Guidelines for Cement Design and Operations in DW GoM

EXHIBIT # 791
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1 Introduction

1.1 Overview

Proper tubular placement and obtaining a competent cement job are the most important aspects of well design and construction. By using the guidelines set forth in the Basis of Design, drilling engineers, cementing service providers, and rig personnel will coordinate the detailed planning and design of cement jobs from conception to execution. Drilling engineers are responsible for reviewing the results of cement slurries and spacer tests, as well as the details of cement operations including volumes to be pumped, pumping schedules, casing jewelry, etc.

The key requirements for a successful cement job are as follows:

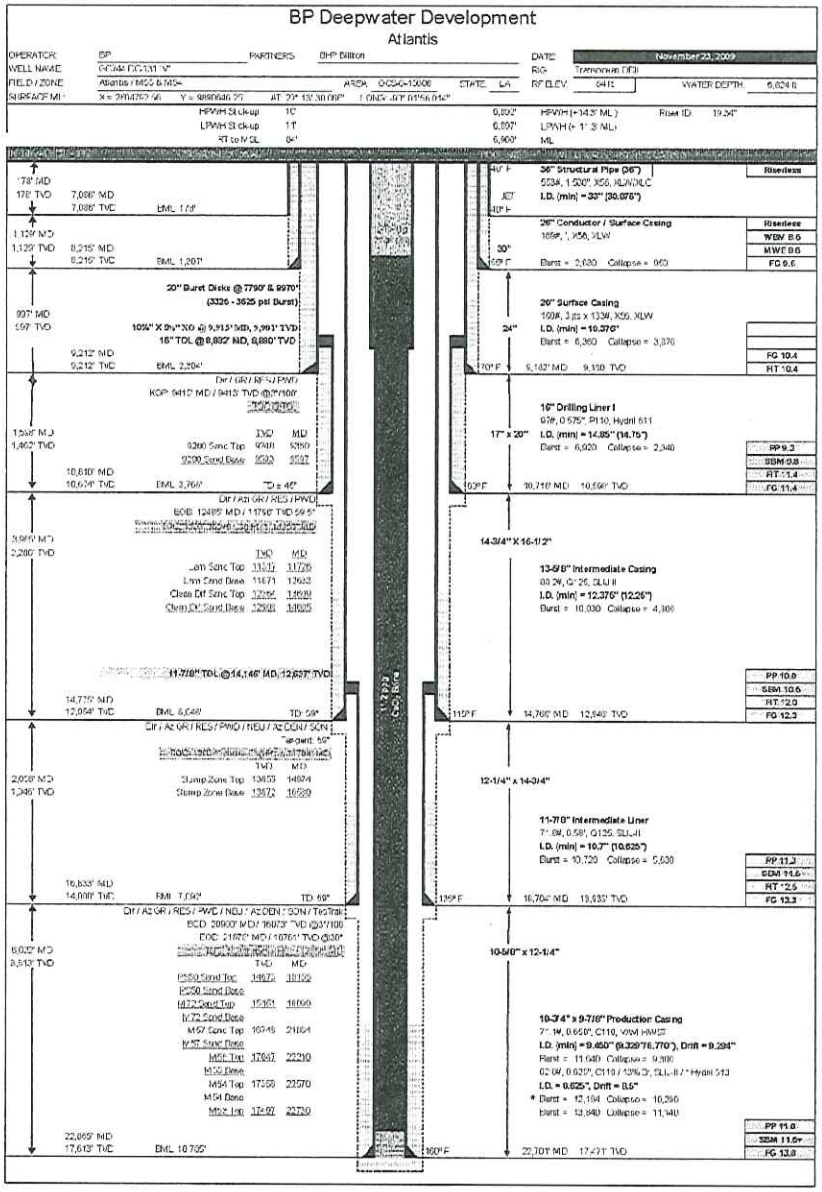
- Conductor
  - Good shoe test and prevention of flow behind pipe
  - Zonal isolation of SWF and SGF sands
  - Structural support of wellhead systems, BOPE, and subsea production tree and jumpers
  - Prevention of casing buckling
  - Compliance with all MMS regulations
- Intermediate casing and liners
  - Good shoe test (integrity) to enable drilling to the next casing point and prevention of flow behind pipe
  - Zonal isolation across any exposed hydrocarbon or water bearing formations
  - Seal at the TOL (with packer or cement)
  - Prevention of casing buckling
  - Compliance with all MMS regulations
- Production interval
  - Achieving zonal isolation of all hydrocarbon and water zones and prevention of flow behind pipe
  - Ensuring well integrity throughout the life of the well
  - Prevention of casing buckling
  - Compliance with all MMS regulations

1.2 Acronyms and Definitions

Acronym	Definition
APB	Annular Pressure Buildup
API	American Petroleum Institute
AV	Annular Velocity
Bc	Bearden Units of Consistency, as measured in a cement consistometer. It is an empirical measure of the consistency of the cement slurry
BHCT	Bottom Hole Circulating Temperature
BHST	Bottom Hole Static Temperature
BOD	Basis of Design
BOPE	Blow Out Preventer Equipment
BtB	Beyond the Best
BU	Bottom-Up
Cementing Basis of Design (BOD)	Document outlining the general cementing requirements for the entire well including cementing job Objectives, Risks and Remediation for each casing string
DW GoM	BP Deepwater Gulf of Mexico
DWOP	BP's Drilling and Wells Operations Policy
ECD	Equivalent Circulating Density
ETP	BP's Engineering Technical Practice
Excess	Extra cement added to the calculated cement volume to account for uncertainty of hole size and contamination of the slurry during placement
FIT	Formation Integrity Test
FL	Fluid Loss; Flow Line
Flow Potential Factor	A dimensionless number used to gauge the potential for invasion of gas into a cement column after the cement becomes static
FMA	Fluid Migration Analyzer – laboratory equipment used to measure the capacity of cement slurries to control gas migration under simulated downhole conditions
GoM	Gulf of Mexico
HPHT	Pressure threshold: 15,000 psi
HSSE	Health, Safety, Security, Environment
HTHP	Temperature threshold: 350°F
ID	Internal Diameter
ISO	International Standards Organization
JSEA	Job Safety and Environmental Assessment
LAS	Liquid Additive System
Lead Cement	Normally a light density formulation that may be used when top of cement is required to cover up-hole hydrocarbon or water zones

LOT	Leak Off Test
MD	Measured Depth
MEPT	Maximum Estimated Job Placement Time
MMS	Minerals Management Service
MOC	Management of Change (BP process)
MSDS	Material Safety Data Sheet
OD	Outside Diameter
PPE	Personal Protective Equipment
Project	Field, a well, a casing or a liner string
RP	Recommended Practice
SBM	Synthetic Base Mud
SGSA	Static Gel Strength Analyzer. An updated version of the UCA test device. This testing apparatus can, in addition to estimating the compressive strength development of cements, estimate the static gel strength development of cement slurries vs. time
SPL	Service Provider Leader
SWF	Shallow Water Flow
Tail Cement	Higher density formulation that will be used from total depth to 1,000 ft MD or 500 ft TVD (whichever is higher) above the Intermediate casing or liner shoe
TOC	Top of Cement
TOL	Top of the Liner
TT	Thickening Time
TVD	True Vertical Depth
UCA	Ultrasonic Cement Analyzer. A lab test device which estimates compressive strength development (vs. time) of cement formulations
WOC	Waiting On Cement

1.3 Typical Deepwater Wellbore Schematic



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2 Minimum Requirements and Standards

2.1 Purpose

The purpose of this manual is to guide Drilling personnel through the cement design process and to identify minimum requirements and standards of cement design and operations. It is imperative that all of the requirements be met.

Note: The attitude of "all we need is a shoe test" is unacceptable. In some cases, a shoe test might be the most important aspect of the cement job, but future well utility must be considered as well.

In instances where adverse conditions prohibit compliance to the following standards, team leaders and managers will be notified and drilling engineers will prepare to present the adverse conditions and the revised procedure to the Drilling Engineering Manager.

Standards	Responsible Parties
Casing Jewelry	Drilling engineers are responsible for design and proper placement of casing jewelry.
Cement Slurries and Spacer Tests	Drilling engineers are responsible for overseeing the implementation and required specifications of all tests.
Dual Plugs	Drilling engineers are responsible for designing all cement jobs with dual plugs.
Tandem Spacers	Drilling Engineers are responsible for running tandem spacers on every cement job.
Hydraulic Modeling	Service providers and drilling engineers, liner equipment must be assessed.
Meetings	Drilling engineers are responsible for conducting the following meetings: • Project Initiation meeting with all team members • Planning meetings Planning or Operations engineers should attend JSEA and rig floor meetings.
Pumping Schedules	Drilling engineers are responsible for designing and following pump schedules that include all plug and dart bumps.
Rig Duty	Delivery or Operations engineers will be on the rig for tubular running, cementing, FIT/LOT, and production tubular testing.
Volumes to be Pumped	Drilling engineers are responsible for calculating necessary cement volumes and ensuring that adequate dry cement

	volumes are on the rig prior to all cement jobs.

2.2 BtB Cementing Process Guide

As with all BP engineering work, engineers shall follow the logic of the BtB process. Refer to BP document 2200-T2-DO-RP-0003, "Drilling Engineering BtB Stage Gate Process (Well Level)."

Figure 1: Casing Running and Cementing Evaluation, Selection, Design and Execution

APPRAISE	SELECT	DEFINE	EXECUTE
•			
• Slurry and Spacer Testing • Cost Benefit Analysis • Value Proposition	• Recommendation • Including Hole Size • High Level Plan, Timeline Milestones • Team Buy-In • Onshore • Offshore • Vendors • Set Joint Objectives • BP Lessons Learned • MSDS Sheets	• Detailed Plan • Drag Model for Casing Running Weights • Hydraulics Model for Hole Cleaning, BU Circulating, Mud Conditioning and Liner Setting • Centralization Plan for Running and Cementing • Equipment Inspection and Preparation • Onshore Pre-Spud with Vendors	• Rig-Based "Pre-Spud" Meeting • Job Execution and Monitoring • Casing Running • Cementing • After Action Review

3 Job Design: Cement Slurries

The drilling engineer is responsible for providing the cementing service provider with all of the necessary data and information to allow for the effective cement slurry, spacer design, and cement job plan. Drilling engineers will also provide the Test Matrix for BP GoM and any additional required tests to be run on cement slurries and spacers.

The data and information provided by the drilling engineer will include, but will not be limited to:

- Clearly defined cementing objectives which are listed in the BOD.
- Identified potential risks to achieving the objectives.
- Formation properties and formation fluids (e.g., detailed pore pressure and fracture pressure profiles, LOT or FIT at the previous shoe, caliper if available, inclination profile, location of all hydrocarbon and water zones, and drilling fluid type and properties).
- Estimated bottom hole static temperature.
- Complete wellbore geometry: all ODs, IDs, drift, depths, etc.

3.1 General Slurry Design Considerations

- Slurry density to prevent or minimize lost circulation, based on the mud density and hole conditions.
- Depending on hole conditions, the slurry design should address the potential for wellbore fluid migration after the cement job.
- Length of the cement column (TOC):
  - Design should cover all productive horizons
  - WOC time considerations due to length of the cement column
  - May require a lead and a tail slurry
  - May require a 2-stage job
  - May require a low-density (but competent) cement slurry for a good shoe test
  - APB considerations
- Fluid loss in production jobs should be low, particularly for tight liner configurations, to minimize flow migration after cementing and damage to the pay zones permeability from the cement filtrate (~ 50 ml API fluid loss).
- In the case of intermediate jobs with tight annular configurations, low fluid loss (~ 50 ml API) may be needed to prevent cement slurry dehydration against permeable zones. If good annular clearances are present, normally a moderate FL control is all that will be needed (~ 200 ml API).
- Zero free fluid to prevent high hole side channeling. If the hole section is vertical and there is no potential for formation fluids after cementing, free fluid of 1% may be allowed.

- No settling (static or dynamic depending on the well configuration).
- Compressive strength on production jobs sufficient for perforating (minimum 1,000 psi after 24 hours with the cement slurry contaminated with 5% of the mud).

- Compressive strength on intermediate jobs sufficient to generate a good shoe test (2,000+ psi, particularly when relatively small volumes of slurry are pumped, as is the case when all that is needed is a good shoe). High compressive strength slurries have greater resistance to contamination than lower compressive strength slurries.
- Thickening time should be calculated as job time + $1^1/_2$ to 2 hours at BHCT. The calculated job time when cementing a liner, if the cement is brought above the TOL, should include a minimum of 45 minutes to release from the hanger. If a lead and tail slurry are to be pumped, the lead slurry will always have a longer thickening time than the tail slurry. If the excess cement slurry at the top of the liner is going to be reversed out, the cement slurry thickening time and gel strength development testing will mimic and account for the time to release the packer, circulate and reverse out.
- As required by the Cement Slurry and Spacer Testing Protocol and Test Matrix for BP GoM, all final testing on the cement slurries will be performed using the actual mix water, cement and additives located on-site, prior to pumping the job. All tests will be completed and reported to the drilling engineer ahead of pumping the job.

3.2 Selection of Cement Systems

The selection of cement slurries for hydrocarbon and water zones will depend on well conditions. Below are several scenarios requiring different cement slurries.

3.2.1 Benign Cases

In some cases, tectonics, or large changes in reservoir pressures and/or compaction are negligible and holes are capable of supporting normal cement slurry densities with no expectation of extreme casing loading. In these cases, use class H cement. Use silica flour for density requirements ~ 16.6 ppg plus additives to control fluid loss, free fluid and thickening time.

3.2.2 Low Fracture Gradients

In these situations, low density slurries will be required (for example, 13.5 ppg). Specialty solids-laden systems like Schlumberger's CemCRETE or Halliburton's Tune-Light should be used.

3.2.3 Extremely Low Fracture Gradients

In cases of extremely low fracture gradients (e.g., across highly depleted zones) foam cement systems will be required (for slurry densities lower than ~ 11-12 ppg).

3.2.4 Other Extreme Situations

Cases of extreme reservoir temperatures (300+°F), expected large changes in casing loads due to reservoir compaction during production, or due to tectonics, etc. are possible. Specialty cement systems will be required to ensure well longevity. In those situations, the drilling engineer, with approval from management, will coordinate with the service provider for special services needed to design the cement slurries for the life of the well (e.g., Halliburton's Life of the Well Service).

3.3 Slurry Volume and Excess Factors

3.3.1 ETP Zonal Isolation Requirements (GP 10-60)

Note: The following criteria are a direct quote from the (ETP Section 5.1.3).

Zonal isolation design criteria for primary casing strings to meet well integrity and future abandonment requirements

Cement design shall meet one of the following:

A. 30 mTVD (100 ft TVD) above the top of the distinct permeable zone where the TOC is to be determined by a proven cement evaluation technique (ETP Section 5.3)

B. 300 m mD (1,000 ft MD) above the distinct permeable zone where the hydraulic isolation is not proven except by estimates of TOC (ETP Section 5.3)

For each well the actual TOC shall be recorded along with the method used for this determination. Where the actual TOC is below the plan, the TOC shall be reviewed with stakeholders for its impact on future well integrity, operability, suspension and abandonment operations.

3.3.2 Liners

When cementing a liner, the best practice is to bring cement above the top of the liner to minimize the potential for weak, contaminated cement in the liner overlap. An additional best practice used in the GoM is to incorporate liner top packers in the design. However, there are situations when it may not be desirable to bring cement above the TOL (for example, to prevent APB). In those cases, a liner top packer will be used to achieve isolation.

If Cement is Pumped above the Liner

In deepwater operations, often an open hole caliper is not run. If one is available, the cement volume will be: caliper-calculated open hole annular volume from the shoe plus 10% excess + shoe track volume + casing/liner lap volume + volume of casing from TOC to TOL.

If no caliper is available, the hole will be assumed to be gauge (this is normally a reasonable assumption for holes drilled with oil base type muds). In this case, the cement volume will be: gauge hole-calculated open hole annular volume from the shoe plus 15%

excess + shoe track volume + casing/liner lap volume + volume of casing from TOC to TOL.

If the Top of Cement is not planned to reach the Previous Casing

If a caliper is available, the cement volume will be: caliper-calculated open hole annular volume from the shoe to the desired TOC plus 10% excess + shoe track volume.

If no caliper is available, the cement volume will be: gauge hole-calculated open hole annular volume from the shoe to the desired TOC plus 15% excess + shoe track volume.

3.3.3 Long Strings

Single Stage Cement Job

Single stage with a single cement slurry system: the top of cement should be a minimum of 1,000 ft MD or 100 ft TVD above the uppermost zone of interest. However, consideration should be given to issues of APB. The drilling engineer will consult with the production and/or the completion engineers on issues of APB.

3.3.4 Spacers

All cement jobs will require the BP-patented tandem spacer design. The drilling engineer will give the service company provider the spreadsheet (Test Matrix) containing the required tests for the spacer, and those requirements should be based on BP's GoM Testing Protocol.

A spacer volume sufficient to cover 1,000 ft of open hole or provide 10 minutes of contact time at the planned displacement rate should be pumped ahead of the cement slurry. The spacer must be compatible with both the drilling fluid and the cement slurry. The density normally should be designed midway between the mud density and cement density.

The use of a pre-flush will be optional. One of the main purposes of a pre-flush is to reduce the hydrostatic head during the cement job to help minimize losses. When used, volume of pre-flush used will consider the wellbore ECD limits (dynamic) and also well control requirements (static and dynamic).

3.3.5 Cementing Wiper Plugs

Cementing wiper plugs will be certified by the service provider to be applicable for the temperature and chemical environment of the well. They will be rated for all the pressures that will be applied to the plug during the cementing operations (plug bumping) and subsequent pressure testing of the casing.

Dual plug systems will be used in all instances when equipment is available. Cement slurries can become severely contaminated with the spacer while going down the casing if a bottom plug is not used in between the spacer and the cement slurry. Therefore, the bottom plug will be dropped ahead of the cement slurry and not in front of the spacer.

In the event of adverse conditions where a single plug is used, the EXCESS volume of cement pumped should be increased to account for the contamination of the cement inside the casing and any APB issues (for example, to 20-25%).

4 Centralization, Hole Cleaning and Casing Hardware

4.1 Centralization

The goal will be to obtain a minimum of 80% standoff. The shoe track will always be centralized, with a minimum of one centralizer/joint. In addition, all hydrocarbon and water zones will be centralized below, across, and above the zone. When hole conditions allow, the zones will be centralized a minimum of 300 ft above and below the zone.

The drilling engineer will coordinate with the service provider (equipment or cementing services) to run a centralizer placement simulator to optimize the selection and placement of centralizers for the hole section at hand. The simulations will be run using the actual hole inclination profile and if available, the caliper log or best estimate of the actual hole diameter. The type of centralizer (bow, rigid or solid) will be selected based first on torque and drag implications, and second on the ability of obtaining the desired standoff. Stop collar selection will be based on drift restrictions and the maximum obtainable holding force. The goal is to obtain a minimum of 30,000 lbs tested on the selected grade of pipe.

Use two rigid centralizers in the liner overlap when the TOC is required to be brought above the liner. This is especially important when cement is required to isolate hydrocarbon or water zones.

The shoe will contain two spring loaded valves (plunger or flapper) rated (API RP 10F) for the expected circulation and cementing times, rates and temperature. The float collar should contain one valve (or no valve if surge equipment will be used).

4.2 Cleaning the Hole Prior to Running Pipe

The drilling engineer will ensure that every effort is taken to properly clean the hole from cuttings, sag barite, etc. prior to running the casing or liner. This is particularly important in deviated sections of the well and extremely important when a liner will be run. The drilling engineer will coordinate with rig personnel to apply best hole cleaning practices as included in the well's mud program, in preparation for running the casing or liner. This is especially important when utilizing auto-fill float equipment to minimize debris inside the casing.

4.2.1 Running Casing or Liner

The drilling engineer and service provider will determine running speeds based on surge and swab simulations to minimize losses. Information will be provided to the rig personnel with instructions to be followed as per the design.

Run surge reduction equipment if losses are expected while running the pipe to bottom.

Drilling engineers will obtain a dispensation to de-activate the surge equipment near the bottom of the hole. However, well control issues should be considered and accounted for when requesting this dispensation.

When running in the hole, stopping at the previous shoe to circulate the hole should be considered, particularly in cases when the hole has been static for a long time, and if losses in the open hole are a possibility. The intention is to break the mud gels in the casing-casing section of the hole to reduce surge pressures ahead of running the pipe in the hole. Also, record torque, pick-up and slack-off values.

4.3 Hole Conditioning Ahead of the Cement Job

Once the casing is on bottom or the liner is hung off, circulation of the hole should be started slowly at a previously calculated safe pump rate, not to exceed AVs achieved during the drilling phase, to prevent pack-offs. After the risk of pack-off has decreased, maximize circulation rates to ensure proper hole cleaning and conditioning for cementing. Maximum circulating rates should be calculated using the fracture gradient profile and a safety factor.

A sensitive pressure drop transducer near the top of the casing or drill pipe (may be on or near the cementing head) will be used to monitor the surface pressure while conditioning the hole and during the entire cementing operation. GoM Best Practice is to circulate a minimum of two bottoms up before starting to pump the cement job, or a minimum of five hours, whichever is greater. Pressure should be modeled before the job and then compared to the real time pressures.

If hole conditions and wellhead systems allow, reciprocate the casing while conditioning and cementing. Also, consider using rotating liner hangers that allow rotation to 20+rpm.

4.4 Performing the Cement Job

Every effort will be made to mix and pump the cement job exactly as it was designed (optimized). The density and surface rheology of the spacer after batch-mixed and ahead of the cement job will be tested on location by the cementing service provider to confirm that they meet design specifications.

The pump schedule will be followed whenever possible. The job surface pressures, densities and rates will be continuously monitored and recorded during placement and particularly during displacement, for a permanent record of the job. Pressure test the casing or liner right after bumping the plug (prior to the cement setting) to avoid damaging the cement sheath if testing is done after the cement is set.

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5 QA/QC of Cementing Jobs at Wellsite

5.1.1 Overview

The following guidelines assume that the entire cementing operation, from lab testing of the fluids to be mixed and pumped, to the pump schedule to be used, has been carefully designed and optimized by the Service Provider and the operator engineers. Therefore, these Guidelines are to help with performing the cementing operation as closely as possible to the way the job was optimized and simulated.

5.1.2 Documents Needed

Item	✓
Lab report from the Service Provider showing the cement slurry/slurries and spacer formulations and testing results including density, thickening time, compressive strength. fluid loss, free fluid, etc.	
Final, optimized job simulation by the Service Provider including volumes to be pumped, pump (rate) schedule and expected surface pressures.	
Other relevant documentation, for example, surge/swab simulation, centralizer placement simulation, well inclination profile, latest mud log report, etc.	

5.1.3 Actions Prior to the Cement Job

Allow Plenty of Time Ahead of the Cement Job	✓
Review entire cementing job procedure from mixing to completion with the Wellsite Leader and the Service Provider Leader on location, to collect information, and to gain complete understanding/agreement on how the job will be performed from start to finish.	
As a team, clear up any misunderstandings and address/answer all questions, for example, making sure the bottom plug will be released ahead of the cement slurry.	
Review all needed calculations. This should include review of calculated displacement volume which may consider the addition of extra volume to account for compressibility of the mud, vs. length/volume of the shoe track.	
Review the centralizer program, float equipment and cementing plugs to be used.	
Review the casing running speed. If casing is already on bottom, were losses experienced? Is there a need for the SPL to rerun the cement job simulator to adjust the pumping schedule to minimize losses during the cement job?	
Discuss hole conditioning ahead of the cement job: rates schedule, time. Pressure transducer installed to monitor the surface pressure while circulating?	

Review Equipment with Service Provider Leader	✓
With the Service Provider Leader, go over all the equipment that will be used for the cementing operation: pumping equipment, flow meters, densitometers, pressurized mud balance, liquid additives delivery system, etc.	
Pumping unit: recently maintained? Pressure tested? Recent problems?	
Flow meters, maintained, calibrated? Recent problems and actions taken?	
Densitometer calibration: how and when done? Correlates well with pressurized mud balance?	
Pressurized mud balance, recently calibrated with water? Functioning correctly? Piston, valve?	
Note: Verify calibration of pressurized mud balance with water. Check proper functionality of piston and valve. Proper functionality and cleanliness of this device is important to the success of the cementing job.	
Liquid additives delivery system: how does it work, recent maintenance, calibration?	
Equipment backup: what if some equipment fails? Preventive actions?	
Cement and mix water delivery systems: rig-up to minimize interruptions? Past experiences and corrective actions taken?	
Cement venting system: rig-up to minimize problems?	
Spacer mixing: cleaning of pits ahead and after mixing? Procedure to ensure spacer is mixed as designed?	
Cementing head working pressure rating: ________ psi.	
Testing of lines, to what pressure? _________ psi	
Darts loading procedure.	
Recording of the job parameters during mixing and displacement even if the displacement is done by the rig. Onsite PC working properly and ready to collect all the job data?	

With the SPL and Rig Personnel	✓
Quickly review the experience level of service provider personnel on location, including previous experience and experience with cement jobs on this rig.	
With the SPL and rig personnel, walk around the cement bulk equipment and cement and water delivery systems as well as venting rig-up including lines, to gain assurance that no interruptions will take place during the job due to poor materials movement or venting of cement into (for example) a pressurized tank. Ask about previews delivery or venting problems, if any, and recent corrective actions taken.	
Quickly review the experience level of rig personnel that will be assisting during the cementing operation.	

Safety Meeting Before the Cement Job	✓
Detailed review of relevant HSE issues: lines pressure testing, areas to stay away from, PPE equipment needed for the job, emergency shut-in procedure, contingencies plan, etc.	
Review of cement job, e.g., volumes, pump schedules, maximum displacement volumes, etc. Emphasize that the job is to be mixed and pumped as closely as possible to the way it was designed and simulated. Need to keep written logs of all operations including time, volumes and pressures at the time of the events.	
Pipe movement, if any. For example, liner rotation. Rate, duration? Maximum allowed torque/drag.	
Darts, plugs releasing. Expected release pressures. Expected volume, pressure when plug bumps.	
Assignment of responsibilities. For example, who will be monitoring returns? Where will the Wellsite Leader and SPL be located during the job if needed? Who will be checking the density with the pressurized mud balance? How often? Who will be watching the cement delivery? Releasing of darts, delivering of liquid additives to the mix water? Collecting cement, additive, mix water samples, wet samples? etc.	
Communication devices: type, availability, who will have them?	

5.1.4 Cement Job Execution

Cementing Job Execution	✓
All personnel wearing required PPE?	
SPL present when mixing spacer?	
Correct spacer volume mixed in clean pits including dead volume? _________ bbls	
Density of spacer verified with pressurized mud balance? _______ lbs/gal	
Surface rheology of spacer measured and corresponding to expected/lab values? If not, spacer disposed of and remixed?	
Lines pressure tested to desired pressure? Lines retested if needed? _________ psi	
Spacer and slurry/slurries pumped as per design: volumes, rates?	
Spacer and slurry/slurries pumped at the designed density?	
Density monitored with densitometer and periodically checked during the job with the pressurized mud balance?	
Surface job pressures periodically checked vs. simulation?	
Measured surface pressures correlating to expected/predicted pressures?	
Samples taken and sealed: mix water, dry cement, additives?	
Wet samples taken: spacer, lead and tail slurries?	
Wet samples placed in water bath? Bath temperature: _________ °F	
All job data recorded including during displacement? Rates, densities, surface pressure.	

Pumping equipment working properly?	
Delivery systems working properly?	
Good communications among all personnel involved?	
Rate of returns during the job? Full, partial losses, total losses? When?	
Corrective action taken if losses are experienced? Reduction of rate?	
Darts, plugs released and landing as expected?	
Displacement volume pumped as agreed? Total ___________ bbls	
Top plug landed?	
Extra pressure applied to plug after landing as agreed?________ psi	
Final lifting pressure? Value as expected? ___________ psi	
Floats held?	
Flowback volume after releasing the surface pressure? _________ bbls	

5.1.5 Post Cement Job

Actions after the Cement Job	✓
Document detailed description of any event not going as planned: shutdowns, leaks, problems with delivery of materials, rates, densities, pressures different from plan, etc.	
Conduct a brief materials balance: cement, mix water, additives used vs. expected quantities?	
After the job, conduct a meeting with the Wellsite Leader and Service Provider Leader. What went right? What went wrong? Lessons Learned?	