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One Trip Displacement with Negative Test

List of Tables

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1. Introduction

1.1 Purpose

This operations manual establishes the minimum global standards and guidelines for effective execution of a One Trip **Wellbore Cleanup, Displacement with Negative Test.**

1.2 Scope

This manual focuses on employee safety, environmentally sound practices, and/or troubleshooting. This procedure does not serve as a substitute for critical thought and the experience of the XX Company representative.

This manual is not intended to be an overriding document, meaning that all local, customer, governmental, or occupational policies or procedures that are the most stringent must be followed.

This system combines several high-performance tools to seek debris, collect it, and eliminate it on a single trip. These tools are used to dress off the top of the liner, scrape packer setting depths, cleanout and the casing and liner, displace the well to completion fluid, jet the BOP, wellhead and riser and perform a negative test at the liner top.

1.3 Responsibility and Authority

Operations Manuals are intended for use by XX Company representatives qualified to run the tools or services as per the master qualifications list or competency list. The specific job title and reporting structure of the representative will be documented in the pre-job planning paperwork and defined prior to the beginning of each job.

1.4 Terms and Definitions

Enterprise Glossary

1.5 Technical Description/Component or System Level

EE Clean Bore Riser Brush and Boot Basket, H13104

The XX Company clean bore riser brush and boot basket cleans the inside diameter (ID) of drilling and production riser systems. The tool is used to brush and wipe mud residue, cement, or other debris from the riser inside wall and recover them to surface. Recovery is done with a boot basket that is designed in with the brush/wiper assembly and built on a mandrel that is full drill pipe strength.

RR Riser Brush and Boot Basket

The RR riser brush and boot basket is a durable tool designed for deep-water applications. It is used to clean the inside diameter (ID) associated with deep-water drilling and intervention. The tool cleans mud residue, cement or other debris from the riser inside wall and recover them to surface. Recovery is accomplished with a boot basket and magnet integral to the brush/wiper assembly and built on a robust mandrel that is full drill pipe strength. The tool can be short tripped with BOP jet sub and Multi-task Wellbore Filter or as an integral part of a complete wellbore cleaning system with circulation tools, scrapers, brushes, magnets, filters and displacement chemicals. The RR riser brush and boot basket is designed with high tensile and torque strength, high allowable rotational speed, and a large bypass flow area. The tool is ideal for deep-water application.

EE BOP Jet Sub

The BOP (Wellhead Blowout Preventer) Jet Sub was developed to wash debris and clean out the BOP, risers, wellhead area, and casing and tubing anchor.

Circulation Valve (Dart Activated Circulation Sub, Pump Out Sub or FFV.)

EE Dart Activated Circulation Sub

The Dart Activated Circulation Sub was designed for circulating at high flow rates to boost the annular velocity in areas of the well, such as above a liner top or where casing sizes change. The boost in annular velocity enables the effective removal of debris from areas of the casing profile where debris can accumulate and create issues. Typically, operators run the tool in the closed-to-annulus mode and position it close to the liner top when total depth is reached. After circulating the lower liner section clean, the surface drops a dart and activates the tool to shift a piston into the open-to-annulus position. This enables pumping large volumes of fluid at higher flow rates into the liner section, where the tool is positioned. Operators drop a second dart and apply pressure to the tool when the desired volume of fluid has been pumped, resulting in the flow's redirection path through the lower assembly (i.e., the closed to-annulus position). If more than one open-close cycle is needed, you can run an additional tool with a different dart size in the same string. A Catcher Sub is required to retain the darts once they have passed through the tool.

EE Full Function Valve

The Full Function Valve (FFV) was designed to allow direct circulation to the annulus to boost annular flow rate or avoid pulling a wet string. The simple design consists of the main body, upper piston, lower piston, and shear screws. When needed, a ball is dropped down the drill string to the lower piston. Additional pump pressure shears the lower piston, allowing circulation through the side ports. If desired, an additional ball can be dropped to shear the upper piston, which will seal the circulation ports and direct all flow through the drill string below.

EE Pump Our Sub

The Pump Out Sub was designed to allow direct circulation to annulus to boost annular flow rate or avoid pulling a wet string. The simple design consists of the main body, piston, and shear pin. When needed, a ball is dropped down the drill string to the piston. Additional pump pressure shears the shear pin, allowing the piston to shift. This allows circulation through the side port.

EE Multi-task Wellbore Filter

The XX Company EE multi-task wellbore filter allows brushing of debris from the wellbore wall, filtering the fluid, and recovering debris, all in one trip. Operators can run this tool with other XX Company wellbore cleanup tools to perform displacement and wellbore cleanup operations. The Multi-Task Wellbore Filter™ will allow collection of debris from the wellbore wall, brushing the wellbore wall, and filtering of fluid all in one run. It was designed to seek out junk, collect it, then carry it to the surface. The Multi-task Wellbore Filter will catch the debris dislodged from jetting the BOP. Note that one version of the multi-task wellbore filter has restricted usage. See the Specifications section of this document for more information.

RR Multi-task Wellbore Filter

The XX Company RR Multi-task Wellbore Filter™ is a durable tool especially designed for deep, deviated, deep-water, extended reach, and high dogleg severity well applications. It collects debris from the wellbore, brushes off the wellbore wall and filters fluid, all in one run. It is a modular tool and can be run by itself or as an integral part of a complete wellbore cleaning system with circulation tools, scrapers, brushes, magnets, bits, and displacement chemicals. The RR Multi-task Wellbore Filter was designed with high tensile and torque strength, high allowable rotational speed, and a large bypass flow area. It features a slidable brush design, providing an effective method to divert flow and collect debris.

1.6 Test Packer EE Wellbore Test Packer

The Wellbore Test Packer was designed to perform a negative inflow test on a liner top. The tool is normally run on the same trip as the wellbore cleanup tools. The Wellbore Test Packer eliminates the need for a designated run with a retrievable packer. A negative test is completed by displacing fluid in the upper drill pipe with a lighter weight fluid than is in the remainder of the wellbore.

EE Inflow Test Packer

The Inflow Test Packer (ITP) was designed to perform a negative inflow test on a liner top and can be run on the same trip as the wellbore cleanup tools. The Inflow Test Packer eliminates the need for a designated run with a retrievable packer. A negative test is completed by displacing fluid in the upper drill pipe with lighter weight fluid than is in the remainder of the wellbore.

EE Ball/Dart Catcher

The Ball/Dart Catcher Sub is used to catching drop balls. A sufficient bypass area is built into the tool to allow full flow around the balls/darts after they are retained in the inner sleeve. The ball catcher sub is used with several tools and is available in two sizes. The inner sleeve has a reverse flow ball stop near the upper end to retain the balls in the event of reverse circulation. This tool is used below the Wellbore Test Packer and/or Dart Activated Jet/Circulation Sub.

2. Safety and Regulatory

Safety is of primary importance in our operations. All of XX Company management, employees, and contract employees have the responsibility to make the safety of ourselves and our co-workers a fundamental concern. The following has been compiled as a reference to the potential safety risks associated with this operation. Refer to the Stop Work Authority and other related Health, Safety, Environment, and Security (HSE&S) Enterprise Operational Controls located on the HSE&S Management System website. Always consider that if more than one safety rule or standard exists, then always default to the most stringent.

2.1 HSE Operational Controls

- Dropped Objects Prevention (DROPS)
- Equipment Safety (EQIP)
- Facility HSE Management (FACMT)
- First Aid (FAID)
- Hand Protection (HAND)
- Hazard Risk Assessment (HRA)
- Hydrogen Sulfide (H2S)
- Job Hazard Analysis (JHA)
- Lifting and Rigging (LIFT)
- Manual Handling (MH)
- Naturally Occurring Radioactive Materials (NORM)
- Personal Protective Equipment (PPE)
- Wellsite HSES Management (WELL)

2.2 Minimum Safety and Regulatory Requirements

The following information outlines minimum safety and regulatory requirements for operations. However, if more than one rule or guideline applies, always default to the most stringent guideline or rule.

2.2.1 Product Specific Hazards

Sharp Metal Debris in Magnets

Potential cuts to hands

- Wear proper safety gloves
- Wear safety glasses

3. Pre-job Procedures

This document should be used with local Health, Safety, Environment, and Security (HSES) quality and warehouse procedures as a guideline for the technical procedures determined as important to the proper function of the equipment.

3.1 Assumptions

Tools, tool system, pumping equipment, and software (etc.) are defined and fit for purpose.

- All required inspection and calibrations records are up to date and available.
- All required regulatory documents are available.
- Work packet for the job is available.
- If applicable, tools and/or tool system, and sub-assemblies have been correctly assembled and tested at the XX Company facility.
- If applicable, the tools and/or tool system, and sub-assemblies that the Company representative cannot measure at the rig, have been measured correctly at the XX Company facility. (OD, ID, lengths, space-outs, etc.).

Note	To save rig time and as a best practice, connect and apply recommended torque to the all the components listed in each assembly below. Based on customer preference, rig lift capacities, or warehouse shipping limitations, other practices should be considered.

Note	The recommended make-up torque values for the thread connections in each individual component are listed in each individual tech unit.

3.2 Negative Pressure Test calculations

A = Well bore fluid (ppg)
B = Displacement fluid (ppg)
C = Capacity of tubular (bbl./ft.)
DD = Displacement fluid depth (ft.)
P = Pressure required (psi)
Volume = DD*C
Volume = Volume required (bbl.)

$$DD = \frac{P}{(A-B) * 0.052}$$

3.3 Mud Weight Equivalent calculations

A = Well bore fluid (ppg)
B = Displacement Fluid (ppg)
P = (A-M) * 0.052 * D
M = Desired Mud Weight Eq (ppg)
C = Capacity of tubular (bbl./ft.)
P = Pressure required (psi)
Volume = Volume required (bbl.)
D = Setting Depth (TVD) (ft.)

$$Volume = \frac{P * C}{(A-B) * 0.052}$$

Note	The displaced fluid depth must be less than the setting depth of the packer.

4. Fault Finding

4.1 PFMEA

Process failure modes and effects analysis (PFMEA) is a step-by-step approach for identifying possible failures in a design, a manufacturing or assembly process, or a product, service, or operation.

The following are definitions of headings in the PFMEA table.

- Function–Steps presented in order from the procedure section (4) of this manual
- Potential Failure Mode–the ways, or modes, in which something might fail. Failures are errors or defects, especially ones that affect the product or customer, and can be potential or actual issues
- Potential Cause(s) of Failure–cause of the failure mode
- Potential Effect(s) of Failure–damaging effects of the failure
- Current Control–efforts that will be made to increase detection or reduce the occurrence of an issue
- Recommended Action–actions taken to mitigate both health hazards and damage to property after a failure occurs

Note	Higher Numbers are the most severe while lower numbers are less severe. Risk Priority = Severity X Occurrence X Detection

4.1.1 Content Reference

Table 1: PFMEA Severity Ratings

Severity (S)		Description
1	Improbable/Minor	Failure will not have any perceptible effect on the performance of the product. The user will probably not notice the failure.
2 to 3	Insignificant/Low	The failure is insignificant, and the user is only minimally affected. The user will probably notice only a minor negative impact on the product and the product may be operable at reduced performance.
4 to 6	Moderately/Significant	Product operable at reduced performance and gradual performance degradation. The failure causes dissatisfaction on the part of the user and/or the user will notice a negative impact on the product or system performance.
7 to 8	Significant/High	Loss of product function but not system function. The failure causes greater annoyance on the part of the user.
9	Extremely Significant/Very High	Loss of system function, but not safety and/or compliance with industry or international regulations.
10	Catastrophic	Safety related and/or involves non-compliance with industry or international regulation

Table 2: PFMEA Occurrence Ratings

Occurrence (O)		Description
1	Remote	Failure is unlikely
2 to 3	Low:	Relatively few
4 to 6	Moderate	Occasional
7 to 8	High	Repeated failures
9	Extreme	Almost inevitable
10	No Reference Point	Inevitable

Table 3: PFMEA Detection Ratings

Detection (D)	Description
1	Will be detected prior to installation/running.
2 to 3	Highly likely; can be detected prior to installation/running.
4 to 6	May be detected prior to installation/running.
7 to 8	The control may not likely detect a potential problem; however, the failure mode will be detected prior to running tools.
9 to 10	Undetectable until failure occurs in the field.

4.1.2 Risk Priority Number Calculations

The failure mode can be considered critical if the Risk Priority Number (RPN) number is greater than 225. The failure mode must be addressed at these critical levels. A severity class level that is equal to 10 also requires the failure mode to be addressed.

Usually, all efforts should be made to eliminate failures which result in RPN numbers of greater than 225. Unfortunately, reliance on RPN number alone can be misleading, as seen in the following examples:

S=1, O=5, D=10, the RPN=50

S=10, O=5, D=1, the RPN=50.

Although, both RPN = 50, the RPN which includes a Severity rating of 10 is obviously a hazard as compared to an RPN with Severity =1. Basing decisions solely on RPN may result in inefficiency and/or increased risk. Recommended order of importance for selecting action is high numbers on Severity followed by Occurrence and Detection.

Table 4: PFMEA

	Function	Potential Failure Mode	Potential Cause(s) of Failure	Potential Effect(s) of Failure	Current Control	Control Type	Recommended Action	Severity	Occurrence	Detection	Risk Priority
Running In											
1.	Pick up Assembly 1 and hang off in the rotary	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
2.	Trip in hole (TIH) with work string as needed for space out.	plug tools	not circulating when running in hole; building up standpipe	unable to get to bottom	Procedure	D	break circulation every 30 standards or as pressures dictate	1	1	5	5
3.	Pick up Assembly 2 to work string. Make up Assembly 2 to work string. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
4.	Pick up Assembly 3 below and make up to Assembly 2. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
5.	Pick up Assembly 4 below and make up to Assembly 3. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
6.	Pick up Assembly 5 below and make up to Assembly 4. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
7.	Pick up work string as needed and TIH.	plug tools	not circulating when running in hole; building up standpipe	unable to get to bottom	Procedure	D	break circulation every 30 standards or as pressures dictate	1	1	5	5
8.	Pick up Assembly 6 below and makeup to work string. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
9.	TIH with work string as needed for proper space out.	plug tools	not circulating when running in hole; building up standpipe	unable to get to bottom	Procedure	D	break circulation every 30 standards or as pressures dictate	1	1	5	5
10.	Pick up Assembly 7 below and makeup to work string. RIH and hang off in the rotary.	damaged connections	over torque, poor handling	unable to make connections	Procedure	D	replace/recut threads	8	1	4	32
11.	TIH with work string to surface. Do not to exceed 150 ft./min. Use caution when passing through BOPs, well head area and liner top.	cannot pass through BOP, wellhead or liner top	tools too large to pass through restriction	unable to run in hole	Administrative	P	replace with appropriately sized tool(s)	8	2	2	32
Record Operating Parameters											
12.	Continue to TIH. Wash in last three stands prior to tagging liner top.	plug tools	not circulating when running in hole	buildup in standpipe pressure; unable to get to bottom	Procedure	D	break circulation every 30 stands or as pressures dictate	1	1	5	5

	Function	Potential Failure Mode	Potential Cause(s) of Failure	Potential Effect(s) of Failure	Current Control	Control Type	Recommended Action	Severity	Occurrence	Detection	Risk Priority
Tag Top of Liner											
13.	Wash down last 3 stands prior to tagging liner top. Slack off slowly and tag liner top. Land the Top Dress Mill (TDM) onto the liner top with up to 5,000 lbs. set down weight. Confirm space out is correct. The pumps can be used to circulate at a low rate to give extra indication of entering and landing out in the PBR. Mark depth on pipe during reference for reciprocation. Record string weight and pumping parameters.	plug tools	no communication above and below the mill	pressure building up at liner top	Procedure	P	always use a dress off mill with flow by water courses	2	1	5	10
Top, Dress, Polish											
14.	Prepare to dress off the liner top polish bore receptacle (PBR) by pumping at 2-34-5 BPM, rotating at up to 40 rpm for 20 4-5 minutes with 2,000-4,000 lbs. of weight on the TDM. The string may stall out and the pressure will increase slightly when the TDM lands out on the PBR. Slack off slowly until the liner top PBR is engaged. Repeat if required.	plug tools	no communication above and below the mill	pressure building up at liner top	Procedure	P	always use a dress off mill with flow by water courses	2	1	5	10
15.	Pick up distance of PBR space out and slowly reciprocate while circulating, taking care not to hit the top of the liner.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Condition Mud in Liner											
16.	Pull back from liner top and rotate the string. Refer to the technical unit for rotational parameters. Pump a minimum of 150 ft/min annular velocity or maximum allowable safe surface working rate and pressure. Condition mud in the liner until desired properties are achieved per fluid engineer’s parameters (minimum of 2 liner volumes). Record pump rate through bit for future reference when functioning lower circulation valve.	plug tools	plugged bit	Over-pressuring work string	Procedure	P	break circulation every 30 stands or as pressures dictate: pump steady rate	4	2	5	40
Open Circulation Ports to Annulus											
17.	Set down weight string weight below the tool plus weight of shear ring rating in J-Type Circulation Swivel on the PBR to shear ring in JTCS. Pick back up to position key in top of J slot (3-1/2 in. stroke).	may not be able to shear	not enough available weight	will not be able to function the tool	Procedure	D	pull out of hole; include torque and drag analysis in pre-job planning	9	2	2	36

	Function	Potential Failure Mode	Potential Cause(s) of Failure	Potential Effect(s) of Failure	Current Control	Control Type	Recommended Action	Severity	Occurrence	Detection	Risk Priority
18.	Slack off and tag the PBR with the weight of the BHA below the J-Type Circulation Swivel recorded earlier. Slack off and slowly rotate the string to the right, limiting torque to 3K ft-lbs. above previously recorded FRT. Set down to open the J-Type circulation ports. If the string does not stroke more than 3-1/2 in., pick back up and apply an additional 2K ft-lbs. to the string and set down to open the tool. (26 in. of travel will be seen when the tool strokes to the open position.) Set down 10,000-20,000 lbs. on the thrust bearing in the JTCS. Adjust set down weight as necessary to account for hydraulic or shrinkage of the string.	unable to open ports	did not set down enough weight	will not be able to circulate to annulus	Procedure	D	set down more weight	2	5	2	20
19.	If running a ball or dart drop Circulation Valve, follow step 1 below: 1. Drop ball or dart and increase pump pressure to shift ports open.		wrong ball or dart dropped		Administrative	P	Pull out of hole; confirm proper size of dart or ball prior to dropping	9	2	9	162
Condition Mud in Casing											
20.	Reference established pump rate and pressure to check if ports are open. Mud in the casing can be conditioned by pumping at maximum allowable safe surface working rate and pressure. At least 2 x casing volumes must be pumped. Continue to rotate, circulate and condition mud per fluid procedure until mud rheology and solids returns are within spec.	ports will not open if you cannot disengage J	damaged J lugs	cannot circulate to annulus	Procedure	D	Pull out of hole	9	2	9	162
Close Circulation Ports to Annulus											
21.	Monitor returns. Once mud has been conditioned, close the ports. If running the JTCS, pick up the up original weight. The J should re-engage after picking up 26 in.	cannot close ports	damaged J lugs	cannot circulate through tool	N/A	D	Pull out of hole	9	1	7	63
22.	If running a ball or dart drop circulation valve, drop second ball or dart to shift ports closed.		wrong ball or dart dropped	not able to function tool	N/A	D	Pull out of hole	9	1	7	63
Negative Test (optional)											
23.	Function Test Packer and perform negative test and pump fluids per procedures in the service unit and customer guidelines. If an influx is observed, refer to well control procedures.	surface equipment failure	exceeding specifications	injury to rig personnel	Administrative	P	JSA	8	1	1	8
		plug tools	pressure imbalance	unexpected build up in pressure	Procedure	D	follow rig well control procedures	9	1	9	81

	Function	Potential Failure Mode	Potential Cause(s) of Failure	Potential Effect(s) of Failure	Current Control	Control Type	Recommended Action	Severity	Occurrence	Detection	Risk Priority
Pump Chemical Train											
24.	Tag liner top and pick up 1 foot.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25.	Prepare and pump pills as per displacement procedure. Monitor returns and take samples as needed. Displace well per fluid procedure.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Re-Open JTCS, if applicable											
26.	Once the tail of the spacer is approximately 500 feet above the J-Type Circulation Swivel, re-open J-Type Circulation Swivel and pump max allowable safe pressure. Set down 10,000-20,000 lbs. on the bearing in the JTCS.	cannot reopen tool	lugs were damaged	poor displacement	Procedure	D	continue with displacement at maximum rate through bit	7	2	9	126
27.	**Upper Clean Out**										
28.	Position BOP Jet Sub at the wellhead at the bottom of the BOP stack. Mark work string at surface for reference. Start pumping at recommended pump rate (typically 15-30 bpm) while reciprocating the pipe 10 feet per min.	plug tools	not circulating	buildup in standpipe pressure	Procedure	D	break circulation as pressures dictate	1	1	5	5
29.	Make three complete passes (up, down, up). Ensure drill pipe is across BOP stack and then function all rams possible. Do not function shear or blind rams. Resume pumping and make three additional passes across stack (down, up, down).	plug tools	not circulating	buildup in standpipe pressure	Procedure	D	break circulation as pressures dictate	1	1	5	5
Pull Out of Hole (POOH)											
30.	POOH and lay down assemblies. Do not exceed 150 ft/min.	Tools stuck in the hole	Debris or obstruction in the well	Cannot pull out of hole	Procedure	P	Fish tools or rotate to help pull out of hole	9	2	5	90
Breakout Assemblies											
31.	With the tools at the surface, check the contents of the Multi-task Wellbore Filter by opening window. Check debris captured by Magnets. Record any debris found and take pictures where possible and send to the BOT Onshore engineer. If Multi-task Wellbore Filter is more than 80% full of debris, a second run should be considered.	completion fluid slung at rig floor	spinning out too fast; rig crew too close	completion fluid contamination on rig crew	Procedure	P	spin out slowly at surface so completion fluid is not slung	3	3	3	27