Appendix 1.1: Cementing Calculations - Casing

PRIMARY CEMENTATION CALCULATIONS - CASING	
PROCEDURAL STEP	**SUB CALCULATIONS**
1. Calculate Tail Slurry Data	1.1 Calculate Volume • *Total Volume (bbls) = Shoetrack vol + (rathole + excess) + (annulus to top of tail + excess)* • *Total Volume (cu. ft.) = bbls × 5.615* 1.2 Calculate Cement Requirements • Sacks of Cement = slurry cu. ft. ÷ slurry yield (cu. ft./sx) • *Tonnes of Cement (MT)* = $\left(\frac{\text{sacks of cement} \times 94}{2200}\right)$ 1.3 Calculate Mixwater Requirements • Total Mixwater (bbls) = $\left(\frac{\text{sacks of cement} \times \text{mixwater (gal/sx)}}{42}\right)$ *+ excess (dependent on job)* 1.4 Calculate Additive Requirements (for each additive) • Total Volume = Concentration (gal / sk) × sacks of cement (BWOC) • Total Volume = Concentration (% BWOC) × total mix water (BWOC) <u>Note</u>: • Water excess to be considered if additives are mixed with water.
2. Calculate Lead Slurry Data	2.1 Calculate Slurry Volume • *Total Volume (bbls) = (hole / csg annulus to TOC or shoe) + (csg / csg annulus vol to TOC (if require overlap))* • Total Volume (cu. ft.) = bbls × 5.615 2.2 Calculate Cement Requirements *(As per 1.2)* 2.3 Calculate Mixwater Requirements *(As per 1.3)* 2.4 Calculate Additive Requirements *(As per 1.4)*
3. Calculate Displacement Data	3.1 Calculate Displacement Volume • *Total Volume to Float Collar (bbls)* • *Mud Displacement Volume (bbls)* • *Pump Strokes to Bump Plug*
4. Calculate Minimum Hydrostatic During Job	4.1 Assume minimum hydrostatic when (low weight) spacer pre flush in annulus • Ht of Spacer / preflush = $\frac{\text{volume (bbls)}}{\left(\frac{\text{hole ID}^2 - \text{csg OD}^2}{1029.4}\right)}$ • *Loss in psi hydrostatic = (mud wt - spacer wt) × 0.0519 × spacer ht* • *Hydrostatic Gradient = MW (ppg) -* $\left(\frac{\text{hyd loss (psi)}}{0.052 \times \text{Depth of Interest (DOI) (ft.)}}\right)$

Table 52. Primary Cementing Calculations – Casing (i)

PRIMARY CEMENTATION CALCULATIONS - CASING	
PROCEDURAL STEP	**SUB CALCULATIONS**
5. Calculate Maximum Hydrostatic	5.1 Calculate Cement Hydrostatic (Tail) $= wt\ cmt\ (ppg) \times tail\ ht \times 0.052$ 5.2 Calculate Cement Hydrostatic (Lead) $= wt\ cmt\ (ppg) \times lead\ ht \times 0.052$ 5.3 Calculate Spacer Hydrostatic • $Calculate\ spacer\ ht = \left(\frac{spacer\ vol}{annulus\ volume\ (bbl/ft)}\right)$ • $Calculate\ spacer\ Hydrostatic = spacer\ wt\ (ppg) \times ht\ (ft) \times 0.052$ 5.4 Calculate Preflush Hydrostatic (as applicable) • $Calculate\ preflush\ ht = \left(\frac{preflush\ vol}{annulus\ volume\ (bbl/ft)}\right)$ • Calculate Preflush Hydrostatic = preflush wt × ht × 0.052 5.5 Calculate Mud Hydrostatic (as applicable) • $Calculate\ Mud\ ht = top\ of\ preflush\ to\ surface\ (ft)$ • $Calculate\ Mud\ Hydrostatic = MW \times ht \times 0.052$ 5.6 Calculate Total EMW = $Total\ of\ (5.1 - 5.5) \div 0.052 \div Depth\ (ft)$ Note: * Calculate hydrostatic at known weak points in the wellbore and advise DTL if fracture gradient will be exceeded.
6. Calculate Job Time	6.1 Calculate Mixing/Pumping Time • $Total\ Time = (slurry\ bbls \div pumping\ rate) + 10\ minute\ pre\ mix\ time\ (or\ as\ advise)$ 6.2 Calculate Post Cement Spacer/Post Flush Time • Total Time = bbls ÷ pumping rate (bpm) 6.3 Calculate Displacement Time • $Total\ Time = displacement\ volume\ (bbls) \div displacement\ rate\ (bpm)$ 6.4 Calculate Total Job Time Total of (6.1 - 6.4) × 2 (100% SF) * Compare to thickening time and advise DTL if thickening time is insufficient.

Table 52 (cont'd). Primary Cementing Calculations – Casing (ii)

Appendix 1.2: Cementing Calculations - Liner

PRIMARY CEMENTATION CALCULATIONS - LINER	
PROCEDURAL STEP	**SUB CALCULATIONS**
1. Calculate Hydrostatic Loss/ Increase Due To Pre-Flush	Assume worst case with pre-flush in annulus. 1.1 Calculate preflush ht $ht\,(ft) = \dfrac{vol\ preflush\ (bbls)}{\left(\frac{hole\ ID^2 - liner\ OD^2}{1029}\right)}$ 1.2 Calculate Hydrostatic loss/gain $loss/gain\ (psi) = (MW - PF\ wt) \times 0.052 \times ht\ preflush$ + check against pore pressure for safety margin.
2. Calculate Slurry Volume For Job	2.1 Calculate shoetrack volume $= shoetracklength \times \left(\frac{ID\ liner^2}{1029.4}\right)$ 2.2 Calculate rathole Volume $= rathole\ length \times \left(\frac{OH^2}{1029.4}\right)$ 2.3 Calculate O.H./Liner Annulus $= (Liner\ Shoe\ Depth - Casing\ Shoe\ Depth) \times \left(\frac{OH^2 - liner\ OD^2}{1029.4}\right)$ 2.4 Calculate Liner/Casing Annulus $= (Casing\ Shoe\ -\ Line\ Hanger\ Depth) \times \left(\frac{ID\ casing^2 - liner\ OD^2}{1029.4}\right)$ 2.5 Calculate Casing Vol to planned TOC $= (Hanger\ Depth\ -\ TOC) \times \left(\frac{ID\ casing^2 - liner\ OD^2}{1029.4}\right)$ 2.6 Apply Excess to 2.2 and 2.3. 2.7 Sum 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6 for total volume slurry (bbls) 2.8 Calculate Slurry Vol (cu. ft.) $= \text{Total Vol (bbls)} \times 5.615$
3. Calculate Cement Mixwater and Additive Volumes	3.1 Calculate cement volume required $= \left(\frac{Slurry\ Vol\ (cu.\ ft.)}{yield\ (cu.\ ft./sk)}\right)$ 3.2 Calculate cement requirement (MT) $= \left(\frac{No.\ sacks \times 94}{2200}\right)$ 3.3 Calculate Mixwater Volume (bbls) $= \left(\frac{Mixwater\ gal/sk \times No.\ sacks}{42}\right) + excess$ 3.4 Calculate Additive Requirements (for each) $= additive\ concentration\ (gal/sk) \times No.\ sacks\ cement$ <u>Note</u>: * Excess water to be considered in additives requirement.
4. Calculate Cement Line Volume	4.1 Calculate Cement Line Volume $= length\ (ft) \times \left(\frac{ID\ line^2}{1029.4}\right)$
5. Calculate Displacement Volume to Land Dart in Wiper Plug	5.1 Calculate Volume to Land Dart = Total Displacement Volume $= length\ to\ wiper\ plug\ seat \times \left(\frac{ID\ running\ string^2}{1029.4}\right)$ 5.2 Calculate Mud Displacement Volume $= total\ disp\ vol - spacer\ behind\ volume$ 5.3 Calculate Strokes to Shear Wiper Plug $= \left(\frac{Result\ of\ 5.2}{Pump\ output\ (bbl/stk)}\right)$

Table 53. Primary Cementing Calculations – Liner (i)

PRIMARY CEMENTATION CALCULATIONS - LINER			
PROCEDURAL STEP	**SUB CALCULATIONS**		
6. Calculate Total Displacement Volume	6.1	Calculate Displacement Volume from Wiper Plug-Landing Collar	$= \{\text{wiper plug seat - landing collar}\} \times \left(\frac{ID\ liner^2}{1029.4}\right)$
	6.2	Calculate Total Displacement Volume	$= \text{'Result 5.2'} + \text{'Result 6.1'}$
	6.3	Calculate Strokes to bump	$= \left(\frac{\text{'Result 6.2'}}{\text{pump output (bbl / stk)}}\right)$
7. Calculate Differential Pressure & Hydrostatic @ End of Job	7.1	Calculate Differential Pressure prior to bump	
	7.1.1	Calculate cmt hyd (psi)	$= cmt\ wt \times 0.052 \times cmt\ ht$
	7.1.2	Calculate spacer hyd (psi)	$= spacer\ wt \times 0.052 \times spacer\ ht$
	7.1.3	Calculate mud hyd (psi)	$= MW \times 0.052 \times (depth\ liner - cmt\ ht - spacer\ ht)$
	7.1.4	Calculate cmt hyd in liner	$= shoetrack\ length \times 0.052 \times cmt\ wt$
	7.1.5	Calculate spacer behind in liner	$= spacer\ ht \times 0.052 \times spacer\ wt$
	7.1.6	Calculate mud hyd in string	$= MW \times 0.052 \times (shoe\ depth - cmt\ ht - spacer\ ht)$
	7.1.7	Calculate differential pressure	$= (7.1.1 + 7.1.2 + 7.1.3) - (7.1.4 + 7.1.5 + 7.1.6)$
	7.1.8	Calculate hydrostatic (ppg) at end job	$ppg = \left(\frac{\sum(7.1.1 + 7.1.2 + 7.1.3)}{0.052 \times shoe\ depth}\right)$
		Note * Check final hydrostatic against minimum fracture gradient in open hole. * If hydraulics programme is available calculate ECD prior to end displacement.	
8. Calculate Running String wt.	8.1	Calculate Running String wt in mud	$= string\ ppf \times length \times bouyancy\ factor\ of\ mud$
	8.2	Running wt in cement	$= string\ ppf \times length\ in\ cmt \times bouyancy\ factor\ of\ cement$
		Note * Check running string wt on POOH to TOC and when out of cement.	

Table 53 (cont'd). Primary Cementing Calculations – Liner (ii)

Appendix 1.3: Cementing Calculations – Balanced Plug

PRIMARY CEMENTATION CALCULATIONS - BALANCED PLUG	
PROCEDURAL STEP	**SUB CALCULATIONS**
1. Calculate Slurry Volume	1.1 Calculate Slurry Volume (bbls) $= required\ ht \times \left(\frac{ID\ csg^2\ or\ OH^2}{1029.4}\right)$ 1.1.1 If across shoe or stub, calculate a) ht cmt in cased hole section b) volume cmt in in cased hole section c) ht cmt in open hole section d) volume cmt in open hole section e) total volume = sum 'b' + 'd' 1.2 Calculate Slurry Volume (cu. ft.) = Total vol (bbls) x 5.615
2. Calculate Cement and Additive Requirements	2.1 Calculate sacks cement required (no. of sacks) $= \left(\frac{slurry\ vol\ (cu.ft.)}{slurry\ yield\ (cu.\ ft./sk)}\right)$ 2.2 Calculate cement required (MT) $= \left(\frac{no.\ of\ sacks \times 94}{2200}\right)$ 2.3 Calculate mixwater volume $gals = no.\ of\ sacks\ cmt \times mixwater\ (gal/sk) + excess$ $bbls = \left(\frac{gals\ mixwater}{42}\right)$ 2.4 Calculate additive requirements (for each) $= no.\ of\ sacks\ cmt \times additive\ concentration\ (gal/sk)$ Note: * Excess water to be considered in additive requirement.
3. Calculate Minimum Hydrostatic	3.1 Calculate ht of spacer or preflush (worst case w/ preflush spacer out of pipe) $ht = \frac{vol\ spacer\ or\ preflush}{\left(\frac{hole\ or\ csg\ ID^2 - pipe\ OD^2}{1029.4}\right)}$ 3.2 Calculate hydrostatic loss/gain $psi = (MW\ (ppg) - spacer/preflush\ wt\ (ppg)) \times 0.052 \times spacer\ ht\ preflush$ Note: * Check resultant EMW against any exposed formation pore pressures at depth of interest.

Table 54. **Primary Cemnting Calculations – Balanced plug (i)**

PRIMARY CEMENTATION CALCULATIONS - BALANCED PLUG			
PROCEDURAL STEP	**SUB CALCULATIONS**		
4. Calculate Spacer Volume Behind Cement	4.1	Calculate volume behind (bbls)	$= \text{ht spacer or preflush} \times \left(\frac{\text{pipe ID}^2}{1029.4}\right)$
5. Calculate Displacement Volume to Balance	5.1	Calculate cmt ht prior to pull back	$\text{ht ft} = \left(\frac{\text{slurry volume (bbls)}}{\text{annulus vol (bbl/ft)} + \text{DP string capacity (bbl/ft)}}\right)$
		Note: If stinger used calculate slurry vol inside and outside stinger. Subtract this total volume stinger from total cmt volume and use remainder in formula above to gain ht outside DP. Then add stringer length to get total ht.	
	5.2	Calculate ht spacer prior to pullback	$\text{ht spacer (ft)} = \left(\frac{\text{spacer volume}}{\text{annulus vol (bbl/ft)} + \text{DP capacity (bbl/ft)}}\right)$
	5.3	calculate ht of mud to displace	$= \text{cement string length} - \text{slurry ht (5.1)} - \text{spacer ht (5.2)}$
	5.4	Calculate displacement volume (bbls)	$= \left(\frac{\text{DP ID}^2}{1029.4}\right) \times \text{ht of mud required (5.3)}$
	5.5	Calculate displacement volume (STKS)	$= \frac{(\text{disp vol (bbls)} - 2\text{ bbls under displacement})}{\text{pump output (bbl/stk)}}$

Table 54 (cont'd). Primary Cementing Calculations – Balanced Plug (ii)

CHAPTER 9
EVALUATION

TABLE OF CONTENTS

9.1 OBJECTIVES

The primary objectives of evaluation are:

- To obtain the maximum amount of subsurface information as detailed in the Drilling Program, in a safe and cost-efficient manner.
- To ensure that data acquisition is not impaired or damaged by drilling fluids or drilling practices during the drilling of the wellbore.
- To ensure that the DSV retains overall control and responsibility for the safe and efficient execution of all evaluation activities performed at the wellsite.

It is important that the geological objectives and requirements are fully understood and documented in the Drilling Program.

9.2 RESPONSIBILITIES

At the well site, the Wellsite Geologist (WGL) is responsible for the supervision of the evaluation of the well. The DSV controls operations on the rig and executes the evaluation program as requested by the WGL. The DSV is also responsible for the following activities:

1. Ensuring that equipment and logging personnel are on the site and prepared for activities.
2. Ensuring that all personnel involved in evaluation are trained and qualified for the job.
3. Ensuring that logging and testing tools are run in accordance with the Drilling Program.
4. Managing safety, in particular for well control, explosives, chemical cutters and radioactive tools.
5. Reporting of logging and testing activities, in conjunction with the Wellsite Geologist.

Geological requirements for logging shall be detailed in the Drilling Program and may be revised during operations. The sequence of logging shall also be included and shall not be changed without an authorised revision to the program.

The responsibilities for the different evaluation activities (electric logging, coring, mud logging, and testing) are defined in the tables below.

9.2.1 Generic Responsibilities for all Evaluation Activities

Task	Performed by	Verified by
Specify evaluation requirements	WGL	DM
Mobilise equipment and tools	DSV / DM	DSV / WGL
Run evaluation tools	Contractor	WGL/DSV
Fish for tools (if required)	Contractor	DSV
Revise evaluation program	WGL	DSV/DM
Prepare reports and logs	Contractor/WGL/DSV	DM

Table 55. Responsibilities for Evaluation Activities - Generic

9.2.2 Specific Evaluation Responsibilities

Task	Performed by	Verified by
Logging		
Authorise commencement and continuation of logging	DSV / WGL	DM
Rig up, monitor hole	Drilling Contractor	DSV
QC wirelinelogs	WGL	DM
Provide logging results	Logging Contractor	WGL
Coring		
Determine core point	WGL	DM
Approve pulling out to core	DSV	DM
Make up core barrel, cut core, record parameters and recover core	Coring Contractor / Drilling Contractor	DSV
Prepare core description	WGL	DM
Package and ship core	Mud loggers / WGL	DM
Mudlogging		
Prepare unit for start-up, ensure unit safety, calibrate equipment	Mud Logging Contractor	WGL / DSV
Perform mudlogging	Mud Logging Contractor	WGL / DSV
QC mudlog	WGL	DM
Prepare and package cutting samples for transport	Mud Logging Contractor	WGL
Testing		
Identify need for test	WGL	DM
Select test interval	WGL	WGL / DSV / DM
Operate surface test equipment (i.e. separator)	Separator Contractor / Testing Company	DSV
Ensure safety and integrity during the test	Drilling Contractor / Testing Company	DSV
Prepare work instructions	Drilling Contractor / DSV	DM
Monitor operations	WGL / DSV	DM
Monitor recovery, collect samples	WGL	DSV
Conduct the test	Testing Contractor	DSV

Table 56. Responsibilities for Evaluation Activities - Specific

9.3.0 ELECTRIC LOGGING

This section describes the electric wireline logging for formation evaluation supervised by the Drilling Department and carried out by contractors.

9.3.1 Responsibilities

At the wellsite the Wellsite Geologist (WGL) is responsible for the supervision of logging operations, ensuring logs are run in accordance with the logging order form and the quality control of the logs. However, the DSV is responsible for the following activities:

- Ensuring that equipment and logging personnel are on site and prepared for activities.
- Ensuring that fishing equipment for each programmed logging tool is available on location or at a proximal logistics base.
- Controlling operations on the rig.
- Managing safety, in particular for well control, explosives, chemical cutters and radioactive tools.
- Reporting logging activities, in conjunction with the WGL.

9.3.2 Wireline Logging Safety

Full safety awareness is required at all times and safety meetings should be held prior to all logging operations. The following guidelines must be adhered to:

- All wireline logging personnel must be trained, certified (where applicable) and competent in the job they are doing.
- All wireline contractor personnel must be familiar with the mandatory requirements for explosive and radioactive materials.
- Explosive magazines and radioactive stores must be set aside in a designated, marked area away from the camp and rig traffic.
- The senior representative of the Logging Contractor must ensure that all crew are familiar with and comply with both GSLM and the logging Contractor's safety procedures.
- The Drilling Contractor must ensure that personnel are aware of the dangers of radioactivity and explosives.
- All persons not directly involved in the tasks must be kept well away from sheaves, cable and the winch drum when tools are being run, and when logging tools are at surface.
- Loads must not be moved across the cable when logging operations are in progress.
- The hole must be covered at all times, unless a tool is being run in the hole. A slotted hole cover must be installed whilst running logs.

9.3.3 Wireline Logging Preparation

The DSV shall ensure the following requirements are met before the start of logging operations.

- The logging unit is in position and ready to rig up at start of operation and the work area, i.e. catwalk, rig floor, etc. is clear of tools which may hinder the operations.
- The Logging Contractor is given assistance from the drilling crew during rigging-up and rigging-down.
- When rigging up, the Logging Contractor shall ensure that the winch operator has the clearest possible view of the rig floor.
- Prior to rigging up, all wireline sheaves shall be adequately guarded. No rig-up or operation is permitted without properly guarded sheaves. All wireline logging tools should also be checked and tested prior to rigging up.

- Logging operations shall only commence when hole conditions are stable. A check trip may be required before any logging run if there were hole problems during the previous run.
- The drilling fluid parameters (in and out) must meet the agreed specification contained in the Drilling Program. The overbalance shall be at least 50 psi for oil wells and 150 psi for gas wells.
- The well condition shall be closely monitored throughout the operation by the Mud Loggers and Drilling Contractor with regard to possible well flow, losses, etc.
  The well must be circulated through the trip tank during logging operations.
- Fishing equipment must be at the wellsite or available from a proximal supply base for all logging tools. The lengths OD's and connections of all the tools must be recorded.

9.3.4 General Logging Operations

The table below provides guidelines which shall be observed during logging operations.

Operation	Guideline
Trip Tank	• The hole shall be circulated using the trip tank during logging operations. • The hole must be kept full throughout, and the trip tank volume recorded every 15 minutes. • The trend must be monitored whilst running in and pulling out.
Calibration	• The wireline logging depths must be set to zero at surface and checked when pulling out to surface. • Additional checks must be made at casing depths and at TD.
Tool Failure	• If a tool hangs up while running in, and the section has not been logged before, log whilst POOH. • If one of the detectors on a combination tool does not function properly, log with the remaining detectors which have not been recorded before. • Inform the DM of any tool failure. • If poor hole conditions are anticipated, always log in, as well as out of the hole to secure data.
Repeat Sections	• A 60 m repeat section must be made on each logging run, and a 30 m overlap with previous logging runs must be made. • When running a caliper tool in a section where the top of the logged interval is below the casing shoe a 30 m section over the shoe must be run to check shoe depth and caliper gauge.
Mud Sampling	• Mud shall be sampled from both the pits and flowline just before the end of circulation before a logging job for analysis and resistivity measurement. This must be repeated after check trips if resistivity tools are to be run.
Wiper Trips	• May be required to ensure that the hole and mud conditions remain stable.
Tension Limits	• The weak-point tension limit and cable tension limit must be checked and tool weight in mud calculated before entering open hole. • Normal logging tension should be checked every 300 m in open hole. This is especially important in deviated holes where significant drag can occur.

Table 57. Guidelines to General Logging Operations

9.3.4.1 Log Quality Control

Quality Control of electric logs is the responsibility of the Wellsite Geologist. The following checks shall be conducted:

a) The depth correlation of all the curves on the log must be checked with each other. The repeat section must be checked with the main log for agreement. The curves must be examined to see if they have sensible values.
b) The correct logging speed must be verified with the logging engineer.The

acceptable range is ±10%.

c) A 60 m repeat section of logs must be made on each run and a 30m minimum overlap with previous runs must be made between succesive logging runs. Depth discrepancies must be less than 0.6 m.
d) Plot both the formation pressure and mud pressures on the formation pressure test plots as they are taken. Inconsistencies in the mud gradient must be checked immediately (a smooth mud gradient should be regarded as a quality check).

9.3.5 Tough Logging Conditions

Tough Logging Conditions (TLC) may exist in deviated wells. Logging tools may require installation and running on tubing or drill pipe to ensure all programmed logging can be achieved. The following sections describe the planning and operational guidelines for TLC.

Planning and preparation

The following information is required for the Logging Contractor to prepare for a TLC operation:

- Casing depth, size, and weight.
- Liner top (if applicable).
- Hole size and TD.
- Directional data.
- Mud weight and temperature, mud type, relevant mud additives (i.e. LCM).
- Drill pipe size, grade, tool connections, IDs.
- Drill collars and heavy weight pipe.
- Drill pipe connections, including drill pipe size and weight.
- Details of tubular handling equipment.

Running in Hole

The following considerations shall be adhered to:

- The running in speed should not exceed that used when running a packer on drill pipe. Obstructions downhole (e.g. liner tops) should be passed with caution. Break circulation at regular intervals (i.e. every 15 stands).
- A down log should be taken while running in. The Logging Contractor procedures may recommend that the tools do not tag the bottom of the hole but stay a minimum 6 m above. Depth control should be monitored with the drill pipe which should be checked during in-run and out-run.
- Continuous communication is essential between the Driller and the wireline logging unit to ensure that the pulling speed and cable spooling speed are matched, and to minimise reaction time if the tool begins to stick. Downward movement must be minimised when setting slips, as the calliper is in the open position.
- The cable must not be slacked off, to avoid the risk of damaging it at the Side Entry Sub.
- A cable head tension/compression meter readout should be made available to the Driller on the rig floor.
- The side entry sub should not be run in open hole if possible..

9.3.6 Attempts to Free Stuck Logging Tools

In preparation to free a stuck logging tool, the weak-point tension, cable tension limit and tool weight in mud must be checked and the Logging Contractor's stretch chart must be available to verify the pull.

Note: In the event a logging tool with a radioactive source becomes stuck the DM shall be immediately informed and supplied with all the relevant data. The course of action to be taken shall be formulated by the DSV/DM in consultation with the Logging Contractor. Written approval shall be required from DM prior to execution of the plan.

The table below provides guidelines in how to attempt to free a stuck logging tool (refer also to Chapter 12 of this Manual).

Stuck Position	Guideline	
Stuck on Bottom	If the tool is stuck on bottom, close the tool and pull to maximum safe tension to keep the weak-point intact.	
Stuck during Logging Upward	If the tool is stuck during logging upward, close the tool and try to go down.	
	Free to Descend:	• Make several attempts to pass the bridge
	Not Free to Descend:	• Pull to maximum safe tension to keep weak-point intact

Table 58. Guidelines whilst Attempting to Free Stuck Logging Tools

If a tension meter is installed on top of the tool and does not register any overpull, then the cable is stuck.

- Make a stuck point estimation by stretch measurement.
- Pull up to cable tension limit slowly, checking for any response on the cable head tension meter.
- If the tool does not come free immediately, additional attempts to work the tool should be considered in consultation with the Logging Contractor. Once the tool is stuck, pulling on the cable does not help.

If the tool fails to come free after several attempts have been made, stripping over is the next course of action. This technique makes use of the cable as a guide for the overshot.

On no account shall an attempt be made to break the weak point unless permission has been given by the DM.

Before stripping operations, a meeting shall be held at the wellsite with all relevant personnel to review the operating procedure.

9.3.7 Stripping Over

If the tool fails to come free after several attempts have been made, stripping over should be the next course of action. This technique makes use of the cable as a guide for the overshot. **On no account shall an attempt be made to break the weak point** unless permission has been given by the DM.

The following procedure shall be used:

1. Hold a pre-job safety meeting to discuss the task. This shall involve as a minimum the WSG, DSV, toolpusher, logging contractor and mud engineer.

2. Apply tension to the cable as advised by the Logging Contractor.
3. Insert T Bar, clamp and hang on rotary table.
4. Cut cable above rotary table. Connect a spear head to the hole end of the cable, and a spear head overshot assembly to the unit end.
5. Make up wireline overshot to drillpipe.
6. Install a circulating sub in the fishing assembly one stand above the overshot.
7. Thread the cable with the overshot through the drill pipe, stand by stand, maintaining the tension in the cable.

   Note: While running in with the overshot a decrease in cable tension may occur indicating that the tool has come free. In this case pull the tool up until the overshot latches onto the fishing head. The procedure is then as before.

8. Prior to latching on the fish install the special bushing and land the cable in it. Circulate to remove debris in the overshot and on top of the tool before latching on the fish, and record pressure versus pump strokes.
9. After circulating, connect spear head overshot to spear head and apply tension to the cable as advised by the Logging Contractor.

   Note: If a radioactive tool is stuck, circulate bottoms up and have the Logging Contractor monitor the mud returns with a GR tool placed in the return line. No personnel other than the Logging Contractor's personnel shall be allowed near the mud pits or the return lines.

10. Lower the drill string and latch onto the fish. Do not locate or engage the logging tool with more than the weight advised by the Logging Contractor. A pressure increase may indicate if the fish is caught in the overshot. A cable head tension increase when lowering the drill string, or a decrease when pulling the drill string, indicates that the fish is connected.
11. After latching onto the fish, part the cable at the weak point with the travelling block, remove the spearhead overshot combination, connect the cable together and wind in.
12. Ensure that with the tool engaged in the overshot, circulation remains possible, using the circulating sub if necessary.
13. Pull the string and recover the fish. Do not rotate the string while pulling out.

   Note: If a tool with a radioactive source is stuck, the weak link must not be broken without approval by the DM. Reverse strip out the hole.

   When handling a retrieved source, the following procedure shall be adhered to:

   a) Limit rig personnel to the minimum required on the rig floor.
   b) Pull the source as far as possible in the derrick (minimum 15 m {50 ft}).
   c) Cover the rotary table, close the rams, then all rig personnel except Driller must leave the rig floor.

   The Driller shall assist the Logging Contractor to lay down the equipment.

9.4.0 CORING

This section describes the coring operations for formation evaluation supervised by the Drilling Department and carried out by contractors.

9.4.1 Responsibilities

All coring requirements shall be detailed in the Drilling Program.

The WGL/DSV shall verify that sufficient Fibreglass/Aluminium barrels and endcaps are on site and that a cut-off saw for core cutting is available. If the core is to be seal pealed the WGL shall ensure that the core bath is working and that sufficient supplies of seal peal are available.

The WGL shall be responsible for determining when the core point has been reached. Upon reaching the core point, the DSV shall be informed. The DSV shall instruct the Drilling Contractor to stop drilling and to prepare for cutting the core. The WGL shall confirm that the program specifications for determining the core point have been met.

The WGL shall be responsible for geological descriptions of the core and any wellsite testing to be carried out. The DSV shall ensure that the core is recovered safely and in such a way as to minimise damage to the core.

9.4.2 Coring Procedures

Preparation

The following preparations shall be made prior to cutting core:

- Hole conditions must be suitable for cutting core. Particularly, the drilling fluids shall be conditioned to the programmed properties before pulling out of the hole.
- The last BHA pulled before coring shall be carefully checked for gauge. If the bit is more than 1/16" under gauge, consideration should be given to reaming the hole with a full gauge bit. Reaming BHA should have similar stabiliser placement as coring BHA.
- The bit and BHA must be carefully checked for broken and lost cutters after pulling out the hole. Where a severe loss of cutters has occurred, **a junk run shall be made** . The hole must be circulated after running to bottom before commencing to cut core.

9.4.2.1 Conventional Coring

The following generic procedures should be used to assist in compiling the detailed procedures:

1. Run in the hole slowly, beware of hanging up in open hole.
2. If reaming is necessary, pump at maximum allowable rate (determined by the core barrel specification and normal drilling engineering considerations). Do not exceed 30 RPM and maintain minimal WOB. After reaming a section pull back to check trip the reamed section.
3. Tag the bottom gently with high circulating rate without rotation until the mud weights in and out are the same.

4. Drop the ball and when it seats measure slow circulating rates (SCRs). Start rotating and record the pressures on and off bottom. If back flow is present before dropping the ball pump a heavy slug. Prior to the ball seating slow the pump.

   Note: As a rule of thumb, the ball should take 3 minutes per 1,000 ft to drop.

5. The starting WOB must be applied slowly, and additional weight and RPM applied smoothly until the coring rate is maximised. Watch carefully for any indication of torque increase, ROP decrease or pump pressure change. The Driller shall inform the DSV of any change immediately. Changes may indicate the following:

   a) A pressure increase when coring may be due to plugging of the barrel, "O" ringing or plugging of the waterways of the corehead, or a change in formation.
   b) If the ROP is simultaneously reduced, the corehead is probably ringed or plugged. Continuation in this condition shall seriously damage the corehead.
   c) A decrease in pump pressure and ROP, accompanied by erratic torque readings, indicates jamming of the core. The barrel must be pulled out of the hole.

   Note: Barrel plugging can be checked by comparing the off-bottom pressure with that recorded prior to coring. If plugging is suspected the barrel must be pulled out of the hole.
   When making a connection or pulling off bottom, overpull may be seen as the core catcher grips the core. Pull to a maximum of 2,200 lbs. overpull, after allowing for drag. If the core fails to break, start circulating up to the maximum used while coring and hold the overpull until the core breaks.

6. Cut core until the barrel is full or becomes jammed, the end of the programd coring interval is reached, or cuttings indicate that the required section is cored.

7. Circulate bottoms up, condition the mud and POOH.

   Note: Extreme care must be taken when tripping with a core barrel. Flow checks must be performed as normal when tripping out of hole, and any deviation from expected hole fill-up volume must be investigated. When pulling out with a core, do not rotate and attempt at all times to minimise jarring or shock loads. The slips must be set carefully. POOH slowly and watch the well closely as the corebarrel is a tight fit in the hole and acts as a piston. Swabbing the well can easily occur.

9.4.2.2 Oriented Coring

Oriented coring provides the data to determine the amount of dip and direction of tilt of the formations cored. Scribe knives mark the core and electronic multishot survey instruments measure and record the orientation of the scribe marks. Due to magnetic interference, orientated coring must not be done less than 18 m (60 ft) below the shoe. Additional checks must be made as follows:

- Identify that the main knife and centre punch is installed in accordance with manufacturer's drawings.
- Check that the electronic multishot survey instruments have sufficient battery life and memory for the duration of the coring and surveying.

Two NMDCs shall be run above the coring equipment to reduce magnetic interference from the drill string.

9.4.2.3 Coring Unconsolidated Formations

a) In unconsolidated formations, face discharge coreheads, fibreglass inner barrels, extended pilot shoes and special core catchers shall be used.

b) Circulating rates shall be the minimum required to keep the hole clean and sufficiently cool the corehead.

9.4.2.4 Rat-hole Coring

Coring a hole diameter smaller than the existing hole diameter is called rat-hole coring. When rat-hole coring, place existing hole sized stabilisers (i.e., 8 1/2" stabiliser if the existing hole size is 8 1/2") above the core barrel. On subsequent cores place these stabilisers correspondingly higher in the string, and place rat-hole sized drill collars and stabilisers above the core barrel.
No more than 36 m (120 ft) of rat-hole core should be cut without opening the hole.

9.4.3 Coring Assemblies

The coring assembly shall be considered on a well by well basis.

9.4.3.1 Coring Bits

A range of coring bits shall be provided by the Coring Contractor. The bit to be run shall be determined by the last bit run performance and grading. Face discharge coreheads shall be used in unconsolidated formations.

9.4.3.2 Core Barrels

The guidelines below must be checked by the Coring Contractor and verified by the DSV:

- Make up torque is in accordance with manufacturer's figures.
- Bearing assembly free.
- Inner barrel straight, with minimal corrosion on steel barrels.
- Inner barrel space-out is correct in accordance with manufacturer's figures.
- Barrel stabilisers are the correct gauge.
- Safety joint clean and properly lubricated.
- Ball seat is compatible with the ball.
- Fibreglass/Aluminium inner barrels made up to manufacturers specifications.
- Clamps and lifting equipment available.

9.4.3.3 Drill String

The following steps in planning the drillstring configuration shall be made when preparing to core:

- Drill collar weight must be calculated to allow the maximum planned WOB plus 20% extra.
- Drill pipe must be drifted when pulling out the hole for coring to ensure that the ball will pass through. New pipe added whilst coring must also be drifted.
- Full gauge stabilisers may be run at 9 m and 27 m above the top core barrel stabiliser.
- Jars should **always** be run in the coring / drilling assemblies.