NEWPARK
FLUIDS SYSTEMS

AleAnna Italia SRL

Technical Proposal for

Fornace 2 Dir

ALEANNA
ITALIA SRL

ALLEGATO A

Firmato digitalmente da: MARCO BRUN
Data: 28/09/2022 15:33:44

Drilling Fluids Program

for

AleAnna Italia SRL

Well Type

Fornace 2 Dir

Issue 2

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Rev.	Date	Reason

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INTRODUCTION

Il permesso di ricerca “San Marco” è situato nel settore orientale della regione Emilia-Romagna, nella provincia di Ravenna, in corrispondenza delle strutture più interne del sistema delle pieghe ferraresi-romagnole. Il prospetto minerario che si intende verificare, mediante la perforazione del sondaggio “Fornace#2D”, è ubicato nella porzione nord-occidentale del permesso, vicino al comune di Savarna, circa 1 km a Nord-Ovest dell’abitato
Il sondaggio avrà come target i reservoir situati nella Formazione del Pliocene Superiore di Porto Garibaldi, la quale rappresenta uno dei principali giacimenti testati a gas nei campi limitrofi, e nell’intera area della Pianura Padana. I reservoir sono generalmente costituiti inizialmente da torbiditi, le quali sono organizzate in una sequenza di intercalazioni di sabbie e silt, con alternanze di strati di argilla. La mineralizzazione attesa è composta principalmente da gas metano, con concentrazione superiore a 98%.
Il CP da 13 3/8” sarà battuto e successivamente lavato nella perforazione della fase da 12 ¼” e 8 ½”. Si utilizzerà un sistema FW-EXTRADRILL ad alto grado di inibenza. I fluidi impiegati nel corso della perforazione dovranno essere in grado di assicurare una buona pulizia del foro (capacità di trasporto dei cuttings in condizioni dinamiche e capacità di mantenere in sospensione il carico solido in condizioni statiche) soprattutto per un buon livello di inibenza nei confronti dei terreni attraversati con conseguente diminuzione dei volumi di diluizione ed una buona azione incapsulante.

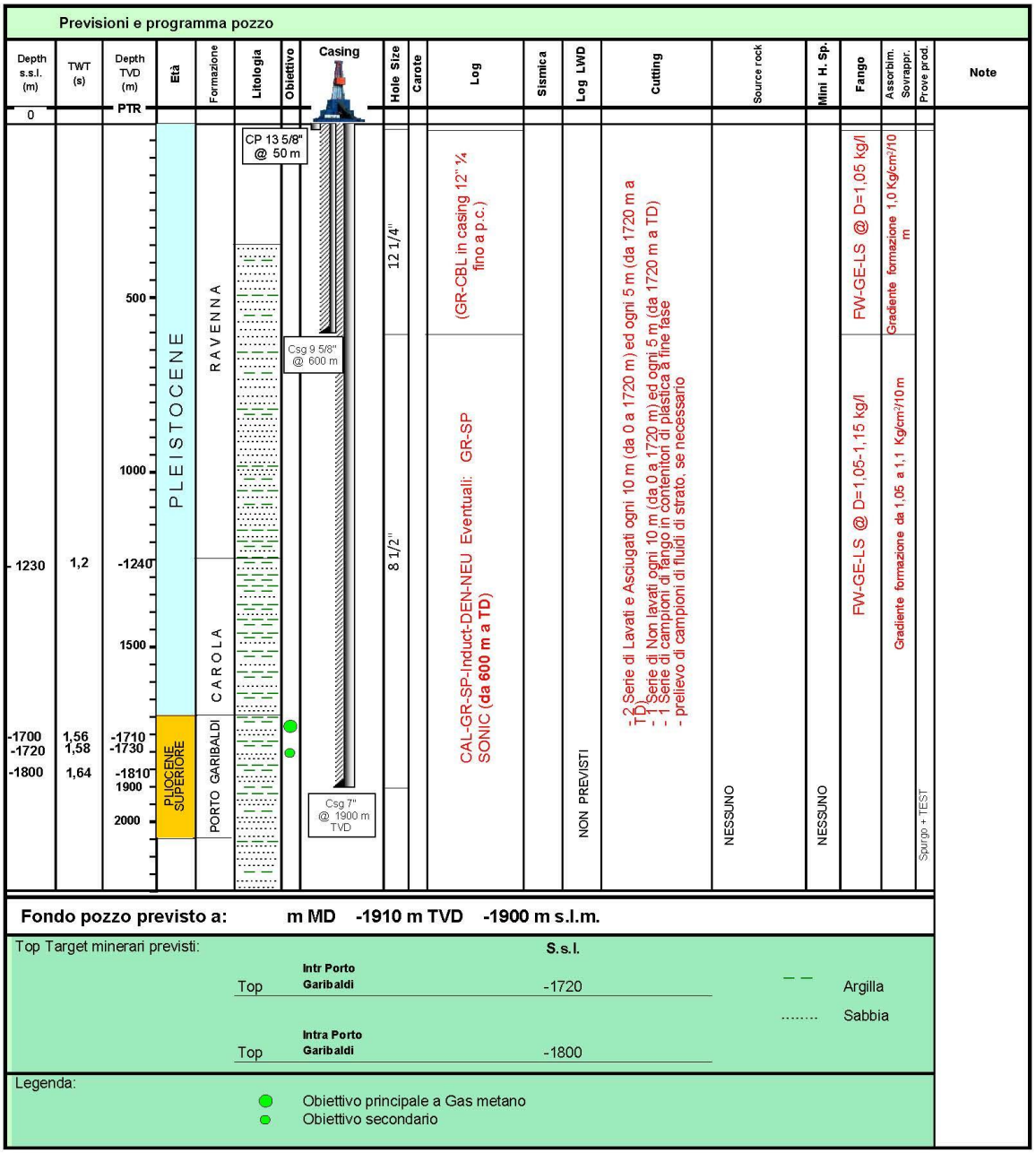
L’utilizzo di sistemi di rimozione solidi adeguati garantirà il mantenimento dei fluidi ai valori ottimali contenendo i volumi delle diluizioni e quindi dei reflui. Per cui l’impiego di shakers adeguati con reti di meschatura opportuna insieme ad una Centrifuga in alleggerimento garantiranno un buon controllo dei volumi di diluizione e quindi dei reflui.

Dal punto di vista ecologico i sistemi proposti sono estremamente safe, infatti i prodotti impiegati sono per la maggior parte di origine naturale e tutti a basso impatto ambientale.

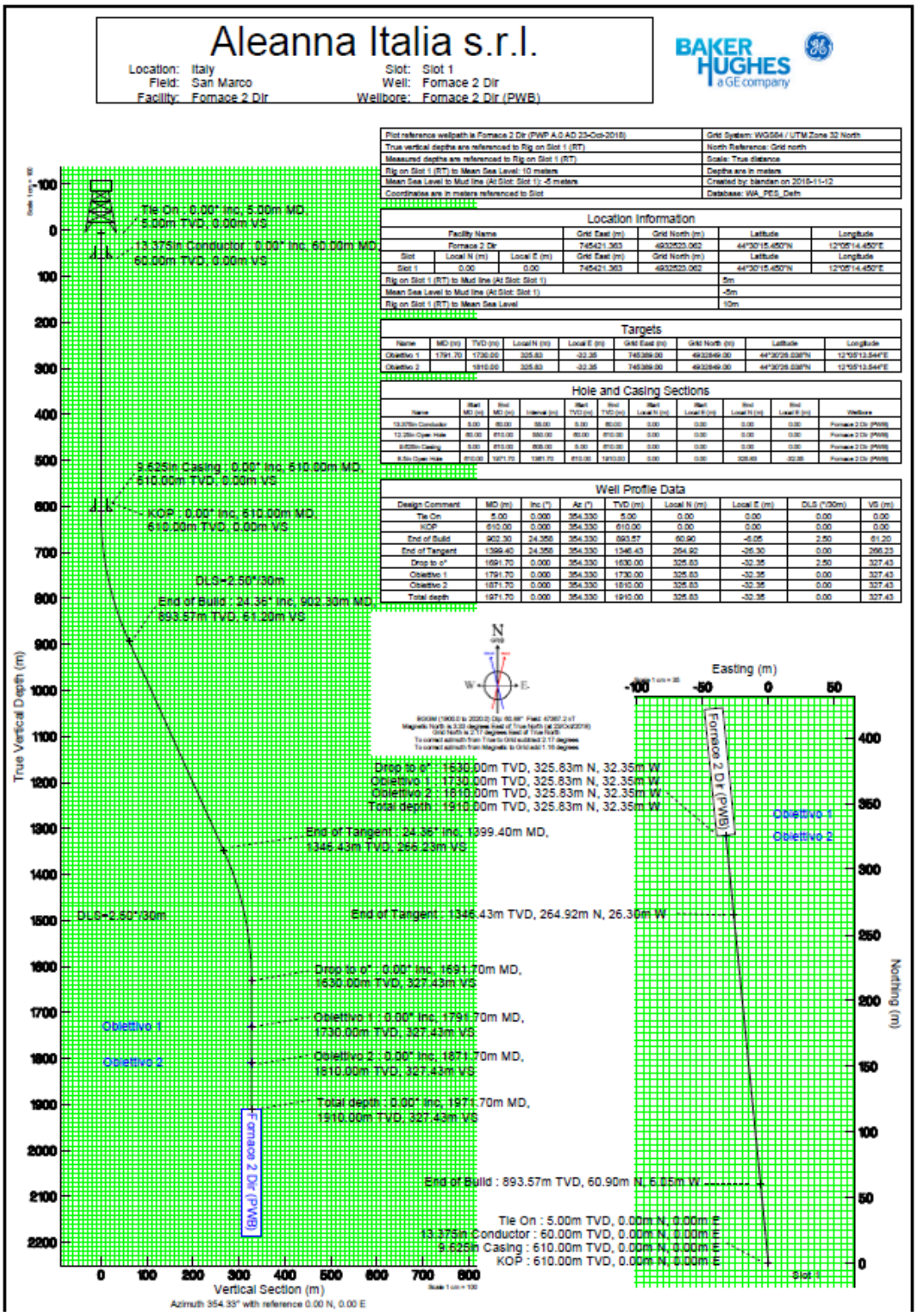
WELL DETAIL

ALEANNA ITALIA SRL

Pozzo: **Fornace#2D**



Deviation


Aleanna Italia s.r.l.
Location: Italy
Field: San Marco
Facility: Fornace 2 Dir
Slot: Slot 1
Well: Fornace 2 Dir
Wellbore: Fornace 2 Dir (PWB)
BAKER HUGHES a GE company
Plot reference wellpath is Fornace 2 Dir (PWP A.0 AD 23-Oct-2018)
True vertical depths are referenced to Rig on Slot 1 (RT)
Measured depths are referenced to Rig on Slot 1 (RT)
Rig on Slot 1 (RT) to Mean Sea Level: 10 meters
Mean Sea Level to Mud line (At Slot: Slot 1): -5 meters
Coordinates are in meters referenced to Slot
Grid System: WGS84 / UTM Zone 32 North
North Reference: Grid north
Scale: True distance
Depths are in meters
Created by: blandan on 2018-11-12
Database: WA_PES_Delh
Location Information
Facility Name
Fornace 2 Dir
Slot
Slot 1
Rig on Slot 1 (RT) to Mud line (At Slot: Slot 1)
Mean Sea Level to Mud line (At Slot: Slot 1)
Rig on Slot 1 (RT) to Mean Sea Level
5m
-5m
10m
Targets
Hole and Casing Sections
Well Profile Data
Tie On : 0.00° Inc, 5.00m MD, 5.00m TVD, 0.00m VS
13.375in Conductor : 0.00° Inc, 60.00m MD, 60.00m TVD, 0.00m VS
9.625in Casing : 0.00° Inc, 610.00m MD, 610.00m TVD, 0.00m VS
KOP : 0.00° Inc, 610.00m MD, 610.00m TVD, 0.00m VS
DLS=2.50°/30m
End of Build : 24.36° Inc, 902.30m MD, 893.57m TVD, 61.20m VS
Drop to 0° : 1630.00m TVD, 325.83m N, 32.35m W
Obiettivo 1 : 1730.00m TVD, 325.83m N, 32.35m W
Obiettivo 2 : 1810.00m TVD, 325.83m N, 32.35m W
Total depth : 1910.00m TVD, 325.83m N, 32.35m W
End of Tangent : 24.36° Inc, 1399.40m MD, 1346.43m TVD, 266.23m VS
End of Tangent : 1346.43m TVD, 264.92m N, 26.30m W
Drop to 0° : 0.00° Inc, 1691.70m MD, 1630.00m TVD, 327.43m VS
Obiettivo 1 : 0.00° Inc, 1791.70m MD, 1730.00m TVD, 327.43m VS
Obiettivo 2 : 0.00° Inc, 1871.70m MD, 1810.00m TVD, 327.43m VS
Total depth : 0.00° Inc, 1971.70m MD, 1910.00m TVD, 327.43m VS
End of Build : 893.57m TVD, 60.90m N, 6.05m W
Tie On : 5.00m TVD, 0.00m N, 0.00m E
13.375in Conductor : 60.00m TVD, 0.00m N, 0.00m E
9.625in Casing : 610.00m TVD, 0.00m N, 0.00m E
KOP : 610.00m TVD, 0.00m N, 0.00m E
Fornace 2 Dir (PWB)
Obiettivo 1
Obiettivo 2
Slot 1
True Vertical Depth (m)
Vertical Section (m)
Azimuth 354.33° with reference 0.00 N, 0.00 E
Easting (m)
Northing (m)

Well Design and Mud Parameters

MUD PARAMETERS	U.M.	Phase 1	Phase 2	Phase 3
Bit diameter	in	**12 ¼"**	**8 ½"**	**Completamento**
Interval (MD)	m-m	50-600	600-1910	0-1910
Footage	m	550	1310	1910
CSG	in	9 5/8"	7"	
Max Deviation angle	º		24,36°	
Expected BHST	ºC			
Type of fluid	-	**FW-EXTRADRILL**	**FW-EXTRADRILL**	**Brine CaCl2**
Density	sg	1,15-1,2	1,26-1,28	1,28
Marsh Viscosity	sec/l	50-55	55-60	
PV	cP	10-12	12-20	
Yield Point	gr/100cm²	10-14	12-16	
Gel 10 sec.	gr/100cm²	6-8	3-5	
Gel 10 min	gr/100cm²	4-6	10-15	
API Filtrate	cm³/30'	<10	<5	
pH	-	9,5-10,5	9,5-10,5	7,0-8,0
LGS (drilled solids)	% Vol	5-8	7	
MBT	Kg/m³	<40	<35	
Salinità NaCl	g/l			403,92
Salinità Cl-	g/l			245,02

INTERVAL DESCRIPTION

Phase 1 (Foro da 12 ¼" da 50 a 600 m)

Interval Discussion

La fase inizierà con il lavaggio del CP da 13 3/8" e successiva perforazione. Il fluido impiegato in questa sezione sarà un FW-EXTRADRILL.
L'AVAEXTRADRILL è formato da una miscela di polimeri polivinilici e poligliceroli in sospensione acquosa, in associazione con AVAPERM NF esplica sulle argille una forte azione inibente, evitando che l'acqua contenuta nel sistema penetri nell'argilla stessa provocandone l'idratazione, la dispersione e quindi la conseguente instabilità.
Differentemente da altri prodotti polimerici e sali minerali stabilizzanti ed inibenti delle argille, l' AVAEXTRADRILL grazie all'azione combinata polimero-poliglicerolo, esplica l'azione stabilizzante creando sulla superficie dell'argilla una barriera che evita l'assorbimento dell'acqua da parte della matrice argillosa, riducendone quindi drasticamente lo sfaldamento e ritardando notevolmente tutti quei problemi d'instabilità che si manifestano generalmente in concomitanza all'invecchiamento del foro. Proprio per la presenza di poligliceroli il prodotto esplica una azione lubrificante riducendo fenomeni di attriti e torsioni in foro. L'AVAEXTRADRILL essendo costituito da polimeri a basso peso molecolare non induce aumenti della reologia del sistema e può essere dosato anche a concentrazioni elevate senza controindicazioni.
L'AVAPERM NF è un inibitore di argilla a base amminica, espressamente sviluppato per aumentare il livello di inibizione nella perforazione dei terreni argillosi.
AVAPERM NF agisce sulla superficie delle argille da cui viene assorbito sostituendo gli ioni della matrice argillosa, favorendo così la non idratazione delle particelle di argilla.
Addizionare al fango AVAPOLYMER 5050 in modo da provvedere inibizione delle argille e stabilità foro. AVAPOLYMER 5050 è un blend di polialcool e polimeri di derivazione della cellulosa, quindi ecocompatibile. AVAPOLYMER 5050 stabilizza effettivamente le argille idratabili e dispersibili riducendo al tempo stesso l'invasione del filtrato nella formazione.

Se necessario, per aumentare l'inibizione del fango, aggiungere come incapsulante il prodotto NDFT 374.
Mantenere il fluido alle caratteristiche richieste (ottimizzando il funzionamento dei sistemi di rimozione solidi a disposizione) operando con valori di Yield Point tra 10 -12 g/100cm² e di Gel Flash tra 6 - 8 g/100cm², in maniera da garantire una ottimale capacità di trasporto ed una buona pulizia foro: all'uopo utilizzare come viscosizzante NEWZAN D (VISCO XC 84).
Prestare molta attenzione alle attrezzature di rimozione solidi presenti sull'impianto soprattutto all'ottimizzazione delle reti ai vagli.
Per il controllo del filtrato, si utilizzerà VISCO 83 XLV.

In presenza di assorbimenti parziali in corrispondenza degli orizzonti sabbiosi più permeabili, intervenire pompando cuscini intasanti a media concentrazione a base di INTASOL ed INTAFLOW.

Alternativamente intervenire con intasanti direttamente in circolazione in concentrazioni da 10-15 kg/m3.

Solids Control

- Vibrovagli: Per questa fase, viste le caratteristiche geologiche della formazione da attraversare, viene consigliato come combinazione di reti primaria l'utilizzo di API 100 e API 120. In caso sui vagli possano essere installate anche le reti scalping si suggerisce di installare le reti da 20 o 30 mesh.
  I tecnici fanghisti, insieme ai pontisti in turno, dovranno controllare regolarmente, a cadenza al massimo oraria, il corretto funzionamento delle attrezzature di rimozione solidi, che il loro settaggio sia ottimale e che le reti non presentino fori.

- Centrifughe: l'utilizzo delle centrifughe è richiesto in questa fase per minimizzare l'aumento di solidi, e conseguentemente dei valori reologici del fluido, all'interno del fango, oltre a contenere l'aumento di densità. Si suggerisce di installare le centrifughe in modo che possano aspirare sia dalle vasche di decantazione che dalle vasche di riserva in modo da poter trattare il fango sia in fase di perforazione/circolazione che durante le manovre. Ciò permetterà di ridurre le diluizioni da apportare al sistema fango. I parametri di settaggio della centrifuga consigliati per ottimizzare lo scarto degli LGS sono i seguenti:

VELOCITA' ASSOLUTA	2200 - 2500 rpm
VELOCITA' DIFFERENZIALE	25 - 35 rpm

Mud Parameters

MUD PARAMETERS	U.M.	Phase 1
Bit diameter	in	**12 ¼"**
Interval (MD)	m-m	50-600
Footage	m	550
Csg	in	9 5/8"
Type of fluid	-	**FW-EXTRADRILL**
Density	sg	1,15-1,2
Marsh Viscosity	sec/l	50-55
PV	cP	10-12
Yield Point	lb/100ft²	10-14
Gel 10 sec.	lb/100ft²	6-8
Gel 10 min	lb/100ft²	4-6
API Filtrate	cm³/30'	<10
PH	-	9,5-10,5
LGS (drilled solids)	mg/l	5-8
LGS (drilled solids)	% Vol	
MBT	Kg/m³	<40

Product Function

Product	Function
SODA CAUSTICA	Alcalinizzante
STEARALL LQD	Antischiuma
BICARBONATO DI SODIO	Precipitante del calcio
AVAPOLYMER 5050	Incapsulante di argilla
NEWZAN D (VISCO XC 84)	Viscosizzante
AVAEXTRADRILL	Inibente d'argilla
AVAPERM NF	Inibente d'argilla
VISCO 83 XLV	Riduttore di filtrato
AVACARB	Materiale appesantente
NDFT 374	Incapsulante d'argilla

Mud volume

Mud Volumes	m³
Volume foro 30"	42
Volume CP 13 3/8"	4
Superficie	40
Diluizione/Mantenimento	84
Total Mud	**170**
Volume Kill Mud	**40**
Total Mud to build up	**210**

Mud formulation and estimated consumption

Products	Package	Conc. [Kg/m³]	Metric Ton
SODA CAUSTICA	25 kg/sacco	0.5 – 1.0	**0.150**
AVAPOLYMER 5050	25 kg/sacco	5.0 – 8.0	**1.350**
STEARALL LQD	170 kg/fusto	1.0 – 2.0	**0.340**
NEWZAN D (VISCO XC 84)	25 kg/sacco	1.0 – 2.0	**0.400**
VISCO 83 XLV	22,68 kg/sacco	5.0 – 6.0	**1.000**
AVAEXTRADRILL	1100 kg/IBC	30.0 – 40.0	**6.600**
AVAPERM NF	200 kg/fusto	10.0 – 15.0	**1.800**
AVACARB	SFUSA	220.0 – 230.0	**39.000**

Mud formulation and estimated consumption for Kill Mud

Products	Package	Conc. [Kg/m³]	Metric Ton
SODA CAUSTICA	25 kg/sacco	0.5 – 1.0	**0.100**
NEWZAN D (VISCO XC 84)	25 kg/sacco	2.0 – 3.0	**0.150**
BARITE	1500 kg/saccone	520.0 – 550.0	**22.000**

Safety Stock on site

Products	Function	Ton
AVACARB	Weighting material	60.000
INTAFLOW	Bridging Agent	5.000
SODA CAUSTICA	Alcalinizzante	1.000
SODA ASH	Calcium remover	1.000
VISCO 83 XLV	Riduttore di filtrato	1.000
NEWZAN D (VISCO XC 84)	Viscosizzante	1.000
BARITE	Weighting material	60.000
AVAEXTRADRILL	Inibente d'argille	1.760
INTASOL F/M/C	Intasante	4.500
AVAPERM NF	Inibente d'argille	1.600
AVAPOLYMER 5050	Incapsulante d'argilla	1.000
STEARALL LQD	Antischiuma	0.800
DE BLOCK'S LT	Antipresa	1.440
AVATENSIO LT	Antipresa	1.320
NDFT 374	Incapsulante d'argilla	1.000

Phase 2 (Foro da 8 ½" da 600 a 1910 m)

Interval Discussion

La fase sarà perforata con il sistema FW-EXTRADRILL in parte recuperato dalla fase precedente.
L'AVAEXTRADRILL è formato da una miscela di polimeri polivinilici e poligliceroli in sospensione acquosa, in associazione con AVAPERM NF esplica sulle argille una forte azione inibente, evitando che l'acqua contenuta nel sistema penetri nell'argilla stessa provocandone l'idratazione, la dispersione e quindi la conseguente instabilità.
Differentemente da altri prodotti polimerici e sali minerali stabilizzanti ed inibenti delle argille, l' AVAEXTRADRILL grazie all'azione combinata polimero-poliglicerolo, esplica l'azione stabilizzante creando sulla superficie dell'argilla una barriera che evita l'assorbimento dell'acqua da parte della matrice argillosa, riducendone quindi drasticamente lo sfaldamento e ritardando notevolmente tutti quei problemi d'instabilità che si manifestano generalmente in concomitanza all'invecchiamento del foro. Proprio per la presenza di poligliceroli il prodotto esplica una azione lubrificante riducendo fenomeni di attriti e torsioni in foro. L'AVAEXTRADRILL essendo costituito da polimeri a basso peso molecolare non induce aumenti della reologia del sistema e può essere dosato anche a concentrazioni elevate senza controindicazioni.
L'AVAPERM NF è un inibitore di argilla a base amminica, espressamente sviluppato per aumentare il livello di inibizione nella perforazione dei terreni argillosi.
AVAPERM NF agisce sulla superficie delle argille da cui viene assorbito sostituendo gli ioni della matrice argillosa, favorendo così la non idratazione delle particelle di argilla.
Addizionare al fango AVAPOLYMER 5050 in modo da provvedere inibizione delle argille e stabilità foro. AVAPOLYMER 5050 è un blend di polialcool e polimeri di derivazione della cellulosa, quindi ecocompatibile. AVAPOLYMER 5050 stabilizza effettivamente le argille idratabili e dispersibili riducendo al tempo stesso l'invasione del filtrato nella formazione.
Se necessario, per aumentare l'inibizione del fango, aggiungere come incapsulante il prodotto NDFT 374.
Mantenere il fluido alle caratteristiche richieste (ottimizzando il funzionamento dei sistemi di rimozione solidi a disposizione) operando con valori di Yield Point tra 12 -16 g/100cm² e di Gel Flash tra 3 - 5 g/100cm², in maniera da garantire una ottimale capacità di trasporto ed una buona pulizia foro: all'uopo utilizzare come viscosizzante NEWZAN D (VISCO XC 84).
Prestare molta attenzione alle attrezzature di rimozione solidi presenti sull'impianto soprattutto all'ottimizzazione delle reti ai vagli.
Per il controllo del filtrato, si utilizzerà VISCO 83 XLV. In considerazione della deviazione, a forma "S", per limitare attriti in foro è consigliabile addizionare il fluido con Lubrificante Avagreenlube. Avagreenlube è un lubrificante di origine naturale a base di esteri ad elevata performance.

La densità iniziale di questa fase sarà mantenuta intorno a 1.2 – 1.28 sg con Avacarb. Tale densità sarà adeguata in funzione della risposta del pozzo.
Considerata la natura dei terreni attraversati, alternanze di sabbie ed argille, per migliorare la formazione del, utilizzare 40-60 Kg/m3 di INTAFLOW, carbonato di calcio a granulometria sezionata, per aiutare il fango a creare un pannello ancora più efficiente.

In presenza di assorbimenti parziali in corrispondenza degli orizzonti sabbiosi più permeabili, intervenire pompando cuscini intasanti a media concentrazione a base di INTASOL ed INTAFLOW. Alternativamente intervenire con intasanti direttamente in circolazione in concentrazioni da 10-15 kg/m3.

Solids Control

- Vibrovagli: Per questa fase, viste le caratteristiche geologiche della formazione da attraversare, viene consigliato come combinazione di reti primaria l'utilizzo di API 100 e API 120. In caso sui vagli possano essere installate anche le reti scalping si suggerisce di installare le reti da 20 o 30 mesh.
  I tecnici fanghisti, insieme ai pontisti in turno, dovranno controllare regolarmente, a cadenza al massimo oraria, il corretto funzionamento delle attrezzature di rimozione solidi, che il loro settaggio sia ottimale e che le reti non presentino fori.

- Centrifughe: l'utilizzo delle centrifughe è richiesto in questa fase per minimizzare l'aumento di solidi, e conseguentemente dei valori reologici del fluido, all'interno del fango, oltre a contenere l'aumento di densità. Si suggerisce di installare le centrifughe in modo che possano aspirare sia dalle vasche di decantazione che dalle vasche di riserva in modo da poter trattare il fango sia in fase di perforazione/circolazione che durante le manovre. Ciò permetterà di ridurre le diluizioni da apportare al sistema fango. I parametri di settaggio della centrifuga consigliati per ottimizzare lo scarto degli LGS sono i seguenti:

VELOCITA' ASSOLUTA	2200 - 2500 rpm
VELOCITA' DIFFERENZIALE	25 - 35 rpm

Mud Parameters

MUD PARAMETERS	U.M.	Phase 2
Bit diameter	in	**8 ½"**
Interval (MD)	m-m	600-1910
Footage	m	1310
Csg	in	7"
Max Deviation angle		24,36°
Type of fluid	-	**FW-EXTRADRILL**
Density	sg	1,26-1,28
Marsh Viscosity	sec/l	55-60
PV	cP	12-20
Yield Point	lb/100ft²	12-16
Gel 10 sec.	lb/100ft²	3-5
Gel 10 min	lb/100ft²	10-15
API Filtrate	cm³/30'	<5
PH	-	9,5-10,5
LGS (drilled solids)	mg/l	7
MBT	% Vol	<35

Product Function

Product	Function
SODA CAUSTICA	Alcalinizzante
STEARALL LQD	Antischiuma
BICARBONATO DI SODIO	Precipitante del calcio
AVAPOLYMER 5050	Incapsulante di argilla
NEWZAN D (VISCO XC 84)	Viscosizzante
AVAEXTRADRILL	Inibente d'argilla
AVAPERM NF	Inibente d'argilla
VISCO 83 XLV	Riduttore di filtrato
AVACARB	Materiale appesantente
AVAGREEN LUBE	Lubrificante
INTAFLOW	Bridging Agent
NDFT 374	Incapsulante di argilla

Mud volume

Mud Volumes	m³
Volume CSG	23
Volume foro 8 ½"	48
Superficie	100
Diluizione/Mantenimento	89
Total Mud	**260**
Recovered Volume	**70**
Total Mud to build up	**190**

Mud formulation and estimated consumption

Products	Package	Conc. [Kg/m³]	Metric Ton
SODA CAUSTICA	25 kg/sacco	0.5 – 1.0	**0.200**
AVAPOLYMER 5050	25 kg/sacco	8.0 – 10.0	**1.900**
STEARALL LQD	170 kg/fusto	1.0 – 2.0	**0.340**
NEWZAN D (VISCO XC 84)	25 kg/sacco	1.0 – 2.0	**0.400**
VISCO 83 XLV	22,68 kg/sacco	5.0 – 6.0	**1.150**
AVAEXTRADRILL	1100 kg/IBC	30.0 – 40.0	**7.700**
AVAPERM NF	200 kg/fusto	10.0 – 15.0	**2.800**
AVACARB	SFUSA	230.0 – 240.0	**46.000**
AVAGREENLUBE	175 kg/fusto	10.0 – 15.0	**3.850**
INTAFLOW	25 kg/sacco	40.0 – 60.0	**10.000**

Safety Stock on site

Products	Function	Ton
AVACARB	Weighting material	60.000
INTAFLOW	Bridging Agent	5.000
SODA CAUSTICA	Alcalinizzante	1.000
SODA ASH	Calcium remover	1.000
VISCO 83 XLV	Riduttore di filtrato	1.000
NEWZAN D (VISCO XC 84)	Viscosizzante	1.000
BARITE	Weighting material	60.000
AVAEXTRADRILL	Inibente d'argille	1.760
INTASOL F/M/C	Intasante	4.500
AVAPERM NF	Inibente d'argille	1.600
AVAPOLYMER 5050	Inibente d'argille	1.000
STEARALL LQD	Antischiuma	0.800
DE BLOCK'S LT	Antipresa	1.440
AVATENSIO LT	Antipresa	1.320
AVAGREENLUBE	Lubrificante	1.400
INTAFLOW	Bridging Agent	3.000
NDFT 374	Incapsulante di argilla	1.000

Phase 3 (Completamento)

Interval Discussion

Dopo l'esecuzione dei logs nel caso di accertata mineralizzazione si procederà ai test.
Per il completamento è previsto un Brine Cloruro di Calcio a densità 1,280 kg/l.
Durante lo spiazzamento si procederà alla pulizia dei casings mediante la circolazione in foro di un cuscino di lavaggio con AVAWASH WBM seguendo la seguente procedura:

1. CUSCINO ACQUA 5 m^3

2. ACQUA + AVAWASH WBM 8 m^3
   Ottenuto miscelando 7,0 m^3 di Fresh Water con 0,8 m^3 (4 fusti) di AVAWASH WBM per ottenere 8 m^3 finali e almeno 6 m^3 aspirabili:
   AVAWASH WBM ha una azione detergente, in grado di rimuovere completamente le incrostazioni residue di fango dal csg.

3. BRINE VISCOSIZZATO 6 m^3
   con NEWZAN D (VISCO XC 84) in concentrazione di circa 7 - 8 kg per m^3 di BRINE

A seguire il BRINE CaCl2 @ 1,280 S.G. pulito.

Durante l'ultima circolazione, prima di discendere il completamento verrà addizionato il brine di anticorrosivo (INCORR) e Oxygen scavenger (Deoxi DEHA).

Mud Parameters

MUD PARAMETERS	U.M.	Phase 3
Bit diameter	in	**Completamento**
Interval (MD)	m-m	0-1910
Footage	m	1910
Csg	in	
Max Deviation angle	°	
Type of fluid	-	
Density	sg	**Brine CaCl2**
Marsh Viscosity	sec/l	1,28
PV	Cp	
Yield Point	lb/100ft²	
6/3 low readings	rpm	
Gel 10 sec.	lb/100ft²	
Gel 10 min	lb/100ft²	
API Filtrate	cm³/30’	
PH	-	7,0-8,0
Ca++	mg/l	
LGS (drilled solids)	% Vol	
Salinità NaCl	g/l	403,92
Salinità Cl-	g/l	245,02

Product Function

Product	Function
SODA CAUSTICA	Alcalinizzante
NEWZAN D (VISCO XC 84)	Viscosizzante
STEARALL LQD	Antischiuma
CLORURO DI CALCIO 94-96%	Brine
AQUGAR GA 24	Biocida
DEOXY DEHA	Oxygen Scavenger
INCORR	Anticorrosivo
AVAWASH WBM	Casing Cleaner

Mud volume

Mud Volumes	m³
Volume CSG 7”	36
Vol. di superficie + riserve + cuscini	104
Total Mud to build up	**140**

Mud formulation and estimated consumption

Products	Package	Conc. [Kg/m³]	Metric Ton
DEOXY DEHA	200 kg/fusto	1.0 – 2.0	**0.200**
CLORURO DI CALCIO 94-96%	25 kg/sacco	370.0 – 390.0	**55.000**
NEWZAN D (VISCO XC 84) per cuscino viscoso	25 kg/sacco	7.0 – 8.0	**0.050**
AVAWASH WBM per cuscino di lavaggio	200 kg/fusto	100.0	**0.800**
STEARALL LQD	170 kg/fusto	1.0 – 2.0	**0.340**
INCORR	200 kg/fusto	3.0 – 4.0	**0.600**

Safety Stock on site

Product	Function	Ton
NEWZAN D (VISCO XC 84)	Viscosizzante	1.000
CLORURO DI CALCIO	Weighting material	5.000
SODA CAUSTICA	Alcalinizzante	1.000
SODA ASH	Calcium remover	1.000
BICARBONATO DI SODIO	Previene contaminazione da cemento	1.000
STEARALL LQD	Antischiuma	0.680
AQUGAR GA 24	Biocida	0.840
INTASOL F	Intasante CaCO3	1.200
INTASOL M	Intasante CaCO3	1.200
INTASOL C	Intasante CaCO3	1.200
INTAFLOW	Sized CaCO3	1.500
INCORR	Anticorrosivo	0.800
AVAWASH WBM	Casing Cleaner	0.800
DEOXI DEHA	Oxygen Scavenger	1.000
AVATENSIO LT	Antipresa	1.320
DE BLOCK'S LT	Antipresa	1.440

TOTAL CONSUMPTION

Consumi Brine/Fango

Prodotto	Quantità ton/ft
SODA CAUSTICA	0,450
NEWZAN D (VISCO XC 84)	1,000
CLORURO DI CALCIO 94-96%	55,000
STEARALL LQD	1,020
AVAEXTRADRILL	14,300
AVAPERM NF	4,600
VISCO 83 XLV	2,150
AVAPOLYMER 5050	3,250
AVACARB	85,000
BARITE	22,000
AVAGREENLUBE	3,850
INTAFLOW	10,000
DEOXY DEHA	0,200
INCORR	0,600
AVAWASH WBM	0,800
TOTALE POZZO	

ATTACHED PROCEDURES

LCM PROCEDURES

Formation Losses

Overview about losses

Loss Causes

- Formation pore spaces are too large, or the particles in the fluid are too small, to allow filter cake formation.
- Hydrostatic pressure is sufficient to force wellbore fluids into the pore spaces
- Hydrostatic pressure causes closed natural fractures to open and take wellbore fluid
- Hydrostatic pressure induces fractures in weak formations.
- Open Karst fractures, vugs or caverns present in the formation

Symptoms of Lost Circulation

- Reduction in pit volume
- Bit may drop/losing bit weight
- Decrease in pump pressure

Corrective / Preventive measures

- Maintain the proper density (in our scenario keep MW as low as possible)
- Preventive drilling fluid measures: control trip speeds / hydrostatic / swabbing/back reaming
- Minimize annular friction pressure losses
- Maintain adequate hole cleaning (use NewPark HyCalc software for hydraulic calculations)
- Motorize the ECD with the use of HyCalc software
- Set casing to protect weaker formations
- If losses are anticipated, treat the whole mud with lost prevention materials

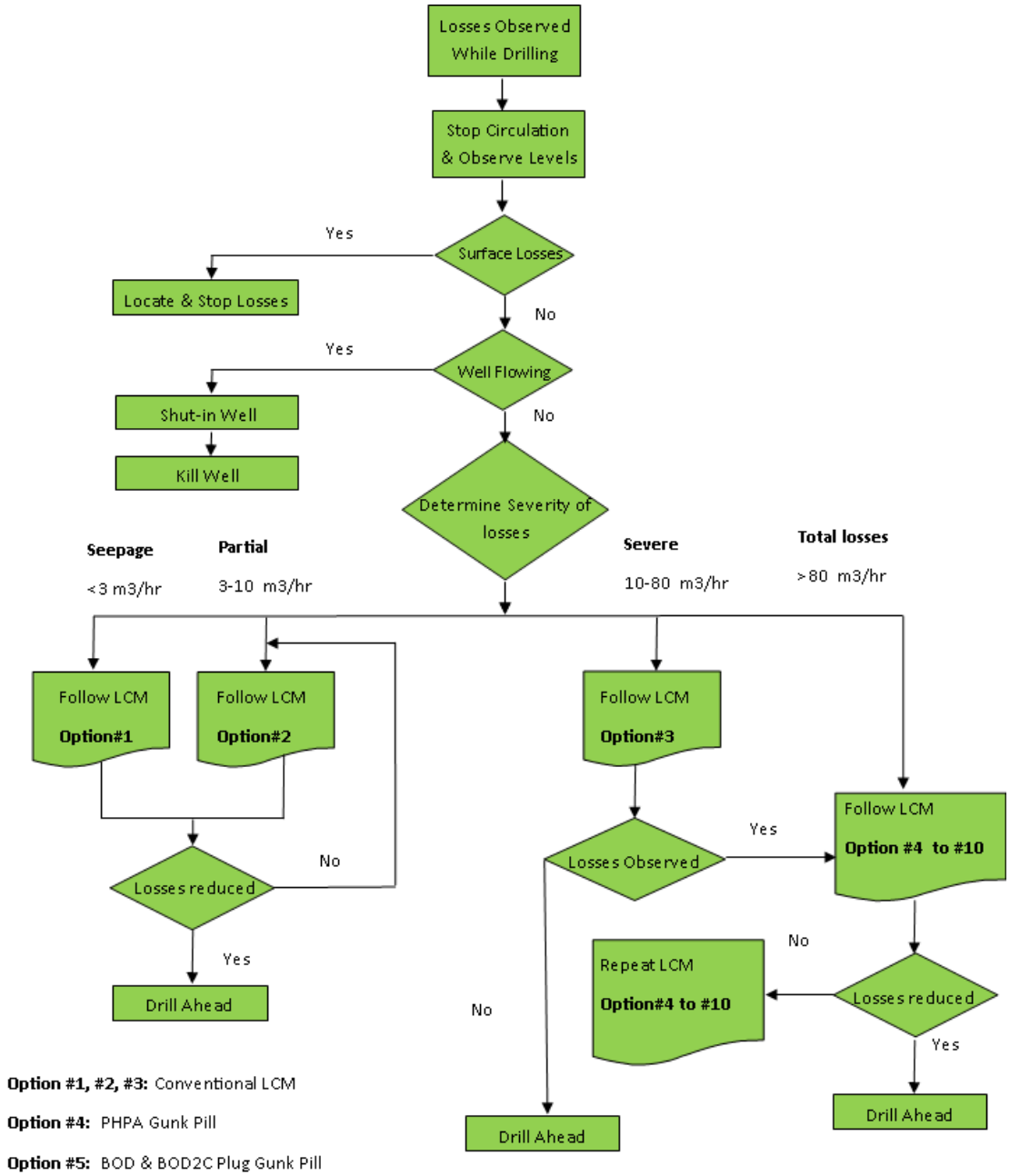
Type of Losses	Loss Rate (m3/hr)	Typical Formations
Seepage	< 3.0	- Porous & Permeable
Partial	3.0 – 10.0	- Unconsolidated sands and gravel - Small nature or induced fractures
Severe	10.0 – 80.0	- Long sections of unconsolidated sands and gravel - Larger natural or induced fractures
Total	>80	- Cavernous formations - Large and numerous natural or induced fractures

If lost circulation occurs

- Cure with standard LCM (added to the mud circulation or as a pill) to seal the fractures or pore throats, depending on the type of losses.
- Seal the zone with other materials; unconventional pills if standard LCM pills are unsuccessful
- Consider cement plugs if mud solutions are not successful
- Set casing

If an LCM Pill is pumped

- Pump LCM pill through the valve across the thief zone
- Pull the bit above the pill
- Monitor flow check and keep the annulus full if necessary
- If the flow check is OK, RIH to bottom and gently break circulation
- Repeat the procedure, pumping another LCM (by increasing concentration and size of LCM) pill if the previous pill fails.



Option #1, #2, #3: Conventional LCM

Option #4: PHPA Gunk Pill

Option #5: BOD & BOD2C Plug Gunk Pill

Option #6: X-PRIMA High Solid/High Fluid loss Squeeze slurry

Option #7: PBS Crosslinking Pill

Option #8: EXPANGEL SP7 & SP7 E12

Option#10: Expangel Slurry/CEMENT Slurry

Option#9: AVALC39

LCM Decision Tree

Option 1 – Seepage Losses (drill ahead) (< 3 m3/hr)

For seepage losses is advised to pump direct in circulation a proposed concentration of INTAFLOW. The INTAFLOW sized will guarantee a wide range of particle size able to produce a performing bridging.

Product	Conc. (kg/m3)	Conc.
INTAFLOW	25	8.77

Or

Product	Conc. (kg/m3)	Conc.
INTAFLOW	15	5.26
SAND SEAL F	10	3.5
Total	**8.77**	**8.77**

Note: *drilling ahead treating the circulation system with LCM at the recommended concentration. The upper limit concentration of LCM used to control these losses is typically about 55 Kg/m3 of LCM in drilling fluid.*

Option 2 – Partial Losses (drill ahead) (3 – 10 m3/hr)

Partial losses require a stronger action to control the losses and plug the thief zone. The pumping procedure is going to be different according to the concentration:
Following formulation is suggested to pump the pill and drill ahead.

Product	Conc. (kg/m3)	Conc. (ppb)
INTAFLOW	20	7.02
INTASOL M	15	5.26
Total	**35**	**12.28**

Note*: drilling ahead treating the circulation system with carbonatic LCM at the recommended concentration based on losses entity. For this type of losses a total concentration of LCM in drilling mud between 55-70 Kg/m3 of LCM may be required*

Following formulation is suggested for partial losses close to 6-10 m3/hr and it is suggested to be pumped as pill:

Product	Conc. (kg/m3)	Conc. (ppb)
INTASOL F/M	60	21.05
AVAMICA F/M	30	10.53
INTASOL F/M	30	10.53
SAND SEAL F	10	3.5
Total	**130**	**45.61**

Note*: If pumped as a pill, the concentration of LCM should be increased to 130-150 Kg/m3. MAGMA FIBER F/C can be added at the above formulation at the concentration of 10-15 Kg/m3.*

Option 3 – Severe Losses (stop drilling and spot pill) (10 – 80 m^3 /hr)

Severe losses must be fight with a very strong formulation by spotting a LCM pill. The resulting pill is intended to be pumped, spotted, and squeezed at the bottom, although in required condition they can be pumped and circulated. The concentration is depending to the severity of the losses.

Product	Conc. (kg/m3)	Conc. (ppb)
INTASOL M/C	50	17.55
SAND SEAL C	50	17.55
AVAMICA M/C	50	17.55
INTASOL M/C	50	17.55
INTAFLOW	50	17.55
Total	**250**	**87.72**

Product	Conc. (kg/m3)	Conc. (ppb)
INTASOL M/C	80	28.07
SAND SEAL C	60	21.05
AVAMICA M/C	80	28.07
INTASOL M/C	80	28.07
Total	**300**	**105.26**

Product	Conc. (kg/m3)	Conc. (ppb)
INTASOL M/C	105	36.84
SAND SEAL C	60	21.05
AVAMICA M/C	105	36.84
INTASOL M/C	105	36.84
Total	**375**	**131.57**

***Note**: the pill formulations reported above can be also formulated with the addition of MAGMA FIBER C at concentration of 15-30 Kg/m3.*

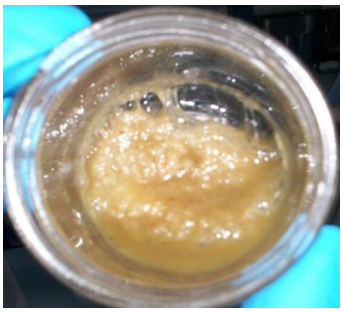
UNCONVENTIONAL LCM PILL (total losses > 80 m3/hr – spot pill)

The unconventional LCM pills are those pills to be used in very severe losses, as well with losses > 80 m3/hr that can be classified "total losses". Normally the unconventional pills comes when the conventional ones fails.

Option 4 – PHPA Gunk Pill (Oil Based LCM Pill)

This type of plug utilizes PHPA as the plugging material. PHPA doesn't hydrate when dispersed in an oil-carrier but, in contact with formation water or water pill, PHPA is rapidly hydrated, forming a strong plugging material.

Product	Description	Conc. (kg/m3)	Conc. (ppb)
Diesel or Low toxicity Oil	Oil Carrier	As needed	As needed
POLIVIS PWD	PHPA	275	96
SAND SEAL C	Micronized cellulose C grade	30	10.52
SODA ASH	Sodium Carbonate	28	9.82
AVAGEL	Bentonite	70	24.56



In case of total losses the PHPA pill can be pumped as downhole mixed LCM pill following this procedure:

- Positioned bit at or just below casing/drive-pipe
- Pump PHPA pill down annulus to near bit
- Pump water down drill pipe to bit
- Close annulus, resume pumping PHPA pill down annulus as water is pumped through bit at equal pump rate and injected to create putty-like gunk mixture
- Displace mixture into loss zone

Option 5 – BDO or BDO2C Plug (Oil Based LCM Pill)

This type of plug utilizes bentonite as the plugging material. Bentonite doesn't hydrate when dispersed in an oil carrier but, in contact with formation water or water pill, bentonite is rapidly hydrated, forming a strong plugging material

Mixing formulations

Product for BDO	Description	Conc. (kg/m3)	Conc. (ppb)
Diesel or Low toxicity Base Oil	Oil Carrier	As needed	As needed
AVAGEL	Bentonite	850	298

Products for BDO2C	Description	Conc. (Kg/m3)	Conc. (ppb)
Diesel or Low toxicity Base Oil	Oil Carrier	580,4 (730 Lt/m3)	203.6
Cement	Cement	520	182.5
AVAGEL	Bentonite	278	97.5
INTASOL C	Calcium Carbonate C grade	100	35

In case of total losses, the BDO or BDO2C pill can be pumped as downhole mixed LCM pill following this procedure:

- Positioned bit at or just below casing/drive-pipe
- Pump BDO or BDO2C pill down annulus to near bit
- Pump water down drill pipe to bit
- Close annulus, resume pumping BDO or BDO2C pill down annulus as water is pumped through bit at equal pump rate and injected to create putty-like gunk mixture
- Displace mixture into loss zone

Option 6 –X-Prima High Solid/high Fluid Loss Squeeze slurry

X-Prima is a proprietary blend of Intasol and fibrous materials, formulated as a one-sack High Solids/High Fluid Loss squeeze product for use in the remediation of severe lost circulation. X-Prima is designed to provide deep sealing in natural and induced fractures, vugular formations, severely depleted sands, and rubble zones

Application: Application will most frequently be in the form of a hesitation squeeze, whereby the slurry is pumped into the loss zone and then subjected to a series of low-volume injections. Each is followed by a waiting period to allow dewatering and sedimentation to take place. As the thief zone is bridged and sealing begins, incremental increases in pressure force water out of the slurry leaving a matrix of solids in place to plug and strengthen the formation. Once circulation is restored, the annular face of the plug is sealed and reinforced by the deposition of mud solids. Where appropriate, the X-Prima slurry may be supplemented with additions of NEWBRIDGE™ C/M, a blend of Intasol and fibrous bridging and meshing agents to further enhance Prima's effectiveness in sealing thief zones. When added into a squeeze slurry and injected into a fractured or vugular formation, the Intasol particles in NEWBRIDGE™ C/M become lodged in the throat of the loss zone and act as anchor points around which the fibrous material and finer solids accumulate and form an immovable plug matrix.

Formulations

MIXING CHART PER ONE FINISHED BARREL (m^3)							
Slurry Weight (lb/gal)	Slurry Weight (kg/m^3)	Water (bbl)	Water (L)	X-Prima (ppb)	X-Prima (kg/m^3)	Barite (ppb)	**Barite (kg/m^3)**
9.3	1116	0.81	0.810	105	299.3	0.0	**0.0**
9.5	1140	0.79	0.790	112.5	320.6	0.0	**0.0**

10.0	1200	0.77	0.770	110.3	314.4	28.8	**82.1**
10.5	1260	0.76	0.760	107.9	307.5	57.7	**164.4**
11.0	1320	0.75	0.750	105.3	300.1	86.5	**246.5**
11.5	1380	0.74	0.740	102.5	292.1	115.4	**328.9**
12.0	1440	0.73	0.730	99.6	283.9	144.2	**411.0**
12.5	1500	0.72	0.720	96.5	275.0	173.1	**493.3**
13.0	1560	0.71	0.710	93.3	265.9	201.9	**575.4**
13.5	1620	0.70	0.700	90.0	256.5	230.7	**657.5**
14.0	1680	0.69	0.690	86.5	246.5	259.6	**739.9**
14.5	1740	0.68	0.680	83.0	236.6	288.4	**821.9**
15.0	1800	0.67	0.670	79.3	226.0	317.3	**904.3**
15.5	1860	0.66	0.660	75.5	215.2	346.1	**986.4**
16.0	1920	0.65	0.650	71.6	204.1	375.0	**1068.8**
16.5	1980	0.64	0.640	67.6	192.7	403.8	**1150.8**
17.0	2040	0.63	0.630	63.5	181.0	432.6	**1232.9**
17.5	2100	0.62	0.620	59.3	169.0	461.5	**1315.3**
18.0	2160	0.61	0.610	55.0	156.8	490.3	**1397.4**
18.5	2220	0.60	0.600	50.6	144.2	519.2	**1479.7**
19.0	**2280**	**0.59**	**0.59**	**46.2**	**131.7**	**548.0**	**1561.8**

Depending on BHA components (MWD, PWD, LWD, mud motor) in the drill string, and/or jet sizes, and if the risk of plugging is low, it may be advisable to add some concentration of NEWBRIDGE™ M to the slurry, up to 2.5 ppb (7 kg/m^3). If a ported bypass sub is in use, or if the squeeze is to be performed through open-end drill string, both NEWBRIDGE™ M and NEWBRIDGE™ C up to 2.5 ppb (7kg/m^3), may be added to establish a bridging mechanism in severe loss zones.

Option 7 – PBS Crosslinking Pill (total losses > 80 m3/hr – spot pill)

PBS is a blend of sized borate salts and polymers, designed to set downhole into a semi-rigid, soft, acid soluble plug, formed by polymer crosslinking. The system includes:

1. Sized borate mineral is the main bridging component and also acts as a cross linking initiator for the biopolymers. The borate mineral is ULEXITE - hydrated calcium-sodium-borate ($NaCaB_5O_9 - 8H_2O$)
2. Xanthan biopolymer to provide suspension and the crosslinking polymer.
3. Pregelatinized corn starch and polyanionic cellulose as filtration control.

When conventional Lost Circulation Materials (LCM) are insufficient to control losses in extreme conditions, the PBS pill can offer the advantage of the crosslinking mechanism where the fluid sets to its semi-rigid consistency in situ, thus making it stronger than standard LCM. The formulation of the PBS can be adjusted for density in the range between 1,12 sg and 2,16 sg, according to the BHT.
PBS is a surface-mixed pumpable plugging material formulated to provide a rigid cross linked gel structure. PBS 500 and 2000 contain sized particles of borate minerals and polymers (Xanthan biopolymer, starch and PAC) which provide formulating flexibility to meet various formation requirements in lost circulation applications. The PBS Activator is a salt/magnesia compound which serves as a crosslink catalyst when mixed with PBS. The catalyst initiates the crosslink reaction by raising the pH and salinity of the fresh water mixture. This reaction is accelerated by the normally higher temperature in the wellbore. PBS Retarder is used to delay the set, increase the available pumping time, and broaden the window of possible application.
Usually, 90% of the strength of the plug is achieved in one hour and it continues to full strength in 24 hours. The reaction rate depends on the BHT and concentration of PBS retarder.

PBS and PSD: PBS is available in two different size distributions: 500 micron and 2000 micron. Usually, the PBS 500 is used for permeability up to approximately 3 Darcey's and can be pumped through bit cones (nozzles). The PBS 2000 is larger and must be pumped through open ended pipe to assure that drill pipe plugging is not an issue.

PBS and Calcium Carbonate: To re-enforce the integrity of the plug it is possible to add calcium carbonate of the proper size (more than 2000 micron) to the system. As the plug density increases, it is advisable to use reduced volume of coarse carbonate.

Proposed formulation

Products	Kg/m3	Conc. (ppb)
PBS 500 (or PBS 2000)	171.5	60.16
PBS Accelerator	85	29.8
PBS Retarder (if needed)	17	6
INTASOL M/C	If needed	If needed

Option 8 – Expangel SP7 and SP7 E12 (total losses > 80 m3/hr – spot pill)

Description: The EXPANGEL SP7 is made using best quality bentonite (natural sodium montmorillonite) at high mixing rates. The EXPANGEL SP7 does not contain any organic or inorganic additives. Dry compressed to a density of 2.12 sg, the pellets of EXPANGEL SP7, with their pseudo-spherical shape, settle in the well at a speed of 0.35 m / second in water (1m in 3 seconds). The pellets of EXPANGEL SP7 swell in the aqueous wellbore fluid to form a " completely waterproof." Plug. To carry out plugging deeper wells, we use EXPANGEL® SP7 E12

which is partially inhibited to delay swelling in water by means of a semi-permeable, micro-porous coating. The inhibition of the swelling time of EXPANGEL® SP7 E12 is approximately 15 to 20 minutes in water up to a maximum temperature of 40° C. The non-stick coating on E12 avoids creating bridges in the tubing prior to placement at the bottom of the well. The rupture of the protective film is complete after about 30 minutes.

Applications: Thanks to its high absorption capacity, the E12 EXPANGEL SP7 very quickly forms a strong waterproof seal. It is particularly recommended for:

- Dividing and isolating aquifers.
- Isolating and sealing the casing to the suction
- Filling all holes drilled for seismic studies and increasing the effect of explosives.
- Recapping old oil and gas surveys, at the end of operations

Mechanism: Positioned in the desired area, the EXPANGEL SP7 E12 naturally swells by absorption of water and thus forms a tight and sustainable seal. To observe the swelling capacity of EXPANGEL SP7 E12, simply pour into a container one volume of E12 EXPANGEL SP7 and add 3 volumes of water - note the consistency and swelling after 1h, 12h, and 24h. The EXPANGEL SP7 E12 (montmorillonite 100% natural pelletized) is not considered toxic.

Option 9 – Expangel Slurry/CEMENT Slurry (total losses > 80 m3/hr – spot pill)

Additional laboratory tests with use of Expangel and Cement slurry are under evaluation in our laboratory in Rome. The purpose is to evaluate the use of Bentonite slurry with the addition of Bentonite Pellets to be blended with cement slurry to improve cement plug performance.

Description of the Slurry Pills:

- A Bentonite slurry made by around 50 Kg/m3 AVAGEL will be mixed with ¼" volume EXPANGEL SP7.
- Positioned bit at or just below casing/drive-pipe
- Pump Bentonite slurry down annulus to near bit
- Pump Class G cement down drill pipe to bit
- Close annulus, resume pumping Bentonite slurry down annulus as cement is pumped through bit at equal pump rate and injected into gel slurry to create putty-like gunk mixture
- Displace mixture into loss zone

Option 10 – AVA LC39 (total losses > 80 m3/hr – spot pill)

The Ava LC39 pill is designed to provide an effective seal in fractured, severe lost circulation zones. The pill remains in a liquid state while pumping and spotting, allowing it to penetrate deep into the fractures. Once in place, the pill setup time is accelerated by the down hole temperature and the presence of calcium ions in the formation, forming a strong, cement-like plug. Once set up, the pill will maintain integrity, preventing the pill from washing away when drilling resumes. The pill can also be activated by pumping a second pill made by $CaCl_2$ Brine Pill (or $MgCl_2$ Brine pill).

Advantages:

- Fast and easy to prepare when time is critical
- No special equipment needed to mix or pump the pill
- Non-damaging and acid soluble
- Safe to work with, requiring no special PPE
- Allows sufficient time to spot in the loss zone and pull above
- Formulation setup time is accelerated at down hole temperatures
- Once set up, the pill maintains integrity, preventing it from washing away once drilling resumes

Products	Description	Unit	Kg/m3	Conc. (ppb)
AVASILIX 39	Potassium silicate	Lt/m3	840	295
AVACARB	Calcium carbonate	Kg/m3	285	100
AVAGREENLUBE	Lubricant	Kg/m3	50	17.5

In case of total losses, the AVA LC39 pill can be pumped as downhole mixed LCM pill following this procedure:

- Positioned bit at or just below casing/drive-pipe
- Pump AVA LC39 pill down annulus to near bit
- Pump CaCl2 brine pill down drill pipe to bit
- Close annulus, resume pumping AVA LC39 pill down annulus as water is pumped through bit at equal pump rate and injected to create solid-like mixture.
- Displace mixture into loss zone

NEW X-PRIMA

Product description

New X-Prima is a proprietary blend of granular and fibrous materials, formulated as a one-sack High Solids/High Fluid Loss squeeze product for use in the remediation of severe lost circulation.

Application

New X-Prima is designed to provide deep sealing in natural and induced fractures, vugular formations, severely depleted sands, and rubble zones. Application will most frequently be in the form of a hesitation squeeze whereby slurry is pumped into the loss zone and then subjected to a series of low-volume injections, each followed by a waiting period to allow dewatering and sedimentation to take place. As the thief zone is bridged and sealing begins, incremental increases in pressure force water out of the slurry leaving a matrix of solids in place to plug and strengthen the formation. Once circulation is restored, the annular face of the plug is sealed and reinforced by the deposition of mud solids.

Treatment recommendations

New X-Prima is mixed as a slurry and weighted to the density of the mud system. **New X-Prima** can be mixed with fresh water, oil, or synthetic fluid, but it should be noted that the filtration rate and the quality of the plug

matrix are negatively affected if oil or synthetic fluid is used in the slurry. It is generally recommended that slurry volume be twice as much as the open hole volume, provided the mixing facilities have that capacity. The squeeze operation can be performed using rig equipment, but for maximum efficiency and precision it is advisable that a cement pumping unit be utilized to conduct the displacement and hesitation squeeze sequence.

Physical properties

Appearance……..White to light gray blended material
Specific Gravity……1.75 – 1.85
Solubility in Water……~ 4%
Flash Point……N/A

Particle size distribution

Retained on 10 Mesh……..2%
Retained on 20 Mesh……..3%
Retained on 50 Mesh……27%
Retained on 100 Mesh……. 38%
Retained on 140 Mesh……. 22%
Retained on 200 Mesh……6%
Retained on 325 Mesh……2%
Passing 325 Mesh……..Trace

Storage and handling

Store in dry area, keep shrink-wrapped and dry if stored outdoors. Minimize personal exposure to dust, use appropriate hygiene, clothing, and PPE while handling or mixing product. Read MSDS thoroughly prior to using this product.

PACKAGING New X-Prima is available in 25-lb (11.3 Kg) multiple-walled bags.

New X-Prima Mixing Chart (Per finished barrel)			
Slurry Weight (#/gal)	Water (bbl)	New X-Prima (lbs per bbl)	Barite (lbs per bbl)
9.3	0.81	105	0.0
9.5	0.79	112.5	0.0
10.0	0.77	110.3	28.8
10.5	0.76	107.9	57.7
11.0	0.75	105.3	86.5
11.5	0.74	102.5	115.4
12.0	0.73	99.6	144.2
12.5	0.72	96.5	173.1
13.0	0.71	93.3	201.9
13.5	0.70	90.0	230.7
14.0	0.69	86.5	259.6
14.5	0.68	83.0	288.4
15.0	0.67	79.3	317.3
15.5	0.66	75.5	346.1
16.0	0.65	71.6	375.0
16.5	0.64	67.6	403.8
17.0	0.63	63.5	432.6
17.5	0.62	59.3	461.5
18.0	0.61	55.0	490.3
18.5	0.60	50.6	519.2
19.0	0.59	46.2	548.0

New BridgePak (Medium, Coarse)

PRODUCT DESCRIPTION

New BridgePak is a blend of granular and fibrous materials designed to be utilized as bridging and meshing agents when added to **New X-Prima** or other high-solids high-fluid-loss squeeze slurries used in the remediation of severe lost circulation.

APPLICATION

When added to a squeeze slurry and injected into a fractured or vugular formation, the granular particles in **New BridgePak** become lodged in the throat of the loss zone and act as anchor points around which the fibrous material and finer solids accumulate and form an immovable plug matrix.

TREATMENT RECOMMENDATIONS

NOTE: Prior to pumping any slurry containing either grade of **New BridgePak**, ensure that trash screens have been removed from drill pipe and, if possible, pump suctions.

New BridgePak Medium

If MWD tools or mud motor are in use, or if bit jets are smaller than 10/32, limit additions of **New BridgePak Medium** to 2 to 6 #/bbl to the squeeze slurry following weight-up. If no sensitive tools are in use, and if bit jets are greater than 10/32, 7 to 10 #/bbl are recommended. If drill string is open-ended, add up to 15 #/bbl or more if slurry viscosity allows.

New BridgePak Coarse

New BridgePak Coarse is intended for use in extreme cases of lost circulation and if fracture or vugular openings are suspected to be greater than 1.5 to 2.0 inches.
To extend the particle size range, **New BridgePak Medium** should be added to the slurry in conjunction with **New BridgePak Coarse** at a 1:1 ratio. Depending on jet sizes, the combined concentration of these additives should not exceed 15 #/bbl unless the drillstring is open-ended or a ported bypass sub is being utilized.

PHYSICAL PROPERTIES

Appearance……Brown fibrous material, light-colored granules
Specific Gravity……1.3 – 1.5
Solubility in Water……N/A
Flash Point……N/A

PARTICLE SIZE DISTRIBUTION

New BridgePak Medium

Retained on 4 Mesh……..4%
Retained on 6 Mesh……..6%
Retained on 10 Mesh……33%
Retained on 20 Mesh……45%
Retained on 40 Mesh……..6%
Retained on 80 Mesh……4%
Passing 80 Mesh……..2%

New BridgePak Coarse

Retained on 4 Mesh……..21%
Retained on 6 Mesh……..27%
Retained on 10 Mesh……16%
Retained on 20 Mesh……27%
Retained on 40 Mesh…….. 5%
Passing 40 Mesh……..4%

STORAGE AND HANDLING

Store in dry area, keep shrink-wrapped and dry if stored outdoors. Minimize personal exposure to dust, use appropriate hygiene, clothing, and PPE while handling or mixing product. Read MSDS thoroughly prior to using this product.

PACKAGING

New BridgePak is available in 25-lb (11.3 Kg) multiple-walled bags.

New X-Prima Squeeze Procedure

If conventional LCM treatments prove ineffective in stopping mud losses, an **New X-Prima** squeeze application is recommended. The following is presented as an overview only, and procedural adjustments may be necessary based on the parameters and conditions of each well.

For maximum success of this operation, additional mixing and pumping equipment should be considered. The mixing pumps and hopper must be able to accommodate rapid additions of **New X-Prima** and barite. Vigorous agitation is necessary for the optimum blending of this slurry, especially during weight-up. After the slurry is mixed, it may be pumped into the drillstring with rig pumps, but given the degree of precision required for accurate monitoring of volumes and pressures, it is strongly advised that the displacement, injection, and hesitation squeeze sequence be performed utilizing a cement unit.

The **New X-Prima** squeeze can be executed in the presence of fresh water, seawater, oil, or synthetic fluid systems. Regardless of the mud type, some fluid properties may be temporarily affected by contact with the slurry, but any irregularities should be easily corrected with proper chemical treatments and/or dilution once circulation is restored.

Note: Newpark does **not** recommend mixing **New X-Prima** as an oil or synthetic based slurry. The compaction quality and erosion resistance of the plug matrix are significantly reduced if component solids are oil-wet.

PREPARATIONS

Pull the bit into the casing to a depth which will leave between 20 (minimum) and 50 (maximum) barrels of working volume between the bit and the shoe. The working volume should be about 25% of the total slurry volume.

Calculate required slurry volume and refer to the **New X-Prima** mixing chart to determine prescribed amounts of water, product, and barite. Slurry volume should ideally be twice the open hole volume. If the mixing pit cannot accommodate that volume, the slurry may be mixed in multiple batches and transferred to

a holding tank (with adequate agitation) or pumped into the drillstring until the remainder is built. If volume is stored in the drillstring, care should be taken not to pump the lead of the slurry into the drill collars or other BHA components. **Reminder:** Extra slurry should be built to compensate for dead volume left in mud pits. If volume requirements exceed the capacity of mixing facilities, refer to the section below in which the procedure for spotting a divided slurry is described.

The **Newpark** engineer should compare and confirm all hole volume calculations with the operator's representative and the cementer. **Reminder**: Displacement calculations must include volume in surface lines between pumps and standpipe (or between cement unit and standpipe. **Note**: Depending on the type of drill pipe being used, string volume should be calculated using the adjusted capacity factors from the following chart:

ADJUSTED DRILL PIPE CAPACITY			
SIZE O.D. (in)	**WEIGHT/FT (lbs)**	**GRADE**	**ADJUSTED CAPACITY (bbls/ft)**
5"	19.5	E	0.017146
4.5"	16.6	E	0.014191
3.5"	13.3	E	0.007386
2.875"	10.4	E	0.00449
5"	19.5	X	0.017268
4.5"	16.6	X	0.014127
3.5"	13.3	X	0.007323
2.875"	10.4	X	0.004439
5"	19.5	G	0.017176
4.5"	16.6	G	0.014127
3.5"	13.3	G	0.007291
2.875"	10.4	G	0.004439
5"	19.5	S	0.01701
4.5"	16.6	S	0.014032
3.5"	13.3	S	0.00722
2.875"	10.4	S	0.004379

Operator's representative should specify the maximum allowable injection pressure. Ceiling pressure should be based on last shoe test and maximum anticipated mud weight and ECD in current open hole section. The annular or casing gauge should be used to determine maximum pressure, but expect a lag in pressure readings between drill pipe and casing gauges.

MIXING THE SLURRY

MIXING CHART PER ONE FINISHED BARREL			
Slurry Weight (#/gal)	Water (bbl)	New X-Prima (lbs per bbl)	Barite (lbs per bbl)
9.3	0.81	105	0.0
9.5	0.79	112.5	0.0
10.0	0.77	110.3	28.8
10.5	0.76	107.9	57.7
11.0	0.75	105.3	86.5
11.5	0.74	102.5	115.4
12.0	0.73	99.6	144.2
12.5	0.72	96.5	173.1
13.0	0.71	93.3	201.9
13.5	0.70	90.0	230.7
14.0	0.69	86.5	259.6
14.5	0.68	83.0	288.4
15.0	0.67	79.3	317.3
15.5	0.66	75.5	346.1
16.0	0.65	71.6	375.0
16.5	0.64	67.6	403.8
17.0	0.63	63.5	432.6
17.5	0.62	59.3	461.5
18.0	0.61	55.0	490.3
18.5	0.60	50.6	519.2
19.0	0.59	46.2	548.0

If rig equipment is to be use for mixing or holding the slurry, clean and rinse all pits, pumps, and manifolds which the slurry may come in contact with. If this equipment has been exposed to oil or synthetic mud, any affected components should be flushed with a high-strength detergent product and rinsed.

Add the required amount of water to the mixing pit. Prior to mixing **New X-Prima,** add one or two buckets of defoamer (glycol type recommended) as needed to minimize foaming. If the slurry weight is to be higher than 11.0 #/gal, add 75-80% of the prescribed amount of **New X-Prima** before weighting up. The remainder of the **New X-Prima** will be added following weight-up. Additional water or barite may be needed to adjust final density or excessive viscosity.

Depending on BHA components (MWD, PWD, LWD, mud motor) in the drillstring, and/or jet sizes, and if the risk of plugging is low, it may be advisable to add some concentration of **New BridgePak M** to the slurry. If a ported bypass sub is in use, or if the squeeze is to be performed through open-ended drillstring, both **New BridgePak M** and **New BridgePak C** may be added to establish a bridging mechanism in severe loss zones.

Line up manifold to supply cement unit with mud for displacement.

Remove screens from drillstring.

Configure surface lines to enable annular pressure to be read on choke once the Hydril is closed. Ensure that HCR valve is open.

Once the slurry is completed, the **Newpark** engineer should call for a pre-job meeting with all involved personnel and the squeeze procedure should be outlined and specific tasks assigned. If hand-held radios are available, squeeze engineer, cementer, and rig floor should each have one.

PUMPING THE SLURRY

With the Hydril open, pump slurry into the drillstring with either rig pumps or the cement unit. If rig pumps are used, continuous strapping of volume is **imperative** to keep track of the exact amount of slurry pumped. Do NOT rely on pump strokes to quantify volume pumped due to reduced efficiency. This oversight can result in significant under-displacement. Slurry can be pumped into the drill string at 4-5 barrels per minute, but rate should remain constant, taking any returns to pits.

DISPLACEMENT & INITIAL INJECTION

When all of the slurry has been pumped, swap pumps to mud and begin displacement. If the cement unit was used to pump the slurry, a quick rinse and flushing of the pump manifold is recommended prior to beginning displacement, regardless of mud type. This should not take more than 15-20 minutes. Once displacement is underway, keep careful track of both the lead of the slurry and of the mud. When the lead of the slurry is within 5-7 barrels of the bit, shut the pumps down. If necessary, fill backside with water. Close the Hydril. Resume pumping (bullheading) at slower rate, not exceeding 2-3 barrels per minute. As lead of slurry enters the open hole, reduce pump rate to 1 barrel per minute. Monitor pump gauges for any rapid increase in pressure.

Pump tail of the slurry 5 barrels out of the bit and shut pumps down for one hour prior to resuming the squeeze. Record drill pipe and casing pressures every 10-15 minutes while waiting. Note: If casing pressure reaches maximum allowable level before all of the slurry has been pumped out of the drillstring, shut pumps down, open Hydril, and circulate the excess slurry out of the drill pipe and out of the hole. Once the excess slurry has been pumped out of the hole the hesitation squeeze can begin.

HESITATION SQUEEZE

The squeeze sequence is the most critical and variable phase of the operation. After the initial one-hour delay, turn pumps on and inject 5-10 barrels at 0.5 barrels per minute. Pressure on the drill pipe gauge should climb as 'gel' structures are broken, but the reading on the casing gauge is the critical parameter. After circulation is broken, monitor drill pipe gauge closely, looking for signs of initial pack-off (spikes or gradual, steady increases in pressure). If pressure begins and continues to build, shut pumps down, shut down pumps for 30 to 90 minutes, monitoring and recording pressure changes every 10-15 minutes as the slurry de-waters during wait period. During wait time, pressures on both DP and CSG can either increase (ballooning shale) or decrease (slurry de-watering), but will usually move together in the same direction.

Repeat the inject-and-wait cycle until the ceiling pressure is reached. Reduce wait time to 15 to 30 minutes, then resume pump-in at minimum pump rate (as low as ¼ barrel per minute on cement unit). As the plug matrix is formed, pressures will increase rapidly as incrementally less volume is injected. Repeat slow, low-volume injections, reaching ceiling pressure several times. **Note: Do not pump the top of the slurry past the casing or liner shoe with the Hydril closed. The injection cycles can continue as long as there are at least 5-7 barrels of working volume above the shoe, but should be discontinued beyond that point.**

FINAL DE-WATERING

Once the ceiling pressure has been reached two or three times with consecutive low-volume injections, the squeeze sequence should be halted. Pressure should be held for a minimum of 8 hours to allow the plug to de-water and reach is final strength. Do not 'bump' the pressure or otherwise disturb the matrix during this time. Pressures on both the DP and CSG gauges should be recorded every 15 minutes. Again, pressures may increase or decrease with time, depending on activity in the slurry or formation. If the mud system is oil or synthetic based, pressure increases could be the result of heat expansion.

Important: Time is your strongest ally. Hesitation squeezes do not always perform as described above. It is not unusual to inject nearly all the working volume with little pressure increase over the duration of the entire sequence. However, the squeeze should not immediately be considered a failure.

In such a case, it is recommended that after the initial eight-hour wait, the Hydril be opened and circulation attempted. If the hole circulates with full returns (as it should), it is advisable to circulate surface to surface, then wash down to just above the shoe. At that point continue pumping for an additional 4 to 6 hours, during which time the mud system can be conditioned, and the light, constant pressure of the ECD can be applied to the slurry. In a majority of situations, this measure will prove to be successful. If circulation is not possible at this point, a second squeeze will have to be performed.

If the hole can be circulated at full pump rate and with full returns, a pressure test may be desirable prior to washing to bottom. With the bit inside the shoe, close the Hydril and slowly apply pressure with the rig pumps. If ceiling pressure is again attained, do not expect that pressure to hold for any extended period of time as the plug may continue de-watering. Do not exceed the ceiling squeeze pressure. This may disturb or loosen the plug or expand the formation.

WASH & REAM TO BOTTOM

While circulating inside the shoe, build a slugging pit of sweep volume, adding 8-12 #/bbl medium fiber, 8-12 #/bbl fine fiber, and 10 #/bbl New Seal. Begin wash-down and reaming to bottom. As stated earlier, residual squeeze material may have some effect on mud properties, but these should be easily corrected. If the bit takes weight while reaming, note the depth where this occurs, since this is indicative of the presence of de-watered plug across the loss zone.

It is recommended that the hole be swept every 30' while reaming to seal any formation permeability surrounding the squeeze matrix. Mud solids should easily seal the annular face of the matrix itself as it is drilled. Sweep volume should equal approximately 1 barrel per inch of hole diameter. Continue sweeping the hole in this manner until TD is reached. To further measure the integrity of the squeeze, it may be advisable to short trip to the shoe before drilling ahead.

DIVIDED SLURRY

If, due to large open hole volume or limited mixing capacity, the desired amount of slurry cannot be mixed and spotted monolithically, it is recommended that the squeeze procedure be performed with a divided slurry. This measure is advisable if losses are known to be occurring on bottom or in a section of the wellbore which would require an excessively long column of slurry to reach while still keeping the shoe covered and providing sufficient working volume inside the casing.

At or just above the suspected thief zone, spot enough slurry to cover 750' to 1,000' feet of open hole. Placement should be carried out in balanced-plug fashion with the Hydril open. Pipe is then pulled out of the slurry, slowly pumping displacement plus capacity of the drillstring removed from slurry. After the bit (or bottom of the drillstring) clears the calculated top of the slurry, circulation should be attempted, bringing pumps online gradually. If circulation is possible, pump any residual slurry out of the drillstring, and pull pipe to the shoe. **Note: Full circulation at this point should not be considered as proof that the loss zone is adequately sealed. Until the formation has been squeezed, there can be no assurance of plug integrity.**

The volume of the upper **New X-Prima** slurry should be at least 40 barrels greater than the one spotted in the lower hole. This slurry may be pumped in either of two ways:

1) **Balanced plug:** This procedure is recommended if the hole can be circulated with full returns after spotting the lower slurry. Place the bit (or bottom of the pipe) at a depth below the shoe where the slurry can be spotted so as to leave at least 40 barrels above the shoe once drill pipe has been pumped out of it. The Hydril will remain open while spotting.

2) **Bullhead:** If the hole cannot be circulated with full returns after spotting the lower slurry, place the bit (or bottom of the pipe) at a point inside the casing where there are at least 40 barrels of volume between it and the shoe. With the Hydril open, pump the lead of the slurry to within 5 barrels of the bit, then close the Hydril. Bullhead the slurry at no more than 2 barrels per minute until the lead of the slurry is at the shoe. Reduce pump rate to 1 barrel per minute and pump the tail of the slurry 5 barrels outside the drillstring. Refer to the section '**PUMPING THE SLURRY**' above and proceed with the hesitation squeeze sequence as outlined from there.