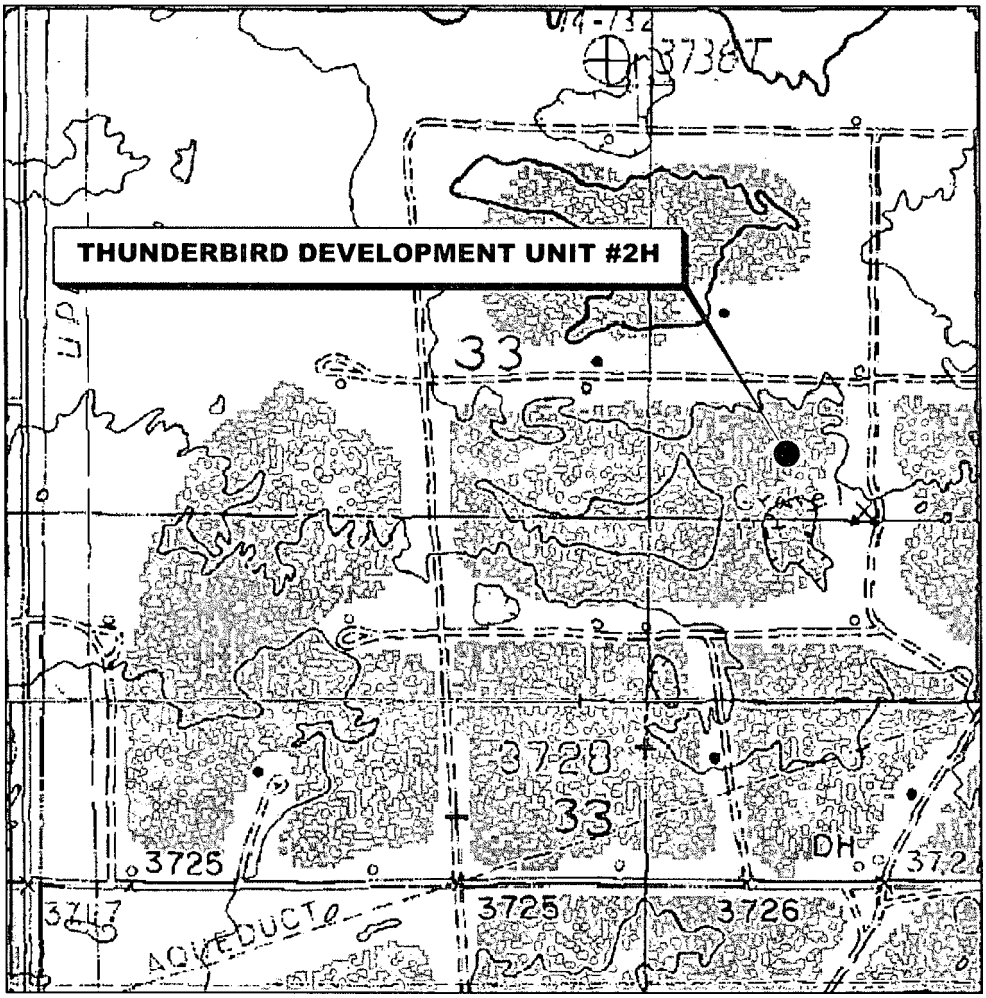
From the intersection of CR-219 (Goat Roper Rd.) and CR-257 (Mallet Rd.)
Go North on CR-219 approx. 0.2 miles to a lease road on the left;
Turn left and go Northwest approx. 0.2 miles to lease road on the right;
Turn right and go North approx. 0.2 miles to a proposed road on the left;
Turn left and go West approx. 232 feet to location on the South.

	WELL NAME	1.30.19
NO.	REVISION	DATE
JOB NO.: LS1605192		
DWG. NO.: 1605192REC		

RRC
SURVEYING, LLC
701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 100'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: RMH
APPROVED BY: RMH
SHEET : 1 OF 1

LOCATION VERIFICATION MAP



SECTION 33, TWP. 16 SOUTH, RGE. 30 EAST,
N. M. P. M., EDDY CO., NEW MEXICO

OPERATOR: Apache Corporation
LEASE: Thunderbird Development Unit
WELL NO.: 2H
ELEVATION: 3738'

LOCATION: 2411' FNL & 1050' FEL
CONTOUR INTERVAL: 10'
USGS TOPO. SOURCE MAP:
Henshaw Tank, NM (P. E. 1985)

	WELL NAME	1.30.19
NO.	REVISION	DATE
JOB NO.: LS1605192		
DWG. NO.: 1605192LVM		

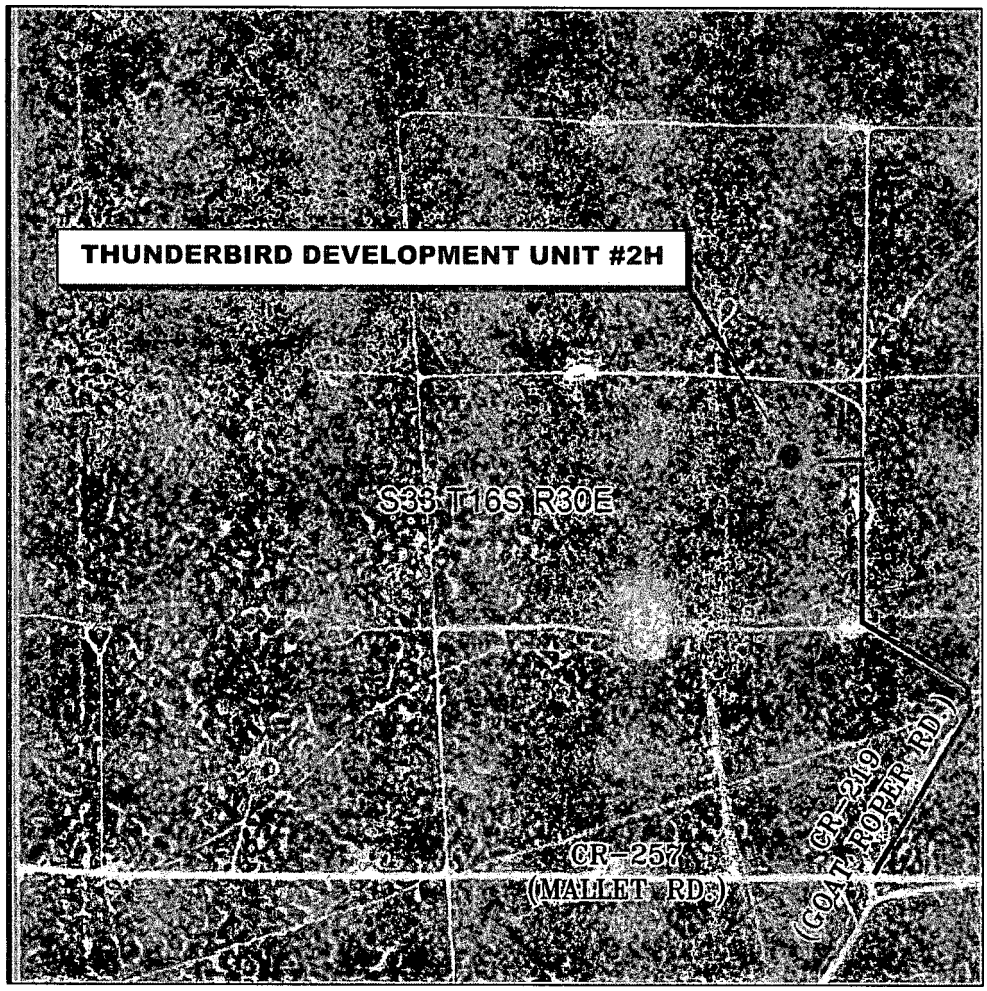
RRC SURVEYING, LLC

701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

VICINITY MAP

NOT TO SCALE



SECTION 33, TWP. 16 SOUTH, RGE. 30 EAST, N. M. P. M., EDDY CO., NEW MEXICO

OPERATOR: Apache Corporation
LEASE: Thunderbird Development Unit
WELL NO.: 2H

LOCATION: 2411' FNL & 1050' FEL
ELEVATION: 3738'

	WELL NAME	1.30.19
NO.	REVISION	DATE
JOB NO.: LS1605192		
DWG. NO.: 1605192VM		

RRC
SURVEYING, LLC
701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: NTS
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

Drilling Plan Data Report
09/30/2019

APD ID: 10400038856 **Submission Date:** 02/07/2019

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Well Type: OIL WELL **Well Work Type:** Drill

Highlighted data reflects the most recent changes

Show Final Text

Section 1 - Geologic Formations

Formation ID	Formation Name	Elevation	True Vertical Depth	Measured Depth	Lithologies	Mineral Resources	Producing Formation
1	RUSTLER	3738	376	376		POTASH	N
2	TOP SALT	3224	514	514		NONE	N
3	TANSILL	2538	1200	1200		NONE	N
4	YATES	2379	1359	1359		NATURAL GAS,OIL	N
5	SEVEN RIVERS	2119	1619	1619		NATURAL GAS,OIL	N
6	QUEEN	1519	2219	2219		NATURAL GAS,OIL	N
7	GRAYBURG	1086	2652	2652		NATURAL GAS,OIL	N
8	SAN ANDRES	769	2969	2969		NATURAL GAS,OIL	N
9	GLORIETA	-661	4399	4399		NATURAL GAS,OIL	Y
10	YESO	-714	4452	4452		NATURAL GAS,OIL	Y

Section 2 - Blowout Prevention

Pressure Rating (PSI): 2M **Rating Depth:** 8000

Equipment: Rotating Head, Mud Gas Separator, Blow Down Pit, Flare Line, Ignitor

Requesting Variance? YES

Variance request: Apache request a variance to use a flexible hose between BOP and choke manifold. Flex hose may vary pending availability. A quality control inspection and test certificate will be available for review.
Testing Procedure: BOP/BOPE will be tested by independent service company to 250psi low and high pressure indicated above per Onshore Order 2 requirements. System may be upgraded to higher pressure but sill tested to WP listed . If system is upgraded, all components installed will be functional and tested. Pipe rams will be operationally checked each 24 hr period. Blind rams will be operationally checked on each TOOH. These checks will be noted on daily tour sheets. Other accessories to BOP equipment will include Kelly cock and floor safety valve (inside BOP), choke lines and choke manifold. (see attached schematic)
Choke Diagram Attachment:

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

ThunderbirdDevUnit_BOP_3M_2M_AnnularManifoldSchematic_20190205162100.pdf

BOP Diagram Attachment:

ThunderbirdDevUnit_BOP_3M_2M_Inst_on_Surf_Manifold_Schem_20190205162112.pdf

Flexline_20190827145950.pdf

Section 3 - Casing

Casing ID	String Type	Hole Size	Csg Size	Condition	Standard	Tapered String	Top Set MD	Bottom Set MD	Top Set TVD	Bottom Set TVD	Top Set MSL	Bottom Set MSL	Calculated casing length MD	Grade	Weight	Joint Type	Collapse SF	Burst SF	Joint SF Type	Joint SF	Body SF Type	Body SF
1	SURFACE	17.5	13.375	NEW	API	N	0	400	0	400	-974	-1374	400	H-40	48	ST&C	7.21	1.39	BUOY	2.07	BUOY	3.47
2	INTERMEDIATE	12.25	9.625	NEW	API	N	0	3200	0	3200	-974	-4174	3200	J-55	36	LT&C	2.19	2.33	BUOY	2.07	BUOY	2.56
3	PRODUCTION	8.5	7.0	NEW	API	N	0	4565	0	4565	-974	-5168	4565	L-80	26	LT&C	2.64	1.125	BUOY	2.29	BUOY	2.68
4	OTHER	8.5	5.5	NEW	API	Y	4565	12933	4565	5146	-5168	-5689	8368	L-80	17	LT&C	2.71	1.17	BUOY	1.87	BUOY	2.17

Casing Attachments

Casing ID: 1 **String Type:** SURFACE

Inspection Document:

Spec Document:

Tapered String Spec:

Casing Design Assumptions and Worksheet(s):

ThunderbirdDevUnit_SurfCsgDesignAssumpt_20190129141122.pdf

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Casing Attachments

Casing ID: 2 **String Type:** INTERMEDIATE

Inspection Document:

Spec Document:

Tapered String Spec:

Casing Design Assumptions and Worksheet(s):

ThunderbirdDevUnit_IntermCsgDesignAssumpt_20190129141134.pdf

Casing ID: 3 **String Type:** PRODUCTION

Inspection Document:

Spec Document:

Tapered String Spec:

Casing Design Assumptions and Worksheet(s):

ThunderbirdDevUnit_ProdCsgDesignAssumpt_20190129141146.pdf

Casing ID: 4 **String Type:** OTHER - Tapered Production String

Inspection Document:

Spec Document:

Tapered String Spec:

ThunderbirdDevUnit2H_ProdCsgTaperedSpecs_20190205162540.pdf

Casing Design Assumptions and Worksheet(s):

ThunderbirdDevUnit_ProdCsgDesignAssumpt_20190205144415.pdf

Section 4 - Cement

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

String Type	Lead/Tail	Stage Tool Depth	Top MD	Bottom MD	Quantity(sx)	Yield	Density	Cu Ft	Excess%	Cement type	Additives
OTHER	Lead		0	0	0	0	0	0	0	0	0
SURFACE	Lead		0	400	291	1.33	14.8	387.03	25	Class C	1% Calcium Chloride
INTERMEDIATE	Lead		0	2560	535	1.87	12.9	1000.45	25	Class C	5% Salt + 6% Bentonite + 0.5% Suspension Aid + 0.4 #/sk Defoamer
INTERMEDIATE	Tail		2560	3200	205	1.33	14.8	272.65	25	Class C	0.2% Retarder
PRODUCTION	Lead	4144	0	3265	300	2.03	12.6	609	25	Class C	5% Salt + 6% Bentonite + 0.2% Retarder + 0.4#/sk Defoamer
PRODUCTION	Tail		3265	4565	100	1.48	13	148	25	TXI Lite	1.3% Salt, 5% Gas Migration Expansion Additive , 0.5% Fluid Loss Agent + 0.1% Anti-settling agent, 0.4#/sk Defoamer

Section 5 - Circulating Medium

Mud System Type: Closed

Will an air or gas system be Used? NO

Description of the equipment for the circulating system in accordance with Onshore Order #2:

Diagram of the equipment for the circulating system in accordance with Onshore Order #2:

Describe what will be on location to control well or mitigate other conditions: BOP, Choke Manifold, Gas Buster, Blow Down Pit, Flare Line with Igniter, Pre-Mix Pit, Rotating Head

Describe the mud monitoring system utilized: PVT/Pason/Visual Monitoring

Circulating Medium Table

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Top Depth	Bottom Depth	Mud Type	Min Weight (lbs/gal)	Max Weight (lbs/gal)	Density (lbs/cu ft)	Gel Strength (lbs/100 sqft)	PH	Viscosity (CP)	Salinity (ppm)	Filtration (cc)	Additional Characteristics
0	400	SPUD MUD	8.3	9							
3200	5200	OTHER : Cut Brine	8	9.5							
400	3200	SALT SATURATED	9.8	10.5							

Section 6 - Test, Logging, Coring

List of production tests including testing procedures, equipment and safety measures:

If drill stem tests are performed, Onshore Order 2.III.D shall be followed.

List of open and cased hole logs run in the well:

CBL,CNL/FDC,DS,GR,MWD,MUDLOG

Coring operation description for the well:

N/A

Section 7 - Pressure

Anticipated Bottom Hole Pressure: 2250 **Anticipated Surface Pressure:** 1117.87

Anticipated Bottom Hole Temperature(F): 116

Anticipated abnormal pressures, temperatures, or potential geologic hazards? NO

Describe:

Contingency Plans geoharzards description:

Contingency Plans geohazards attachment:

Hydrogen Sulfide drilling operations plan required? YES

Hydrogen sulfide drilling operations plan:

ThunderbirdDevUnit_H2SOpsContgPlan_20190130132210.pdf

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Section 8 - Other Information

Proposed horizontal/directional/multi-lateral plan submission:

ThunderbirdDevUnit2H_DirectionalPlan_20190205163302.pdf

ThunderbirdDevUnit2H_DirectionalPlan_20190205163302.xls

Other proposed operations facets description:

Apache Corp respectfully request approval to utilize a spudder rig to pre-set surf csg. Please see attachment for procedure. Apache has included a 2-stage cement job contingency, see cement detail attached. This well will have an open hole completion attached to the 5-1/2" csg. 5-1/2" will cross over to 7" where a DVT will be placed at the bottom of 7". The 5-1/2" csg will be uncemented and the 7" from DVT to surf will be cemented. Apache also request approval to use multi-bowl wellhead, procedure attached.

Other proposed operations facets attachment:

CameronMN_DS_WellheadProcedureForThunderbirdPermitsToUseMultibowlWellheads_20190130160318.pdf

ThunderbirdDevUnit2H_CmtDetail_20190205163625.pdf

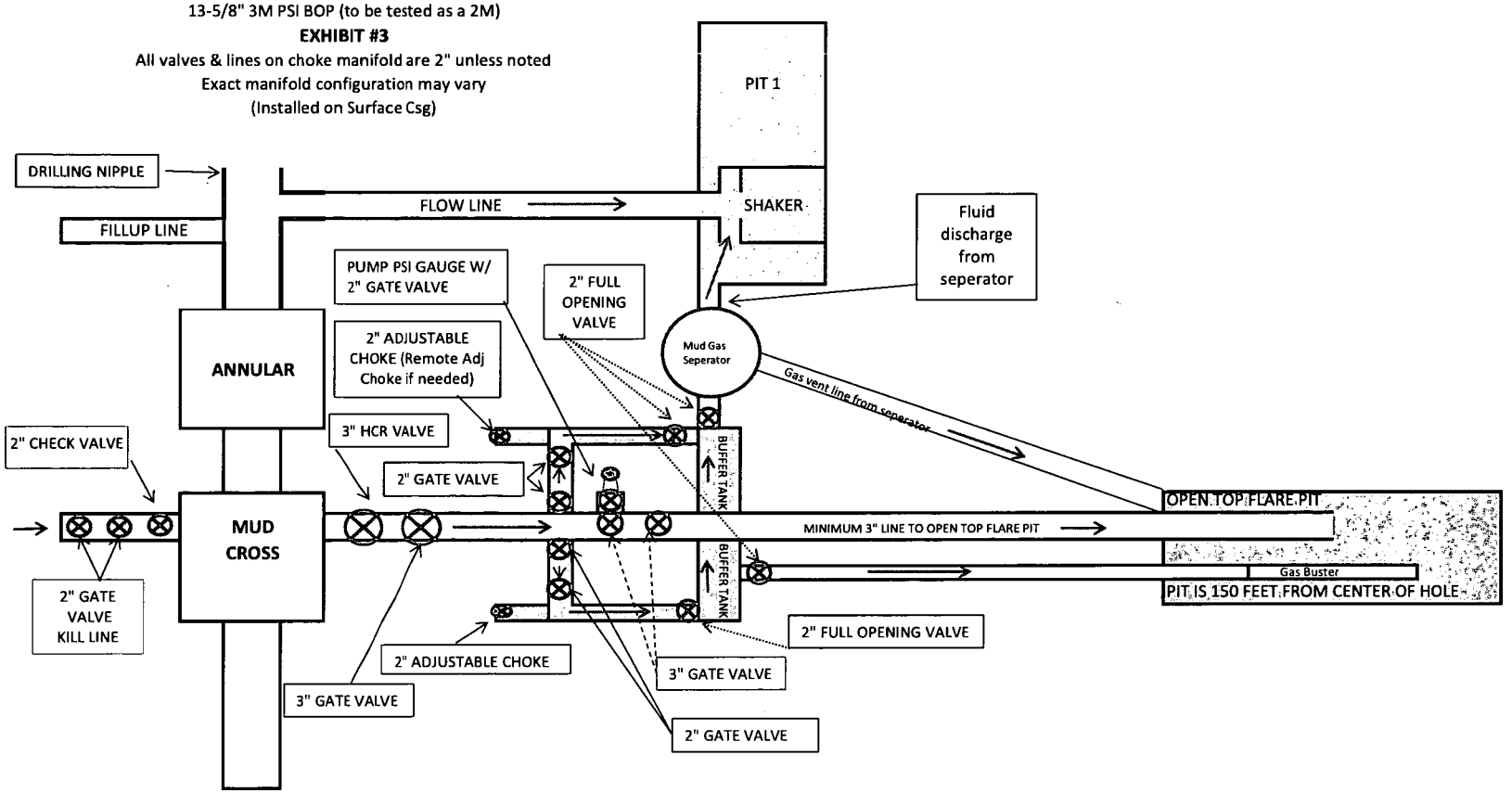
ThunderbirdDevUnit2H_CsgDetail_20190205163625.pdf

ThunderbirdDevUnit2H_SpudderRigProcedure_20190205163626.pdf

Other Variance attachment:

APACHE BOP AND CHOKE MANIFOLD SCHEMATIC

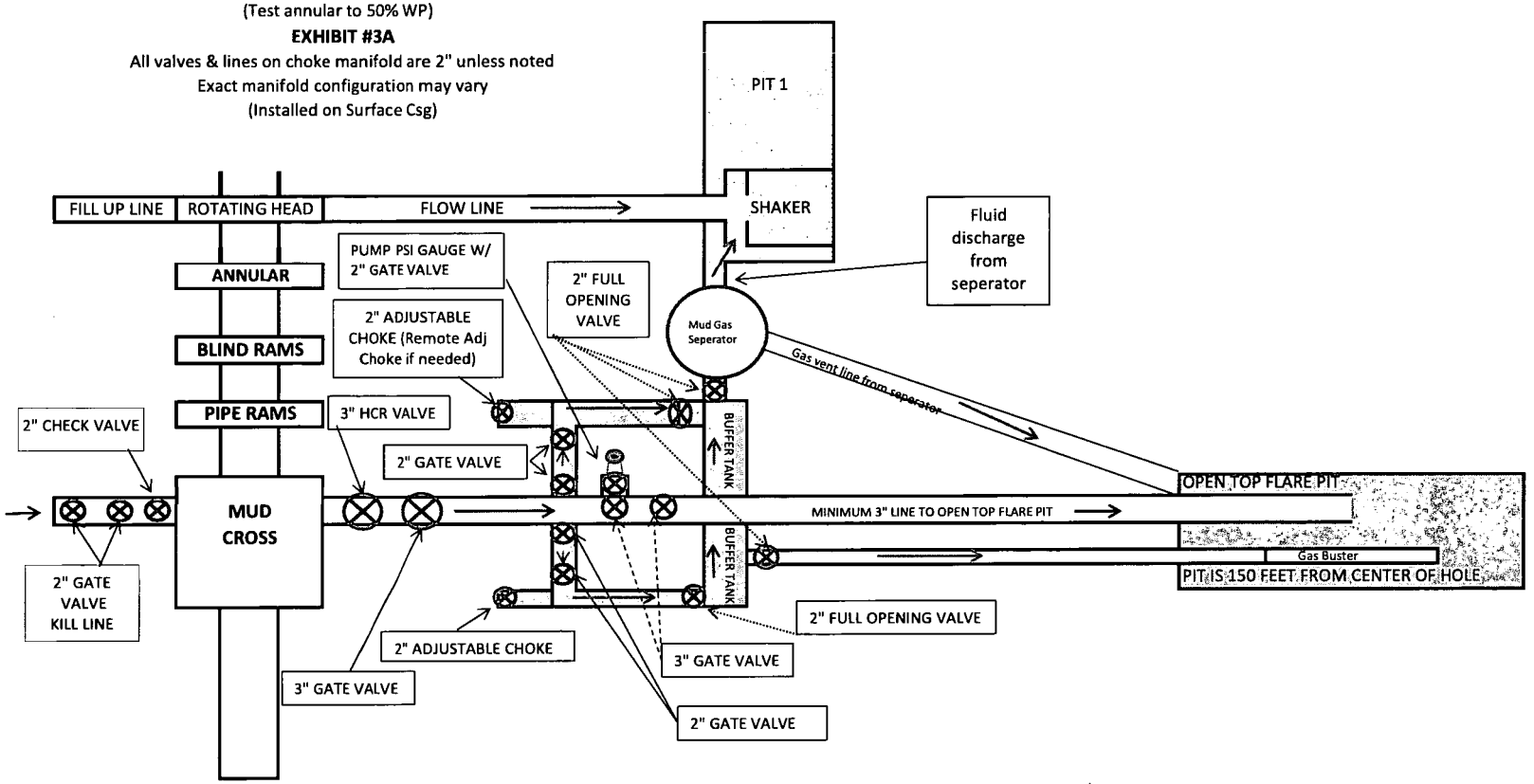
13-5/8" 3M PSI BOP (to be tested as a 2M)
EXHIBIT #3
All valves & lines on choke manifold are 2" unless noted
Exact manifold configuration may vary
(Installed on Surface Csg)



***** If H2S is encountered in quantities greater than 100ppm, Apache will shut in well & install a remote operated choke *****

APACHE BOP AND CHOKE MANIFOLD SCHEMATIC

13-3/8" 3M PSI BOP (to be tested as a 2M)
(Test annular to 50% WP)
EXHIBIT #3A
All valves & lines on choke manifold are 2" unless noted
Exact manifold configuration may vary
(Installed on Surface Csg)



***** If H2S is encountered in quantities greater than 100ppm, Apache will shut in well & install a remote operated choke *****

QUALITY CONTROL INSPECTION AND TEST CERTIFICATE				CERT. N°: 581	
PURCHASER: ContiTech Oil & Marine Corp.				P.O. N°: 4500511543	
CONTITECH RUBBER order N°: 540352		HOSE TYPE: 3" ID		Choke and Kill Hose	
HOSE SERIAL N°: 69915		NOMINAL / ACTUAL LENGTH:		10,67 m / 10,76 m	
W.P. 68,9 MPa 10000 psi		T.P. 103,4 MPa 15000 psi		Duration: 60 min.	

Pressure test with water at ambient temperature

See attachment. (1 page)

COUPLINGS Type	Serial N°	Quality	Heat N°
3" coupling with	7563 7565	AISI 4130	A0996X
4 1/16" 10K API b.w. Flange end		AISI 4130	036282

NOT DESIGNED FOR WELL TESTING

API Spec 16 C

Temperature rate:"B"

All metal parts are flawless

WE CERTIFY THAT THE ABOVE HOSE HAS BEEN MANUFACTURED IN ACCORDANCE WITH THE TERMS OF THE ORDER INSPECTED AND PRESSURE TESTED AS ABOVE WITH SATISFACTORY RESULT.

STATEMENT OF CONFORMITY: We hereby certify that the above items/equipment supplied by us are in conformity with the terms, conditions and specifications of the above Purchaser Order and that these items/equipment were fabricated inspected and tested in accordance with the referenced standards, codes and specifications and meet the relevant acceptance criteria and design requirements.

COUNTRY OF ORIGIN HUNGARY/EU

Date:	Inspector	Quality Control
18. March 2015.		ContiTech Rubber Industrial Kft. Quality Control Dept. (1)

ATTACHMENT OF QUALITY CONTROL INSPECTION AND TEST CERTIFICATE *No: 579, 580, 581*

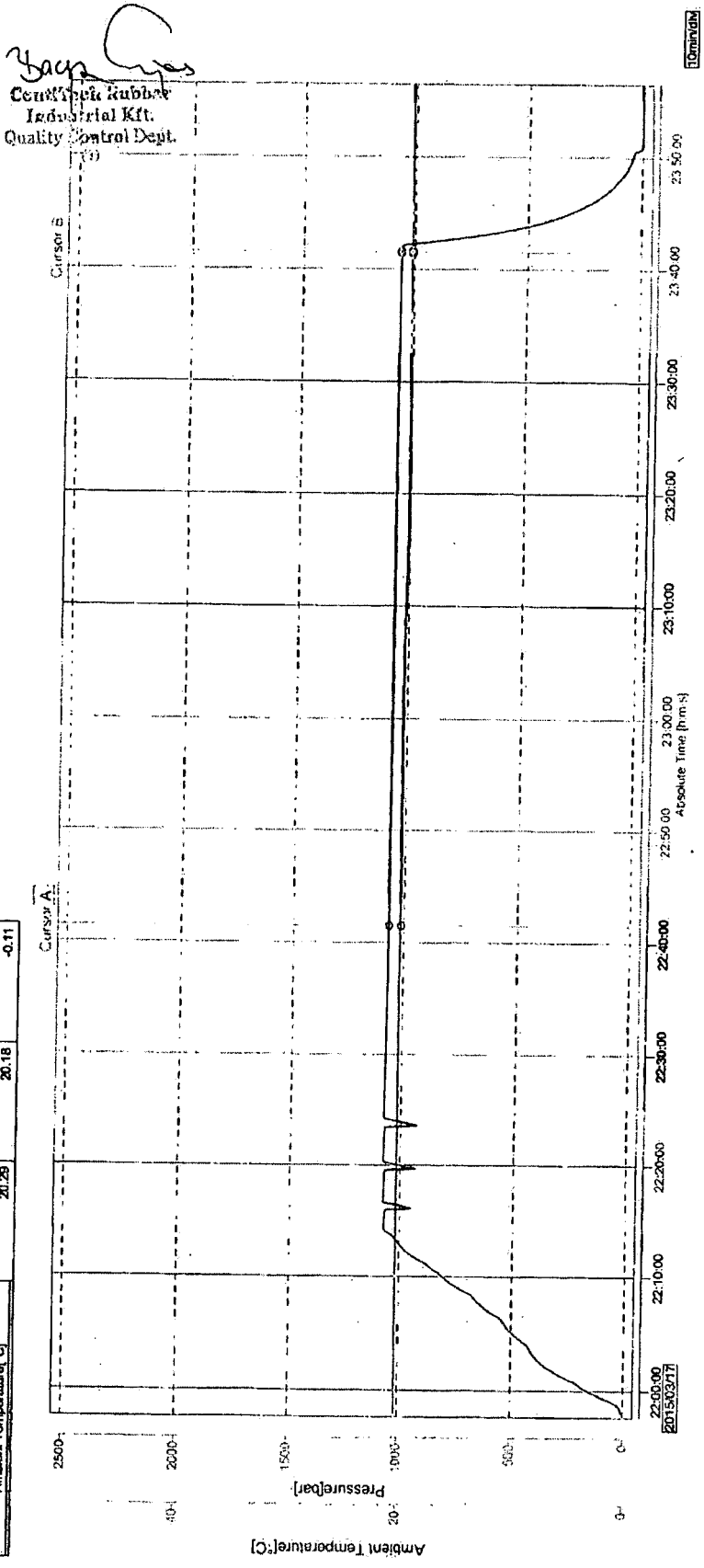
Certified Rubber Industrial Kft.
Quality Control Dept.

File Name : 004409_69913,-914,-915.GEV,...,004420_69913,-914,-915.GEV
File Message : 69913,69914,69915
Device Type : GX10
Serial No. : S5P606399
Data Count : 1426

Sampling Int. : 5.000 sec
Start Time : 2015/03/17 21:57:40.000
Stop Time : 2015/03/17 23:58:25.000

Print Group : Press-Temp
Print Range : 2015/03/17 21:57:40.000 - 2015/03/17 23:58:25.000
Comment : 69913,69914,69915

	Cursor A	Cursor B	Difference
Data No.	526	1246	720
Absolute Time	2015/03/17 22:41:30.000	2015/03/17 23:41:30.000	01:00:00.000
Tag Comment	Value A	Value B	Value B-A
Pressure[bar]	1069.30	1057.33	-11.97
Ambient Temperature[°C]	20.29	20.18	-0.11



Thunderbird Development Unit 2H Production Casing Tapered String Specs

All casing design assumptions were ran in StressCheck to determine safety factors which meet or exceed both Apache Corp and BLM minimum requirements. All casing strings will be filled while running in hole in order to not exceed collapse rating of the casing.

String	OD/Weight/Grade	Connection	MD Interval (ft)	Minimum Safety Factor (Abs)		
				Burst	Collapse	Axial
Production Casing	7", 26 ppf, L-80	LTC, L-80	0-4565'	1.125	2.64	2.29
	5 ½", 17 ppf, L-80	LTC, L-80	4565'-12933'	1.17	2.71	1.87

*This will have an open hole completion consisting of open hole hydraulic packers and sliding sleeves attached to the 5-1/2" casing. 5-1/2" will crossover to 7" where a DV tool will be placed at the bottom of the 7" (KOP @~4565'). The 5-1/2" casing will be uncemented and the 7" from the DV tool to surface will be cemented.

Production Casing Burst Design		
Load Case	**External Pressure**	**Internal Pressure**
Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Fluid in hole (water or produced water) + test psi
Tubing Leak	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Packer @ KOP, leak below surface 8.6 ppg packer fluid
Stimulation	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max frac pressure with heaviest frac fluid
Green Cement Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max pressure used to bump the plug during cement job
Production Casing Collapse Design		
Load Case	**External Pressure**	**Internal Pressure**
Full Evacuation	Mud weight string was set in	None
Cementing	Wet cement weight	Water (8.33 ppg)

Production Casing Axial Design	
Load Case	**Assumptions**
Overpull	100 kips
Running in hole	2 ft/s
Green Cement Pressure Test	Max pressure when bumping plug
Service Loads	N/A

Casing Design Assumptions and Load Cases

Surface

All casing design assumptions were ran in StressCheck to determine safety factors which meet or exceed both Apache Corp and BLM minimum requirements. All casing strings will be filled while running in hole in order to not exceed collapse rating of the casing.

Surface Casing Burst Design		
Load Case	**External Pressure**	**Internal Pressure**
Pressure Test	Mud and Cement Mix Water	Test psi with Mud Weight of displacement fluid
Fracture @ shoe w/ Gas Gradient Above	Mud and Cement Mix Water	Fracture psi at shoe and 0.7 gas gravity above shoe
Green Cement Pressure Test	Mud and Cement Mix Water	Max pressure used to bump the plug during cement job
Lost Returns with Water	Mud and Cement Mix Water	Pressure to fracture shoe with water hydrostatic

Surface Casing Collapse Design		
Load Case	**External Pressure**	**Internal Pressure**
Full/Partial Evacuation	Mud weight string was set in	50% casing evacuation with surface mud inside casing
Lost Returns with Mud Drop	Mud weight string was set in	Lost returns at intermediate casing point with brine
Cementing	Wet cement weight	Water (8.33 ppg)

Surface Casing Axial Design	
Load Case	**Assumptions**
Overpull	100 kips
Running in hole	2 ft/s
Green Cement Pressure Test	Max pressure when bumping plug
Service Loads	N/A

Casing Design Assumptions and Load Cases

Intermediate

All casing design assumptions were ran in StressCheck to determine safety factors which meet or exceed both Apache Corp and BLM minimum requirements. All casing strings will be filled while running in hole in order to not exceed collapse rating of the casing.

Intermediate Casing Burst Design		
Load Case	**External Pressure**	**Internal Pressure**
Pressure Test	Mud and Cement Mix Water	Test psi with Mud Weight of displacement fluid
Fracture @ shoe w/ Gas Gradient Above	Mud and Cement Mix Water	Fracture psi at shoe and 0.7 gas gravity above shoe
Green Cement Pressure Test	Mud and Cement Mix Water	Max pressure used to bump the plug during cement job
Lost Returns with Water	Mud and Cement Mix Water	Pressure to fracture shoe with water hydrostatic

Intermediate Casing Collapse Design		
Load Case	**External Pressure**	**Internal Pressure**
Full/Partial Evacuation	Mud weight string was set in	50% casing evacuation with intermediate mud inside casing
Lost Returns with Mud Drop	Mud weight string was set in	Lost returns at TD casing shoe with 8.33 ppg mud
Cementing	Wet cement weight	Water (8.33 ppg)

Intermediate Casing Axial Design	
Load Case	**Assumptions**
Overpull	100 kips
Running in hole	2 ft/s
Green Cement Pressure Test	Max pressure when bumping plug
Service Loads	N/A

Casing Design Assumptions and Load Cases

Production

All casing design assumptions were ran in StressCheck to determine safety factors which meet or exceed both Apache Corp and BLM minimum requirements. All casing strings will be filled while running in hole in order to not exceed collapse rating of the casing.

Production Casing Burst Design		
Load Case	**External Pressure**	**Internal Pressure**
Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Fluid in hole (water or produced water) + test psi
Tubing Leak	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Packer @ KOP, leak below surface 8.6 ppg packer fluid
Stimulation	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max frac pressure with heaviest frac fluid
Green Cement Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max pressure used to bump the plug during cement job

Production Casing Collapse Design		
Load Case	**External Pressure**	**Internal Pressure**
Full Evacuation	Mud weight string was set in	None
Cementing	Wet cement weight	Water (8.33 ppg)

Production Casing Axial Design	
Load Case	**Assumptions**
Overpull	100 kips
Running in hole	2 ft/s
Green Cement Pressure Test	Max pressure when bumping plug
Service Loads	N/A

Casing Design Assumptions and Load Cases

Production

All casing design assumptions were ran in StressCheck to determine safety factors which meet or exceed both Apache Corp and BLM minimum requirements. All casing strings will be filled while running in hole in order to not exceed collapse rating of the casing.

Production Casing Burst Design		
Load Case	**External Pressure**	**Internal Pressure**
Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Fluid in hole (water or produced water) + test psi
Tubing Leak	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Packer @ KOP, leak below surface 8.6 ppg packer fluid
Stimulation	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max frac pressure with heaviest frac fluid
Green Cement Pressure Test	Mud base fluid density to TOC, cement mix-water gradient to outer shoe and pore pressure to TD	Max pressure used to bump the plug during cement job

Production Casing Collapse Design		
Load Case	**External Pressure**	**Internal Pressure**
Full Evacuation	Mud weight string was set in	None
Cementing	Wet cement weight	Water (8.33 ppg)

Production Casing Axial Design	
Load Case	**Assumptions**
Overpull	100 kips
Running in hole	2 ft/s
Green Cement Pressure Test	Max pressure when bumping plug
Service Loads	N/A

HYDROGEN SULFIDE (H_2S) DRILLING OPERATIONS PLAN

Hydrogen Sulfide Training:

All regularly assigned personnel, contracted or employed by Apache Corporation will receive training from qualified instructor(s) in the following areas prior to commencing drilling possible hydrogen sulfide bearing formations in this well:

- The hazards and characteristics of hydrogen sulfide (H_2S)
- The proper use and maintenance of personal protective equipment and life support systems.
- The proper use of H_2S detectors, alarms, warning systems, briefing area, evacuation procedures & prevailing winds.
- The proper techniques for first aid and rescue procedures.

Supervisory personnel will be trained in the following areas:

- The effects of H_2S on metal components. If high tensile tubulars are to be utilized, personnel will be trained in their special maintenance requirements.
- Corrective action & shut-in procedures when drilling or reworking a well & blowout prevention / well control procedures.
- The contents and requirements of the H_2S Drilling Operations Plan

There will be an initial training session just prior to encountering a known or probable H_2S zone (within 3 days or 500') and weekly H_2S and well control drills for all personnel in each crew. The initial training session shall include a review of the site specific H_2S Drilling Operations Plan and the Public Protection Plan. This plan shall be available at the well site. All personnel will be required to carry documentation that they have received proper training.

H_2S SAFETY EQUIPMENT AND SYSTEMS:

Well Control Equipment that will be available & installed if H_2S is encountered:

- Flare Line with electronic igniter or continuous pilot.
- Choke manifold with a minimum of one remote choke.
- Blind rams & pipe rams to accommodate all pipe sizes with properly sized closing unit.
- Auxiliary equipment to include: annular preventer, mud-gas separator, rotating head & flare gun with flares

Protective Equipment for Essential Personnel:

- Mark II Survive-air 30 minute units located in dog house & at briefing areas, as indicated on wellsite diagram.

H2S Dection and Monitoring Equipment:

- Two portable H_2S monitors positioned on location for best coverage & response. These units have warning lights & audible sirens when H_2S levels of 20 ppm are reached.
- One portable H_2S monitor positioned near flare line.

H2S Visual Warning Systems:

- Wind direction indicators are shown on wellsite diagram.
- Caution / Danger signs shall be posted on roads providing direct access to location. Signs will be painted a high visibility yellow with black lettering of sufficient size to be readable at a reasonable distance from the immediate location. Bilingual signs will be used when appropriate.

Mud Program:

- The Mud Program has been designed to minimize the volume of H_2S circulated to the surface. Proper mud weights, safe drilling practices & the use of H_2S scavengers will minimize hazards when penetrating H_2S bearing zones.
- A mud-gas separator and H_2S gas buster will be utilized as needed.

Metallurgy:

- All drill strings, casing, tubing, wellhead, blowout preventers, drilling spool, kill lines, choke manifold & lines, & valves will be suitable for H_2S service.
- All elastomers used for packing & seals shall be H_2S trim.

Communication:

- Cellular telephone and 2-way radio communications in company vehicles, rig floor and mud logging trailer.

HYDROGEN SULFIDE (H_2S) CONTINGENCY PLAN

Assumed 100 ppm ROE = 3000'

100 ppm H_2S concentration shall trigger activation of this plan.

Emergency Procedures

In the event of a release of gas containing H_2S, the first responder(s) must

- Isolate the area and prevent entry by other persons into the 100 ppm ROE.
- Evacuate any public places encompassed by the 100 ppm ROE.
- Be equipped with H_2S monitors and air packs in order to control the release.
- Use the "buddy system" to ensure no injuries occur during the response
- Take precautions to avoid personal injury during this operation.
- Contact operators and/or local officials to aid in operation. See list of phone numbers attached.
- Have received training in the :
    - Detection of H_2S, and
    - Measures for protection against the gas,
    - Equipment used for protection and emergency response.

Ignition of Gas source

Should control of the well be considered lost and ignition considered, take care to protect against exposure to Sulfur Dioxide (SO_2). Intentional ignition must be coordinated with the NMOCD and local officials. Additionally the NM State Police may become involved. NM State Police shall be the Incident Command on scene of any major release. Take care to protect downwind whenever this is an ignition of the gas.

Characteristics of H_2S and SO_2

Common Name	Chemical Formula	Specific Gravity	Threshold Limit	Hazardous Limit	Lethal Concentration
Hydrogen Sulfide	H_2S	1.189 Air = I	10 ppm	100 ppm/hr	600 ppm
Sulfur Dioxide	SO_2	2.21 Air = I	2 ppm	N/A	1000 ppm

Contacting Authorities

Apache Corporation personnel must liaison with local and state agencies to ensure a proper response to a major release. Additionally, the OCD must be notified of the release as soon as possible but no later than 4 hours. Agencies will ask for information such as type and volume of release, wind direction, location of release, etc. Be prepared with all information available including directions to site. The following call list of essential and potential responders has been prepared for use during a release. Apache's response must be in coordination with the State of New Mexico's *"Hazardous Materials Emergency Response Plan" (HMER).*

WELL CONTROL EMERGENCY RESPONSE PLAN

I. GENERAL PHILOSOPHY

Our objective is to ensure that during an emergency, a predetermined procedure is followed so that prompt decisions can be made based on accurate information.

The best way to handle and emergency is with an experienced organization set up for the sole purpose of solving the problem. The *Well Control Emergency Response Team* was organized to handle dangerous & expensive well control problems. The *Team* is structured such that each individual can contribute the most from his area of expertise. Key decision-makers are determined prior to an emergency to avoid confusion about who is in charge.

If the well is flowing uncontrolled at the surface or subsurface, *The Emergency Response Team* will be mobilized. The *Team* is customized for the people currently on the Apache staff. Staff changes may require a change in the plan.

II. EMERGENCY PROCEDURE ON DRILLING OR COMPLETION OPERATIONS

A. In the event of an emergency the *Drilling Foreman or Tool-Pusher* will immediately contact only one of the following starting with the first name listed:

Name	Office	Mobile	Home
Danny Laman – Drlg Superintendent	432-818-1022	432-634-0288	
John Vacek – Drilling Engineer	432-818-1882	281-222-1812	
Bobby Smith – Drilling Manager	432-818-1020	432-556-7701	
Bill Jones – EH&S Coordinator		432-967-9576	

***This one phone call will free the Drilling Foreman to devote his full time to securing the safety of personnel & equipment. This call will initiate the process to mobilize the Well Control Emergency Response Team. Apache maintains an Emergency Telephone Conference Room in the Houston office. This room is available for us by the Permian Region. The room has 50 separate telephone lines.*

B. The Apache employee contacted by the Drilling Foreman will begin contacting the rest of the *Team*. If **DANNY LAMAN** is out of contact, **JOHN VACEK** will be notified.

C. If a member of the *Emergency Response Team* is away from the job, he must be available for call back. Telephone numbers should be left with secretaries or a key decision-maker.

D. Apache's reporting procedure for spills or releases of oil or hazardous materials will be implemented when spills or releases have occurred or are probable.

EMERGENCY RESPONSE NUMBERS:

SHERIFF DEPARTMENT	
Eddy County	575-887-7551
Lea County	575-396-3611
FIRE DEPARTMENT	911
Artesia	575-746-5050
Carlsbad	575-885-2111
Eunice	575-394-2111
Hobbs	575-397-9308
Jal	575-395-2221
Lovington	575-396-2359
HOSPITALS	911
Artesia Medical Emergency	575-746-5050
Carlsbad Medical Emergency	575-885-2111
Eunice Medical Emergency	575-394-2112
Hobbs Medical Emergency	575-397-9308
Jal Medical Emergency	575-395-2221
Lovington Medical Emergency	575-396-2359
AGENT NOTIFICATIONS	
Bureau of Land Management	575-393-3612
New Mexico Oil Conservation Division	575-393-6161

PERMIAN

NW DISTRICT - NM EZ NAD 83
THUNDERBIRD DEV UNIT PAD (1,2,3,4)
THUNDERBIRD DEVL UNIT #2

THUNDERBIRD DEVL UNIT #2

Plan: Design #1

Standard Survey Report

19 October, 2018

apachecorp

Survey Report

Company:	PERMIAN	**Local Co-ordinate Reference:**	Well THUNDERBIRD DEVL UNIT #2
Project:	NW DISTRICT - NM EZ NAD 83	**TVD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Site:	THUNDERBIRD DEV UNIT PAD (1,2,3,4)	**MD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Project NW DISTRICT - NM EZ NAD 83

Map System:	US State Plane 1983	**System Datum:**	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site THUNDERBIRD DEV UNIT PAD (1,2,3,4)

Site Position:		**Northing:**	683,581.90 ft	**Latitude:**	32° 52' 43.176 N
From:	Map	**Easting:**	652,371.90 ft	**Longitude:**	103° 58' 17.968 W
Position Uncertainty:	0.0 ft	**Slot Radius:**	13.200 in	**Grid Convergence:**	0.20 °

Well THUNDERBIRD DEVL UNIT #2

Well Position	**+N/-S**	0.0 ft	**Northing:**	683,581.70 ft	**Latitude:**	32° 52' 43.176 N
	+E/-W	0.0 ft	**Easting:**	652,332.00 ft	**Longitude:**	103° 58' 18.436 W
Position Uncertainty		0.0 ft	**Wellhead Elevation:**	0.0 ft	**Ground Level:**	3,738.0 ft

Wellbore THUNDERBIRD DEVL UNIT #2

Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	10/16/2018	7.42	60.65	48,178

Design Design #1

Audit Notes:

Version:		**Phase:**	PLAN	**Tie On Depth:**	0.0

Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.0	0.0	0.0	177.95

Survey Tool Program **Date** 10/19/2018

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
0.0	12,933.5	Design #1 (THUNDERBIRD DEVL UNIT #	MWD+HDGM (MWD)	OWSG MWD + HDGM

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
100.0	0.00	0.00	100.0	0.0	0.0	0.0	0.00	0.00	0.00
200.0	0.00	0.00	200.0	0.0	0.0	0.0	0.00	0.00	0.00
300.0	0.00	0.00	300.0	0.0	0.0	0.0	0.00	0.00	0.00
400.0	0.00	0.00	400.0	0.0	0.0	0.0	0.00	0.00	0.00
500.0	0.00	0.00	500.0	0.0	0.0	0.0	0.00	0.00	0.00
600.0	0.00	0.00	600.0	0.0	0.0	0.0	0.00	0.00	0.00
700.0	0.00	0.00	700.0	0.0	0.0	0.0	0.00	0.00	0.00
800.0	0.00	0.00	800.0	0.0	0.0	0.0	0.00	0.00	0.00
900.0	0.00	0.00	900.0	0.0	0.0	0.0	0.00	0.00	0.00

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Survey Report

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Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
1,000.0	0.00	0.00	1,000.0	0.0	0.0	0.0	0.00	0.00	0.00
1,100.0	0.00	0.00	1,100.0	0.0	0.0	0.0	0.00	0.00	0.00
1,200.0	0.00	0.00	1,200.0	0.0	0.0	0.0	0.00	0.00	0.00
1,300.0	0.00	0.00	1,300.0	0.0	0.0	0.0	0.00	0.00	0.00
1,400.0	0.00	0.00	1,400.0	0.0	0.0	0.0	0.00	0.00	0.00
1,500.0	0.00	0.00	1,500.0	0.0	0.0	0.0	0.00	0.00	0.00
1,600.0	1.00	60.00	1,600.0	0.4	0.8	-0.4	1.00	1.00	0.00
1,700.0	2.00	60.00	1,700.0	1.7	3.0	-1.6	1.00	1.00	0.00
1,800.0	2.00	60.00	1,799.9	3.5	6.0	-3.3	0.00	0.00	0.00
1,900.0	2.00	60.00	1,899.8	5.2	9.1	-4.9	0.00	0.00	0.00
2,000.0	2.00	60.00	1,999.8	7.0	12.1	-6.5	0.00	0.00	0.00
2,100.0	2.00	60.00	2,099.7	8.7	15.1	-8.2	0.00	0.00	0.00
2,200.0	2.00	60.00	2,199.7	10.5	18.1	-9.8	0.00	0.00	0.00
2,300.0	2.00	60.00	2,299.6	12.2	21.2	-11.5	0.00	0.00	0.00
2,400.0	2.00	60.00	2,399.5	14.0	24.2	-13.1	0.00	0.00	0.00
2,500.0	2.00	60.00	2,499.5	15.7	27.2	-14.7	0.00	0.00	0.00
2,600.0	2.00	60.00	2,599.4	17.4	30.2	-16.4	0.00	0.00	0.00
2,700.0	2.00	60.00	2,699.4	19.2	33.2	-18.0	0.00	0.00	0.00
2,800.0	2.00	60.00	2,799.3	20.9	36.3	-19.6	0.00	0.00	0.00
2,900.0	2.00	60.00	2,899.2	22.7	39.3	-21.3	0.00	0.00	0.00
3,000.0	2.00	60.00	2,999.2	24.4	42.3	-22.9	0.00	0.00	0.00
3,100.0	2.00	60.00	3,099.1	26.2	45.3	-24.5	0.00	0.00	0.00
3,200.0	2.00	60.00	3,199.0	27.9	48.4	-26.2	0.00	0.00	0.00
3,300.0	1.00	60.00	3,299.0	29.2	50.6	-27.4	1.00	-1.00	0.00
3,400.0	0.00	0.00	3,399.0	29.7	51.4	-27.8	1.00	-1.00	0.00
3,500.0	0.00	0.00	3,499.0	29.7	51.4	-27.8	0.00	0.00	0.00
3,600.0	0.00	0.00	3,599.0	29.7	51.4	-27.8	0.00	0.00	0.00
3,700.0	0.00	0.00	3,699.0	29.7	51.4	-27.8	0.00	0.00	0.00
3,800.0	0.00	0.00	3,799.0	29.7	51.4	-27.8	0.00	0.00	0.00
3,900.0	0.00	0.00	3,899.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,000.0	0.00	0.00	3,999.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,100.0	0.00	0.00	4,099.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,200.0	0.00	0.00	4,199.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,300.0	0.00	0.00	4,299.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,400.0	0.00	0.00	4,399.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,500.0	0.00	0.00	4,499.0	29.7	51.4	-27.8	0.00	0.00	0.00
4,565.5	0.00	0.00	4,564.5	29.7	51.4	-27.8	0.00	0.00	0.00
4,600.0	4.14	164.00	4,599.0	28.5	51.7	-26.6	12.00	12.00	0.00
4,700.0	16.14	164.00	4,697.2	11.6	56.6	-9.5	12.00	12.00	0.00
4,800.0	28.14	164.00	4,789.7	-24.6	66.9	27.0	12.00	12.00	0.00
4,900.0	40.14	164.00	4,872.3	-78.4	82.4	81.3	12.00	12.00	0.00
5,000.0	52.14	164.00	4,941.5	-147.6	102.2	151.2	12.00	12.00	0.00
5,100.0	64.14	164.00	4,994.2	-229.1	125.6	233.5	12.00	12.00	0.00
5,200.0	76.14	164.00	5,028.1	-319.4	151.5	324.6	12.00	12.00	0.00

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Survey Report

Company:	PERMIAN	**Local Co-ordinate Reference:**	Well THUNDERBIRD DEVL UNIT #2
Project:	NW DISTRICT - NM EZ NAD 83	**TVD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Site:	THUNDERBIRD DEV UNIT PAD (1,2,3,4)	**MD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
5,300.0	88.14	164.00	5,041.7	-414.4	178.7	420.5	12.00	12.00	0.00
5,315.5	90.00	164.00	5,042.0	-429.3	183.0	435.6	12.00	12.00	0.00
5,400.0	90.00	166.54	5,042.0	-511.0	204.5	518.0	3.00	0.00	3.00
5,500.0	90.00	169.54	5,042.0	-608.8	225.2	616.5	3.00	0.00	3.00
5,600.0	90.00	172.54	5,042.0	-707.6	240.8	715.7	3.00	0.00	3.00
5,700.0	90.00	175.54	5,042.0	-807.1	251.2	815.5	3.00	0.00	3.00
5,800.0	90.00	178.54	5,042.0	-906.9	256.3	915.5	3.00	0.00	3.00
5,841.7	90.00	179.79	5,042.0	-948.6	257.0	957.2	3.00	0.00	3.00
5,883.9	89.16	179.76	5,042.3	-990.8	257.1	999.3	2.00	-2.00	-0.07
5,900.0	89.16	179.76	5,042.5	-1,006.9	257.2	1,015.4	0.00	0.00	0.00
6,000.0	89.16	179.76	5,044.0	-1,106.9	257.6	1,115.4	0.00	0.00	0.00
6,100.0	89.16	179.76	5,045.5	-1,206.9	258.0	1,215.3	0.00	0.00	0.00
6,200.0	89.16	179.76	5,046.9	-1,306.9	258.5	1,315.3	0.00	0.00	0.00
6,300.0	89.16	179.76	5,048.4	-1,406.9	258.9	1,415.2	0.00	0.00	0.00
6,400.0	89.16	179.76	5,049.9	-1,506.8	259.3	1,515.1	0.00	0.00	0.00
6,500.0	89.16	179.76	5,051.3	-1,606.8	259.7	1,615.1	0.00	0.00	0.00
6,600.0	89.16	179.76	5,052.8	-1,706.8	260.2	1,715.0	0.00	0.00	0.00
6,700.0	89.16	179.76	5,054.3	-1,806.8	260.6	1,815.0	0.00	0.00	0.00
6,800.0	89.16	179.76	5,055.8	-1,906.8	261.0	1,914.9	0.00	0.00	0.00
6,900.0	89.16	179.76	5,057.2	-2,006.8	261.4	2,014.8	0.00	0.00	0.00
7,000.0	89.16	179.76	5,058.7	-2,106.8	261.9	2,114.8	0.00	0.00	0.00
7,100.0	89.16	179.76	5,060.2	-2,206.8	262.3	2,214.7	0.00	0.00	0.00
7,200.0	89.16	179.76	5,061.6	-2,306.7	262.7	2,314.7	0.00	0.00	0.00
7,300.0	89.16	179.76	5,063.1	-2,406.7	263.1	2,414.6	0.00	0.00	0.00
7,400.0	89.16	179.76	5,064.6	-2,506.7	263.6	2,514.5	0.00	0.00	0.00
7,500.0	89.16	179.76	5,066.1	-2,606.7	264.0	2,614.5	0.00	0.00	0.00
7,600.0	89.16	179.76	5,067.5	-2,706.7	264.4	2,714.4	0.00	0.00	0.00
7,700.0	89.16	179.76	5,069.0	-2,806.7	264.8	2,814.4	0.00	0.00	0.00
7,800.0	89.16	179.76	5,070.5	-2,906.7	265.3	2,914.3	0.00	0.00	0.00
7,900.0	89.16	179.76	5,071.9	-3,006.7	265.7	3,014.2	0.00	0.00	0.00
8,000.0	89.16	179.76	5,073.4	-3,106.7	266.1	3,114.2	0.00	0.00	0.00
8,100.0	89.16	179.76	5,074.9	-3,206.6	266.6	3,214.1	0.00	0.00	0.00
8,200.0	89.16	179.76	5,076.4	-3,306.6	267.0	3,314.1	0.00	0.00	0.00
8,300.0	89.16	179.76	5,077.8	-3,406.6	267.4	3,414.0	0.00	0.00	0.00
8,400.0	89.16	179.76	5,079.3	-3,506.6	267.8	3,513.9	0.00	0.00	0.00
8,500.0	89.16	179.76	5,080.8	-3,606.6	268.3	3,613.9	0.00	0.00	0.00
8,600.0	89.16	179.76	5,082.2	-3,706.6	268.7	3,713.8	0.00	0.00	0.00
8,700.0	89.16	179.76	5,083.7	-3,806.6	269.1	3,813.8	0.00	0.00	0.00
8,800.0	89.16	179.76	5,085.2	-3,906.6	269.5	3,913.7	0.00	0.00	0.00
8,900.0	89.16	179.76	5,086.7	-4,006.5	270.0	4,013.6	0.00	0.00	0.00
9,000.0	89.16	179.76	5,088.1	-4,106.5	270.4	4,113.6	0.00	0.00	0.00
9,100.0	89.16	179.76	5,089.6	-4,206.5	270.8	4,213.5	0.00	0.00	0.00
9,200.0	89.16	179.76	5,091.1	-4,306.5	271.2	4,313.4	0.00	0.00	0.00

apachecorp

Survey Report

Company:	PERMIAN	**Local Co-ordinate Reference:**	Well THUNDERBIRD DEVL UNIT #2
Project:	NW DISTRICT - NM EZ NAD 83	**TVD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Site:	THUNDERBIRD DEV UNIT PAD (1,2,3,4)	**MD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
9,300.0	89.16	179.76	5,092.5	-4,406.5	271.7	4,413.4	0.00	0.00	0.00
9,400.0	89.16	179.76	5,094.0	-4,506.5	272.1	4,513.3	0.00	0.00	0.00
9,500.0	89.16	179.76	5,095.5	-4,606.5	272.5	4,613.3	0.00	0.00	0.00
9,600.0	89.16	179.76	5,097.0	-4,706.5	272.9	4,713.2	0.00	0.00	0.00
9,700.0	89.16	179.76	5,098.4	-4,806.5	273.4	4,813.1	0.00	0.00	0.00
9,800.0	89.16	179.76	5,099.9	-4,906.4	273.8	4,913.1	0.00	0.00	0.00
9,900.0	89.16	179.76	5,101.4	-5,006.4	274.2	5,013.0	0.00	0.00	0.00
10,000.0	89.16	179.76	5,102.8	-5,106.4	274.6	5,113.0	0.00	0.00	0.00
10,100.0	89.16	179.76	5,104.3	-5,206.4	275.1	5,212.9	0.00	0.00	0.00
10,200.0	89.16	179.76	5,105.8	-5,306.4	275.5	5,312.8	0.00	0.00	0.00
10,300.0	89.16	179.76	5,107.3	-5,406.4	275.9	5,412.8	0.00	0.00	0.00
10,400.0	89.16	179.76	5,108.7	-5,506.4	276.3	5,512.7	0.00	0.00	0.00
10,500.0	89.16	179.76	5,110.2	-5,606.4	276.8	5,612.7	0.00	0.00	0.00
10,600.0	89.16	179.76	5,111.7	-5,706.3	277.2	5,712.6	0.00	0.00	0.00
10,700.0	89.16	179.76	5,113.1	-5,806.3	277.6	5,812.5	0.00	0.00	0.00
10,800.0	89.16	179.76	5,114.6	-5,906.3	278.0	5,912.5	0.00	0.00	0.00
10,900.0	89.16	179.76	5,116.1	-6,006.3	278.5	6,012.4	0.00	0.00	0.00
11,000.0	89.16	179.76	5,117.6	-6,106.3	278.9	6,112.4	0.00	0.00	0.00
11,100.0	89.16	179.76	5,119.0	-6,206.3	279.3	6,212.3	0.00	0.00	0.00
11,200.0	89.16	179.76	5,120.5	-6,306.3	279.7	6,312.2	0.00	0.00	0.00
11,300.0	89.16	179.76	5,122.0	-6,406.3	280.2	6,412.2	0.00	0.00	0.00
11,400.0	89.16	179.76	5,123.4	-6,506.3	280.6	6,512.1	0.00	0.00	0.00
11,500.0	89.16	179.76	5,124.9	-6,606.2	281.0	6,612.1	0.00	0.00	0.00
11,600.0	89.16	179.76	5,126.4	-6,706.2	281.4	6,712.0	0.00	0.00	0.00
11,700.0	89.16	179.76	5,127.9	-6,806.2	281.9	6,811.9	0.00	0.00	0.00
11,800.0	89.16	179.76	5,129.3	-6,906.2	282.3	6,911.9	0.00	0.00	0.00
11,900.0	89.16	179.76	5,130.8	-7,006.2	282.7	7,011.8	0.00	0.00	0.00
12,000.0	89.16	179.76	5,132.3	-7,106.2	283.1	7,111.8	0.00	0.00	0.00
12,100.0	89.16	179.76	5,133.7	-7,206.2	283.6	7,211.7	0.00	0.00	0.00
12,200.0	89.16	179.76	5,135.2	-7,306.2	284.0	7,311.6	0.00	0.00	0.00
12,300.0	89.16	179.76	5,136.7	-7,406.1	284.4	7,411.6	0.00	0.00	0.00
12,400.0	89.16	179.76	5,138.1	-7,506.1	284.8	7,511.5	0.00	0.00	0.00
12,500.0	89.16	179.76	5,139.6	-7,606.1	285.3	7,611.5	0.00	0.00	0.00
12,600.0	89.16	179.76	5,141.1	-7,706.1	285.7	7,711.4	0.00	0.00	0.00
12,700.0	89.16	179.76	5,142.6	-7,806.1	286.1	7,811.3	0.00	0.00	0.00
12,800.0	89.16	179.76	5,144.0	-7,906.1	286.5	7,911.3	0.00	0.00	0.00
12,900.0	89.16	179.76	5,145.5	-8,006.1	287.0	8,011.2	0.00	0.00	0.00
12,933.5	89.16	179.76	5,146.0	-8,039.6	287.1	8,044.7	0.00	0.00	0.00

Company:	PERMIAN	**Local Co-ordinate Reference:**	Well THUNDERBIRD DEVL UNIT #2
Project:	NW DISTRICT - NM EZ NAD 83	**TVD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Site:	THUNDERBIRD DEV UNIT PAD (1,2,3,4)	**MD Reference:**	WELL @ 3764.0ft (Original Well Elev)
Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Design Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (ft)	Easting (ft)	Latitude	Longitude
bhl THUNDERBIRD DE\ - plan hits target center - Point	0.00	0.00	5,146.0	-8,039.6	287.1	675,542.10	652,619.10	32° 51' 23.615 N	103° 58' 15.393 W

Checked By: _____ Approved By: _____ Date: _____

PERMIAN

NW DISTRICT - NM EZ NAD 83
THUNDERBIRD DEV UNIT PAD (1,2,3,4)
THUNDERBIRD DEVL UNIT #2

THUNDERBIRD DEVL UNIT #2

Plan: Design #1

Standard Survey Report

, 19 October, 2018

apachecorp

Survey Report

Company:	PERMIAN	**Local Co-ordinate Reference:**	Well THUNDERBIRD DEVL UN
Project:	NW DISTRICT - NM EZ NAD 83	**TVD Reference:**	WELL @ 3764.0ft (Original Wel
Site:	THUNDERBIRD DEV UNIT PAD (1,2,3,4)	**MD Reference:**	WELL @ 3764.0ft (Original Wel
Well:	THUNDERBIRD DEVL UNIT #2	**North Reference:**	Grid
Wellbore:	THUNDERBIRD DEVL UNIT #2	**Survey Calculation Method:**	Minimum Curvature
Design:	Design #1	**Database:**	PEDM

Project	NW DISTRICT - NM EZ NAD 83		
Map System:	US State Plane 1983	**System Datum:**	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site	THUNDERBIRD DEV UNIT PAD (1,2,3,4)				
Site Position:		**Northing:**	683,581.90 ft	**Latitude:**	
From:	Map	**Easting:**	652,371.90 ft	**Longitude:**	
Position Uncertainty:	0.0 ft	**Slot Radius:**	13.200 in	**Grid Convergence:**	

Well Position	**+N/-S**	0.0 ft	**Northing:**	683,581.70 ft	**Latitude:**
	+E/-W	0.0 ft	**Easting:**	652,332.00 ft	**Longitude:**
Position Uncertainty		0.0 ft	**Wellhead Elevation:**	0.0 ft	**Ground Level:**

Wellbore THUNDERBIRD DEVL UNIT #2

Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Fi**
	HDGM	10/16/2018	7.42	60.65	

Design Design #1

Audit Notes:

Version:		**Phase:**	PLAN	**Tie On Depth:**	
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**	

	0.0	0.0	0.0	177.95

Survey Tool Program **Date** 10/19/2018

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
0.0	12,933.5	Design #1 (THUNDERBIRD DEVL UNIT #	MWD+HDGM (MWD)	OWSG MWD + HDG

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vert Sec (f
0.0	0.00	0.00	0.0	0.0	0.0	
100.0	0.00	0.00	100.0	0.0	0.0	
200.0	0.00	0.00	200.0	0.0	0.0	
300.0	0.00	0.00	300.0	0.0	0.0	
400.0	0.00	0.00	400.0	0.0	0.0	
500.0	0.00	0.00	500.0	0.0	0.0	
600.0	0.00	0.00	600.0	0.0	0.0	
700.0	0.00	0.00	700.0	0.0	0.0	
800.0	0.00	0.00	800.0	0.0	0.0	
900.0	0.00	0.00	900.0	0.0	0.0	

Well THUNDERBIRD DEVL UNIT #2

Planned Survey

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vert Sec (f
1,000.0	0.00	0.00	1,000.0	0.0	0.0	
1,100.0	0.00	0.00	1,100.0	0.0	0.0	
1,200.0	0.00	0.00	1,200.0	0.0	0.0	
1,300.0	0.00	0.00	1,300.0	0.0	0.0	
1,400.0	0.00	0.00	1,400.0	0.0	0.0	
1,500.0	0.00	0.00	1,500.0	0.0	0.0	
1,600.0	1.00	60.00	1,600.0	0.4	0.8	
1,700.0	2.00	60.00	1,700.0	1.7	3.0	
1,800.0	2.00	60.00	1,799.9	3.5	6.0	
1,900.0	2.00	60.00	1,899.8	5.2	9.1	
2,000.0	2.00	60.00	1,999.8	7.0	12.1	
2,100.0	2.00	60.00	2,099.7	8.7	15.1	
2,200.0	2.00	60.00	2,199.7	10.5	18.1	
2,300.0	2.00	60.00	2,299.6	12.2	21.2	
2,400.0	2.00	60.00	2,399.5	14.0	24.2	
2,500.0	2.00	60.00	2,499.5	15.7	27.2	
2,600.0	2.00	60.00	2,599.4	17.4	30.2	

2,700.0	2.00	60.00	2,699.4	19.2	33.2
2,800.0	2.00	60.00	2,799.3	20.9	36.3
2,900.0	2.00	60.00	2,899.2	22.7	39.3
3,000.0	2.00	60.00	2,999.2	24.4	42.3
3,100.0	2.00	60.00	3,099.1	26.2	45.3
3,200.0	2.00	60.00	3,199.0	27.9	48.4
3,300.0	1.00	60.00	3,299.0	29.2	50.6
3,400.0	0.00	0.00	3,399.0	29.7	51.4
3,500.0	0.00	0.00	3,499.0	29.7	51.4
3,600.0	0.00	0.00	3,599.0	29.7	51.4
3,700.0	0.00	0.00	3,699.0	29.7	51.4
3,800.0	0.00	0.00	3,799.0	29.7	51.4
3,900.0	0.00	0.00	3,899.0	29.7	51.4
4,000.0	0.00	0.00	3,999.0	29.7	51.4
4,100.0	0.00	0.00	4,099.0	29.7	51.4
4,200.0	0.00	0.00	4,199.0	29.7	51.4
4,300.0	0.00	0.00	4,299.0	29.7	51.4
4,400.0	0.00	0.00	4,399.0	29.7	51.4
4,500.0	0.00	0.00	4,499.0	29.7	51.4
4,565.5	0.00	0.00	4,564.5	29.7	51.4
4,600.0	4.14	164.00	4,599.0	28.5	51.7
4,700.0	16.14	164.00	4,697.2	11.6	56.6
4,800.0	28.14	164.00	4,789.7	-24.6	66.9
4,900.0	40.14	164.00	4,872.3	-78.4	82.4
5,000.0	52.14	164.00	4,941.5	-147.6	102.2
5,100.0	64.14	164.00	4,994.2	-229.1	125.6
5,200.0	76.14	164.00	5,028.1	-319.4	151.5

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vert Sec (f
5,300.0	88.14	164.00	5,041.7	-414.4	178.7	
5,315.5	90.00	164.00	5,042.0	-429.3	183.0	
5,400.0	90.00	166.54	5,042.0	-511.0	204.5	
5,500.0	90.00	169.54	5,042.0	-608.8	225.2	
5,600.0	90.00	172.54	5,042.0	-707.6	240.8	
5,700.0	90.00	175.54	5,042.0	-807.1	251.2	
5,800.0	90.00	178.54	5,042.0	-906.9	256.3	
5,841.7	90.00	179.79	5,042.0	-948.6	257.0	
5,883.9	89.16	179.76	5,042.3	-990.8	257.1	
5,900.0	89.16	179.76	5,042.5	-1,006.9	257.2	
6,000.0	89.16	179.76	5,044.0	-1,106.9	257.6	
6,100.0	89.16	179.76	5,045.5	-1,206.9	258.0	
6,200.0	89.16	179.76	5,046.9	-1,306.9	258.5	
6,300.0	89.16	179.76	5,048.4	-1,406.9	258.9	
6,400.0	89.16	179.76	5,049.9	-1,506.8	259.3	
6,500.0	89.16	179.76	5,051.3	-1,606.8	259.7	
6,600.0	89.16	179.76	5,052.8	-1,706.8	260.2	
6,700.0	89.16	179.76	5,054.3	-1,806.8	260.6	
6,800.0	89.16	179.76	5,055.8	-1,906.8	261.0	
6,900.0	89.16	179.76	5,057.2	-2,006.8	261.4	
7,000.0	89.16	179.76	5,058.7	-2,106.8	261.9	
7,100.0	89.16	179.76	5,060.2	-2,206.8	262.3	

7,200.0	89.16	179.76	5,061.6	-2,306.7	262.7
7,300.0	89.16	179.76	5,063.1	-2,406.7	263.1
7,400.0	89.16	179.76	5,064.6	-2,506.7	263.6
7,500.0	89.16	179.76	5,066.1	-2,606.7	264.0
7,600.0	89.16	179.76	5,067.5	-2,706.7	264.4
7,700.0	89.16	179.76	5,069.0	-2,806.7	264.8
7,800.0	89.16	179.76	5,070.5	-2,906.7	265.3
7,900.0	89.16	179.76	5,071.9	-3,006.7	265.7
8,000.0	89.16	179.76	5,073.4	-3,106.7	266.1
8,100.0	89.16	179.76	5,074.9	-3,206.6	266.6
8,200.0	89.16	179.76	5,076.4	-3,306.6	267.0
8,300.0	89.16	179.76	5,077.8	-3,406.6	267.4
8,400.0	89.16	179.76	5,079.3	-3,506.6	267.8
8,500.0	89.16	179.76	5,080.8	-3,606.6	268.3
8,600.0	89.16	179.76	5,082.2	-3,706.6	268.7
8,700.0	89.16	179.76	5,083.7	-3,806.6	269.1
8,800.0	89.16	179.76	5,085.2	-3,906.6	269.5
8,900.0	89.16	179.76	5,086.7	-4,006.5	270.0
9,000.0	89.16	179.76	5,088.1	-4,106.5	270.4
9,100.0	89.16	179.76	5,089.6	-4,206.5	270.8
9,200.0	89.16	179.76	5,091.1	-4,306.5	271.2

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vert Sec (f
9,300.0	89.16	179.76	5,092.5	-4,406.5	271.7	
9,400.0	89.16	179.76	5,094.0	-4,506.5	272.1	
9,500.0	89.16	179.76	5,095.5	-4,606.5	272.5	
9,600.0	89.16	179.76	5,097.0	-4,706.5	272.9	
9,700.0	89.16	179.76	5,098.4	-4,806.5	273.4	
9,800.0	89.16	179.76	5,099.9	-4,906.4	273.8	
9,900.0	89.16	179.76	5,101.4	-5,006.4	274.2	
10,000.0	89.16	179.76	5,102.8	-5,106.4	274.6	
10,100.0	89.16	179.76	5,104.3	-5,206.4	275.1	
10,200.0	89.16	179.76	5,105.8	-5,306.4	275.5	
10,300.0	89.16	179.76	5,107.3	-5,406.4	275.9	
10,400.0	89.16	179.76	5,108.7	-5,506.4	276.3	
10,500.0	89.16	179.76	5,110.2	-5,606.4	276.8	
10,600.0	89.16	179.76	5,111.7	-5,706.3	277.2	
10,700.0	89.16	179.76	5,113.1	-5,806.3	277.6	
10,800.0	89.16	179.76	5,114.6	-5,906.3	278.0	
10,900.0	89.16	179.76	5,116.1	-6,006.3	278.5	
11,000.0	89.16	179.76	5,117.6	-6,106.3	278.9	
11,100.0	89.16	179.76	5,119.0	-6,206.3	279.3	
11,200.0	89.16	179.76	5,120.5	-6,306.3	279.7	
11,300.0	89.16	179.76	5,122.0	-6,406.3	280.2	
11,400.0	89.16	179.76	5,123.4	-6,506.3	280.6	
11,500.0	89.16	179.76	5,124.9	-6,606.2	281.0	
11,600.0	89.16	179.76	5,126.4	-6,706.2	281.4	
11,700.0	89.16	179.76	5,127.9	-6,806.2	281.9	
11,800.0	89.16	179.76	5,129.3	-6,906.2	282.3	
11,900.0	89.16	179.76	5,130.8	-7,006.2	282.7	
12,000.0	89.16	179.76	5,132.3	-7,106.2	283.1	

12,100.0	89.16	179.76	5,133.7	-7,206.2	283.6
12,200.0	89.16	179.76	5,135.2	-7,306.2	284.0
12,300.0	89.16	179.76	5,136.7	-7,406.1	284.4
12,400.0	89.16	179.76	5,138.1	-7,506.1	284.8
12,500.0	89.16	179.76	5,139.6	-7,606.1	285.3
12,600.0	89.16	179.76	5,141.1	-7,706.1	285.7
12,700.0	89.16	179.76	5,142.6	-7,806.1	286.1
12,800.0	89.16	179.76	5,144.0	-7,906.1	286.5
12,900.0	89.16	179.76	5,145.5	-8,006.1	287.0
12,933.5	89.16	179.76	5,146.0	-8,039.6	287.1

Design Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (ft)	Eas (f
bhl THUNDERBIRD DEVL UNIT - plan hits target center - Point	0.00	0.00	5,146.0	-8,039.6	287.1	675,542.10	6

Checked By: Approved By: Date:

lIT #2

l Elev)

l Elev)

32° 52' 43.176 N

103° 58' 17.968 W

0.20 °

32° 52' 43.176 N

103° 58' 18.436 W

3,738.0 ft

eld Strength (nT)

48,178

0.0

M

tical tion t)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00

tical tion t)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
0.0	0.00	0.00	0.00
-0.4	1.00	1.00	0.00
-1.6	1.00	1.00	0.00
-3.3	0.00	0.00	0.00
-4.9	0.00	0.00	0.00
-6.5	0.00	0.00	0.00
-8.2	0.00	0.00	0.00
-9.8	0.00	0.00	0.00
-11.5	0.00	0.00	0.00
-13.1	0.00	0.00	0.00
-14.7	0.00	0.00	0.00
-16.4	0.00	0.00	0.00

-18.0	0.00	0.00	0.00
-19.6	0.00	0.00	0.00
-21.3	0.00	0.00	0.00
-22.9	0.00	0.00	0.00
-24.5	0.00	0.00	0.00
-26.2	0.00	0.00	0.00
-27.4	1.00	-1.00	0.00
-27.8	1.00	-1.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-27.8	0.00	0.00	0.00
-26.6	12.00	12.00	0.00
-9.5	12.00	12.00	0.00
27.0	12.00	12.00	0.00
81.3	12.00	12.00	0.00
151.2	12.00	12.00	0.00
233.5	12.00	12.00	0.00
324.6	12.00	12.00	0.00

tical tion t)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
420.5	12.00	12.00	0.00
435.6	12.00	12.00	0.00
518.0	3.00	0.00	3.00
616.5	3.00	0.00	3.00
715.7	3.00	0.00	3.00
815.5	3.00	0.00	3.00
915.5	3.00	0.00	3.00
957.2	3.00	0.00	3.00
999.3	2.00	-2.00	-0.07
1,015.4	0.00	0.00	0.00
1,115.4	0.00	0.00	0.00
1,215.3	0.00	0.00	0.00
1,315.3	0.00	0.00	0.00
1,415.2	0.00	0.00	0.00
1,515.1	0.00	0.00	0.00
1,615.1	0.00	0.00	0.00
1,715.0	0.00	0.00	0.00
1,815.0	0.00	0.00	0.00
1,914.9	0.00	0.00	0.00
2,014.8	0.00	0.00	0.00
2,114.8	0.00	0.00	0.00
2,214.7	0.00	0.00	0.00

2,314.7	0.00	0.00	0.00
2,414.6	0.00	0.00	0.00
2,514.5	0.00	0.00	0.00
2,614.5	0.00	0.00	0.00
2,714.4	0.00	0.00	0.00
2,814.4	0.00	0.00	0.00
2,914.3	0.00	0.00	0.00
3,014.2	0.00	0.00	0.00
3,114.2	0.00	0.00	0.00
3,214.1	0.00	0.00	0.00
3,314.1	0.00	0.00	0.00
3,414.0	0.00	0.00	0.00
3,513.9	0.00	0.00	0.00
3,613.9	0.00	0.00	0.00
3,713.8	0.00	0.00	0.00
3,813.8	0.00	0.00	0.00
3,913.7	0.00	0.00	0.00
4,013.6	0.00	0.00	0.00
4,113.6	0.00	0.00	0.00
4,213.5	0.00	0.00	0.00
4,313.4	0.00	0.00	0.00

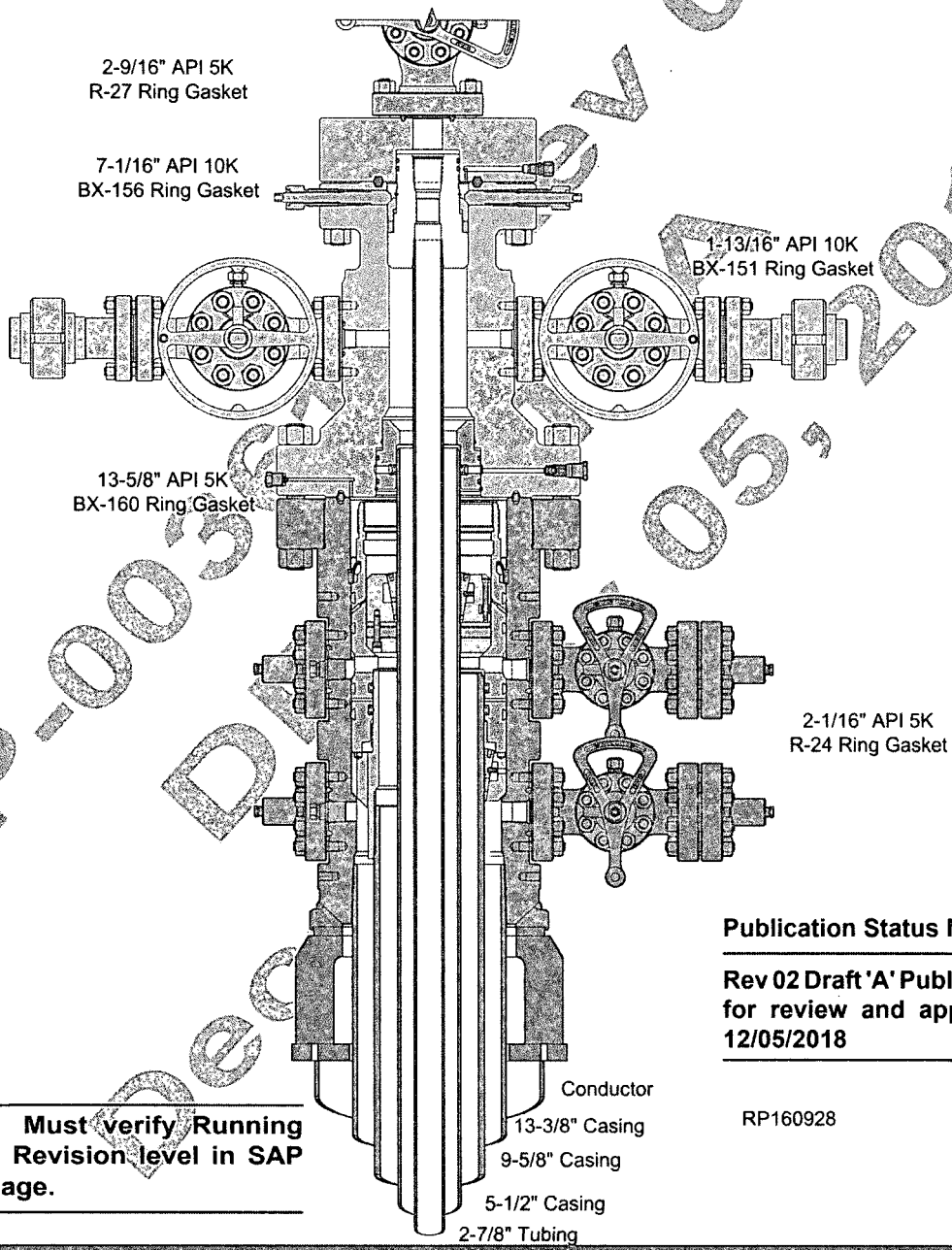
tical tion t)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
4,413.4	0.00	0.00	0.00
4,513.3	0.00	0.00	0.00
4,613.3	0.00	0.00	0.00
4,713.2	0.00	0.00	0.00
4,813.1	0.00	0.00	0.00
4,913.1	0.00	0.00	0.00
5,013.0	0.00	0.00	0.00
5,113.0	0.00	0.00	0.00
5,212.9	0.00	0.00	0.00
5,312.8	0.00	0.00	0.00
5,412.8	0.00	0.00	0.00
5,512.7	0.00	0.00	0.00
5,612.7	0.00	0.00	0.00
5,712.6	0.00	0.00	0.00
5,812.5	0.00	0.00	0.00
5,912.5	0.00	0.00	0.00
6,012.4	0.00	0.00	0.00
6,112.4	0.00	0.00	0.00
6,212.3	0.00	0.00	0.00
6,312.2	0.00	0.00	0.00
6,412.2	0.00	0.00	0.00
6,512.1	0.00	0.00	0.00
6,612.1	0.00	0.00	0.00
6,712.0	0.00	0.00	0.00
6,811.9	0.00	0.00	0.00
6,911.9	0.00	0.00	0.00
7,011.8	0.00	0.00	0.00
7,111.8	0.00	0.00	0.00

7,211.7	0.00	0.00	0.00
7,311.6	0.00	0.00	0.00
7,411.6	0.00	0.00	0.00
7,511.5	0.00	0.00	0.00
7,611.5	0.00	0.00	0.00
7,711.4	0.00	0.00	0.00
7,811.3	0.00	0.00	0.00
7,911.3	0.00	0.00	0.00
8,011.2	0.00	0.00	0.00
8,044.7	0.00	0.00	0.00

ting t)	Latitude	Longitude
;52,619.10	32° 51' 23.615 N	103° 58' 15.393 W

RUNNING PROCEDURE

Apache Corp.
5-1/2" or 7" Producer



Publication Status Note:

Rev 02 Draft 'A' Publication sent for review and approval; EA 12/05/2018

RP160928

⚠ CAUTION Must verify Running Procedure Revision level in SAP prior to usage.

Surface Systems Publication

CAMERON A Schlumberger Company	**13-5/8" 5K MN-DS System** **13-3/8" x 9-5/8" x 5-1/2"(or 7") x 2-7/8" Casing Program**	**RP-003612** **Rev 02 Draft A**

Safety Hazard Indicators

The Safety Hazard Indicators listed below will be used throughout this procedure to indicate potentially hazardous and/or personnel risks that may be encountered during the performance of the tasks outlined in this procedure.

⚠ CAUTION — Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury

⚠ WARNING — Indicates a hazardous situation which, if not avoided, could result in death or serious injury

⚠ DANGER — Indicates a hazardous situation which, if not avoided, will result in death or serious injury

NOTICE — Preferred to address practices not related to personal injury

ES-000175-02

This document alone does not qualify an individual to Install/Run the Equipment. This document is created and provided as a reference for Qualified Cameron Service Personnel and does not cover all scenarios that may occur.

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Table of Contents

RUNNING PROCEDURE GENERAL WARNING

READ AND UNDERSTAND ALL INSTRUCTIONS. Failure to follow may result in serious personal injury and damage not only to the equipment but also the environment.

1. Safety is a combination of staying alert, common sense, and experience with the oil field equipment and environment. Read this Running Procedure prior to operating and installing the equipment. Be familiar with the operation terminologies of oil field equipment.

2. This document includes basic installation guidance. **The field service personnel shall be fully trained in all aspects of handling pressure control equipment as well as of the job that they are going to perform.** If any of the procedures and policies listed in this procedure cannot be followed, contact a Cameron Representative for the best course of action.

3. Proper **Personal Protective Equipment (PPE)** shall be utilized according to Company policies. Always use proper tools when servicing the equipment.

4. A **Job Hazard Analysis (JHA)** must be performed prior to beginning any service on a well location. A JHA review meeting will be held with all affected rig personnel PRIOR to the commencement of work to review the results of the JHA, evacuation routes, emergency contacts, etc. All meeting attendees and a Company Representative will sign-off on the JHA to acknowledge this meeting has taken place

5. **Be aware of unexpected circumstances** that may arise when operating or servicing the equipment. Utilize the **Step Back 5X5 Process** in order to assess the hazards posed before, during, and after the servicing of equipment under pressure or with the potential of hazardous chemicals present. Be familiar with the company's and facility's Lockout/Tagout program in order to ensure all sources of energy (i.e. electrical, pneumatic, pressure) are isolated and/or de-energized prior to beginning work.

6. All **governmental or Company safety requirements** shall be met before working on the equipment. **Requirements of fully tested pressure barriers prior to servicing the equipment shall be observed. Cameron recommends that two mechanical pressure barriers is the preferred practice.** Additional precautions should be taken to ensure that the mechanical pressure barriers are functioning correctly prior to any work being carried out on this particular equipment.

7. Always check for any **trapped pressure** before servicing the equipment. All valves downstream of the pressure barriers must be cycled several times to release any trapped pressure.

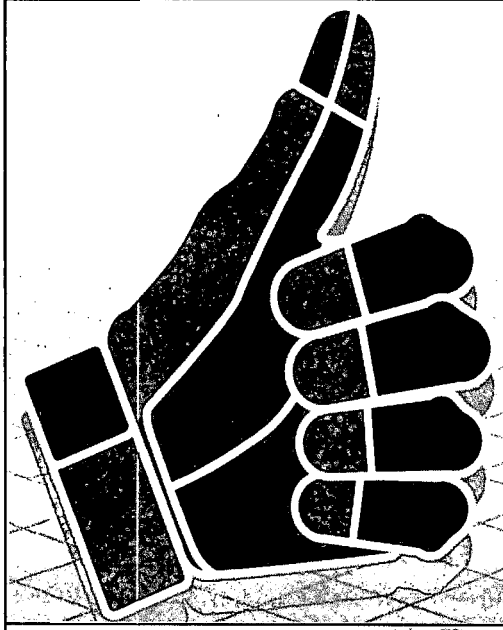
8. Ensure the chemical and physical properties of the fluid flow product inside the equipment are known. Obtain applicable **Safety Data Sheets (SDS)** for commonly encountered chemicals such as hydrogen sulfide, cements, etc. in order to identify appropriate PPE to use, emergencies, procedures, and methods or exposure control.

9. Always use **correct lifting devices** and follow safety rules in handling heavy products. The actual weight can vary for the system configurations. Never attempt to lift the equipment by hand.

10. Cameron manufactures a variety of oil field equipment with different features and operating requirements. Be certain of the equipment model and refer to the appropriate procedure, before attempting any operation or service on the equipment. **This procedure is to assist field personnel in the operation and installation of the equipment that is listed in this document. Different procedures are available for other oil field products.**

SD-045055-01 Rev 02

HSE Hand Safety Rules



1. No Hands on Loads
   Select the appropriate device to control the load
2. Hands on Handles Only
   Use manufacturers handles or safe alternatives
3. Permission to Touch
   Use lifting assistance/technology for loads > 20kg or 44 lbs
4. Hands Off...Energy On
   Remove hands from load BEFORE setting in motion
5. Safe Cargo Handling
   Use pallets & crates designed to prevent tip over or loss of load
6. Use the Correct PPE
   Use the right glove for the job (chemical, hot work, impact, etc.)

HSE VISION: NO ONE GETS HURT; NOTHING GETS HARMED — HEALTH, SAFETY & ENVIRONMENT

HSE Tenets of Operation

Stop Work
Stop work immediately until unsafe behaviors and conditions are addressed.

Report ALL Incidents
Immediately report incidents, including injuries, illnesses, property damage, near misses, and environmental releases.

Leadership & Accountability
Hold each other accountable for working safely and complying with applicable regulations.

Equipment Operations
Always operate equipment and vehicles with safety devices enabled, and never beyond their capabilities, environmental limits, or designed purposes.

Follow Procedures
Maintain all training and follow established HSE policies and practices.

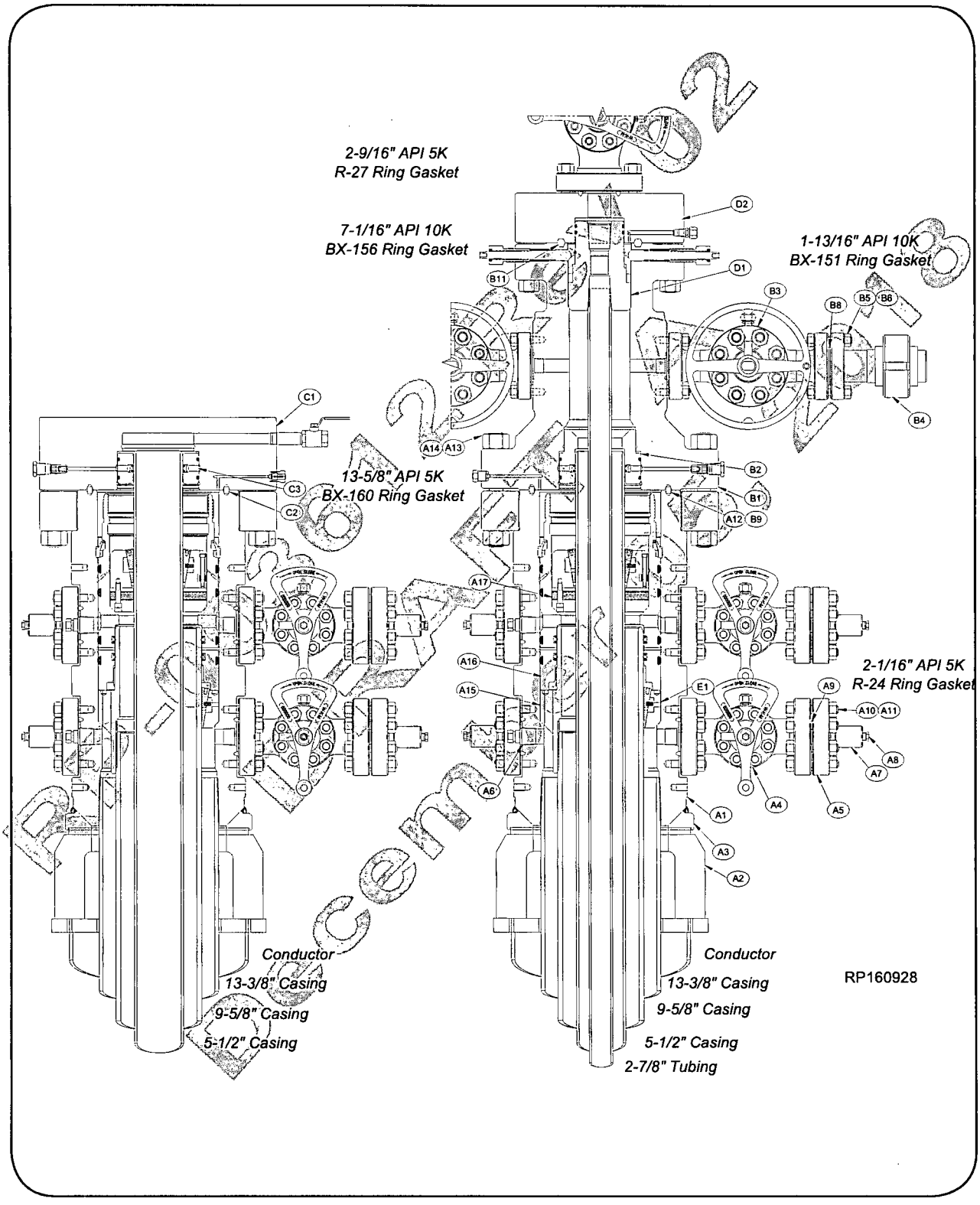
HSE Observations
Recognize safe behaviors and conditions, and address those at-risk.

PPE
Always wear the correct Personal Protective Equipment for the task.

Ask
Ask questions when in doubt, and for assistance when dealing with new or unusual situations.

HSE VISION: NO ONE GETS HURT; NOTHING GETS HARMED — HEALTH, SAFETY & ENVIRONMENT

System Drawing



Bill of Materials

NOTE Contact your Cameron representative for replacement part inquiries. Cameron personnel can check the latest revision of the assembly bill-of-material to obtain the appropriate and current replacement part number.

CASING HEAD

Item	Qty	Description
Section Assembly : A1 - A14		
PN: 2393657-02-01		
A1	1	Csg Hd Housing,MN-DS, 13-5/8" OEC 5K x 13-3/8" API BC box btm, (4) 2-1/16" 5M SSO's 12.615 Min Bore Part # 2345472-14-01
A2	1	Landing Base, CR, 13-5/8" Flange, 24" OD Part# 2057661-05-01
A3	1	Body; Load Ring Adapter f/ 13-5/8" MN-DS Housing w/ CR Landing Base Part #2379363-01-01
A4	2	Gate Valve, Manual Model M, 2-1/16" 5,000 flg x flg Part# 2737400-01-12
A5	4	Companion Flange 2-1/16" 5,000 x 2" LP Part# 142362-01-03-02
A6	2	VR Plug, 2-1/16" 1-1/2" VEE Tubing thread Part# 255290-01
A7	4	Bull Plug, 2" LP x 1/2" NPT Part# 007481-01
A8	4	Vent Fitting, 1/2" NPT Part# 2738068-02
A9	6	Ring Gasket, R-24 Part# 702001-24-02
A10	16	Stud Cont thread, .875"-9 x 6" long Part# 702533-08-10-60
A11	32	Nut, Heavy Hex, .875"-9 Part# 2709000-09-01
A12	1	Ring Gasket, BX-160 Part#702003-16-02
A13	16	Stud Cont thread, 1.625"-8 x 12.50" long Part# 702533-14-11-22
A14	32	Nut; Heavy Hex, 1.625"-8 Part# 2709000-15-01

CASING HEAD CONT.

Item	Qty	Description
A15	1	Mandrel Csg Hng MN-DS, 13-5/8"Nom x 9-5/8" 40 LB/FT API Buttress Box thd btm x 10.00"-4 TPI L.H. Stub Acme R/Thd top Min. Bore: 8.835" Part # 2345509-09-01
A16	1	Bushing, Packoff Support, MN-DS, 13-5/8" Nom, w/ 13-5/8" dovetail seal, w/ 9-5/8" 'T' seals, internal and external lock ring prep Min. Bore: 8.835" Part # 2161673-29-01
A17	1	Casing Hanger, IC-2, 11" x 5-1/2" Part # Y15001-21002901

TUBING SPOOL

Item	Qty	Description
B1	1	Tubing Spool, Type 'C', 13-5/8" API 5K BX-160 flg btm x 7-1/16 API 10K BX-156 flg top, w/ (2) 1-13/16" API 10K BX-151 SSo's and 11" NOM 'NX' prep btm. Min. Bore: 6.34" Part# 2247641-04-01
B2	1	NX Bushing, 11" x 5-1/2" w/ Integral Bit Guide Min. Bore: 4.92 Part# 2161829-02-01
B3	2	Gate Valve, Manual, Model 'FLS', 1-13/16" API 10K Part# 141510-41-95-02
B4	2	Assy; Flg, Weco, 1-13/16" API 10K x 2" Nom Weco 1502 Female Fitting, Min Bore: 1.81" Part# 2133556-02-03
B5	16	Stud Cont thread, .750"-10 x 5.00" long Part# 702533-07-10-50
B6	32	Nut, Heavy Hex, .750"-10 Part# 2709000-08-01

TUBING SPOOL

Item	Qty	Description
B7	1	Ring Gasket, BX-160 Part# 702003-16-02
B8	4	Ring Gasket, BX-151 Part# 702003-15-14
B9	1	Ring Gasket, BX-156 Part# 702003-15-62

CAPPING FLANGE

Item	Qty	Description
C1	1	Capping Flange, 13-5/8" API 5K stud'd btm w/ 11" NOM x 7" CSG NX Bushing, (1) NPT Ball valve Part # 2378469-06-01
C2	1	Ring Gasket, BX-160 Part# 702003-16-02
C3	1	NX Bushing, 11" x 5-1/2" Part# 608783-12

CHRISTMAS TREE

Item	Qty	Description
D1	1	Assy, Hanger, TC-1A-EN, 7 In Nom., w/5.487 OD Extended Neck, 2-7/8" API EU 8RD Box Thd Btm x Top 2-1/2" Nom 'H' BPV Thread Part # 2203910-01-01
D2	1	Purchased Tubing Head Adapter A5P Shorty 7-1/16" 10K Flg Btm x 2-9/16" 5K Std'd Top w/ 5-1/2 Seal Pocket Part # 2737555-01

EMERGENCY EQUIPMENT

Item	Qty	Description
E1	1	Casing Hanger, MN-DS-IC-1, 13-5/8" nom x 9-5/8" casing Part # 2161741-08-01

Bill of Materials

NOTE Contact your Cameron representative for replacement part inquiries. Cameron personnel can check the latest revision of the assembly bill-of-material to obtain the appropriate and current replacement part number.

HOUSING CONTINGENCY

Item	Qty	Description
A1a	1	Conversion Casing Hd housing, MN-DS, 13-5/8" OEC API 5K BX-160 w/ 18.250-4TPI LH Stub ACME top for thd flange and prep f/ internal snap ring x 13-3/8" SOW btm, two upper and two lower 2-1/16" API 5K SSO's Min. Bore:12.615 Part# 2031060-48-04
A2a	1	Landing Base, CR, for 13- 5/8" housing, 32" OD base plate w/ flow-by slots Capacity: 850,000 LBS Part# 2057661-04-01

7" CASING CONTINGENCY

Item	Qty	Description
A17a	1	Casing Hanger, IC-2, 11" x 7" Part # 2133152-03-05
B2a	1	NX Bushing, 11" x 7" w/ Integral Bit Guide Min. Bore: 6.34 Part# 2161829-17-01
C3a	1	NX Bushing, 11" x 7" Part# 608783-17

SERVICE TOOLS CONT.

Item	Qty	Description
ST1	1	Test Plug, 'C', 13-5/8" nom x 4-1/2" IF Box btm x top Part # 2247044-01-01
ST2	1	Wear Bushing Running Tool, IC-2, 13-5/8" nom w/ double lead pin thd. btm x NC50 (4-1/2" IF) box top, w/ 6-1/2" OD ext. Part # 608536-19
ST3	1	Wear Bushing, 13-5/8" Nom, w/ (4) O-Rings, Min bore. 12.615" Part # 2394103-01-01

SERVICE TOOLS CONT.

Item	Qty	Description
ST4	1	Hanger Running Tool, 13-5/8" nom x 10.000"-4TPI LH Stub Acme bottom thread x 9-5/8" 8RD LC top thread, w/ 3 centralizing ribs for 10K Csg Hanger Part # 2161757-69-01
ST5	1	Running Tool f/ 13-5/8" Nom Seal Packoff w/ 4-1/2" IF top and bottom and 12.375-4TPI LH Stub Acme thread Part # 2017712-10-01
ST6	1	Test Plug, C, 11" Nom x 4-1/2" IF Box top x pin btm Part # 2247042-10-01
ST7	1	Wear Bushing Running and Retrieving Tool f/ 11" nom x 4-1/2" IF thd Part # 661822-06
ST8	1	Wear Bushing f/ 11" nom type MN-DS; 8.910" Min. Bore Part # 2125720-10-01
ST9	1	Assy; Housing Running Tool, 13-3/8" API Btc Box Thd Top x 18.250" Od-4TPI LH Stub Acme Running Thd, Min Bore: 12.59" Part# 2017488-17
ST10	1	Snap Ring Installation Tool Part# 2209192-01
ST11	1	Wash Tool, 13-5/8" nom x 4-1/2" IF Box top Part# 2125914-01
ST12	1	Saver Sub, 4-1/2" IF pin x 4-1/2" IF Box Part# 2361943-01
ST13	4	VR Flush Plugs, Type with 1-1/2" Vee Tubing Thrds Part# 255290-01
ST14	2	VR Plug, 2-1/16", 1-1/2" VEE tubing thread Part# 2222164-02-01

SERVICE TOOLS CONT.

Item	Qty	Description
ST15	1	Assy, Casing Head Housing R/Tool, W/ 18.250-4TPI LH Stub Acme Box Thd Btm x Threaded Holes Top. Min Bore 13.588 Part# 2143701-84
ST16	1	Lift Plate f/Casing Head Rt w/Ext 14.75" Stub Acme LH Thd ; (2) OD O-Ring Seals. Safe Working Load 150,000 Lbf, 2,000 PSI Part# 2368935-01-01
ST17	1	Casing Hd Running Tool, 14.750"-4 TPI LH Internal Stub Acme Thd Btm x 13-3/8" API 8RND Short Thread Casing Box Thd Top, For "SSDC" Compact Casing Head, Min Bore: 12.968 Part# 2254468-03-01
ST18	1	Pump In Cap, f/13-5/8" Nom 5K MN-DS Housing, 14.750"-4 TPI LH Stub Acme Thd Btm x 2" LP Top. ***Max Working Pressure: 2000 Psi*** Part# 2394118-02-01
ST19	1	Assy, Drilling Adapter, 13-5/8 API, 10K Top x 13-5/8 10K Fastlock Sub-Assembly, Bx-160 Gasket Prep Btm, Min Bore: 13.630, **Max WP 5,000 PSI, to be Hydro Tested to 7,500 PSI**, **Make-Up Torque is 600 Ft/Lbf **, **Max Bending Moment @ WP. 220,000 FT-LBF** Part# 2403803-01-01
ST20	1	Assy, Fastlock Hub, Type 'MN-DS' 13-5/8 10K API 16A #15 Clamp Hub x 18.250-4 TPI LH Stub Acme, use w/13-5/8 API 10K Fastlock Adapter Part# 2403930-01-01

Stage 1.0 — 13-3/8" Casing

SAFETY NOTE: Always wear proper PPE (Personal Protective Equipment) such as safety shoes, safety glasses, hard hat, gloves, etc. to handle and install equipment.

⚠ CAUTION Threaded Devices should *NEVER* be routinely tightened under pressure. This includes: Flange Bolting, Pipe Plugs, Bull Plugs, Union Nuts, Tiedown/Lockscrew Glands.

⚠ CAUTION Use of Teflon tape is prohibited. Use appropriate thread compound/sealant only. TS-73; PN: 687950-38-31-26, TF-15; PN: 687950-39-31-26, Liquid O-Ring 104G or any other thread sealant approved by Cameron Engineering.

1.1. Install the MN-DS Housing and CR Landing Base

1.1.1. Run the Conductor and space out as required.

1.1.2. Final Cut the Conductor at the required elevation.

NOTE Ensure the conductor cut is level and smooth as this will determine the position and elevation of the entire Wellhead and Tree.

1.1.3. Ensure Conductor cut is smooth and level.

1.1.4. Place a 3/8" x 3/16" bevel on the OD of the conductor and remove all burrs and sharp edges and bevel the OD corner.

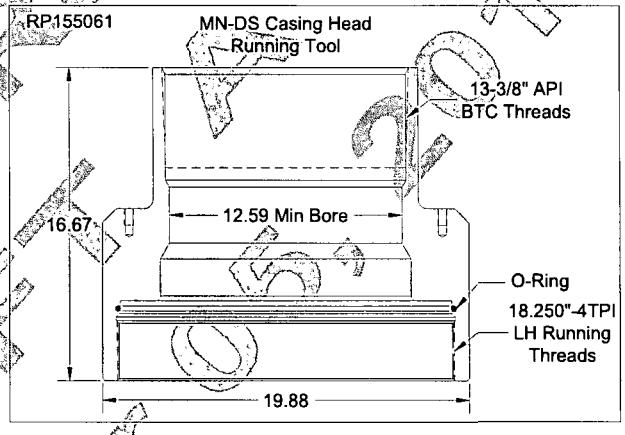
1.1.5. Run the 13-3/8" casing and space out as required. Retrieve the landing joint.

NOTE Running Tool will be bucked up to the landing joint offline and shipped to location as one assembly.

1.1.6. Examine the ***MN-DS Housing Running Tool (Item ST9).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- o-ring seal is properly installed, clean and undamaged
- landing joint is installed properly, clean and undamaged

1.1.7. Orient the Tool as illustrated.

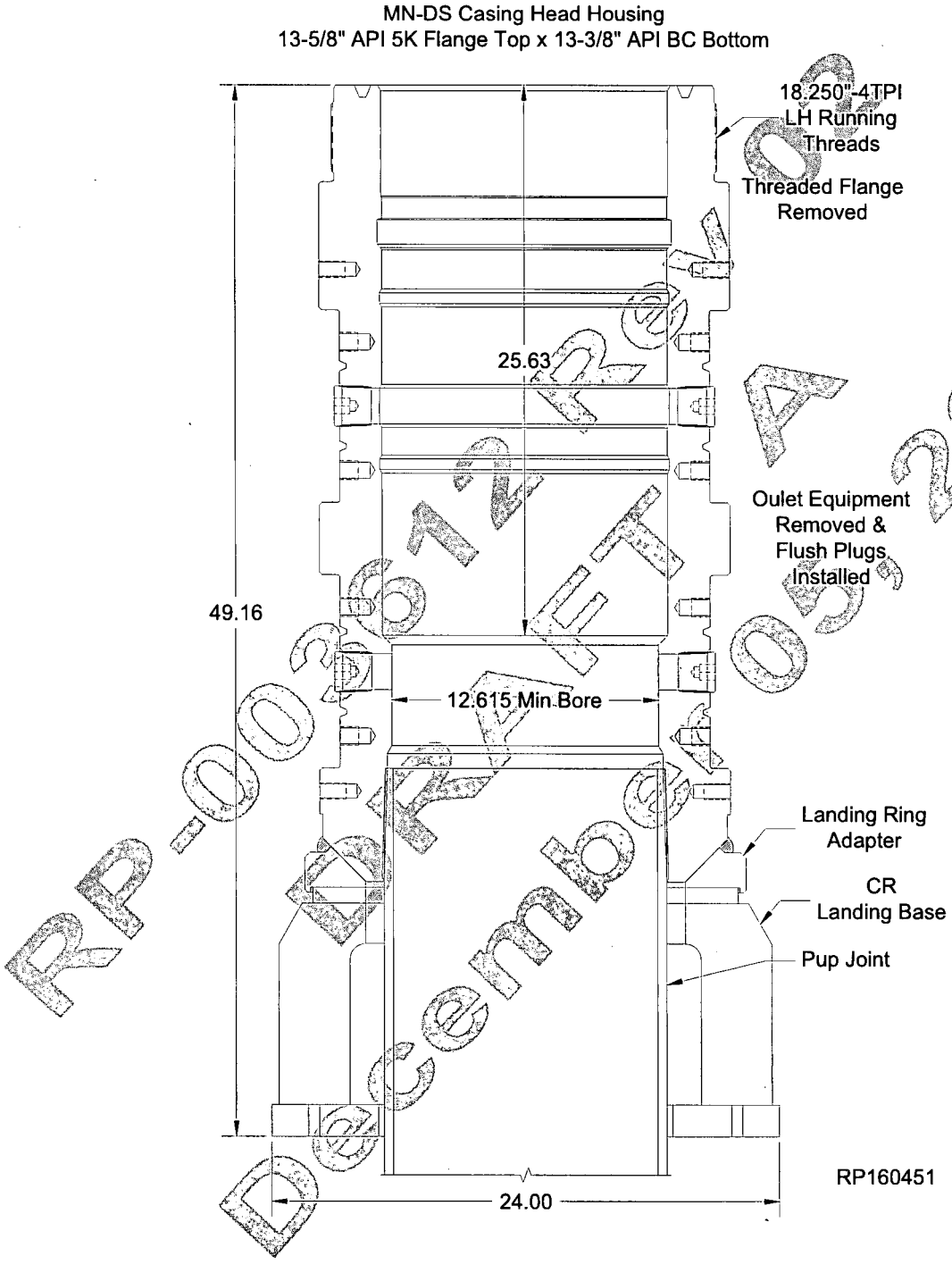


1.1.8. Examine the ***MN-DS Housing (Item A1).*** Verify the following:

- bore is clean and free of debris
- ring groove and seal areas are clean and undamaged
- all threads are clean and undamaged
- threaded flange has been removed
- pup joint is properly installed, clean, undamaged and compatible with casing run by rig
- all outlet equipment has been removed and replace with Flush Plugs
- ***Load Ring Adapter and Landing Base (Items A2 & A3)*** is properly installed, clean and undamaged

1.1.9. Orient the Housing illustrated on page 11.

Stage 1.0 — 13-3/8" Casing



1.1.10. Mark the land out of the Casing Head on the landing joint to the rig floor.

1.1.11. Wipe the o-ring and threads of the Running Tool and the running threads of the Housing with a light coat of oil or grease.

CAUTION Excessive oil or grease may prevent a positive seal from forming.

1.1.12. Lower the Running Tool onto the Housing until the running threads make contact. Turn the Tool first to the right until thread 'jump' is felt. Then make up the connection with left hand rotation to a positive stop. Approximately 14 turns.

1.1.13. Carefully lower the Housing until the mating threads of the 13-3/8" Casing and the pin threads of the pup joint make contact and rotate the outlets as required. Make up to the thread manufacturer's recommended optimum torque per rig procedure.

CAUTION Ensure Running Tool connection to Casing Head is not backed off during make up of the pup joint to the casing string.

CAUTION Make sure not torque is applied to Landing Joint!

CAUTION Do not use CRT or torque on Landing Joint! Torque on pup joint below Housing as running and retrieving tool has Left Hand threads.

1.1.14. Release the casing from the floor slips, and carefully lower the Casing Head Assembly and land as required.

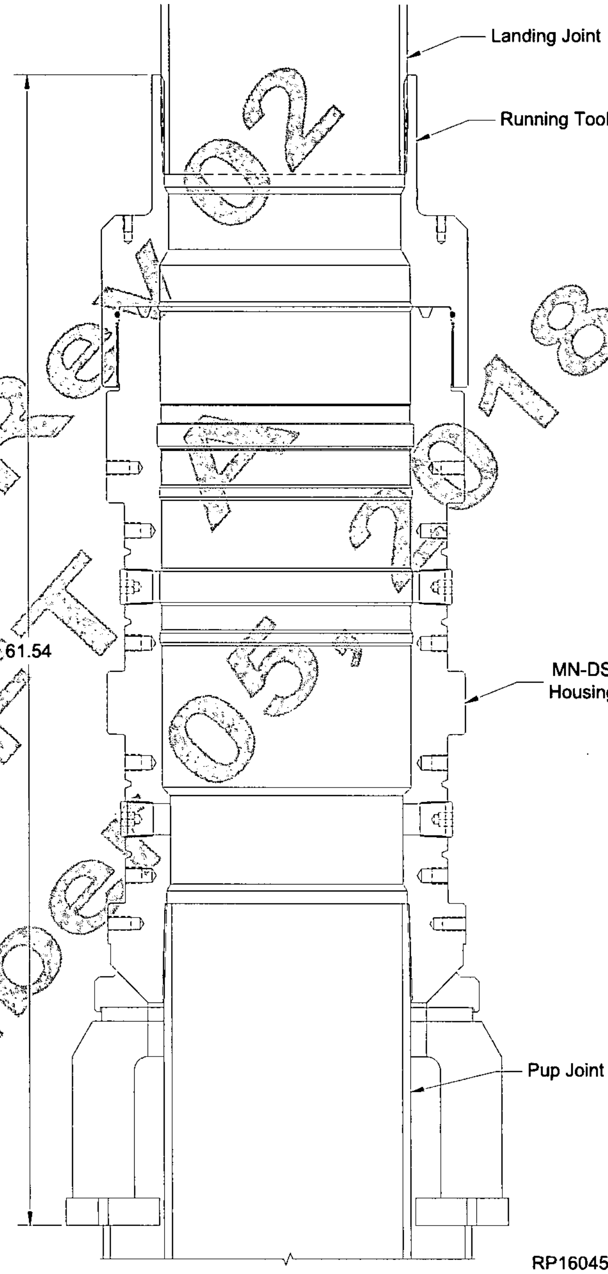
1.1.15. Confirm landing measurement as landing out with 5 ft stick system.

1.1.16. Rig should chain down landing joint during cement to prevent the Casing Head from rising during the cement operations.

NOTE Ensure landing joint remains level after it is chained down.

1.1.17. Cement as required.

NOTE Cement returns may be taken through the flow by slots of the MN-DS Housing.



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Stage 1.0 — 13-3/8" Casing

1.1.18. Rotate the landing joint to the right, approximately 14 turns or until thread 'jump' is felt, to remove the Running Tool from the Head.

1.1.19. Retrieve the Running Tool to the rig floor.

1.1.20. Clean, grease and store the Running Tool as required.

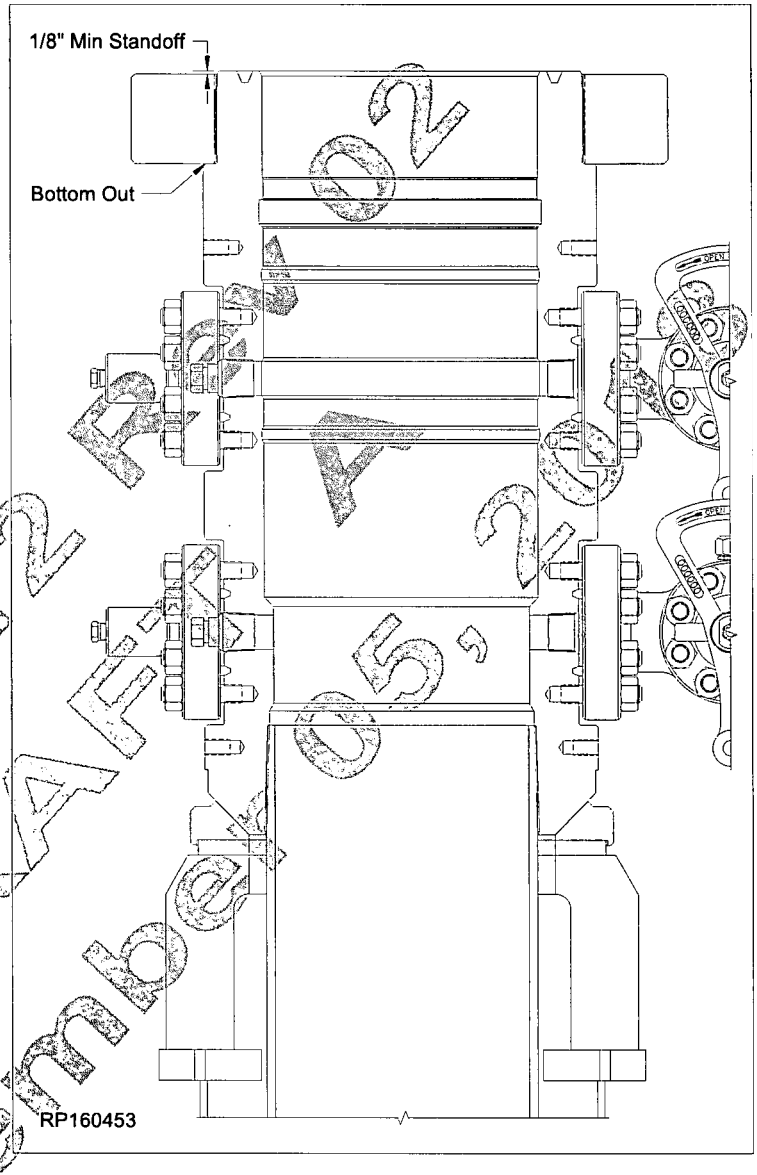
1.1.21. Remove Flush Plugs and install upper and lower Casing Head Outlet equipment.

1.1.22. Install VR plugs and test the outlet valve connections against VR plugs to ***5,000 PSI*** as required per rig procedure.

1.1.23. Remove VR Plug and close the Upper and Lower outlet Valves.

1.1.24. Install the Blind Flanges and test against VR plugs to ***5,000 PSI*** as required per rig procedure.

1.1.25. Install the Threaded flange to the top of the Casing Head Housing.



⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

1.2. Install the CR Landing Base and MN-DS Housing (Contingency)

1.2.1. Run the 20" Conductor and space out as required.

1.2.2. Run and space out the 13-3/8" casing as required.

1.2.3. Determine the correct elevation for the top of the Housing and cut the 20" Conductor at a recommended height.

NOTE Ensure the conductor cut is level and smooth as this will determine the position and elevation of the entire Wellhead and Tree.

NOTE Always measure the bottom prep of the equipment to be installed to know the correct cut off height.

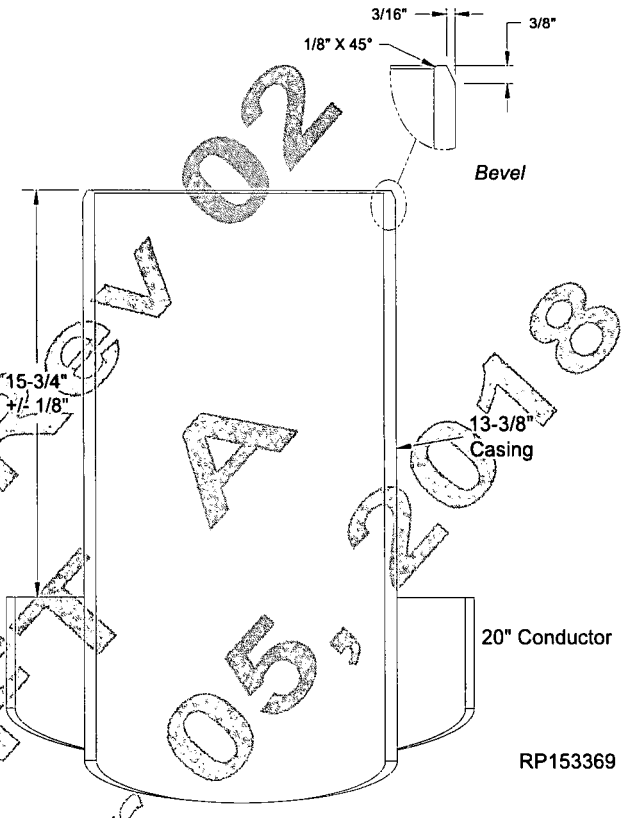
1.2.4. Final cut the 13-3/8" casing at 15-3/4" +/-1/8" above the conductor.

1.2.5. Ensure the Casing is cut smooth and level.

1.2.6. Place a 3/8" x 3/16" bevel on the OD of the casing stub and remove all burrs and sharp edges and bevel the OD corner as illustrated.

NOTE There must not be any rough edges or the seal of the MN-DS housing will be damaged.

NOTE The ID of the casing may be ground slightly to allow drill pipe and casing collars to pass smoothly.



1.2.7. Examine the ***MN-DS Housing (Item A1a)***. Verify the following:

- bore is clean and free of debris
- ring groove and seal areas are clean and undamaged
- all threads are clean and undamaged
- all peripheral equipment is intact and undamaged
- threaded flange is properly installed

1.2.8. Orient the assembly as illustrated.

1.2.9. Remove the pipe plug from test port located near the bottom of the housing.

1.2.10. Lightly oil the ID of the Housing and O-ring.

CAUTION Excessive oil may prevent a positive seal from forming.

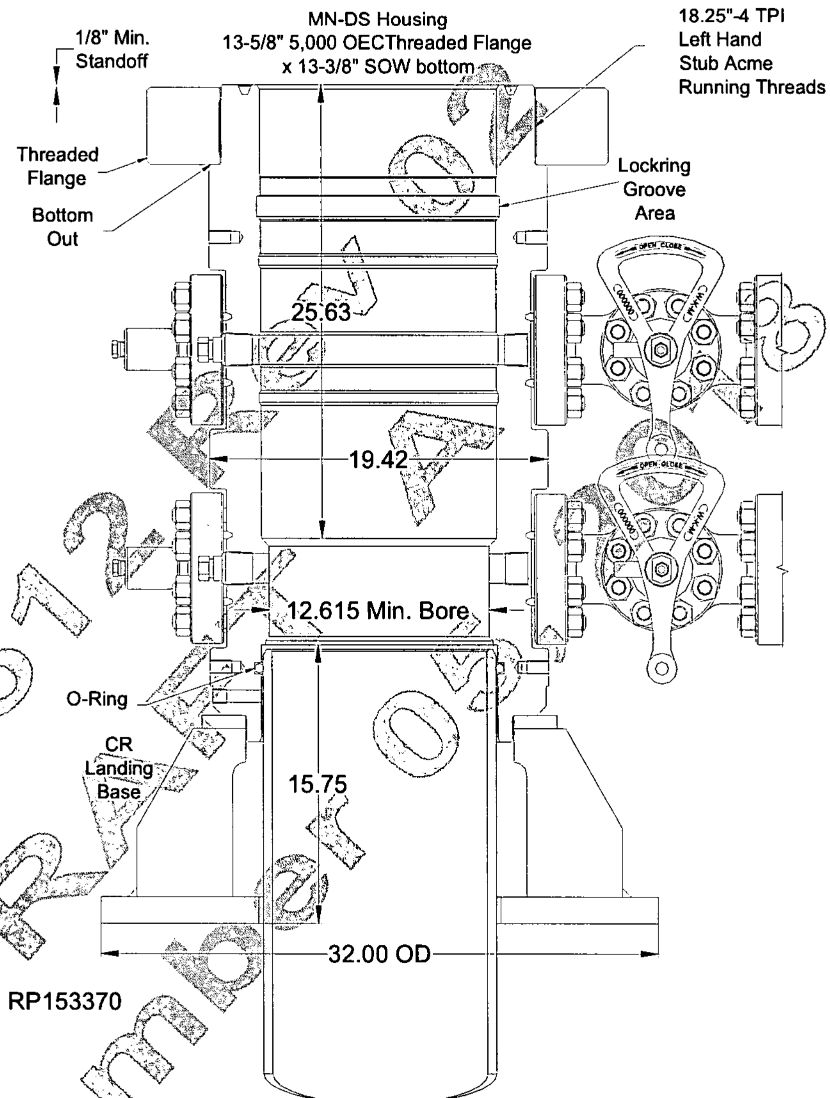
1.2.11. Align and level the Housing Assembly above the casing stub orienting the outlets to be compatible with the drilling equipment.

1.2.12. Slowly and carefully lower the assembly onto the casing stub and land as required.

CAUTION Be Careful not to damage the O-Ring or sealing ability will be impaired.

1.2.13. Level the Casing Head, weld it to the 13-3/8" Casing.

1.2.14. Test the weld using Nitrogen as per customer requirements.



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CAUTION If applying heat greater then 400°F (with such device as strip heater or Hot Hed), remove o-ring in Casing Head prior to preheat. Inside weld may be used instead of o-ring for testing the outside weld.

NOTE The weld should be a fillet-type with welds no less then the wall of the casing. Weld legs of 1/2" to 5/8" are adequate for most jobs.

NOTE Refer to the Recommended Procedure for Field Welding Pipe to Wellhead Parts for Pressure Seal found in the back of this manual for details of welding and testing procedures.

1.3. Install the Fastlock Hub

1.3.1. Remove the Threaded Flange from the top of the Housing.

1.3.2. Examine the ***Fastlock Hub (Items ST20)***. Make sure:

- bore is clean and free of debris
- all threads are clean and undamaged
- set screws (2) are retracted from the bore and undamaged

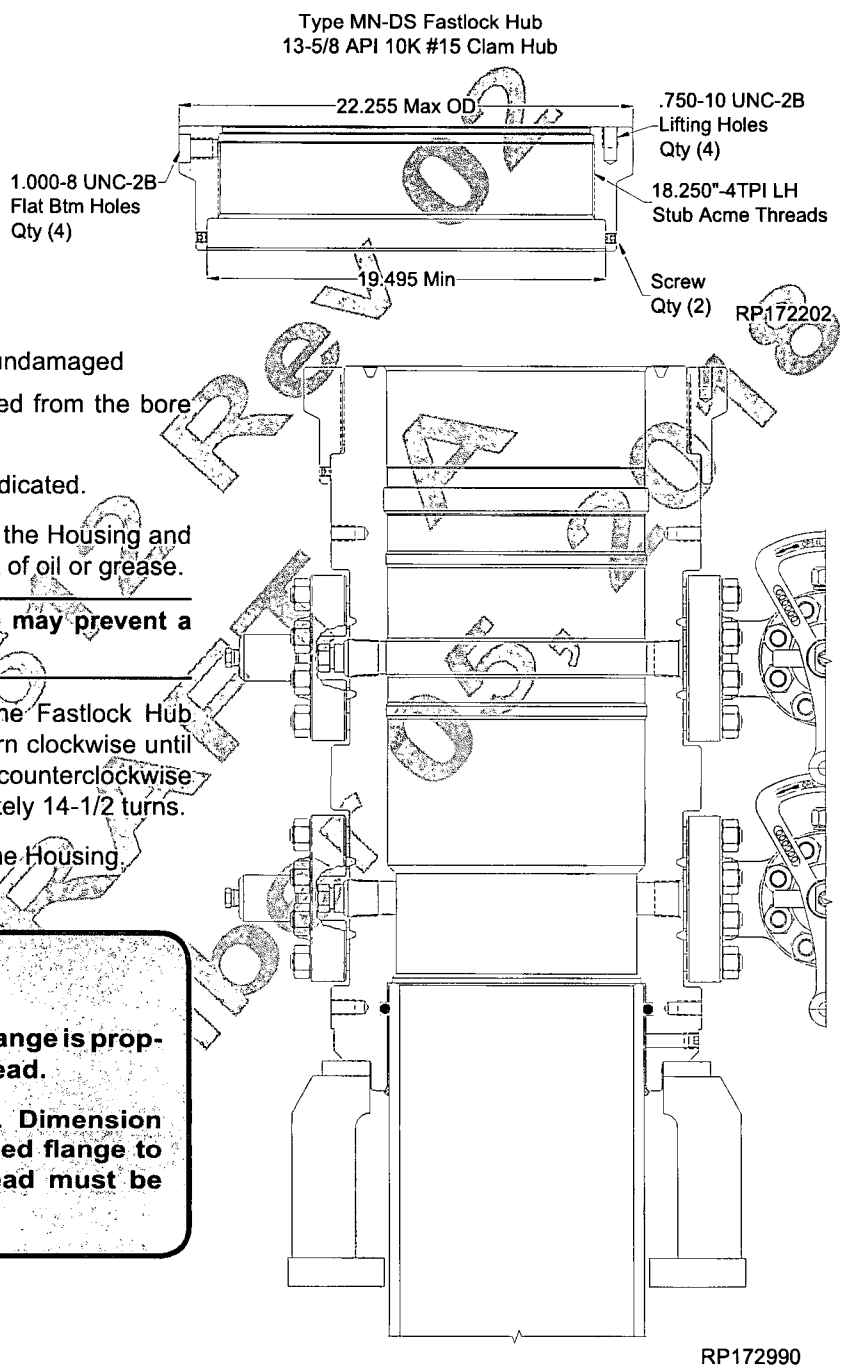
1.3.3. Orient the Fastlock Hub as indicated.

1.3.4. Lubricate the threads of both the Housing and Fastlock Hub with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

1.3.5. Carefully lower and install the Fastlock Hub to the top of the Housing. Turn clockwise until thread 'jump' is felt and then counterclockwise to a positive stop. Approximately 14-1/2 turns.

1.3.6. Run in both set screws into the Housing.



⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the Casing Head must be .15" ± .03".**

1.4. Install the Drilling Adapter

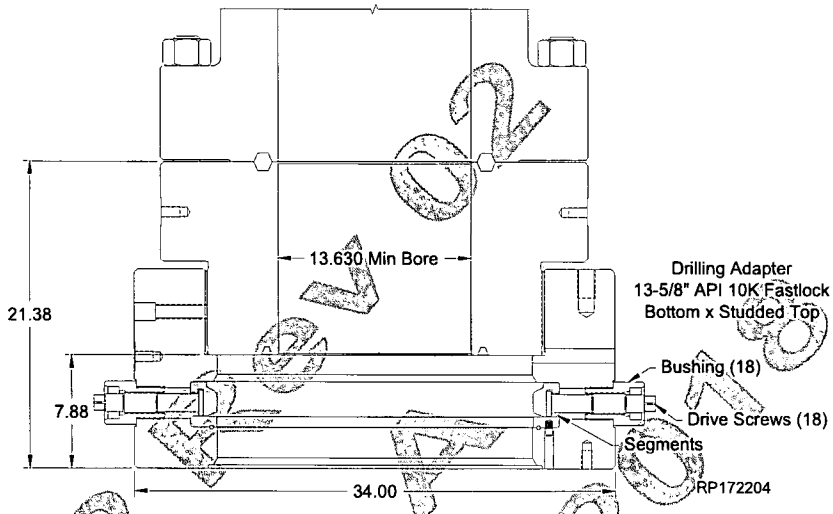
1.4.1. Examine the ***Drilling Adapter (Items ST3)/ BOP Stack Assembly.*** Make sure:

- bore is clean and free of debris
- all drivescrews are fully retracted
- seal areas are clean and undamaged

1.4.2. Orient the Drilling Adapter as indicated.

1.4.3. Clean the mating ring grooves of the Housing and Drilling Adapter. Lubricate each groove with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.



1.4.4. Install a spare ***BX-160 Ring Gasket (Item B9)*** into the ring groove of the Housing.

1.4.5. Lift and suspend the Drilling Adapter over the Housing, ensuring it is level.

1.4.6. Lower the Drilling Adapter onto the Fastlock Hub and make sure it has landed properly. A make-up mark provided on the Hub is the best way to get visual verification.

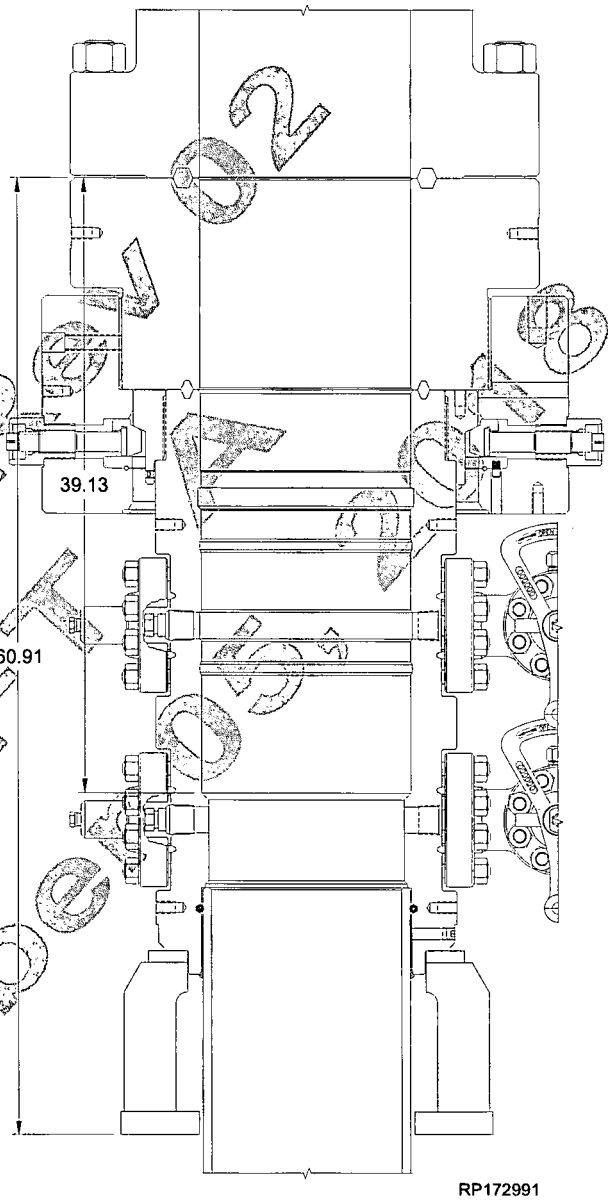
1.4.7. Run in all of the drive screws by hand or with a small wrench until the segments all contact the Hub. This is to make sure that the body is initially centered on the Hub prior to make-up.

1.4.8. Using 180° alternating pattern, tighten the screws to approximately ***600 ft-lbs maximum***.

1.4.9. Using the same 180° pattern, make up the screws. Check each screw to make sure that it has the proper amount of torque.

1.4.10. When properly made up, the end of the drive screw should be flush with the end of the bushing. This is a secondary verification that the connector is properly made up.

1.4.11. Fill the area around the segments with a general purpose grease, using the grease fitting on the OD of the body. A vent fitting is located opposite the grease fitting to release any trapped air. Fill the connector with grease until all of the air is displaced and grease begins coming out the vent fitting.



2.1. Test the BOP Stack

NOTE ***Previously used BOP Test Plug must be inspected for damage due to wear.***

2.1.1. Clean and inspect the ***BX seal groove*** on the MN-DS housing. Make up the BOP stack using a spare ring gasket as required.

2.1.2. Examine the ***Test Plug (Item ST1).*** Verify the following:

- seal is in place and undamaged
- 1/2" LP pipe plug is removed
- all threads are clean and undamaged

NOTE **Ensure the 1/2" LP pipe plug is removed**

2.1.3. Orient the Tool as illustrated.

2.1.4. Make up a joint of drill pipe to the top of the Tool.

WARNING **A minimum of one joint of Drill Pipe is required on the bottom of the BOP Test Plug to ensure BOP Test plug remains centralized.**

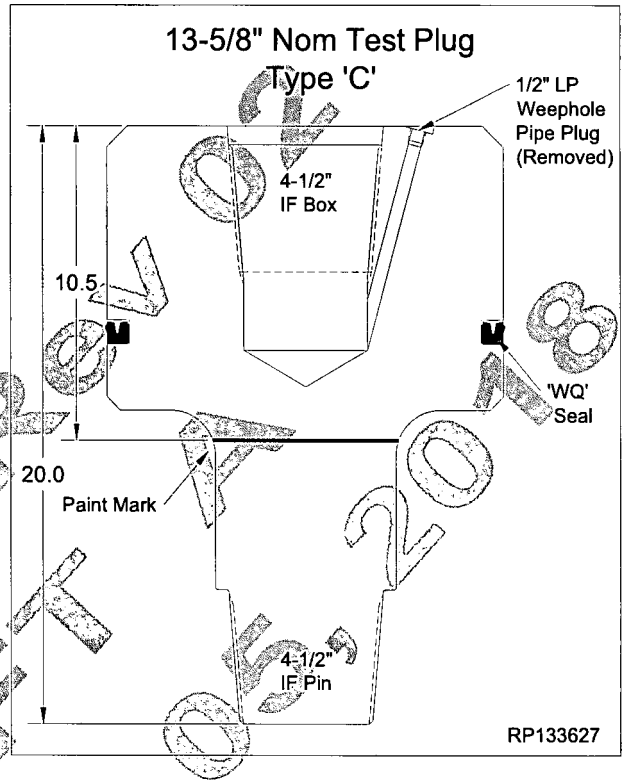
2.1.5. Place a paint mark around the Test Plug for landing verification.

NOTE **When the Test Plug is properly landed, paint mark will be visible in the center of the lowermost annulus valve of the Housing.**

2.1.6. Wipe the seal of the Tool with a coat of light oil.

CAUTION **Excessive oil may prevent a positive seal from forming.**

2.1.7. Open the lowermost annulus valve of the Housing, and drain fluid to land the Test Plug. Leave valve open.



2.1.8. Slowly lower the tool through the BOP stack until it lands on the load shoulder in the housing. Measure and record.

NOTE Distance from the Housing load shoulder to the face of the BOP Flange is 39.13"

2.1.9. Close the BOP rams on the drill pipe and test to ***5,000 psi maximum.***

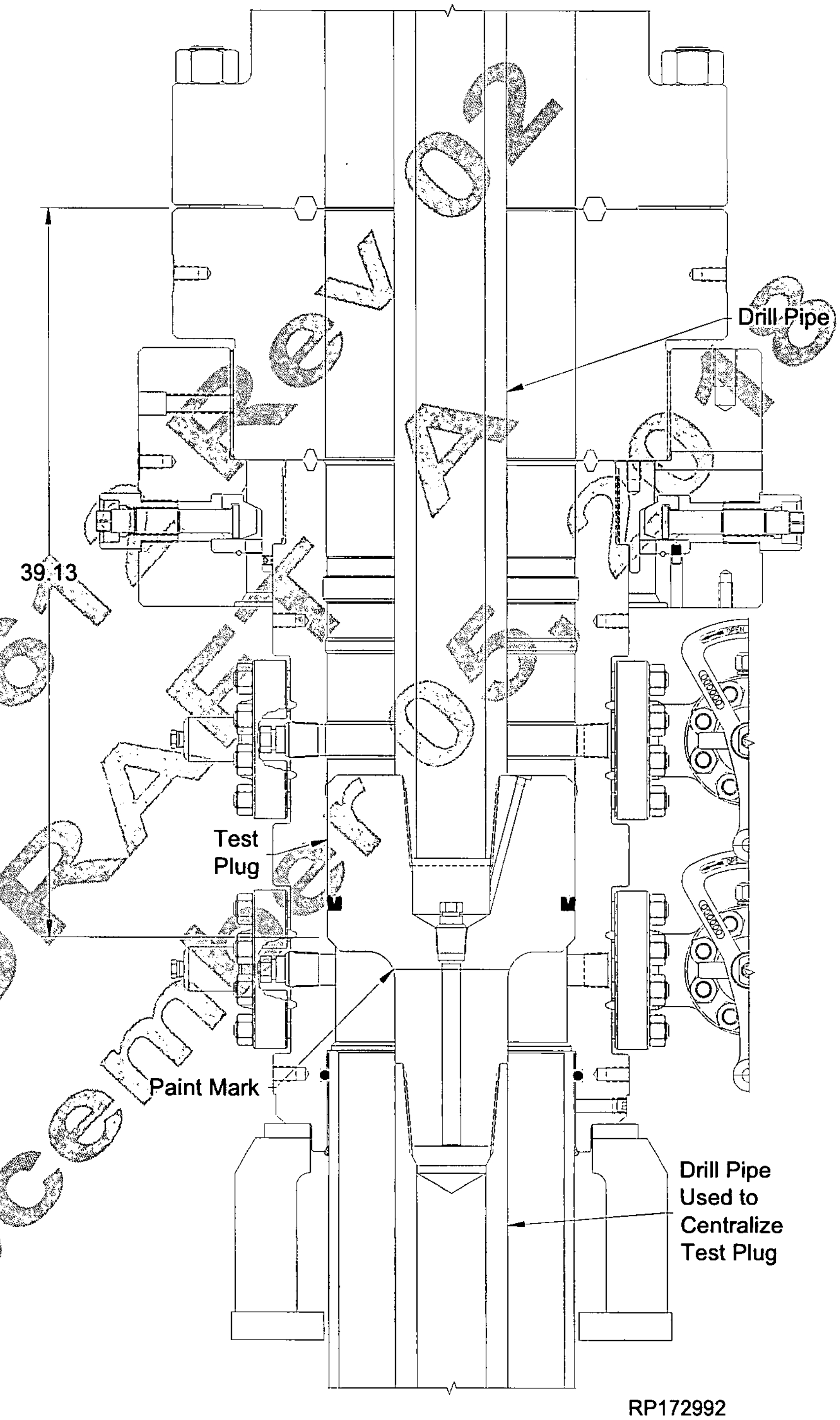
2.1.10. Monitor the annulus valve for signs of pressure.

2.1.11. After a satisfactory test is achieved, release pressure, close the annulus valve and open the rams.

2.1.12. Open upper casing valve and remove as much fluid from the BOP as possible.

2.1.13. Retrieve the Test Plug slowly to avoid damage to the seal.

NOTE It may be necessary to open the upper annulus valve when starting to retrieve the Test Plug to relieve any vacuum that may occur. Leaving annulus valve open during testing insures safety of surface casing.



Stage 2.0 — 9-5/8" Casing

NOTE Always use a Wear Bushing while drilling to protect the load shoulder from damage by the drill bit or rotating drill pipe. The Wear Bushing must be retrieved prior to running the casing.

2.2. Run the Wear Bushing Before Drilling

2.2.1. Examine the ***Running Tool (Item ST2).*** Verify the following:

- all threads are clean and undamaged
- pup joint is properly installed for tonging

2.2.2. Orient the Tool with the Lead Threads down.

2.2.3. Examine the ***Wear Bushing (Item ST3).*** Verify the following:

- bore is clean and free of debris
- threads are clean and free of debris
- o-ring seals are in place, clean and undamaged

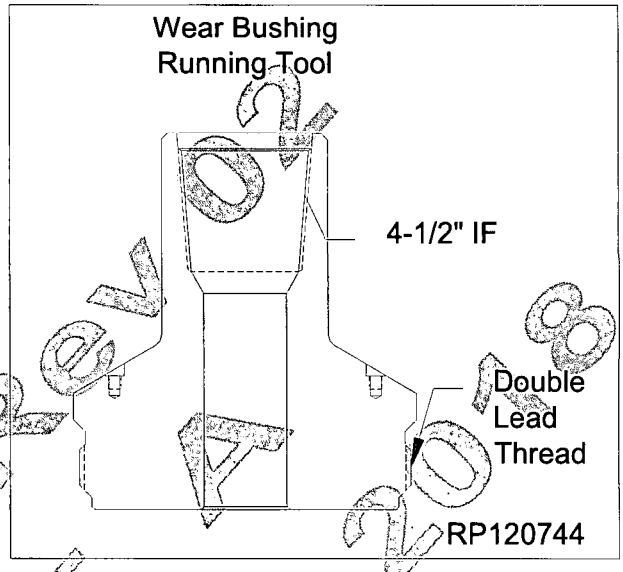
2.2.4. Orient the Wear Bushing as illustrated.

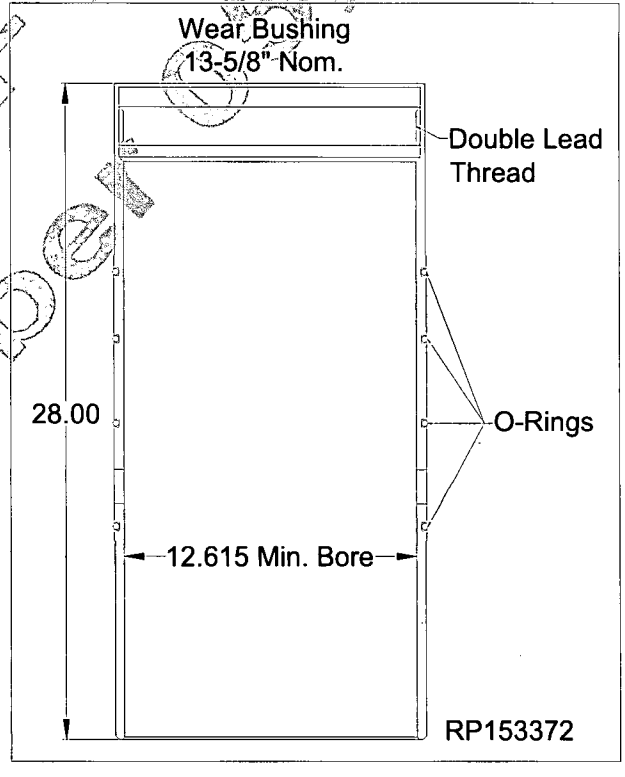
2.2.5. Wipe the o-ring seals of the wear bushing with a light oil or grease.

2.2.6. Make up a joint of drill pipe to the top of the Tool.

NOTE Do Not Cut O-rings

⚠ CAUTION This Wear Bushing has no mechanical retention device. Care must be exercised when tripping out the hole to avoid dislodging the Wear Bushing which could compromise safety if it become lodged in the BOP.





2.2.7. Lower the Tool into the Wear Bushing and rotate the drill pipe counter clockwise until thread jump can be felt, then clockwise to a positive stop to thread the Tool into the Wear Bushing.

WARNING DO NOT overtighten the Tool/Wear Bushing connection.

2.2.8. Carefully lower the Tool/ Wear Bushing Assembly through the BOP stack. Measure depth while lowering the assembly into the wellhead. Measure and record.

2.2.9. Land the tool/wear bushing on the load shoulder in the Housing and mark drill pipe joint.

2.2.10. Compare and confirm dimension against BOP stack drilling adapter and wellhead housing.

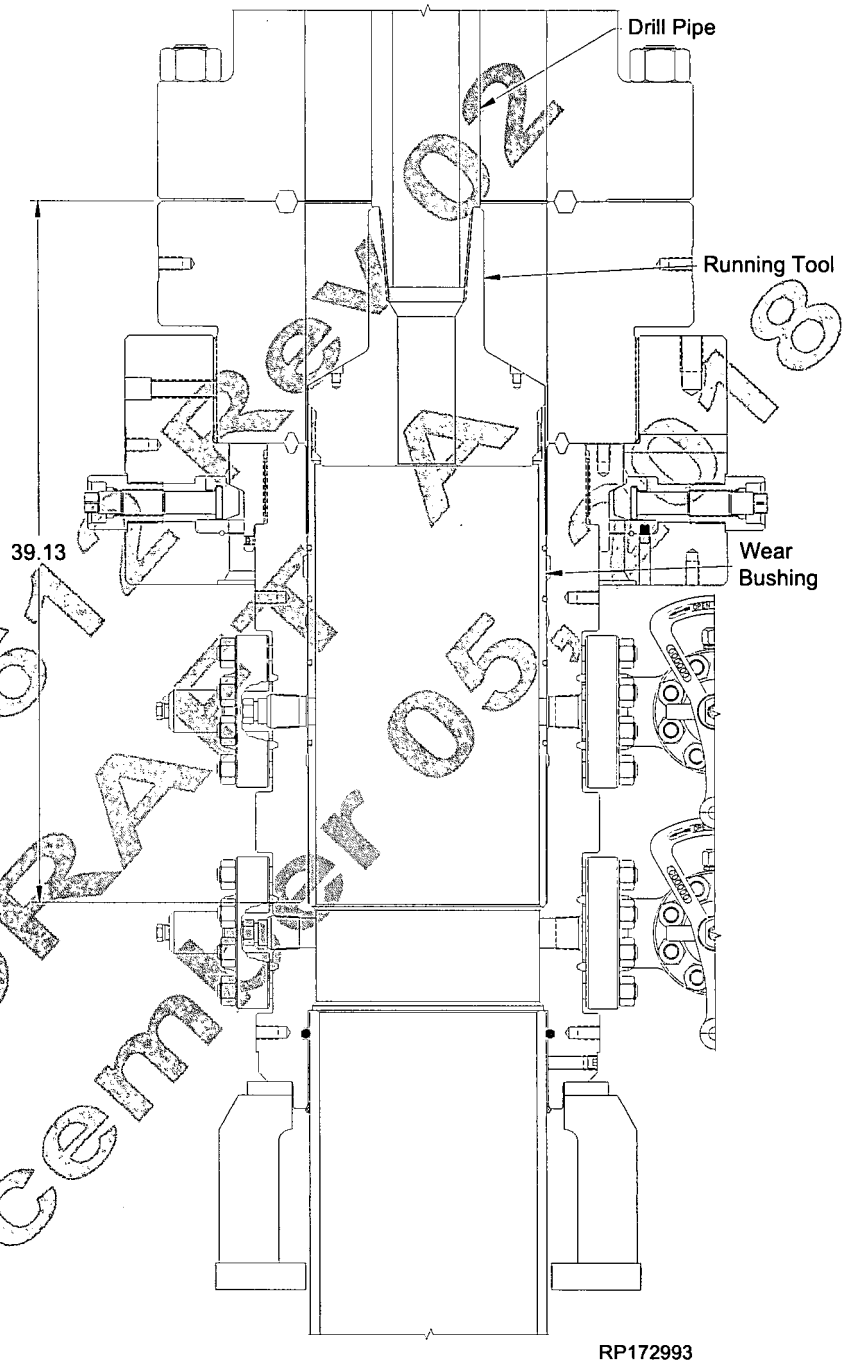
NOTE Distance from the Housing load shoulder to the face of the BOP Flange is 25.63"

2.2.11. Disengage the Tool from the Wear Bushing by rotating the drill pipe counterclockwise and lifting straight up.

2.2.12. Remove the Tool from the drill string.

2.2.13. Clean, grease, and store the Tool as required.

2.2.14. Drill as required.



2.4. Retrieve the Wear Bushing After Drilling

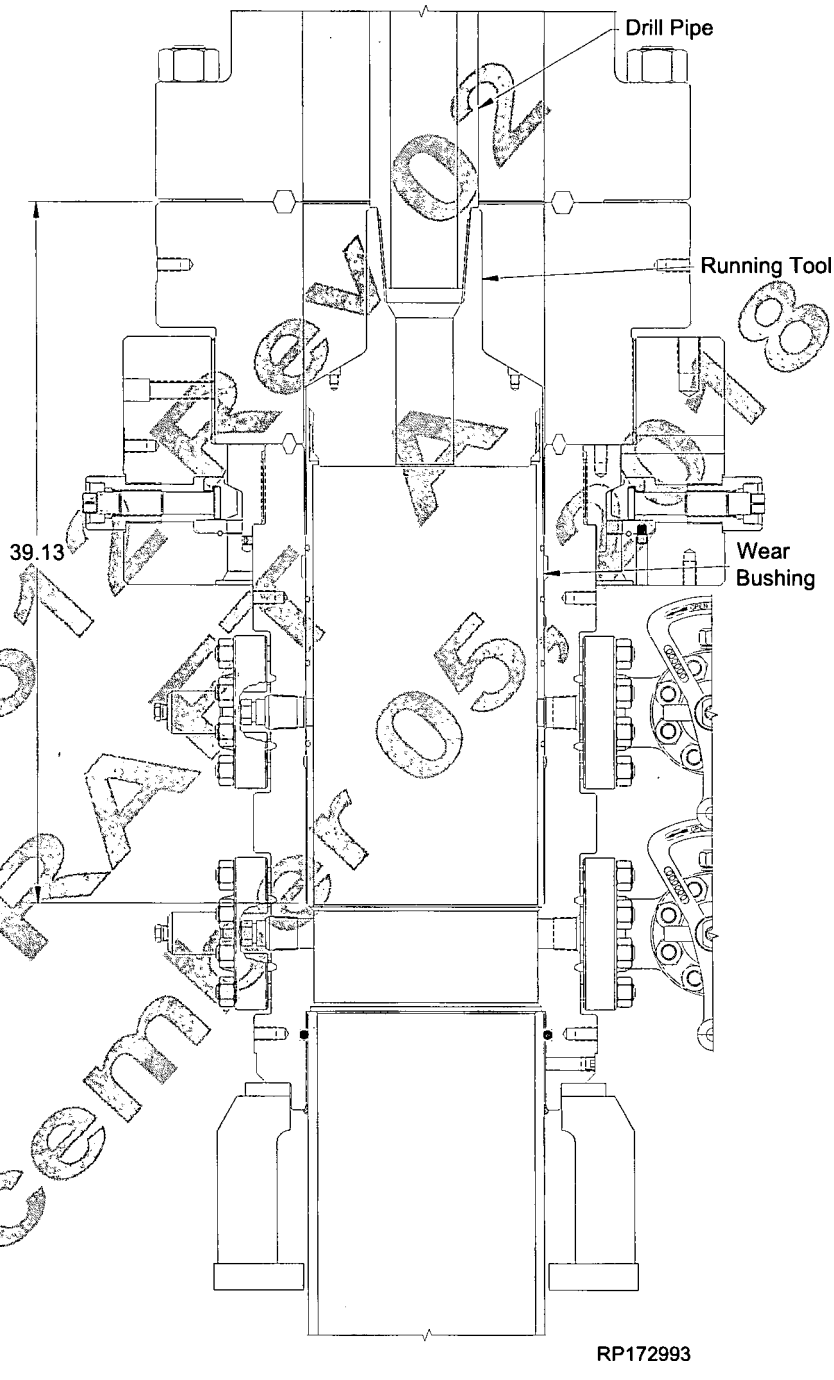
2.4.1. Make up the Tool to the drill pipe with the threads down.

2.4.2. Slowly lower the Tool into the Wear Bushing. Confirm dimension.

2.4.3. Rotate the Tool counter clockwise until thread jump can be felt. Slack off all weight to make sure tool is down. Then rotate clockwise to a positive stop.

2.4.4. Slowly retrieve the Wear Bushing to the rig floor and remove it and the Tool from the drill string.

2.4.5. Clean, grease and store the Tool and Wear Bushing.

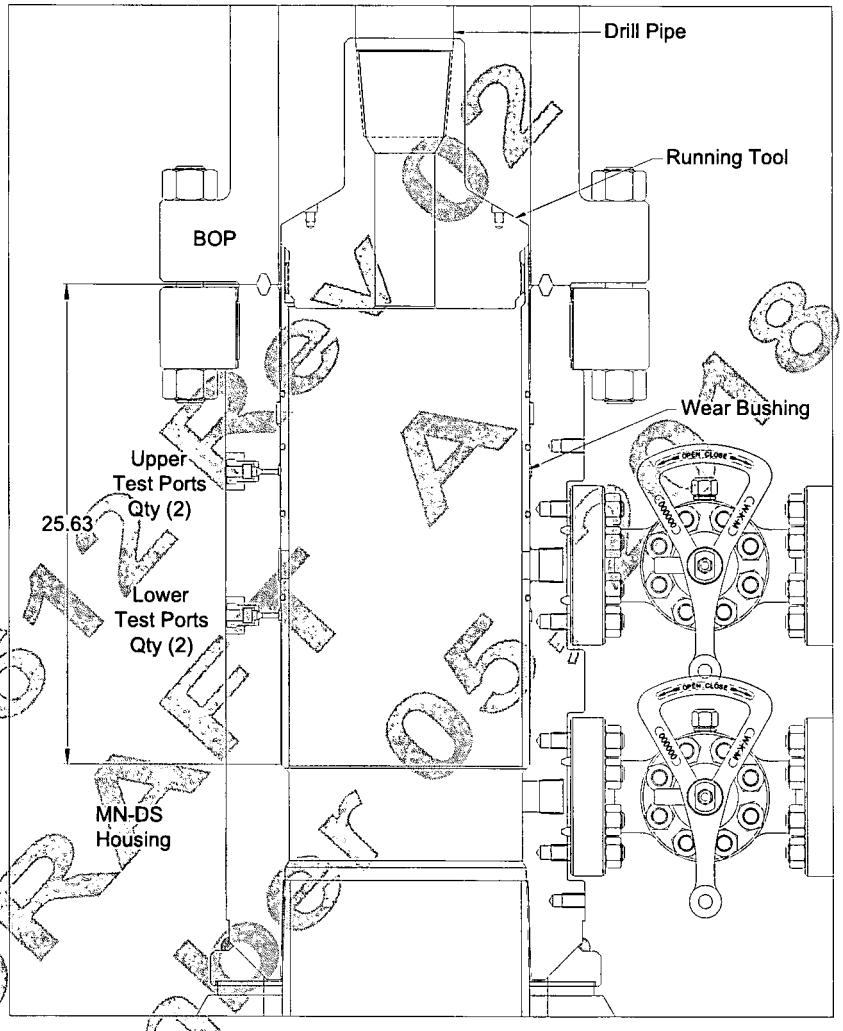


2.5. Contingency to retrieve a wear bushing that has become stuck due to debris

2.5.1. If the wear bushing becomes stuck due to debris, follow the steps below:

- Pump grease or hydraulic oil into test ports on the MN-DS housing to remove debris
- Pump fresh water through the upper most 2" 5K outlet valves for 15 minutes to wash out around the wear bushing

NOTE Communicate with company representative on desired overpull. Pull over in 10,000 lb increments(to maximum allowed, per engineering specification and tool ratings.)



Landing of Mandrel Hangers

Cameron service personnel must verify that the mandrel hanger is landed properly on the load shoulder in the wellhead. This can be accomplished by one of two methods.

- Calculate the distance from the rig floor to the landing shoulder and confirm that the hanger has traveled the required distance.
- Or the preferred method: Prior to running the casing or tubing, conduct a dry (dummy) run using the air hoist (recommended) and mark the dedicated landing joint.

2.6. Hang Off the Casing

2.6.1. Run the 9-5/8" casing and space out appropriately.

2.6.2. Hang off the last joint of casing to be run in the floor slips at height that will enable easy handling and make up of the hanger and landing joint.

NOTE Steps 2.5.3 - 2.5.12 will be conducted offline in the shop and ship to location as one assembly.

2.6.3. Examine the ***Casing Hanger Running Tool (Item ST4)***. Verify the following:

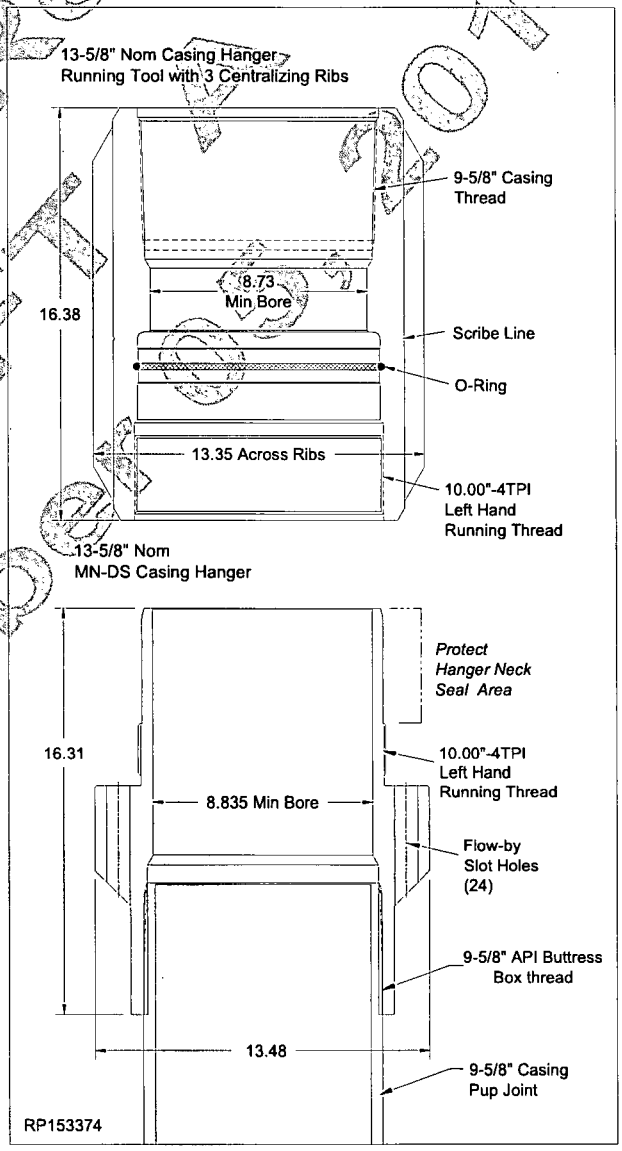
- bore is clean and free of debris
- all threads are clean and undamaged
- internal seal is properly installed, clean and undamaged

2.6.4. Orient the Running Tool with the stub acme running threads down.

2.6.5. Examine the ***Casing Hanger (Item A15)***. Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- neck seal area is clean and undamaged
- casing pup joint is properly installed

2.6.6. Orient the Hanger with the casing threads down.



2.6.7. Make up a landing Joint to the top of the Running Tool.

2.6.8. Wipe the running threads of both the Tool and the Hanger and the seal of the Tool with a light oil or grease.

NOTE Excessive oil or grease may prevent a positive seal from forming.

2.6.9. Lift and suspend the Tool over the Hanger.

2.6.10. Lower the Tool onto the Hanger until the mating threads make contact.

2.6.11. While balancing the weight, rotate the Tool to the right until the thread 'jump' can be felt then to the left to a positive stop. Approximately 8 turns.

WARNING DO NOT Torque the connection.

2.6.12. Back the tool off 1/4 a turn to the right to keep the threads from binding up.

2.6.13. Lift the Hanger above the casing hung off in the floor.

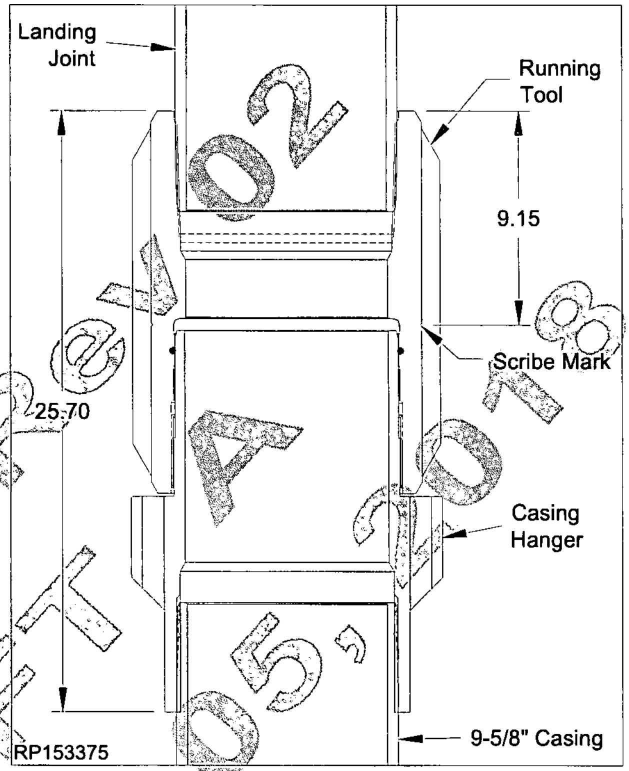
2.6.14. Lower the hanger assembly until the mating threads of the 9-5/8 casing and the pin threads of the pup joint make contact.

NOTE When making up the Hanger to the casing do not use the seal neck area for back up.

WARNING Do not use CRT or torque on Landing Joint! Torque on pup joint below the hanger as running and retrieving tool has Left Hand threads.

2.6.15. While balancing the weight, rotate the assembly to the left until the thread 'jump' can be felt then to the right to the thread manufacturer's recommended optimum torque.

2.6.16. Paint the scribe mark on the running tool all the way around the tool for landing verification.



2.6.17. Open the lowermost valve to drain Housing fully.

a) Ensure the well is stable and no pressure buildup or mud flow is occurring.

b) on lowermost valve companion flange, open bleeder fitting on bull plug.

c) Remove the Bull Plug from companion flange on end of valve.

d) open lowermost valve allowing BOP to drain.

e) Reinstall companion flange with bull plug to end of lowermost valve.

NOTE Verify BOP's are free of debris before landing hanger.

2.6.18. Calculate, measure and record the distance to land the hanger, from the 45 of the hanger to the rig floor or 39.13" below the face of the flange on the BOP Adapter.

2.6.19. Release the casing from the floor slips and lower it into the well, tallying the casing as it is lowered, until the Hanger lands on the load shoulder of the Casing Head.

NOTE Distance from the Housing load shoulder to the face of the BOP Flange is 39.13"

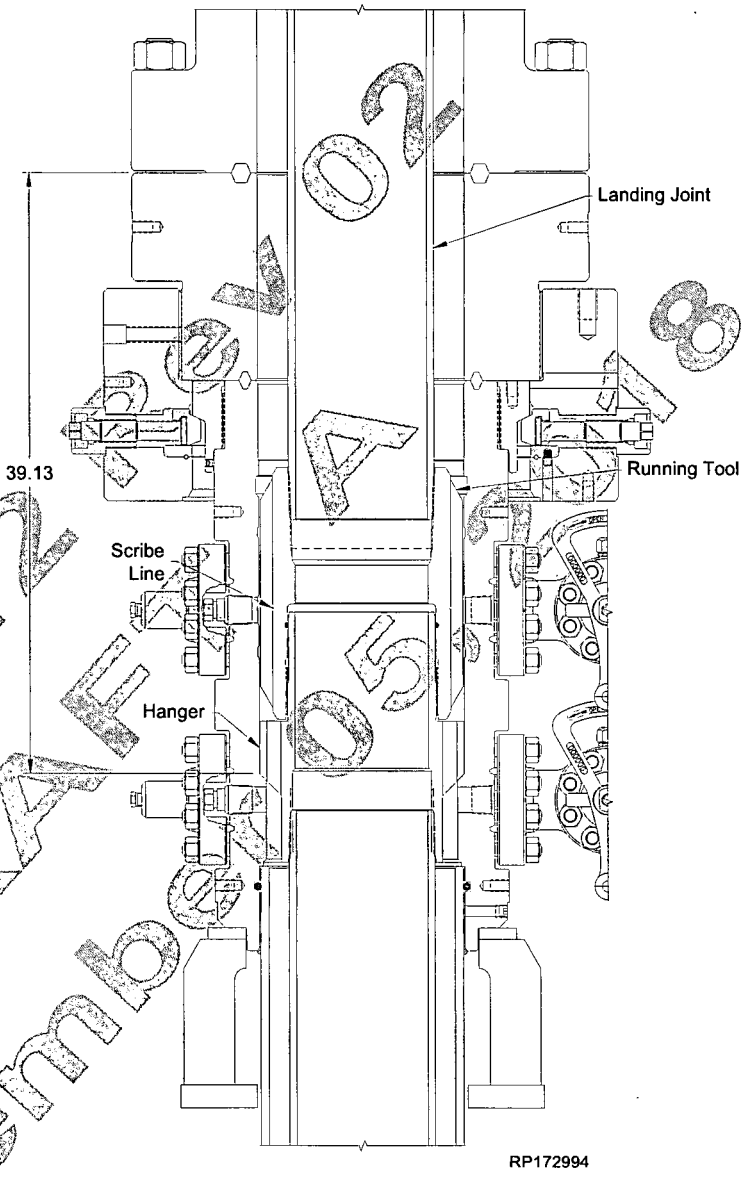
2.6.20. Ensure Mandrel hanger is centered in well bore.

2.6.21. Slack off all weight on the casing.

2.6.22. Tally dimension and ensure hanger has landed properly.

2.6.23. Verify through the open outlet on the MN-DS Housing the hanger has landed properly.

2.6.24. Check to ensure the scribed line on the running tool is in the middle of the uppermost outlet of the MN-DS Housing.



2.6.25. Close the uppermost outlet valves.

2.6.26. Cement as required.

NOTE Cement returns may be taken through the flow-by slots of the Hanger and out of the BOP Stack.

2.6.27. With cementing completed, rotate the landing joint to the right 8 full turns to release the running Tool from the Casing Hanger.

2.6.28. Retrieve the Tool to the rig floor.

2.6.29. Clean, grease and store the Tool as required.

Stage 2.0 — 9-5/8" Casing

SAFETY NOTE: Always wear proper PPE (Personal Protective Equipment) especially gloves to handle and install the slip type casing hanger.

NOTE

1. **Reconfirm the Casing OD and grade. Remove and clean loose scale from Casing OD.**
2. **Verify Slip Bowl taper is smooth, clean with no corrosion and damage free.**
3. **Disassembly of the Hanger to re-orient the slips is not required.**

2.7. Hang off the Casing (Emergency Procedure)

NOTE The following procedure should be followed ONLY if the casing should become stuck. If the Mandrel Casing Hanger was used, skip this stage.

2.7.1. Run the Casing and Cement as required.

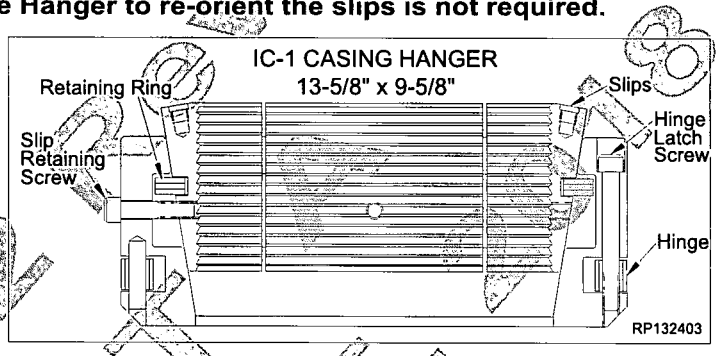
⚠ CAUTION Ensure that the casing is centralized. Hanger clearances are small and centering must be accurate.

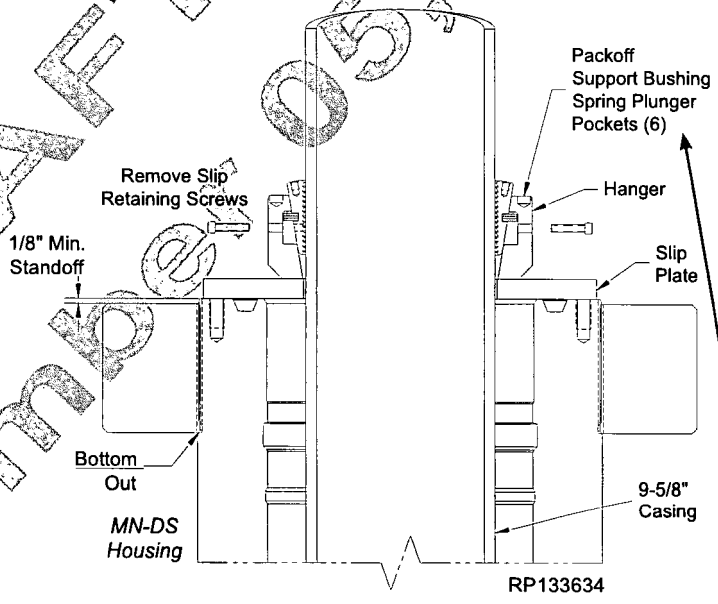
2.7.2. Ensure the well is safe and under control.

2.7.3. Drain the BOP and Housing bowl through the Housing lower side outlet. Leave the valve open until the Casing Hanger is set.

NOTE Ensure hang off weight desired is picked up before installing slips around casing.

2.7.4. Separate the BOP Stack from Housing and suspend it above the Housing high enough to facilitate installation of the Slip Casing Hanger.





2.7.5. Washout as required.

2.7.6. Examine the ***IC-1 Slip Type Casing Hanger (Item E1).*** Verify the following:

- segments are clean, undamaged and secure
- all screws are in place and snug
- verify plunger pin pockets on upper face of hanger body prior to performing any installation, if no pockets are present, do not set hanger.

2.7.7. Remove the latch screw and separate the Hanger halves.

2.7.8. Place a slip plate on the Housing flange against the casing to support the Hanger.

2.7.9. Wrap the Hanger around the casing and replace the latch screw.

Stage 2.0 — 9-5/8" Casing

2.7.10. Remove the four slip retainer screws on the OD of the slip bowl. These screws hold the slips in retracted position. Slips will **NOT** set unless these screws are removed before Hanger is placed in the Housing.

2.7.11. Grease the Casing Hanger's body.

2.7.12. Remove the slip plate and carefully lower the Hanger into the Housing bowl, using a cat-line to center the casing, if necessary. Measure and record.

⚠ CAUTION Do Not Drop the Casing Hanger!

2.7.13. Slack off the casing.

NOTE A sharp decrease on the weight indicator will signify that the Hanger has taken weight and is supporting the casing.

2.7.14. Rough cut the casing at 5-1/2" per Wach's saw procedure, above the top flange of the Housing and move the BOP and excess casing out of the way.

2.7.15. Remove and discard the used ring gasket from the Housing flange.

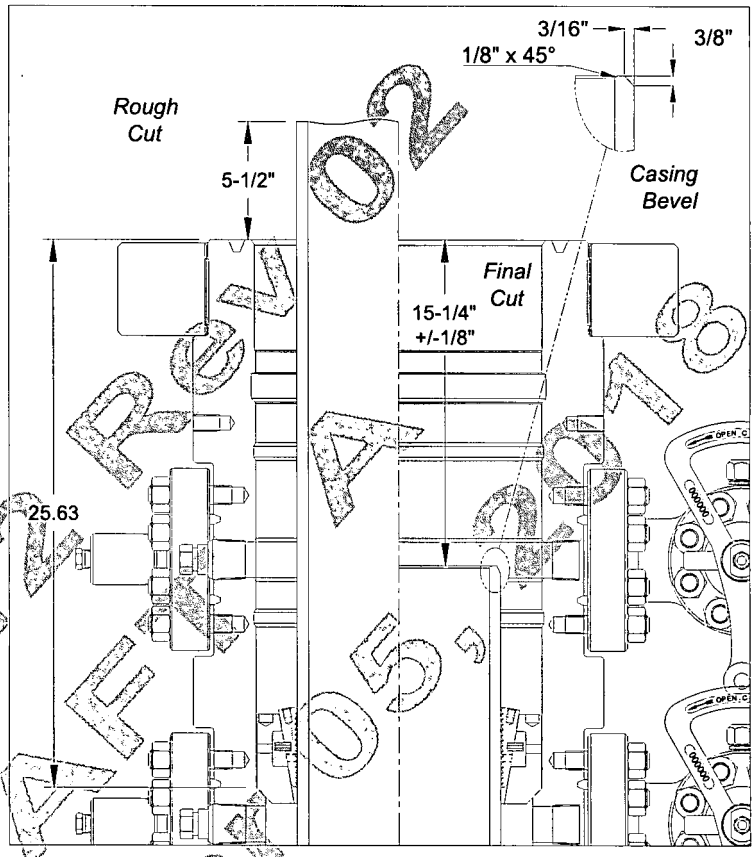
2.7.16. Using an internal cutter, final cut the casing at 15-1/4" +/-1/8" below the Housing flange.

2.7.17. Place a 3/8" x 3/16" bevel on the casing stub and remove all burrs and sharp edges.

NOTE There must not be any rough edges on the casing or the seals of the Packoff will be damaged.

2.7.18. Clean the mating ring grooves of the Housing and BOP Stack.

2.7.19. Install the new ***BX-160 Ring Gasket (Item A12)*** in the Housing ring groove.



2.7.20. Reconnect the BOP Stack to the Housing using the studs and nuts provided. Tightening the studs and nuts in an alternating cross pattern to the torque referenced in the chart in the back of this manual.

2.7.21. Leave valves open. Continue with Packoff Support Bushing Installation per Section 2.8.

⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

2.8. Washout the Spool

NOTE Do Not close the outlet valve on the lowermost Head, it will be left open while landing the Packoff Support Bushing.

2.8.1. Examine the ***Wash Tool (Item ST11).*** Verify the following:

- bore is clean and free of debris
- threads are clean and undamaged
- washports are clean and unobstructed

2.8.2. Orient the Wash Tool with the box connection up.

2.8.3. Make up a joint of drill pipe to the top of the Tool.

2.8.4. Ensure lowermost outlet valve of Housing is open.

2.8.5. Carefully lower the Tool into the well until it lands on the top of the 9-5/8" Casing Hanger. Measure and record.

2.8.6. Lift the Tool approximately 2". Mark tool joint at floor/ rotary table.

2.8.7. Supply pressure through the drill pipe. At the same time the pressure is being supplied, rotate the Tool.

NOTE The maximum pressure rating for the wash tool is 1,000 psi, and at flow rate of 75 gpm.

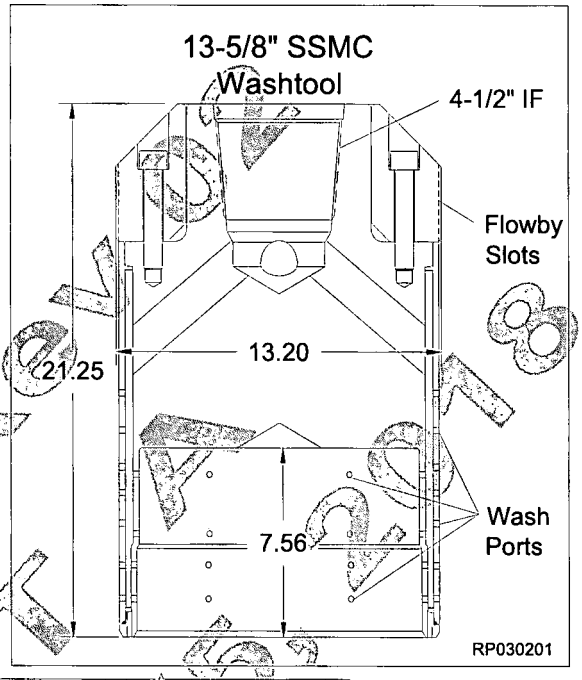
2.8.8. Monitor the outlet valve for returns.

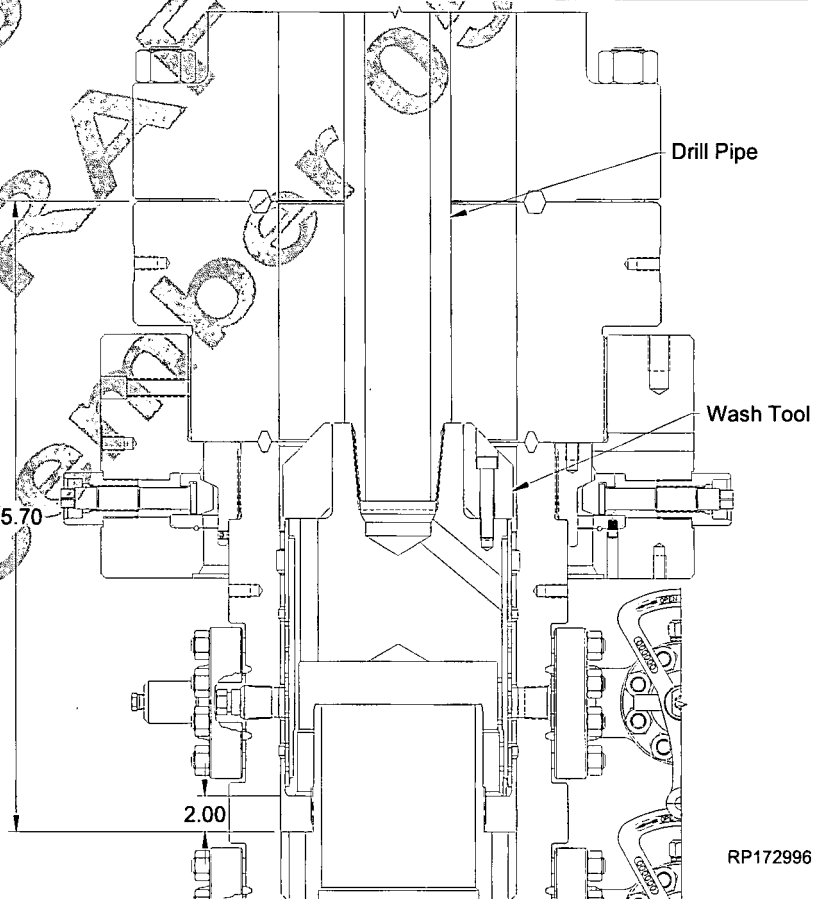
2.8.9. Once the returns are clean and free of debris, stop the rotation and the pump.

2.8.10. Retrieve the Tool to the rig floor.

2.8.11. Clean, grease and store the Wash Tool as required.

NOTE Verify visibility of hanger port and cleanliness of hanger after washing and draining.





2.9. Install the Packoff Support Bushing

2.9.1. Examine the ***Packoff Support Bushing Running Tool (Item ST5).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- required pin x pin crossover stub is properly installed

2.9.2. Orient the Running Tool with the internal running threads down.

2.9.3. Examine the ***Packoff Support Bushing (Item A16)***. Verify the following:

- bore is clean and free of debris
- all elastomer seals are in place, clean and undamaged
- all threads are clean and undamaged
- lockring is in place
- ensure spring plunger pins on the bottom of the Packoff Support Bushing are properly installed and spring loaded pins retract properly.

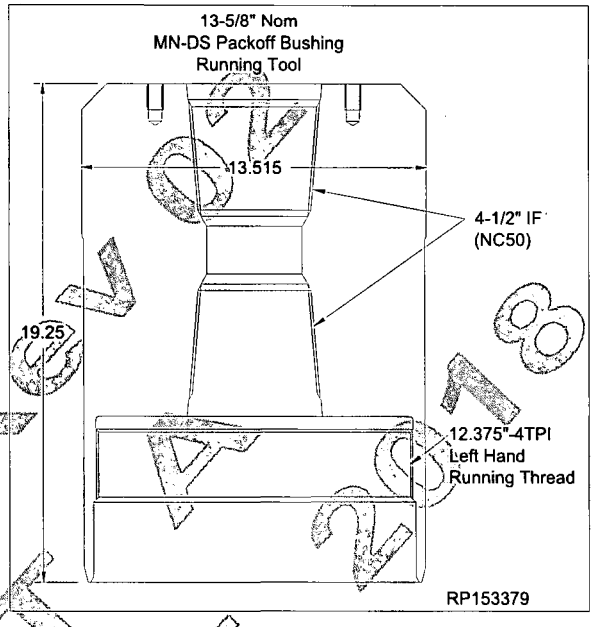
2.9.4. Orient the Seal Assembly with the external running threads up.

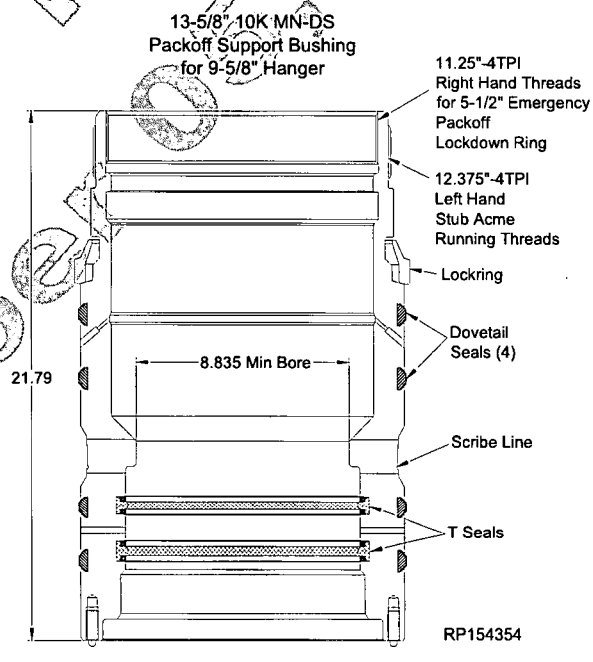
2.9.5. Lubricate the external running threads of the Packoff Support Bushing and threads of the Running Tool with a light coat of oil.

→ 2.9.6. Run drill pipe or heavy weight collars through the rotary table and hang off in the floor slips. This will be used for weight to set the Packoff Support Bushing assembly into position. If running heavy weight pipe, measure OD of all pipe and connection to make sure pipe will drift casing.

NOTE Heavy weight drill pipe or drill collars are used to aid in landing the Packoff Support Bushing. Weight required to run the Packoff Support Bushing into the Housing is approximately 10,000 lbs.

2.9.7. Make up a stand of drill pipe to the top of the Running Tool.



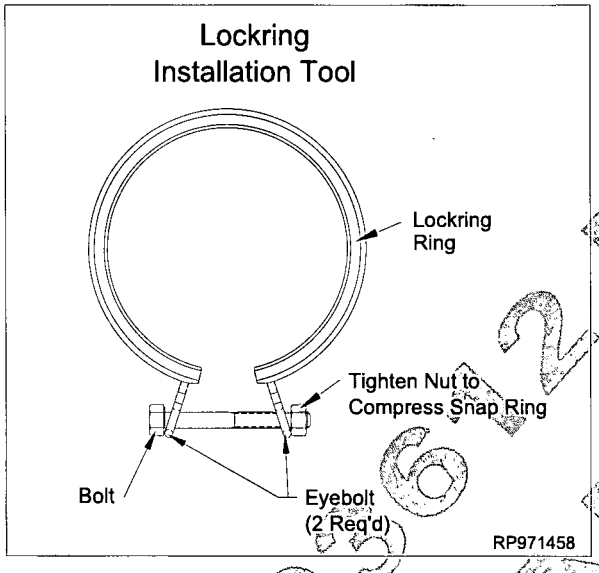


2.9.8. Install a ***Lockring Installation Tool(Item ST10)*** onto the lockring of the Support Bushing.

NOTE See APPENDIX 1 for Optional Lock ring installation tool on the back of this procedure.

2.9.9. Fully compress the lockring.

NOTE The Lockring installation tool will assist in minimizing the length of time that the lockring is compressed.



2.9.10. Carefully lower the Running Tool onto the Packoff Support Bushing Assembly until the threads make contact.

2.9.11. Make up the connection by first turning the Tool to the right to align the threads then to the left until the Tool engages the lockring.

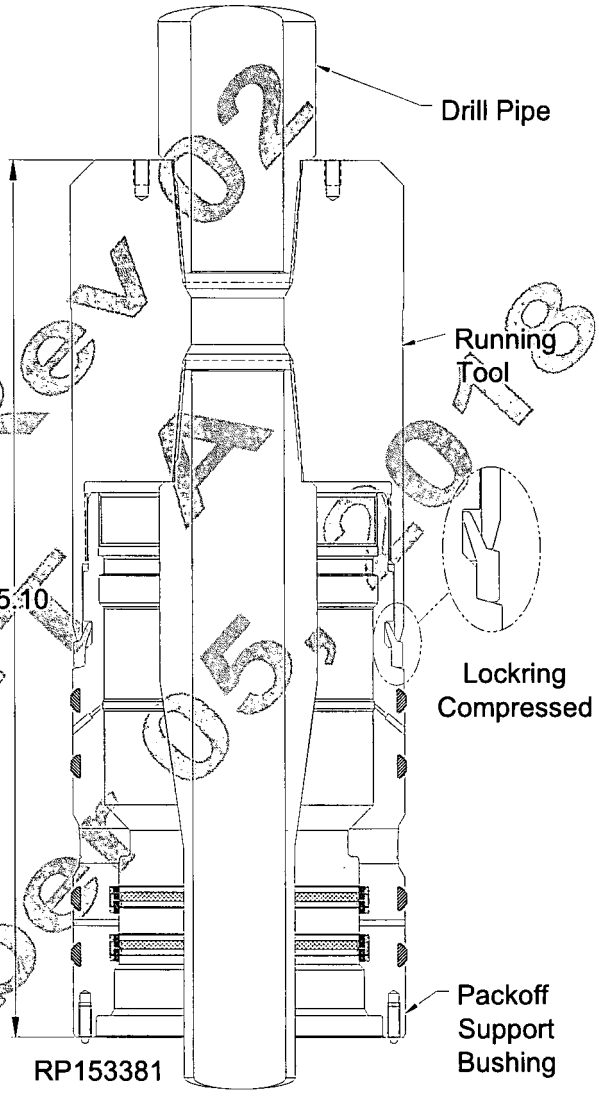
NOTE Approximate 8 turns are required for full make-up. Write down the number of turns to make up the Tool to the Packoff Support Bushing in the Field Service Report.

2.9.12. Once the lockring is engaged remove the Lockring Installation Tool.

NOTE Ensure the lockring is flush or below of the OD of the Seal Assembly.

2.9.13. Wipe the ID of the 'T' seals and the OD of the dovetail seals with a light oil.

NOTE Excessive oil or grease may prevent a positive seal from forming.



2.9.14. Lift and suspend the Assembly/Crossover stub over the drill pipe hung off in the rig floor.

2.9.15. Lower the Assembly/Crossover stub onto the threads of the drill pipe and make up the connection.

CAUTION Do not damage the internal seals of the Packoff Support Bushing assembly!

2.9.16. Open both upper and lower annulus valves on the Housing.

NOTE The upper annulus valve is to remain open during the setting of the Seal Assembly.

2.9.17. Center and lower assembly through the BOP Stack and Housing. Tallying assembly as it is lowered until the Support Bushing lands on the Casing Hanger. Mark landing joint.

2.9.18. Calculate, measure and record the distance to land the Packoff bushing. Distance will be 3.44 less than dimension calculated to land the casing hanger; or 35.70" below the face of the flange on the housing.

2.9.19. Tally dimension and ensure Support Bushing has landed on the casing hanger.

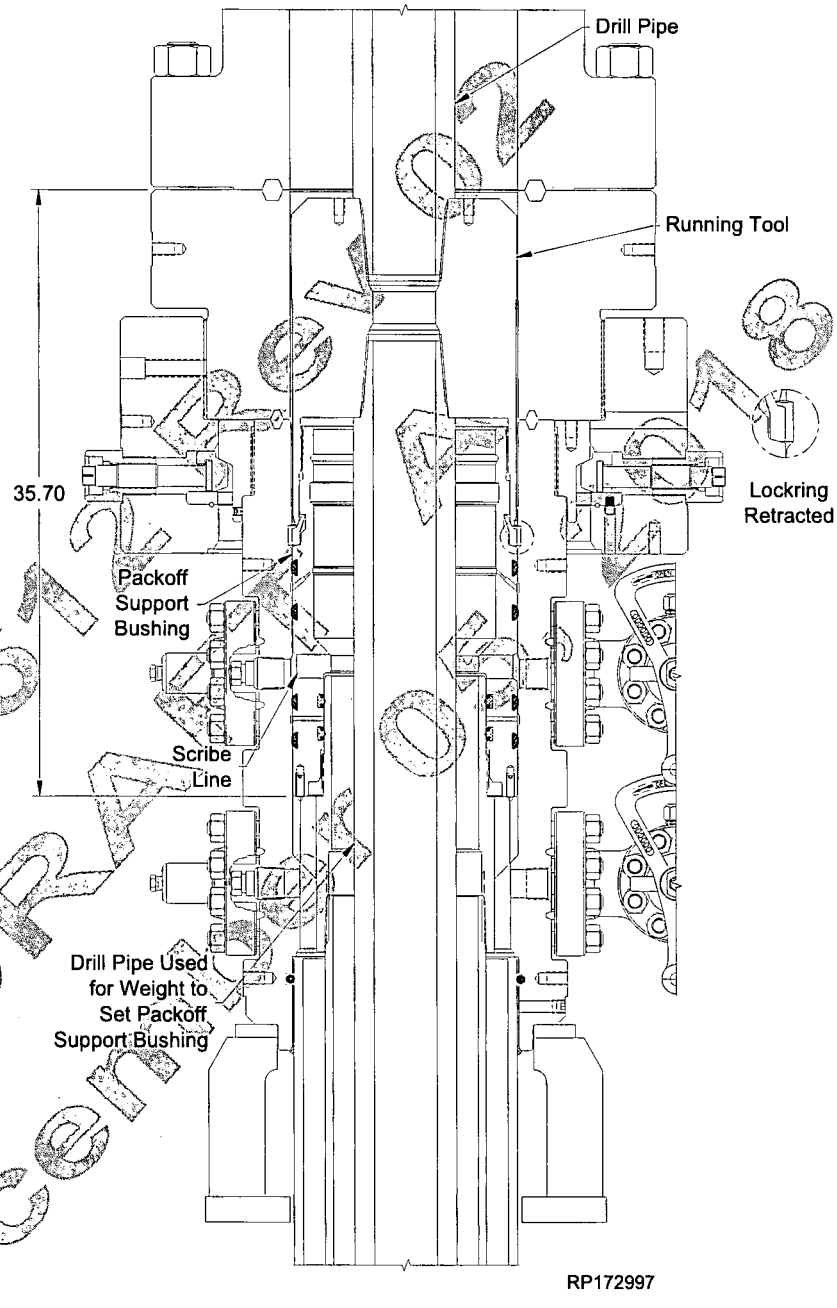
NOTE Distance from the Mandrel Casing Hanger landing shoulder to the face of the BOP Flange is 35.70".

2.9.20. Compare and confirm dimension against BOP stack drilling adapter and wellhead housing.

2.9.21. Verify the Packoff Support Bushing has landed properly through the upper annulus valve of the MN-DS Housing:

- using a flash light, verify the scribe line is visible in the center of the port

2.9.22. Turn the landing joint to the left until the (6) Spring Plunger pins engage the casing hanger mating slots. When the pins engage the hanger, STOP turning when a positive stop is felt.



⚠ CAUTION

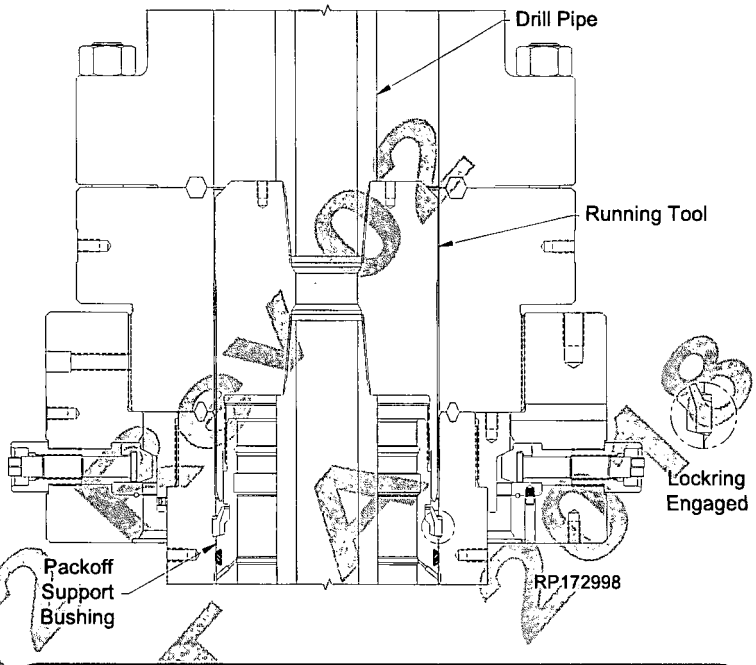
Under **NO CIRCUMSTANCES** should any pressure be applied to the Packoff Support Bushing prior to Lockring engagement into the Housing.

2.10. Set the Packoff Support Bushing Lockdown Ring

NOTE ***Confirm the Packoff Support Bushing has properly landed on Mandrel Casing Hanger by (1) confirming dimension (2) viewing through the upper open annulus valve of the Housing. The scribe line should be in the center of the outlet bore.***

2.10.1. Make a horizontal mark on the landing joint to monitor the number of turns.

2.10.2. Using chain tongs, back out the Tool 3.5 turns clockwise (right) to allow the Locking ring to expand into its mating groove in the Housing.



NOTE **Horizontal mark should raise no more than .875".**

WARNING DO NOT ATTEMPT TO BACK OUT MORE THAN 3.5 TURNS.

2.10.3. Perform an over pull 50,000 lbs over block weight to confirm the lockring has properly engaged.

2.10.4. Once a successful over pull has been achieved, slack off over pull and ensure elevators are well clear of the Drill Pipe Tool Joint.

NOTE **Verify over pull calculated data. Make sure all personnel involved during Lockdown ring setting installation is aware of over pull requirements for Packoff Support Bushing.**

⚠ CAUTION

Clear out personnel from rig floor during over pull test. Precaution must be taken for personnel verifying the over pull.

⚠ CAUTION

There should be maximum of 1/8" vertical movement during over pull. If vertical movement is greater than 1/8" verify the position of the Packoff Support Bushing by checking the location of the scribe line relative to the upper side outlets. If the scribe line has risen more than 1/8", drive the Packoff Support Bushing back down until it lands as per step 2.8.17.

NOTE If ***initial*** over pull test is unsuccessful, do not immediately collapse the lockring for a second installation attempt. Conduct the following steps prior to Support Bushing retrieval:

Ensure Packoff Support Bushing Running Tool is backed off 3.5 turns

- Re-apply the installation load (10,000 - 20,000 lbs) to force the Packoff and Lockring down into the groove of the housing.
- Re-attempt 20,000 lbs over pull test.

⚠ CAUTION

If a successful over pull test is not achieved after three installation attempts, fully retract the lockring and remove the Packoff Support Bushing. Retrieve the Packoff Support Bushing and lockring to the rig floor for trouble shooting.

NOTE **Dovetail seals must be replaced prior to reinstalling the Packoff Support Bushing.**

2.11. Test Between the 9-5/8" Packoff Lower Seals (ID &OD)

2.11.1. Locate the lowermost test port on the OD of the Housing and remove the fitting.

2.11.2. Attach a hydraulic test pump to the open test port and inject test fluid into the Packoff Support Bushing to ***5,000 psi.***

WARNING Do Not over pressurize!

NOTE If Emergency hanger was used do not exceed 80% of casing collapse.

NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

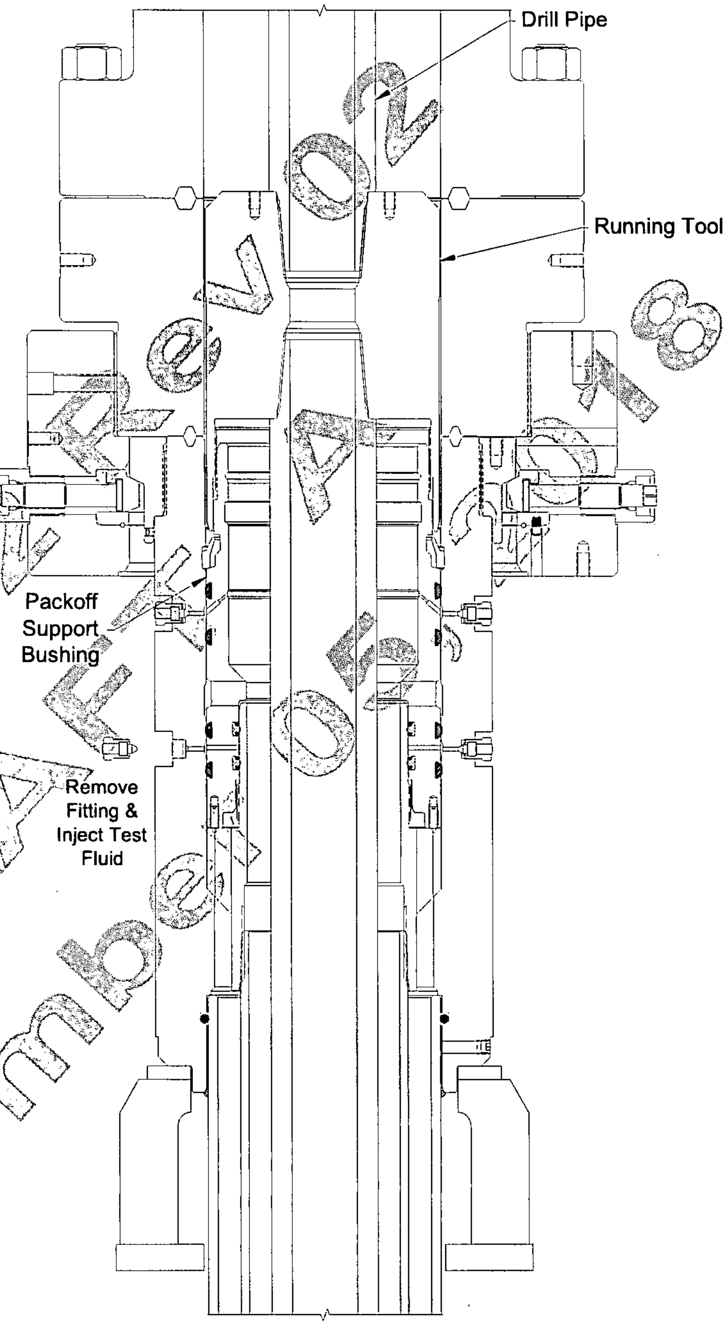
2.11.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

2.11.4. Once a satisfactory test is achieved, carefully bleed off all test pressure, remove the test pump and reinstall the fitting.

2.11.5. Release the running tool from the Packoff Support Bushing by rotating the drill pipe (with chain tongs) to the right approximately 4-1/2 turns or until it comes free from the seal assembly.

2.11.6. Retrieve the Tool to the rig floor and remove it from landing joint.

2.11.7. Clean, grease and store the Tool as required.



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⚠ CAUTION

The following procedure should be followed **ONLY** in the event Retrieval of the Packoff Support Bushing is necessary. If the Packoff Support Bushing Assembly was properly landed, skip this procedure.

2.12. Retrieval of Packoff Support Bushing Assembly

2.12.1. Make up a joint of drill pipe to the top of the ***Packoff Support Bushing Running Tool (Item ST5).***

2.12.2. Lower the Running Tool through BOP stack and land on top of Packoff Support Bushing.

2.12.3. Rotate the Tool counterclockwise approximately 8 turns or the number of turns documented per Section 2.8, until the tool fully engages the lockring and a firm stop is encountered. Back off from this point a maximum 1/8 of a turn.

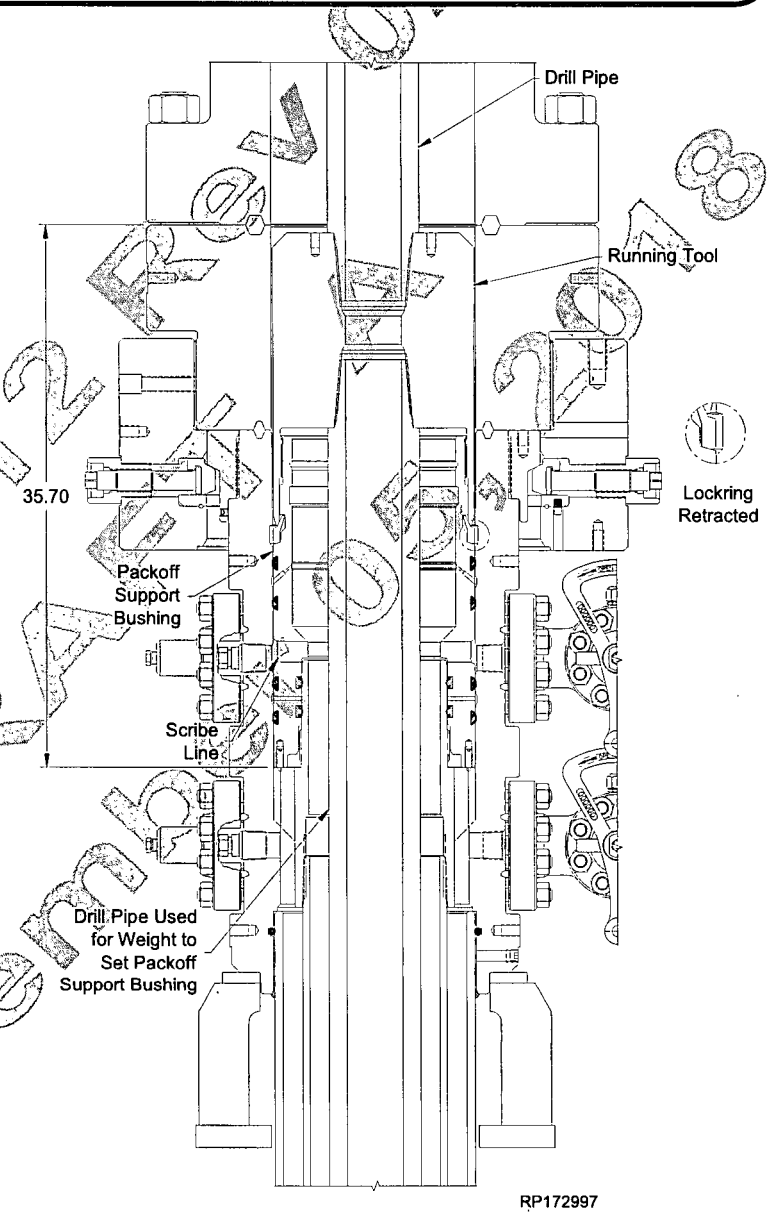
⚠ CAUTION

Do not use Top Drive to engage/disengage the Running Tool. Using Top Drive will permanently damage the equipment running threads and will require damaged part to be replaced.

2.12.4. Retrieve the Packoff Support Bushing by pulling vertically (approximately 15,000 to 20,000 lbs).

⚠ WARNING If overpull exceeds this value, repeat counter-clockwise rotation until a firm stop is encountered and repeat overpull.

2.12.5. To remove Packoff Support Bushing from the running tool, install the Lockring Collapsing Tool and fully compress the Lockring.



NOTE Dovetail seals must be relpaced prior to reinstalling the Packoff Support Bushing.

Stage 3.0 — 5-1/2" or 7" Casing

3.1. Test the BOP Stack - Optional

NOTE ***Previously used BOP Test Plug must be inspected for damage due to wear.***

3.1.1. Examine the ***Test Plug (Item ST6).*** Verify the following:

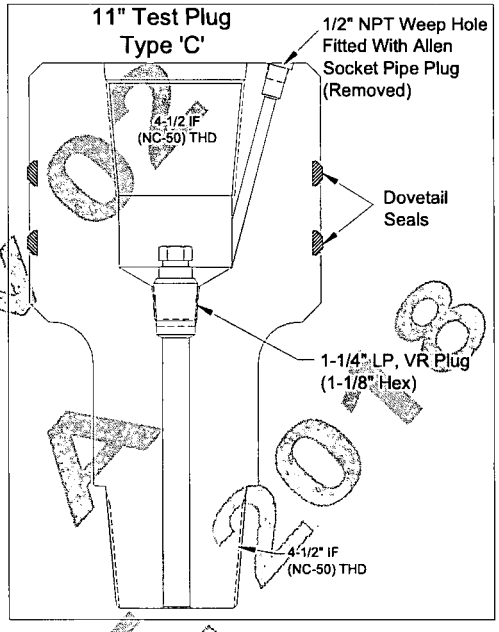
- seals are properly installed, clean and undamaged
- 1/2" pipe plug is removed
- all threads are clean and undamaged

NOTE **Ensure the 1/2" LP pipe plug is removed**

3.1.2. Orient the Tool as illustrated.

3.1.3. Make up a joint of drill pipe to the top of the Tool.

WARNING **A minimum of one joint of Drill Pipe is required on the bottom of the BOP Test Plug to ensure BOP Test plug remains centralized.**



NOTE **A minimum weight of 1,500 lbs is required per dovetail seal to land the test plug.**

3.1.4. Wipe the dovetail seal of the Tool with a coat of light oil.

3.1.5. Open the upper annulus valve of the Housing, and drain fluid to land the Test Plug. Leave valve open.

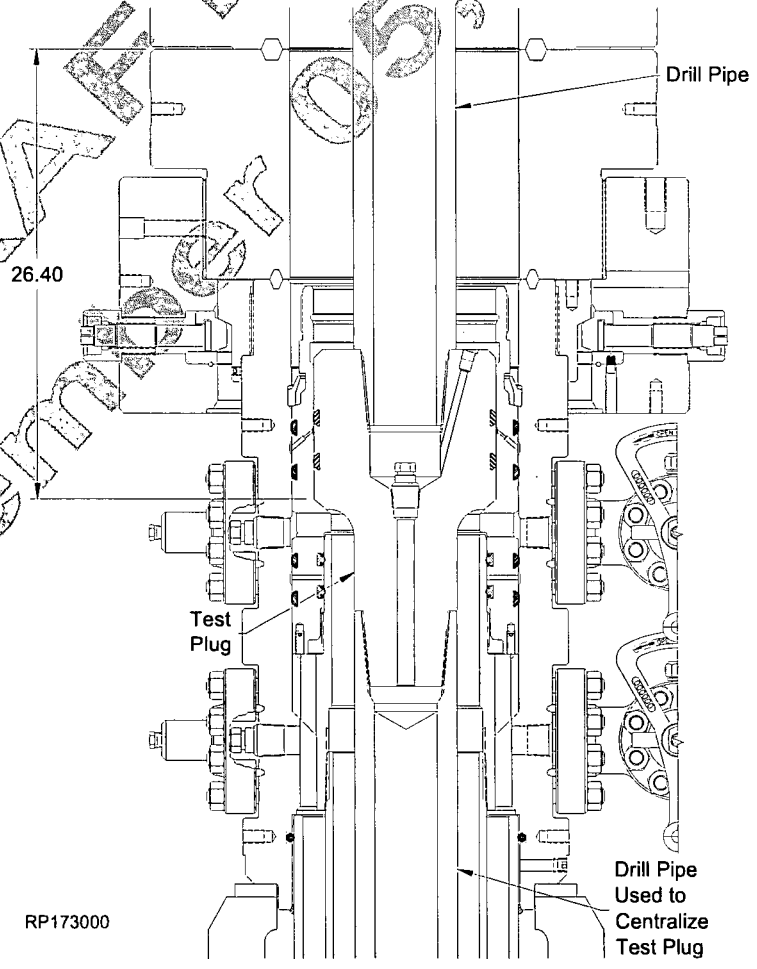
3.1.6. Slowly lower the Tool through the BOP Stack until it lands on the load shoulder in the Packoff. Measure and record.

NOTE **Distance from the Packoff Support Bushing load shoulder to the face of the BOP Flange is 26.40"**

3.1.7. Close the BOP rams on the drill pipe and test to ***5,000 psi maximum.***

3.1.8. Monitor the annulus valve for signs of pressure.

3.1.9. After a satisfactory test is achieved, release pressure. Leave test plug in place to test the Packoff Support Bushing upper dovetail seals.



3.2. Test Between Upper the 9-5/8" Packoff Dovetail Seals - Optional

3.2.1. Locate the uppermost test port on the OD of the Housing and remove the fitting.

3.2.2. Attach a hydraulic test pump to the open test port and inject test fluid into the Packoff Support Bushing to ***5,000 psi.***

WARNING Do Not over pressurize!

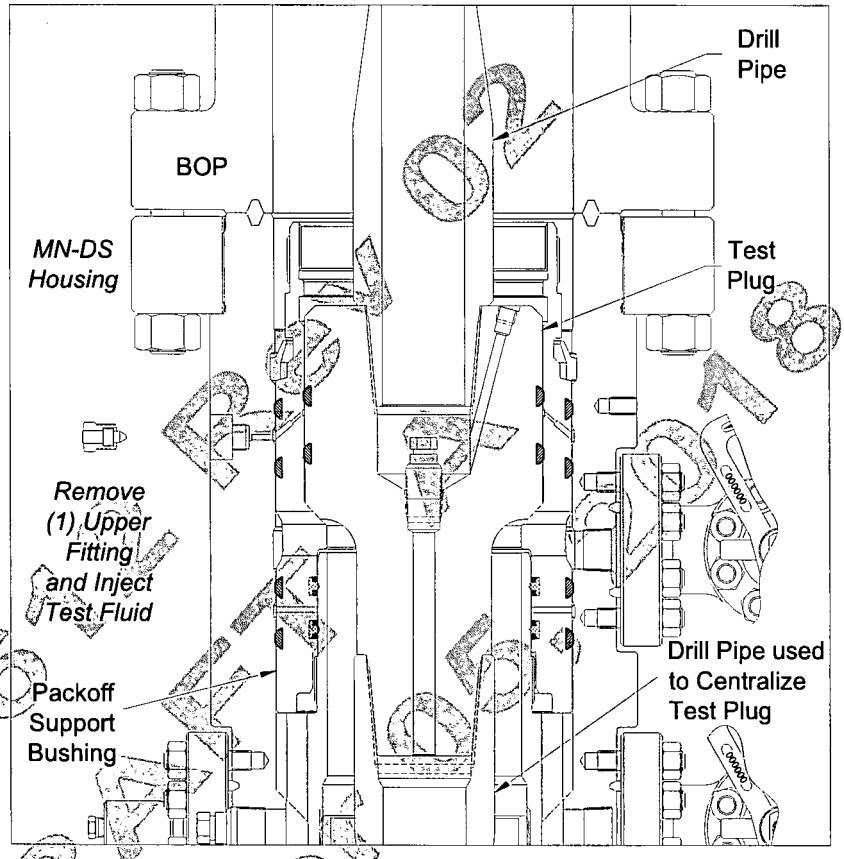
NOTE If Emergency hanger was used do not exceed 80% of casing collapse.

NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

3.2.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

3.2.4. Once a satisfactory test is achieved, carefully bleed off all test pressure, remove the test pump and reinstall the fitting.

3.2.5. Open the annulus valve.



3.2.6. Retrieve the Test Plug slowly to avoid damage to the seal.

NOTE It may be necessary to open the annulus valve when starting to retrieve the Test Plug to relieve any vacuum that may occur. Leaving annulus valve open during testing insures safety of surface casing.

3.2.7. Drain BOP stack.

NOTE Always use a Wear Bushing while drilling to protect the load shoulder from damage by the drill bit or rotating drill pipe. The Wear Bushing must be retrieved prior to running the casing.

3.3. Run the Wear Bushing Before Drilling

3.3.1. Examine the ***Running Tool (Item ST7).*** Verify the following:

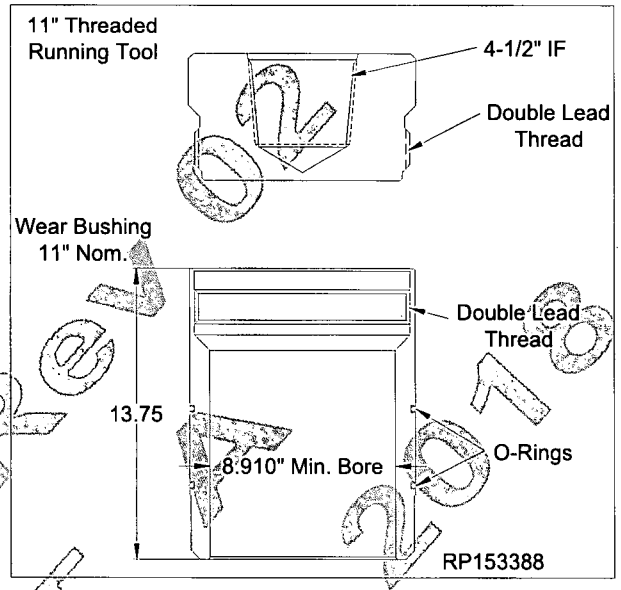
- all threads are clean and undamaged
- pup joint is properly installed for tonging

3.3.2. Orient the Tool with the Double Lead Thread down.

3.3.3. Examine the ***Wear Bushing (Item ST8).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- o-rings are properly installed, clean and undamaged

3.3.4. Orient the Wear Bushing as illustrated.



NOTE Do Not Cut O-rings

⚠ CAUTION This Wear Bushing has no mechanical retention device. Care must be exercised when tripping out the hole to avoid dislodging the Wear Bushing which could compromise safety if it become lodged in the BOP.

3.3.5. Wipe the o-ring seals of the wear bushing with a light oil or grease.

3.3.6. Make up a joint of drill pipe to the top of the Tool.

NOTE Make sure the threads are down when making up the drill pipe to the running tool.

3.3.7. Lower the Tool into the Wear Bushing and rotate the drill pipe counter clockwise until thread jump can be felt, then clockwise to a positive stop.

3.3.8. Carefully lower the Tool/ Wear Bushing Assembly through the BOP until it lands on the load shoulder of the Packoff Support Bushing. Measure and record.

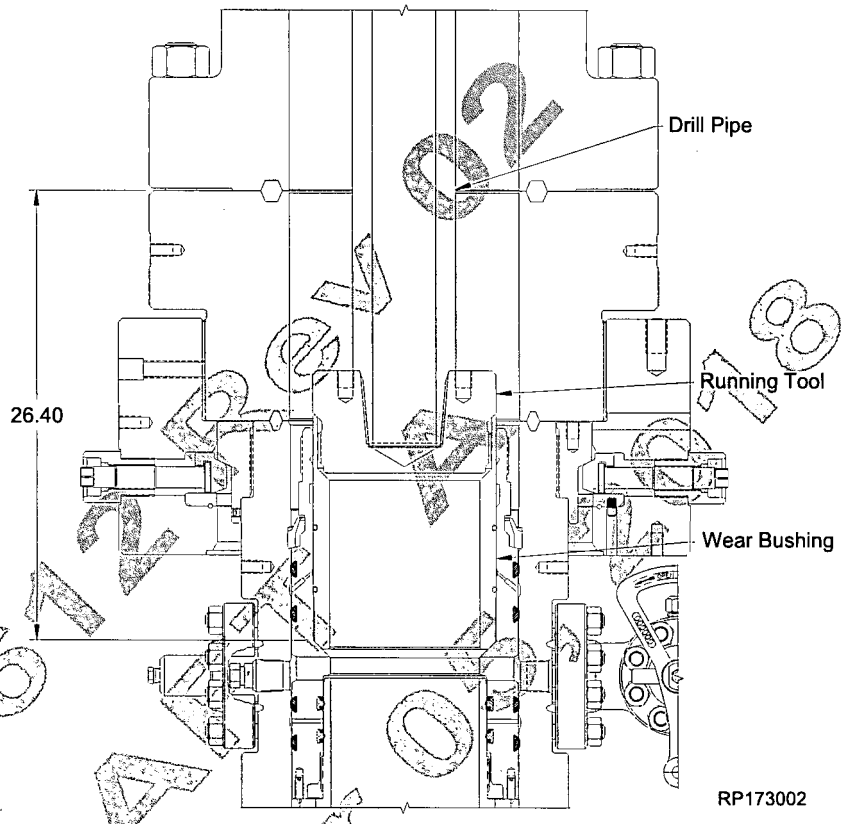
NOTE Distance from the Pack-off Support Bushing load shoulder to the face of the BOP Flange is 12.90"

3.3.9. Remove the Tool from the Wear Bushing by rotating the drill pipe counterclockwise until thread jump is felt to disengage the Tool from the Wear Bushing and lifting straight up.

3.3.10. Remove the Tool from the drill string.

3.3.11. Clean, grease, and store the Tool as required.

3.3.12. Drill as required.



3.4. Retrieve the Wear Bushing After Drilling

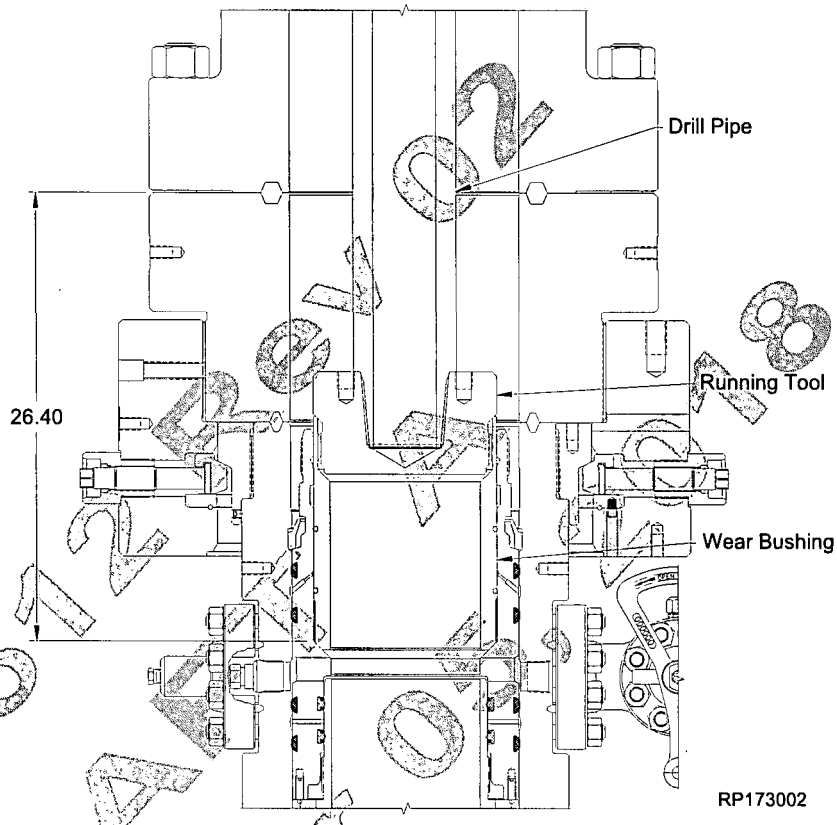
3.4.1. Make up the Tool to the drill pipe with the threads down.

3.4.2. Slowly lower the Tool into the Wear Bushing.

3.4.3. Rotate the Tool counter clockwise until thread jump can be felt, slack off all weight then rotate clockwise to a positive stop.

3.4.4. Slowly retrieve the Wear Bushing to the rig floor and remove it and the Tool from the drill string.

3.4.5. Clean, grease and store the Tool and Wear Bushing.

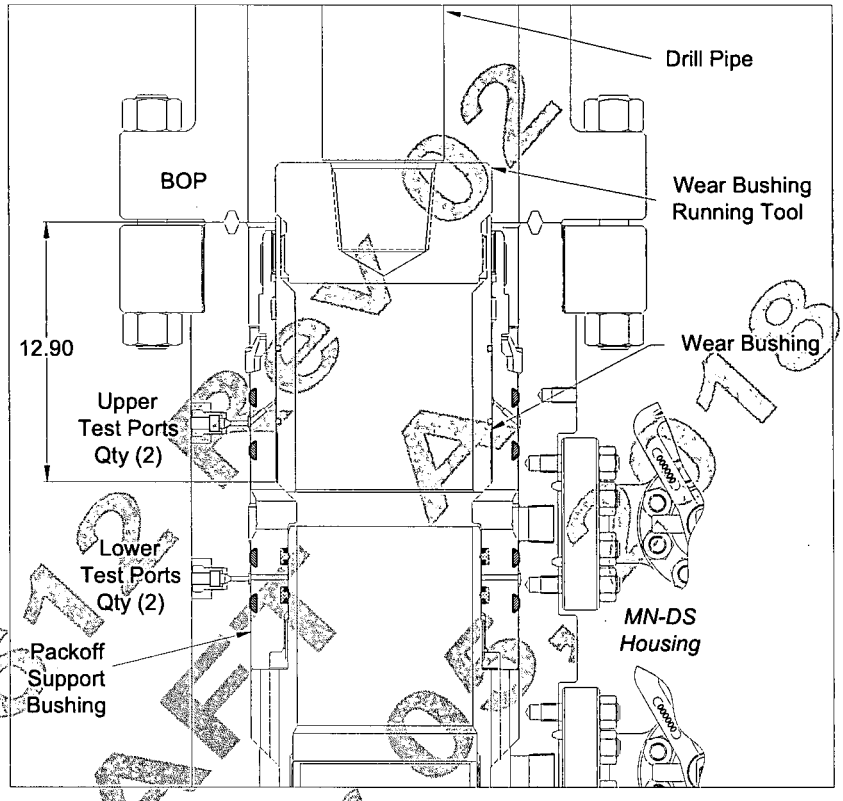


3.5. Contingency to retrieve a wear bushing that has become stuck due to debris

3.5.1. If the wear bushing becomes stuck due to debris, follow the steps below:

- Pump grease or hydraulic oil into test ports on the MN-DS housing to remove debris
- Pump fresh water through the upper most 2" 5K outlet valves for 15 minutes to wash out around the wear bushing

NOTE Communicate with company representative on desired overpull. Pull over in 10,000 lb increments (to maximum allowed, per engineering specification and tool ratings.)



Stage 3.0 — 5-1/2" or 7" Casing

SAFETY NOTE **Always wear proper PPE (Personal Protective Equipment) especially gloves to handle and install the slip type casing hanger.**

NOTE

1. **Reconfirm the Casing OD and grade. Remove and clean loose scale from Casing OD.**
2. **Verify Slip Bowl taper is smooth, clean with no corrosion and damage free.**
3. **Disassembly of the Hanger to re-orient the slips is not required.**

3.6. Hang off the Casing

NOTE **Since the IC-2 Casing Hanger is an automatic, weight energized Hanger, it is necessary to ensure there is adequate casing weight to create an annular seal.**

3.6.1. Run the casing through the BOP to the required depth and cement the hole as required.

3.6.2. Drain the Casing Head bowl through its upper side outlet.

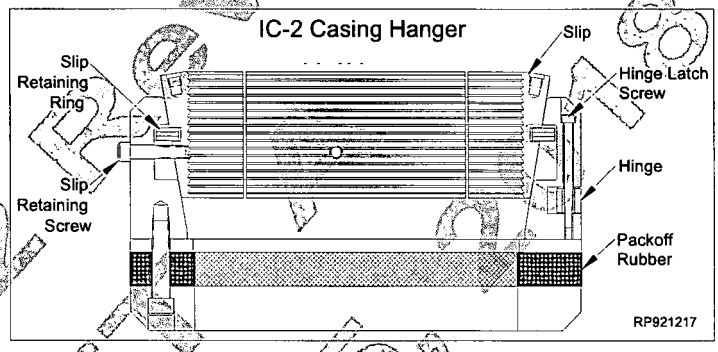
3.6.3. Center the casing, flush with water and verify returns are clean and free of debris.

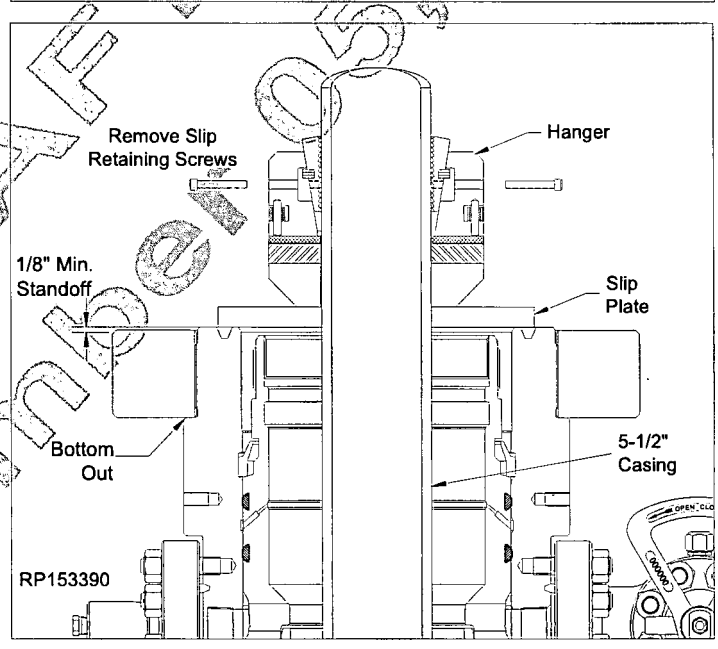
3.6.4. There are two methods used to install the Casing Hanger:

- from the rig floor through a full opening BOP stack, provided no casing collars are between the rig floor and the Head
- alternative method - underneath the BOP stack, provided the well is safe and under control. This option allows the Hanger bowl to be inspected and thoroughly washed prior to the Hanger Installation.

3.6.5. Examine the ***IC-2 Casing Hanger (Item A17/A17a).*** Verify the following:

- the packoff rubber is clean and undamaged
- all screws are in place and intact
- slips are intact, clean, and undamaged
- seal element is not compressed beyond the OD of the Hanger





3.6.6. Remove the latch screw to open the Hanger

3.6.7. Place a slip plate against the casing to support the Hanger.

3.6.8. Wrap the Hanger around the casing and replace the latch screws.

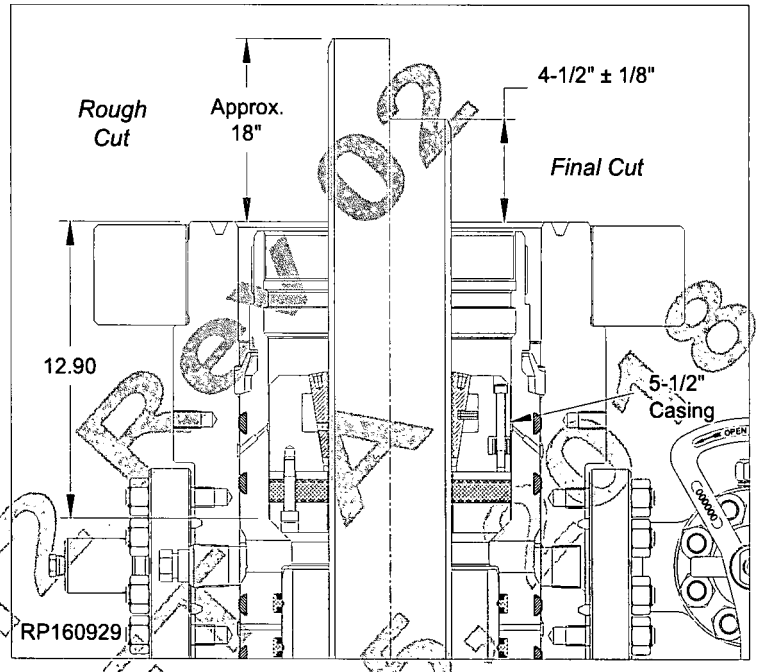
Stage 3.0 — 5-1/2" or 7" Casing

3.6.9. Verify that the seal element is not compressed beyond the OD of the Hanger. If it is, loosen the cap screws in the bottom of the Hanger. The seal **MUST NOT BE COMPRESSED** prior to slacking off casing weight onto the Hanger.

3.6.10. Confirm load shoulder to rig floor dimension. (11" Test plug tally).

3.6.11. Install eye bolts to hanger. Install rope to eyebolts. Ensure enough rope is available to lower and land hanger on load shoulder.

3.6.12. Prepare to lower the Hanger through the BOP stack.



WARNING DO NOT Drop the Hanger!

3.6.13. Grease the Hanger body and packoff rubber and remove the slip retaining screws.

3.6.14. Remove the slip plate and carefully lower the Hanger into the Housing controlling decent with ropes, until the Hanger lands on the load shoulder of the Packoff Support Bushing. Use a cat-line to center the casing, if necessary. Measure and record.

NOTE Establish desired weight to be set on slips before lowering slips.

3.6.15. When the Hanger is down, pull tension on the casing to the desired hanging weight + 1-1/2" then slack off.

NOTE Approximately 70,000 lb ft is needed to set 5-1/2" hanger, 55,000 lb ft is needed to set the 7" hanger.

NOTE A sharp decrease on the weight indicator will signify that the Hanger has taken weight and at what point. If this does not occur, pull tension +1-1/2" again, tug on the soft lines to try to align the Hanger in the bowl and slack off once more.

3.6.16. Lift the BOP Stack as high as possible.

3.6.17. Rough cut the casing approximately 18" above the top of the Housing flange.

3.6.18. Move the BOP and excess casing out of the way.

NOTE Always physically measure the exact cutoff height by measuring the bottom bore of the next component to be installed and subtract 1/4" from this dimension, prior to making the final cutoff.

3.6.19. Final cut the casing at 4-1/2" +/- 1/8" above the top of the Housing Flange.

3.6.20. Place a 15° bevel on the casing stub and remove all burrs and sharp edges.

NOTE The ID edge of the casing must be ground slightly to allow drill pipe and casing collars to pass smoothly.

Stage 4.0 — Install the Capping Flange

4.1. Install the Temporary Abandonment Cap

NOTE Verify the height/standoff measured from the top of the Housing to the top of the Mandrel Hanger as indicated on page 60.

4.1.1. Examine the ***Temporary Abandonment Cap (TA Cap, Item C1)***. Verify the following:

- bore is clean and free of debris
- seal areas are clean and undamaged
- all peripheral equipment is intact and undamaged
- ***NX bushing(Item C3/C3a)*** is properly installed, clean and undamaged

4.1.2. Orient the TA Cap as illustrated.

4.1.3. Clean the mating ring grooves of the Housing and TA Cap. Wipe each groove, the 'P' seal of the TA Cap and the OD of the casing stub with a light oil or grease.

WARNING Excessive oil may prevent a positive seal from forming.

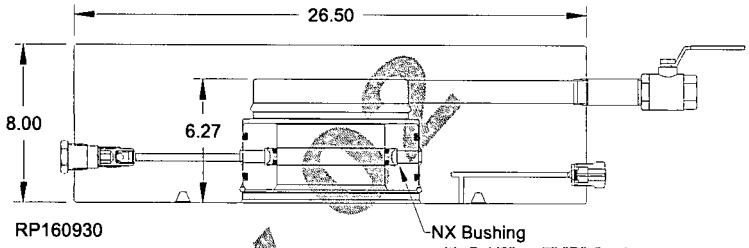
4.1.4. Install a new ***BX-160 Ring Gasket (Item C2)*** into the ring groove of the MN-DS Housing.

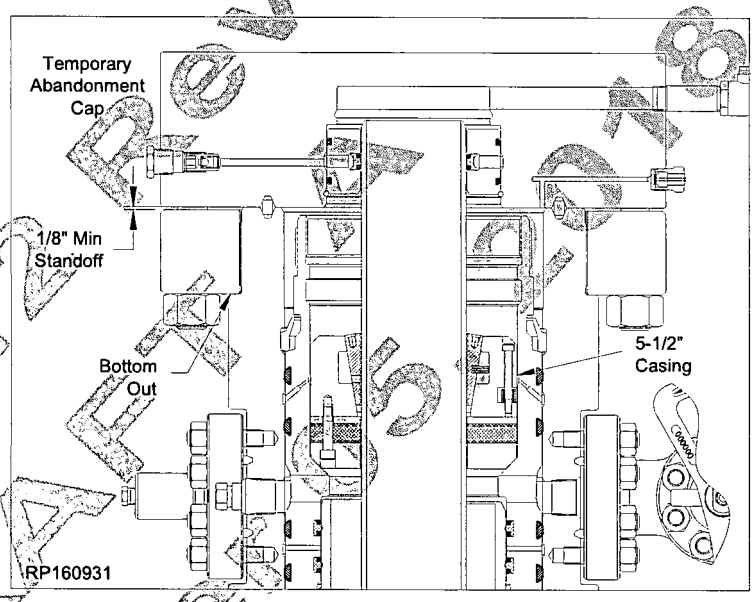
4.1.5. Fill the void above the Casing Hanger with clean oil to the top of the MN-DS Housing.

WARNING DO NOT overfill the void. Oil that becomes trapped under the ring gasket will prevent formation of a positive seal.

4.1.6. Orient the TA Cap per customer's requirements and carefully lower the TA Cap over the casing stub until it lands on the ring gasket.

Capping Flange
13-5/8" API 5K bottom





WARNING Do Not damage the 'P' seal or their sealing ability will be impaired.

4.1.7. Make up the connection using the ***Studs and Nuts*** provided with the TA Cap and tighten the connection in an alternating cross fashion to the torque referenced in the chart in the back of this manual.

⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

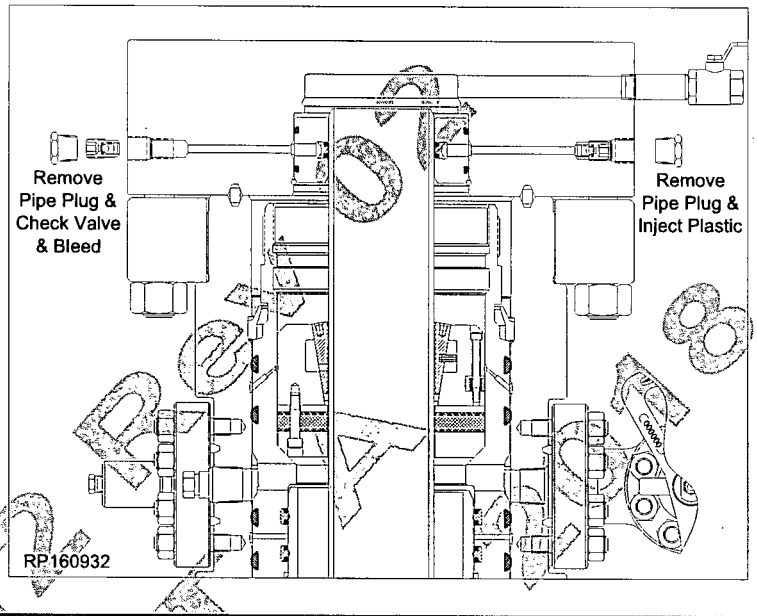
Threaded flange must remain shouldered out during installation.

Stage 4.0 — Install the Capping Flange

4.2. Energize the NX Bushing 'P' Seal

WARNING

SEE RP-000589
PROCEDURE FOR PACKING INJECTION AND ENERGIZING THE 'P' SEALS



4.3. Test the Void Between 5-1/2" or 7" Casing Hanger & Capping Flange 'NX' Bushing

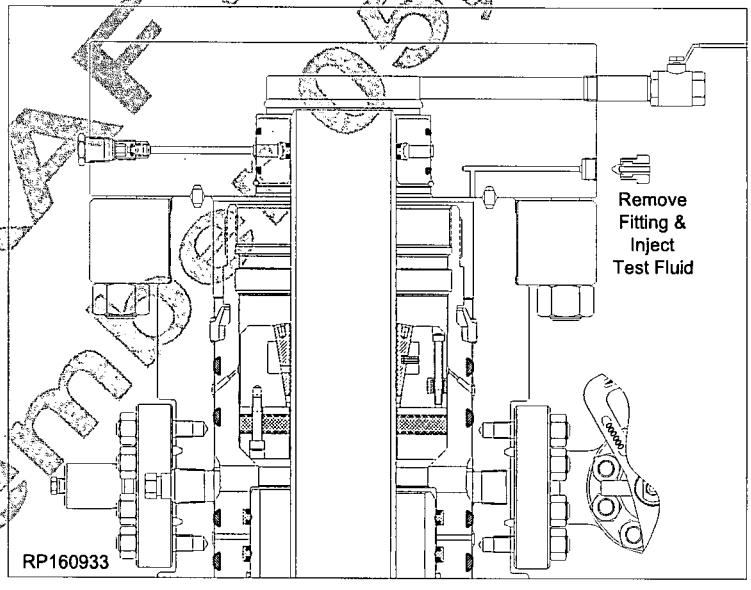
4.3.1. Locate the port on the OD of the Capping Flange for testing the connection and remove the fitting.

4.3.2. Install a test pump to the open port and inject test fluid to ***5,000 PSI maximum or 80% of casing collapse, whichever is less.***

NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

4.3.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

4.3.4. Once a satisfactory test is achieved, carefully bleed off all test pressure and remove the test pump.



4.3.5. Reinstall the fittings.

Stage 4.0 — Install the Capping Flange

4.4. Remove the Temporary Abandonment Cap

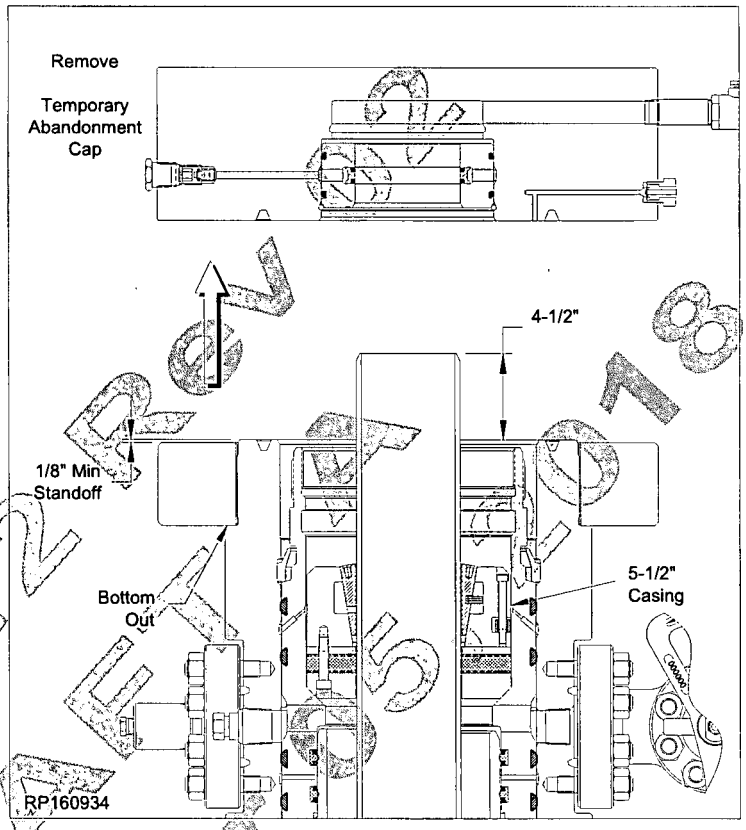
NOTE Verify the well is safe and secure and that there is no trapped pressure in the well.

4.4.1. Carefully remove the 1" NPT test plug and 9/16" allen internal check valve to relieve packing pressure on 'P' Seal.

4.4.2. With the appropriate lifting device, lift and suspend the Cap straight up.

4.4.3. Retrieve the Cap to the rig floor.

4.4.4. Inspect the Packoff for signs of damage and report immediately.



Stage 5.0 — Install the Tubing Spool

5.1. Install the Tubing Spool

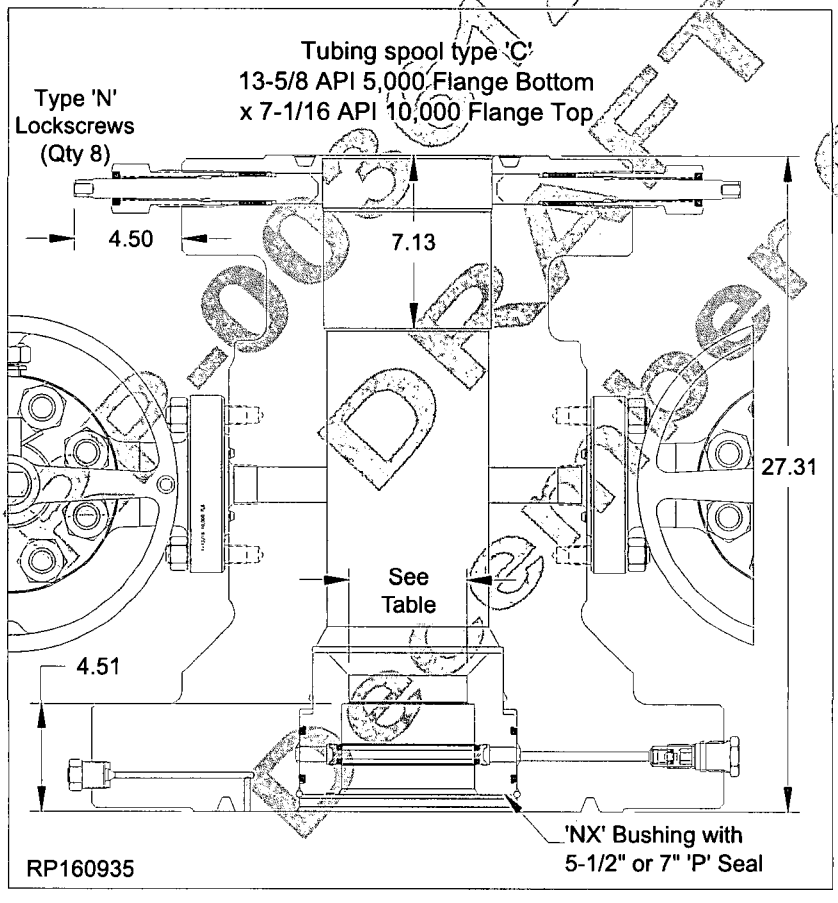
5.1.1. Examine the ***Tubing Spool (Item B1).*** Verify the following:

- bore is clean and free of debris
- ***NX Bushing(Item B2/B2a)*** is properly installed and undamaged.
- ring grooves and seal areas are clean and undamaged
- peripheral equipment is intact and undamaged
- ensure the lockscrews of the tubing spool are retracted from the bore as indicated

WARNING All Lockscrews *MUST* achieve positions as indicated. Otherwise contact Surface Engineering for guidance.

5.1.2. Lubricate the ID of the NX Bushing 'P' seal and the OD of the casing stub with light oil or grease.

NOTE Excessive oil or grease may prevent a positive seal from forming.



NX Bushing		
PN:	Size	Min. Bore
2161829-02-01	5-1/2"	4.92
2161829-17-01	7"	6.34

Stage 5.0 — Install the Tubing Spool

5.1.3. Install a new ***Ring Gasket BX-160 (Item A12)*** into the ring groove of the MN-DS Housing.

5.1.4. Fill the void above the Casing Hanger with clean oil to the top of the MN-DS Housing.

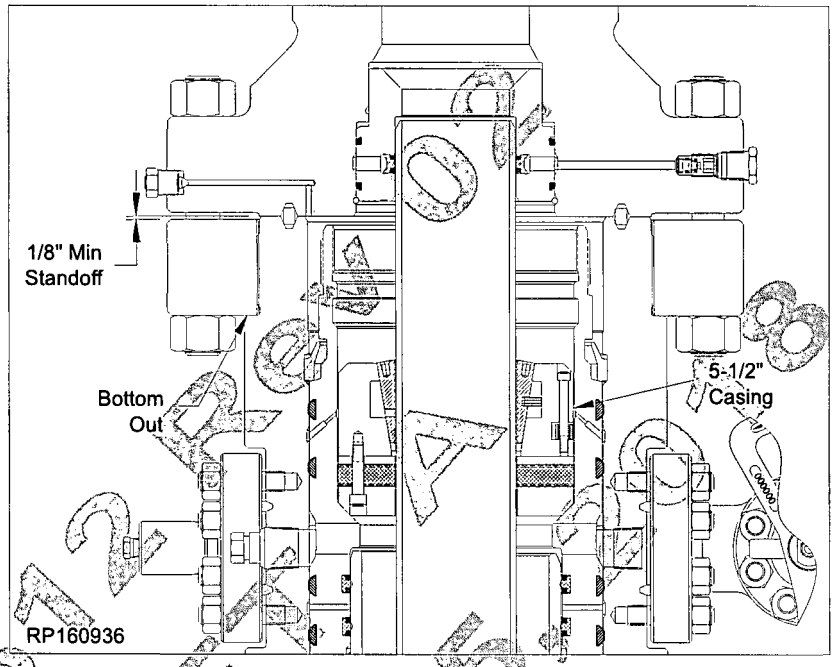
WARNING DO NOT overfill the void. Oil that becomes trapped under the ring gasket will prevent formation of a positive seal.

5.1.5. Lift and suspend the Tubing Spool over the casing stub, ensuring it is level. Align the spool outlets as required. Align the bolts of the Spool as required (two hole).

5.1.6. Carefully lower the Tubing Spool onto the casing stub and land it on the Housing flange.

WARNING Do Not damage the NX Bushing 'P' seal or its sealing ability will be impaired.

5.1.7. Make up the connection using the ***Studs and Nuts (Item A13 & A14)*** in an alternating cross fashion to the torque referenced in the chart in the back of this manual.



⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

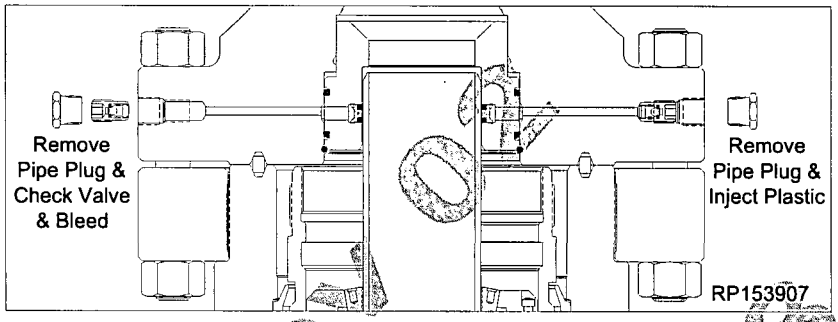
Threaded flange must remain shouldered out during installation.

Stage 5.0 — Install the Tubing Spool

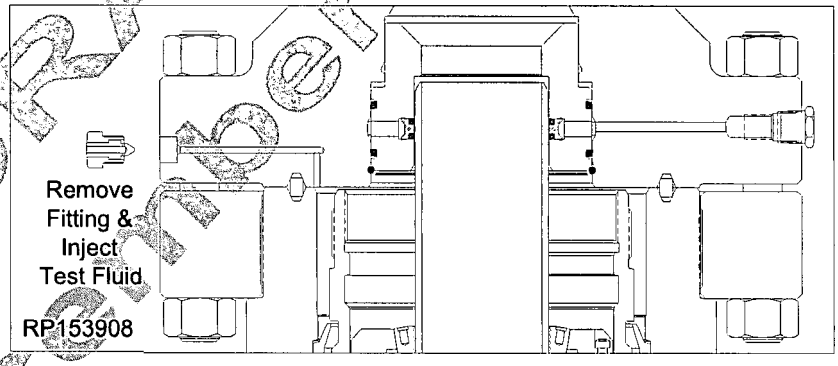
5.2. Energize the NX Bushing 'P' Seal

WARNING

SEE RP-000589 PROCEDURE FOR PACKING INJECTION AND ENERGIZING THE 'P' SEALS



5.3. Test the Void Between 5-1/2" or 7" Casing Hanger & Tubing Spool 'NX' Bushing



5.3.1. Install the test pump into the port for testing the connection and inject test fluid to ***5,000 psi or 80% of casing collapse—whichever is less.***

NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

5.3.2. Monitor the open port for signs of leakage.

5.3.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

5.3.4. Once a satisfactory test is achieved, carefully bleed off all test pressure and remove the test pump.

5.3.5. Reinstall the fittings.

Stage 6.0 — 2-7/8" Tubing

Landing of Mandrel Hangers

Cameron service personnel must verify that the mandrel hanger is landed properly on the load shoulder in the wellhead. This can be accomplished by one of two methods.

- Calculate the distance from the rig floor to the landing shoulder and confirm that the hanger has traveled the required distance.
- Or the preferred method: Conduct a dry run and mark the dedicated landing joint prior to running the casing or tubing.

6.1. Install the Tubing Hanger

6.1.1. Run the tubing as required and space out appropriately.

6.1.2. Examine the ***Tubing Hanger (Item D1).*** Verify the following:

- bore is clean and free of debris
- threads are clean and undamaged
- packing element is properly installed and undamaged
- compression ring is properly installed, moves freely and is properly retained

6.1.3. Orient the Hanger as illustrated.

6.1.4. At a predetermined position in the tubing string, set the tubing in floor slips and remove the tubing collar from the last joint run.

6.1.5. Pick up the Tubing Hanger and make it up to the tubing string, tightening the connection to thread manufacturer's recommended optimum torque.

6.1.6. Make up the tubing to the top of the Hanger and tighten to the thread manufacturer's recommended shoulder torque.

6.1.7. Wipe the packing element with a light coat of oil.

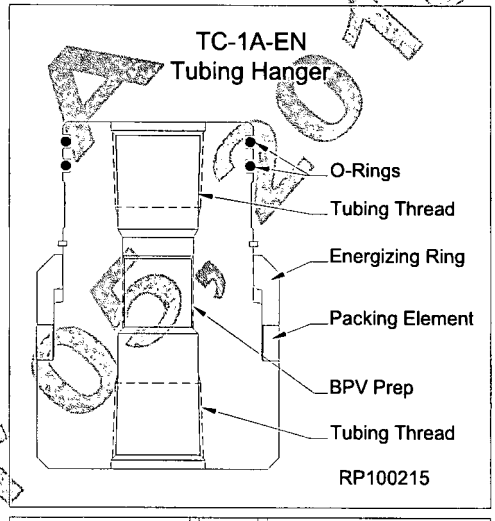
WARNING Excessive oil may prevent a positive seal from forming.

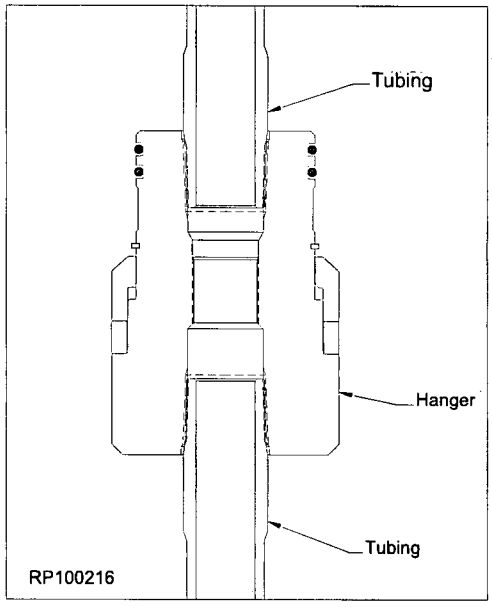
6.1.8. Ensure all of the lockscrews are retracted from bore of the Tubing Spool as indicated on page 47.

WARNING All Lockscrews *MUST* achieve positions as indicated. Otherwise contact Surface Engineering for guidance.

6.1.9. Open side outlet valve of the Tubing Spool and drain BOP.

NOTE Side outlet valve to remain open while landing the Hanger.





Stage 6.0 — 2-7/8" Tubing

6.1.10. Calculate the distance of the load shoulder of the Tubing Spool to the rig floor by measuring from the face of the Spool to the rig floor and add the distance from the flange face to the top of the load shoulder.

NOTE The distance from the flange face to the top of the load shoulder is as follows: 7" Spool = 7.13"

6.1.11. Pick up the tubing string, remove the floor slips. Carefully lower the Tubing Hanger into the well, tallying the tubing every five feet and land the Tubing Hanger on the load shoulder in the Spool. Slack off all weight.

6.1.12. With the Hanger properly landed, energize the tubing hanger packoff seal. Run in all the lockscrews of the Tubing Spool in an alternating cross pattern to the ***torque referenced in the chart in the back of this manual.***

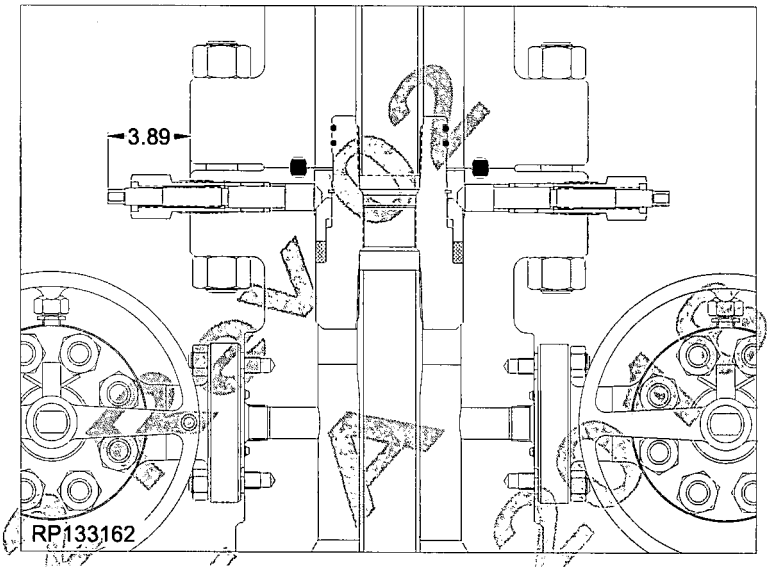
NOTE Reference dimension shown, is to the point of lockscrew contact with the compression ring prior to energizing the Tubing Hanger Packoff seal.

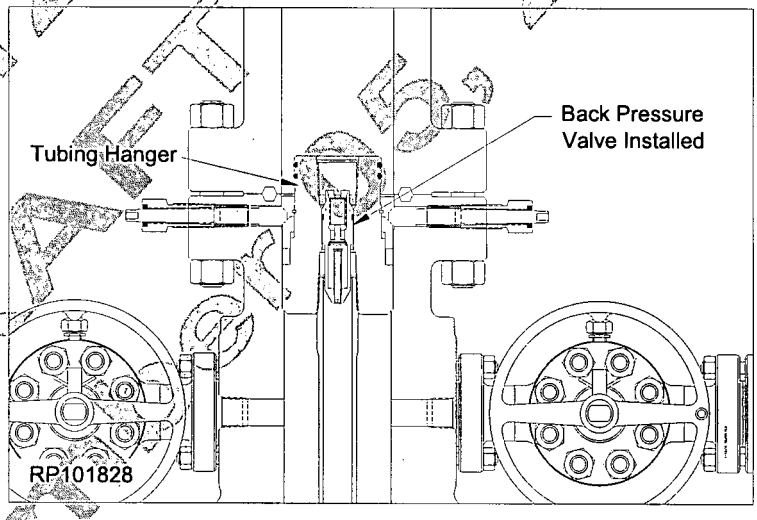
WARNING All Lockscrews *MUST* achieve positions as indicated. Otherwise contact Surface Engineering for guidance.

6.1.13. Remove the landing joint and install appropriate size back pressure valve.

NOTE Installation and/or Removal of the Type 'H' Left Hand threaded Back Pressure Valve to be performed by a Qualified Cameron Technician.

6.1.14. With the well safe and under control, the BOP stack may be removed.





⚠ CAUTION

A TWC (Two Way Check) is a tool used for testing only and shall not under any circumstances be used as a BPV (Back Pressure Valve).

DO NOT remove the Tree or BOP with a TWC in place. A BPV is used for this purpose.

If for some reason, pressure builds up unexpectedly with the TWC in place, a lubricator outfitted with the proper tool can unseat the TWC poppet to allow equalization of the pressure for safe removal of the TWC after which a BPV can be installed with the lubricator to secure the well.

6.2. Install the Christmas Tree

6.2.1. Examine the Christmas Tree Assembly. Verify the following:

- bore is clean and free of debris
- threads are clean and undamaged

6.2.2. Orient the Tree as illustrated.

6.2.3. Clean the mating ring grooves of the Spool and adapter. Wipe each groove, the hanger neck seals and the ID of the Adapter with a light coat of oil or grease.

WARNING Excessive oil may prevent a positive seal from forming.

6.2.4. Place a new ***BX-156 Ring Gasket (Item B9)*** into the gasket prep of the tubing spool.

6.2.5. Fill the void above the Hanger with clean oil to the top of the Tubing Spool.

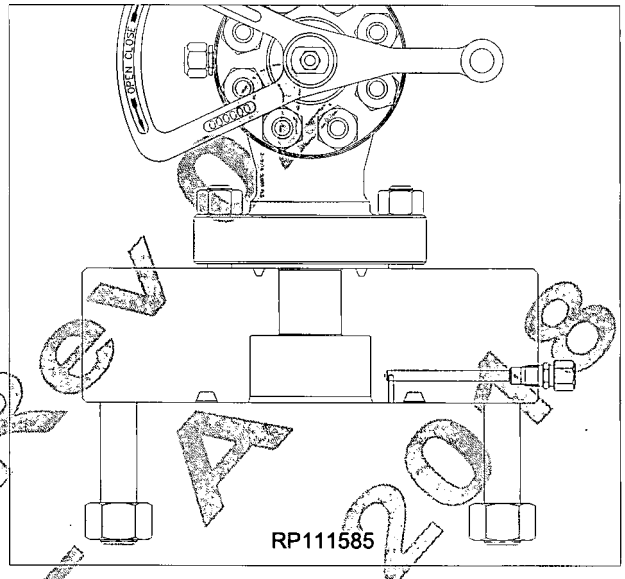
WARNING DO NOT overfill the void. Oil that becomes trapped under the ring gasket will prevent formation of a positive seal.

6.2.6. Locate the port on the OD of the Adapter flange and remove the autoclave fitting. This will allow air to escape while landing Tree assembly over hanger neck.

6.2.7. Lift and suspend Tree Assembly over Tubing Spool.

6.2.8. Orient the Tree Assembly as required per Drilling Supervisor and carefully lower the Tree Assembly until the Adapter lands on the ring gasket of the Tubing Spool.

6.2.9. Make up the connection with the ***Studs and Nuts*** of the Adapter, tightening them in an alternating cross patter to the torque referenced in the chart in the back of this manual.



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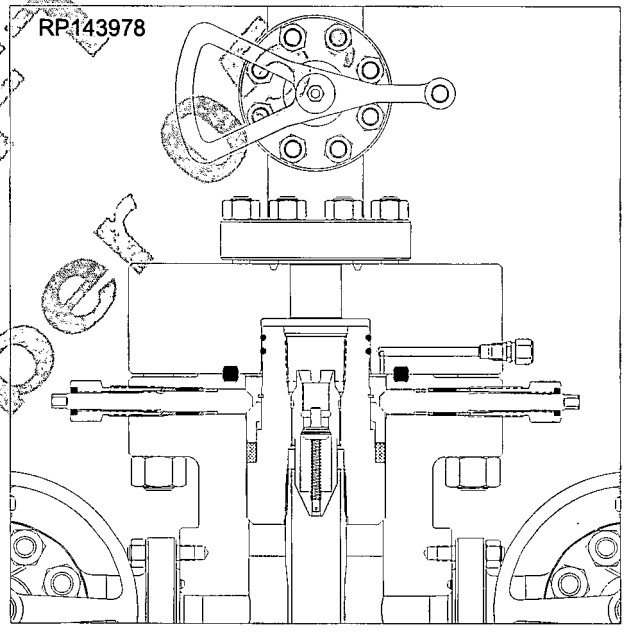
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6.3. Test the Connection

6.3.1. Locate the port on the OD of the Adapter flange and remove the autoclave fitting.

6.3.2. Install a test pump and inject test fluid to ***10,000 psi maximum.***

WARNING ***Do Not overpressurize!***

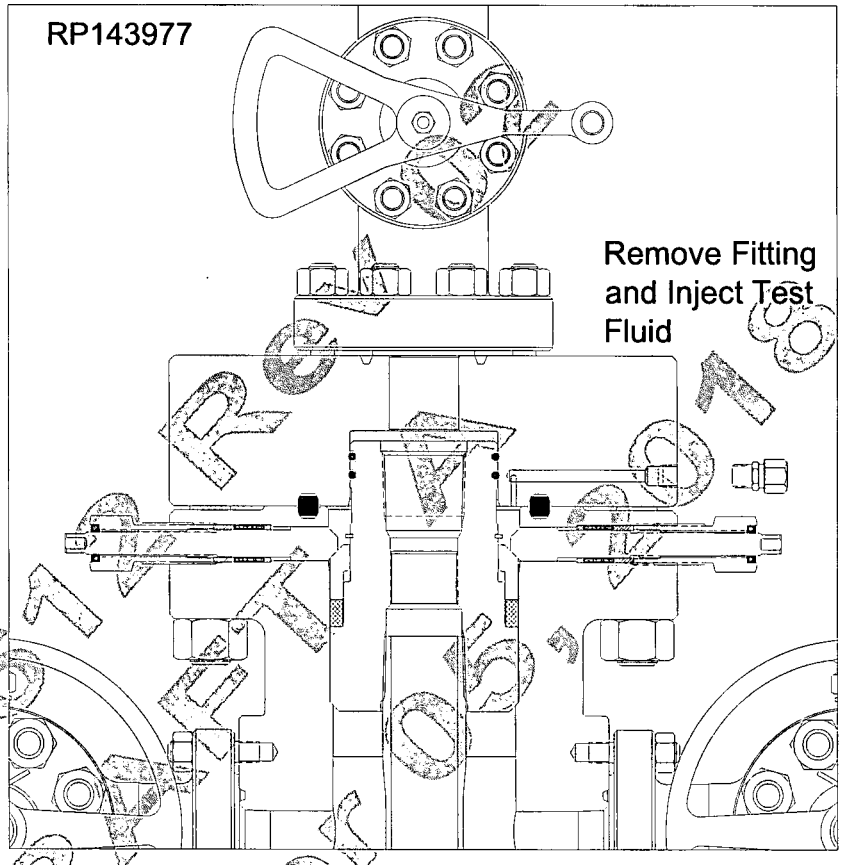
6.3.3. Hold and monitor test pressure for fifteen minutes or as required by Drilling Supervisor.

6.3.4. Once a satisfactory test is achieved, carefully bleed off the test pressure and remove the test pump.

6.3.5. Reinstall the fitting.

6.3.6. Remove the Back Pressure Valve.

NOTE **Installation and/or removal of the Type 'H' Left Hand one way back pressure valve to be performed only by a qualified Cameron Service Technician.**



Torque Chart

Recommended Makeup Torques for Flange Bolting Ft-Lbf Per API 6A: preload = .50Sy				
Bolt Size Nom OD - TPI	B7M, L7M (Sy=80 ksi)		B7, L7, 660 (Sy=105 ksi)	
	cf=0.07	cf=0.13	cf=0.07	cf=0.13
.500-13	27	45	35	59
.625-11	52	88	68	115
.750-10	90	153	118	200
.875-9	143	243	188	319
1.000-8	213	361	279	474
1.125-8	305	523	401	686
1.250-8	421	726	553	953
1.375-8	563	976	739	1280
1.500-8	733	1280	962	1680
1.625-8	934	1640	1230	2150
1.750-8	1170	2050	1530	2700
1.875-8	1440	2540	1890	3330
2.000-8	1750	3090	2300	4060
2.250-8	2500	4440	3280	5820
2.500-8	3430	6120	4500	8030
2.625-8	3970	7100	4720	8430
2.750-8	4570	8180	5420	9700
3.000-8	5930	10700	7050	12700
3.250-8	7550	13600	8970	16100
3.500-8	9430	17000	11200	20200
3.750-8	11600	21000	13800	24900
3.875-8	12800	23200	15200	27500
4.000-8	14100	25500	16700	30300

NOTE

The information in this table is based on API-6A's recommended torque for a given bolt size. The information is presented for the convenience of the user and is based on assumptions of certain coefficients of friction (cf). The coefficients of friction are based on approximations of the friction between the studs and nuts, as well as the nuts and flange face. A coefficient friction of 0.13 assumes the threads and nut bearing surfaces are bare metal and are well lubricated with thread compound. A coefficient of friction of 0.07 assumes the thread and nuts are coated with a fluoropolymer material.

- Lubrication

  It is essential that threads and nut faces be well lubricated with an appropriate grease prior to assembly. Cameron clamps and fast clamps require lubrication on the hub-clamp contact area. Acceptable lubricants include thread joint compounds which meet the formulation, evaluation and testing requirements specified in API Recommended Practice 5A3/ISO13678. (Reference - Jet Lube Grease, 1 lb can PN: 2737980-02).

  Studs and nuts coated with Xylan/PTFE compound in accordance with a Cameron procedure do not require lubrication. However, a light coat of API Recommended Practice 5A3/ISO13678 thread compound is recommended for Xyland-coated bolting as an aid to assembly.

  Material gaskets should be lightly coated with lubricant prior to assembly. Acceptable lubricants include motor oil or Cameron gate valve greases.

IC Test Plug Load Chart

IC Test Plug Maximum Load							
Bowl		Maximum Hanging Load (in 1000s lbs) at Test Pressure					
Size	Pressure	0 psi	2,000 psi	3,000 psi	5,000 psi	10,000 psi	15,000 psi
7-1/16"	2,000 to 5,000 psi	213	135	96	19	N/A	N/A
	10,000 psi	253	175	136	59	0	N/A
	15,000 psi	477	399	360	282	88	0
9"	2,000 to 10,000 psi	600	479	419	299	0	N/A
	15,000 psi	751	630	570	450	149	0
11"	2,000 to 10,000 psi	1277	1091	998	812	348	N/A
	15,000 psi	1596	1410	1317	1131	667	202
13-5/8"	2,000 to 10,000 psi	1713	1426	1283	997	281	N/A
	15,000 psi	2142	1855	1712	1426	710	5
16-3/4"	2,000 to 5,000 psi	3076	2641	2424	1990	N/A	N/A
20"	2,000 to 5,000 psi	2733	2096	1778	1142	N/A	N/A

Minimum Casing Load Chart for IC Type Hangers

Minimum Casing Load for IC-2 & IC-6 Casing Hangers		
Hanger Nom. Size	Casing Size	Load (Pounds)
9"	4-1/2"	46,000
	5-1/2"	42,000
11"	4-1/2"	78,000
	5"	74,000
	5-1/2"	70,000
	6-5/8"	59,000
	7"	55,000
	7-5/8"	48,000
13-5/8"	5-1/2"	120,000
	7"	106,000
	7-5/8"	99,000
	8-5/8"	86,000
	9-5/8"	72,000
	10-3/4"	54,000

Minimum Casing Load for IC-2 & IC-6 Casing Hangers		
Hanger Nom. Size	Casing Size	Load (Pounds)
16-3/4"	9-5/8"	146,000
	10-3/4"	128,000
	11-3/4"	110,000
	11-7/8"	109,000
	13-3/8"	79,000
20-3/4" 21-1/4"	10-3/4"	228,000
	13-3/8"	180,000
	13-5/8"	175,000
	16"	120,000

RP-000573

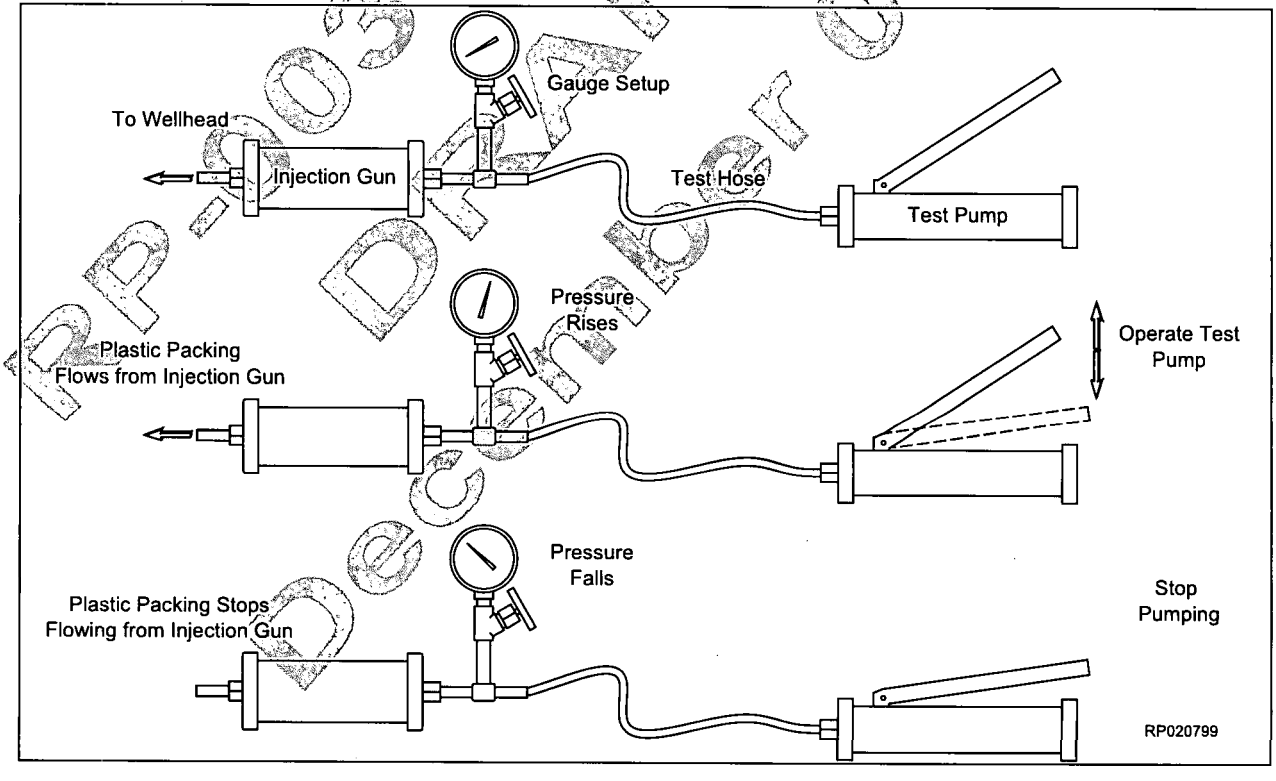
Injection Gun Preparation

1. Maintaining the Injection Gun at ambient temperatures, prepare Test Pump and Injection Gun for injecting P seals.
2. Operate Test Pump to inject fluid into Injection gun.
3. Monitor open end of Injection Gun for signs of plastic packing.
4. After plastic packing begins to flow from open end of Injection Gun continue to inject fluid from Test Pump increasing pressure an additional 200 to 400 psi.
5. Stop pumping Test Pump and monitor plastic packing movement and pressure on the pressure gauge.
6. Once packing has stopped flowing and the pressure gauge has stabilized observe the reading on gauge and record the pressure. **This will be your P1 pressure.**

Screw Type Injection Gun	
Applied Torque (ft-lb)	**Packing Pressure (psi)**
25	1,600
50	5,000
75	7,000
100	8,800
150	14,100
200	17,700
220	20,000

NOTE The pressure recorded will become "0". This is the pressure required to move the plastic packing and is not included in the actual injection pressure.

NOTE The amount of pressure required to force plastic packing to flow from the Injection Gun is dependent on several factors including outside temperature and the plastic injection gun itself. The example given above is for illustration purposes only.



Fraction to Decimal Conversion Chart

FRACTION TO DECIMAL CONVERSION CHART

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES
				1/64	.016	.02					33/64	.516	.52
			1/32		.031	.03				17/32		.531	.53
				3/64	.047	.05					35/64	.547	.55
		1/16			.062	.06			9/16			.562	.56
				5/64	.078	.08					37/64	.578	.58
			3/32		.094	.09				19/32		.594	.59
				7/64	.109	.11					39/64	.609	.61
	1/8				.125	.12		5/8				.625	.62
				9/64	.141	.14					41/64	.641	.64
			5/32		.156	.16				21/32		.656	.66
				11/64	.172	.17					43/64	.672	.67
		3/16			.188	.19			11/16			.688	.69
				13/64	.203	.20					45/64	.703	.70
			7/32		.219	.22				23/32		.719	.72
				15/64	.234	.23					47/64	.734	.73
1/4					.250	.25	3/4					.750	.75
				17/64	.266	.27					49/64	.766	.77
			9/32		.281	.28				25/32		.781	.78
				19/64	.297	.30					51/64	.797	.80
		5/16			.312	.31			13/16			.812	.81
				21/64	.328	.33					53/64	.828	.83
			11/32		.344	.34				27/32		.844	.84
				23/64	.359	.36					55/64	.859	.86
	3/8				.375	.38		7/8				.875	.88
				25/64	.391	.39					57/64	.891	.89
			13/32		.406	.41				29/32		.906	.91
				27/64	.422	.42					59/64	.922	.92
		7/16			.438	.44			15/16			.938	.94
				29/64	.453	.45					61/64	.953	.95
			15/32		.469	.47				31/32		.969	.97
				31/64	.484	.48					63/64	.984	.98
1/2					.500	.50	1					1.000	1.00

Reference Documents

Refer to Operation and Maintenance Manuals and Standard Running Procedures.

Running Procedure	Description
TC-000148-02	Cameron Type FL & FLS Operation and Maintenance Manual
TC-009084-02	WKM Model M Power R-Seal Operation and Maintenance Manual
RP-002153	Make-up Requirements for API Flange Connections
RP-001558	Valve Removal Plugs
RP-003737	Standard MN-DS Housing with Landing Base Running Procedure
RP-003767	Standard MN-DS Housing through Rotary Table Running Procedure
RP-000654	Standard IC Test Plug Procedure for BOP Test
RP-003740	Standard MN-DS Intermediate Hanger Running Procedure
RP-003734	Standard Wash Tool Procedure
RP-003741	Standard MN-DS Intermediate Packoff Support Bushing Running Procedure
RP-003757	Standard MN-DS Production Packoff Running Procedure
RP-000573	Standard IC-2 Casing Hanger Running Procedure
RP-000592	Standard 'NX' Bushing Running Procedure

Document Control

Revision History

Revision	Date	Description	Prepared by:
01	April 26, 2016	Initial Release per 650205763 Houston Surface Systems Engineering	Maria Contreras
02	Draft A December 05, 2018	Revised Publication per 650356691	Eric Ayres

About this Revision

Owner: **Surface Systems Engineering - Running Procedures Department, Houston, TX**

Author: **Eric Ayres**

Reviewer:

Approver:

Released by: **Maria Contreras, SAP**

CEMENT: SURFACE

Stage Tool Depth: N/A

Lead:

Top MD of Segment:	0	Btm MD of Segment:	400
Cmt Type:	C	Cmt Additives:	1% CaCL
Quantity (sks):	291		
Yield (cu/ft/sk):	1.33	Volume (cu/ft):	387.03
Density (lbs/gal):	14.8	Percent Excess:	25%

Tail:

Top MD of Segment:		Btm MD of Segment:	
Cmt Type:		Cmt Additives:	
Quantity (sks):			
Yield (cu/ft/sk):		Volume (cu/ft):	
Density (lbs/gal):		Percent Excess:	

CEMENT: INTERMEDIATE

Single Stage

Lead:

Top MD of Segment:	0	Btm MD of Segment:	2560
Cmt Type:	C	Cmt Additives:	5% Salt + 6% Bentonite + 0.5% Suspension Aid + 0.4 #/sk Defoamer
Quantity (sks):	535		
Yield (cu/ft/sk):	1.87	Volume (cu/ft):	1000.45
Density (lbs/gal):	12.9	Percent Excess:	25%

Tail:

Top MD of Segment:	2560	Btm MD of Segment:	3200
Cmt Type:	C	Cmt Additives:	0.2% Retarder

Quantity (sks):	205		
Yield (cu/ft/sk):	1.33	Volume (cu/ft):	272.65
Density (lbs/gal):	14.8	Percent Excess:	25%

2 Stage Cement Job CONTINGENCY

* DVT depth(s) will be adjusted based on hole conditions and cement volumes will be adjusted proportionally. DVT will be set a minimum of 50 feet below previous casing and a minimum of 200 feet above current shoe. Lab reports with 500psi comp strength time for cmt will be onsite for review.

*If lost circulation is encountered, Apache may 2-stage Interm csg. A DVT may be used in the 9-5/8" csg & ECP may be placed below DVT.

1st Stage

Lead:

Top MD of Segment:	1500	Btm MD of Segment:	2560
Cmt Type:	C	Cmt Additives:	5% Salt + 6% Bentonite + 0.5% Suspension Aid + 0.4 #/sk Defoamer

Quantity (sks):	282		
Yield (cu/ft/sk):	1.87	Volume (cu/ft):	527.34
Density (lbs/gal):	12.9	Percent Excess:	25%

Tail:

Top MD of Segment:	2560	Btm MD of Segment:	3200
Cmt Type:	C	Cmt Additives:	0.2% Retarder

Quantity (sks):	205		
Yield (cu/ft/sk):	1.33	Volume (cu/ft):	396
Density (lbs/gal):	14.8	Percent Excess:	25%

Stage Tool Depth: 1500'

2nd Stage

Lead:

Top MD of Segment:	0	Btm MD of Segment:	820
Cmt Type:	C	Cmt Additives:	5% Salt + 6% Bentonite + 0.5% Suspension Aid + 0.4 #/sk Defoamer
Quantity (sks):	169		
Yield (cu/ft/sk):	1.33	Volume (cu/ft):	224.77
Density (lbs/gal):	12.9	Percent Excess:	25%

Tail:

Top MD of Segment:	820	Btm MD of Segment:	1500
Cmt Type:	C	Cmt Additives:	1-2% Calcium Chloride
Quantity (sks):	200		
Yield (cu/ft/sk):	1.33	Volume (cu/ft):	266
Density (lbs/gal):	14.8	Percent Excess:	25%

CEMENT: PRODUCTION

Stage Tool Depth: 4565

This will have an openhole completion attached to the 5-1/2" casing. 5-1/2" will crossover to 7" where a DVT will be placed at the bottom of the 7". The 5-1/2" casing will be uncemented and the 7" from the DVT to surface will be cemented.

Lead:

Top MD of Segment:	0	Btm MD of Segment:	3652
Cmt Type:	C	Cmt Additives:	5% Salt + 6% Bentonite + 0.2% Retarder + 0.4 #/sk Defoamer
Quantity (sks):	300		
Yield (cu/ft/sk):	2.03	Volume (cu/ft):	609
Density (lbs/gal):	12.6	Percent Excess:	25%

Tail:

Top MD of Segment:	3652	Btm MD of Segment:	4565

Cmt Type:	TXI Lite		Cmt Additives:	1.3% Salt + 5% Gas Migration Expansion Additive + 0.5% Fluid Loss Agent + 0.1% Anti-Settling Agent + 0.4 #/sk Defoamer
Quantity (sks):	100			
Yield (cu/ft/sk):	1.48	Volume (cu/ft):	148	
Density (lbs/gal):	13	Percent Excess:	25%	

String: **SURFACE**

Hole Size:	17.5						
Top Setting Depth (MD):	0	Top Setting Depth (TVD):	0	Btm setting depth (MD):	400	Btm setting depth (TVD):	400
Size:	13.375	Grade:	H-40	Weight (lbs/ft):	48	Joint (Butt,FJ, LTC,STC, SLH, N/A, Other):	STC

Condition (New/Used): New Standard (API/Non-API): API

Tapered String (Y/N)?: N
If yes, need spec attachment

Safety Factors

Collapse Design Safety Factor: 7.21 Burst Design Safety Factor: 1.39

Body Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Body Tensile Design Safety Factor: 3.47

Joint Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Joint Tensile Design Safety Factor: 2.07

String: **INTERMEDIATE**

Hole Size:	12.25						
Top Setting Depth (MD):	0	Top Setting Depth (TVD):	0	Btm setting depth (MD):	3200	Btm setting depth (TVD):	3200
Size:	9.625	Grade:	J-55	Weight (lbs/ft):	36	Joint (Butt,FJ, LTC,STC, SLH, N/A, Other):	LTC

Condition (New/Used): New Standard (API/Non-API): API

Tapered String (Y/N)?: N
If yes, need spec attachment

Safety Factors

Collapse Design Safety Factor: 2.19 Burst Design Safety Factor: 2.33

Body Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Body Tensile Design Safety Factor: 2.56

Joint Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Joint Tensile Design Safety Factor: 2.07

String: **PRODUCTION**

Hole Size: 8.5

Top Setting Depth (MD):	0	Top Setting Depth (TVD):	0	Btm setting depth (MD):	4565	Btm setting depth (TVD):	4565
Size:	7	Grade:	L-80	Weight (lbs/ft):	26	Joint (Butt,FJ, LTC,STC, SLH, N/A, Other):	LTC

Condition (New/Used): New Standard (API/Non-API): API

Safety Factors

Collapse Design Safety Factor: 2.64 Burst Design Safety Factor: 1.125

Body Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Body Tensile Design Safety Factor: 2.68

Joint Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Joint Tensile Design Safety Factor: 2.29

Hole Size: 8.5

String **TAPERED**

Top Setting Depth (MD):	4565	Top Setting Depth (TVD):	4565	Btm setting depth (MD):	12933	Btm setting depth (TVD):	5146
Size:	5.5	Grade:	L-80	Weight (lbs/ft):	17	Joint (Butt,FJ, LTC,STC, SLH, N/A, Other):	LTC

Condition (New/Used): New Standard (API/Non-API): API

Tapered String (Y/N)?: Y
If yes, need spec attachment

Safety Factors

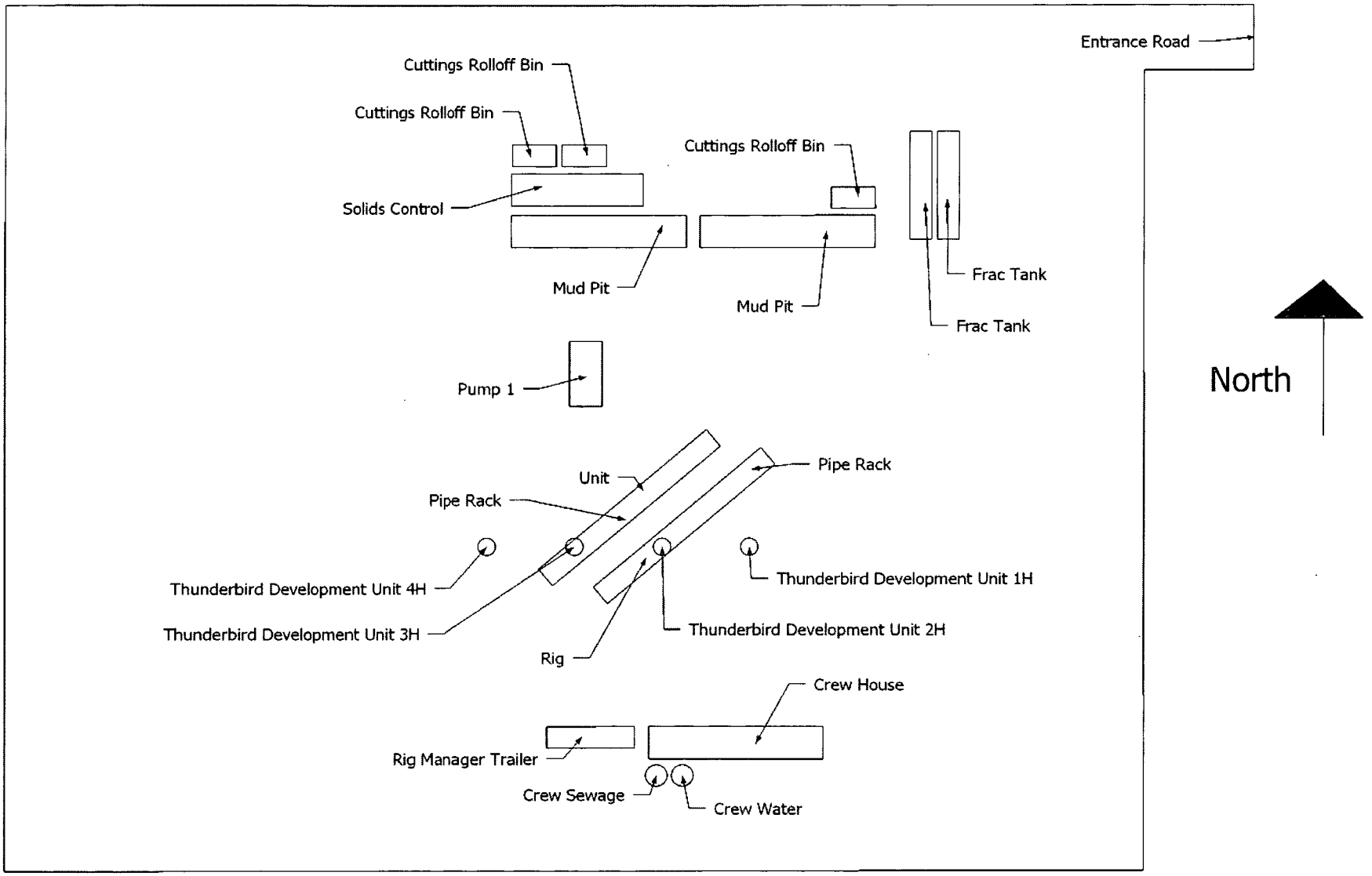
Collapse Design Safety Factor: 2.71 Burst Design Safety Factor: 1.17

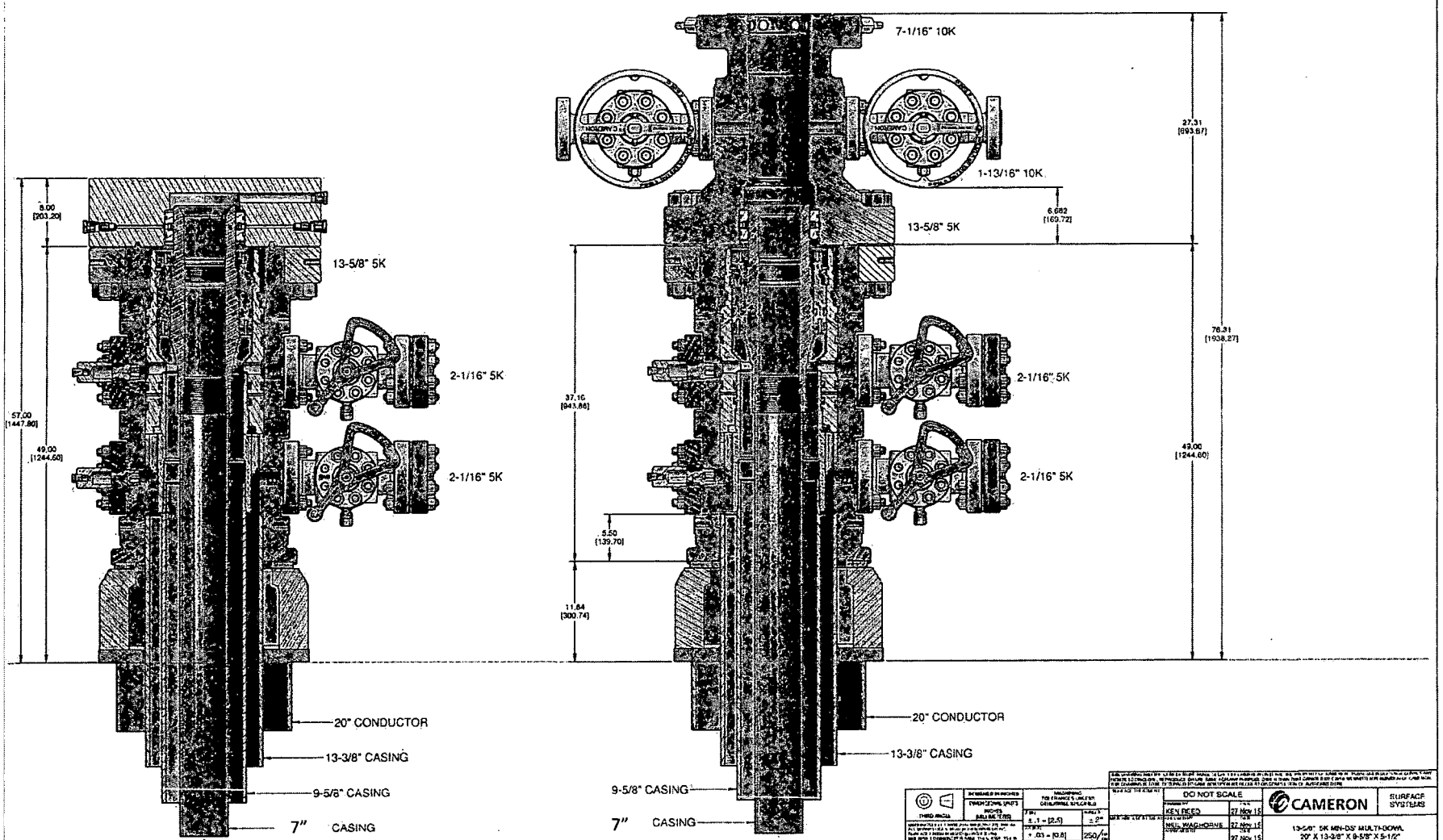
Body Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Body Tensile Design Safety Factor: 2.17

Joint Tensile Design Safety Factor type?: Dry/Buoyant Buoyant
Joint Tensile Design Safety Factor: 1.87

Apache Corp respectfully requests approval for the following changes and additions to the drilling plan:

1. Utilize a spudder rig to pre-set surface casing.
2. Description of Operations
    1. Spudder rig will move in their rig to drill the surface hole section and pre-set surface casing on the Thunderbird Development Unit 2H.
        a. After drilling the surface hole section, the rig will run casing and cement following all of the applicable rules and regulations (Onshore Oil and Gas Order No. 2).
        b. Rig will utilize fresh water based mud to drill 17-1/2" surface hole to TD. Solids control will be handled entirely on a closed loop basis.
2. The wellhead (page 3) will be installed and tested once the 13-3/8" surface casing is cut off and the WOC time has been reached.
3. A blind flange with the same pressure rating as the wellhead will be installed to seal the wellbore. Pressure will be monitored with a pressure gauge installed on the wellhead.
    a. A means for intervention will be maintained while the drilling rig is not over the well.
4. Spudder rig operations is expected to take 1-2 days on a single well pad.
5. The BLM will be contacted and notified 24 hours prior to commencing spudder rig operations.
6. Drilling operations will be performed with the drilling rig. At that time an approved BOP stack will be nippled up and tested on the wellhead before drilling operations commences on each well.
    a. The BLM will be contacted / notified 24 hours before the drilling rig moves back on to the pad with the pre-set surface casing.
7. Apache Corp will have supervision over the rig to ensure compliance with all BLM regulations and to oversee operations.
8. Once the rig is removed, Apache Corp will secure the wellhead area by placing a guard rail around the cellar area.


Entrance Road
Cuttings Rolloff Bin
Cuttings Rolloff Bin
Cuttings Rolloff Bin
Solids Control
Mud Pit
Mud Pit
Frac Tank
Frac Tank
Pump 1
North
Unit
Pipe Rack
Pipe Rack
Thunderbird Development Unit 4H
Thunderbird Development Unit 1H
Thunderbird Development Unit 3H
Thunderbird Development Unit 2H
Rig
Crew House
Rig Manager Trailer
Crew Sewage
Crew Water


7-1/16" 10K
1-13/16" 10K
13-5/8" 5K
2-1/16" 5K
2-1/16" 5K
20" CONDUCTOR
13-3/8" CASING
9-5/8" CASING
7" CASING
8.00
[203.20]
57.00
[1447.80]
49.00
[1244.60]
6.682
[169.72]
27.31
[693.67]
37.16
[943.86]
76.31
[1938.27]
49.00
[1244.00]
5.50
[139.70]
11.84
[300.74]
DO NOT SCALE
KEN REED
27 Nov 15
NEIL WAGHORN
27 Nov 15
27 Nov 15
CAMERON
SURFACE SYSTEMS
13-5/8" 5K MIN-DS MULTI-BOWL
20" X 13-3/8" X 9-5/8" X 5-1/2"
SD-045137-89-01
01

APD ID: 10400038856 **Submission Date:** 02/07/2019

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Well Type: OIL WELL **Well Work Type:** Drill

Highlighted data reflects the most recent changes

Show Final Text

Section 1 - Existing Roads

Will existing roads be used? YES

Existing Road Map:

ThunderbirdDevUnit2H_ExistingRoads_20190205163808.pdf

Existing Road Purpose: ACCESS **Row(s) Exist?** NO

ROW ID(s)

ID:

Do the existing roads need to be improved? NO

Existing Road Improvement Description:

Existing Road Improvement Attachment:

Section 2 - New or Reconstructed Access Roads

Will new roads be needed? YES

New Road Map:

ThunderbirdDevUnit1H_4H_NewRoad_20190130135553.pdf

New road type: LOCAL

Length: 231.91 Feet **Width (ft.):** 30

Max slope (%): 2 **Max grade (%):** 2

Army Corp of Engineers (ACOE) permit required? NO

ACOE Permit Number(s):

New road travel width: 14

New road access erosion control: Road will be crowned for water drainage and to control erosion

New road access plan or profile prepared? NO

New road access plan attachment:

4_Plat_Access Road_Thunderbird A 5H_6.20.16_08-18-2016.pdf

Access road engineering design? NO

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Access road engineering design attachment:

Turnout? N

Access surfacing type: NONE

Access topsoil source: ONSITE

Access surfacing type description: Caliche

Access onsite topsoil source depth: 6

Offsite topsoil source description:

Onsite topsoil removal process: Push top 6"

Access other construction information:

Access miscellaneous information:

Number of access turnouts: 0 **Access turnout map:**

Drainage Control

New road drainage crossing: OTHER

Drainage Control comments: Road will be crowned for water drainage

Road Drainage Control Structures (DCS) description: Road will be crowned to allow for water drainage

Road Drainage Control Structures (DCS) attachment:

Access Additional Attachments

Section 3 - Location of Existing Wells

Existing Wells Map? YES

Attach Well map:

ThunderbirdDevUnit2H_1MiRadius_20190207090259.pdf

Section 4 - Location of Existing and/or Proposed Production Facilities

Submit or defer a Proposed Production Facilities plan? SUBMIT

Production Facilities description: A pipeline to transport gas/emulsion will be installed from the proposed wellpad to the approved battery facility. Apache plans to install a 10 inch buried SDR-7 gas line rated 135psi, operating pressure at 80psi and 6 inch buried emulsion flexflow line rated 750psi operating pressure at 350psi from the proposed well to the offsite production facility (battery approved on APD for Thunderbird A #5H). The proposed length of the pipeline will be 1583.73 feet. A 30 feet wide disturbance will be needed to install the buried pipeline. In areas where blading is allowed, topsoil will be stockpiled and separated from the excavated trench mineral material. Final reclamation procedures will match procedures in plans for surface reclamation. When excavated soil is backfilled, it will be compacted to prevent subsidence. No berm over pipeline will be evident. The proposed pipeline does not cross lease boundaries, so a ROW will not need to be acquired from BLM.

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Production Facilities map:

ThunderbirddevUnit_Battery_20190130140011.pdf

ThunderbirdDevUnit1H_4H_ProdLinePlat_REV_8.27.19_20190827150046.pdf

Section 5 - Location and Types of Water Supply

Water Source Table

Water source type: GW WELL

Water source use type: INTERMEDIATE/PRODUCTION CASING
SURFACE CASING

Source latitude: 32.819386 **Source longitude:** -103.98483

Source datum: NAD83

Water source permit type: PRIVATE CONTRACT

Water source transport method: TRUCKING

Source land ownership: PRIVATE

Source transportation land ownership: PRIVATE

Water source volume (barrels): 2214.2856 **Source volume (acre-feet):** 0.28540614

Source volume (gal): 93000

Water source type: OTHER

Describe type: Brine

Water source use type: INTERMEDIATE/PRODUCTION CASING

Source latitude: 32.87279 **Source longitude:** -103.5045

Source datum: NAD83

Water source permit type: PRIVATE CONTRACT

Water source transport method: TRUCKING

Source land ownership: STATE

Source transportation land ownership: INDIAN (TRIBAL/ALLOTTED)

Water source volume (barrels): 2214.2856 **Source volume (acre-feet):** 0.28540614

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Source volume (gal): 93000

Water source and transportation map:

ThunderbirdDevUnit_BrineWaterSources_20190130143811.pdf

ThunderbirdDevUnit_FreshWaterSources_20190130143812.pdf

Water source comments:

New water well? NO

New Water Well Info

Well latitude: **Well Longitude:** **Well datum:**

Well target aquifer:

Est. depth to top of aquifer(ft): **Est thickness of aquifer:**

Aquifer comments:

Aquifer documentation:

Well depth (ft): **Well casing type:**

Well casing outside diameter (in.): **Well casing inside diameter (in.):**

New water well casing? **Used casing source:**

Drilling method: **Drill material:**

Grout material: **Grout depth:**

Casing length (ft.): **Casing top depth (ft.):**

Well Production type: **Completion Method:**

Water well additional information:

State appropriation permit:

Additional information attachment:

Section 6 - Construction Materials

Using any construction materials: YES

Construction Materials description: Caliche from State caliche pit - Sec 36, T15S, R29E

Construction Materials source location attachment:

ThunderbirdDevUnit1H_2H_3H_4H_CalichePitMap_20190827150127.pdf

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Section 7 - Methods for Handling Waste

Waste type: GARBAGE

Waste content description: Household garbage, trash and non-toxic mud sacks

Amount of waste: 1500 pounds

Waste disposal frequency : Weekly

Safe containment description: Garbage will be disposed off in portable trash trailers

Safe containmant attachment:

Waste disposal type: OTHER **Disposal location ownership:** STATE

Disposal type description: Private Land Fill

Disposal location description: Lea County Landfill

Waste type: SEWAGE

Waste content description: Human waste and grey water

Amount of waste: 2000 gallons

Waste disposal frequency : Weekly

Safe containment description: Sewage will be stored in steel waste tanks

Safe containmant attachment:

Waste disposal type: OTHER **Disposal location ownership:** STATE

Disposal type description: Municipal waste facility

Disposal location description: Hobbs Municipal Waste Facility

Waste type: DRILLING

Waste content description: Excess cement returns

Amount of waste: 40 barrels

Waste disposal frequency : Weekly

Safe containment description: Cement returns will be stored in steel roll off bins then transferred to disposal vacuum trucks

Safe containmant attachment:

Waste disposal type: OTHER **Disposal location ownership:** PRIVATE

Disposal type description: Haul to private facility

Disposal location description: R360, 6601 W. Hobbs Hwy, Carlsbad, NM, 88220

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Waste type: DRILLING

Waste content description: Drilling fluid from well, during drilling operations, will be stored safely and recycled to next well. Any excess will be hauled to approved NMOCD disposal facility

Amount of waste: 3600 barrels

Waste disposal frequency : One Time Only

Safe containment description: Drilling fluids will be stored in sealed frac tanks

Safe containmant attachment:

Waste disposal type: RECYCLE **Disposal location ownership:** OTHER

Disposal type description:

Disposal location description: Operators next well

Reserve Pit

Reserve Pit being used? NO

Temporary disposal of produced water into reserve pit?

Reserve pit length (ft.) **Reserve pit width (ft.)**

Reserve pit depth (ft.) **Reserve pit volume (cu. yd.)**

Is at least 50% of the reserve pit in cut?

Reserve pit liner

Reserve pit liner specifications and installation description

Cuttings Area

Cuttings Area being used? NO

Are you storing cuttings on location? YES

Description of cuttings location Cuttings will be stored in steel haul off bins & taken to an NMOCD approved disposal facility

Cuttings area length (ft.) **Cuttings area width (ft.)**

Cuttings area depth (ft.) **Cuttings area volume (cu. yd.)**

Is at least 50% of the cuttings area in cut?

WCuttings area liner

Cuttings area liner specifications and installation description

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Section 8 - Ancillary Facilities

Are you requesting any Ancillary Facilities?: NO

Ancillary Facilities attachment:

Comments:

Section 9 - Well Site Layout

Well Site Layout Diagram:

ThunderbirdDevUnit2H_WellPadPlat_20190207080021.pdf

ThunderbirdDevUnit1H_2H_3H_4H_RigLayoutDiagram_20190207080137.pdf

Comments:

Section 10 - Plans for Surface Reclamation

Type of disturbance: New Surface Disturbance

Multiple Well Pad Name: PAD 1

Multiple Well Pad Number: 2H

Recontouring attachment:

Drainage/Erosion control construction: Slight slope for water drainage

Drainage/Erosion control reclamation: Reclamation is going to follow natural terrain to control erosion, runoff and siltation of surrounding area

Well pad proposed disturbance (acres): 4.775

Road proposed disturbance (acres): 0.16

Powerline proposed disturbance (acres): 0.918

Pipeline proposed disturbance (acres): 1.091

Other proposed disturbance (acres): 0

Total proposed disturbance: 6.944

Well pad interim reclamation (acres): 1.79

Road interim reclamation (acres): 0.16

Powerline interim reclamation (acres): 0

Pipeline interim reclamation (acres): 0

Other interim reclamation (acres): 0

Total interim reclamation: 1.95

Well pad long term disturbance (acres): 2.98

Road long term disturbance (acres): 0.16

Powerline long term disturbance (acres): 0.918

Pipeline long term disturbance (acres): 0

Other long term disturbance (acres): 0

Total long term disturbance: 4.058

Disturbance Comments: Other long term/short term disturbance will be for installation of electrical line approx. 1332.27' in length and 30' wide for construction

Reconstruction method: Areas planned for interim reclamation will be contoured to original contour if feasible, or if not feasible, to an interim contour that blends with surrounding topography as much as possible. Where applicable, fill material of well pad will be back filled into the cut to bring area back to original contour.

Topsoil redistribution: Topsoil that was spread over interim reclamation areas will be stockpiled prior to recontouring. Topsoil will be redistributed evenly over entire disturbed site to ensure successful revegetation

Soil treatment: No soil treatment expected

Existing Vegetation at the well pad:

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Existing Vegetation at the well pad attachment:

Existing Vegetation Community at the road:

Existing Vegetation Community at the road attachment:

Existing Vegetation Community at the pipeline:

Existing Vegetation Community at the pipeline attachment:

Existing Vegetation Community at other disturbances:

Existing Vegetation Community at other disturbances attachment:

Non native seed used? NO

Non native seed description:

Seedling transplant description:

Will seedlings be transplanted for this project? NO

Seedling transplant description attachment:

Will seed be harvested for use in site reclamation? NO

Seed harvest description:

Seed harvest description attachment:

Seed Management

Seed Table

Seed type:

Seed source:

Seed name:

Source name:

Source address:

Source phone:

Seed cultivar:

Seed use location:

PLS pounds per acre:

Proposed seeding season:

Total pounds/Acre:

Seed Summary	
Seed Type	**Pounds/Acre**

Seed reclamation attachment:

Operator Contact/Responsible Official Contact Info

First Name: **Last Name:**

Phone: **Email:**

Seedbed prep:

Seed BMP:

Seed method:

Existing invasive species? NO

Existing invasive species treatment description:

Existing invasive species treatment attachment:

Weed treatment plan description: Operator will consult with authorized officer for acceptable weed control methods, which include following EPA and BLM requirements and policies.
Weed treatment plan attachment:

Monitoring plan description: Interim reclamation, reclaimed areas, will be monitored periodically to ensure vegetation has re-established, that area is not redisturbed, and erosion is controlled
Monitoring plan attachment:

Success standards: Objective of interim reclamation is to resore vegetative cover and a portion of landform sufficient to maintain healthy, biologically active topsoil, control erosion, and minimize habitat and forage loss, visual impact, and weed infestation during life of well or facilities. Long term objective of final reclamation is to return land to a condition similar to what existed prior to disturbance. This includes restoration of landform and natural vegetative community, hydrologic systems, visual resources, and wildlife habitats. To ensure that the long term objective will be reached through human and natural processes, actions will be taken to ensure standards are met for site stability, visual quality, hydrological functioning, and vegetative productivity. BLM will be notified 3 days prior to commencement of any reclamation procedures. If circumstances allow, interim and/or final reclamation actions will be completed no later than 6 months from when the final well on location has been completed or plugged. We will gain written permission from BLM if more time is needed.
Pit closure description: Not applicable

Pit closure attachment:

Section 11 - Surface Ownership

Disturbance type: WELL PAD

Describe:

Surface Owner: BUREAU OF LAND MANAGEMENT

Other surface owner description:

BIA Local Office:

BOR Local Office:

COE Local Office:

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

DOD Local Office:

NPS Local Office:

State Local Office:

Military Local Office:

USFWS Local Office:

Other Local Office:

USFS Region:

USFS Forest/Grassland: **USFS Ranger District:**

Disturbance type: PIPELINE

Describe:

Surface Owner: BUREAU OF LAND MANAGEMENT

Other surface owner description:

BIA Local Office:

BOR Local Office:

COE Local Office:

DOD Local Office:

NPS Local Office:

State Local Office:

Military Local Office:

USFWS Local Office:

Other Local Office:

USFS Region:

USFS Forest/Grassland: **USFS Ranger District:**

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Disturbance type: NEW ACCESS ROAD

Describe:

Surface Owner: BUREAU OF LAND MANAGEMENT

Other surface owner description:

BIA Local Office:

BOR Local Office:

COE Local Office:

DOD Local Office:

NPS Local Office:

State Local Office:

Military Local Office:

USFWS Local Office:

Other Local Office:

USFS Region:

USFS Forest/Grassland: **USFS Ranger District:**

Disturbance type: OTHER

Describe: ELECTRIC LINE

Surface Owner: BUREAU OF LAND MANAGEMENT

Other surface owner description:

BIA Local Office:

BOR Local Office:

COE Local Office:

DOD Local Office:

NPS Local Office:

State Local Office:

Military Local Office:

USFWS Local Office:

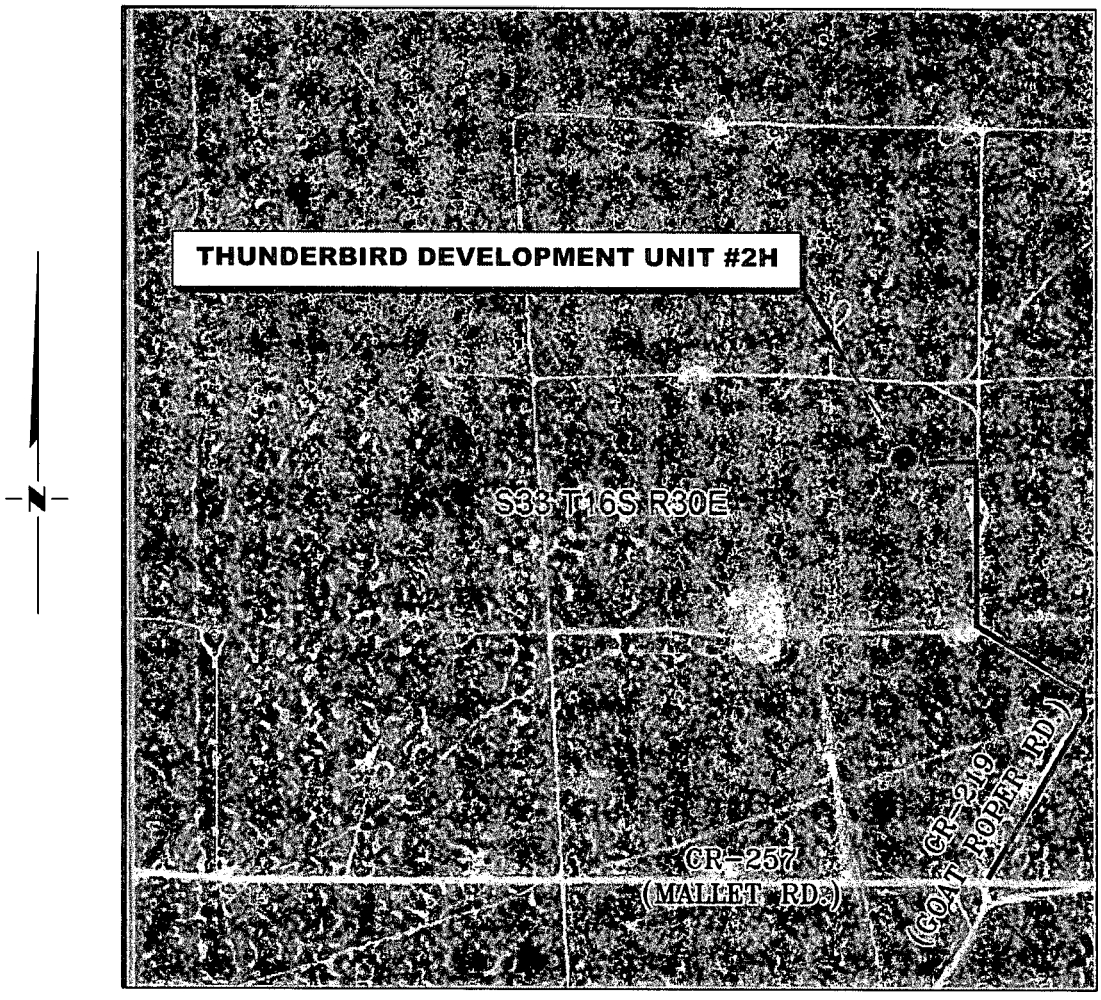
Other Local Office:

USFS Region:

USFS Forest/Grassland: **USFS Ranger District:**

VICINITY MAP

NOT TO SCALE



SECTION 33, TWP. 16 SOUTH, RGE. 30 EAST,
N. M. P. M., EDDY CO., NEW MEXICO

OPERATOR: Apache Corporation
LEASE: Thunderbird Development Unit
WELL NO.: 2H

LOCATION: 2411' FNL & 1050' FEL
ELEVATION: 3738'

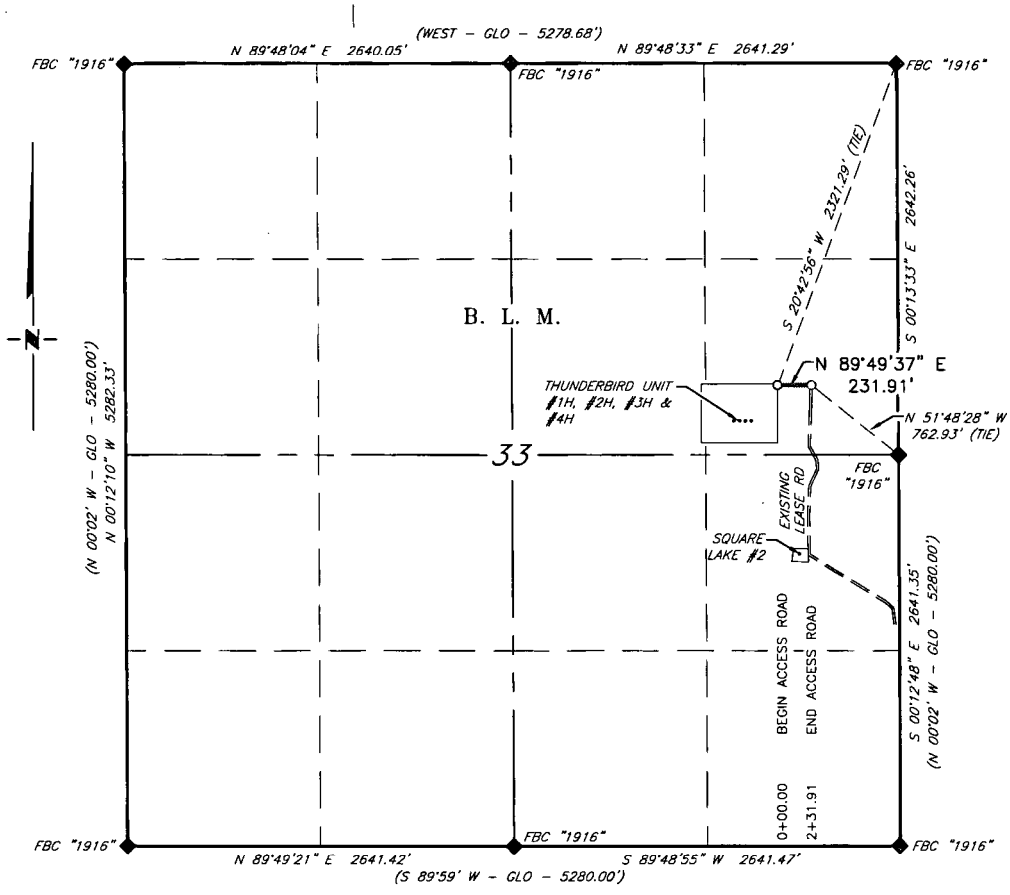
NO.	REVISION	DATE
	WELL NAME	1.30.19

JOB NO.: LS1605192
DWG. NO.: 1605192VM

RRC
SURVEYING, LLC
701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: NTS
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

APACHE CORPORATION
PROPOSED ACCESS ROAD
FOR THE THUNDERBIRD DEV UNIT#1H, #2H, #3H & #4H WELL LOCATIONS
SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO



DESCRIPTION

A strip of land 30 feet wide, being 231.91 feet or 14.055 rods in length, lying in Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, being 15 feet left and 15 feet right of the following described survey of a centerline across B. L. M. land:

BEGINNING at Engr. Sta. 0+00, a point in the Northeast quarter of Section 33, which bears, S 20°42'56" W, 2,321.29 feet, from a brass cap, stamped "1916", found for the Northeast corner of Section 33;

Thence N 89°49'37" E, 231.91 feet, to Engr. Sta. 2+31.91, the End of Survey, a point in the Northeast quarter of Section 33, which bears, N 51°48'28" W, 762.93 feet, from a brass cap, stamped "1916", found for the East quarter corner of Section 33.

Said strip of land contains 0.160 acres, more or less, and is allocated by forties as follows:

SW 1/4 NE 1/4	14.055 Rods	0.160 Acres

SCALE: 1" = 1000'
0 500' 1000'

BEARINGS ARE GRID NAD 27 NM EAST
DISTANCES ARE HORIZ. GROUND.

LEGEND

( ) RECORD DATA - GLO

◆ FOUND MONUMENT AS NOTED

PROPOSED ACCESS ROAD

I, R. M. Howett, a N. M. Professional Surveyor, hereby certify that I prepared this plat from an actual survey made on the ground under my direct supervision, said survey and plat meet the Min. Stds. for Land Surveying in the State of N. M. and are true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett NM PS 19680

ROBERT M. HOWETT NEW MEXICO 19680 6/07/16 PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

NO.	REVISION	DATE

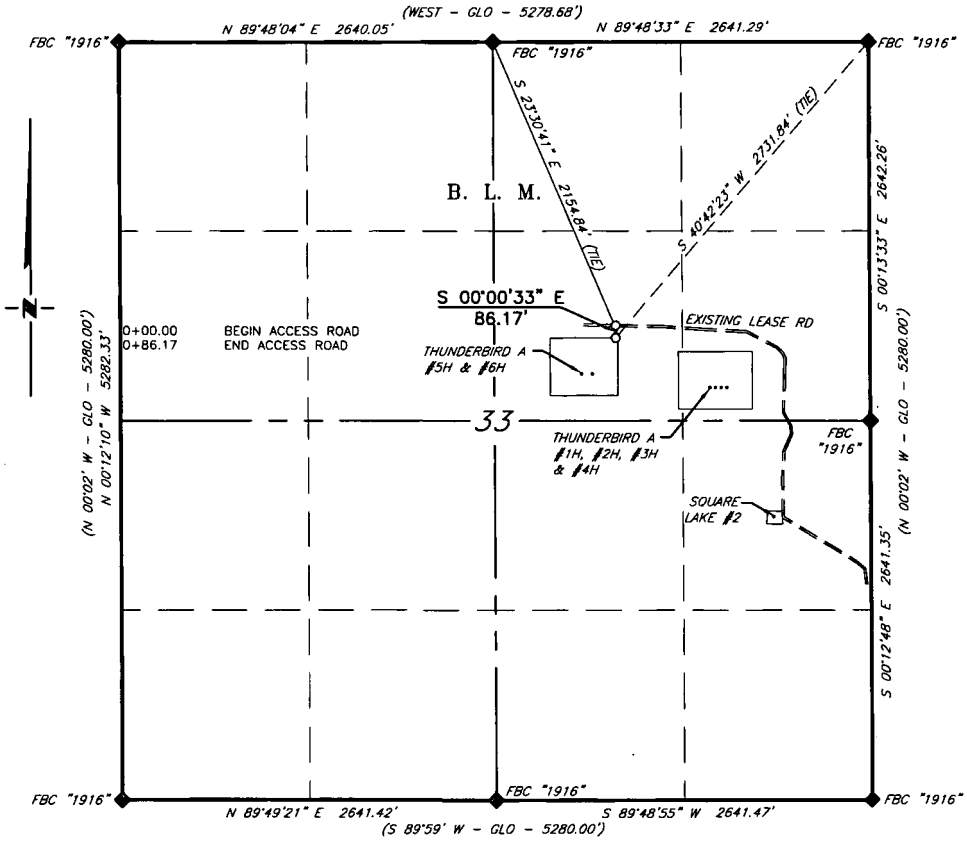
JOB NO.: LS1605191RD
DWG. NO.: 1605191-1

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

APACHE CORPORATION
PROPOSED ACCESS ROAD
FOR THE THUNDERBIRD A #5H & #6H WELL LOCATIONS
SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO



DESCRIPTION

A strip of land 30 feet wide, being 86.17 feet or 5.222 rods in length, lying in Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, being 15 feet left and 15 feet right of the following described survey of a centerline across B. L. M. land:

BEGINNING at Engr. Sta. 0+00, a point in the Northeast quarter of Section 33, which bears, S 23°30'41" E, 2,154.84 feet, from a brass cap, stamped "1916", found for the North quarter corner of Section 33;

Thence S 00°00'33" E, 86.17 feet, to Engr. Sta. 0+86.17, the End of Survey, a point in the Northeast quarter of Section 33, which bears, S 40°42'23" W, 2,731.84 feet, from a brass cap, stamped "1916", found for the Northeast corner of Section 33.

Said strip of land contains 0.059 acres, more or less, and is allocated by forties as follows:

SW 1/4 NE 1/4	5.222 Rods	0.059 Acres

SCALE: 1" = 1000'
0 500' 1000'

BEARINGS ARE GRID NAD 27 NM EAST
DISTANCES ARE HORIZ. GROUND.

LEGEND
( ) RECORD DATA - GLO
◆ FOUND MONUMENT AS NOTED
PROPOSED ACCESS ROAD

I, R. M. Howett, a N. M. Professional Surveyor, hereby certify that I prepared this plat from an actual survey made on the ground under my direct supervision, said survey and plat meet the Min. Stds. for Land Surveying in the State of N. M. and are true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett NM PS 19680

ROBERT M. HOWETT NEW MEXICO 19680 6/17/16 PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

NO.	REVISION	DATE

JOB NO.: LS1605195RD
DWG. NO.: 1605195-1

RRC

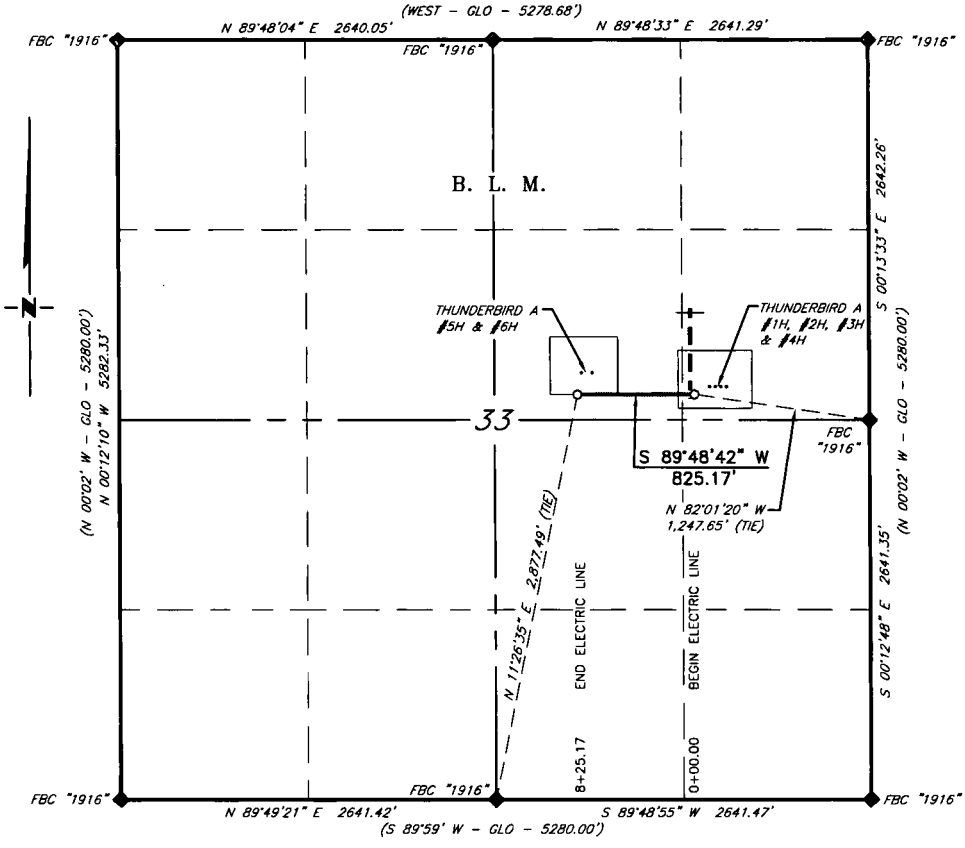
308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: BC/HD
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

APACHE CORPORATION

PROPOSED ELECTRIC LINE FROM THE THUNDERBIRD A #1H, #2H, #3H & #4H TO THE THUNDERBIRD A #5H & #10H WELL LOCATIONS

SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO



DESCRIPTION

A strip of land 30 feet wide, being 825.17 feet or 50.010 rods in length, lying in Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, being 15 feet left and 15 feet right of the following described survey of a centerline across B. L. M. land:

BEGINNING at Engr. Sta. 0+00, a point in the Northeast quarter of Section 33, which bears, N 82°01'20" W, 1,247.65 feet, from a brass cap, stamped "1916", found for the East quarter corner of Section 33;

Thence S 89°48'42" W, 825.17 feet, to Engr. Sta. 8+25.17, the End of Survey, a point in the Northeast quarter of Section 33, which bears, N 11°26'35" E, 2,877.49 feet, from a brass cap, stamped "1916", found for the South quarter corner of Section 33.

Said strip of land contains 0.568 acres, more or less, and is allocated by forties as follows:

SE 1/4 NE 1/4	5.208 Rods	0.059 Acres
SW 1/4 NE 1/4	44.802 Rods	0.509 Acres

SCALE: 1" = 1000'
0 500' 1000'

BEARINGS ARE GRID NAD 27 NM EAST
DISTANCES ARE HORIZ. GROUND.

LEGEND
( ) RECORD DATA - GLO
◆ FOUND MONUMENT AS NOTED
PROPOSED ELECTRIC LINE

I, R. M. Howett, a N. M. Professional Surveyor, hereby certify that I prepared this plat from an actual survey made on the ground under my direct supervision, said survey and plat meet the Min. Stds. for Land Surveying in the State of N. M. and are true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett NM PS 19680

ROBERT M. HOWETT NEW MEXICO 19680 6/17/16 PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

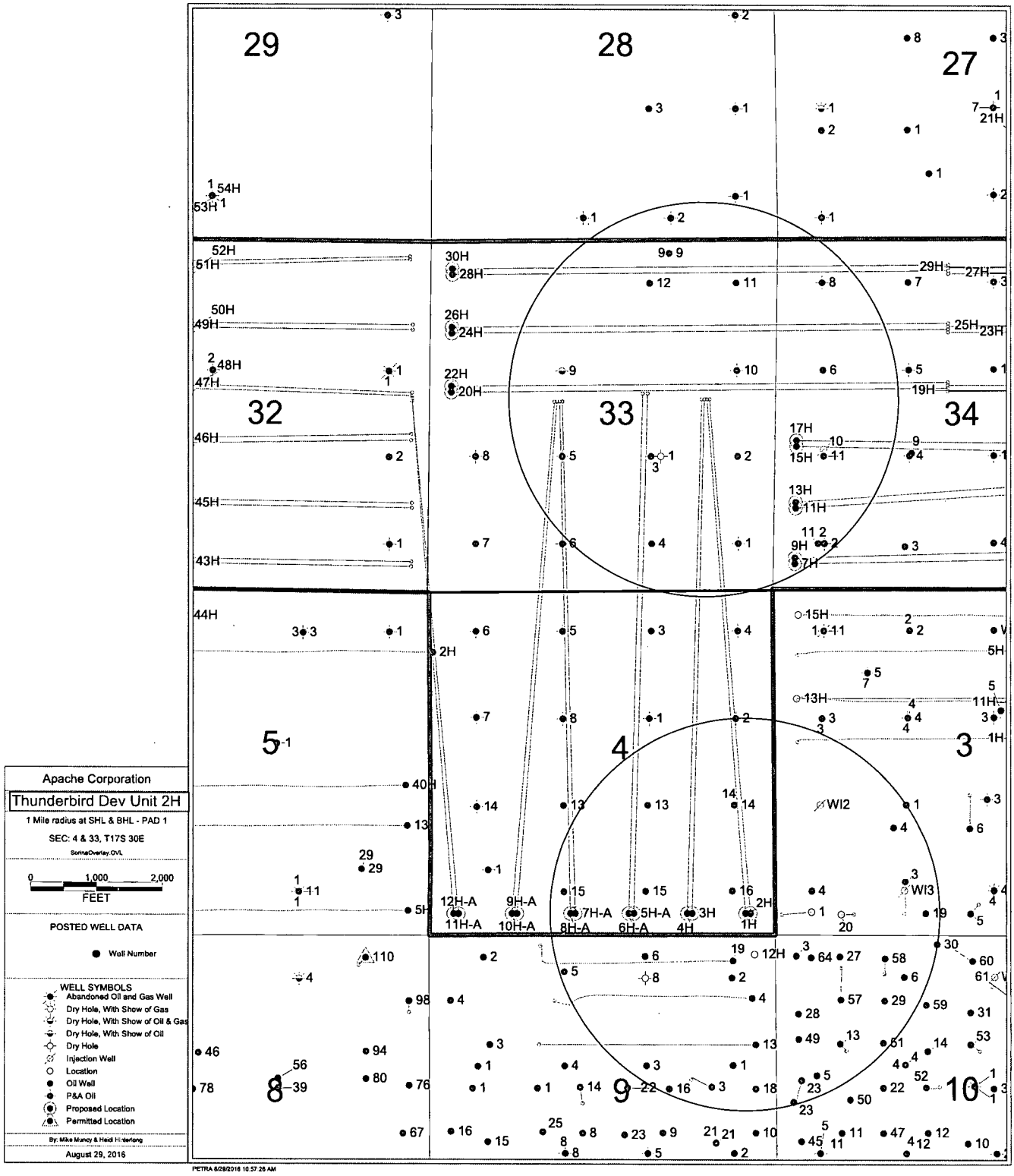
NO.	REVISION	DATE

JOB NO.: LS1605195EL
DWG. NO.: 1605195-1

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: BC/HD
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1


Apache Corporation
Thunderbird Dev Unit 2H
1 Mile radius at SHL & BHL - PAD 1
SEC: 4 & 33, T17S 30E
SonnaOverlay.OVL
0 1,000 2,000
FEET
POSTED WELL DATA
Well Number
WELL SYMBOLS
Abandoned Oil and Gas Well
Dry Hole, With Show of Gas
Dry Hole, With Show of Oil & Gas
Dry Hole, With Show of Oil
Dry Hole
Injection Well
Location
Oil Well
P&A Oil
Proposed Location
Permitted Location
By: Mike Muncy & Heidi Hinterlong
August 29, 2016
PETRA 8/29/2016 10:57:26 AM
29
28
27
32
33
34
5
4
3
8
9
10
54H
53H
52H
51H
50H
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48H
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27H
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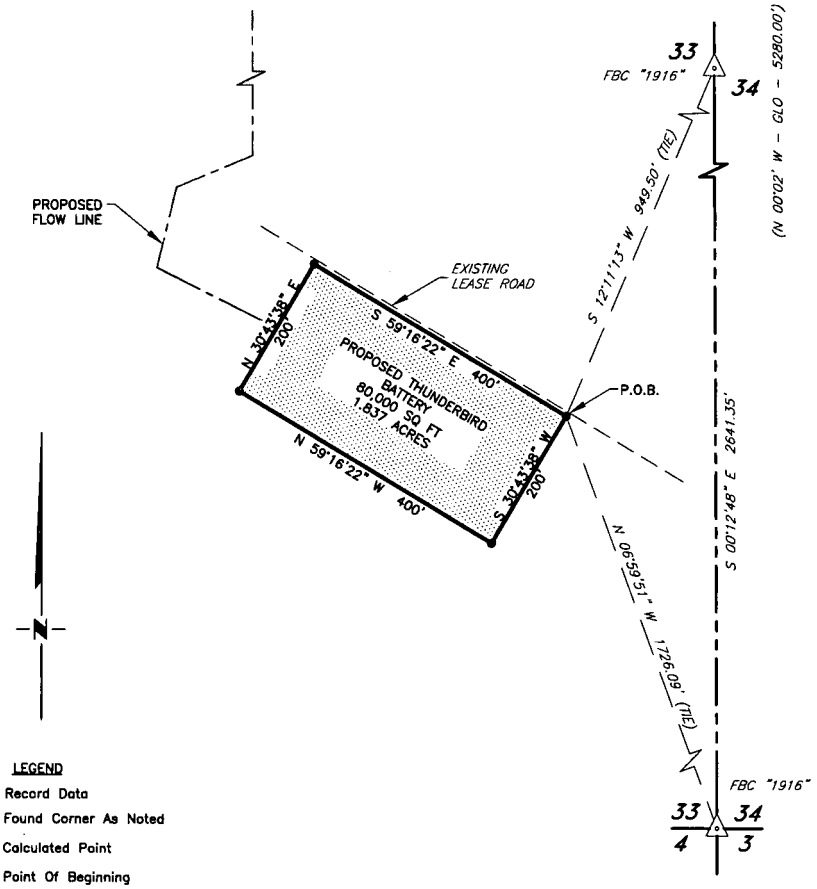
24H
25H
23H
22H
20H
19H
17H
15H
13H
11H
9H
7H
21H
2H
5H
40H
13H
1H
12H-A
11H-A
9H-A
10H-A
7H-A
8H-A
5H-A
6H-A
3H
4H
2H
1H
WI2
WI3

APACHE CORPORATION
SURVEY OF THE PROPOSED THUNDERBIRD BATTERY SITUATED WITHIN THE NE 1/4, SE 1/4, SECTION 33, TOWNSHIP 16 SOUTH, RANGE 30 EAST, N. M. P. M., EDDY CO., NEW MEXICO



LEGEND

(-GLO-)	Record Data
△	Found Corner As Noted
●	Calculated Point
P.O.B.	Point Of Beginning

SCALE: 1" = 200'
0 200'

BEARINGS ARE NAD 27 GRID NM EAST & DISTANCES ARE HORIZ. GROUND.

ROBERT M. HOWETT NEW MEXICO 19680 PROFESSIONAL SURVEYOR

I, Robert M. Howett, New Mexico Professional Surveyor No. 19680, do hereby certify that this survey plat and the actual survey on the ground upon which it is based was performed under my direct supervision and this survey meets the minimum standards for surveying in the State of New Mexico and is true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett
Date: 6/17/2016

Firm No.: TX 10193838 NM 4655451

DESCRIPTION

A tract of land situated within the Northeast quarter, of the Southeast quarter of Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, across B. L. M. land, and being more particularly described by metes and bounds as follows:

BEGINNING at a point, which bears N 06°59'51" W, 1,726.09 feet, from a brass cap, stamped "1916", found for the Southeast corner of Section 33 and being S 12°11'13" W, 949.50 feet, from a brass cap, stamped "1916", found for the East quarter corner of Section 33;

Thence S 30°43'38" W, 200 feet, to a point;

Thence N 59°16'22" W, 400 feet, to a point;

Thence N 30°43'38" E, 200 feet, to a point;

Thence S 59°16'22" E, 400 feet, to the Point Of Beginning.

Said tract of land contains 80,000 square feet or 1.837 acres, more or less.

NO.	REVISION	DATE

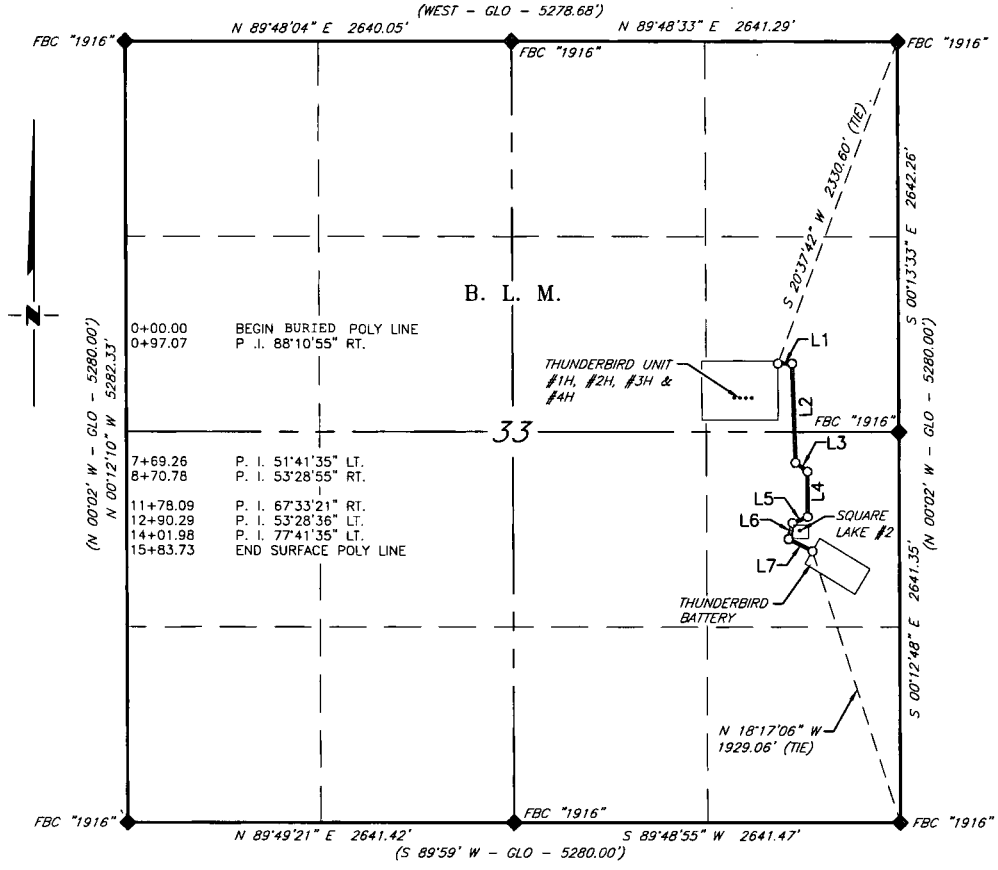
JOB NO.: LS1606200
DWG. NO.: 1606200BT

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE:	1"=200'
DATE:	6-1-2016
SURVEYED BY:	BC/HD
DRAWN BY:	CMJ
APPROVED BY:	RMH
SHEET :	1 OF 1

APACHE CORPORATION
PROPOSED BURIED POLY LINE
FROM THE THUNDERBIRD DEVELOPMENT UNIT #1H, #2H, #3H, #4H
TO THE THUNDERBIRD BATTERY
SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO



LINE TABLE		
LINE	BEARING	LENGTH
L1	N 89°49'33" E	97.07'
L2	S 01°59'32" E	672.19'
L3	S 53°41'07" E	101.52'
L4	S 00°12'12" E	307.31'
L5	S 67°21'09" W	112.20'
L6	S 13°52'33" W	111.69'
L7	S 63°49'02" E	181.75'

SCALE: 1" = 1000'
0 500' 1000'

BEARINGS ARE GRID NAD 27 NM EAST
DISTANCES ARE HORIZ. GROUND.

LEGEND

( ) RECORD DATA - GLO

◆ FOUND MONUMENT AS NOTED

PROPOSED SURFACE POLY LINE

I, R. M. Howett, a N. M. Professional Surveyor, hereby certify that I prepared this plat from an actual survey made on the ground under my direct supervision, said survey and plot meet the Min. Stds. for Land Surveying in the State of N. M. and are true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett NM PS 19680

ROBERT M. HOWETT NEW MEXICO 19680 6/07/16 PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

NO.	REVISION	DATE

JOB NO.: LS1605191PL
DWG. NO.: 1605191-1

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 2

APACHE CORPORATION
PROPOSED BURIED POLY LINE
FROM THE THUNDERBIRD DEVELOPMENT UNIT #1H, #2H, #3H, #4H
TO THE THUNDERBIRD BATTERY
SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO

DESCRIPTION

A strip of land 30 feet wide, being 1,583.73 feet or 95.984 rods in length, lying in Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, being 15 feet left and 15 feet right of the following described survey of a centerline across B. L. M. land:

BEGINNING at Engr. Sta. 0+00, a point in the Northeast quarter of Section 33, which bears, S 20°37'42" W, 2,330.60 feet, from a brass cap, stamped "1916", found for the Northeast corner of Section 33;

Thence N 89°49'33" E, 97.07 feet, to Engr. Sta. 0+97.07, a P. I. of 88°10'55" right;

Thence S 01°59'32" E, 672.19 feet, to Engr. Sta. 7+69.26, a P. I. of 51°41'35" left;

Thence S 53°41'07" E, 101.52 feet, to Engr. Sta. 8+70.78, a P. I. of 53°28'55" right;

Thence S 00°12'12" E, 307.31 feet, to Engr. Sta. 11+78.09, a P. I. of 67°33'21" right;

Thence S 67°21'09" W, 112.20 feet, to Engr. Sta. 12+90.29, a P. I. of 53°28'36" left;

Thence S 13°52'33" W, 111.69 feet, to Engr. Sta. 14+01.98, a P. I. of 77°41'35" left;

Thence S 63°49'02" E, 181.75 feet, to Engr. Sta. 15+83.73, the End of Survey, a point in the Southeast quarter of Section 33, which bears, N 18°17'06" W, 1,929.06 feet, from a brass cap, stamped "1916", found for the Southeast corner of Section 33.

Said strip of land contains 1.091 acres, more or less, and is allocated by forties as follows:

SW 1/4 NE 1/4	34.001 Rods	0.386 Acres
NE 1/4 SE 1/4	61.983 Rods	0.705 Acres

NO.	REVISION	DATE

JOB NO.: LS1605191PL

DWG. NO.: 1605191-2

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'

DATE: 6-01-2016

SURVEYED BY: ML/CG

DRAWN BY: LPS

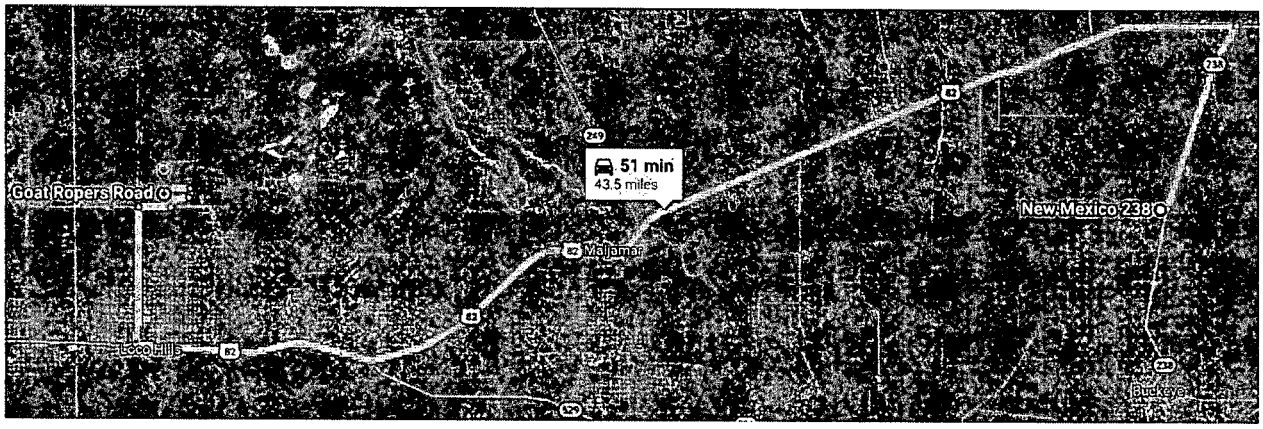
APPROVED BY: RMH

SHEET : 2 OF 2

Thunderbird 1H Brine Water Sources

Source:

Wesserhund



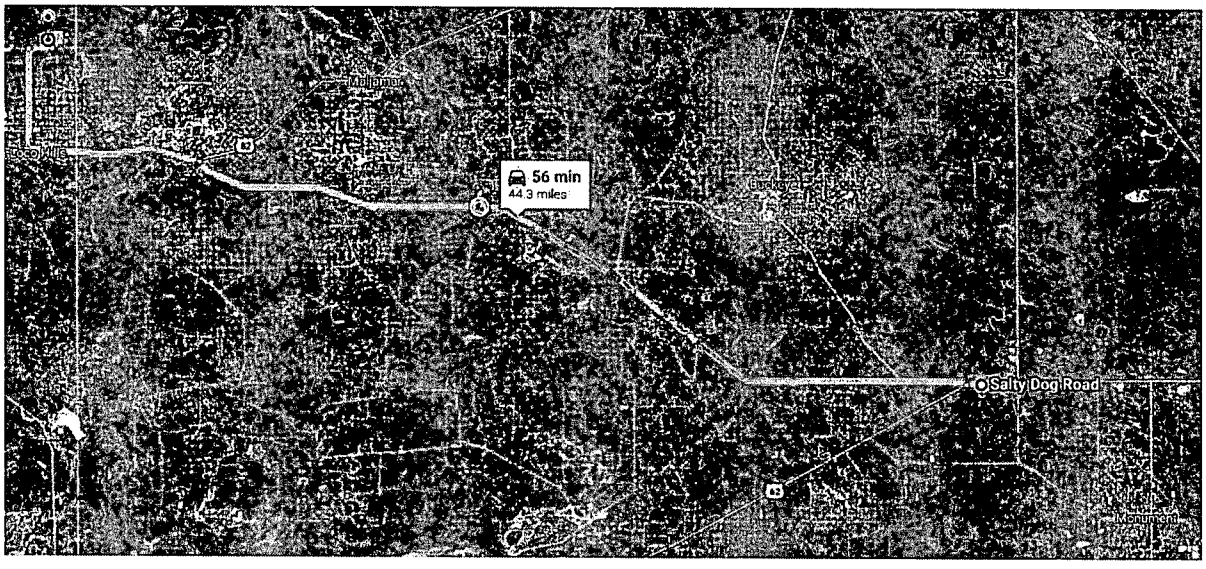
New Mexico 238
Lovington, NM 88260

- Head north on NM-238 N
  5.3 mi
- Turn left onto US-82 W
  32.3 mi
- Turn right onto Hagerman Cutoff Rd
  3.7 mi
- Turn right onto Mallett Rd
  0.9 mi
- Turn left at the 1st cross street onto Goat Ropers Rd
  0.6 mi
- Turn left
  0.2 mi
- Turn left
  0.4 mi

Destination: Thunderbird 1H

Source:

Salty Dog



Salty Dog Road
Hobbs, NM 88240

1. Head north on Salty Dog Rd toward US-180 E/US-62 E
22 s (453 ft)

Take NM-529 to Hagerman Cutoff Rd in Loco Hills
38 min (38.4 mi)

2. Turn left at the 1st cross street onto US-180 W/US-62 W
0.9 mi
3. Turn right onto NM-529
31.0 mi
4. Turn left onto US-82 W
6.6 mi

Continue on Hagerman Cutoff Rd to your destination
13 min (5.9 mi)

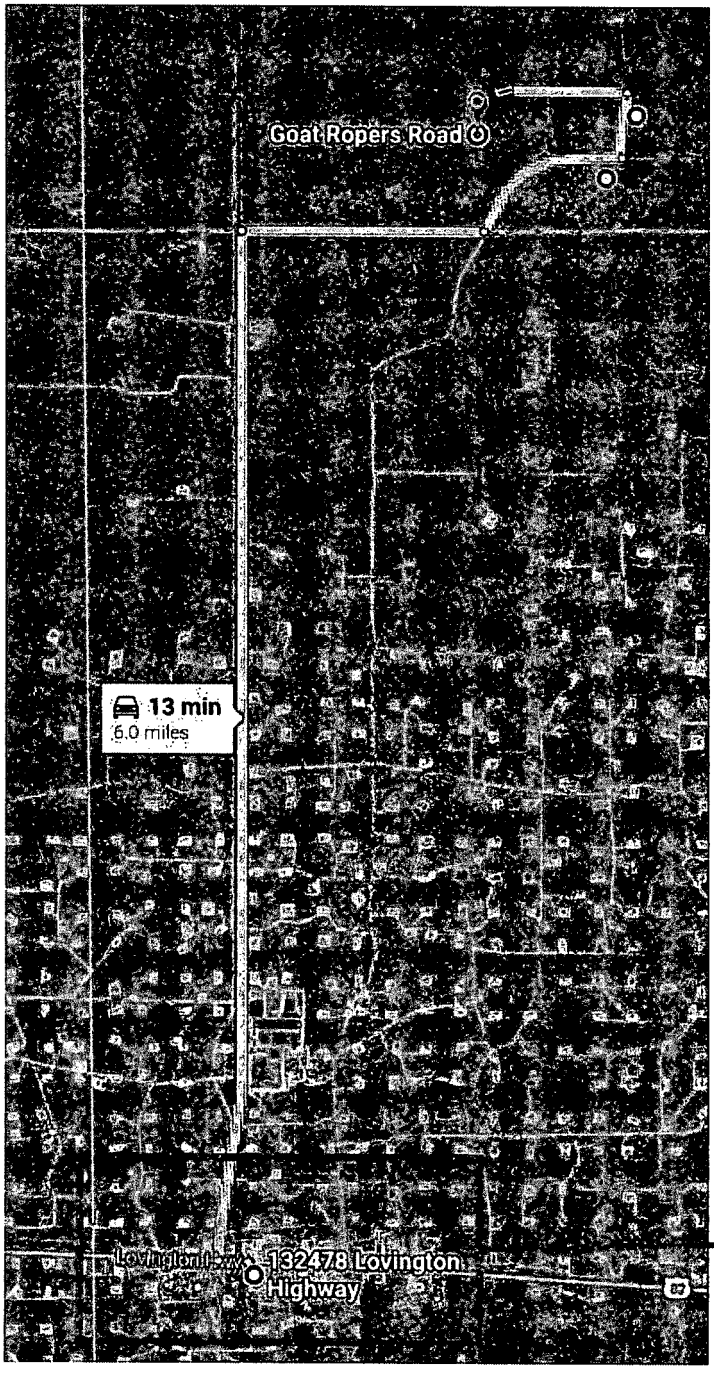
5. Turn right onto Hagerman Cutoff Rd
3.7 mi
6. Turn right onto Mallett Rd
0.9 mi
7. Turn left at the 1st cross street onto Goat Ropers Rd
0.6 mi
8. Turn left
0.2 mi
9. Turn left
0.4 mi

Destination: Thunderbird 1H

Thunderbird 1H Fresh Water Sources

Source:

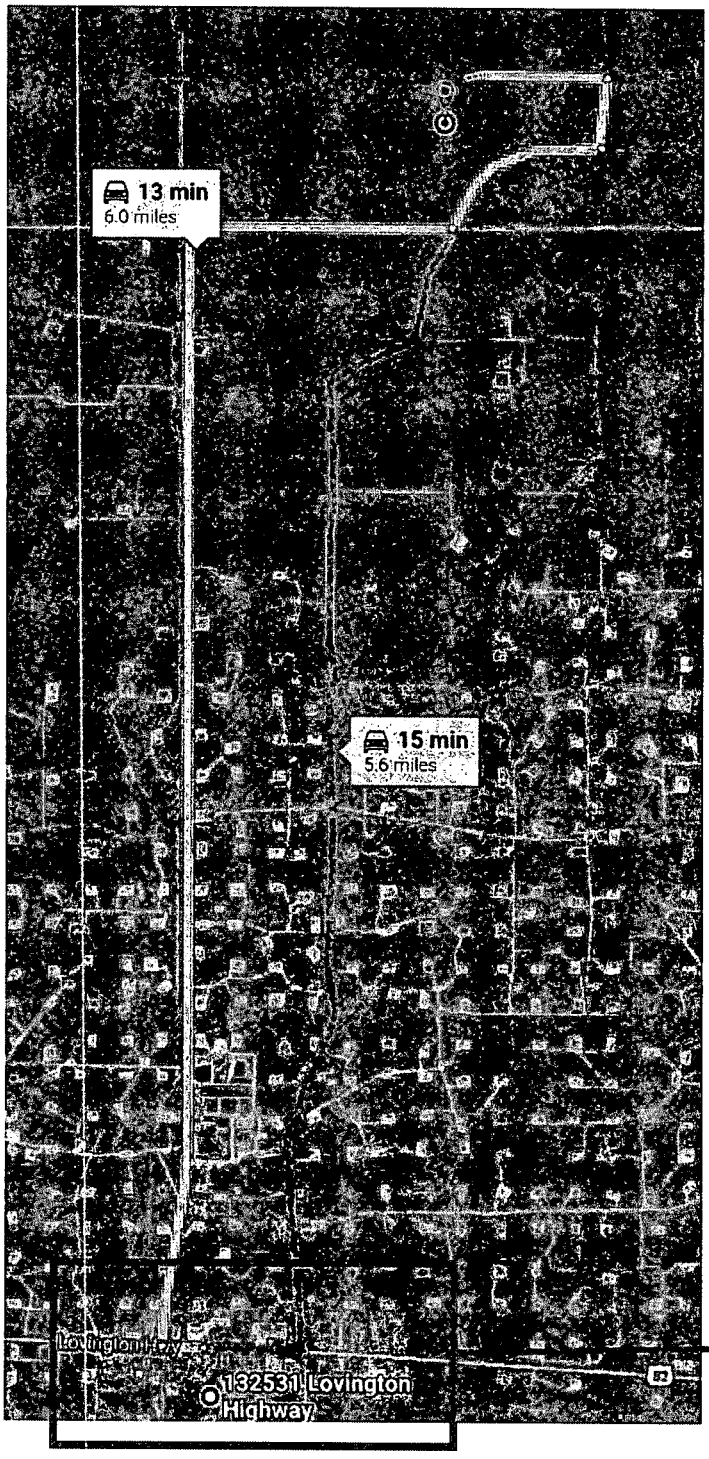
Mor-West Corporation



Loco Hills, New Mexico

Source:

Loco Hills Water Solutions, LLC



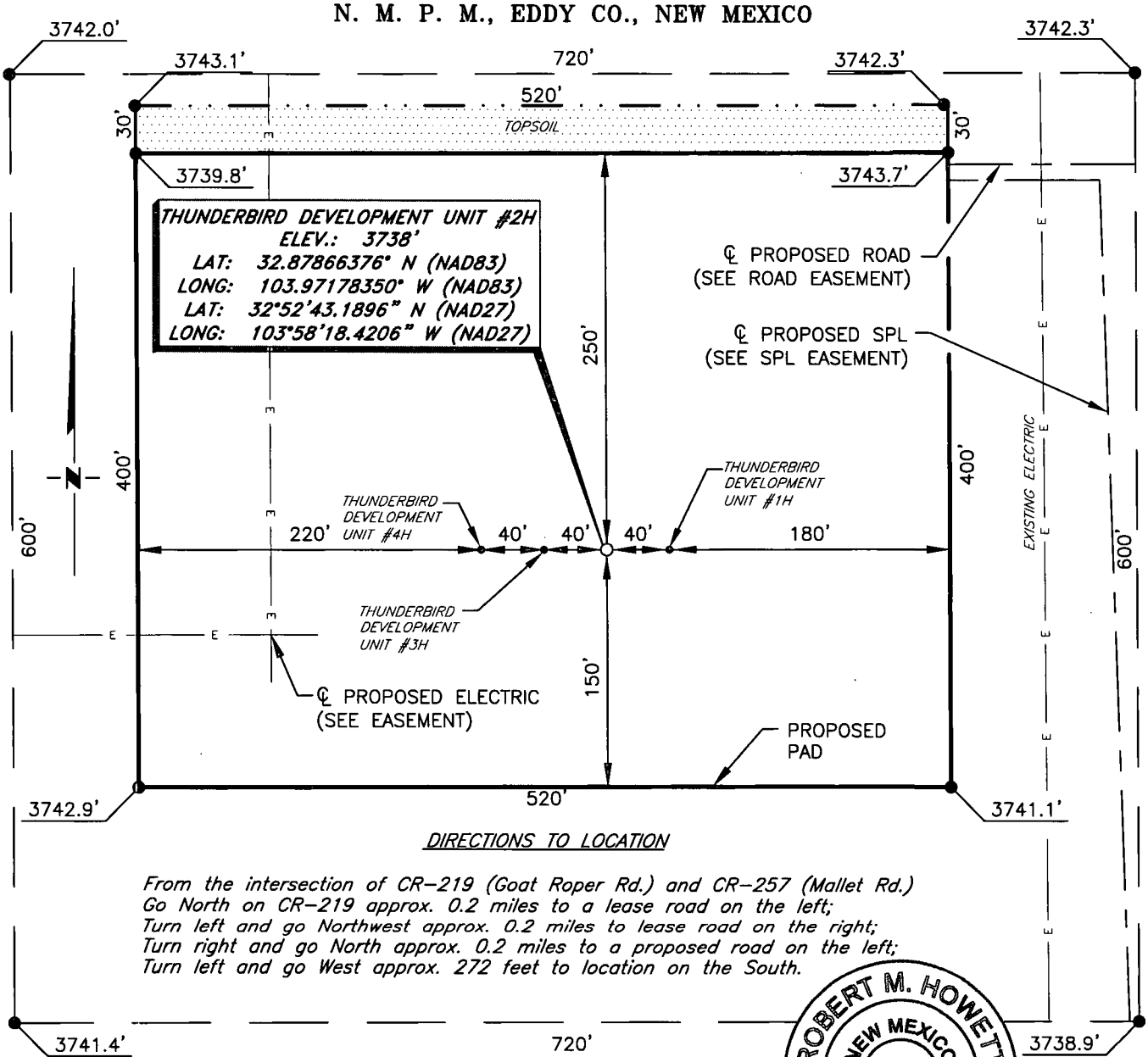
Loco Hills, New Mexico

THUNDERBIRD DEV UNIT 1H, 2H, 3H, 4H

PROPOSED CONSTRUCTION MATERIAL SOURCE – STATE CALICHE PIT

SEC 36 T15S R29E

APACHE CORPORATION
THUNDERBIRD DEVELOPMENT UNIT #2H
(2411' FNL & 1050' FEL)
SECTION 33, T16S, R30E
N. M. P. M., EDDY CO., NEW MEXICO



DIRECTIONS TO LOCATION

From the intersection of CR-219 (Goat Roper Rd.) and CR-257 (Mallet Rd.)
Go North on CR-219 approx. 0.2 miles to a lease road on the left;
Turn left and go Northwest approx. 0.2 miles to lease road on the right;
Turn right and go North approx. 0.2 miles to a proposed road on the left;
Turn left and go West approx. 272 feet to location on the South.

SCALE: 1" = 100'
0 50 100

BEARINGS ARE NAD 83 GRID - NM EAST DISTANCES ARE GROUND.

ROBERT M. HOWETT
NEW MEXICO
19680
6/17/16
PROFESSIONAL SURVEYOR

Firm No.: TX 10193838 NM 4655451

NO.	REVISION	DATE
	WELL NAME	1.30.19

JOB NO.: LS1605192
DWG. NO.: 1605192PAD

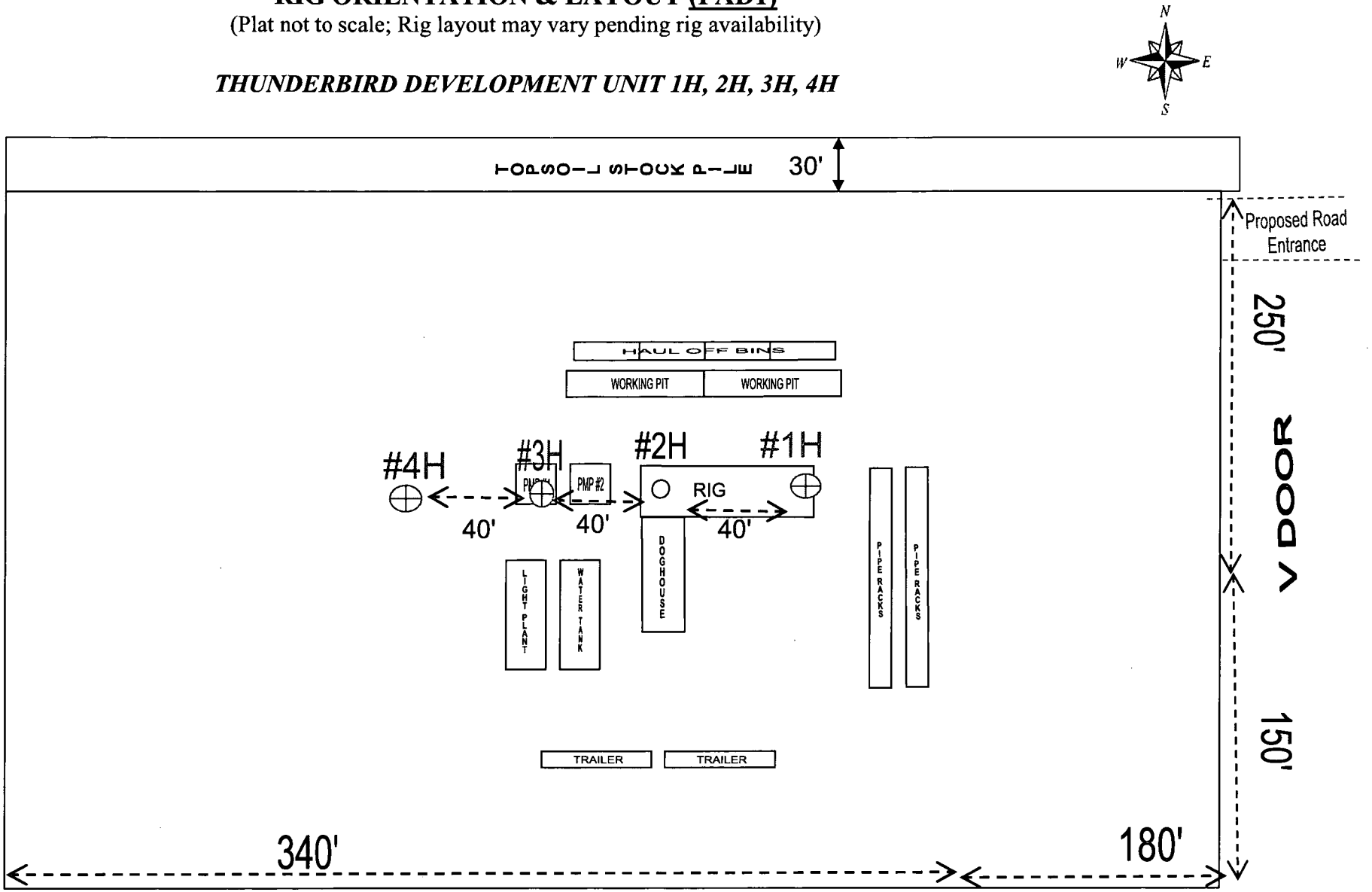
RRC SURVEYING, LLC
701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 100'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: RMH
APPROVED BY: RMH
SHEET : 1 OF 1

RIG ORIENTATION & LAYOUT (PAD1)

(Plat not to scale; Rig layout may vary pending rig availability)

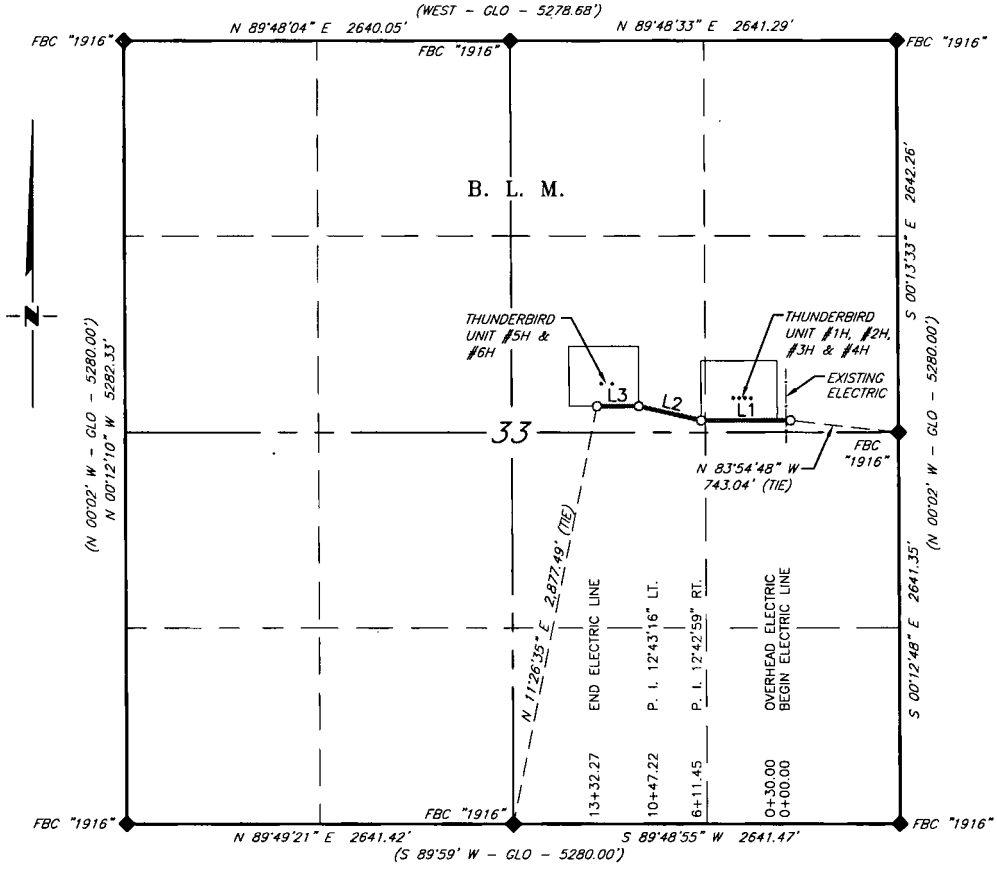
THUNDERBIRD DEVELOPMENT UNIT 1H, 2H, 3H, 4H



APACHE CORPORATION

PROPOSED ELECTRIC LINE FROM THE THUNDERBIRD UNIT #1H, #2H, #3H & #4H TO THE THUNDERBIRD UNIT #5H & #6H WELL LOCATIONS

SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO



LINE TABLE		
LINE	BEARING	LENGTH
L1	S 89°48'59" W	611.45'
L2	N 77°28'02" W	435.77'
L3	S 89°48'42" W	285.05'

SCALE: 1" = 1000'
0 500' 1000'

BEARINGS ARE GRID NAD 27 NM EAST
DISTANCES ARE HORIZ. GROUND.

LEGEND

( ) RECORD DATA - GLO

◆ FOUND MONUMENT AS NOTED

PROPOSED ELECTRIC LINE

Firm No.: TX 10193838 NM 4655451

I, R. M. Howett, a N. M. Professional Surveyor, hereby certify that I prepared this plat from an actual survey made on the ground under my direct supervision, said survey and plat meet the Min. Stds. for Land Surveying in the State of N. M. and are true and correct to the best of my knowledge and belief.

Robert M. Howett
Robert M. Howett NM PS 19680

ROBERT M. HOWETT NEW MEXICO 19680 6/21/16 PROFESSIONAL SURVEYOR

NO.	REVISION	DATE

JOB NO.: LS1605195EL
DWG. NO.: 1605195-1

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'
DATE: 6-01-2016
SURVEYED BY: BC/HD
DRAWN BY: LPS
APPROVED BY: RMH
SHEET : 1 OF 1

APACHE CORPORATION
PROPOSED ELECTRIC LINE
FROM THE THUNDERBIRD UNIT #1H, #2H, #3H & #4H
TO THE THUNDERBIRD UNIT #5H & #6H WELL LOCATIONS
SECTION 33, T16S, R30E,
N. M. P. M., EDDY CO., NEW MEXICO

DESCRIPTION

A strip of land 30 feet wide, being 1,332.27 feet or 80.744 rods in length, lying in Section 33, Township 16 South, Range 30 East, N. M. P. M., Eddy County, New Mexico, being 15 feet left and 15 feet right of the following described survey of a centerline across B. L. M. land:

BEGINNING at Engr. Sta. 0+00, a point in the Northeast quarter of Section 33, which bears, N 83°54'48" W, 743.04 feet, from a brass cap, stamped "1916", found for the East quarter corner of Section 33;

Thence S 89°48'59" W, 611.45 feet, to Engr. Sta. 6+11.45, a P. I. of 12°42'59" right;

Thence N 77°28'02" W, 435.77 feet, to Engr. Sta. 10+47.72, a P. I. of 12°43'16" left;

Thence S 89°48'42" W, 285.05 feet, to Engr. Sta. 13+32.27, the End of Survey, a point in the Northeast quarter of Section 33, which bears, N 11°26'35" E, 2,877.49 feet, from a brass cap, stamped "1916", found for the South quarter corner of Section 33.

Said strip of land contains 0.918 acres, more or less, and is allocated by forties as follows:

SE 1/4 NE 1/4	35.291 Rods	0.401 Acres
SW 1/4 NE 1/4	45.453 Rods	0.517 Acres

NO.	REVISION	DATE

JOB NO.: LS1605195EL

DWG. NO.: 1605195-2

RRC

308 W. BROADWAY ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 1000'

DATE: 6-01-2016

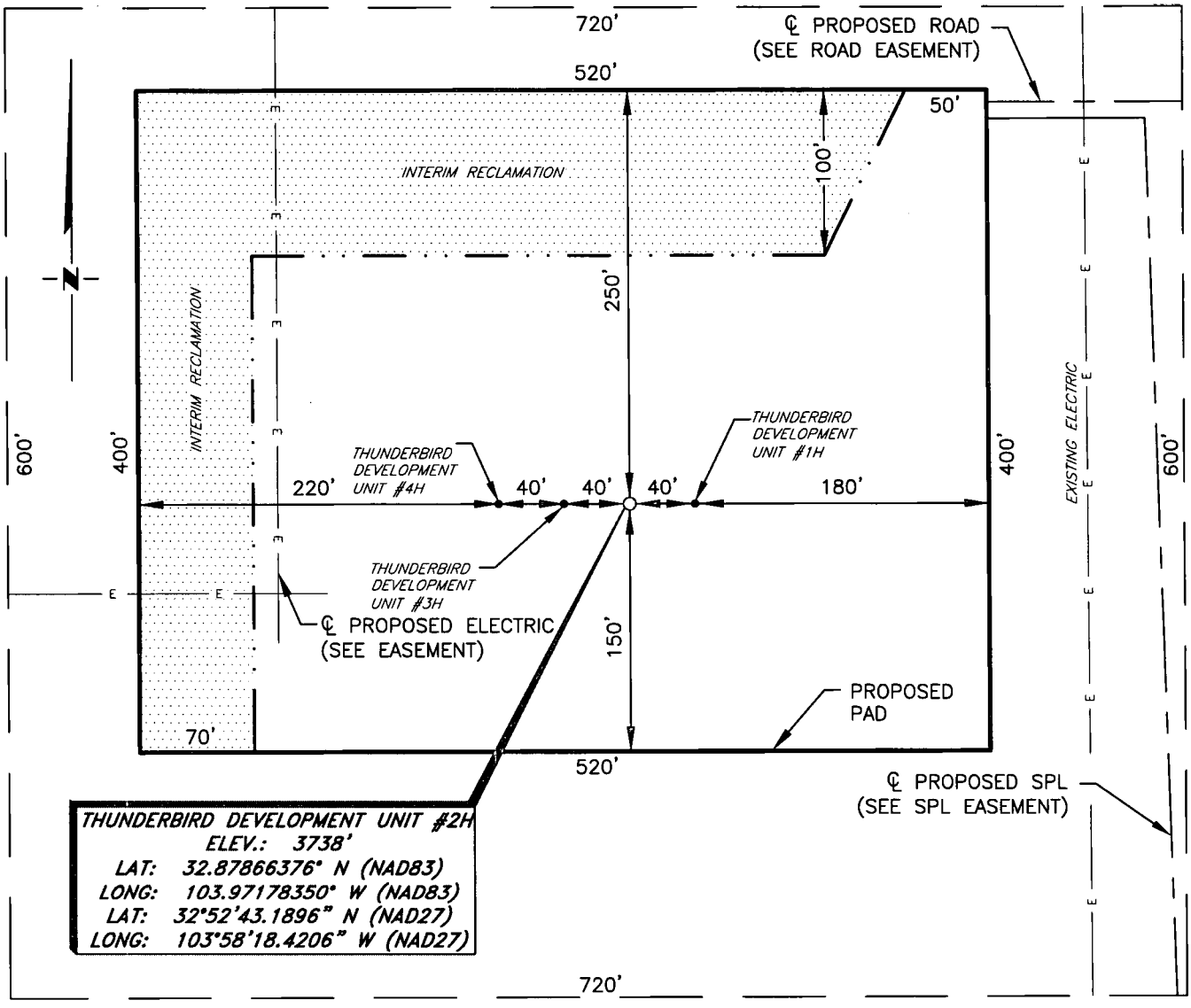
SURVEYED BY: BC/HD

DRAWN BY: LPS

APPROVED BY: RMH

SHEET : 1 OF 1

APACHE CORPORATION
INTERIM RECLAMATION
THUNDERBIRD DEVELOPMENT UNIT #2H
(2411' FNL & 1050' FEL)
SECTION 33, T16S, R30E
N. M. P. M., EDDY CO., NEW MEXICO



THUNDERBIRD DEVELOPMENT UNIT #2H
ELEV.: 3738'
LAT: 32.87866376° N (NAD83)
LONG: 103.97178350° W (NAD83)
LAT: 32°52'43.1896" N (NAD27)
LONG: 103°58'18.4206" W (NAD27)

SCALE: 1" = 100'
0 50 100

BEARINGS ARE NAD 83 GRID - NM EAST DISTANCES ARE GROUND.

DIRECTIONS TO LOCATION

From the intersection of CR-219 (Goat Roper Rd.) and CR-257 (Mallet Rd.)
Go North on CR-219 approx. 0.2 miles to a lease road on the left;
Turn left and go Northwest approx. 0.2 miles to lease road on the right;
Turn right and go North approx. 0.2 miles to a proposed road on the left;
Turn left and go West approx. 232 feet to location on the South.

	WELL NAME	1.30.19
NO.	REVISION	DATE
JOB NO.: LS1605192		
DWG. NO.: 1605192REC		

RRC
SURVEYING, LLC
701 S. CECIL ST., HOBBS, NM 88240 (575) 964-8200

SCALE: 1" = 100'
DATE: 6-01-2016
SURVEYED BY: ML/CG
DRAWN BY: RMH
APPROVED BY: RMH
SHEET : 1 OF 1

AFMSS

U.S. Department of the Interior
BUREAU OF LAND MANAGEMENT

PWD Data Report
09/30/2019

APD ID: 10400038856 **Submission Date:** 02/07/2019

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Well Type: OIL WELL **Well Work Type:** Drill

Section 1 - General

Would you like to address long-term produced water disposal? NO

Section 2 - Lined Pits

Would you like to utilize Lined Pit PWD options? NO

Produced Water Disposal (PWD) Location:

PWD surface owner: **PWD disturbance (acres):**

Lined pit PWD on or off channel:

Lined pit PWD discharge volume (bbl/day):

Lined pit specifications:

Pit liner description:

Pit liner manufacturers information:

Precipitated solids disposal:

Decribe precipitated solids disposal:

Precipitated solids disposal permit:

Lined pit precipitated solids disposal schedule:

Lined pit precipitated solids disposal schedule attachment:

Lined pit reclamation description:

Lined pit reclamation attachment:

Leak detection system description:

Leak detection system attachment:

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Lined pit Monitor description:

Lined pit Monitor attachment:

Lined pit: do you have a reclamation bond for the pit?

Is the reclamation bond a rider under the BLM bond?

Lined pit bond number:

Lined pit bond amount:

Additional bond information attachment:

Section 3 - Unlined Pits

Would you like to utilize Unlined Pit PWD options? NO

Produced Water Disposal (PWD) Location:

PWD disturbance (acres): **PWD surface owner:**

Unlined pit PWD on or off channel:

Unlined pit PWD discharge volume (bbl/day):

Unlined pit specifications:

Precipitated solids disposal:

Decribe precipitated solids disposal:

Precipitated solids disposal permit:

Unlined pit precipitated solids disposal schedule:

Unlined pit precipitated solids disposal schedule attachment:

Unlined pit reclamation description:

Unlined pit reclamation attachment:

Unlined pit Monitor description:

Unlined pit Monitor attachment:

Do you propose to put the produced water to beneficial use?

Beneficial use user confirmation:

Estimated depth of the shallowest aquifer (feet):

Does the produced water have an annual average Total Dissolved Solids (TDS) concentration equal to or less than that of the existing water to be protected?

TDS lab results:

Geologic and hydrologic evidence:

State authorization:

Unlined Produced Water Pit Estimated percolation:

Unlined pit: do you have a reclamation bond for the pit?

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Is the reclamation bond a rider under the BLM bond?

Unlined pit bond number:

Unlined pit bond amount:

Additional bond information attachment:

Section 4 - Injection

Would you like to utilize Injection PWD options? NO

Produced Water Disposal (PWD) Location:

PWD surface owner: **PWD disturbance (acres):**

Injection PWD discharge volume (bbl/day):

Injection well mineral owner:

Injection well type:

Injection well number: **Injection well name:**

Assigned injection well API number? **Injection well API number:**

Injection well new surface disturbance (acres):

Minerals protection information:

Mineral protection attachment:

Underground Injection Control (UIC) Permit?

UIC Permit attachment:

Section 5 - Surface Discharge

Would you like to utilize Surface Discharge PWD options? NO

Produced Water Disposal (PWD) Location:

PWD surface owner: **PWD disturbance (acres):**

Surface discharge PWD discharge volume (bbl/day):

Surface Discharge NPDES Permit?

Surface Discharge NPDES Permit attachment:

Surface Discharge site facilities information:

Surface discharge site facilities map:

Section 6 - Other

Would you like to utilize Other PWD options? NO

Produced Water Disposal (PWD) Location:

PWD surface owner: **PWD disturbance (acres):**

Other PWD discharge volume (bbl/day):

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Section 12 - Other Information

Right of Way needed? NO **Use APD as ROW?**

ROW Type(s):

ROW Applications

SUPO Additional Information: Apache plans to install an overhead electrical line for the proposed well. The proposed length of the electrical line will be 1332.27 feet from Pad 1- Thunderbird Dev Unit 1H, 2H, 3H, 4H to Pad 2-Thunderbird Dev Unit 5H, 6H. Electrical line will e constructed to provide protection from raptor electrocution. The proposed electrical line does not cross lease boundaries, so a ROW grant will not need to be acquired from BLM.
Use a previously conducted onsite? YES

Previous Onsite information: 5/26/2016; BLM Rep: Jeffery Robertson; Thunderbird A 1H - 10H

Other SUPO Attachment

ThunderbirdDevUnit1H_6H_ElectricLine_20190205145023.pdf
ThunderbirdDevUnit2H_InterimReclaimPlat_20190207080345.pdf

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT **Well Number:** 2H

Other PWD type description:

Other PWD type attachment:

Have other regulatory requirements been met?

Other regulatory requirements attachment:

AFMSS

U.S. Department of the Interior
BUREAU OF LAND MANAGEMENT

Bond Info Data Report

09/30/2019

APD ID: 10400038856

Submission Date: 02/07/2019

Operator Name: APACHE CORPORATION

Well Name: THUNDERBIRD DEVELOPMENT UNIT

Well Number: 2H

Well Type: OIL WELL

Well Work Type: Drill

Highlighted data reflects the most recent changes

Show Final Text

Bond Information

Federal/Indian APD: FED

BLM Bond number: NMB000736

BIA Bond number:

Do you have a reclamation bond? NO

Is the reclamation bond a rider under the BLM bond?

Is the reclamation bond BLM or Forest Service?

BLM reclamation bond number:

Forest Service reclamation bond number:

Forest Service reclamation bond attachment:

Reclamation bond number:

Reclamation bond amount:

Reclamation bond rider amount:

Additional reclamation bond information attachment: