

Appendix A

Notes:

1. Product concentrations are indicative only and vary per actual drilling fluid conditions as measured on site.
2. All products listed have been in common use in the U.K., both onshore and offshore.
3. Drilling fluid volume requirements per hole section are subject to variation due to subsurface conditions.
4. Any items marked as 'presumed hazardous' are yet to be assessed by the Environment Agency and would only be assessed if deemed to be required. These items would only be considered for use following satisfactory assessment from the Environment Agency and in accordance with any proposed mitigations.



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A. Water-based mud formulations throughout:			Pilot	J-curve						
Drilled Hole:			24	16	12.25	8.5	8.5	6		
WB Mud vol built /m3			222	301	127	436	133	110	1329	
kg/m3	Mud composition:							Total	Units	Primary purpose
0.95	Water	211	286	121	415	127	105	1265	m3	Main constituent
0.7	Caustic Soda	156	211	89	306	94	77	933	kg	Water hardness treatment
0.7	Soda ash	156	211	89	306	94	77	933	kg	pH control, hardness
14.3	Bentonite (added to polymer mud)	3175	4305	1817	0	0	0	9297	kg	Viscosification, filtrate control
4.3	Xanthan (polysaccharide derivative)	955	1295	547	1875	572	473	5717	kg	Viscosification, filtrate control
14.3	Drilling starch (polysaccharide, various)	3175	4305	1817	6235	1902	1573	19007	kg	Filtrate control
4.3	Polyanionic cellulose			547	1875	572	473	3467	kg	Filtrate control
314	Sodium chloride	69.8		39.9	137	41.8	34.6	324	Ton	Drilling halite formations
28.6	Potassium chloride				12470	3804	3146	19420	kg	Clay stabilisation
14.3	Calcium carbonate, ground	3175	4305	1817	6235	1902	1573	19007	kg	Bridging agent
30	Lubricant (ester-based)					3990	3300	7290	ltr	Lubricity
								Total	Units	
	Displacement Fluids /m3		10	10	10	10	10	50	m3	
0.97	Water		9.7	9.7	9.7	9.7	9.7	48.5	m3	Viscosification
8.6	Viscosifier (polysaccharide derivative)		86	86	86	86	86	430	kg	Main constituent
100	Sodium chloride			1000				1000	kg	
	Surfactant (detergent) - LTOBM only									Base oil film removal
								Total	Units	
	Completion / Suspension fluid							100	m3	
7.2	Corrosion inhibitor							720	ltr	Protection of steel casings
1.8	Oxygen scavenger							180	kg	Reduction of corrosion
kg/m3	Contingency Products							Total	Units	
200	Barite				87200	26600	22000	136	Ton	Densification: well control, borehole stabilisation
5.8	Viscosifier (polysaccharide derivative)			737	2529	772	638	4676	kg	Viscose pills / hole cleaning
11.5	Cellulosic fibers		3462	1461	5014	1530		11467	kg	Lost circulation healing
11.5	Nut shells, ground/graded		3462	1461	5014	1530		11467	kg	Lost circulation healing
0.8	Defoaming agent	178	241	102	349	107	88	1065	kg	Removal of foam from surface system
2.9	Mangesium oxide				1265	386	319	1970	kg	pH buffer
11.5	Wellbore stabilisation solids			1461	5014	1530	1265	9270	kg	Organic solids + metal oxides
	Sodium bicarbonate							1000	kg	Treatment for cement contamination
	Sugar (cement retarder)							1000	kg	Returned cement treatment
0	Citric acid							4000	kg	Filter cake removal, e.g. stuck drill string
0	Sodium acid pyrophosphate (SAPP)							1500	kg	Mud thinner, e.g. for stuck drill string
0	Hydrochloric acid, <10% v/v conc.							1500	kg	Filter cake removal, e.g. stuck drill string

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B. Water-based mud & LTOBM formulations combined:				Pilot	J-curve				
	Drilled Hole:	24	16	12.25	8.5	8.5	6		
	WB Mud vol built /m3	222	301	0	0	0	0	523	
	Oil Mud used /m3	0	0	317	75	45	79	516	
kg/m3	Mud composition:							Total	Units
0.95	Water	211	286					497	m3
0.7	Caustic Soda	156	211					367	kg
0.7	Soda ash	156	211					367	kg
14.3	Bentonite (added to polymer mud)	3175	4305					7480	kg
4.3	Xanthan (polysaccharide derivative)	955	1295					2250	kg
14.3	Drilling starch (polysaccharide, various)	3175	4305					7480	kg
4.3	Polyanionic cellulose							0	kg
286	Barite, milled (flour)							0	kg
314	Sodium chloride	69.8						70	Ton
28.6	Potassium chloride							0	Ton
14.3	Calcium carbonate, ground	3175	4305					8	Ton
30	Lubricant (ester-based)							0	litr
kg/m3	Oil-based mud Formulation (nominally 10lb/gal):							Total	Units
0.63	Low-toxicity base oil (e.g. Total DF-1)			200	48	29	50	327	m3
0.237	Water			76	18	11	19	124	m3
148.4	Calcium chloride			47.233	11.175	6.705	11.771	77	Ton
14.3	Primary emulsifier			4534	1073	644	1130	7381	kg
14.3	Secondary emulsifier			4534	1073	644	1130	7381	kg
14.3	Lime			4534	1073	644	1130	7381	kg
14.3	Organophilic clay			4534	1073	644	1130	7381	kg
14.3	Fluid loss control (e.g. asphalt-based)			4534	1073	644	1130	7381	kg
291	Barite for densification			92.247	21.825	13.095	22.989	151	Ton
								Total	Units
	Displacement Fluids /m3	10	10	10	10	10	10	50	m3
0.97	Water	9.7	9.7	9.7	9.7	9.7	9.7	48.5	m3
8.6	Viscosifier (polysaccharide derivative)	86	86	86	86	86	86	430	kg
0.1	Sodium chloride	1.00	1.00	1.00	1.00	1.00	1.00	5.0	Ton
	Surfactant (detergent) - only for LTOBM			1000	1000	1000	1000	5000	litr
								Total	Units
	Completion / Suspension fluid							100	m3
7.2	Corrosion inhibitor							720	litr
1.8	Oxygen scavenger							180	kg
kg/m3	Contingency Products							Total	Units
10%	Base oil			32	8	5	8	53	m3
200	Barite				15	9	15.8	40	Ton
5.8	Viscosifier (polysaccharide derivative)							0	kg
11.5	Cellulosic fibers	3462	3646					7108	kg
11.5	Nut shells, ground/graded	3462	3646					7108	kg
0.8	Defoaming agent	178	241					419	kg
2.9	Mangesium oxide							0	kg
11.5	Wellbore stabilisation solids			3646	863	518	909	5936	kg
	Sodium bicarbonate							1000	kg
	Sugar (cement retarder)							1000	kg
0	Citric acid							4000	kg
0	Sodium acid pyrophosphate (SAPP)							1500	kg
0	Hydrochloric acid, <10% v/v conc.							1500	kg

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List of Potential Additives:

Additive	Status	Source
Xanthum Gum	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Sodium Hydroxide	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Sodium Carbonate	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Barite	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Silica, crystalline, quarts	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Carboxymethylcellulose sodium salt	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Mica	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
2, 2, 2- triethanol	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Glycine, carboxymethyl, tetrasodium salt	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Ethanolamine	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Calcium Carbonate	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Cellulose	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Polypropylene	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Cellophane	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Sodium Chloride	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Calcium Carbonate	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Starch	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Fatty acids tall-oil	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Potassium Chloride	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Starch, 2-hydroxypropyl ether	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Magnesium Oxide	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Radiagreen EME Salt	Non- hazardous	Environment Agency Balcombe Hydrogeological assessment
Methanol	Non-hazardous	JAGDAG Interim determination 2018
Polyanionic Cellulose (PAC)	Non-hazardous	Igas Mining Waste Permit
XC Polymer	Non-hazardous	Igas Mining Waste Permit



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Additive	Status	Source
Diethylene glycol monobutyl ether	Presumed Hazardous	Precautionary Assumption
Ethylene glycol monobutyl ether	Presumed Hazardous	Precautionary Assumption
Calcium Chloride	Non-hazardous	Igas Mining Waste Permit
Primary Emulsifier	Presumed Hazardous	Precautionary Assumption
Sec. Emulsifier	Presumed Hazardous	Precautionary Assumption
Organophilic clay	Presumed Hazardous	Igas Mining Waste Permit
Sec. Viscosifier	Presumed Hazardous	Igas Mining Waste Permit
Fluid Loss (asphalt)	Presumed Hazardous	Igas Mining Waste Permit
Barite	Non-hazardous	Environment Agency Balcombe Hydrogeological assessment
Hydrotreated light Petroleum Distillate	Presumed Hazardous	Precautionary Assumption
Hydrocarbons, C11-C14, n-alkanes, isoalkanes, cyclics < 2% aromatics	Presumed Hazardous	Precautionary Assumption
Fatty Acids, tall oil, reaction product with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetriamine	Presumed Hazardous	Precautionary Assumption
Methanol	Presumed Hazardous	Precautionary Assumption
Morpholine process residue	Presumed Hazardous	Precautionary Assumption
N, N'- Methylene bis (5-methyl oxazolidine)	Presumed Hazardous	Precautionary Assumption
Nitrilotriacetic acid, trisodium salt monohydrate	Presumed Hazardous	Precautionary Assumption

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