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# MC252 #3 MACONDO RELIEF WELL DRILLING PROGRAM

## SECTION 13: PLUG & ABANDON PROCEDURE

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| **RPIC APPROVAL:** | JEFF HOLME | Jeff Holme | Sept 17, 2010 | 11:55 |
| | PRINT Name above | Sign Above | Date | Time |
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| **CGIC (USCG) APPROVAL:** | N/A | | | |
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| **USCG (Houston Review):** | N/A | | | |
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Logged in Sarre William Broman WilliamBroman 9/17/10 1035 hrs.

| | | | |
|---|---|---|---|
| 0 | 9/15/2010 | Final | Barbara Lasley |
| **REV** | **DATE** | **DOCUMENT STATUS** | **PREPARED BY** |
| | | | |
| **PRINT DATE** | 9/15/2010 | **Document Number** | 2200-T2-DO-PR-4790 |

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# Macondo Relief Well Drilling Program

# MC252 #3

# Section 13: Plug & Abandon Procedure

September 15, 2010

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## Amendment Record

| Name | Date | Amendment |
|---|---|---|
| Barbara Lasley | 9/18/2010 | 1) Pg 5: Insert 7/8"<br>2) Pg 5: Change 9-5/8" shoe to 9-7/8" liner shoe<br>3) Pg 5: Insert MD after 17,969-ft (TD)<br>4) Pg 5: Change 300-ft to 375-ft (consistent with wellbore schematic)<br>5) Pg 8 step 13.4: Add note that the testing of Plug #1 is covered by Ops Note #31<br>6) Pg 9 step 12: Change 10-k WOB to 10-K lbs WOB<br>7) Pg 10 step 25: Insert step for pressure test to 1,150 psi.<br>8) Pg 11 step 8: Insert MD after 7,750-ft<br>9) Pg 12 step 13: Change 12,030-ft to 12,038-ft (consistent with wellbore schematic)<br>10) Pg 13 step 30: Change 10-k WOB to 10-K lbs WOB<br>11) Pg 14 step 42: Insert step for pressure test to 1,150 psi.<br>12) Pg 17 step 42: Insert step for pressure test to 1,150 psi.<br>13) Pg 20: Update estimated TOC to 17,300' for plug #1 (9/18/10 morning meeting).<br>14) Pg 20: Update estimated TOC to 17,300' for plug #1 (9/18/10 morning meeting). |
| Barbara Lasley | 9/19/2010 | 1) Pg 5: Change 9-7/8-in liner hanger setting TVD to 12,836-ft TVD (consistent with wellbore schematic)<br>2) Pg 7: Add comment that each cement plug will be pressure tested to 1,150 psi per BOEM request.<br>3) Attachment 4: Remove comment that the BOP will be left in place.<br>4) Attachment 4: Update weight of base oil to 6.5 ppg.<br>5) Throughout: Referenced MD to maintain consistency. If a depth is listed without reference to TVD or MD, the depth / length is referenced as a measured depth. |
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# 13 Plug and Abandon Procedure

## 13.1 Introduction

The objective is to properly secure the Macondo #3 relief well following successful isolation from the Macondo #1. This will be accomplished by placing cement plugs for zonal isolation. Additionally, mechanical bridge plugs will be used in providing permanent abandonment isolation.

| Interval Notes | |
|---|---|
| **Item** | **Comment** |
| Hole Size | 8 ½-in from the 9 ⅞-in liner shoe to Total Depth.<br>Note: This open hole will be filled with cement from previous operations. |
| Previous Casing | 9 ⅞-in, 62.8 ppf, Q-125, Hydril 513, (ID = 8.625-in, Drift = 8.50-in)<br>• Liner hanger set at 13,227-ft MD, (12,836-ft TVD)<br>• 9 ⅞-in liner shoe set at 17,856-ft MD, (17,099-ft TVD)<br>13 ⅝-in, 88.2 ppf, Q-125, SLIJ-II, (ID = 12.375-in, Drift = 12.25-in)<br>• Casing hanger set at 5,235-ft MD, TVD<br>• 9 ⅞-in TOL at 13,227-ft MD. |
| 9 ⅞-in Shoe FIT | 14.94 ppge Down Hole Mud Weight (DMW) |
| Mud System | Baroid "Encore" Synthetic Oil Based Mud (SOBM)<br>14.0 ppg (SMW), 14.2 ppg (DHMW) |
| Drill String | 5 ⅞-in, 34.03 ppf, S-135, XT57, (ID = 4.875-in) |
| Special Equipment | DrilQuip Multi-Purpose Tool (MPT), Smith Hydraulic Casing Cutter, Halliburton Cement Support Tool (CST) and diverter. |
| Cementing Stinger | 3 ½-in, 13.30 ppf, S-135, NC38, (ID = 2.764-in) |
| Cement Plug #1 (see 8-1/2" section Rev 1) | 17,969-ft MD (TD) to 17,207-ft MD, (~649-ft lap into 9 ⅝-in casing shoe) |
| Cement Plug #2 | 13 ⅝-in EZSVB set at 12,200-ft MD. Spot 500-ft cement on top of EZSVB (TOC 11,700-ft MD). |
| Cement Plug #3 | 13 ⅝-in EZSVB set at 7,875-ft MD. Spot 250-ft cement on top of EZSVB. Spot 375-ft above 13 ⅝-in casing stub in 22-in casing (TOC 7,250-ft MD). |
| Cement Plug #4 | 6,100-ft MD (Cement Support Tool) to 5,350-ft MD, (100-ft below mud line). |

## 13.2 Well Preparation

- Conduct the appropriate Task Specific Think Plan (TSTP) prior to the operation starting.
- Ensure all cement calculations are verified using actual depths.
- Accurately strap all pits prior to commencing each cement job. Driller to record the straps and electronic pit levels prior to the cement job.
- Locate all necessary cross-over joints. Primarily the crossovers to transition from the 3 ½-in cementing stinger to the 5 ⅞-in, XT57 drill pipe. Ensure all rabbits are accounted for.
- Ensure the following equipment is used to make up the Blackhawk cementing head:
    - 5 ⅞-in, XT57, drill pipe single (drift to 2 ⅞-in)
    - 5 ⅞-in, XT57, drill pipe pup joint (drift to 2 ⅞-in)
    - Full Open Safety Valve (drift to 2 ⅞-in)
    - Blackhawk Top Drive Remote Cement Head (with HES "Nerf" wiper balls and 5.5-in hard rubber balls loaded)
    - Full Open Safety Valve (drift to 2 ⅞-in)
    - 5 ⅞-in, XT57, drill pipe pup joint (drift to 2 ⅞-in)
- Ensure the Halliburton 5.5-in diameter hard rubber wiper balls and 7-in diameter "Nerf" balls are available to load into the Blackhawk cementing head.
- Halliburton Cementer to run through the pre-job checklist from the cement unit. Ensure that the Procon system (screens, etc.) are all set-up, calibrated, and tested well before the cement job. Cementer to calibrate the auto-density system.
- Ensure the dedicated pressurized mud balance is available to weigh the samples. Do NOT use the mud engineer's balance.
- Ensure the Halliburton Cement Support Tool (CST) is on board and ready for deployment. Measure the O.D. of the transport tube to confirm the CST is the correct size. The 2 ½-in CST will be used.
- Ensure the IBOP and appropriate TIW are on the floor and ready to make up.
- Have scrapers on board for the 13-$^{5}/_{8}$-in casing in the event it is not possible to get down with the gauge ring.
- Ensure Franks equipment is available for handling the 13-$^{5}/_{8}$-in casing on the main and aux rotaries.
- Ensure the necessary equipment is available on the rig floor in order to lay down drill pipe in singles if problems occur with the primary handling equipment while pulling out of hole (POOH) during the plug job.

### 13.3 Objectives

- Ensure adequate isolation of hydrocarbon bearing zones, per Bureau of Ocean Energy Management (BOEM) requirement.
- Continue to isolate the cased hole, per BOEM requirement, to the mud line.
  - Utilize Halliburton EZSVB as mechanical barriers, in support of additional cement plugs.
  - Each of the cement plugs must be weight tested to 15,000 lbs and pressure tested to 1,150 psi, per BOEM request.
  - Cut and recover approximately 2,390-ft of the 13 ⅝-in casing, prior to spotting plugs #3 and #4.

## 13.4 Test P&A Plug #1

This procedure is based on the assumption that Plug #1 (primary barrier), which isolates the 8-$^{1}/_{2}$-in open hole, has been placed during previous operations and the drill string has been pulled out of the hole, per previous 8 ½-in hole operations Revision 1. This plug will be pressure and weight tested as per Ops Note #31.

1. PU and RIH with 8 ½-in mill tooth bit assembly (open jets). Tag the cement plug and weight test the plug to 15,000-lbs. POOH.
   - Ensure pumps are on prior to tagging cement to prevent plugging the bit.
   - Cement should be at 1,000 psi compressive strength, per cement lab analysis prior to tagging.
2. Pressure test Plug #1 (primary barrier) to 1,150 psi with 14.2 ppg (DMW), based upon the following criteria:
   - 500 psi above the FIT of 14.94 ppge.
   - A FIT of 14.94 ppge at the 9⅞-in liner shoe on 14.0 ppg DMW, (825 psi surface), performed 8/06/2010.
   - An equivalent test on 14.2 ppg would require 650 psi surface pressure.
   - 500 psi plus 650 psi surface test pressure = 1,150 psi.
3. Record the results of both the pressure test and the weight test on the daily Open Wells Drilling Report and the IADC Report.

## 13.5 P&A Plug #2 -- Set EZSVB, Place balanced plug

### *13.5.1 WL set EZSVB at 12,200-ft MD*

1. Rig up the Halliburton wireline unit in preparation of running:
   - 12.0-in gauge ring / junk basket (this is the size recommended by Halliburton).
   - 13 ⅝-in Halliburton EZSVB *(EZ-Drill, Sliding Valve, Brass plug)*
2. Make up a 12.0-in gauge ring with junk basket. Run in the hole to a depth of 12,500-ft MD. POOH and rig down the assembly.
   - EZSVB OD = 11.68-in before set.
   - If the gauge ring cannot be run to the desired depth, POOH with wire line and prepare to make a cleanout run with scraper assembly.
3. Make up a 13 ⅝-in Halliburton EZSVB, with "slow burn" Down-hole Power Unit (DPU) and CCL.

4. RIH with the 13 5/8-in EZSVB on wireline.
5. Set the EZSVB at +/-12,200-ft MD, avoiding connections, per Halliburton procedure.
6. POOH with wire line and RD same.

### *13.5.2 Place balanced plug #2*

7. Review the pre-job checklist, and ensure the cement unit is properly lined up.
8. Pick up ~700 feet of 3½-in drill pipe for cementing stinger assembly with diverter.
9. Transition and cross over to the 5 7/8-in, XT57 drill pipe.
10. MU one joint of 5 7/8-in, XT57 drill pipe.
11. MU a Halliburton 5 ½-in Indicating Ball Catcher sub (7.25-in OD), with crossovers to the 5 7/8-in, XT57 drill pipe.
12. RIH with the cementing stinger on the 5 7/8-in, XT57 drill pipe.
    - Be cautious as the cementing stinger nears the EZSVB bridge plug at approximately 12,200-ft MD, to avoid damaging the stinger.
    - Tag to confirm EZSVB is in place. Apply no more than 10-k lbs WOB to prevent sinusoidal buckling.
13. Space out and MU the Blackhawk cementing head. Rig up and test cement lines to 250 psi low for 5 minutes and 5,000 psi high for 5 minutes.
14. Position the end of the stinger just above the EZSVB at 12,200-ft MD.
15. Circulate one drill pipe volume while preparing to spot abandonment cement plug #2.
16. Pump **80-bbls** of 14.5-ppg Tuned Spacer, per Halliburton recipe.
    - Drop one 5.5-in hard rubber ball, for fluid segregation, from the Blackhawk head.
17. Mix and pump **75-bbls** of 16.4-ppg cement as directed. Volume based upon 0% excess to provide a 500' cement plug.
18. Pump **5 bbls** of 14.5-ppg Tuned Spacer, per Halliburton recipe.
19. Displace the cement with 14.0 ppg SMW at maximum achievable rate.
20. Adjust displacement volume accordingly when the ball lands in the Ball Catcher Sub. Finish displacing slurry with the 14.0 ppg SMW at 10 bpm with DDIII rig pump. Slow displacement rate to 2 bpm and leave **14 bbls** of cement in the stinger/drill string.
    - 14 bbls allows for 4 bbls required for balance + 10 bbls underdisplacement to enable pulling dry.

- Rotate drill pipe at 30 rpm throughout displacement.
- Calculated displacement to balance is 263 bbls (underdisplace by 10 bbls leaving 14 bbls of cement inside the drillstring).

21. Slowly pull out of the cement plug at 3-4 min/stand to put the end of the 3-½-in stinger at the planned top of spacer (~11,100-ft MD).
    - The planned top of P&A plug #2 is 11,700-ft MD.
22. Drop 2 "Nerf" wiper balls and circulate bottoms up, continuing to rotate.
23. POOH with the 5 ⅞-in drill pipe and the 3 ½-in cementing stinger. Lay down the 3 ½-in cementing stinger in doubles.
24. PU and RIH with 8 ½-in mill tooth bit assembly (open jets). Tag the cement plug and weight test the plug to 15,000-lbs. POOH.
    - Ensure pumps are on prior to tagging cement to prevent plugging the bit.
    - Cement should be at 1,000 psi compressive strength, per cement lab analysis prior to tagging.
25. Pressure test Plug #2 to 1,150 psi per UAC (Unified Area Command) request.
26. Record the results of the weight test on the daily Open Wells Drilling Report and the IADC Report.

## 13.6 P&A Plug #3 -- Set EZSVB, Swap mud, Cut/pull csg, Place balanced plug

### *13.6.1 WL set EZSVB at 7,875-ft MD*

1. Rig up the Halliburton wireline unit in preparation of running:
    - 13 ⅝-in Halliburton EZSVB (EZ-Drill, Sliding Valve, Brass plug)
2. Make up a 13 ⅝-in Halliburton EZSVB, with "slow burn" Down-hole Power Unit (DPU) and CCL.
3. RIH with the 13 ⅝-in EZSVB on wireline.
4. Set the EZSVB at +/-7,875-ft MD, avoiding connections, per Halliburton procedure.
5. POOH with wire line and RD same.

### *13.6.2 Swap mud to 12.6 ppg SMW, Retrieve wear bushing*

6. Negative test the EZSVB prior to reducing the mud weight. Follow the General Negative Test Procedure (See Attachment 4).
    - Choke line displaced with 34 bbls (2,200-ft) of 6.5 ppg base oil, with 14.0 ppg SMW in the hole, will provide ~860 psi differential (which equates to a 12.8 ppg DMW).

7. RIH with approximately 2,500-ft of open ended 5 ⅞-in drill pipe. PU the DrilQuip Multi-Purpose Tool (MPT) dressed for retrieving the wear bushing (ensure the DrilQuip jet sub is included).
   - Space the MPT as necessary to avoid tagging the EZSVB at 7,875-ft MD and to keep the MPT above the stack during the displacment.
   - EZSVB is located ~2,625-ft below mud line. Approximately 2,500-ft of drill pipe will place the end of the drill pipe approximately 125-ft above the EZSVB.
   - DrilQuip minimum requirement for weight below is 12,000 lbs.
8. Continue to RIH with 5 ⅞-in drill pipe to approximately 7,750-ft MD, ~125'ft above the EZSVB. Circulate the well to 12.6 ppg SMW (12.8 ppg DHMW).
   - This is in preparation of cutting the 13 ⅝-in casing, which may allow communication to formation below the 16-in liner shoe at 12,057-ft MD, (11,874-ft TVD).
   - The interval below the 16-in shoe was drilled to total depth with 12.8 ppg DMW.
9. After the displacement, land the MPT in the well head and engage the wear bushing with MPT per DrilQuip representative. Retrieve same.
10. POOH with 5 ⅞-in drill pipe. LD the MPT and the wear bushing.

### *13.6.3 Pull seal assembly*

11. PU ~5 stands of 5 ⅞-in drill pipe. Make up and run in the hole with the DrilQuip Multi-Purpose Tool (MPT) well head seal assembly running/ retrieving tool.
    - DrilQuip requires at least 20,000 lbs below the MPT to land out on the seal assembly.
    - Activate the active heave draw works prior to landing the MPT.
12. Retrieve the seal assembly per DrilQuip representative. The outer lock ring is biased inward. With overpull, the lock ring will relax inward and allow the seal assembly to be retrieved.
    - Close the annular and line up on the choke prior to unseating the seal assembly. Maintain minimum closing pressure on the annular preventer when straight pulling the seal assembly in event of trapped pressure below.
    - Straight pull with 20,000-lbs to 120,000-lbs overpull, in addition to the stripping drag, to release the outer lock ring and recover the seal assembly. Monitor for pressure.

**Note: If unable to retrieve the seal assembly, do not proceed with casing cutting operations. Notify Houston to discuss plan forward.**

13. Circulate one bottoms up through the choke line. Flow-check the well, minimally 15 minutes.
    - The 16-in liner shoe is set at 12,057-ft MD. The top of cement (TOC) in the 13 $^{5}/_{8}$-in X 16-in annulus has been logged at 12,038-ft MD. Additionally, it has been determined that there are no continuous channels in the cement until above 11,914-ft MD.
    - It is anticipated that the 13 $^{5}/_{8}$-in x 16-in annulus is isolated with cement, and as such a static well bore is expected.
14. POOH and LD MPT with seal assembly.

### *13.6.4 Cut and pull casing*

15. MU and RIH with the casing cutter assembly supplied by Smith.
    - Smith Hydraulic Casing Cutter, an NOV 8-in Mud Motor (7/8, 4-stage), a TMC Bumper Sub, and Spear.
16. RIH and spaceout to place the cutter at the cut depth of 7,625-ft MD.
17. Engage the casing spear per Smith representative.
18. Cut the 13 ⅝-in casing at 7,625-ft MD, per Smith representative instruction. Confirm the casing cut is complete.
    - The cutter blades are set to match the outside diameter (OD) of the casing string. The casing spear centers the hydraulic cutter assembly for a concentric cut.
    - The casing will be placed in tension at the cut depth prior to initiating the cut.

    **Note: If the first cut fails, move up hole ~100-ft and attempt to cut again. If the second attempt fails, notify Houston and POOH.**
19. After a successful cut, flow-check the well, minimally 15 minutes.
20. Once the well is confirmed static, release the spear and pull up hole to place the spear at approximately 5,255-ft MD (just below mud line).
21. Re-engage the casing with the spear in the uppermost joint of 13 ⅝-in casing.
22. Pull out of the hole with the 13 ⅝-in casing stub (approximately 2,390-ft length).
    - The assembly and 13 ⅝-in casing is comprised of:
      - ~2,390-ft of 13 ⅝-in, 88.2 ppf, Q-125, SLIJ-II casing = 210,800-lbs
      - ~5,250-ft of 5 ⅞-in, 34.03 ppf, S-135 drill pipe = 178,500-lbs
      - ~270-ft of Smith Hydraulic casing cutter assembly = 9,500-lbs
    - The air weight of the assembly is estimated at 400,000-lbs
    - The buoyed weight of the assembly is estimated at 322,000-lbs.

23. Once the casing hanger reaches the floor, release the spear and stand back the casing cutter BHA.
24. RU Franks 13 5/8-in casing equipment.
25. Pull the 13 5/8-in casing joints, racking back the stands of casing in the derrick (to be handled later by the aux).
26. Clear the rig floor.

### *13.6.5 Place balanced plug #3*

27. Review the pre-job checklist, and ensure the cement unit is properly lined up.
28. Make up a 5 7/8-in cementing diverter sub and RIH with approximately 1,100-ft (approximately 25-bbl capacity) of 5 7/8-in, XT57 drill pipe.
    - No 3 1/2-in stinger will be used for this plug.
29. MU a 5 ½-in Halliburton Indicating ball catcher sub, with appropriate crossovers.
30. Continue to RIH with 5 7/8-in, XT57 drill pipe cementing string.
    - Be cautious as the diverter sub nears the EZSVB bridge plug at approximately 7,875-ft MD, to avoid damaging the diverter.
    - Tag to confirm EZSVB is in place. Apply no more than 10-k lbs WOB to prevent sinusoidal buckling.
31. Space out and MU the Blackhawk cementing head. Rig up and test cement lines to 250 psi low for 5 minutes and 5,000 psi high for 5 minutes.
32. Position the end of the diverter sub just above the EZSVB at 7,875-ft MD.
33. Circulate at least one bottoms up while preparing to spot abandonment cement plug #3.
34. Pump **100-bbls** of 14.6 ppg tuned spacer, per Halliburton recipe.
    - Drop one 5.5-in hard rubber ball, for fluid segregation, from the Blackhawk head.
35. Mix and pump **165-bbls** of 16.4-ppg cement as directed. Volume based upon 0% excess.
    - Volume based upon 250-ft of 13 5/8-in stump above the EZSVB, 75-ft of 16-in liner between the top of the 13 5/8-in stump and the 16-in TOL, and 300-ft of 22-in casing above the 16-in TOL.
    - The calculated fluid weight at the 16-in shoe of the mud, spacer, and cement with pipe out is equivalent to a 13.0 ppge MW. The actual LOT was a 13.85 ppge; however, this is over the PRESGRAF predicted LOT of 13.2 ppge which was honored while drilling.
36. Pump **7-bbls** of 14.6-ppg tuned spacer, per Halliburton recipe.

37. Adjust displacement volume accordingly when the ball lands in the Ball Catcher Sub. Finish displacing slurry with the 14.0 ppg SMW at 10 bpm with DDIII rig pump. Slow displacement rate to 2 bpm and leave **25 bbls** of cement in the stinger/drill string.
    - 25 bbls allows for 15 bbls required for balance + 10 bbls underdisplacement to enable pulling dry.
    - Rotate drill pipe at 30 rpm throughout displacement.
    - Calculated displacement to balance is 146 bbls (underdisplace by 10 bbls leaving 25 bbls of cement inside the drillstring).
38. Slowly pull out of the cement plug at 3-4 min/stand to put the end of the diverter sub at the planned top of spacer (~6,950-ft MD).
    - The planned top of P&A plug #3 is 7,250-ft MD.
39. Drop 2 "Nerf" wiper balls and circulate bottoms up while continuing to rotate.
40. POOH with the 5 ⅞-in drill pipe and cementing diverter sub.
41. PU and RIH with 8 ½-in mill tooth bit assembly. Tag the cement plug and weight test the plug to 15,000-lbs. POOH.
    - Ensure pumps are on prior to tagging cement to prevent plugging the bit.
    - Cement should be at 500 psi compressive strength, per cement lab analysis prior to tagging.
42. Pressure test Plug #3 to 1,150 psi per UAC (Unified Area Command) request.
43. Record the results of the weight test on the daily Open Wells Drilling Report and the IADC Report.

## 13.7 P&A Plug #4 -- CST, Place two-stage IBOP plug

### *13.7.1 Run and set CTS*

This plug will be spotted in two separate stages:

- The first stage of the plug will be approximately 75 bbls in volume. The objective is to place a relatively small volume of cement on the Halliburton Cement Support Tool (CST), to avoid overwhelming the CST and to serve as a solid foundation for the remainder of the uppermost plug.
- The second stage will be approximately 215 bbls in volume. It will be spotted once the initial plug has developed 500 psi compressive strength to support this additional cement plug.

1. Review the pre-job checklist, and ensure the cement unit is properly lined up.

2. Prepare the CST assembly for deployment in the 22-in, 224 ppf casing (20.0-in ID).
3. RIH with a Halliburton CST ball seat and diverter sub on the 5 ⅞-in, XT57 drill pipe cementing string. No stinger will be required.
4. TIH to depth of 6,100-ft MD. Circulate bottoms up.
5. Deploy the CST to be set at approximately 6,100-ft MD.
   - Insert the Halliburton CST, displacement dart and phenolic ball.
   - Circulate the CST/dart/ball to the end of the work string.
   - Follow Halliburton recommendation regarding displacement rate. Maximum rate in the 5 ⅞-in drill pipe with a CST is approximately 6-bbls/min.
   - Slow rate to 1-½-bbls/min for the last 100 to 200-ft. This facilitates "soft launching" the CST.
6. Once the CST is deployed out of the drill pipe string, the phenolic ball will land on seat and divert flow to the diverter holes.

### *13.7.2 IBOP Plug #4 - Stage 1*

7. Pull up hole approximately 1,000-ft.
8. Install a TIW, 10-ft pup, and then an IBOP in the drill string such that it will be approximately 1,000-ft below the rig floor once the cementing stinger is at position, just above the CST, for spotting the abandonment plug.
9. Space out and MU the Blackhawk cementing head. Rig up and test cement lines to 250 psi low for 5 minutes and 5,000 psi high for 5 minutes.
10. RIH to place the cementing diverter just above the CST. Do not tag the CST.
11. Circulate one drill pipe volume while preparing to spot the first stage of abandonment cement plug #4.
12. Pump **100-bbls** of 14.6 ppg tuned spacer per Halliburton recipe.
13. Mix and pump **78-bbls** of 16.4-ppg Premium cement as directed. This volume is based upon ~200-ft of 22-in casing (20.0-in ID) with 0% excess.
    - This will leave the top of cement (TOC) at approximately 5,900-ft MD.
    - Do not drop a wiper ball behind the cement on this plug, as the IBOP is in the string.
14. Pump **7-bbls** of 14.6-ppg tuned spacer, per Halliburton recipe.
15. Displace with 12.8 ppg DHMW at maximum achievable rate (calculated displacement to balance is 130 bbls).

16. After 10 bbls of cement has been displaced past the diverter, begin rotating at ~30 rpm until end of job. Do not lower diverter past 6,000-ft MD to avoid any contact with the CST.
17. Displace cement to within 1 bbl of the diverter. This should leave 1 bbl of cement inside the drill pipe.
18. Check that IBOP is holding by bleeding pressure back to the cement unit.
    - If IBOP is not sealing, allow the drill string to balance, pull out of hole to at least 5,500-ft MD, and circulate bottoms up.
19. Slowly pull out of the cement plug at 3-4 min/stand to put the end of the diverter sub at the planned top of spacer (~5,600-ft MD).
    - The planned top of stage 1 of P&A plug #4 is 5,900-ft MD.
20. Close TIW and back out IBOP.
    - Be prepared for potential trapped pressure (~30 psi) between TIW and IBOP.
21. Bleed off any trapped pressure. Open TIW and allow drillstring to balance.
22. Back out TIW. Install a "Nerf" wiper ball, and displace down the drill string while circulating bottoms up.
23. Wait for 500 psi compressive strength to develop, per cement lab design.

### *13.7.3 IBOP Plug #4 - Stage 2*

24. Install a TIW, 10-ft pup, and then an IBOP in the drill string such that it will be approximately 1,000-ft below the rig floor once the cementing stinger is at position, just above the initial cement plug a ~5,900-ft MD.
25. Space out and MU the Blackhawk cementing head. Rig up and test cement lines to 250 psi low for 5 minutes and 5,000 psi high for 5 minutes.
26. Position the CST diverter at the top of the initial cement plug at ~5,900-ft MD.
    - Ensure pumps are on while positioning diverter.
27. Pump **100-bbls** of 14.6-ppg tuned spacer per Halliburton recipe.
28. Mix and pump **215-bbls** of 16.4-ppg Premium cement as directed. This volume is based upon 550-ft of 22-in casing (20.0-in ID) with 0% excess.
    - This will leave the top of cement (TOC) at approximately 5,350-ft MD.
    - Do not drop a wiper ball behind the cement on this plug, as the IBOP is in the string.
29. Pump **7-bbls** of 14.6-ppg tuned spacer, per Halliburton recipe.
30. Displace with 12.8 ppg DHMW at maximum achievable rate (calculated displacement to balance is 117 bbls).

31. After 10 bbls of cement has been displaced past the diverter, begin rotating at ~30 rpm until end of job. Do not lower diverter past 5,900-ft MD.
32. Displace cement to within 1 bb of the diverter sub.
33. Check that IBOP is holding by bleeding pressure back to the cement unit.
    - If IBOP is not sealing, allow the drill string to balance, pull out of hole to at least 5,250-ft MD, and circulate bottoms up.
34. Slowly pull out of the cement plug at 3-4 min/stand to put the end of the diverter sub at ~5,250-ft MD.
    - The planned top of P&A plug #4 is 5,350-ft MD.
35. Close TIW and back out IBOP.
    - Be prepared for potential trapped pressure (~30 psi) between TIW and IBOP.
36. Bleed off any trapped pressure. Open TIW and allow drillstring to balance.
37. Back out TIW. Install two (2) "Nerf" wiper balls, and displace down the drill string while circulating bottoms up.
38. Wait for 500 psi compressive strength to develop, per cement lab design.
39. POOH with the 5 ⅞-in drill pipe and diverter sub.
40. PU and RIH with 8 ½-in mill tooth bit assembly. Tag the cement plug and weight test the plug to 15,000-lbs. POOH.
    - Ensure pumps are on prior to tagging cement to prevent plugging the bit.
41. Pressure test Plug #4 to 1,150 psi per UAC (Unified Area Command) request.
42. Record the results of the weight test on the daily Open Wells Drilling Report and the IADC Report.

## 13.8 Negative test, Displace riser.

1. Negative test the well prior to displacing the riser. Follow the General Negative Test Procedure (See Attachment 4).
    - Choke line displaced with 55 bbls (3,500-ft) of 6.5 ppg base oil, with 12.6 ppg SMW in the hole, will provide ~1,100 psi differential.
2. After the base oil has been displaced out of the choke line and well monitoring has confirmed that the well is static (both with blind rams closed and with blind rams open), displace the riser to seawater.
3. Unlatch from the MC252#3 wellhead and move to safe area.

## Attachments

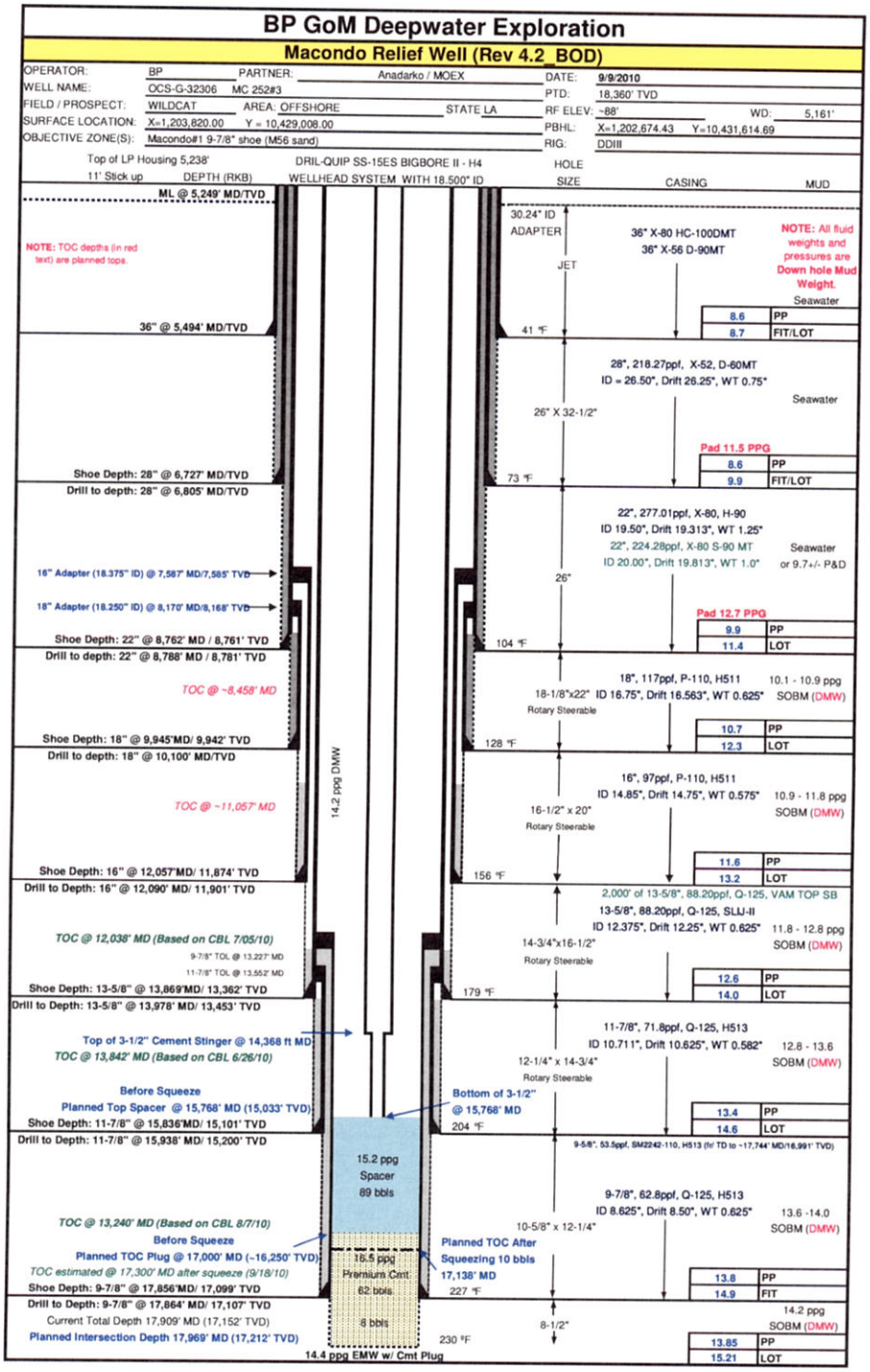
| No. | Title |
|---|---|
| 1 | BOEM Requirements for BOP Testing |
| 2 | Current Wellbore Schematic |
| 3 | Proposed Plug & Abandon Schematic |
| 4 | General Negative Test Procedure |

## *Attachment 1:*
## *BOEM Requirements for BOP Testing*

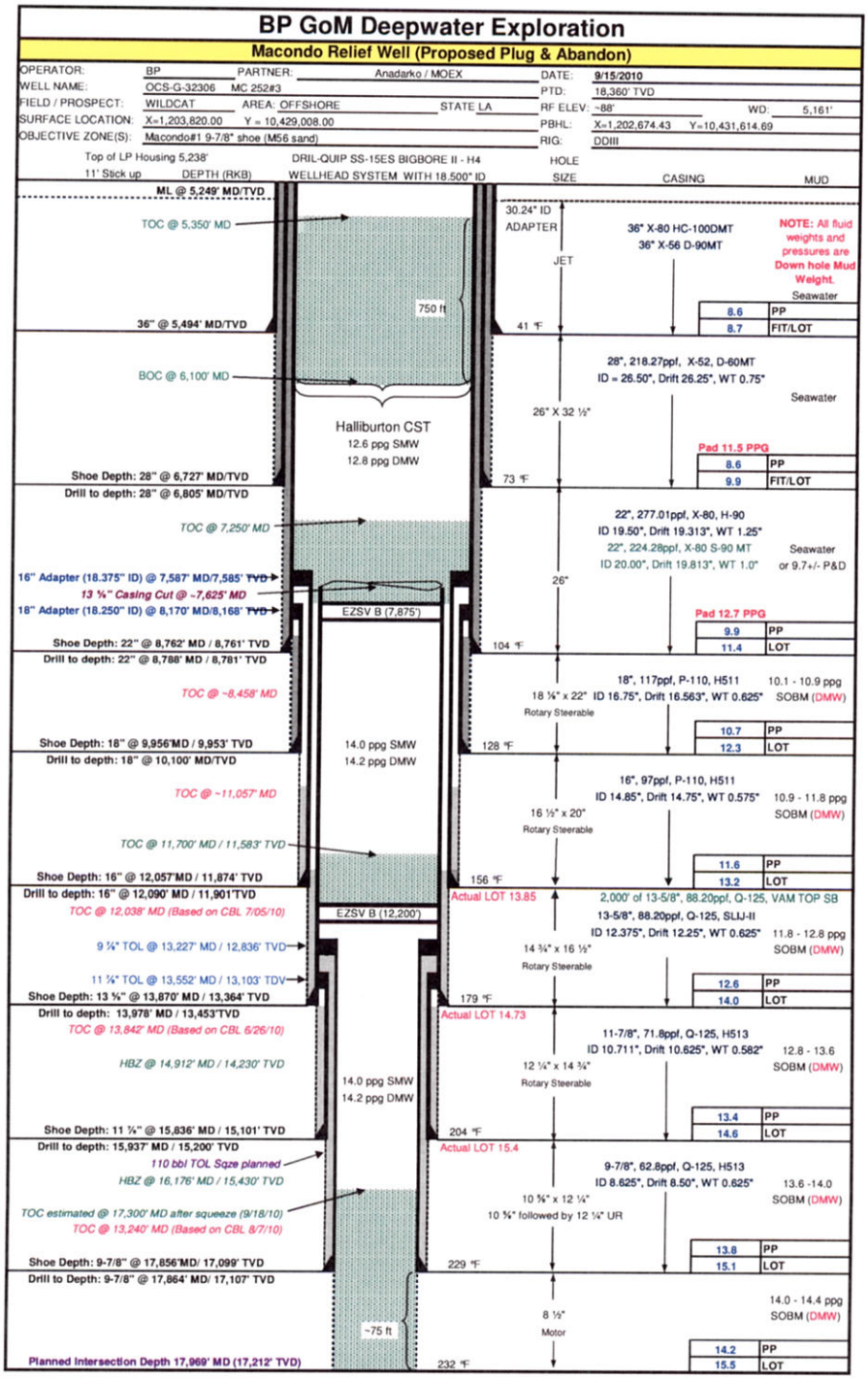
Bureau of Ocean Energy Management (BOEM) requires a Full Function and Pressure Test of all Blow Out Preventer (BOP) components, including choke and kill lines and valves and choke manifold.

- Diverter Function Test
  - Make sure the mud level in the riser is below the diverter vent line outlets. Close diverter in "Normal" Divert mode on Diverter panel MMI. Time packer closure and verify by viewing through rotary. Observe the overboard valves opening.
  - Do not pump through vent/overboard lines. Open the diverter packer and close overboard valves and verify by visual observation.
  - This test will be performed weekly, rotating between the Driller's panel and the Toolpusher's panel on the bridge, and in conjunction with BOP test and weekly function test.
- After running isolation test tool or having used inverted test rams
  - Using the 5 ⅞-in drill pipe that will be run though the BOP stack.
  - Pipe rams tested to 250 psi (low) and 6,500 psi (high).
  - Upper and Lower Annular tested to 250 psi (low) and 5,000 psi (high).
- After retrieving the isolation test tool or without pipe across stack
  - Test Blind Shear Ram (BSR) and casing to 250 psi (low) for 5 minutes and to the equivalent of 2400 psi with 14.0 ppg SMW as per the approved Application for Permit to Modify (APM) psi for 30 minutes.
  - Test second BSR as per the approved APM psi for 5 minutes.
  - Function casing shear rams.

## *Attachment 2:*
## *Current Wellbore Schematic*



## *Attachment 3:*
## *Proposed Plug & Abandon Schematic*



## *Attachment 4:*
## *General Negative Test Procedure*

- *The objective of the Negative Test is to evaluate the readiness for the riser / LMRP to be removed from the well.*
- *This general procedure is written with the assumption that **no drill pipe** is across the BOP stack.*
- *This general procedure includes Lessons Learned from Macondo Relief Wells MC252 #3 & #2 and comments from the BOEM.*

### Well Condition Assumptions

- Wellbore is isolated from all flow paths below wellhead by cement, retrievable plug(s), packer(s), etc.
- Well Site Leader, Mud Engineer, and Rig Contractor Representatives have agreed on the riser displacement procedure.
- Blind rams are closed from a previous test of the plug/RTTS/etc.

### Perform Negative Test

1. The subsea engineer will open the upper inner and outer choke line valves and upper inner and outer kill line valves.
2. Pump sufficient volume of base oil (6.5 ppg) down the choke line to establish an equivalent wellhead pressure of 200 psi below a seawater gradient (8.65 ppg) - take returns up the kill line. Close kill line valves.
   - *Utilize base oil to allow displacing to a seawater or lower gradient without displacing all the way to the stack.*
   - *Pump base oil down the choke line. If the well head seal or downhole isolation is lost, the base oil in the choke line can be recovered / displaced with kill mud weight by circulating a minimum volume from the kill line across the stack.*
   - Calculate the estimated choke shut-in pressure (choke SIP)
   - Choke SIP = (MW-6.5)*0.052*height of base oil column

3. Bleed pressure down on the choke line in steps to 200 psi and monitor on chart.
   - Document the Rig Contractor's acceptable differential pressure from above on the shear rams.
   - ➢ *Monitoring a closed system with pressure on the gauge will minimize any gains to the system if the downhole isolation is lost. The pressure on the choke would increase and an influx would still be taken; however, the gain to the system would be restricted by the shut-in well.*
4. Monitor the pressure for 15 minutes.
   - ➢ *A pressure decrease is anticipated due to temperature effects. Cooling of fluid will cause a small volume decrease, thus a pressure drop may be realized. However, any pressure increases should be fully evaluated for potential isolation failure.*
   - Monitor riser on trip tank.
   - Monitor pressure reading on HPHT sensor on BOP stack.
5. Bleed choke to zero. Open and monitor for flow for 60 minutes.
   - Note that the pressure below the shear rams will be less than a seawater gradient. Ensure this does not exceed acceptable limits set by the Rig Contractor.
6. If flow observed, troubleshoot to determine if the blind shear ram is leaking.
   - If flow is observed and the blind shear rams are holding, the retrievable plug, packer, and/or the subsea wellhead seal assembly should be evaluated. Discuss with Houston and determine forward plan regarding barrier requirements.
7. After a successful negative test, open the lower inner and outer kill line valves. The choke is expected to see the U-tube pressure from the mud in the kill line.
8. Displace the base oil out of the choke line by pumping mud down the lower inner and outer kill line valves and adjusting the choke to take the base oil returns from the upper choke line valves.
9. When the base oil has been recovered monitor below the shear rams with the well monitoring tank and monitor the riser on the trip tank for 15 minutes.
   - Ensure it is possible to visually observe the flow coming into the tank. Do not rely on PVT sensors to determine "no flow" or "flow".
   - The tank should be observed by an experienced crew member and the pit level monitored electronically if possible.
10. Open stack and monitor the riser volume for 15 minutes using the trip tank.