

DOCUMENT TYPE: Final Thesis

DOCUMENT NO: C0105-JUNYONG

BONNY TERMINAL INTEGRATED PROJECT

PIPELINE INSTALLATION SHORE APPROACH FOR WEST AFRICAN VENTURES

FINAL THESIS

APPENDIX

Student No.: 1133958

WAV Contract No.: C0105

 SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LTD	Sign								
	F	19 June 06	Definitive	JYT	SC	HV	LDL	TVDL	
 HYUNDAI HEAVY INDUSTRIES CO., NIGERIA LTD.	E	13 June 06	Update and Revision	JYT	SC	HV	LDL	TVDL	-
	D	9 June 06	Review / Approval	JYT	SC	HV	LDL	TVDL	-
 WEST AFRICAN VENTURES LTD	C	29 May 06	In-External Review	JYT	SC	HV	LDL	TVDL	-
	B	22 May 06	Progress Evaluation	JYT	SC	HV	LDL	TVDL	-
 HOGESCHOOL UTRECHT	A	15 April 06	Personal review	JYT	SC	HV	LDL	TVDL	-
	REV	DATE	DESCRIPTION	BY	CHK	WAV	HU 1st MENTOR	HU 2nd MENTOR	Reserve

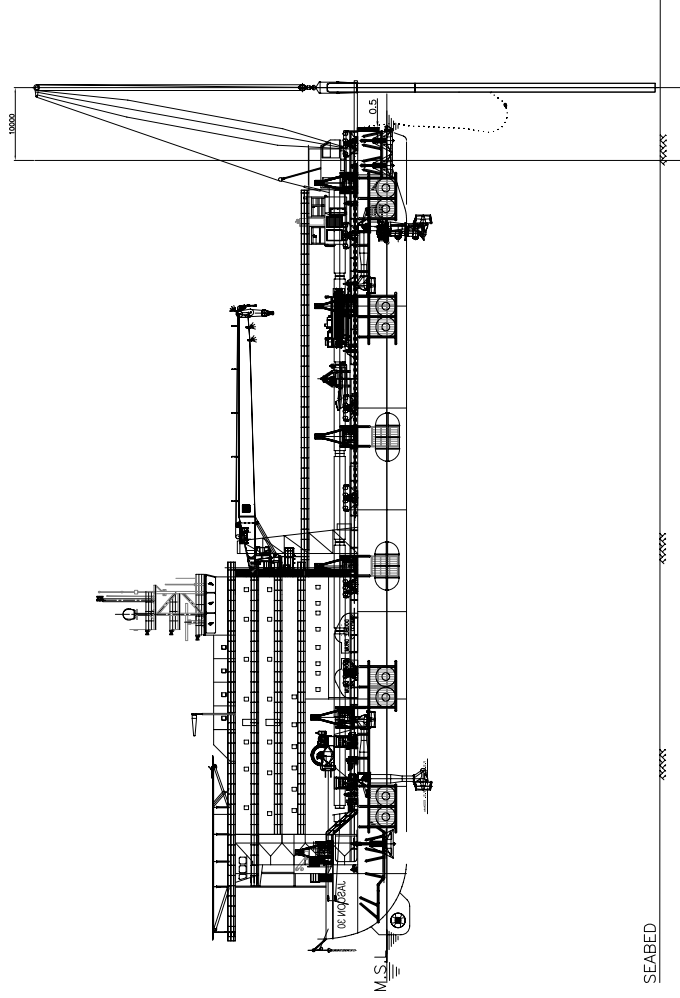
APPENDIX A SPM INSTALLATION

SINGLE MOORING POINT BUOY SPECIFICATION

Water depth	36 m
CALM Buoy	Body diameter 12.0 m Including skirt: 15,3mtr Overall height 5.3 m Operational draft: 3.10 m (incl. chains & hoses connected) Weight 255 mT approx.
Anchor chains	8 No. 81.0 mm chain, each with a continuous length of approx 454 m (chain 81mm x 228m + joining shackle + chain 81mm x 207m + joining shackle + chain 95mm x 19m)
Anchor points	8 No. 48 inch anchor piles (1" WT), each with a length of 33 m. Anchor pile penetration 38 m. Weight 30 mton.
Submarine hoses	two strings of 20" hoses complete with body floats Chinese lantern configuration Length of each string is 42.8 m
Floating hoses	One string of 20" hoses with two 16" tails Overall length: 1 st string 306m, 2 nd string: 316m
Mooring hawser	Two floating 17" circ. Nylon hawsers, complete with end fittings. Length = 70 m.
PLEM	Dimensions: 14.7 m x 9 m Weight in air, 115 mT approx. Base plate anchoring: 2 x 24" x 32 m – 12 mton; 2 x 24" x 27 m – 10 mton
Bottom clearance	600mm

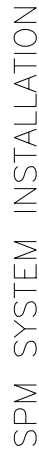
STEP 2 ELEVATION

- LOWER PILE + FOLLOWER INTO WATER AND SET STOPPER INTO THE OUTRIGGER
- ALIGN PILE TO MAKE SURE PILE PADEYE IS WITHIN TOLERABLE CLEARANCE
- ADJUST AND ALIGN CHAIN



ELEVATION

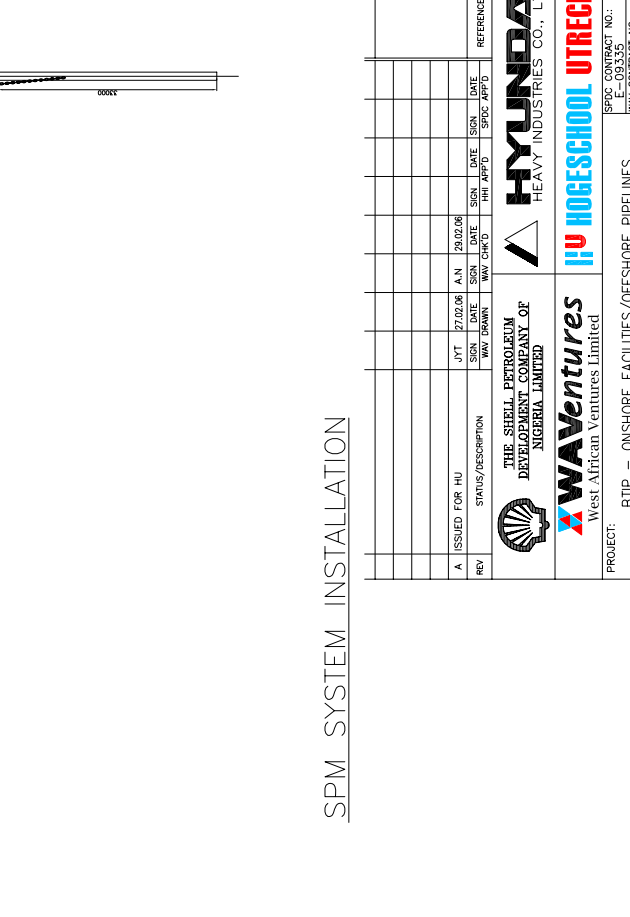
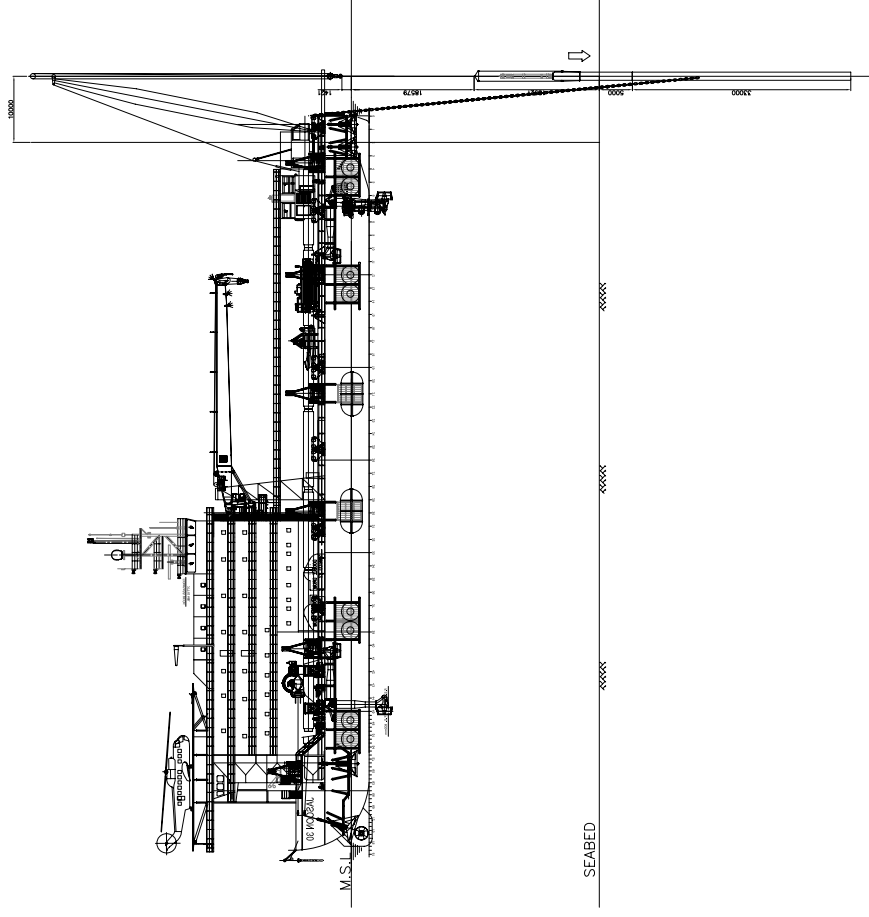
- SEABED



CAD FILE NAME: BTIP-DW-N-017-02
RELEASE: 2006

STEP 5 ELEVATION

- PILE TO REQUIRED DEPTH WHILE RELEASING THE CHAIN
- PICK UP PILE FOLLOWER OFF THE GROUND
- REMOVE PILE FOLLOWER FROM OUTRIGGER
- PICK UP FOLLOWER WITH DAVIT AND CRANE



10

REV	STATUS/DESCRIPTION	DATE				SIGN				REFERENCE	
		WAV	DRAWN	DATE	SIGN	WAV	CHK'D	DATE	SIGN	HHI	SPDC APP'D
A	ISSUED FOR HU			27.02.06		A.N		29.02.06			

THE SHELL PETROLEUM
DEVELOPMENT COMPANY OF
NIGERIA LIMITED

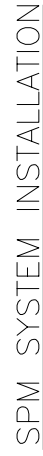
 WAVentures West African Ventures Limited	 HOGESCHOOL UTRECHT
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PROJECT:	BTIP – ONSHORE FACILITIES/OFFSHORE PIPELINES
	SPDC CONTRACT NO.: E-09335
	WAV CONTRACT NO.:

TITLE:	SPM INSTALLATION SEQUENCE ANCHOR PILE INSTALLATION	C0105
WAV DWG. NO:	BTP-DW-N-017-02	
SPM DRAWING No:		

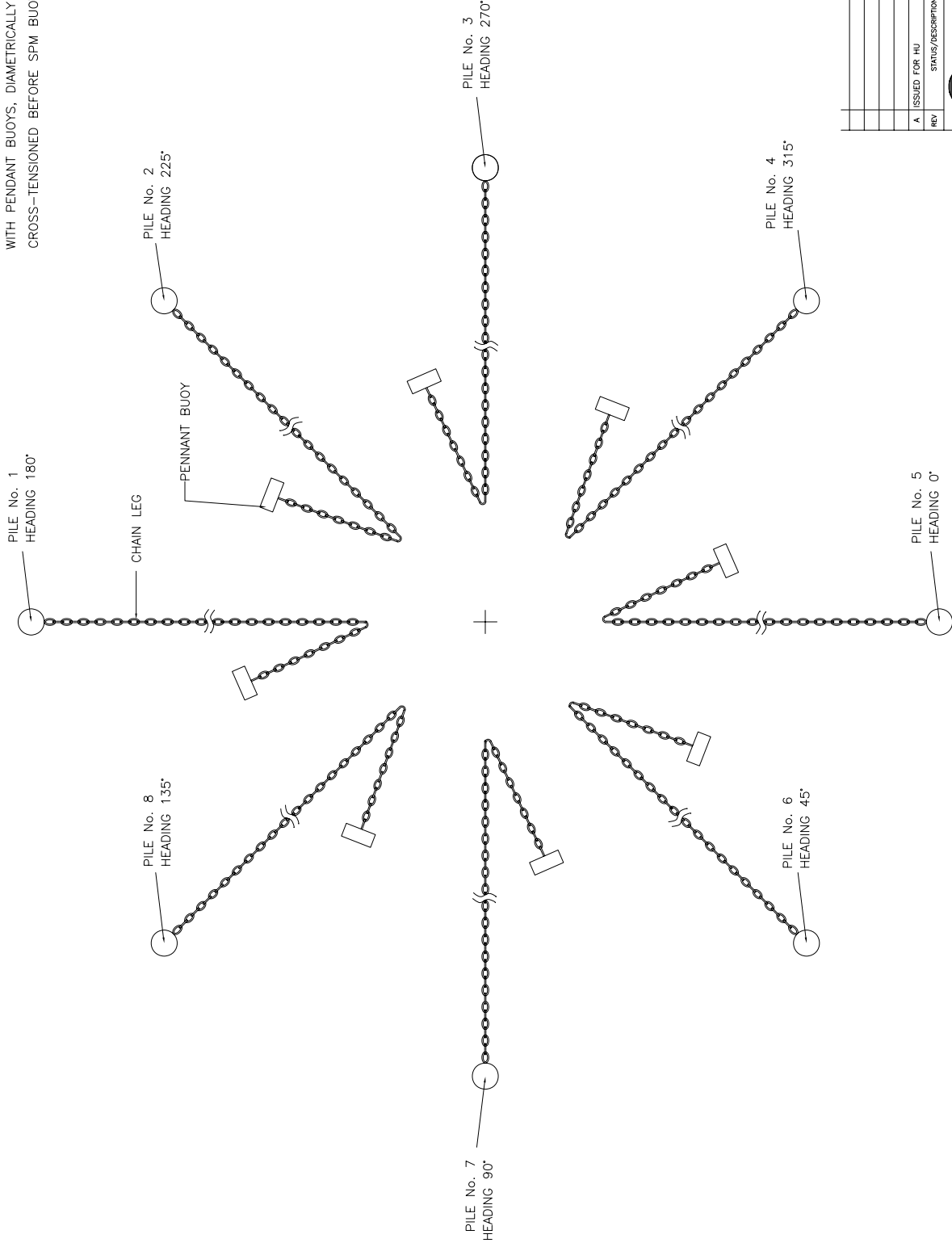
DRAWN: JYT	DATE: 27.02.06	SCALE:	REVISION: A	SHT 2 OF 8
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EACH CHAIN LEG IS LAID TOWARDS THE CENTER OF THE MOORING SPREAD. A MARKER BUOY AND PICK UP CABLE ARE ATTACHED AT CHAIN END FOR FUTURE RECOVERY.

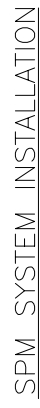


CAD FILE NAME: BTIP-DW-N-017-03
RELEASE: 2006 A

STEP 7

[illegible]

- WITH THE INSTALLATION BARGE IN POSITION OVER MOORING
- PATTERN CENTER, OPPOSITE CHAINS PAIRS ARE PRE-TENSIONED.



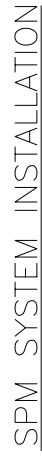
1. BARGE MAIN CRANE NOT SHOWN FOR CLARITY.

	THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED		HYUNDAI HEAVY INDUSTRIES CO., LTD.	THE PETRO CORP LTD
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WEST AFRICAN VENTURES LIMITED	
PROJECT:	BTIP – ONSHORE FACILITIES/OFFSHORE PIPELINES
	SPDC CONTRACT NO.: E-09335
	WAY CONTRACT NO.:

DRAWN: JYT	DATE: 27.02.06	SCALE: 6	REVISION: A	SHT 5 OF 8
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- BUOY IS TOWED TO SIDE OF INSTALLATION BARGE,
- SUCH THAT IT IS POSITIONED OVER MOORING
- PATTERN CENTER.



1. CHAIN LEGS ARE UNDER WATER HENCE THE BARGE CAN FLOAT ON TOP.

CAD FILE NAME: BTIP-DW-N-017-06
RELEASE: 2006

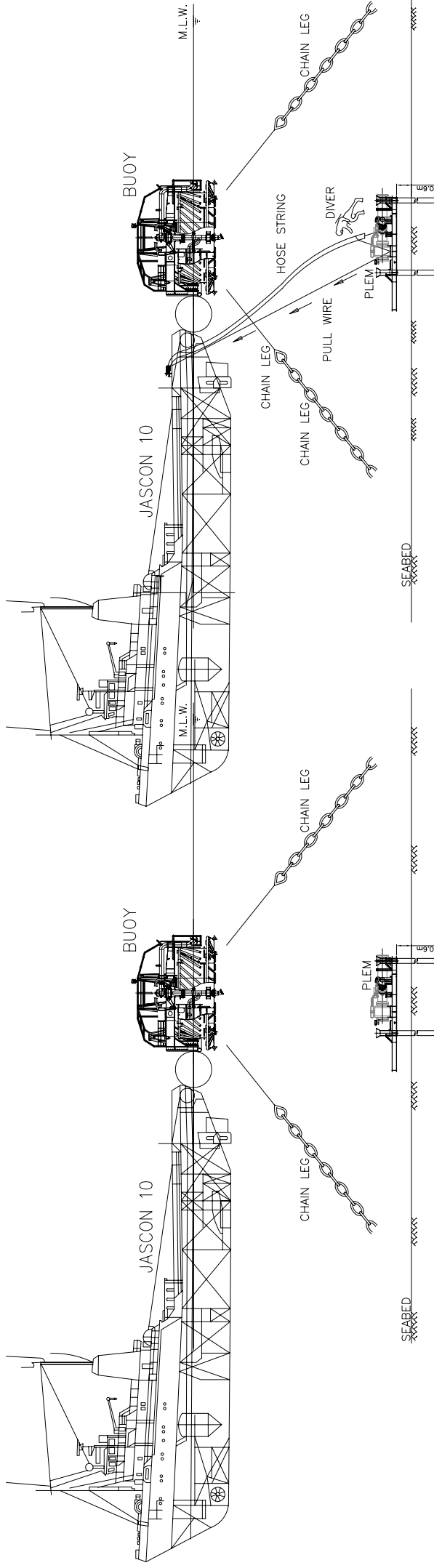
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STEP 10

- EACH STROP IS PULLED THROUGH HAWSE PIPE UNTIL CHAIN IS ABOVE STOPPER AND CAN BE LOWERED TO ENGAGE STOPPER.

STEP 11

- THE UNDERBUOY HOSE STRING IS LOWERED AND PULLED DOWN UNTIL FLANGES OF HOSE AND PLEM MATE.

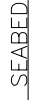


SPM SYSTEM INSTALLATION

CAD FILE NAME: B7IP-DW-N-017-07
2006
RELEASE:

SPM SYSTEM INSTALLATION

- THE UNDERBUOY HOSE STRING IS PULLED UNTIL FLANGES OF HOSE AND BUOY MATE.



CAD FILE NAME: BTIP-DW-N-017-08
RELEASE: 2006 A

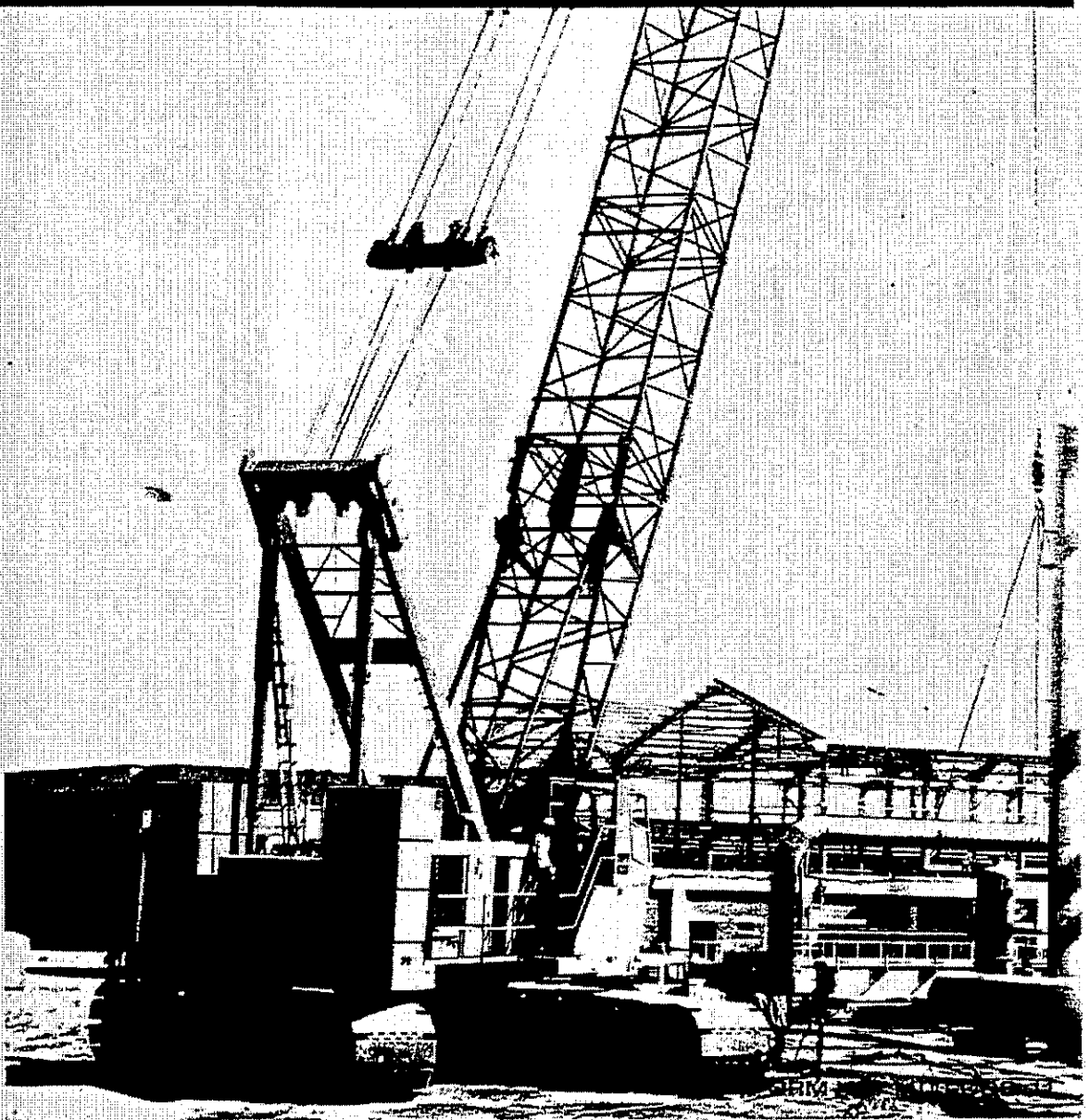
APPENDIX B AMERICAN HOIST LIFTING RATES



1100 SERIES
CRAWLER LIFT CRANE

MODEL 11320

GENERAL SPECIFICATIONS
450 TON





1100 SERIES MODEL 11320 CRAWLER CRANE

LIFT RATINGS With 94H Tubular Chord Boom and "A-B-C-D" Counterweight (230,000 lbs.)

Boom Length (Feet)	Radius in Feet	Boom Angle Degrees	Lift Rating (Pounds)	Feet From Boom Point To Ground
70 feet	17	82.2	900000	75
	20	79.7	758510	76
	25	75.4	574360	75
	30	71.1	445950	73
	35	66.7	348650	71
	40	62.1	285750	69
	50	52.2	205680	62
	60	40.7	163300	57
80 feet	20	81.7	900000	86
	25	81.0	754160	85
	30	77.3	663970	83
	35	73.5	544770	81
	40	69.8	448270	82
	50	65.4	385330	80
	60	61.7	308170	75
	70	47.8	162770	67
90 feet	25	82.0	732960	95
	30	78.7	649760	95
	35	75.5	539740	94
	40	72.1	447930	93
	50	68.7	34950	91
	60	61.7	207750	86
	70	54.0	152340	80
	80	45.6	132440	71
100 feet	30	82.2	670810	105
	35	79.3	535700	106
	40	76.9	429900	105
	45	74.0	347410	103
	50	71.0	284390	102
	60	64.7	207130	98
	70	58.1	161790	92
	80	51.0	131810	85
110 feet	35	82.2	590650	115
	40	80.8	522470	116
	45	78.2	418790	115
	50	75.5	346530	114
	60	72.8	283080	112
	70	67.2	206560	109
	80	61.0	161140	104
	90	55.2	131260	97
120 feet	40	82.1	540690	126
	45	81.6	514170	126
	50	79.2	412830	125
	55	76.7	344850	124
	60	74.2	284290	123
	70	69.2	207040	119
	80	63.9	161630	115
	90	58.5	131750	109

Boom Length (Feet)	Radius in Feet	Boom Angle Degrees	Lift Rating (Pounds)	Feet From Boom Point To Ground
120 feet cont.	80	52.6	110450	103
	90	48.2	94720	95
	100	39.1	82580	85
	110	30.6	72520	73
	120	18.7	65540	46
130 feet	25	82.2	523100	136
	30	80.0	463880	135
	35	77.5	387160	134
	40	75.5	323720	133
	50	71.9	256440	130
	60	66.1	181070	125
	70	61.1	131100	121
	80	55.2	105700	115
140 feet	30	82.0	448570	145
	35	80.7	395790	145
	40	78.6	330090	144
	45	76.5	283240	143
	50	73.3	205950	141
	60	67.9	160450	137
	70	63.1	120600	132
	80	58.1	103300	127
150 feet	35	82.1	420660	155
	40	81.3	380030	155
	45	79.4	323320	155
	50	77.5	277850	154
	60	73.5	203240	151
	70	69.5	159780	148
	80	63.3	120840	143
	90	61.0	103500	138
160 feet	40	82.0	360500	165
	45	81.1	320000	165
	50	79.1	277500	164
	55	77.1	235000	163
	60	75.1	192500	162
	70	71.1	140000	158
	80	67.1	107500	153
	90	63.1	85000	148
170 feet	45	82.0	317500	175
	50	81.0	280000	175
	55	79.0	242500	174
	60	77.0	205000	173
	70	73.0	152500	169
	80	69.0	110000	164
	90	65.0	87500	159
	100	61.0	65000	154

Stated ratings are limited by strength of materials or factors other than stability.

(continued)

LIFT RATINGS (cont.)

With 94H Tubular Chord Boom

Boom Length (Feet)	Radius in Feet	Boom Angle Degrees	Lift Rating (Pounds)	Feet From Boom Point To Ground
170 feet (cont.)	60	73.0	159200	189
	70	68.4	129410	166
	80	64.1	107900	151
	90	60.0	92390	136
	100	56.9	80000	120
	120	48.4	62650	104
	140	38.4	43720	88
	160	28.5	25430	72
180 feet	170	19.6	32730	53
	22	82.2	34380	189
	35	81.3	309410	185
	40	79.6	283430	184
	50	76.3	234040	182
	60	73.0	192590	179
	70	69.6	167800	176
	80	66.2	147320	172
190 feet	90	62.6	12770	161
	100	59.6	10360	151
	120	51.2	81400	141
	140	42.3	62390	128
	160	31.6	40340	101
	180	19.2	23340	54
200 feet	33	82.6	225200	195
	35	81.7	204170	195
	40	80.1	178830	194
	50	77.3	150420	191
	60	73.9	126010	187
	70	70.5	106720	183
	80	67.3	91180	178
	90	64.2	78770	172
210 feet	100	60.8	68390	160
	120	53.0	52890	143
	140	43.0	38970	120
	160	31.9	24950	85
	180	24.1	15950	55
	190	14.7	9440	35
220 feet	35	82.2	296000	205
	40	80.9	266700	201
	50	77.7	229500	200
	60	74.6	193300	200
	70	71.5	157250	197
	80	68.4	132040	194
	90	65.3	106530	189
	100	62.4	81100	184
230 feet	120	55.7	60100	172
	140	46.3	48140	157
	160	35.7	32050	136
	180	24.9	20120	107
	190	14.3	12670	57
240 feet	30	82.2	265500	215
	40	81.1	236000	215
	50	78.2	206600	213
	60	75.2	177200	210
	70	72.2	147800	208
	80	69.2	118400	204
	90	66.2	99000	199
	100	63.2	79600	194
250 feet	120	57.5	59450	184
	140	50.7	47510	170
	160	43.2	35430	151
	180	34.4	23490	126
	200	27.6	15460	89
	210	14.0	9350	53
260 feet	37	82.3	272840	223
	40	81.5	249740	223
	50	78.5	210090	223
	60	75.2	174930	221
	70	72.0	148800	218
	80	68.9	122600	215
	90	65.7	106200	211
	100	62.6	89800	207
270 feet	120	58.7	59380	195
	140	52.5	47490	183
	160	45.9	35400	165
	180	38.1	23400	145
	200	29.5	15390	117
	220	13	9300	62
280 feet	38	82.1	284000	235
	40	81.3	258700	235
	50	78.3	219400	234
	60	75.3	180100	233
	70	72.3	140800	231
	80	69.3	111500	229
	90	66.3	92200	227
	100	63.3	72900	225
290 feet	120	59.8	59300	195
	140	53.8	47400	183
	160	47.8	35500	165
	180	39.8	23600	145
	200	31.8	15700	117
	220	14	9400	62
300 feet	39	82.1	294000	235
	40	81.3	268700	235
	50	78.3	229400	234
	60	75.3	190100	233
	70	72.3	150800	231
	80	69.3	121500	229
	90	66.3	102200	227
	100	63.3	82900	225

Boom Length (Feet)	Radius in Feet	Boom Angle Degrees	Lift Rating (Pounds)	Feet From Boom Point To Ground
230 feet (cont.)	90	63.9	89200	222
	100	60.6	76740	219
	120	50.6	58730	206
	140	41.7	48860	195
	160	32.1	37760	179
	180	22.8	30830	159
	200	13.8	25360	132
	220	13.8	17270	82
240 feet	230	13.8	17140	60
	30	82.2	243300	240
	40	81.3	218770	241
	50	78.3	194200	241
	60	75.3	169630	239
	70	72.3	145060	236
	80	69.3	120490	234
	90	66.3	105920	232
250 feet	100	63.3	89510	229
	120	53.3	70150	225
	140	43.3	58120	219
	160	33.3	46270	207
	180	23.3	37170	192
	200	13.3	30220	173
	220	13.3	24760	156
	240	13.3	18000	117
260 feet	250	13.3	14300	81
	41	82.3	232930	255
	50	80.2	203740	254
	60	77.0	174520	252
	70	73.5	145280	249
	80	70.0	116040	245
	90	66.5	96800	242
	100	63.0	77560	238
270 feet	120	53.2	62440	236
	140	43.2	50440	234
	160	33.2	40400	229
	180	23.2	32350	225
	200	13.2	26300	219
	220	13.2	20250	188
	240	13.2	15200	166
	250	13.2	12150	135
280 feet	260	13.2	9100	86
	43	82.1	215660	265
	50	80.6	190680	264
	60	78.3	165480	262
	70	75.1	140280	260
	80	71.8	115080	257
	90	68.5	99880	254
	100	65.1	84680	250
290 feet	120	54.3	66860	241
	140	45.3	54960	231
	160	36.0	43060	217
	180	26.3	35710	201
	200	17.0	28410	181
	220	13.4	21110	155
	240	13.4	15810	122
	250	13.4	12510	84
270 feet	44	82.2	178800	275
	50	80.3	153800	274
	60	76.6	128800	272
	70	72.9	103800	270
	80	69.2	88800	267
	90	65.5	73800	264
	100	61.8	58800	261
	120	53.3	43800	253
280 feet	140	44.3	38800	242
	160	35.3	30800	230
	180	26.3	22800	215
	200	17.3	14800	196
	220	13.3	11800	173
	240	13.3	9300	143
	260	13.3	6800	100
	270	13.3	4300	69
280 feet	45	82.3	188250	285
	50	81.3	167700	284
	60	78.3	142200	282
	70	75.3	116700	280
	80	72.3	99810	278
	90	69.3	82940	275
	100	66.3	66070	271
	120	57.3	50950	263
290 feet	140	47.3	44710	251
	160	38.3	35290	247
	180	29.3	28130	237
	200	20.3	22340	216
	220	11.3	16950	183
	240	11.3	11670	161
	260	11.3	8590	126
	270	11.3	6340	107

LIFT RATINGS With 94H Tubular Chord Boom and "A-B-C-D" Counterweight (104,320 kg.)

METRIC

Boom Length (Meters)	Radius In Meters	Boom Angle Degrees	Lift Rating (Kilograms)	Meters From Boom Point To Ground
21.3 meters	5.2	82.1	408240	23.3
	6.0	79.9	349680	23.2
	7.0	77.2	291380	23.0
	8.0	74.2	244930	22.7
	9.0	71.5	207180	22.4
	10.0	68.7	174780	22.1
	12.0	62.7	132650	21.1
	14.0	56.4	108450	20.0
	16.0	49.5	88620	18.6
	18.0	41.9	75540	16.4
	20.0	32.7	65950	13.7
24.4 meters	5.5	81.6	358800	25.3
	6.0	81.2	348990	25.3
	7.0	78.8	284340	26.1
	8.0	76.4	246030	25.9
	9.0	73.9	207040	25.6
	10.0	71.5	174620	25.3
	12.0	65.4	132450	24.5
	14.0	61.1	108240	23.5
	16.0	55.5	88410	22.3
	18.0	49.5	75410	20.7
27.4 meters	6.2	81.7	322040	29.3
	7.0	80.1	277730	29.2
	8.0	77.9	235140	29.0
	9.0	75.9	203570	28.6
	10.0	73.8	174480	28.5
	12.0	69.2	132290	27.6
	14.0	64.6	106080	27.0
	16.0	59.8	88220	25.9
	18.0	54.8	75210	24.6
	20.0	49.4	65430	23.0
30.5 meters	7.0	81.1	285290	32.3
	8.0	81.1	270580	32.3
	9.0	79.2	229100	32.1
	10.0	77.2	198500	31.9
	12.0	75.3	174230	31.7
	14.0	71.3	132040	31.1
	16.0	67.3	105800	30.3
	18.0	63.1	87950	29.4
	20.0	58.8	74330	28.2
	22.0	54.2	65150	26.9
33.5 meters	7.5	81.6	266640	35.4
	8.0	80.2	223600	35.2
	9.0	78.4	193720	35.0
	10.0	76.7	171150	34.6
	12.0	73.1	131840	34.3
	14.0	69.5	105480	33.6
	16.0	65.7	87710	32.8
	18.0	61.9	74570	31.8
	20.0	57.9	64960	30.6
	22.0	49.3	50900	27.9
36.6 meters	7.5	81.6	238150	38.4
	8.0	81.0	218160	38.3
	9.0	79.4	189670	38.1
	10.0	77.6	167350	37.9
	12.0	74.5	132600	37.4
	14.0	71.3	103750	36.8
	16.0	67.9	87930	35.7
	18.0	64.4	74890	35.2
	20.0	60.9	65140	34.1
	22.0	53.4	51130	31.5
39.6 meters	7.8	81.9	216520	41.4
	8.0	81.7	214410	41.4
	9.0	80.2	186750	41.2
	10.0	78.7	165180	41.0
	12.0	75.8	131750	40.6
	14.0	72.8	105500	40.0
	16.0	69.7	87670	39.3
	18.0	66.5	74620	38.5

Boom Length (Meters)	Radius In Meters	Boom Angle Degrees	Lift Rating (Kilograms)	Meters From Boom Point To Ground
39.6 meters (cont.)	20.0	53.3	64860	37.5
	24.0	50.5	50850	35.3
	28.0	46.3	41530	32.2
	32.0	41.0	34720	28.2
	36.0	34.8	27470	18.7
42.7 meters	8.3	81.9	201830	44.4
	9.0	80.9	182930	44.3
	10.0	79.6	161740	44.1
	12.0	76.8	131170	43.7
	14.0	74.0	105270	43.2
	16.0	71.2	87430	42.5
	18.0	68.3	74350	41.5
	20.0	65.4	64620	41.0
	24.0	59.3	50590	38.9
	28.0	52.7	41230	36.2
45.7 meters	32.0	45.8	34460	32.7
	36.0	37.6	27210	25.2
	40.0	29.2	23130	18.9
	8.7	81.9	197220	47.4
	9.0	81.5	179540	47.4
	10.0	80.3	158470	47.2
	12.0	77.7	128410	46.9
	14.0	75.1	104990	46.4
	16.0	72.5	87140	45.8
	18.0	69.6	74060	45.1
48.8 meters	20.0	67.1	64320	44.3
	24.0	61.5	50280	42.4
	28.0	55.8	40970	39.9
	32.0	49.2	34150	36.8
	36.0	38.2	26880	30.5
	40.0	28.2	21660	20.2
	9.1	81.9	173670	50.5
	10.0	80.9	155710	50.3
	12.0	78.5	125870	50.0
	14.0	76.1	104720	49.5
51.8 meters	16.0	73.6	86570	49.0
	18.0	71.2	73780	48.3
	20.0	68.6	64050	47.6
	24.0	63.5	49990	45.8
	28.0	58.1	40690	43.6
	32.0	52.3	33870	40.8
	36.0	42.6	26590	35.2
	40.0	33.6	21590	27.0
	44.0	25.2	17790	18.2
	9.5	82.0	163080	53.5
54.8 meters	10.0	81.4	153510	53.4
	12.0	79.2	124040	53.1
	14.0	76.9	104370	52.7
	16.0	74.6	86880	52.1
	18.0	72.3	73800	51.5
	20.0	70.0	64080	50.9
	24.0	65.2	50030	49.2
	28.0	60.1	40750	47.1
	32.0	54.9	33920	44.6
	36.0	48.2	26650	39.6
57.9 meters	40.0	39.0	21660	32.6
	44.0	30.0	17500	21.6
	50.0	22.0	17500	21.6
	9.9	82.0	152980	55.5
	10.0	81.9	150950	55.5
	12.0	79.8	123790	55.2
	14.0	77.6	102360	54.8
	16.0	75.5	88620	54.3
	18.0	73.3	73520	54.7
	20.0	71.1	63910	54.1
57.9 meters	24.0	66.6	49740	52.5
	28.0	62.0	40460	50.6
	32.0	57.1	33570	48.2
	36.0	49.2	26350	42.7
	40.0	40.2	21400	37.6
	44.0	29.0	17560	23.6
	50.0	18.4	14050	19.5
	10.3	82.0	142640	59.5
	12.0	80.3	119720	59.3
	14.0	78.3	100500	58.9
57.9 meters	16.0	76.3	86370	58.4
	18.0	74.2	73260	57.9
	20.0	72.1	63530	57.3
	24.0	67.9	49470	55.9
	28.0	63.6	40200	54.0
	32.0	59.0	33380	51.8
	36.0	51.8	26880	47.7

LIFT RATINGS (cont.)

With 94H Tubular Chord Boom

Boom Length (Meters)	Radius In Meters	Boom Angle Degrees	Lift Rating (Kilograms)	Meters From Boom Point To Ground
57.9 meters (cont.)	44.0	43.7	21130	42.2
	50.0	34.1	17310	34.7
	56.0	21.1	13320	23.0
58.0 meters	10.7	82.0	134750	62.6
	12.0	80.8	117110	52.4
	14.0	79.9	98570	42.0
	16.0	77.0	85290	31.6
	18.0	75.0	72570	21.1
	20.0	73.1	63260	10.6
	24.0	69.1	49170	5.9
	28.0	65.0	39290	3.4
	32.0	60.7	33050	1.4
	36.0	54.0	25760	0.5
	44.0	45.5	20820	0.2
	50.0	38.2	17010	0.1
64.0 meters	56.0	27.7	14080	0.0
	60.0	17.7	10450	0.0
	11.2	82.0	126930	25.6
	12.0	81.3	116990	25.4
	14.0	79.4	96970	25.1
	16.0	77.6	83630	24.7
	18.0	75.8	72600	24.2
	20.0	73.9	63980	23.7
	24.0	70.1	48870	22.4
	28.0	66.3	39610	20.8
	32.0	62.3	32770	19.3
	36.0	58.0	28470	17.2
67.1 meters	44.0	49.2	20540	10.6
	50.0	41.5	16720	8.6
	56.0	33.5	13770	6.6
	62.0	28.2	9770	4.3
	64.0	14.0	7850	1.7
	11.6	82.0	119550	69.8
	12.0	81.7	115540	68.5
	14.0	79.9	99780	68.2
	16.0	78.2	82560	67.8
	18.0	76.4	71630	67.4
	20.0	74.7	62520	66.8
	24.0	71.1	48820	65.6
70.1 meters	28.0	67.4	35580	64.1
	32.0	63.5	32730	62.3
	36.0	57.7	25440	59.2
	44.0	51.4	20530	54.8
	50.0	44.4	16710	49.1
	56.0	38.5	13760	42.0
	62.0	33.5	10910	32.1
	66.0	17.1	7820	21.9
	12.0	82.0	114240	71.6
	12.0	82.0	113850	71.6
	14.0	80.4	94240	71.3
	16.0	78.7	81110	70.6
73.2 meters	18.0	77.9	70270	70.5
	20.0	75.3	62550	70.0
	24.0	71.5	48530	68.8
	28.0	68.4	39290	67.4
	32.0	64.9	32440	65.7
	36.0	59.3	25140	62.5
	44.0	53.4	20240	55.4
	50.0	45.9	16420	53.4
	56.0	39.7	13470	47.0
	62.0	31.2	10960	38.5
	66.0	19.6	7180	25.7
	70.0	13.7	5600	18.5

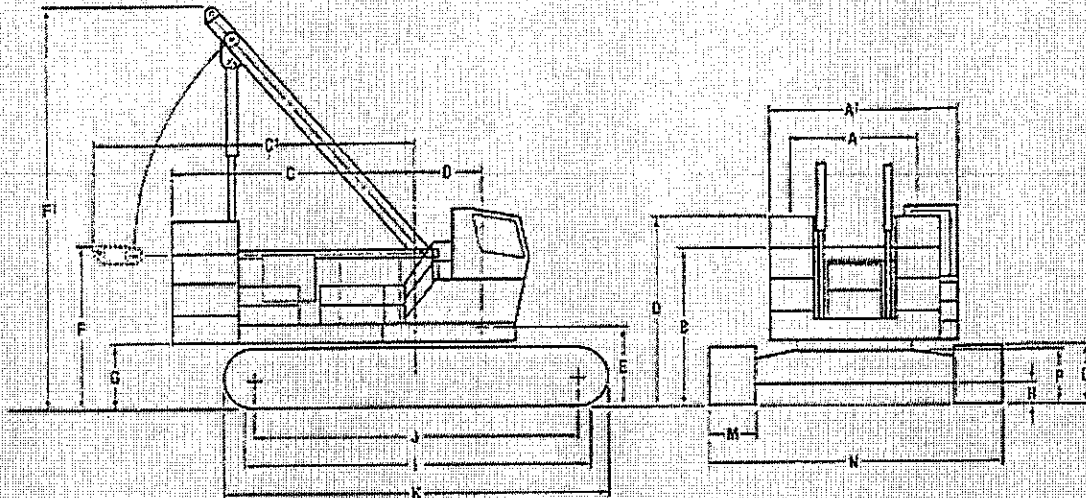
Boom Length (Meters)	Radius In Meters	Boom Angle Degrees	Lift Rating (Kilograms)	Meters From Boom Point To Ground
73.2 meters (cont.)	44.0	55.1	19970	52.2
	50.0	45.4	16150	47.5
	56.0	42.5	13150	41.1
	62.0	25.0	10950	33.7
	68.0	25.5	7620	23.1
76.2 meters	72.0	16.7	5160	15.0
	12.6	82.1	102460	77.7
	14.0	81.1	92390	77.5
	16.0	79.6	78420	77.1
	18.0	78.1	66570	76.7
	20.0	76.5	56460	76.3
	24.0	73.4	47660	75.2
	28.0	70.2	39730	73.9
	32.0	67.0	31860	72.3
	36.0	62.0	24550	69.5
	44.0	56.7	19660	65.9
	50.0	51.1	15840	61.5
79.2 meters	56.0	45.0	12690	56.1
	62.0	38.2	10530	49.3
	68.0	30.0	7660	40.3
	74.0	19.0	4520	26.9
	76.0	13.4	3210	19.9
	13.2	82.1	97090	80.7
	14.0	81.5	91030	80.6
	16.0	80.0	77150	80.2
	18.0	78.5	67450	79.9
	20.0	77.1	59310	79.4
	24.0	74.1	49980	78.8
	28.0	71.0	39450	77.1
82.3 meters	32.0	67.9	31550	75.5
	36.0	63.2	24260	72.9
	44.0	58.2	19390	69.2
	50.0	52.9	15560	65.4
	56.0	47.2	12660	60.3
	62.0	40.9	10250	54.1
	68.0	33.7	7530	48.1
	74.0	24.7	4810	35.3
	76.0	16.2	2740	24.3
	13.6	82.1	80930	85.7
	14.0	81.8	80910	85.6
	16.0	80.4	75280	83.3
85.3 meters	18.0	79.0	66980	83.0
	20.0	77.6	58540	82.5
	24.0	74.7	48300	81.6
	28.0	71.9	38360	80.3
	32.0	68.9	31490	78.9
	36.0	64.2	24170	76.3
	44.0	59.5	19320	73.1
	50.0	54.5	15490	69.2
	56.0	49.1	12550	64.4
	62.0	43.3	10190	58.6
	68.0	35.8	7620	51.4
	74.0	28.4	5160	42.1
85.3 meters (cont.)	80.0	18.4	2520	28.2
	82.0	13.7	1410	21.0
	14.0	82.1	76470	86.7
	16.0	80.7	70990	86.4
	18.0	79.4	65330	85.1
	20.0	78.0	57450	83.7
	24.0	75.2	46240	84.7
	28.0	72.4	37850	83.6
	32.0	69.5	31200	82.2
	36.0	65.2	23670	79.7
	44.0	60.7	19040	76.6
	50.0	55.9	15200	72.9
85.3 meters (cont.)	56.0	50.9	12250	68.4
	62.0	45.4	9750	63.0
	68.0	39.4	7260	56.4
	74.0	32.5	4970	48.1
	80.0	23.9	2690	36.8
	84.0	15.6	940	25.5

BOOM AND JIB ERECTION

Boom Length	No. 75H Jib Length
280	0
250	40
240	60
230	90
220	110

Boom Length	No. 75H Jib Length
35.3 m	0 m
76.2 m	12.2 m
73.2 m	18.3 m
70.1 m	27.4 m
67.1 m	33.5 m

MODEL 11320 LIFT CRANE



GENERAL DIMENSIONS

	FL	MM		FL	MM
A. Width of cab	11'4"	3454	I. Crawler bearing length.....	29'9"	9068
A'. Width over counterweight	15'0"	4572	J. Center to center crawler tumbler	28'7/8"	8557
B. Height over cab	13'9"	4191	K. Over-all length of crawlers	33'0"	10058
C. Tailswing	20'11"	6375	L. Height of crawler track.....	5'2"	1575
C'. Tailswing with A-frame lowered	27'4-1/2"	8344	M. Width of tread shoes (standard)	50"	1270
D. Center of pivot to center of crane boom foot.....	5'10"	1778	M'. Width of tread shoes (optional)	60"	1524
E. Ground to center of crane boom foot.....	7'2"	2184	N. Over-all width over crawlers, 50" (1270 mm) shoes	25'11"	7899
F. Height over A-frame in retracted position.....	14'5"	4394	N'. Over-all width over crawlers, 60" (1524 mm) shoes	26'9"	8153
F'. Height over A-frame in raised position	34'10"	10617	P. Ground to bottom of turntable bearing	4'-11-5/8"	1514
G. Ground to bottom of counterweight.....	5'10"	1778	Q. Ground to top of counterweight.....	16'5-1/2"	5017
H. Ground clearance under carbody.....	1'11"	584			

NOTE: In accordance with our established policy of constant product improvement and varying material conditions, these specifications are subject to change without notice and without incurring responsibility for machines previously sold.

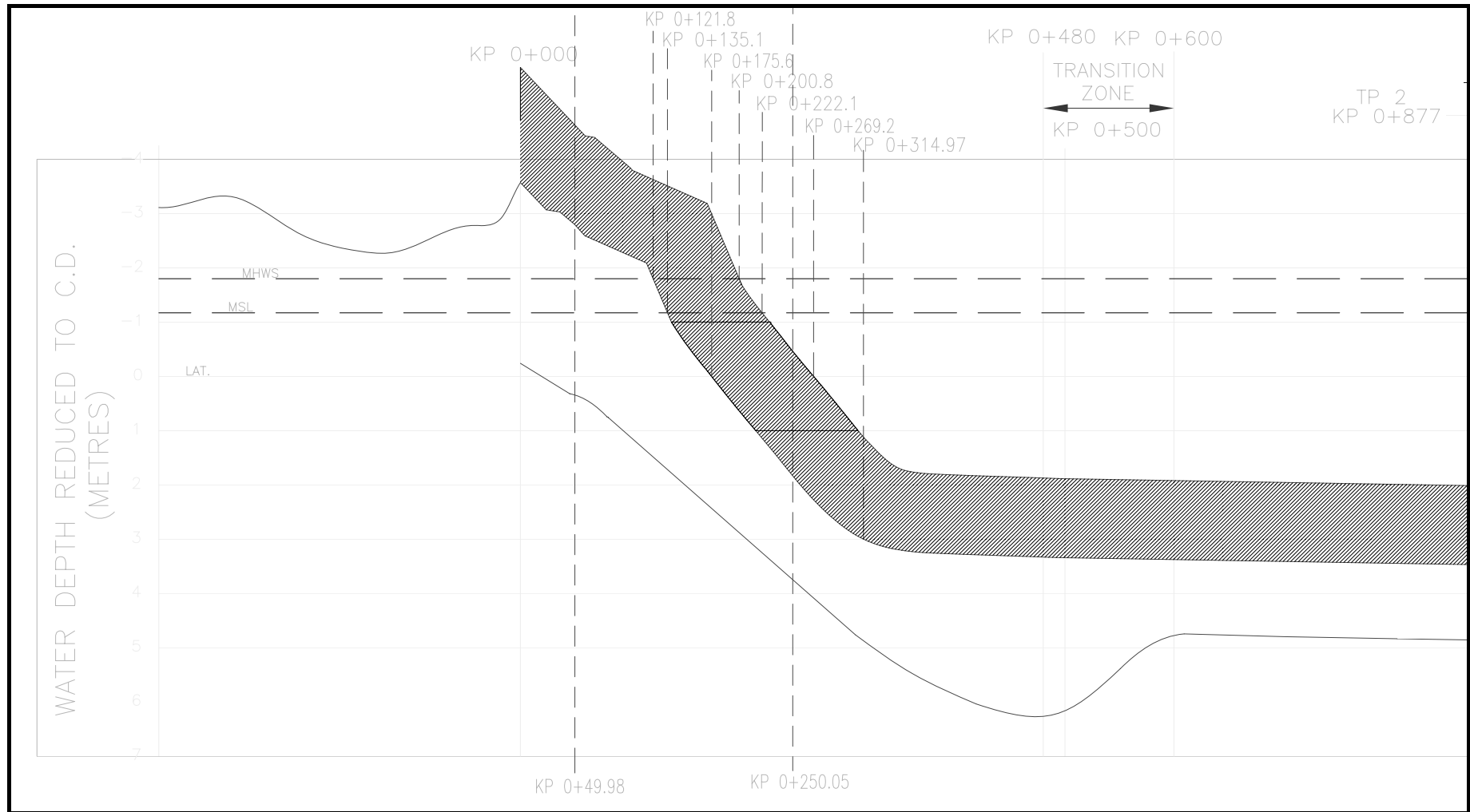
GROUND PRESSURE

11320 Lifting Crane with maximum counterweight and 70 ft. (21.3 m) basic boom:

	Lb./ft ²	kPa
50" (1270 mm) shoes.....	18.1	124.79
60" (1524 mm) shoes.....	15.3	105.48

APPENDIX C SHORE APPROACH ANALYTICAL CALCULATION AND PIPE INSTALLATION

ATTACHMENT C SHORE APPROACH ANALYTICAL CALCULATION AND PIPE INSTALLATION



Shore Pull Force CONTINUOUS Pipe Laying

LAT

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.176	Kp
Transition area end	0.27	Kp

Pipe head	Stinger tip	Touch Down Point	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	61	43
0.236	0.356	0.296	60.0	70	49
0.230	0.362	0.302	60.0	79	55
0.224	0.368	0.308	60.0	88	62
0.218	0.374	0.314	60.0	98	68
0.212	0.381	0.321	60.0	107	75
0.205	0.387	0.327	60.0	116	81
0.199	0.393	0.333	60.0	125	88
0.193	0.399	0.339	60.0	134	94
0.187	0.405	0.345	60.0	144	100
0.181	0.411	0.351	60.0	153	107
0.175	0.417	0.357	60.0	157	110
0.169	0.423	0.363	60.0	171	120
0.163	0.429	0.369	60.0	186	130
0.157	0.435	0.375	60.0	200	140
0.151	0.442	0.382	60.0	215	150
0.144	0.448	0.388	60.0	229	160
0.138	0.454	0.394	60.0	243	170
0.132	0.460	0.400	60.0	258	180
0.126	0.466	0.406	60.0	272	190
0.120	0.472	0.412	60.0	287	201
0.114	0.478	0.418	60.0	301	211
0.108	0.484	0.424	60.0	315	221
0.102	0.490	0.430	60.0	330	231
0.096	0.496	0.436	60.0	344	241
0.090	0.503	0.443	60.0	359	251
0.083	0.509	0.449	60.0	373	261
0.077	0.515	0.455	60.0	387	271
0.071	0.521	0.461	60.0	402	281
0.065	0.527	0.467	60.0	416	291
0.059	0.533	0.473	60.0	430	301
0.053	0.539	0.479	60.0	445	311
0.047	0.545	0.485	60.0	459	321
0.041	0.551	0.491	60.0	474	332
0.035	0.557	0.497	60.0	488	342
0.029	0.564	0.504	60.0	502	352
0.022	0.570	0.510	60.0	517	362
0.016	0.576	0.516	60.0	531	372

Shore Pull Force CONTINUOUS Pipe Laying plus extra buoyancy

LAT

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
Buoyancy	2034	Kg/m
Total weight of Submerged Joint	2440	Kg/Joint
Transition area begin	0.176	Kp
Transition area end	0.27	Kp

Pipe head	Stinger tip	Touch Down Point	Layback from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	57	40
0.236	0.356	0.296	60.0	65	45
0.230	0.362	0.302	60.0	73	51
0.224	0.368	0.308	60.0	81	56
0.218	0.374	0.314	60.0	89	62
0.212	0.381	0.321	60.0	97	68
0.205	0.387	0.327	60.0	105	73
0.199	0.393	0.333	60.0	113	79
0.193	0.399	0.339	60.0	121	85
0.187	0.405	0.345	60.0	129	90
0.181	0.411	0.351	60.0	137	96
0.175	0.417	0.357	60.0	140	98
0.169	0.423	0.363	60.0	154	108
0.163	0.429	0.369	60.0	168	117
0.157	0.435	0.375	60.0	181	127
0.151	0.442	0.382	60.0	195	136
0.144	0.448	0.388	60.0	209	146
0.138	0.454	0.394	60.0	222	156
0.132	0.460	0.400	60.0	236	165
0.126	0.466	0.406	60.0	249	175
0.120	0.472	0.412	60.0	263	184
0.114	0.478	0.418	60.0	277	194
0.108	0.484	0.424	60.0	290	203
0.102	0.490	0.430	60.0	304	213
0.096	0.496	0.436	60.0	318	222
0.090	0.503	0.443	60.0	331	232
0.083	0.509	0.449	60.0	345	241
0.077	0.515	0.455	60.0	358	251
0.071	0.521	0.461	60.0	372	260
0.065	0.527	0.467	60.0	386	270
0.059	0.533	0.473	60.0	399	280
0.053	0.539	0.479	60.0	413	289
0.047	0.545	0.485	60.0	427	299
0.041	0.551	0.491	60.0	440	308
0.035	0.557	0.497	60.0	454	318
0.029	0.564	0.504	60.0	467	327
0.022	0.570	0.510	60.0	481	337
0.016	0.576	0.516	60.0	495	346

Shore Pull Force FIXED LENGTH of Pipe String

LAT

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.176	Kp
Transition area end	0.27	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	450	315
0.025	0.295	0.355	60.0	440	308
0.031	0.301	0.361	60.0	430	301
0.037	0.307	0.367	60.0	420	294
0.043	0.313	0.373	60.0	410	287
0.050	0.320	0.380	60.0	400	280
0.056	0.326	0.386	60.0	390	273
0.062	0.332	0.392	60.0	380	266
0.068	0.338	0.398	60.0	370	259
0.074	0.344	0.404	60.0	360	252
0.080	0.350	0.410	60.0	350	245
0.086	0.356	0.416	60.0	340	238
0.092	0.362	0.422	60.0	330	231
0.098	0.368	0.428	60.0	320	224
0.104	0.374	0.434	60.0	310	217
0.111	0.381	0.441	60.0	300	210
0.117	0.387	0.447	60.0	290	203
0.123	0.393	0.453	60.0	280	196
0.129	0.399	0.460	61.0	270	189
0.135	0.405	0.467	62.0	260	182
0.141	0.411	0.474	63.0	250	175
0.147	0.417	0.481	64.0	240	168
0.153	0.423	0.488	65.0	230	161
0.159	0.429	0.495	66.0	220	154

Shore Pull Force FIXED LENGTH of Pipe String plus extra buoyancy

LAT

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m
Transition area begin	0.176	Kp
Transition area end	0.27	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	441	309
0.025	0.295	0.355	60.0	431	301
0.031	0.301	0.361	60.0	420	294
0.037	0.307	0.367	60.0	409	286
0.043	0.313	0.373	60.0	398	279
0.050	0.320	0.380	60.0	388	271
0.056	0.326	0.386	60.0	377	264
0.062	0.332	0.392	60.0	366	256
0.068	0.338	0.398	60.0	355	249
0.074	0.344	0.404	60.0	345	241
0.080	0.350	0.410	60.0	334	234
0.086	0.356	0.416	60.0	323	226
0.092	0.362	0.422	60.0	312	219
0.098	0.368	0.428	60.0	302	211
0.104	0.374	0.434	60.0	291	204
0.111	0.381	0.441	60.0	280	196
0.117	0.387	0.447	60.0	269	189
0.123	0.393	0.453	60.0	259	181
0.129	0.399	0.460	61.0	248	174
0.135	0.405	0.467	62.0	237	166
0.141	0.411	0.474	63.0	227	159
0.147	0.417	0.481	64.0	216	151
0.153	0.423	0.488	65.0	205	144
0.159	0.429	0.495	66.0	194	136

Shore Pull Force CONTINUOUS Pipe Laying

MSL

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.135	Kp
Transition area end	0.221	Kp

Pipe head	Stinger tip	Touch Down Point	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	37	26
0.236	0.356	0.296	60.0	41	29
0.230	0.362	0.302	60.0	45	31
0.224	0.368	0.308	60.0	49	34
0.218	0.374	0.314	60.0	56	39
0.212	0.381	0.321	60.0	65	45
0.205	0.387	0.327	60.0	74	52
0.199	0.393	0.333	60.0	83	58
0.193	0.399	0.339	60.0	93	65
0.187	0.405	0.345	60.0	102	71
0.181	0.411	0.351	60.0	111	78
0.175	0.417	0.357	60.0	120	84
0.169	0.423	0.363	60.0	129	90
0.163	0.429	0.369	60.0	138	97
0.157	0.435	0.375	60.0	148	103
0.151	0.442	0.382	60.0	157	110
0.144	0.448	0.388	60.0	166	116
0.138	0.454	0.394	60.0	175	123
0.132	0.460	0.400	60.0	183	128
0.126	0.466	0.406	60.0	197	138
0.120	0.472	0.412	60.0	212	148
0.114	0.478	0.418	60.0	226	158
0.108	0.484	0.424	60.0	240	168
0.102	0.490	0.430	60.0	255	178
0.096	0.496	0.436	60.0	269	188
0.090	0.503	0.443	60.0	284	199
0.083	0.509	0.449	60.0	298	209
0.077	0.515	0.455	60.0	312	219
0.071	0.521	0.461	60.0	327	229
0.065	0.527	0.467	60.0	341	239
0.059	0.533	0.473	60.0	356	249
0.053	0.539	0.479	60.0	370	259
0.047	0.545	0.485	60.0	384	269
0.041	0.551	0.491	60.0	399	279
0.035	0.557	0.497	60.0	413	289
0.029	0.564	0.504	60.0	428	299
0.022	0.570	0.510	60.0	442	309
0.016	0.576	0.516	60.0	456	319

Shore Pull Force CONTINUOUS Pipe Laying plus extra buoyancy

MSL

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m
Transition area begin	0.135	Kp
Transition area end	0.221	Kp

Pipe head	Stinger tip	Touch Down Point	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	31	22
0.236	0.356	0.296	60.0	33	23
0.230	0.362	0.302	60.0	36	25
0.224	0.368	0.308	60.0	38	27
0.218	0.374	0.314	60.0	44	31
0.212	0.381	0.321	60.0	52	36
0.205	0.387	0.327	60.0	60	42
0.199	0.393	0.333	60.0	68	48
0.193	0.399	0.339	60.0	76	53
0.187	0.405	0.345	60.0	84	59
0.181	0.411	0.351	60.0	92	64
0.175	0.417	0.357	60.0	100	70
0.169	0.423	0.363	60.0	108	76
0.163	0.429	0.369	60.0	116	81
0.157	0.435	0.375	60.0	124	87
0.151	0.442	0.382	60.0	132	93
0.144	0.448	0.388	60.0	140	98
0.138	0.454	0.394	60.0	148	104
0.132	0.460	0.400	60.0	155	109
0.126	0.466	0.406	60.0	169	118
0.120	0.472	0.412	60.0	182	128
0.114	0.478	0.418	60.0	196	137
0.108	0.484	0.424	60.0	210	147
0.102	0.490	0.430	60.0	223	156
0.096	0.496	0.436	60.0	237	166
0.090	0.503	0.443	60.0	251	175
0.083	0.509	0.449	60.0	264	185
0.077	0.515	0.455	60.0	278	194
0.071	0.521	0.461	60.0	291	204
0.065	0.527	0.467	60.0	305	214
0.059	0.533	0.473	60.0	319	223
0.053	0.539	0.479	60.0	332	233
0.047	0.545	0.485	60.0	346	242
0.041	0.551	0.491	60.0	360	252
0.035	0.557	0.497	60.0	373	261
0.029	0.564	0.504	60.0	387	271
0.022	0.570	0.510	60.0	400	280
0.016	0.576	0.516	60.0	414	290

Shore Pull Force FIXED LENGTH of Pipe String

MSL

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.135	Kp
Transition area end	0.221	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	373	261
0.025	0.295	0.355	60.0	363	254
0.031	0.301	0.361	60.0	353	247
0.037	0.307	0.367	60.0	343	240
0.043	0.313	0.373	60.0	333	233
0.050	0.320	0.380	60.0	323	226
0.056	0.326	0.386	60.0	313	219
0.062	0.332	0.392	60.0	303	212
0.068	0.338	0.398	60.0	293	205
0.074	0.344	0.404	60.0	283	198
0.080	0.350	0.410	60.0	273	191
0.086	0.356	0.416	60.0	263	184
0.092	0.362	0.422	60.0	253	177
0.098	0.368	0.428	60.0	243	170
0.104	0.374	0.434	60.0	233	163
0.111	0.381	0.441	60.0	223	156
0.117	0.387	0.447	60.0	213	149
0.123	0.393	0.453	60.0	203	142
0.129	0.399	0.460	61.0	193	135
0.135	0.405	0.467	62.0	183	128
0.141	0.411	0.474	63.0	178	125
0.147	0.417	0.481	64.0	174	122
0.153	0.423	0.488	65.0	169	118
0.159	0.429	0.495	66.0	164	115

Shore Pull Force FIXED LENGTH of Pipe String plus extra buoyancy

MSL

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m
Transition area begin	0.135	Kp
Transition area end	0.221	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	359	251
0.025	0.295	0.355	60.0	348	244
0.031	0.301	0.361	60.0	337	236
0.037	0.307	0.367	60.0	327	229
0.043	0.313	0.373	60.0	316	221
0.050	0.320	0.380	60.0	305	214
0.056	0.326	0.386	60.0	294	206
0.062	0.332	0.392	60.0	284	199
0.068	0.338	0.398	60.0	273	191
0.074	0.344	0.404	60.0	262	183
0.080	0.350	0.410	60.0	251	176
0.086	0.356	0.416	60.0	241	168
0.092	0.362	0.422	60.0	230	161
0.098	0.368	0.428	60.0	219	153
0.104	0.374	0.434	60.0	208	146
0.111	0.381	0.441	60.0	198	138
0.117	0.387	0.447	60.0	187	131
0.123	0.393	0.453	60.0	176	123
0.129	0.399	0.460	61.0	165	116
0.135	0.405	0.467	62.0	155	108
0.141	0.411	0.474	63.0	150	105
0.147	0.417	0.481	64.0	144	101
0.153	0.423	0.488	65.0	139	97
0.159	0.429	0.495	66.0	134	94

Shore Pull Force CONTINUOUS Pipe Laying

MHWN

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.128	Kp
Transition area end	0.209	Kp

Pipe head	Stinger tip	Touch Down Point	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.207	0.315	0.255	60.0	36	25
0.201	0.321	0.261	60.0	45	32
0.195	0.327	0.267	60.0	55	38
0.189	0.333	0.273	60.0	64	45
0.183	0.339	0.279	60.0	73	51
0.177	0.346	0.286	60.0	82	57
0.170	0.352	0.292	60.0	91	64
0.164	0.358	0.298	60.0	100	70
0.158	0.364	0.304	60.0	110	77
0.152	0.370	0.310	60.0	119	83
0.146	0.376	0.316	60.0	128	90
0.140	0.382	0.322	60.0	137	96
0.134	0.388	0.328	60.0	146	102
0.128	0.394	0.334	60.0	149	104
0.122	0.400	0.340	60.0	163	114
0.116	0.407	0.347	60.0	178	124
0.109	0.413	0.353	60.0	192	135
0.103	0.419	0.359	60.0	207	145
0.097	0.425	0.365	60.0	221	155
0.091	0.431	0.371	60.0	235	165
0.085	0.437	0.377	60.0	250	175
0.079	0.443	0.383	60.0	264	185
0.073	0.449	0.389	60.0	279	195
0.067	0.455	0.395	60.0	293	205
0.061	0.461	0.401	60.0	307	215
0.055	0.468	0.408	60.0	322	225
0.048	0.474	0.414	60.0	336	235
0.042	0.480	0.420	60.0	351	245
0.036	0.486	0.426	60.0	365	255
0.030	0.492	0.432	60.0	379	266
0.024	0.498	0.438	60.0	394	276
0.018	0.504	0.444	60.0	408	286
0.012	0.510	0.450	60.0	423	296
0.006	0.516	0.456	60.0	437	306
0.000	0.522	0.462	60.0	451	316

Shore Pull Force CONTINUOUS Pipe Laying plus extra buoyancy

MHWN

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m
Transition area begin	0.128	Kp
Transition area end	0.209	Kp

Pipe head	Stinger tip	Touch Down Point	Layback from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.207	0.315	0.255	60.0	30	21
0.201	0.321	0.261	60.0	38	27
0.195	0.327	0.267	60.0	46	32
0.189	0.333	0.273	60.0	54	38
0.183	0.339	0.279	60.0	62	44
0.177	0.346	0.286	60.0	70	49
0.170	0.352	0.292	60.0	78	55
0.164	0.358	0.298	60.0	86	61
0.158	0.364	0.304	60.0	94	66
0.152	0.370	0.310	60.0	103	72
0.146	0.376	0.316	60.0	111	77
0.140	0.382	0.322	60.0	119	83
0.134	0.388	0.328	60.0	127	89
0.128	0.394	0.334	60.0	128	90
0.122	0.400	0.340	60.0	142	99
0.116	0.407	0.347	60.0	156	109
0.109	0.413	0.353	60.0	169	119
0.103	0.419	0.359	60.0	183	128
0.097	0.425	0.365	60.0	197	138
0.091	0.431	0.371	60.0	210	147
0.085	0.437	0.377	60.0	224	157
0.079	0.443	0.383	60.0	237	166
0.073	0.449	0.389	60.0	251	176
0.067	0.455	0.395	60.0	265	185
0.061	0.461	0.401	60.0	278	195
0.055	0.468	0.408	60.0	292	204
0.048	0.474	0.414	60.0	306	214
0.042	0.480	0.420	60.0	319	223
0.036	0.486	0.426	60.0	333	233
0.030	0.492	0.432	60.0	346	243
0.024	0.498	0.438	60.0	360	252
0.018	0.504	0.444	60.0	374	262
0.012	0.510	0.450	60.0	387	271
0.006	0.516	0.456	60.0	401	281
0.000	0.522	0.462	60.0	415	290

Shore Pull Force FIXED LENGTH of Pipe String

MHWN

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of Submerged Joint	3977	Kg/Joint
	326	Kg/m
Transition area begin	0.128	Kp
Transition area end	0.209	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	357	250
0.025	0.295	0.355	60.0	347	243
0.031	0.301	0.361	60.0	337	236
0.037	0.307	0.367	60.0	327	229
0.043	0.313	0.373	60.0	317	222
0.050	0.320	0.380	60.0	307	215
0.056	0.326	0.386	60.0	297	208
0.062	0.332	0.392	60.0	287	201
0.068	0.338	0.398	60.0	277	194
0.074	0.344	0.404	60.0	267	187
0.080	0.350	0.410	60.0	257	180
0.086	0.356	0.416	60.0	247	173
0.092	0.362	0.422	60.0	237	166
0.098	0.368	0.428	60.0	227	159
0.104	0.374	0.434	60.0	217	152
0.111	0.381	0.441	60.0	207	145
0.117	0.387	0.447	60.0	197	138
0.123	0.393	0.453	60.0	187	131
0.129	0.399	0.460	61.0	178	124
0.135	0.405	0.467	62.0	173	121
0.141	0.411	0.474	63.0	168	118
0.147	0.417	0.481	64.0	163	114
0.153	0.423	0.488	65.0	159	111
0.159	0.429	0.495	66.0	154	108

Shore Pull Force FIXED LENGTH of Pipe String plus extra buoyancy

MHWN

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Total weight of Joint in Air	24815	Kg/Joint
	2034	Kg/m
Buoyancy		Kg/m
Total weight of Submerged Joint	2440	Kg/Joint
	200	Kg/m
Transition area begin	0.128	Kp
Transition area end	0.209	Kp
String length to TDP	0.27	Kp

Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	341	239
0.025	0.295	0.355	60.0	331	231
0.031	0.301	0.361	60.0	320	224
0.037	0.307	0.367	60.0	309	216
0.043	0.313	0.373	60.0	298	209
0.050	0.320	0.380	60.0	288	201
0.056	0.326	0.386	60.0	277	194
0.062	0.332	0.392	60.0	266	186
0.068	0.338	0.398	60.0	255	179
0.074	0.344	0.404	60.0	245	171
0.080	0.350	0.410	60.0	234	164
0.086	0.356	0.416	60.0	223	156
0.092	0.362	0.422	60.0	212	149
0.098	0.368	0.428	60.0	202	141
0.104	0.374	0.434	60.0	191	134
0.111	0.381	0.441	60.0	180	126
0.117	0.387	0.447	60.0	169	119
0.123	0.393	0.453	60.0	159	111
0.129	0.399	0.460	61.0	149	104
0.135	0.405	0.467	62.0	144	101
0.141	0.411	0.474	63.0	138	97
0.147	0.417	0.481	64.0	133	93
0.153	0.423	0.488	65.0	128	90
0.159	0.429	0.495	66.0	123	86

Shore Pull Force CONTINUOUS Pipe Laying

LAT Pre-Trenched Cofferdam

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Semi-Submerged Joint	791	Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m
Transition area begin	0.24	Kp
Transition area end	0.259	Kp

Pipe head	Stinger tip	Touch Down Point	Lay/Back from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	41	29
0.236	0.356	0.296	60.0	46	32
0.230	0.362	0.302	60.0	53	37
0.224	0.368	0.308	60.0	60	42
0.218	0.374	0.314	60.0	67	47
0.212	0.381	0.321	60.0	73	51
0.205	0.387	0.327	60.0	80	56
0.199	0.393	0.333	60.0	87	61
0.193	0.399	0.339	60.0	94	66
0.187	0.405	0.345	60.0	101	70
0.181	0.411	0.351	60.0	107	75
0.175	0.417	0.357	60.0	114	80
0.169	0.423	0.363	60.0	121	85
0.163	0.429	0.369	60.0	128	90
0.157	0.435	0.375	60.0	135	94
0.151	0.442	0.382	60.0	142	99
0.144	0.448	0.388	60.0	148	104
0.138	0.454	0.394	60.0	155	109
0.132	0.460	0.400	60.0	162	113
0.126	0.466	0.406	60.0	169	118
0.120	0.472	0.412	60.0	176	123
0.114	0.478	0.418	60.0	182	128
0.108	0.484	0.424	60.0	189	132
0.102	0.490	0.430	60.0	196	137
0.096	0.496	0.436	60.0	203	142
0.090	0.503	0.443	60.0	210	147
0.083	0.509	0.449	60.0	216	152
0.077	0.515	0.455	60.0	223	156
0.071	0.521	0.461	60.0	230	161
0.065	0.527	0.467	60.0	237	166
0.059	0.533	0.473	60.0	244	171
0.053	0.539	0.479	60.0	251	175
0.047	0.545	0.485	60.0	257	180
0.041	0.551	0.491	60.0	264	185
0.035	0.557	0.497	60.0	271	190
0.029	0.564	0.504	60.0	278	194
0.022	0.570	0.510	60.0	285	199
0.016	0.576	0.516	60.0	291	204

Shore Pull Force CONTINUOUS Pipe Laying plus extra buoyancy

LAT Pre-Trenched Cofferdam

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m
Semi-Submerged Joint	791	Kg/m
Buoyancy		Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m
Transition area begin	0.24	Kp
Transition area end	0.259	Kp

Pipe head	Stinger tip	Touch Down Point	Layback from stinger tip	Pull force [Ton]	
				Longitudinal friction factor	
Kp	Kp	Kp	[m]	1	0.70
0.242	0.350	0.290	60.0	36	25
0.236	0.356	0.296	60.0	40	28
0.230	0.362	0.302	60.0	46	33
0.224	0.368	0.308	60.0	52	37
0.218	0.374	0.314	60.0	59	41
0.212	0.381	0.321	60.0	65	45
0.205	0.387	0.327	60.0	71	49
0.199	0.393	0.333	60.0	77	54
0.193	0.399	0.339	60.0	83	58
0.187	0.405	0.345	60.0	89	62
0.181	0.411	0.351	60.0	95	66
0.175	0.417	0.357	60.0	101	71
0.169	0.423	0.363	60.0	107	75
0.163	0.429	0.369	60.0	113	79
0.157	0.435	0.375	60.0	119	83
0.151	0.442	0.382	60.0	125	88
0.144	0.448	0.388	60.0	131	92
0.138	0.454	0.394	60.0	137	96
0.132	0.460	0.400	60.0	143	100
0.126	0.466	0.406	60.0	149	104
0.120	0.472	0.412	60.0	155	109
0.114	0.478	0.418	60.0	161	113
0.108	0.484	0.424	60.0	167	117
0.102	0.490	0.430	60.0	173	121
0.096	0.496	0.436	60.0	179	126
0.090	0.503	0.443	60.0	185	130
0.083	0.509	0.449	60.0	192	134
0.077	0.515	0.455	60.0	198	138
0.071	0.521	0.461	60.0	204	143
0.065	0.527	0.467	60.0	210	147
0.059	0.533	0.473	60.0	216	151
0.053	0.539	0.479	60.0	222	155
0.047	0.545	0.485	60.0	228	159
0.041	0.551	0.491	60.0	234	164
0.035	0.557	0.497	60.0	240	168
0.029	0.564	0.504	60.0	246	172
0.022	0.570	0.510	60.0	252	176
0.016	0.576	0.516	60.0	258	181

Shore Pull Force FIX LENGTH of Pipe String

LAT Pre-Trenched Cofferdam

Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m

Sem- Submerged Joint	791	Kg/m
Buoyancy		Kg/m
Total weight of	3977	Kg/Joint
Submerged Joint	326	Kg/m

Transition area begin	0.24	Kp
Transition area end	0.259	Kp

String length to TDP	0.27	Kp
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Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	208	146
0.025	0.295	0.355	60.0	206	144
0.031	0.301	0.361	60.0	204	143
0.037	0.307	0.367	60.0	201	141
0.043	0.313	0.373	60.0	199	139
0.050	0.320	0.380	60.0	196	138
0.056	0.326	0.386	60.0	194	136
0.062	0.332	0.392	60.0	192	134
0.068	0.338	0.398	60.0	189	132
0.074	0.344	0.404	60.0	187	131
0.080	0.350	0.410	60.0	184	129
0.086	0.356	0.416	60.0	182	127
0.092	0.362	0.422	60.0	180	126
0.098	0.368	0.428	60.0	177	124
0.104	0.374	0.434	60.0	175	122
0.111	0.381	0.441	60.0	172	121
0.117	0.387	0.447	60.0	170	119
0.123	0.393	0.453	60.0	168	117
0.129	0.399	0.460	61.0	165	116
0.135	0.405	0.467	62.0	163	114
0.141	0.411	0.474	63.0	161	112
0.147	0.417	0.481	64.0	158	111
0.153	0.423	0.488	65.0	156	109
0.159	0.429	0.495	66.0	154	107

Shore Pull Force FIX LENGTH of Pipe String plus extra buoyancy

LAT Pre-Trenched Cofferdam

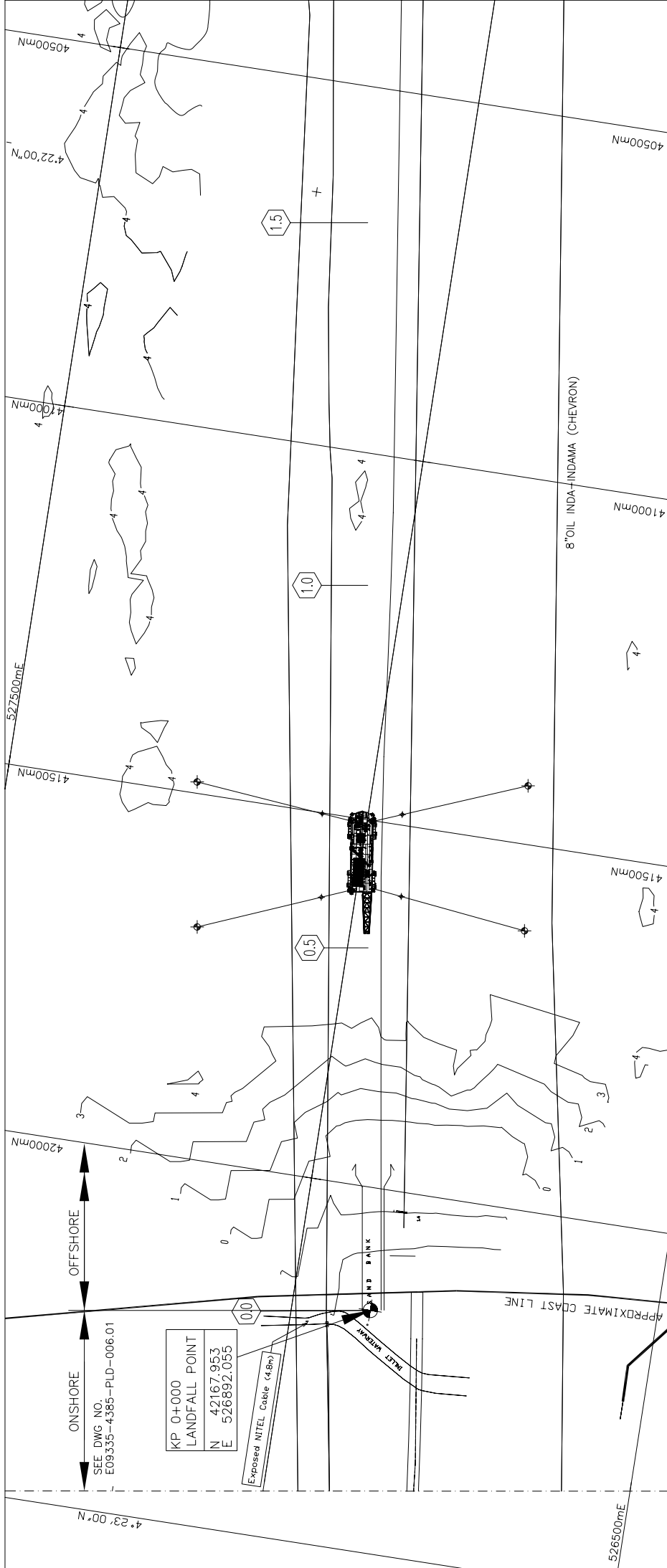
Single Joint length	12.2	m
Longitudinal friction factor	1	
OD	1219.2	mm
Thickness	20.6	mm
Density of steel	7850	Kg/m ³
Bare pipe weight	7429	Kg/joint
Corrosion Coating density	1300	Kg/m ³
External CC thickness	3.7	mm
Corrosion coating Weight	225	Kg/Joint
Concrete coating density	3044	Kg/m ³
Concrete Coating Thickness	115	mm
Concrete coating weight	18000	Kg/Joint
Cable Weight	36	Kg/m
Cable length	1000	m

Semi-Submerged Joint	791	Kg/m
Total weight of	2440	Kg/Joint
Submerged Joint	200	Kg/m

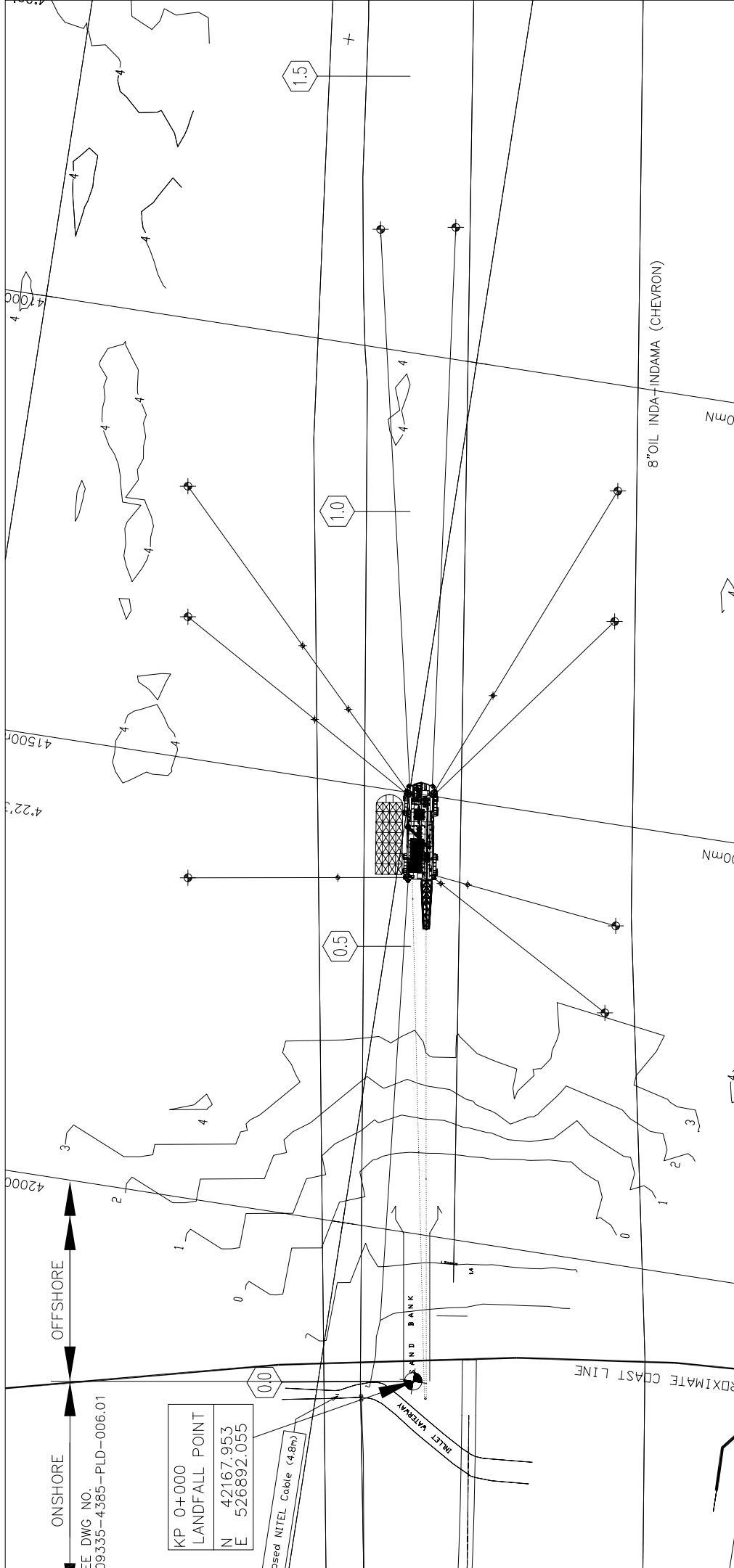
Transition area begin	0.24	Kp
Transition area end	0.259	Kp

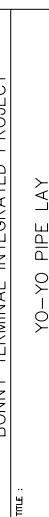
String length to TDP	0.27	Kp
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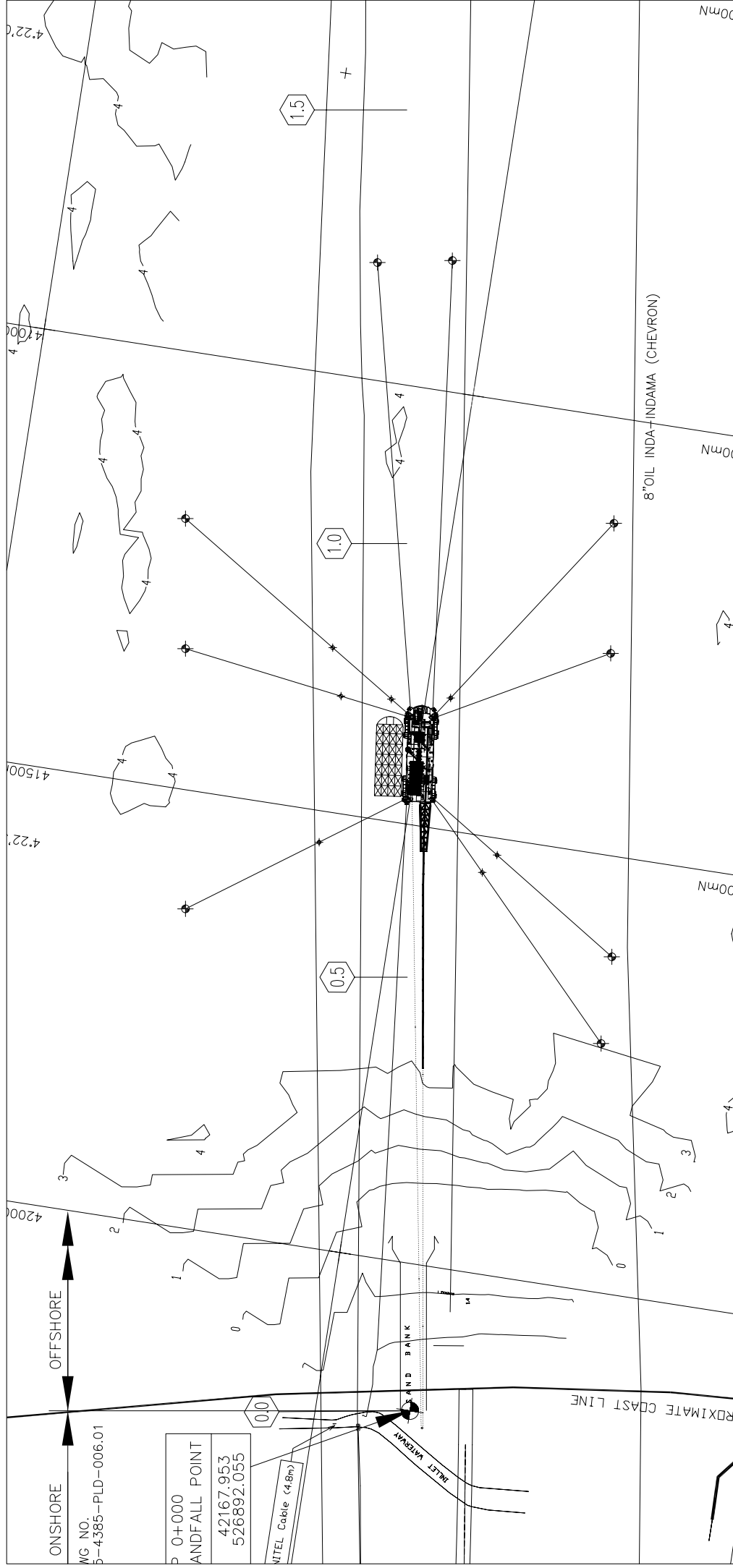
Pipe head	Touch Down Point	Stinger tip	LayBack from stinger tip	Pull force [Ton]	
				Longitudinal Friction Factor	
Kp	Kp	Kp	[m]	1	0.70
0.019	0.289	0.349	60.0	203	142
0.025	0.295	0.355	60.0	200	140
0.031	0.301	0.361	60.0	197	138
0.037	0.307	0.367	60.0	194	136
0.043	0.313	0.373	60.0	191	134
0.050	0.320	0.380	60.0	188	131
0.056	0.326	0.386	60.0	184	129
0.062	0.332	0.392	60.0	181	127
0.068	0.338	0.398	60.0	178	125
0.074	0.344	0.404	60.0	175	122
0.080	0.350	0.410	60.0	172	120
0.086	0.356	0.416	60.0	169	118
0.092	0.362	0.422	60.0	165	116
0.098	0.368	0.428	60.0	162	114
0.104	0.374	0.434	60.0	159	111
0.111	0.381	0.441	60.0	156	109
0.117	0.387	0.447	60.0	153	107
0.123	0.393	0.453	60.0	150	105
0.129	0.399	0.460	61.0	147	103
0.135	0.405	0.467	62.0	143	100
0.141	0.411	0.474	63.0	140	98
0.147	0.417	0.481	64.0	137	96
0.153	0.423	0.488	65.0	134	94
0.159	0.429	0.495	66.0	131	92



GEODETIC PARAMETERS		GENERAL NOTES		HORIZONTAL SCALE		SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED	
HORIZONTAL COORDINATE SYSTEM :		SITUATION 1:		1 : AS SHOWN		HEAVY INDUSTRIES CO., LTD.	
GEODETIC DATUM :		• BARGE IS POSITIONED IN THE START POSITION.		1 : AS SHOWN		WAVentures	
ELIPSOID :		• SLINGS ARE ATTACHED TO THE LAYBARGE		1 : AS SHOWN		West African Ventures Limited	
Semi major axis :		• MSL = 3M AT THE STINGER TIP		1 : AS SHOWN		BONNY TERMINAL INTEGRATED PROJECT	
Inverse flattening :		• LAYBARGE IS MOORED BY NORMAL ANCHOR LAY		1 : AS SHOWN		TITLE :	
PROJECTION :				1 : AS SHOWN		JOB NO.	
Central Meridian (cm) :				1 : AS SHOWN		DRAWING NO.	
False Easting :				1 : AS SHOWN		REV.	
False Northing :				1 : AS SHOWN		C0105	
Scale factor at CM :				1 : AS SHOWN		BTIP-DWG-008-1 of 5	
DATUM TRANSFORMATION :				1 : AS SHOWN		CONTINUOUS PIPELAY	
Source :				1 : AS SHOWN			



SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED HYUNDAI HEAVY INDUSTRIES CO., LTD. WAVentures West African Ventures Limited HOGESCHOOL UTRECHT		BONNY TERMINAL INTEGRATED PROJECT	
JOB NO.		DRAWING NO.	
C0105		BTIP-DWG-008-3 of 8	
REV.		A	
TITLE :		YO-YO PIPE LAY	
SITUATION 3:		GENERAL NOTES	
• JOINTS ARE WELDED TO THE PIPESTRING TILL THE LAYDOWNHEAD ARRIVED AT THE STINGER TIP.		• THE PULLINGWIRE IS CONNECTED TO THE PIPELINEHEAD FROM ONE SIDE AND TO THE LAYBARGE WINCH ON THE OTHER SIDE.	
HORIZONTAL COORDINATE SYSTEM :		GEODETTIC PARAMETERS	
GEODETTIC DATUM		: Minna 1950	
ELLIPSOID		: Clarke 1880	
Semi major axis		: 6378249.145 m	
Inverse flattening		: 293.465	
PROJECTION		: Transverse Mercator Nigerian Mid Belt	
Central Meridian (Cm)		: 8° 30' E	
Latitude of Origin		: 4° N	
False Easting		: 600000 m	
False Northing		: 600000 m	
Scale factor at CM		: 0.99975	
DATUM TRANSFORMATION		: WGS84 to CLARKE 1880	
Source		: Client-supplied	
: dX = 111.916 m, dY = 87.852 m, dZ = -114.499 m		: rX = -1.87527, rY = -0.20214, rZ = -0.21935,	
: scale factor = -0.03245		: Lowest Astronomical Tide (LAT)	



GEODETIC PARAMETERS

HORIZONTAL COORDINATE SYSTEM : :

GEODETIC DATUM : Minna 1950

FLIPPIN · Clarke 1880

Semi major axis : 6378249.145 m

Inverse flattening
: 293.465

PROJECTION

Central Meridian (CM)	Latitude of Origin
: 8° 30' E	: 4° N

False Easting : 670553.98 m
False Northing : 0 000 m

False Normality
Scale factor at CM
: 0.000 m
: 0.99975

DATUM TRANSFORMATION : WGS84 to CLARK

Source
: Client-supplied
: JV - 111 916

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: SX = 111.310
: rX = -1.87527,

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scale factor = -

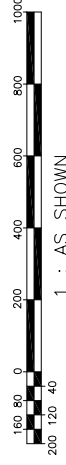
: Lowest Astronomical

SITUATION 4:

- PULLINGWIRE IS TENSIONED AND CLAMPED TO THE LAYBARGE WINCH.
- LAYBARGE HAS MOVED FORWARD AND PIPES ARE WELDED IN FIRE LINE CONSEQUENTLY.
- THE PIPELINE IS PULLED TOWARDS THE BEACH AS DIRECT CONSEQUENCE.

GENERAL NOTES

HORIZONTAL SCALE



1 : AS SHOWN

0
-
0
-
0
-
-

[illegible]

TIME :	
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YO-YO PIPE | AY

JOB NO.	DRAWING NO.
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H C	L C C C
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C0105	BTIP-DWC-008-4 of 8	A
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59133	B III - DWG - 000 + 01 0	A
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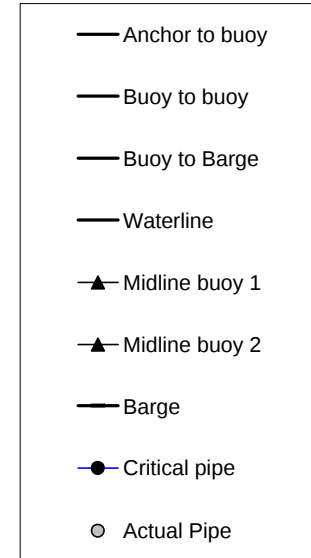
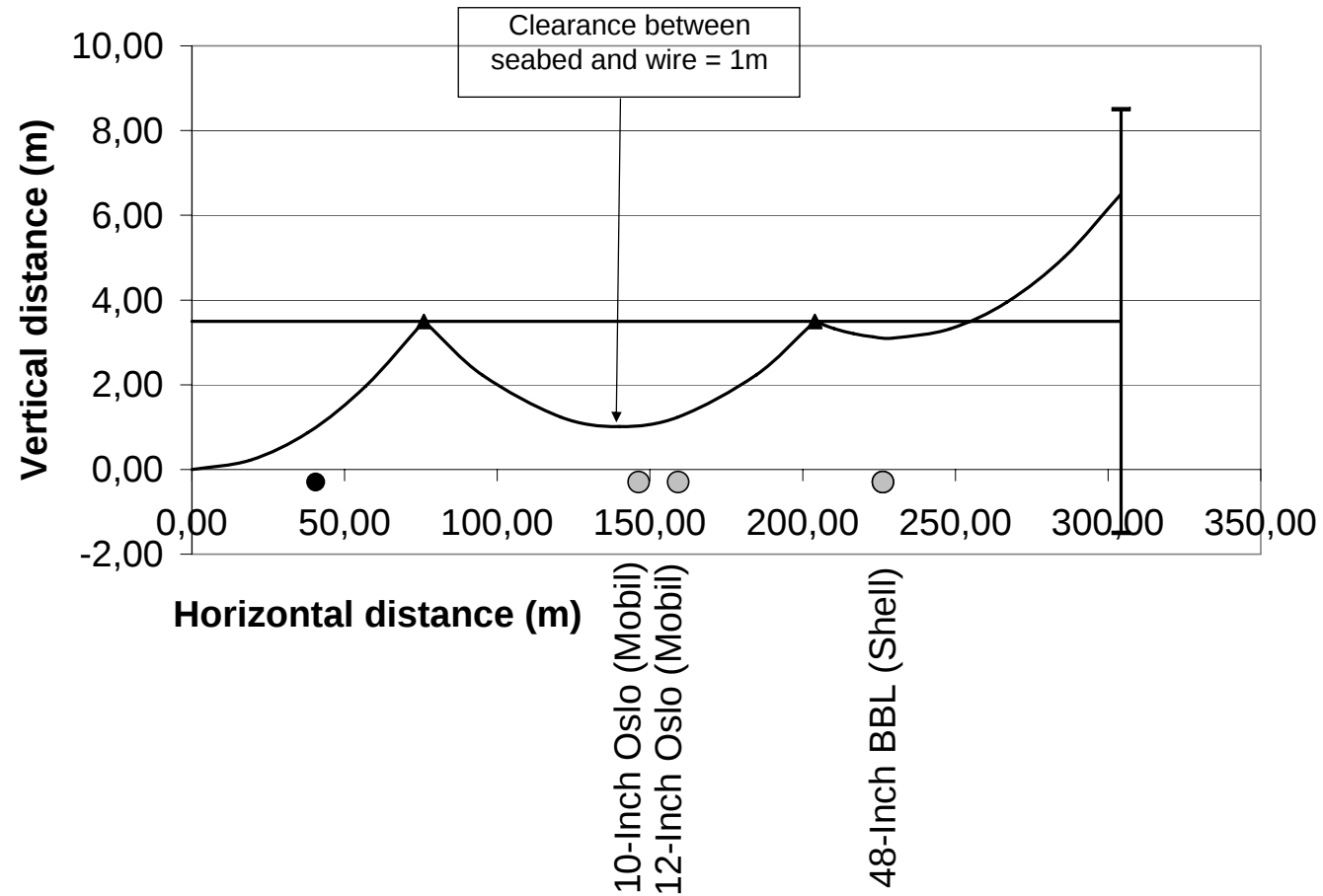
APPENDIX D CATENARIES CALCULATIONS AND DRAWINGS

Field and Project	BTIP	
Barge name	Jascon 30	
Anchor line number	P2 Postlay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	75,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance		
barge to pipeline	158,00	m
barge to pipeline 2	145,00	m
barge to pipeline 3	78,00	m
Distance between first and second buoy	128,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	70 m
Select a distance in excess of	71 m
Enter here your selected value	74,8 m
Distance barge to first buoy	100 m
Distance barge to second buoy	228 m
Distance barge to touch down	304 m
Distance barge to critical pipe	264 m
Minimum req'd distance for anchor drop at max line tension	380 m

10-Inch Oslo
12-Inch Oslo
48-Inch BBL

Catenary with two midline buoys



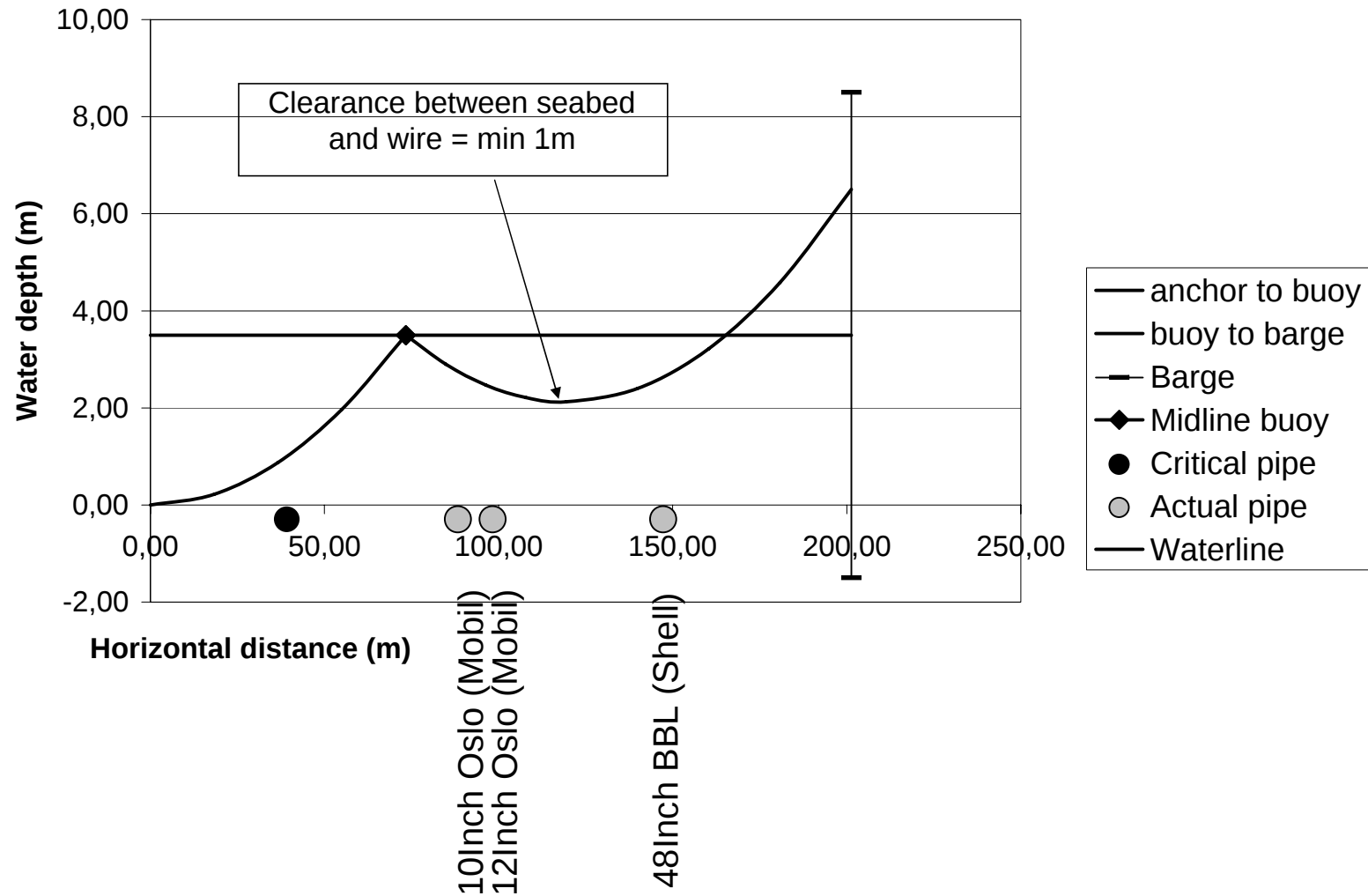
Field and project	BTIP
Barge name	Jascon 30
Anchor line number	P3 Postlay
Water depth	3,5 m
Height of fairlead above water	3 m
Wire data	
Submerged weight	91 N/m
Horizontal tension	70 kN
Midline buoy 1	
Length of pendant	0 m
Vertical clearance with pipeline, etc	1 m
Actual distance barge to pipeline	113,00 m
barge to pipeline 2	103,00 m
barge to pipeline 3	54,00 m
Maximum horizontal wire tension	300 kN

Output	
Choose value in excess of	69 m
Selected value	82 m
and see if catenary is acceptable	
Distance barge to midline buoy	128 m
Distance barge to touch down	201 m
Distance barge to critical pipe	162 m
Minimum req'd distance for anchor drop at maximum line tension	280 m

Note This calculation is based on 1 Buoy, but in reality there would be 2 Buoys and the 2nd Buoy is aprox just above Seawater. There for the 2nd Buoy losses its function

10-inch Oslo
12-Inch Oslo
48-Inch BBL

Anchor catenary with sagging wire



Field and Project BTIP near shore

Barge name Jascon 30

Anchor line number P4 postlay

Water depth 3,50 m

Height of fairlead above water 3,00 m

Wire data

Submerged weight 91,00 N/m

Horizontal tension 70,00 kN

Midline buoys

Length of pendant 0,00 m

Vertical clearance

with pipeline, etc 1,00 m

Actual distance

barge to pipeline 1 170 m

barge to pipeline 2 154 m

barge to pipeline 3 90 m

Distance between

first and second buoy 128,00 m

Maximum horizontal

wire tension 300,00 kN

Output

Minimum distance between barge and
and first midline buoy is 68 m

Select a distance in excess of 68,9 m

Enter here your selected value 82 m

Distance barge to first buoy 128 m

Distance barge to second buoy 256 m

Distance barge to anchor 329 m

Distance barge to critical pipe 290 m

Safe distance barge to anchor

at max line tension 408 m

AUTOMATIC Comment

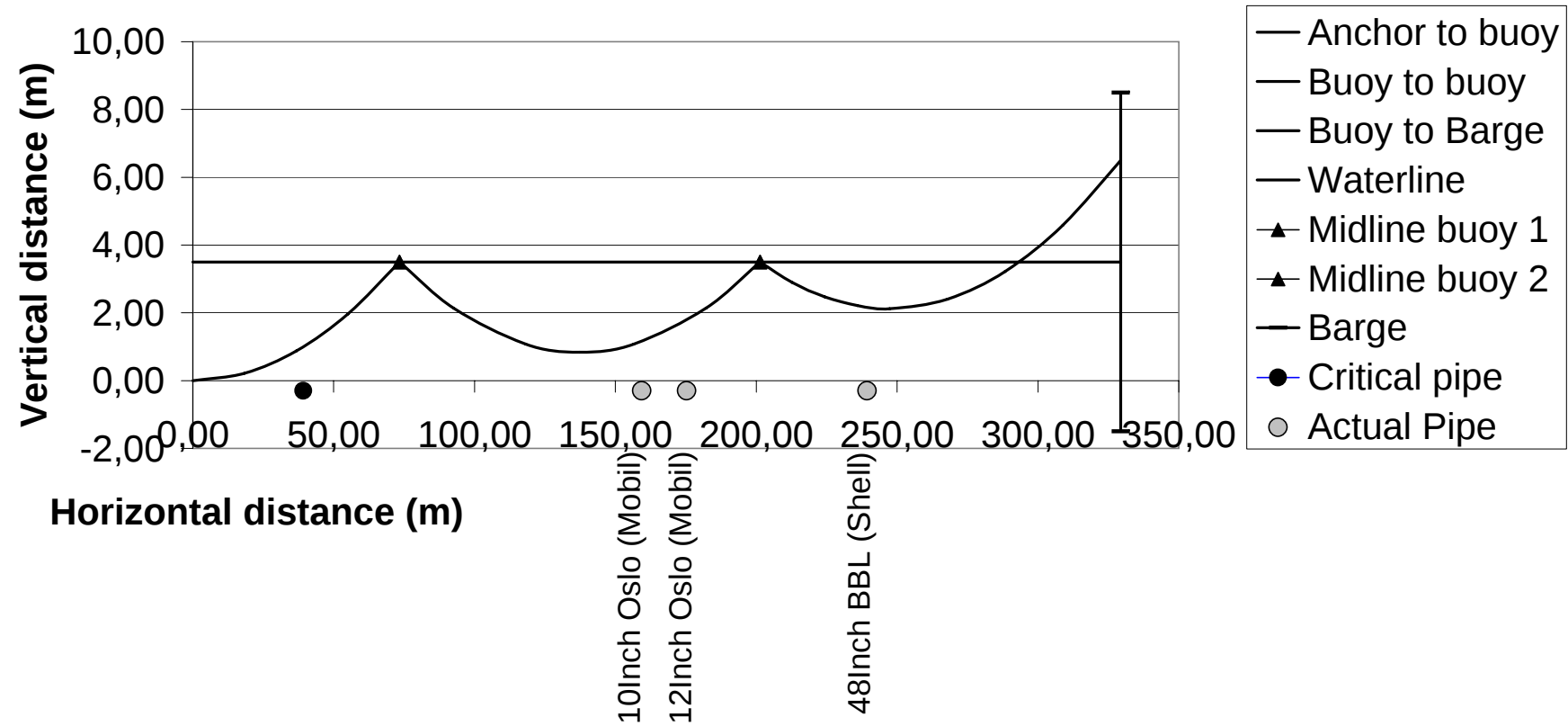
SAGGING CHECK: OK

10-Inch Oslo

12-Inch Oslo

48-Inch BBL

Catenary with two midline buoys

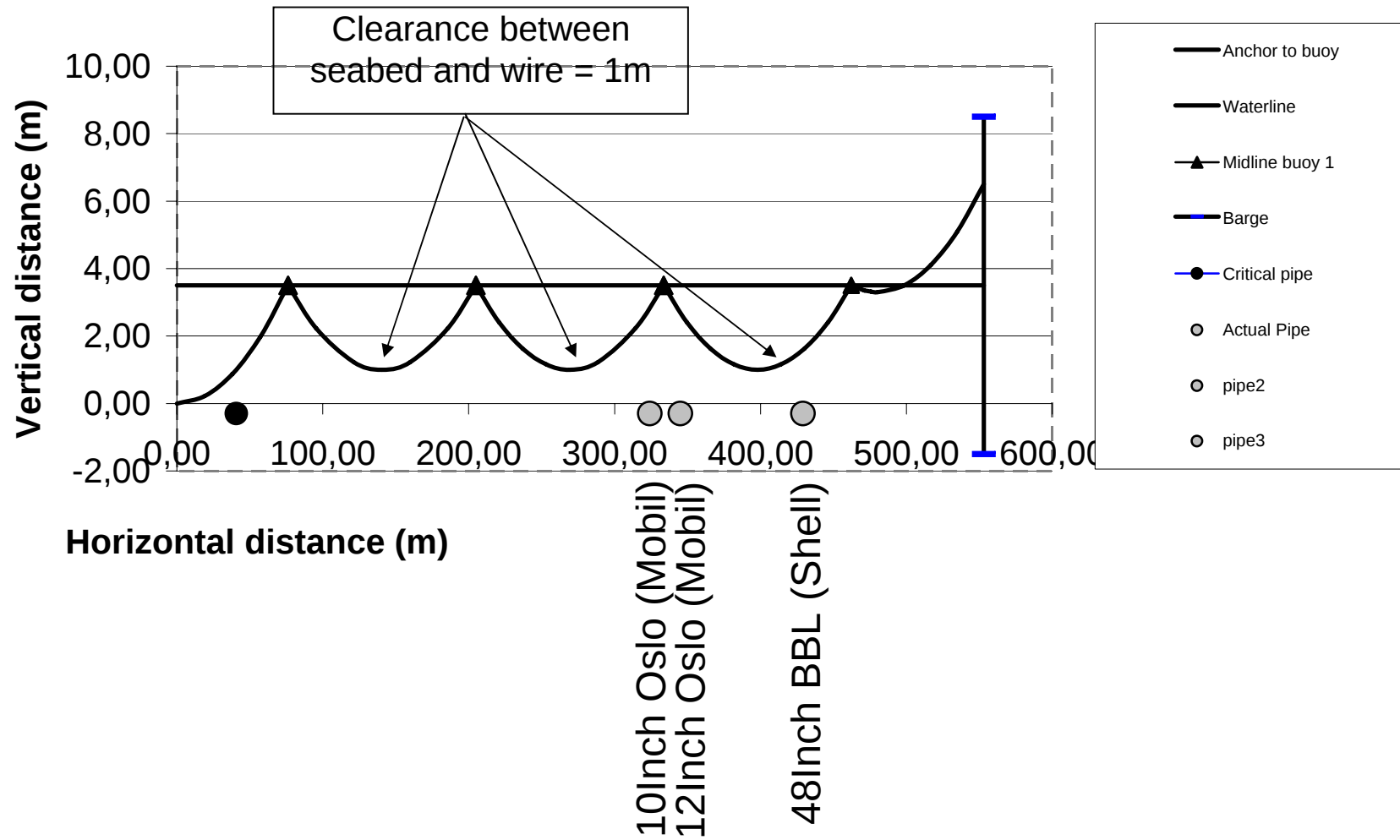


Field and Project	BTIP near shore	
Barge name	JACON 30	
Anchor line number	Anchor S5	PostLay
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	75,50	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	229,00	m
barge to pipeline 2	208,00	m
barge to pipeline 3	124,00	m
Distance between first and second buoy	128,70	m
Distance between second and thirth buoy	128,70	m
Distance between thirth and fourth buoy	128,70	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	71 m
Select a distance in excess of	71,5 m
Enter here your selected value	72,8 m
Distance barge to first buoy	91 m
Distance barge to second buoy	220 m
Distance barge to third buoy	348 m
Distance barge to fourth buoy	477 m
Distance barge to anchor	553 m
Distance barge to critical pipe	512 m
Safe distance barge to anchor at max line tension	629 m

AUTOMATIC Comment	
SAGGING CHECK:	OK

Catenary with Fourth midline buoys

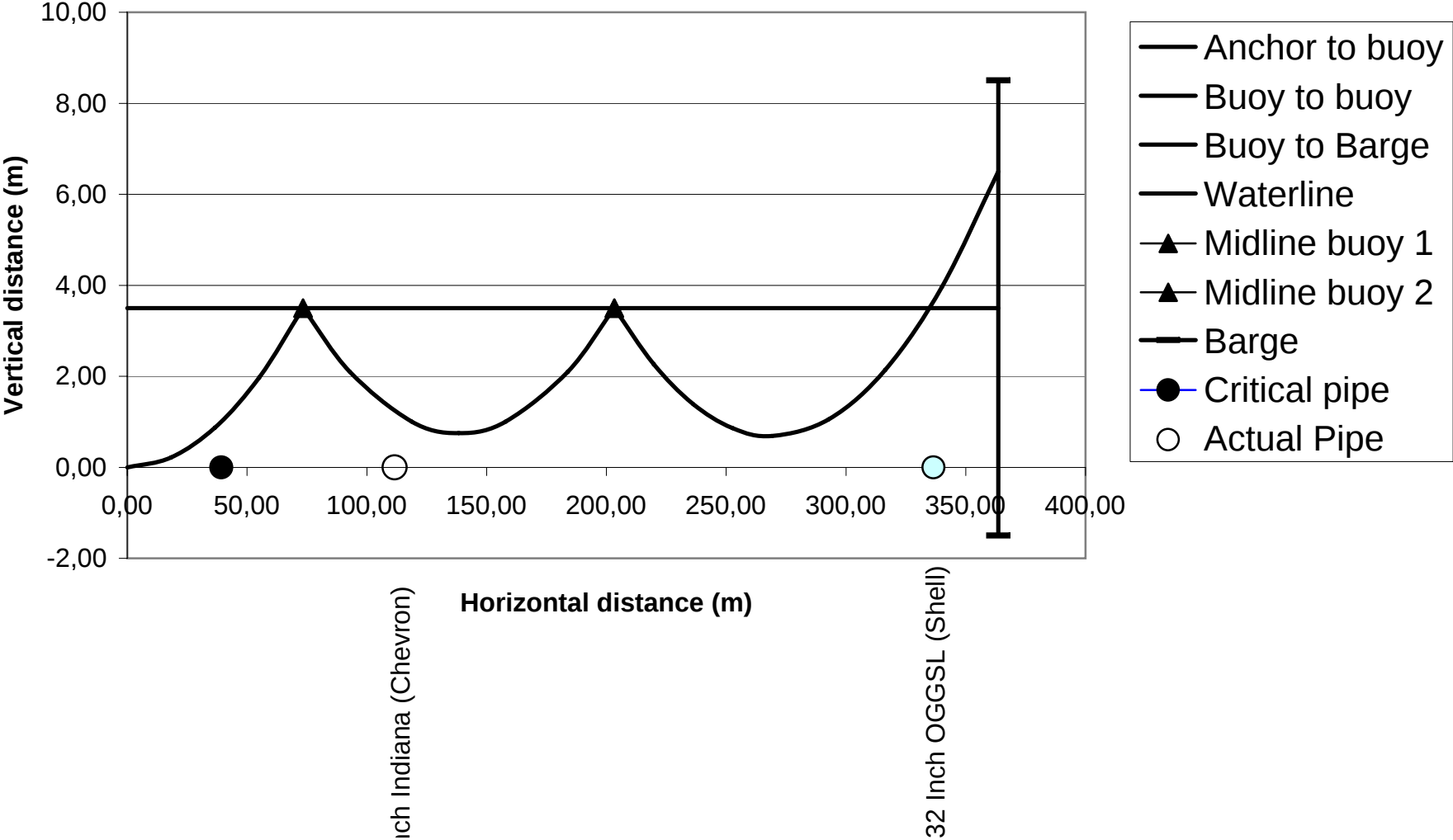


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S2 postlay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	252,00	m
2nd Pipe	27,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	94,5 m
Distance barge to first buoy	160 m
Distance barge to second buoy	290 m
Distance barge to anchor	364 m
Distance barge to critical pipe	324 m
Safe distance barge to anchor at max line tension	442 m

8 Inch Indiana line
32 Inch OGGS Line

Catenary with two midline buoys

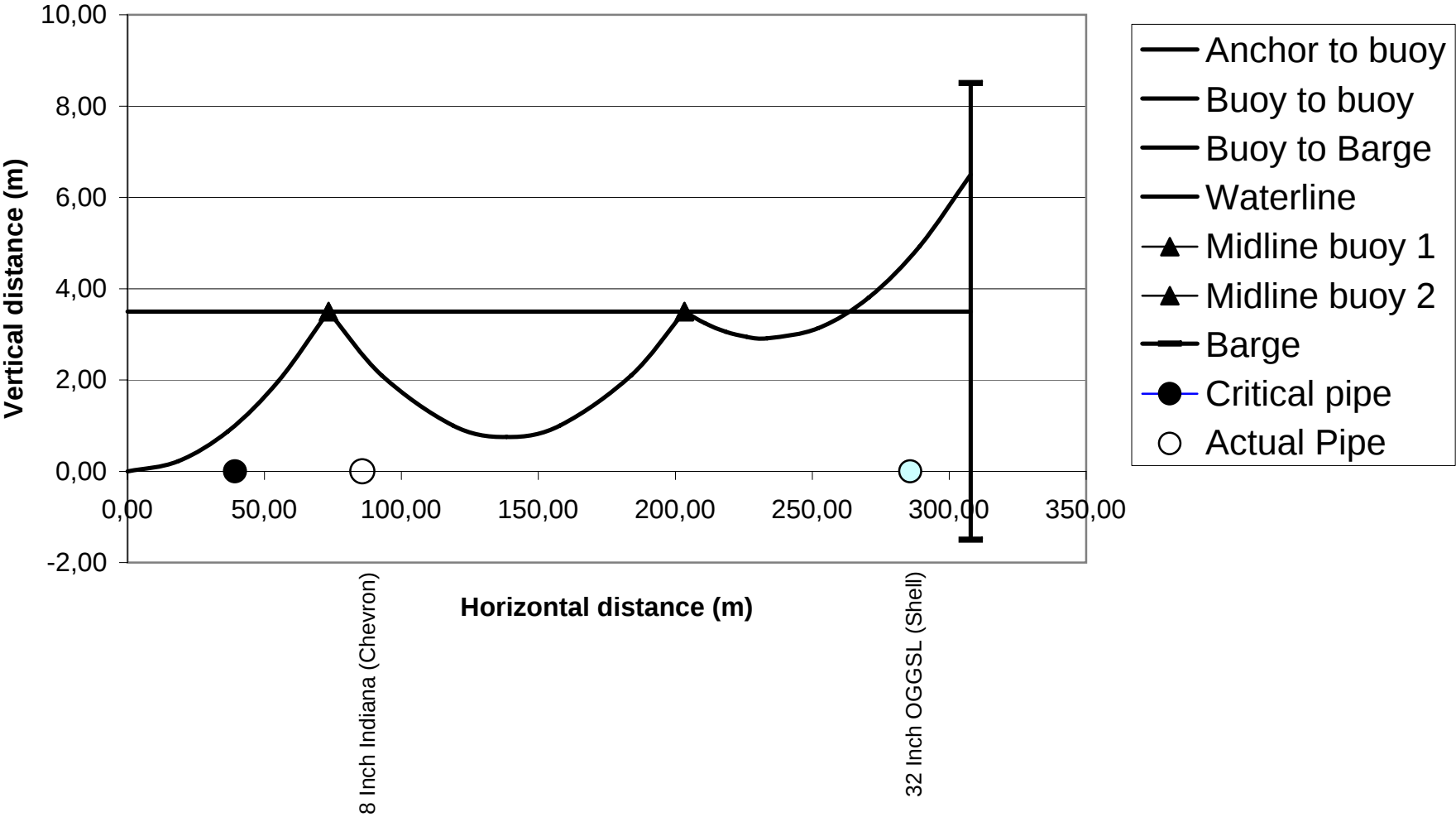


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S3 postlay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	222,00	m
2nd Pipe	22,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	74,3 m
Distance barge to first buoy	104 m
Distance barge to second buoy	234 m
Distance barge to anchor	308 m
Distance barge to critical pipe	269 m
Safe distance barge to anchor at max line tension	386 m

8-Inch
32 Inch OGGS (shell)

Catenary with two midline buoys

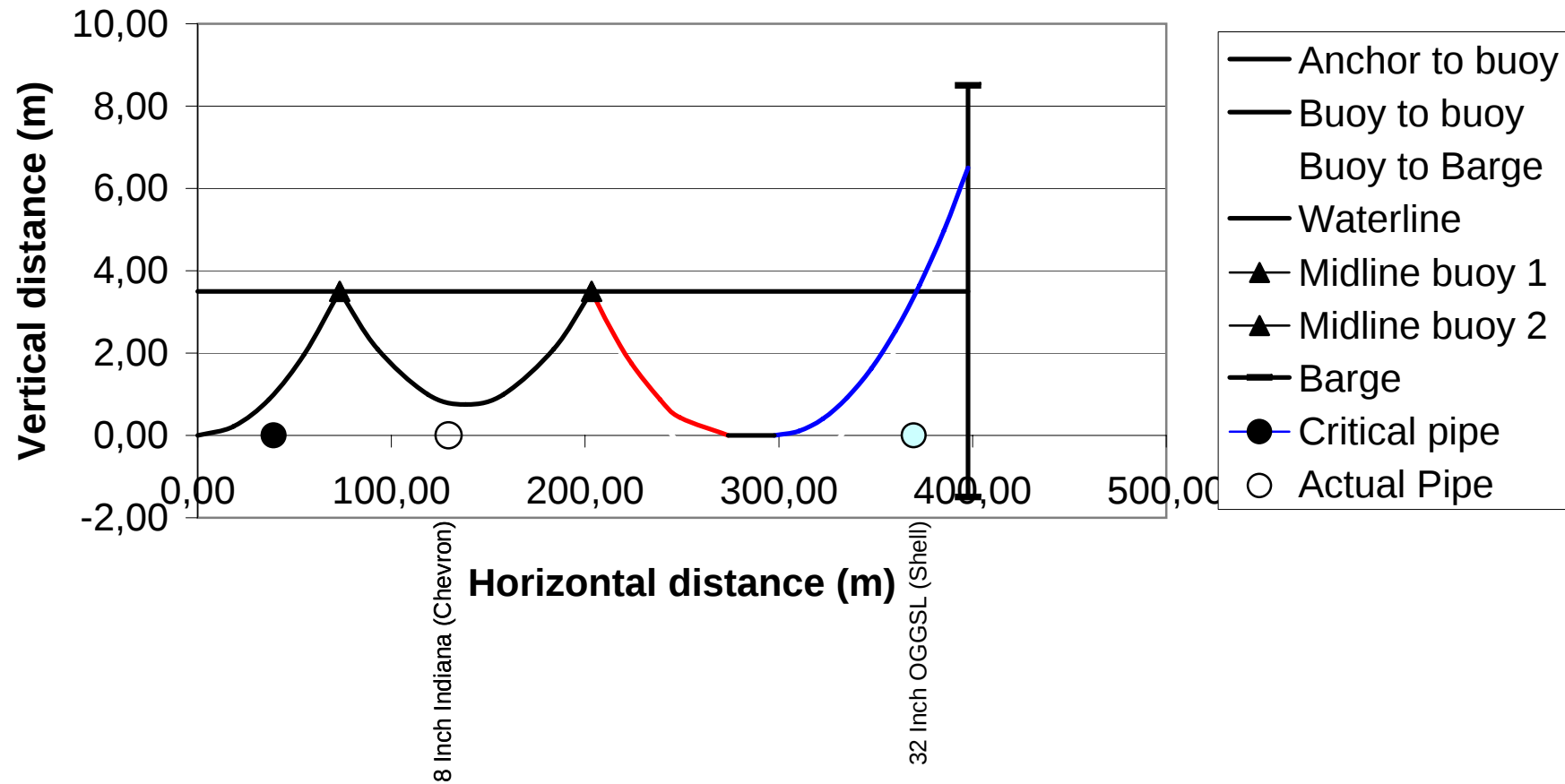


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S4 Postlay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	268,00	m
2nd Pipe	28,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	109 m
Distance barge to first buoy	194 m
Distance barge to second buoy	324 m
Distance barge to anchor	398 m
Distance barge to critical pipe	358 m
Safe distance barge to anchor at max line tension	476 m

8 Inch Indiana Line
32 Inch OGGS Line

Catenary with two midline buoys

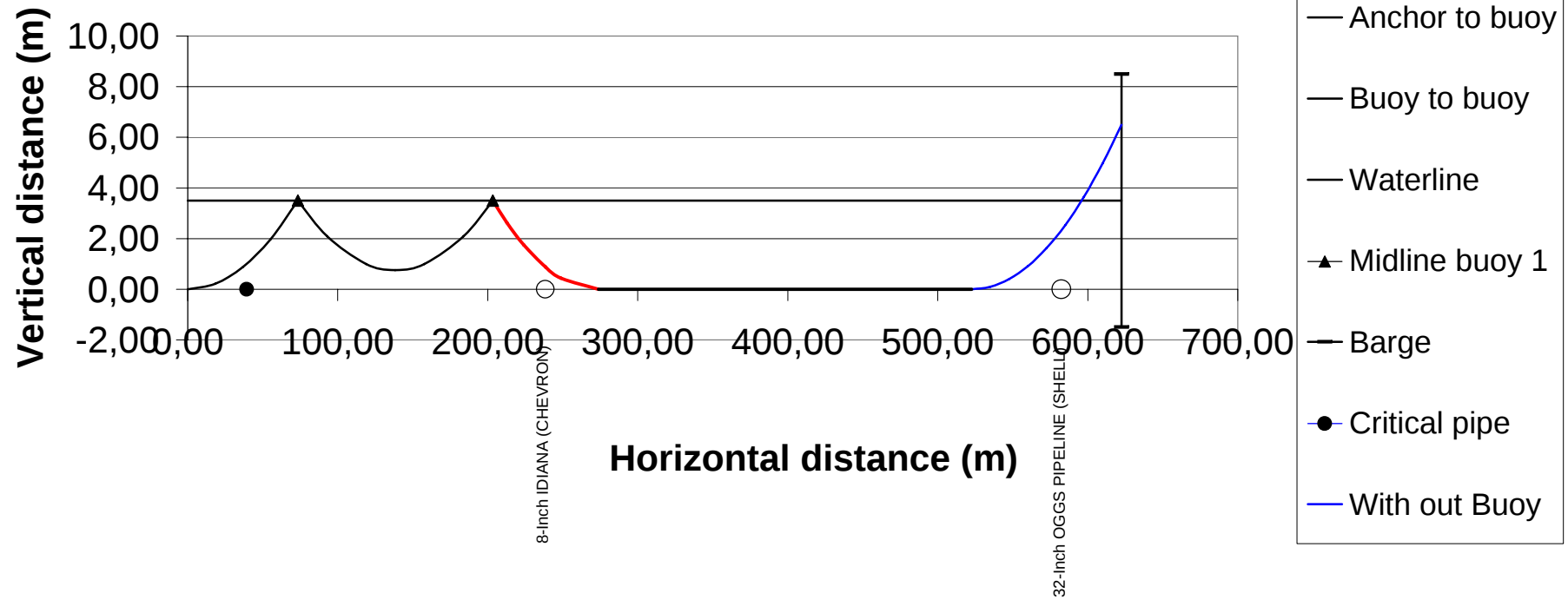


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S5 Postlay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance		
barge to pipeline 1	384,00	m
barge to pipeline 2	40,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	215 m
Distance barge to first buoy	419 m
Distance barge to second buoy	549 m
Distance barge to anchor	622 m
Distance barge to critical pipe	583 m
Safe distance barge to anchor at max line tension	701 m

8-Inch
32 Inch OGGS (shell)

Catenary with two midline buoys

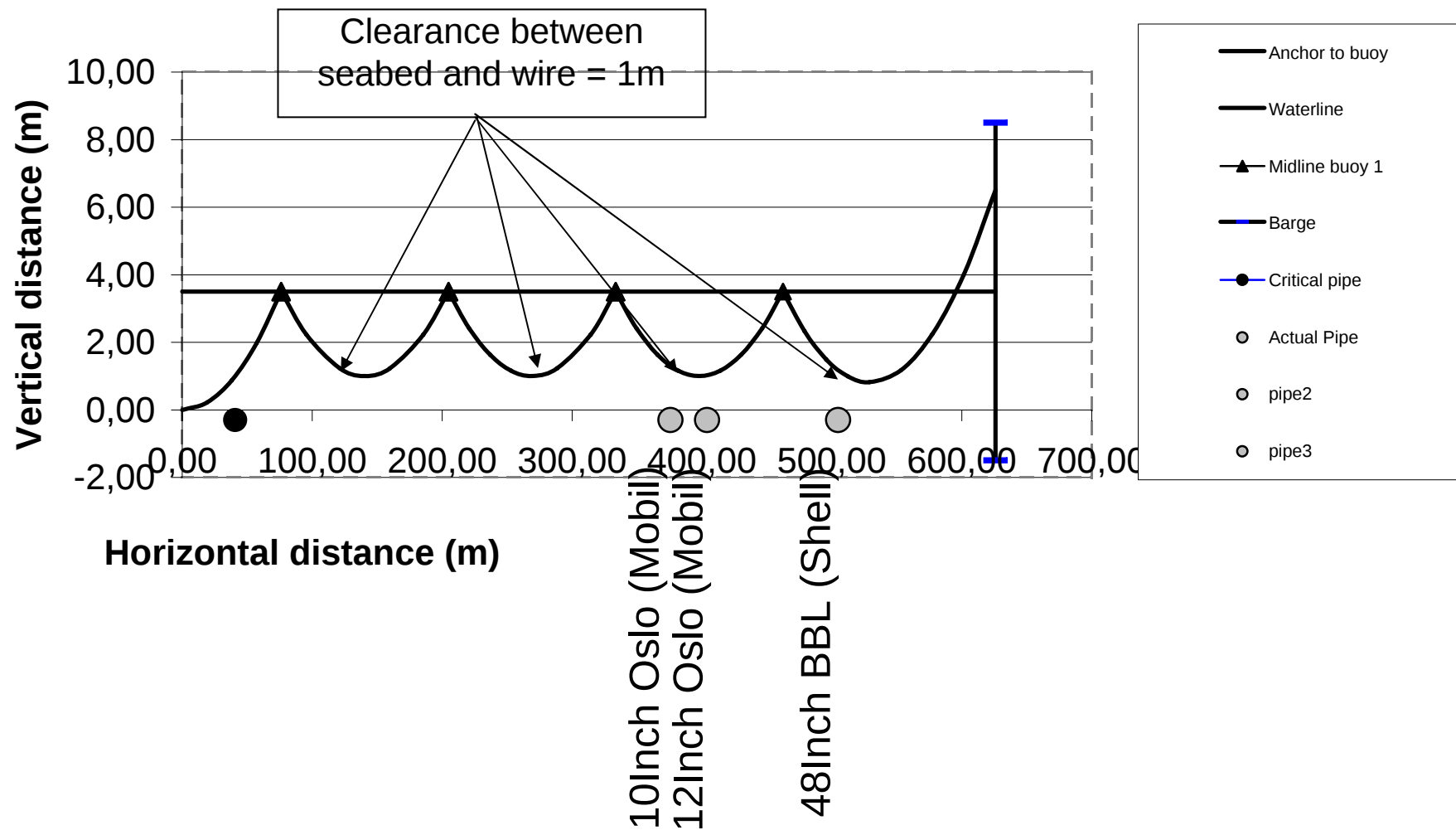


Field and Project	BTIP near shore	
Barge name	JACON 30	
Anchor line number	Anchor P2 Prelay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	75,50	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance		
barge to pipeline	250,00	m
barge to pipeline 2	222,00	m
barge to pipeline 3	121,00	m
Distance between first and second buoy	128,70	m
Distance between second and thirth buoy	128,70	m
Distance between thirth and fourth buoy	128,70	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	71 m
Select a distance in excess of	71,5 m
Enter here your selected value	97 m
Distance barge to first buoy	164 m
Distance barge to second buoy	292 m
Distance barge to third buoy	421 m
Distance barge to fourth buoy	550 m
Distance barge to anchor	626 m
Distance barge to critical pipe	585 m
Safe distance barge to anchor at max line tension	702 m

10-Inch Oslo
12-Inch Oslo
48-Inch BBL

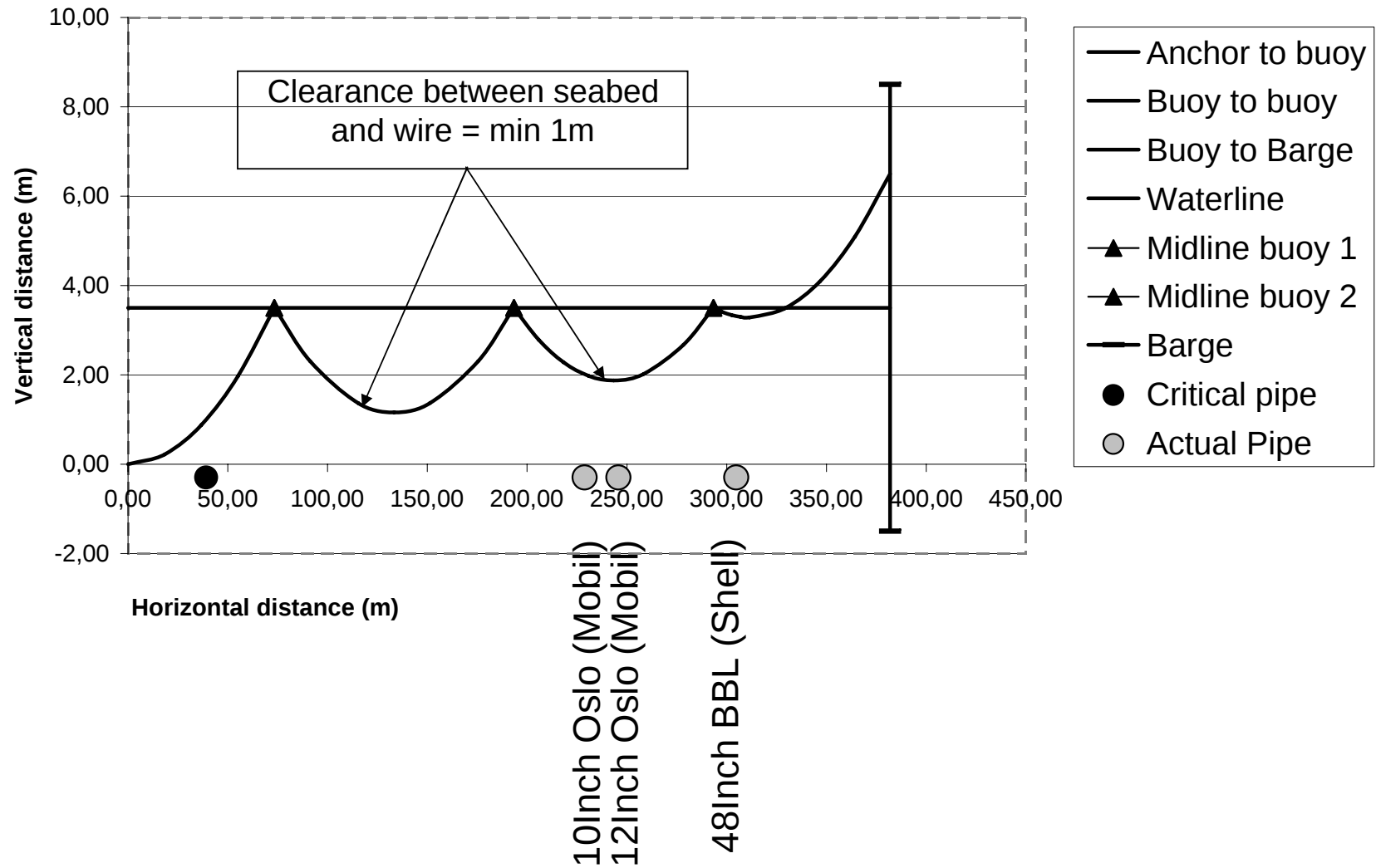
Catenary with Fourth midline buoys



Field and Project	BTIP near shore		
Barge name	Jascon 30		
Anchor line number	P3 prelay		
Water depth	3,50	m	
Height of fairlead above water	3,00	m	
Wire data			
Submerged weight	91,00	N/m	
Horizontal tension	70,00	kN	
Midline buoys			
Length of pendant	0,00	m	
Vertical clearance with pipeline, etc	1,00	m	
Actual distance			
barge to pipeline	153,00	m	10-Inch Oslo
barge to pipeline 2	136,00	m	12-Inch Oslo
barge to pipeline 3	77,00	m	48-Inch BBL
Distance between first and second buoy	120,00	m	
Distance between second and thirth buoy	100,00	m	
Maximum horizontal wire tension	300,00	kN	

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	70,3 m
Distance barge to first buoy	88 m
Distance barge to second buoy	188 m
Distance barge to third buoy	308 m
Distance barge to anchor	382 m
Distance barge to critical pipe	343 m
Safe distance barge to anchor at max line tension	460 m
AUTOMATIC Comment	
SAGGING CHECK:	OK

Catenary with three midline buoys

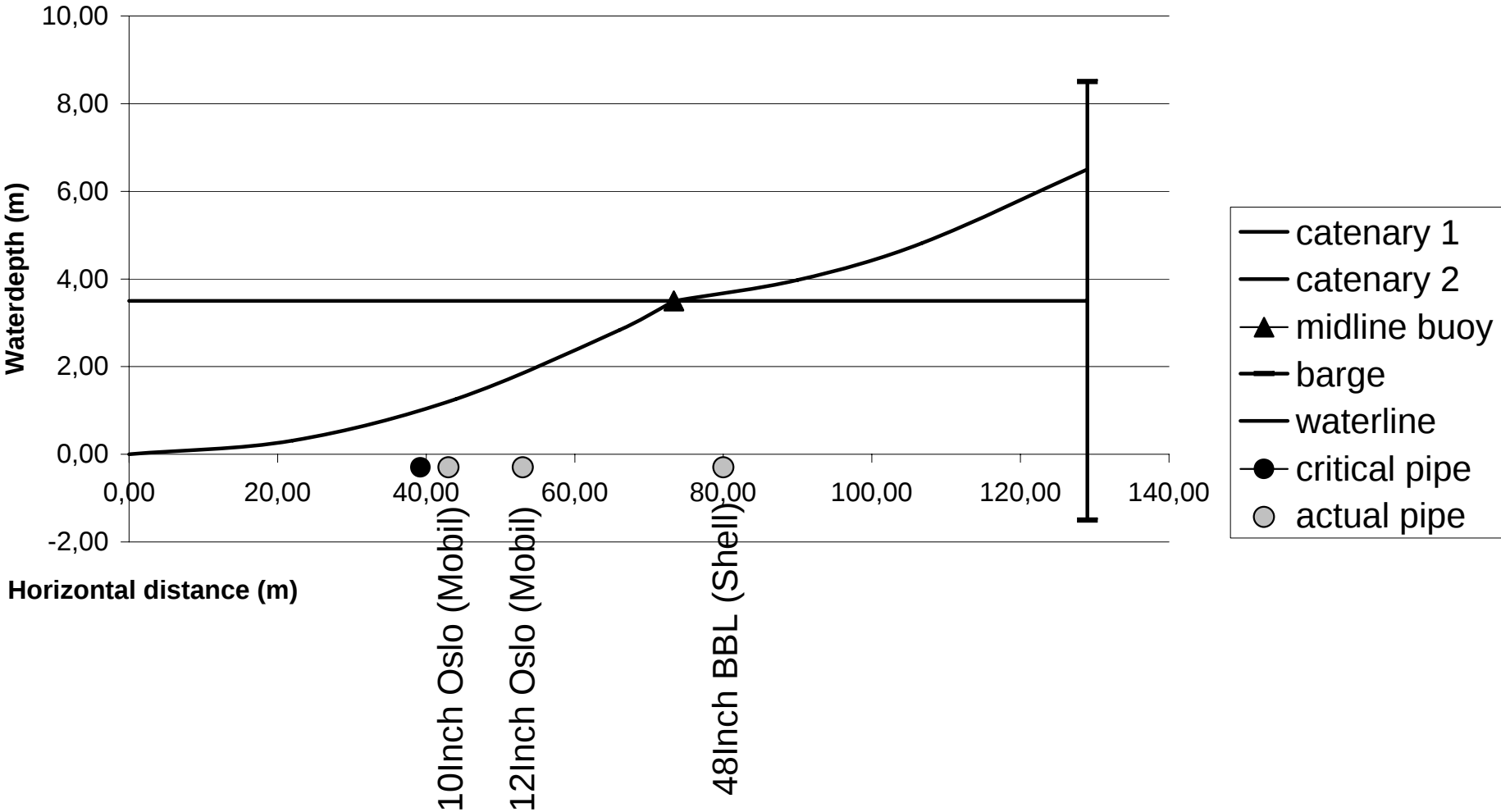


Field and Project	BTIP
Barge Name	Jascon 30
Anchor line number	P4 prelay
Water depth	3,5 m
Height of fairlead above water	3 m
Wire data	
Submerged weight	91 N/m
Horizontal tension	70 kN
Midline buoy 1	
Length of pendant	0 m
Vertical clearance with pipeline, etc	1 m
Actual distance	
barge to pipeline 1	86 m
barge to pipeline 2	76 m
barge to pipeline 3	49 m
Maximum horizontal wire tension	300 kN

Output	To position the midline buoy >> Choose value between 3 m and 7 m and enter your choice here >> 3,12 m and see if location of midline buoy is satisfactory
	Distance barge to midline buoy 56 m Distance barge to touch down 129 m Distance barge to critical pipe 90 m Minimum req'd distance for anchor drop at maximum line tension 208 m

10-Inch Oslo
12-Inch Oslo
48-Inch BBL

Anchorline with Midline Buoy



Field and project BTIP near shore

Barge name Jascon 30

Anchor line number P5 pre-Lay

Water depth 3,5 m

Height of fairlead
above water 3 m

Wire data

Submerged weight 91 N/m

Horizontal tension 75 kN

Midline buoy 1

Length of pendant 0 m

Vertical clearance
with pipeline, etc 1 m

Actual distance

barge to pipeline 1 103 m

barge to pipeline 2 90 m

barge to pipeline 3 60 m

Maximum horizontal
wire tension 300 kN

Output

Choose value in excess of 71,5 m

Selected value 95 m

and see if catenary is acceptable

Distance barge to midline buoy 160 m

Distance barge to anchor 236 m

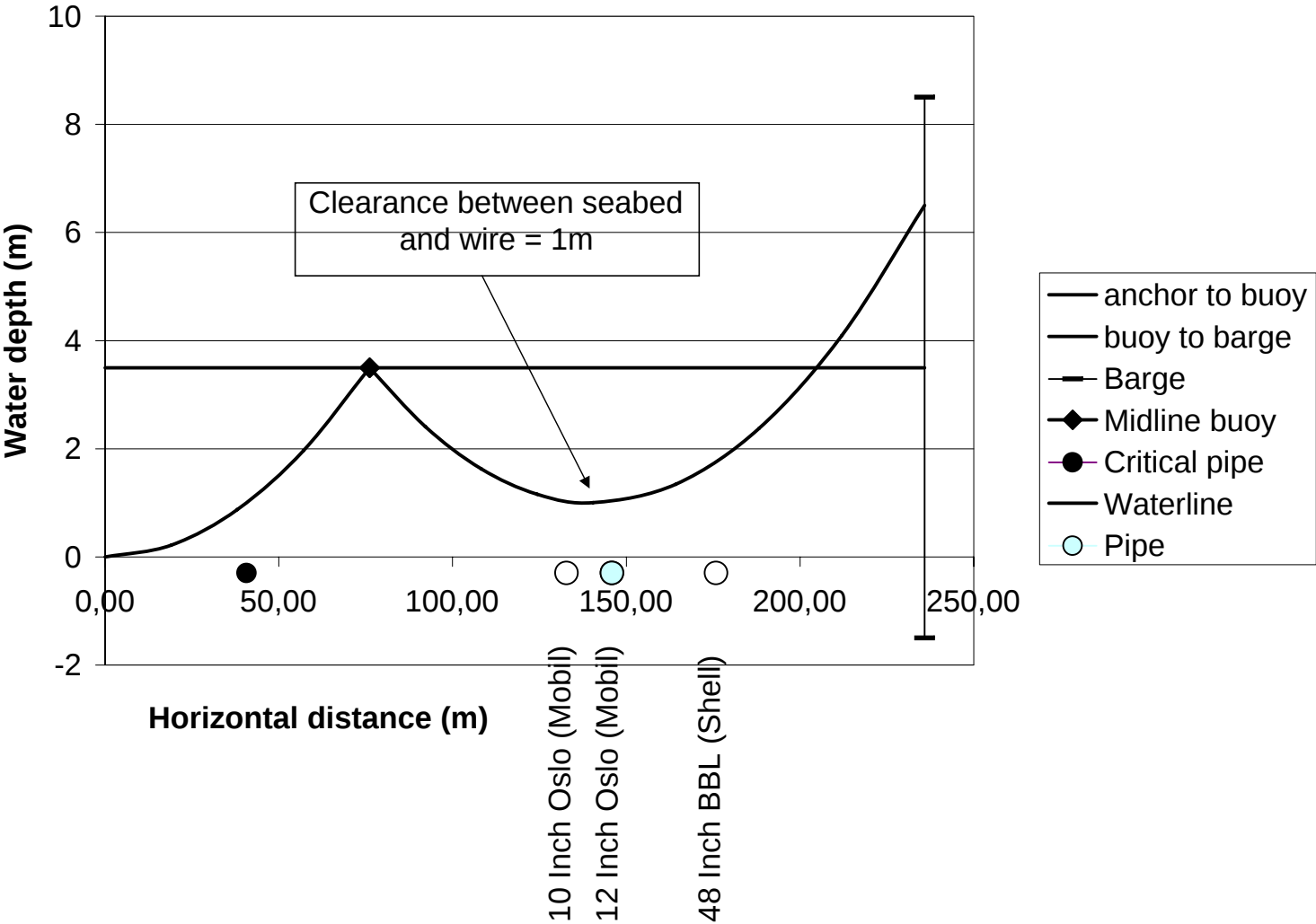
Distance barge to critical pipe 195 m

Safe distance anchor to barge
at maximum line tension 312 m

NOTE

1 Buoy is enough, but in practice we are going
to use 2 buoys

Anchor catenary with sagging wire

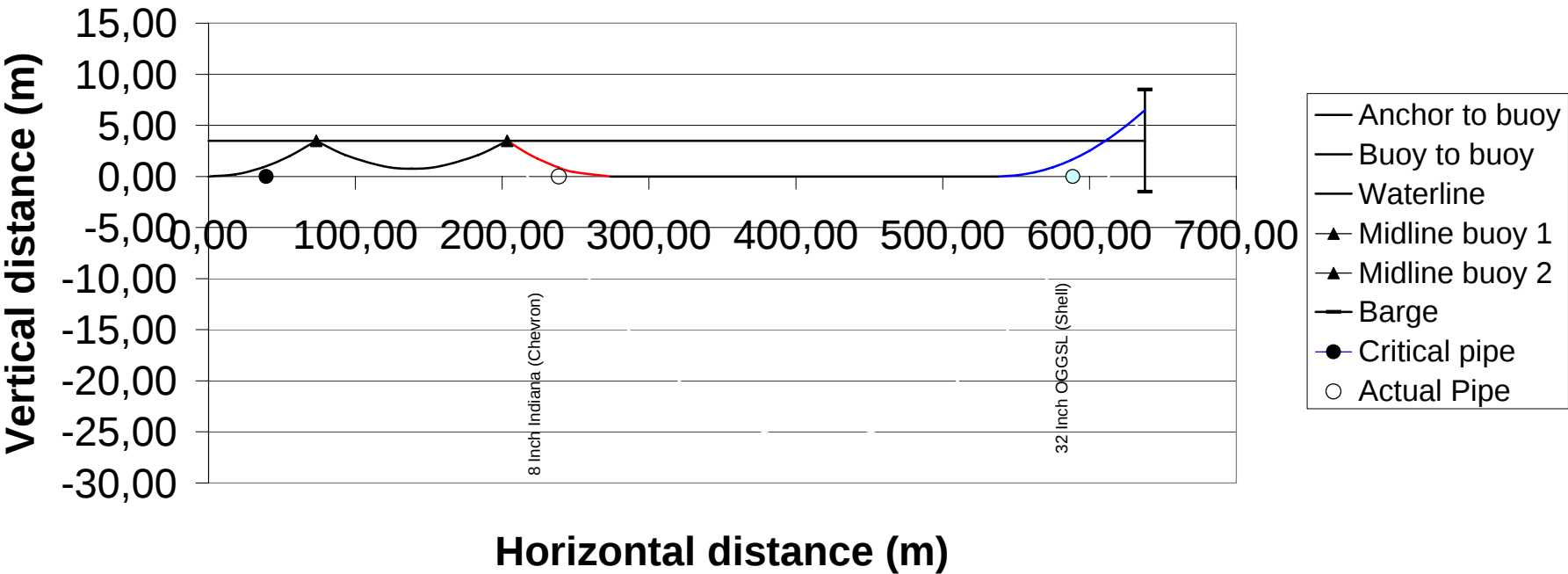


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S2 prelay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	399,00	m
2nd Pipe	49,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	222,4 m
Distance barge to first buoy	434 m
Distance barge to second buoy	564 m
Distance barge to anchor	638 m
Distance barge to critical pipe	598 m
Safe distance barge to anchor at max line tension	716 m

8 Inch Indiana line
32 Inch OGGS Line

Catenary with two midline buoys

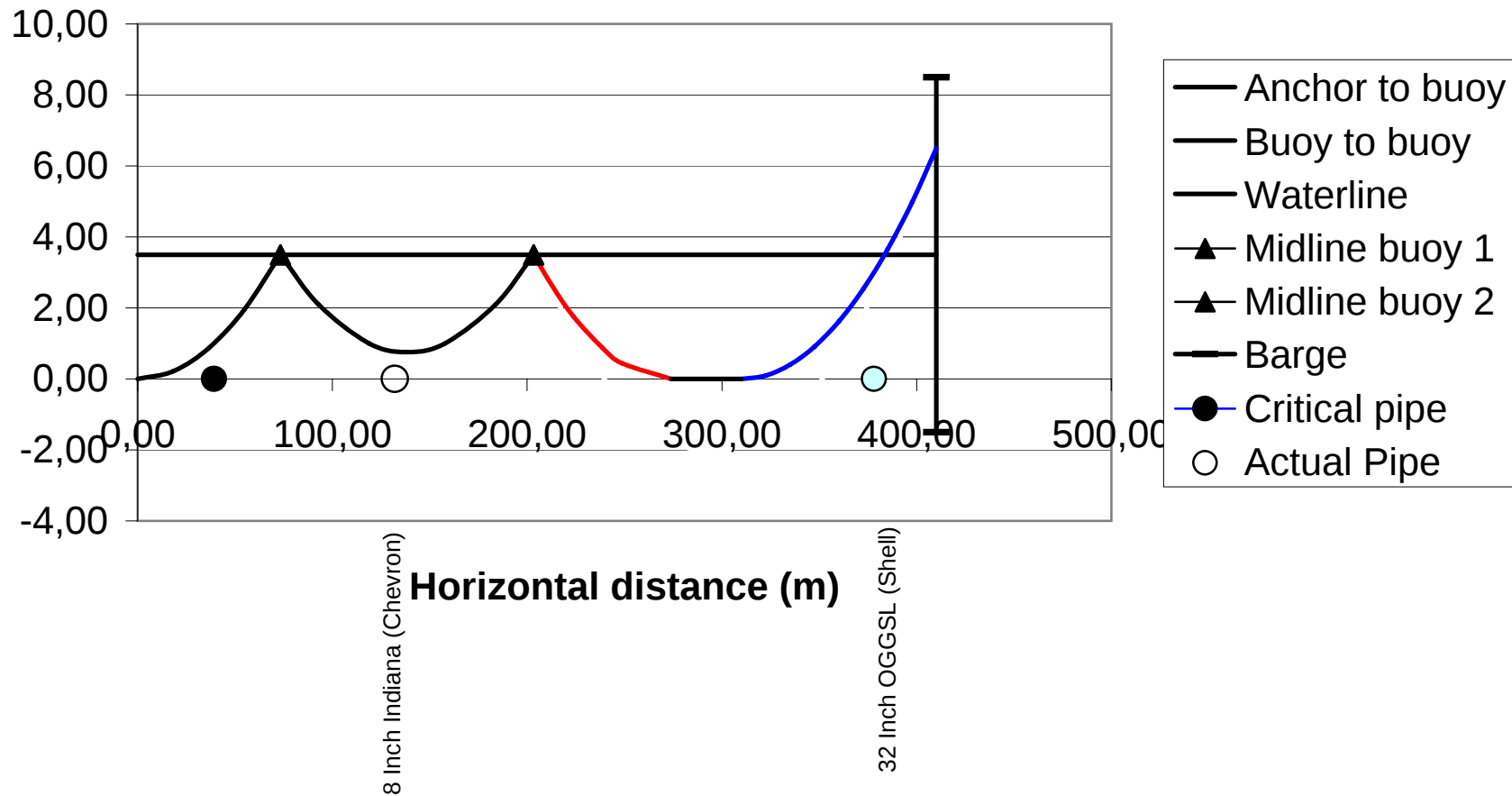


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S3 prelay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	278,00	m
2nd Pipe	32,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	114,5 m
Distance barge to first buoy	207 m
Distance barge to second buoy	337 m
Distance barge to anchor	410 m
Distance barge to critical pipe	371 m
Safe distance barge to anchor at max line tension	489 m

8-Inch
32 Inch OGGS (shell)

Catenary with two midline buoys

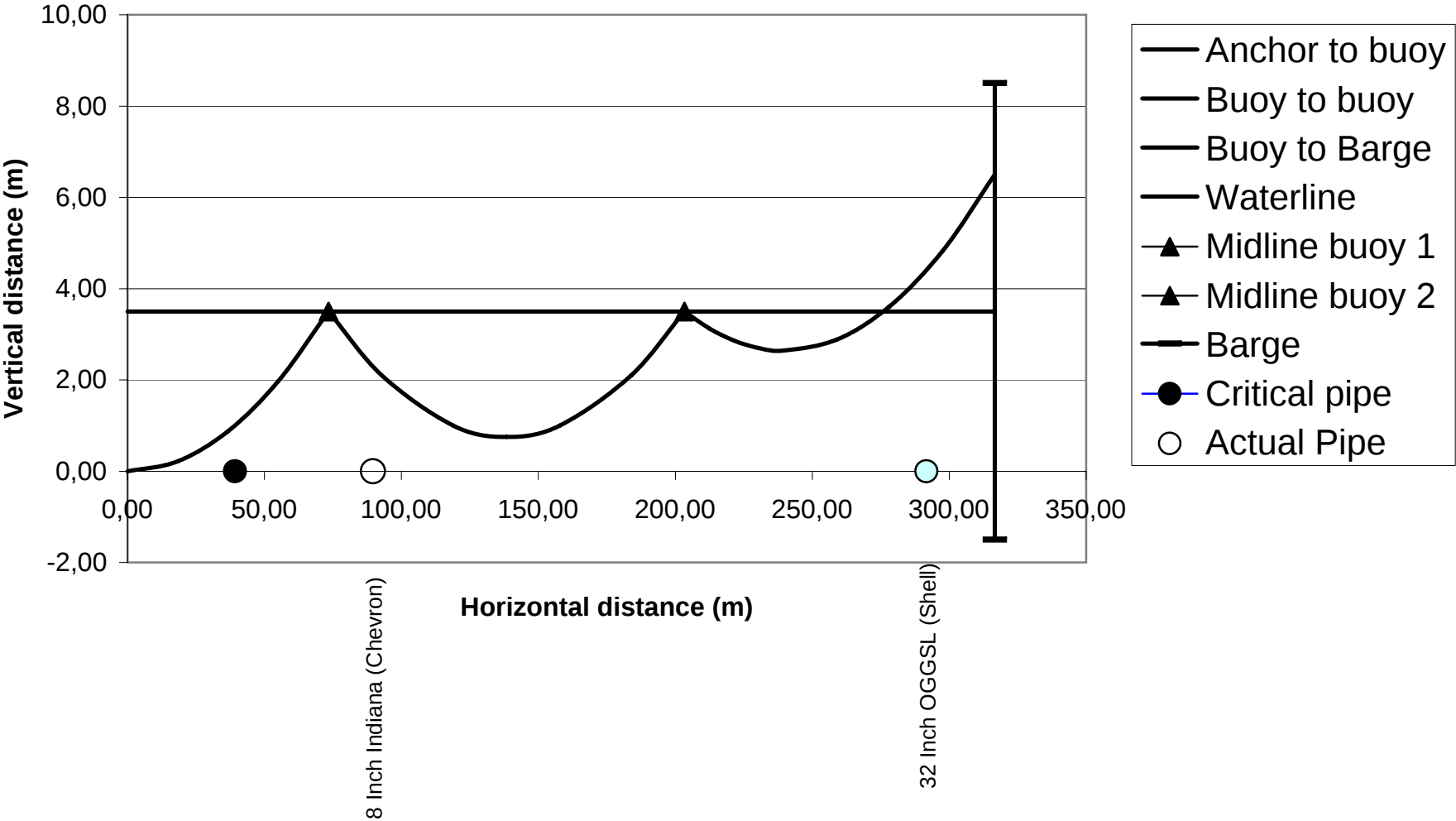


Field and Project	BTIP near shore	
Barge name	Jascon 30	
Anchor line number	S4 Prelay	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	227,00	m
2nd Pipe	25,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	77 m
Distance barge to first buoy	113 m
Distance barge to second buoy	243 m
Distance barge to anchor	317 m
Distance barge to critical pipe	277 m
Safe distance barge to anchor at max line tension	395 m

8-Inch Indiana Chevron
32 Inch OGGS (shell)

Catenary with two midline buoys



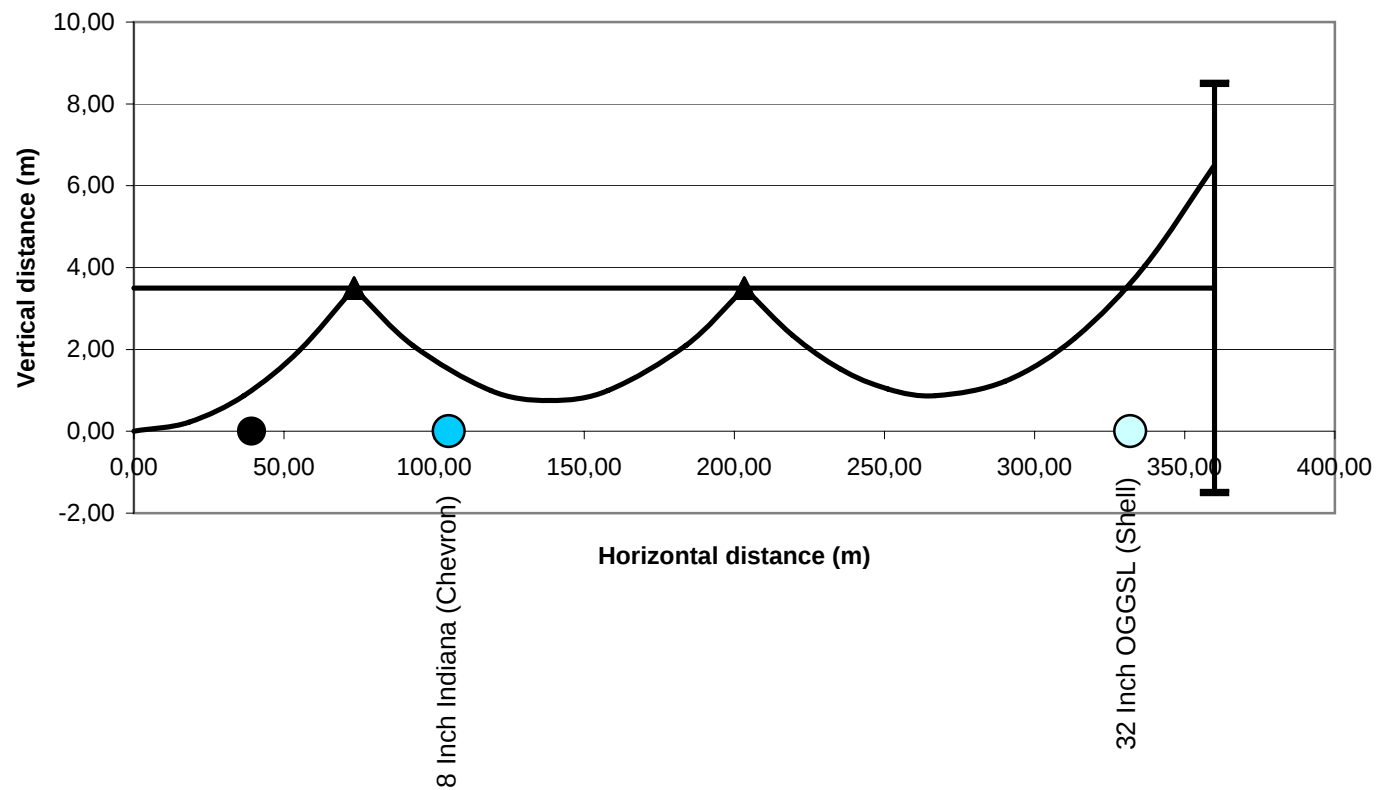
Field and Project	BTIP	
Barge name	Jascon 30	
Anchor line number	prelay S5	
Water depth	3,50	m
Height of fairlead above water	3,00	m
Wire data		
Submerged weight	91,00	N/m
Horizontal tension	70,00	kN
Midline buoys		
Length of pendant	0,00	m
Vertical clearance with pipeline, etc	1,00	m
Actual distance barge to pipeline	255,00	m
2nd Pipe	28,00	m
Distance between first and second buoy	130,00	m
Maximum horizontal wire tension	300,00	kN

Output	
Minimum distance between barge and and first midline buoy is	68 m
Select a distance in excess of	68,9 m
Enter here your selected value	93 m
Distance barge to first buoy	157 m
Distance barge to second buoy	287 m
Distance barge to anchor	360 m
Distance barge to critical pipe	321 m
Safe distance barge to anchor at max line tension	438 m

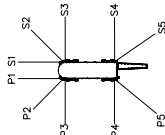
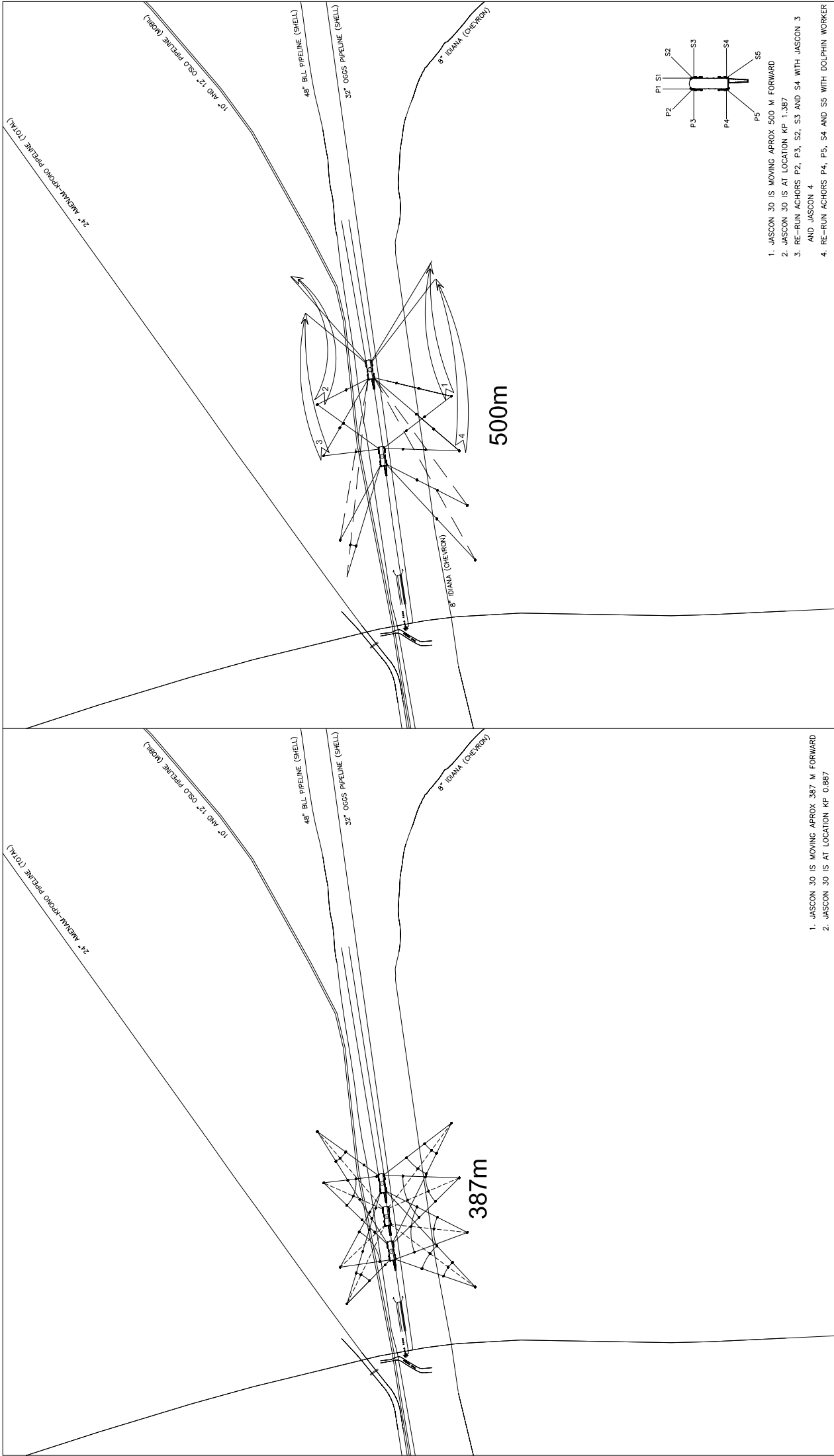
AUTOMATIC Comment	
SAGGING CHECK:	OK

8-Inch
32 Inch OGGS (shell)

Catenary with two midline buoys

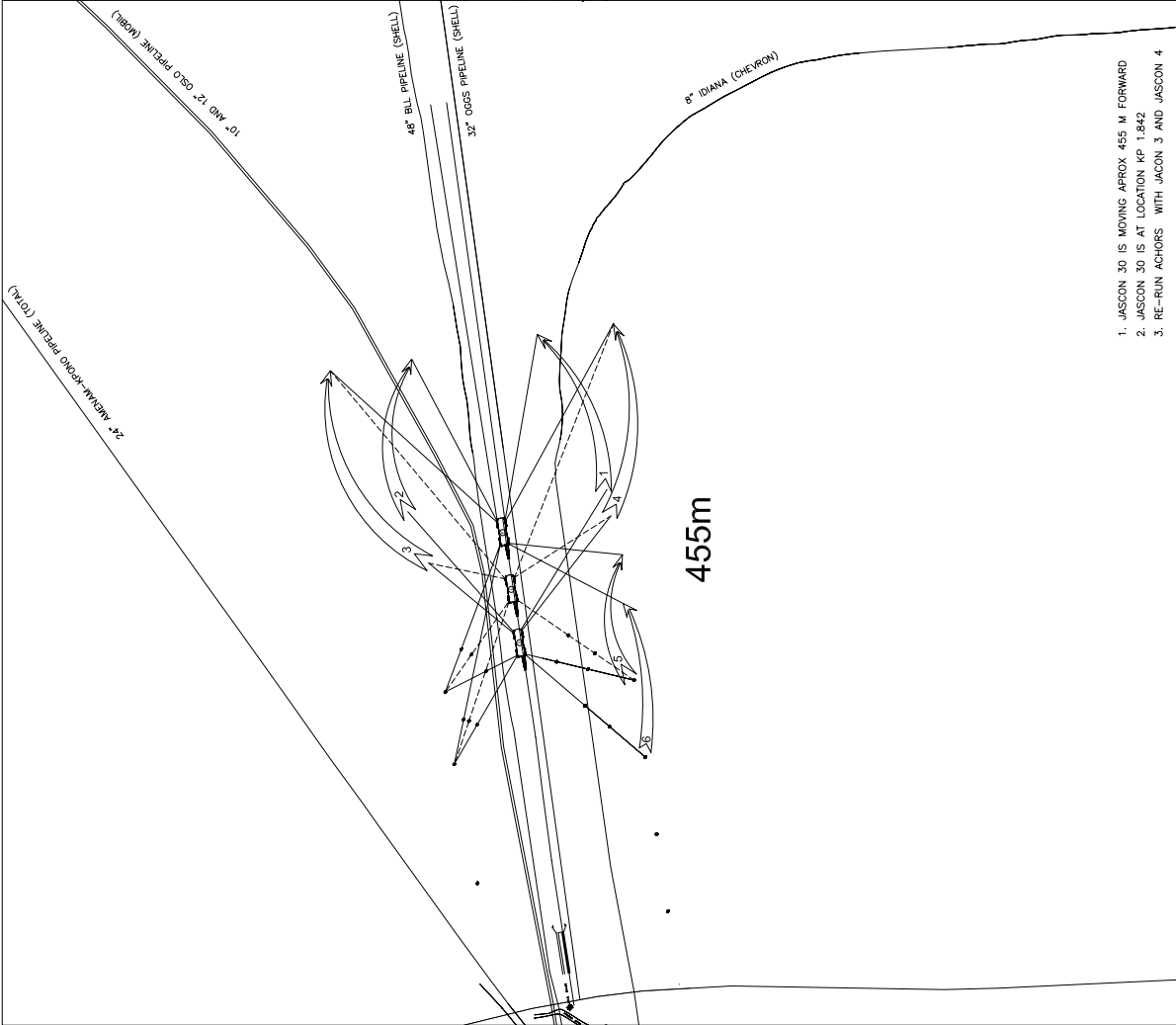


- Anchor to buoy
- Buoy to buoy
- Buoy to Barge
- Waterline
- ▲ Midline buoy 1
- ▲ Midline buoy 2
- Barge
- Critical pipe
- Actual Pipe
- 2nd pipe

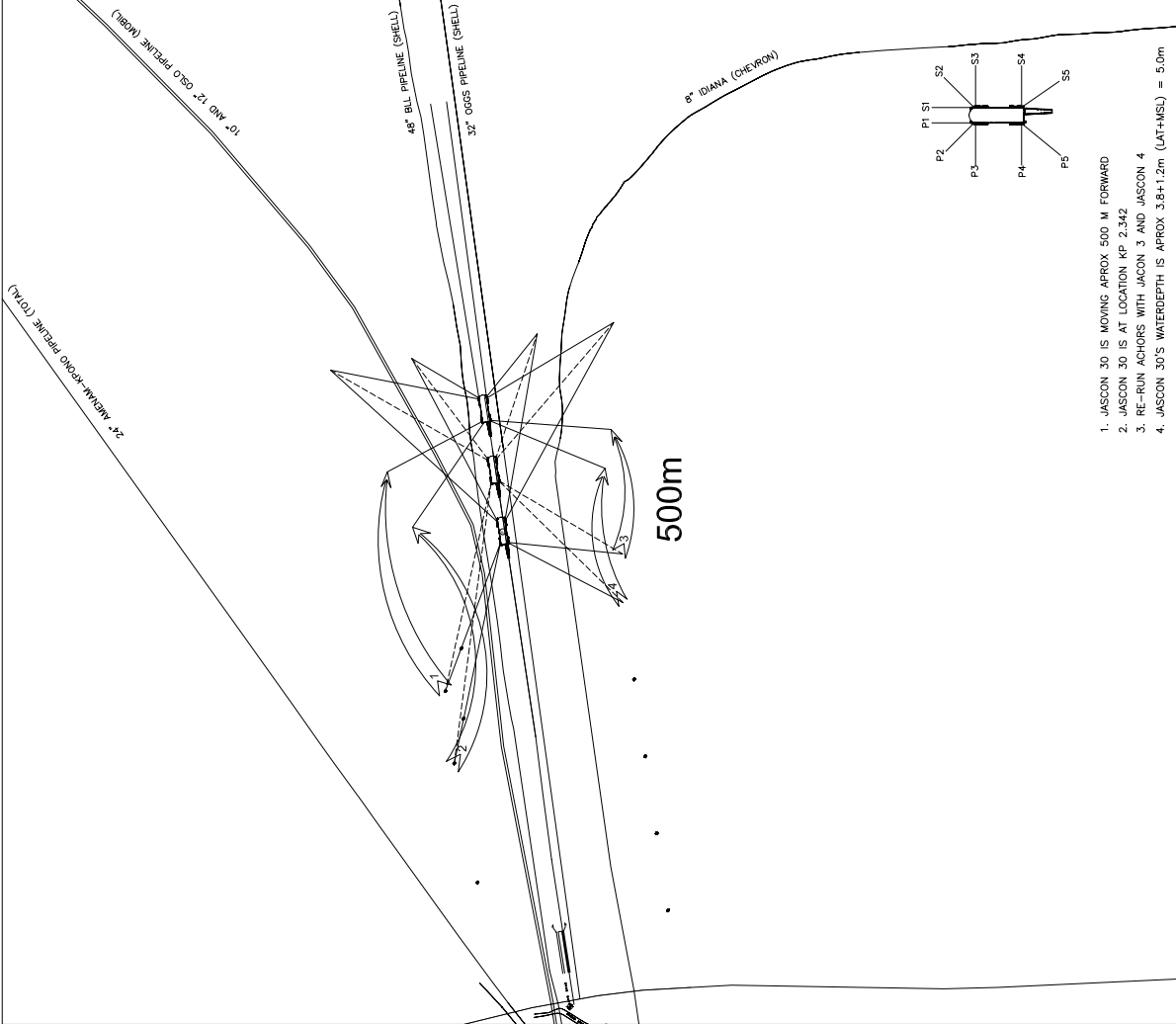


1. JASCON 30 IS MOVING APPROX 500 M. FORWARD
2. JASCON 30 IS AT LOCATION KP 1.387
3. RE-RUN ACHORS P2, P3, S2, S3 AND S4 WITH JASCON 30 AND JASCON 4
4. RE-RUN ACHORS P4, P5, S4 AND S5 WITH DOLPHIN WORK

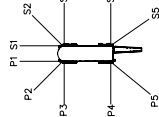
HORIZONTAL COORDINATE SYSTEM :		GEODETIC PARAMETERS		LEGEND		GENERAL NOTES		HORIZONTAL SCALE		SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED	
GEOIDIC DATUM		PREINSTALLED ANCHORS WITH MOUNE BOUYS AND CLAMPIGHT		ANCHOR WIRE FROM THE BASE		1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED. BATHYMETRIC DATA OBTAINED FROM THE SHIP LOG.		160 80 0 200 400 600 800 1000		COMPANY OF NIGERIA LIMITED	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE		2. FOR THIS PROJECT, THE BATHYMETRIC DATA FOR BIP SHORE APPROACH SHALL BE MAINTAINED BETWEEN THE TWO NEW PROPOSED ANCHORS.		200 120 40		HEAVY INDUSTRIES CO., LTD	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE		3. A MINIMUM SEPARATION OF 20m SHALL BE MAINTAINED BETWEEN THE TWO NEW PROPOSED ANCHORS.		1 : XXXXX		WAVentures	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE		4. TYPICAL MANAGEMENT OF PREINSTALLED ANCHOR SEE SHEET 12				West African Ventures Limited	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						JASCON 30	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						MOORING PROCEDURE	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						BONNY TERMINAL INTEGRATED PROJECT	
ELLIPSOID		ANCHOR WIRE FROM THE BASE		ANCHOR WIRE FROM THE BASE						THE :	
ELLIPSOID		ANCHOR WIRE FROM THE BASE									



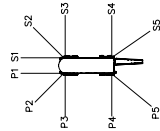
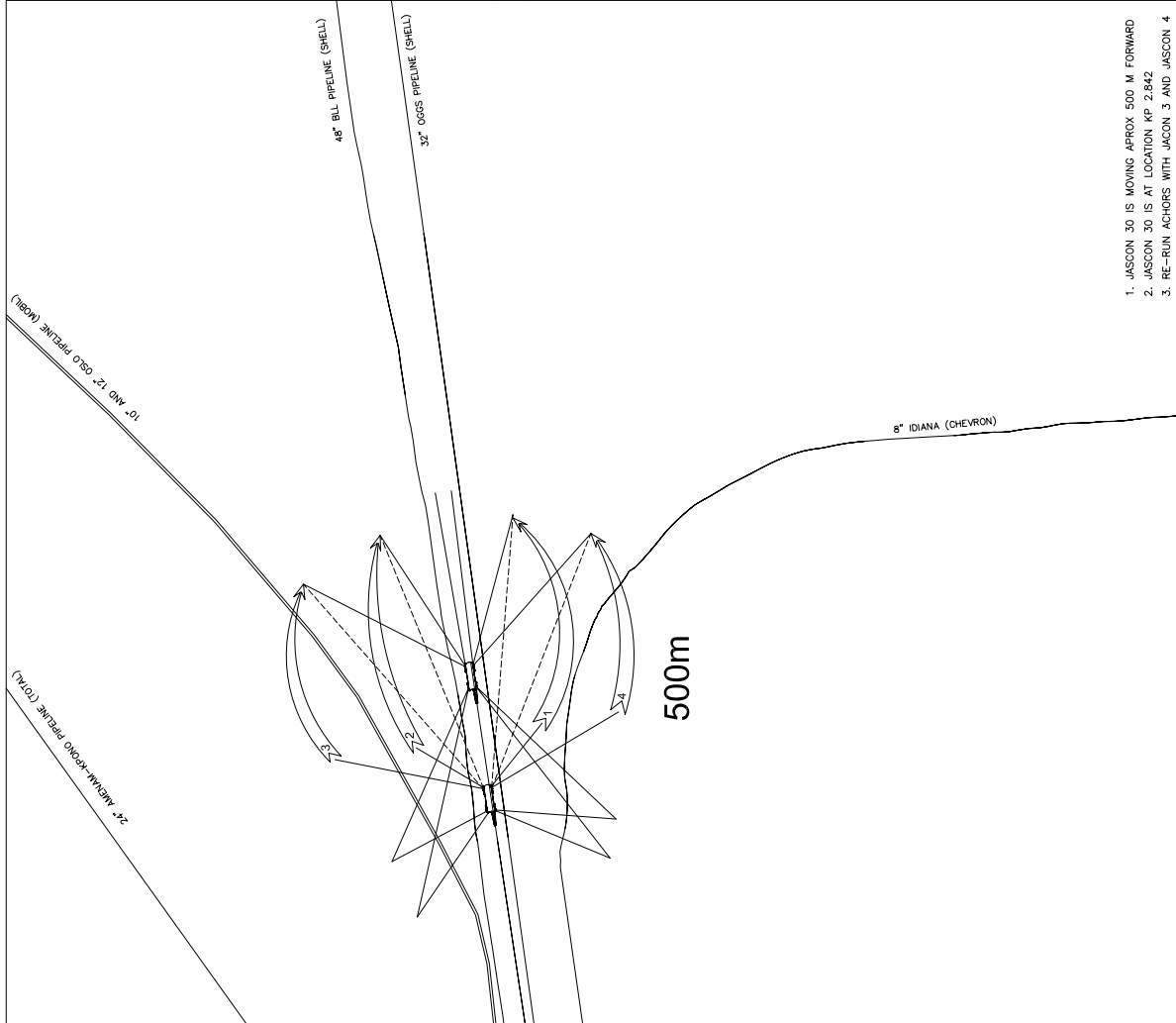
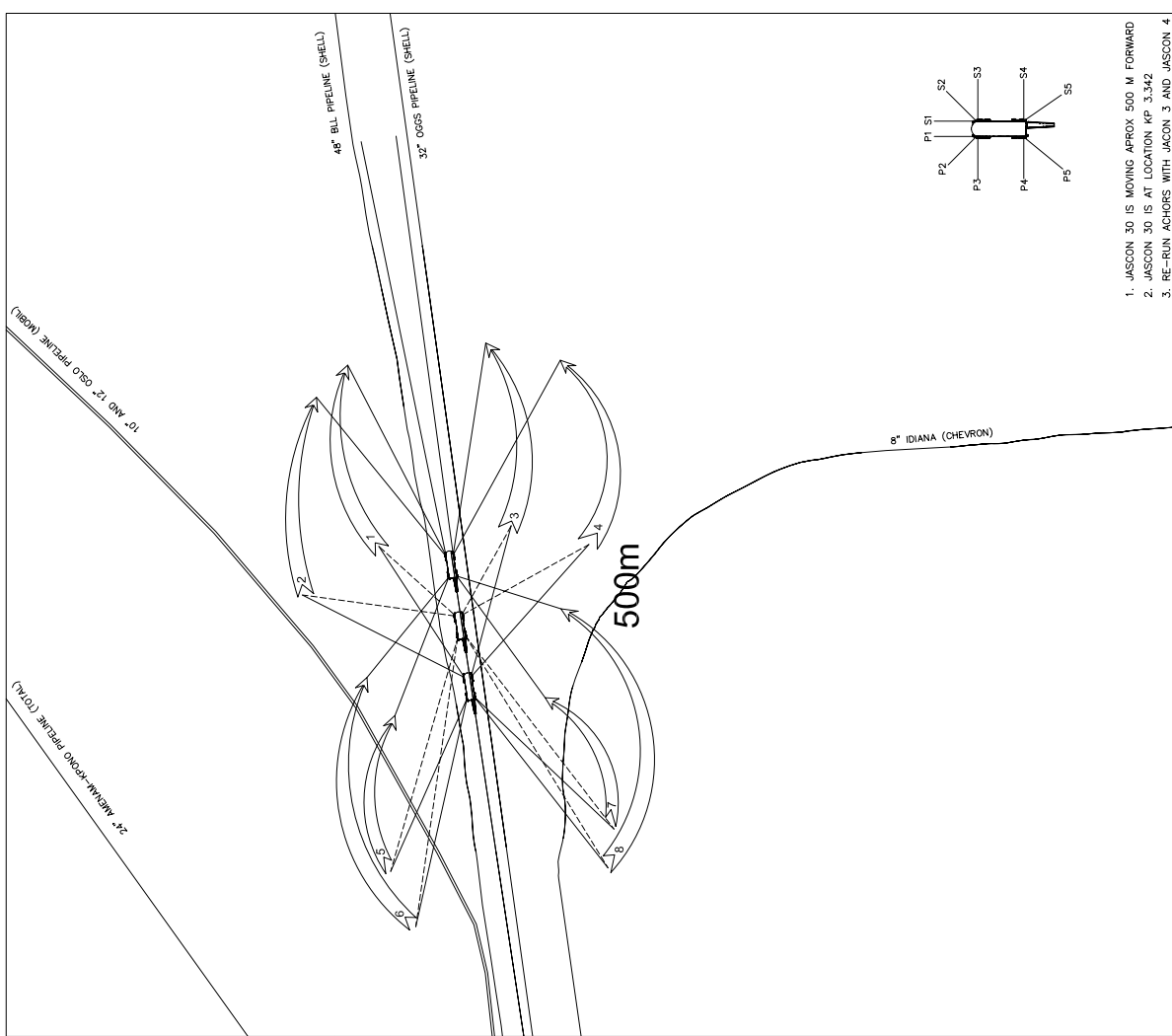
1. JASCON 30 IS MOVING APPROX 455 M FORWARD
2. JASCON 30 IS AT LOCATION KP 1.842
3. RE-RUN ACHORS WITH JACON 3 AND JASCON 4



1. JASCON 30 IS MOVING APPROX 500 M FORWARD
2. JASCON 30 IS AT LOCATION KP 2.342
3. RE-RUN ACHORS WITH JACON 3 AND JASCON 4
4. JASCON 30'S WATERDEPTH IS APPROX 3.8+1.2m (LAT+MSL) = 5.0m

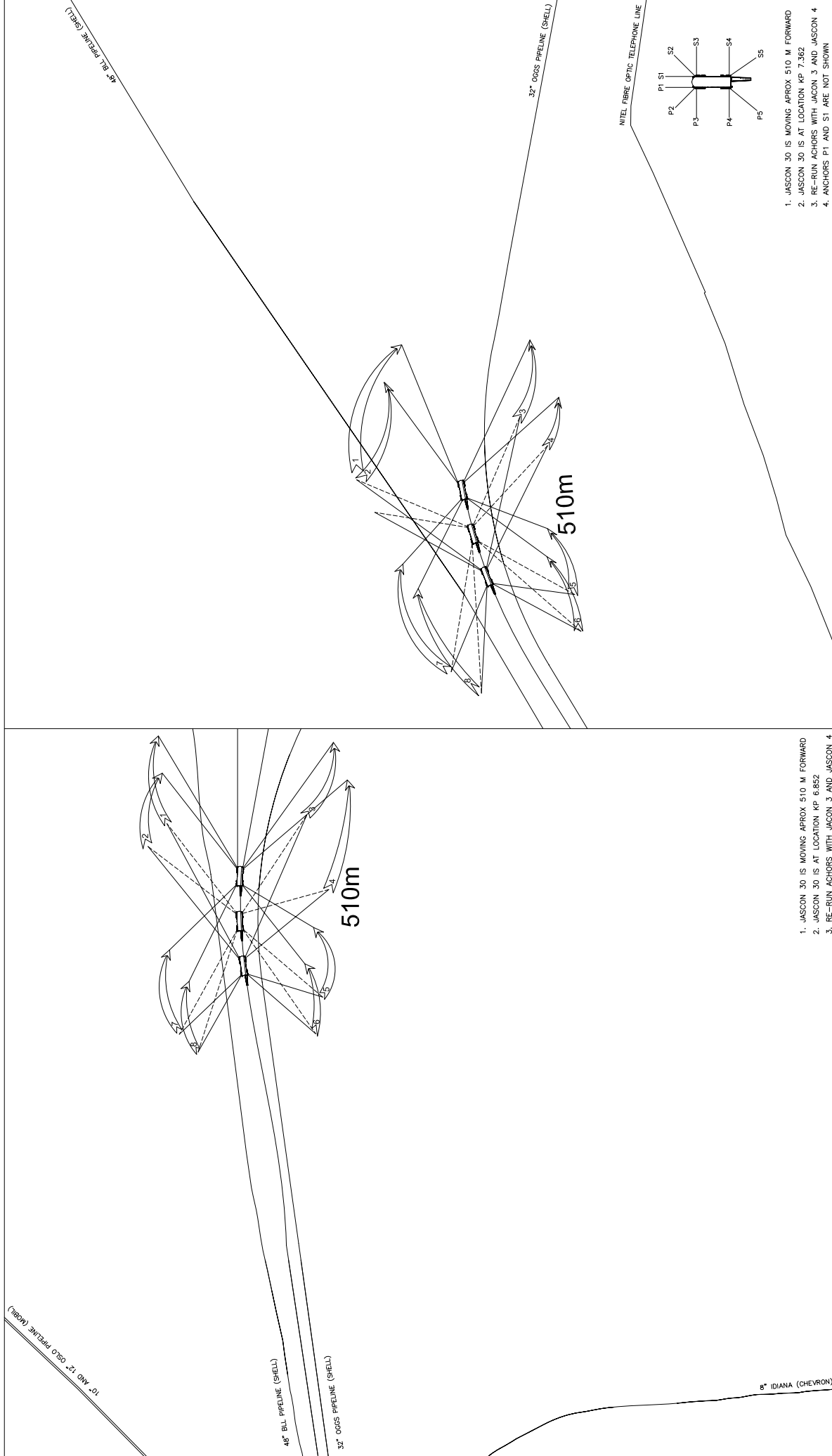


GEODETIC PARAMETERS		LEGEND		GENERAL NOTES		HORIZONTAL SCALE		DRAWING NO.		REV.	
HORIZONTAL COORDINATE SYSTEM : Meris 1950 Clarke 1860 Datum EQUIDISTANT Spheroid WGS84 Datum WGS8											

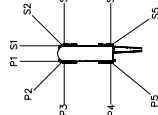


1. JASCON 30 IS MOVING APROX 500 M FORWARD
2. JASCON 30 IS AT LOCATION KP 3.342
3. RE-RUN ACHORS WITH JACON 3 AND JASCON 4

[illegible]



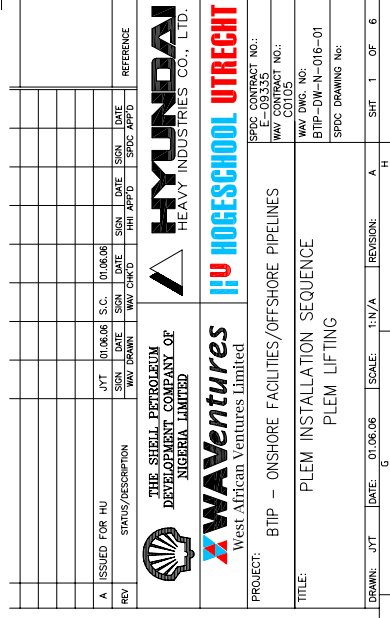
1. JASCON 30 IS MOVING APPROX 510 M FORWARD
2. JASCON 30 IS AT LOCATION KP 7.362
3. RE-RUN ACHORS WITH JACON 3 AND JASCON 4
4. ANCHORS P1 AND S1 ARE NOT SHOWN

[illegible]

APPENDIX E PLEM INSTALLATION DRAWINGS

STEP 1 ELEVATION

- MOOR CARGO BARGE ALONG STERN OF JACSON 30
- ATTACHED 2 AIR TUGGERS TO PLEM FROM JACSON 30
- RIG UP PLEM
- LIFT PLEM OFF THE CARGO BARGE

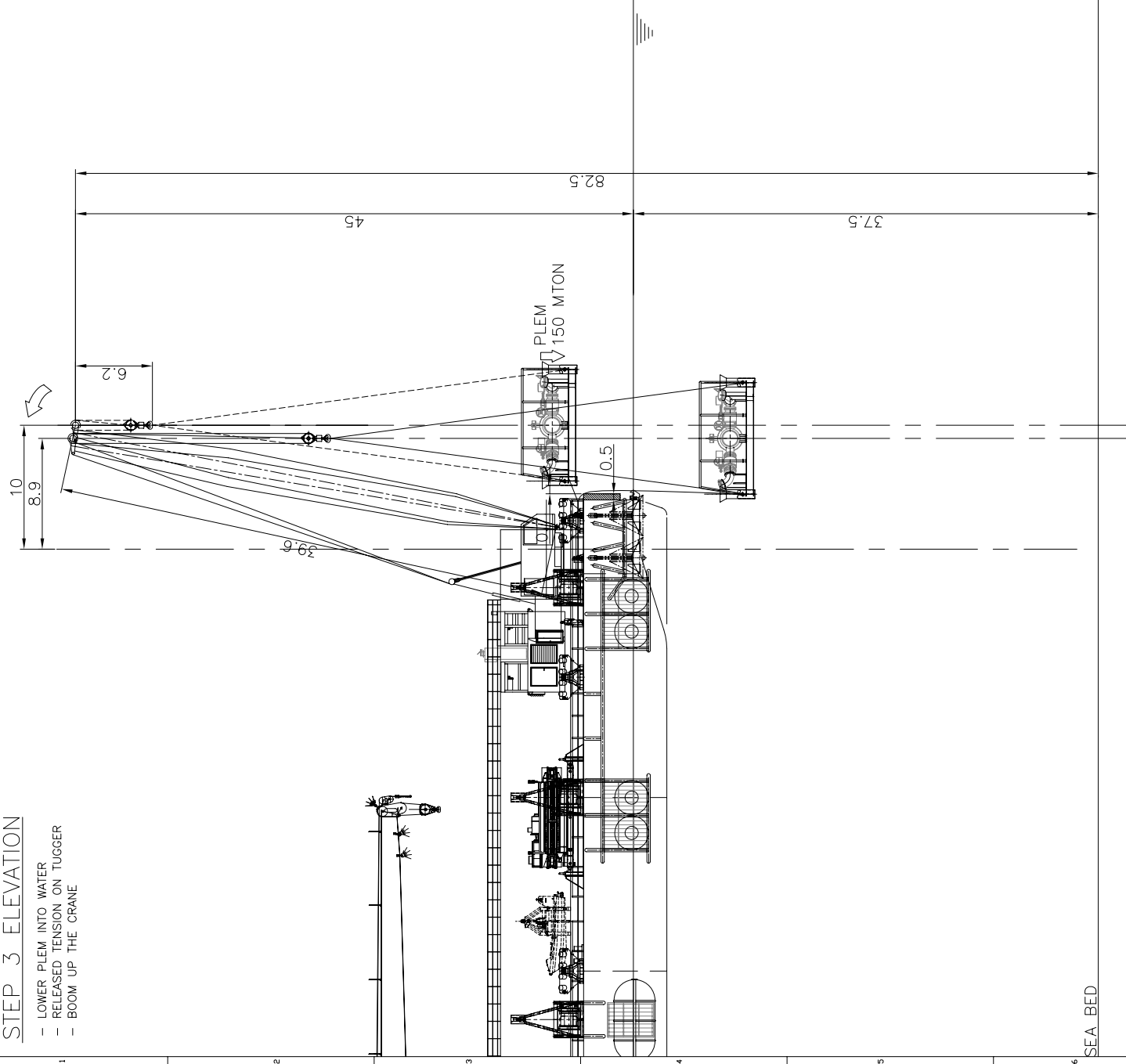


CAD FILE NAME: BTIP-DW-N-016-01
RELEASE: 2006 A

1

STEP 3 ELEVATION

- LOWER PLEM INTO WATER
- RELEASED TENSION ON TUGGER
- BOOM UP THE CRANE



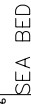
PLEM INSTALLATION

[illegible]

SEA BED

CAD FILE NAME: BTIP-DW-N-016-03
RELEASE: 2006

- LOWER PLEM TO THE SEABED

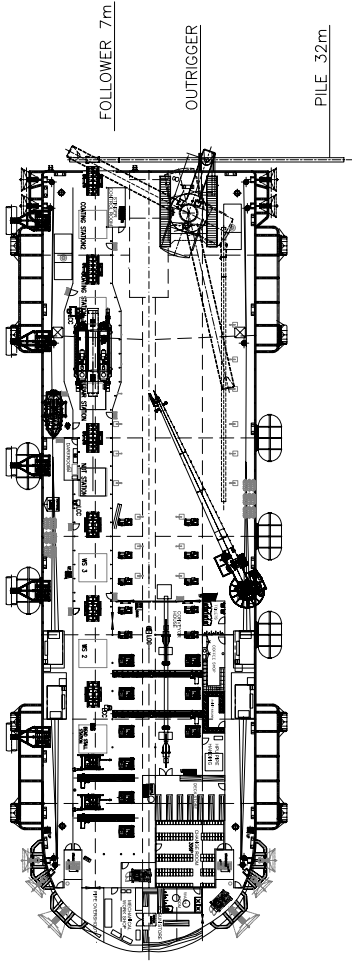


CAD FILE NAME: BTIP-DW-N-016-04
RELEASE: 2006

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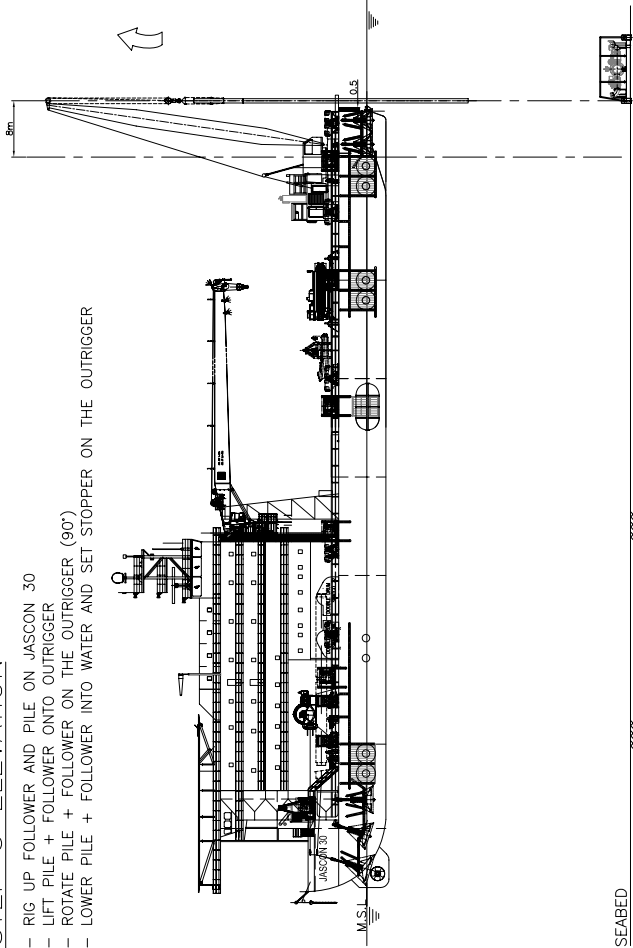
STEP 5 PLAN

- RIG UP FOLLOWER AND PILE ON JASCON 30
- LIFT PILE + HAMMER ONTO OUTRIGGER
- LOWER PILE + FOLLOWER INTO WATER AND SET STOPPER ON THE OUTRIGGER



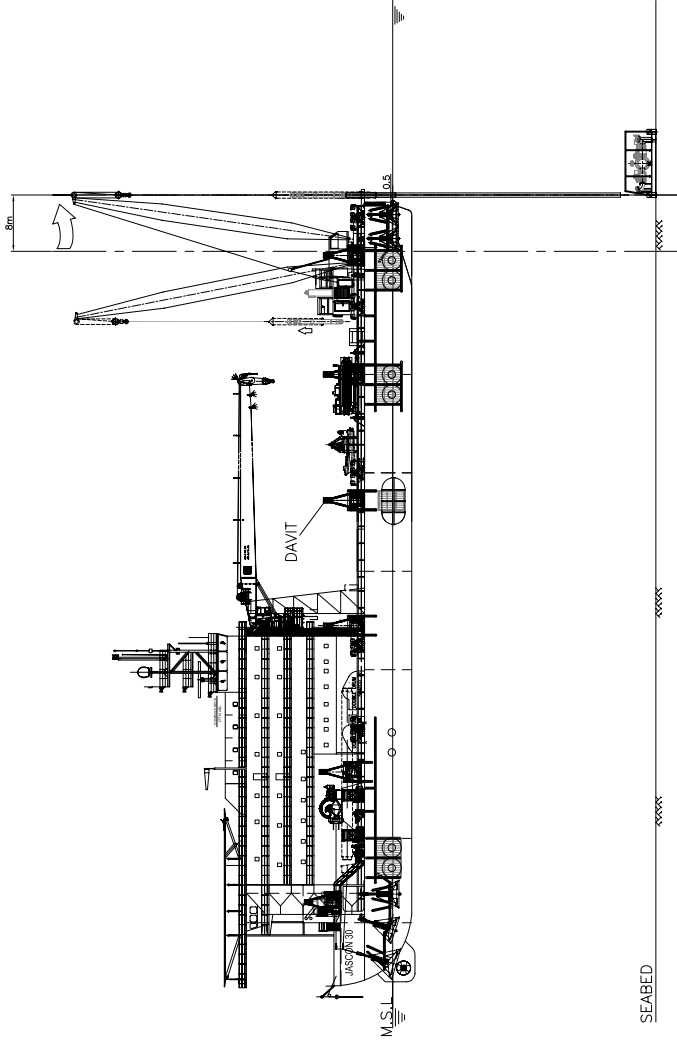
STEP 5 ELEVATION

- RIG UP FOLLOWER AND PILE ON JASCON 30
- LIFT PILE + FOLLOWER ONTO OUTRIGGER
- ROTATE PILE + FOLLOWER ON THE OUTRIGGER (90°)
- LOWER PILE + FOLLOWER INTO WATER AND SET STOPPER ON THE OUTRIGGER



STEP 6 ELEVATION

- RIG UP HAMMER
- LIFT HAMMER AND SET ONTO FOLLOWER + PILE ON THE OUTRIGGER



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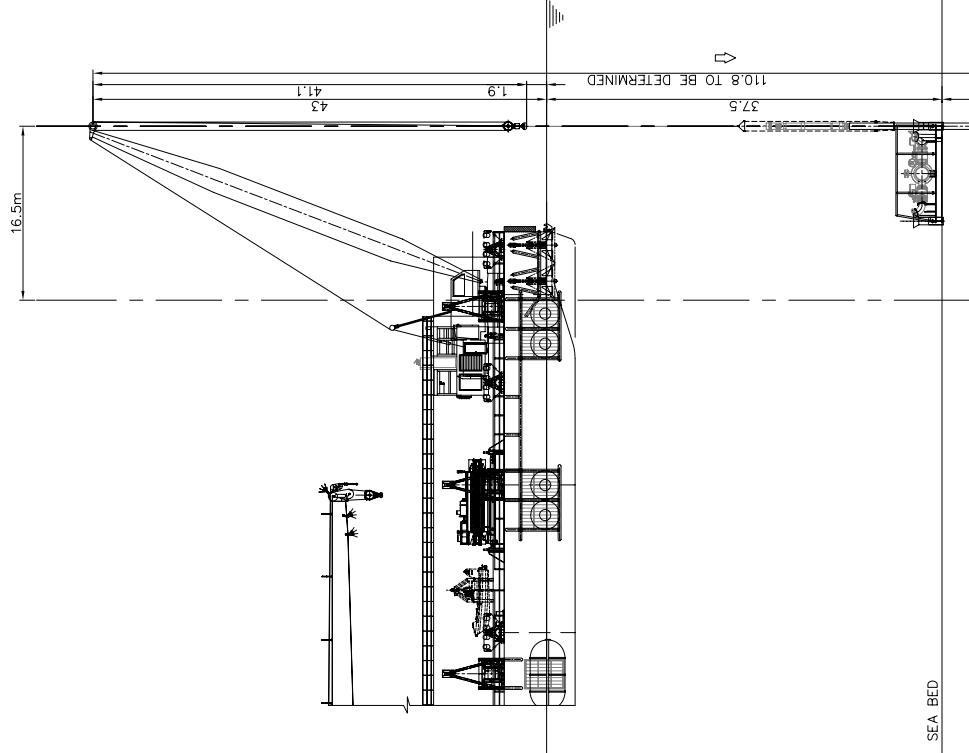
M.S.L.

SEABED

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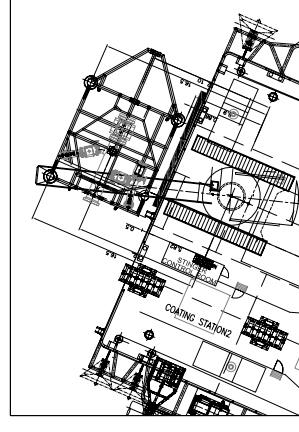
STEP 8 ELEVATION

- PILE TO REQUIRED DEPTH.



STEP 7/8 PLAN

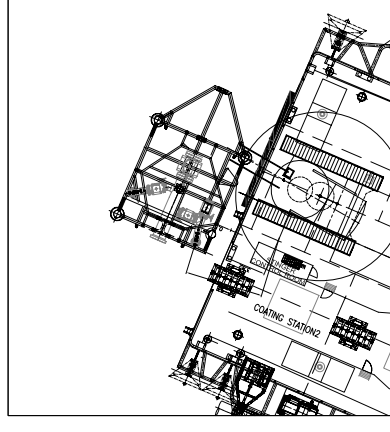
- CHECK PILE ALIGNMENT WITH DIVERS
- PILE TO REQUIRED DEPTH.



PLAN
Barge Position 1

STEP 9 PLAN

- MOVE BARGE TO NEXT LEG
- REPEAT STEP 1 THROUGH 8 FOR ALL THE OTHER LEGS



PLAN
Barge Position 2

[illegible]

 THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED	 HYUNDAI HEAVY INDUSTRIES CO., LTD.				
 WAVentures West African Ventures Limited	 HOGESCHOOL UTRECHT				
PROJECT: BTP – ONSHORE FACILITIES/OFFSHORE PIPELINES					
SPCO CONTRACT NO.: E-09335					
WAV PROJECT NO.: 00105					
WAV DWG. NO.: BTP-DW-N-016-06					
TITLE: PLEM INSTALLATION SEQUENCE PLEM PILE LIFTING/DRIVING					
SPCO DRAWING NO.:					
DRAWN: JYT	DATE: 01.06.06	SCALE: 1:1=N/A	REVISION: A	SHT: 6	OF: 6

LIFTING ANALYSIS AMERICAN HOIST 11320

Comments

This first part is based on the Offshore Curve.

Object

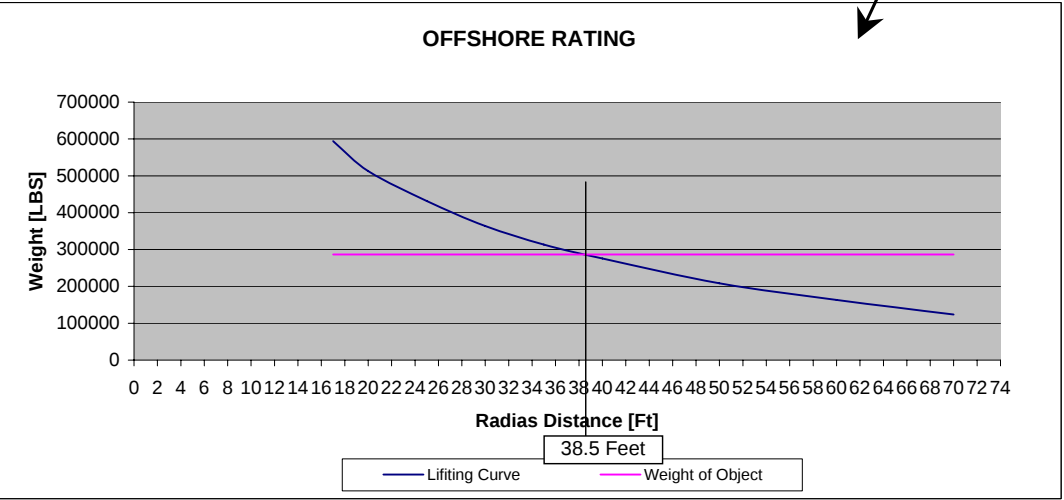
Weight	115	Metric Tonne	
Estimated ? (YES/NO)	Yes	5.75	Extra 5%
Lifting Equipment (shackles, Slings, Ect)	8.05	Metric Tonne	Add extra 7% ontop of it
Total Weight (W)	130	Metric Tonne	286601 Pounds
Width of the Object	10.28	Meter	
Length of The Object	10	Meter	

Crane Specs

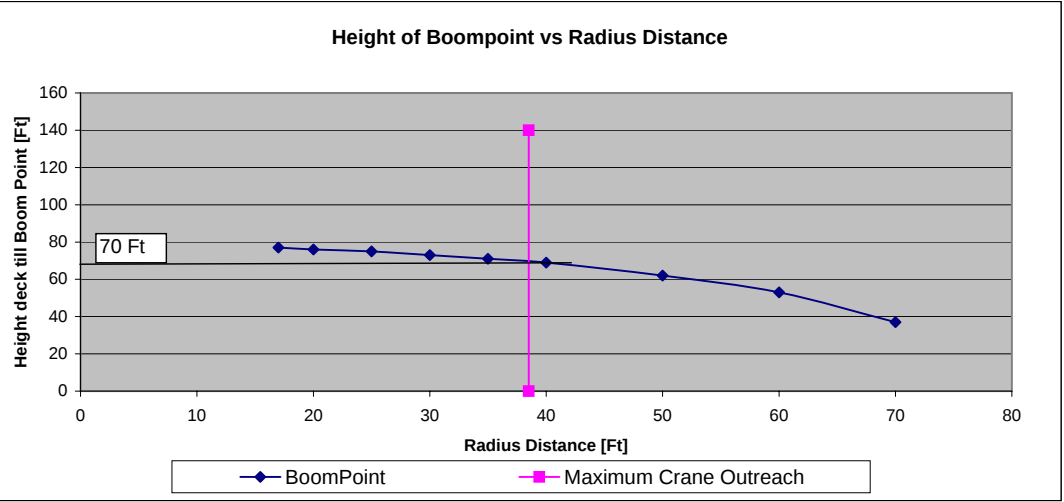
Boomlength	120	Feet	36.576	Meter
Over-all Length of Crawler	25	Feet	7.62	Meter

Maximum crane outreach	38.5	Feet	11.7348	Meter
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Clearance crane and Object	9.13648 Feet	2.7848 Meter	
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Check Lifting Sling Angel



Height between Boompoint and Deck	70 Ft	READ FROM CURVE	21.336	Meter
Angel of the Slings. Min. of 60 degrees	71 Degrees	No problem!		

Conclusion

The Clearance is very small. Recommendation: rotate the crane crawlers or another crane or lift inshore.

Comments

This second part is based on the onshore curve. There for the Dynamic factors is not calculated.

Dynamic Lift

DAF = Dynamic Amplitude Factor

1)

$$E_{KIN} = \frac{1}{2}mv^2 = E_{POT} = \frac{1}{2}ku^2 + mgu$$

$$\frac{1}{2}mv^2 = \frac{1}{2}ku^2$$

$$u = v\sqrt{\frac{m}{k}}$$

2) Implentation of 1) into 2)

$$F_{DYN} = k \times u = v\sqrt{m \times k}$$

$$F_{STAT} = m \times g$$

$$F_{TOT} = m \times g + v\sqrt{m \times k}$$

3)

$$DAF = \frac{F_{TOT}}{F_{STAT}} = \frac{m \times g + v\sqrt{m \times k}}{m \times g}$$

$$DAF = 1 + \frac{V}{g} \sqrt{\frac{K}{m}}$$

$$V = a \times \frac{2\pi}{T}$$

Heave (swell)	h =	1.2 m	a = 0.5*h =	0.6
Period Wave	T =	8 s		
Velocity Wave	V =	0.47 m/s		
Lift Speed Hook	V hook =	0.15 m/s		
Total Velocity	V tot =	0.62 m/s		
Vertical Spring rate	K =	3000 kN/m		
Weight	m =	130 mTon		

Dynamic Amplitude Factor

DAF = 1.304214 (Minus a safety factor of 1.1)

Dynamic Load 154.13433 mTon 339808 Pounds

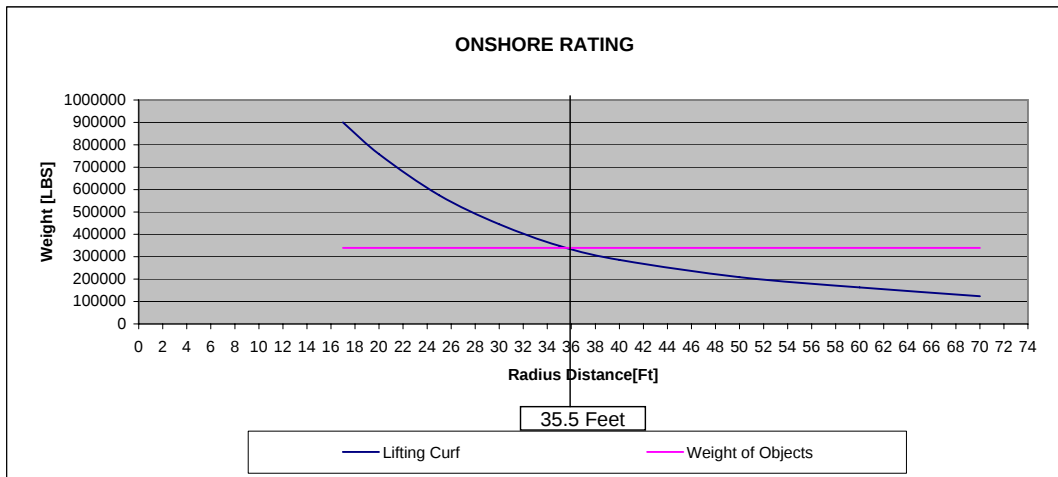
Crane Specs

Boomlength 130 Feet 39.624 Meter
Over-all Length of Crawler 25 Feet 7.62 Meter

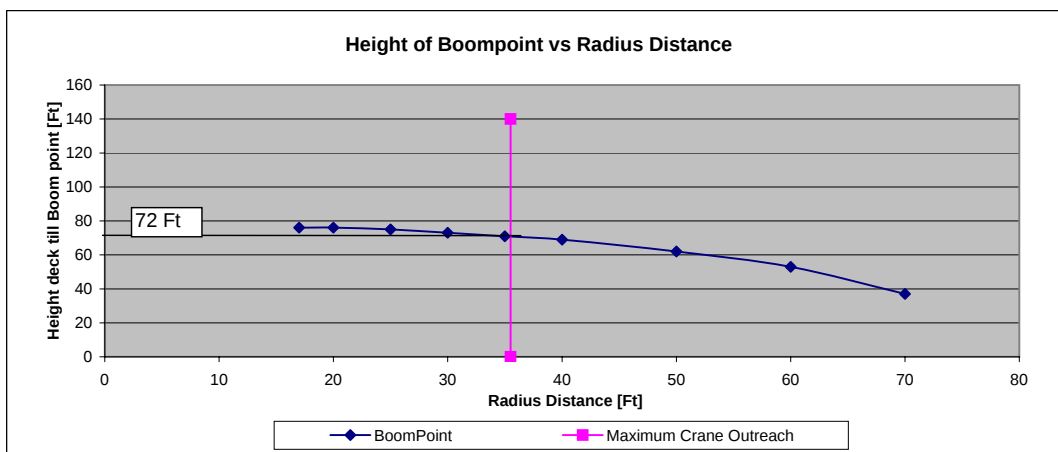
Minimum Distance to pick up 35.5 Feet 10.8204 Meter

READ FROM CURF!

Minimum Clearance 6.13648 Feet 1.8704 Meter



Check Lifting Sling Angel



Height between Boompoint and Deck **72 Ft** **READ FROM CURVE** 21.9456 Meter
 Angel of the Slings. Min. of 60 degrees 72 Degrees No problem!

Conclusion

The Distance between the Barge and the Plem is too small. At this stage the operation cannot done with a fender
 A single Crane lift from another barge is not save there for other method is needed!

Comments

Lowering Calculation. Due to the lowering of the PLEM, an extra weight will be added. Duo to the slam forces

Morrison Equation

$$F_v = \frac{1}{2} \times \delta_w \times V^2 \times C_d \times A + W \times acc + C_d \times C_d \times acc$$

$$acc = a \left(\frac{2\pi}{T} \right)^2$$

Waterproperties	$\delta_w =$	1025	m3/m		
Period Wave	T =	8	s		
Heave (swell)	h =	1.2	m	a =	0.6
Velocity Wave	V =	0.47	m/s		
Drag Coefficiencie	$C_d =$	1.5			
Effectife Area	A =	50	m2		
Volume Object	$V_d =$	150	m3		
Weight	W =	130	Mton		
acceleration	acc =	0.37	m/s2		
Extra Force by Morrison Equation	Fv =	14.0	mTon		
Total Force = M + Fw	Ftot =	144.0	mTon	317449	Pounds

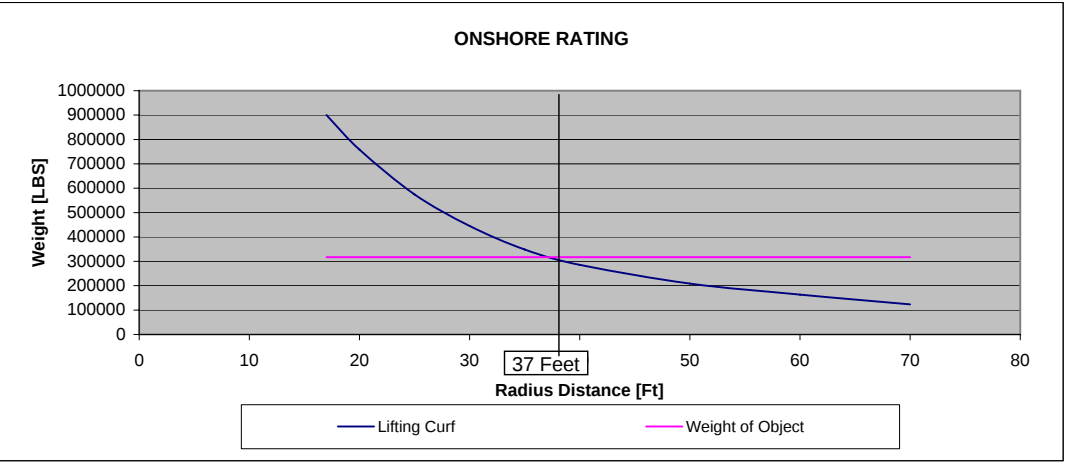
Crane Specs

Boomlength	130	Feet	39.624	Meter
Over-all Length of Crawler	25	Feet	7.62	Meter

Minimum Distance to pick up	37	Feet	11.2776	Meter
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READ FROM CURF!

Minimum Clearance	7.63648	Feet	2.3276	Meter
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Conclusion

Lowering the Plem from the Barge with the extra force due the dynamicloads is no problem

LIFTING ANALYSIS AMERICAN HOIST 11320

Comments

The lift of the object consist of the dry self weight of all the components and rigging materialmultiplied by a "Design Safety factor" SF Value. The design safety factor SF shall be calculated in accordance with guidelines in Ref.[DNV] as follow:

SF = Dynamic Amplification Factor (DAF) x Skew Load Factor x Weight Contingency Factor x Center of Gravity (CoG) Uncertainty Factor

Where:

Dynamic Amplification Factor = 1.20
Skew Load Factor = 1.00
Weight Contingency Factor = 1.05
Center of gravity Uncertainty Factor = 1.00

 $SF = 1.2 * 1.0 * 1.05 * 1.0 = 1.26$

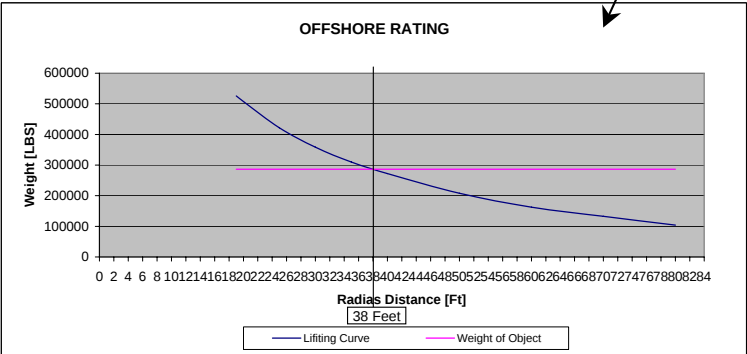
This first part is based on the Offshore Curve.

Object

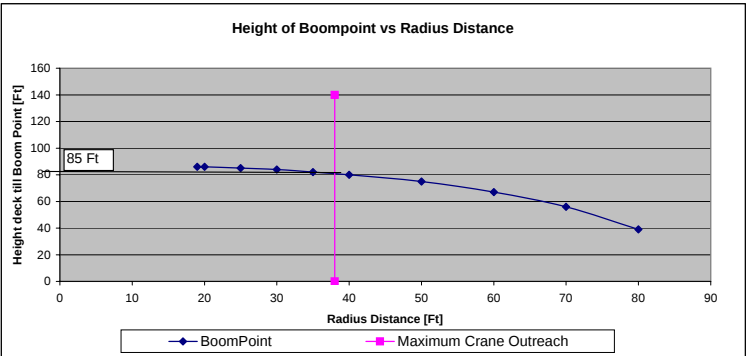
Weight	115	Metric Tonne	
Estimated ? (YES/NO)	Yes	5.75	Extra 5%
Lifting Equipment (shackles, Slings, Ect)	8.05	Metric Tonne	Add extra 7% ontop of it
Total Weight (W)	130	Metric Tonne	286601 Pounds
Width of the Object	10.28	Meter	
Length of The Object	10	Meter	

Crane Specs

Boomlength	120	Feet	36.576	Meter	
Over-all Length of Crawler	25	Feet	7.62	Meter	
Maximum crane outreach	38	Feet	11.5824	Meter	READ FROM CURVE
Clearance crane and Object	8.63648 Feet	2.6324 Meter			



Check Lifting Sling Angel



Height between Boompoint and Deck 85 Ft READ FROM CURVE 25.908 Meter
Angel of the Slings. Min. of 60 degrees 75 Degrees No problem!

Conclusion

The Clearance is very small. Recommendation: rotate the crane crawlers or another crane or lift inshore.

Comments

This second part is based on the onshore curve. There for the Dynamic factors is not calculated.

Dynamic Lift

DAF = Dynamic Amplitude Factor

$$1) \quad E_{KIN} = \frac{1}{2}mv^2 = E_{POT} = \frac{1}{2}ku^2 + mgu$$

$$\frac{1}{2}mv^2 = \frac{1}{2}ku^2$$

$$u = v\sqrt{\frac{m}{k}}$$

$$2) \text{ Implentation of 1) into 2) } \quad F_{DYN} = k \times u = v\sqrt{m \times k}$$

$$F_{STAT} = m \times g$$

$$F_{TOT} = m \times g + v\sqrt{m \times k}$$

$$3) \quad DAF = \frac{F_{TOT}}{F_{STAT}} = \frac{m \times g + v\sqrt{m \times k}}{m \times g}$$

$$DAF = 1 + \frac{V}{g} \sqrt{\frac{K}{m}} \quad \leftarrow V = a \times \frac{2\pi}{T}$$

Heave (swell)	h =	1.2 m	a = 0.5*h =	0.6
Period Wave	T =	8 s		
Velocity Wave	V =	0.47 m/s		
Lift Speed Hook	V hook =	0.15 m/s		
Total Velocity	V tot =	0.62 m/s		
Vertical Spring rate	K =	3000 kN/m		
Weight	m =	130 mTon		

Dynamic Amplitude Factor **DAF = 1.304214** (Plus a safety factor of 1.1)

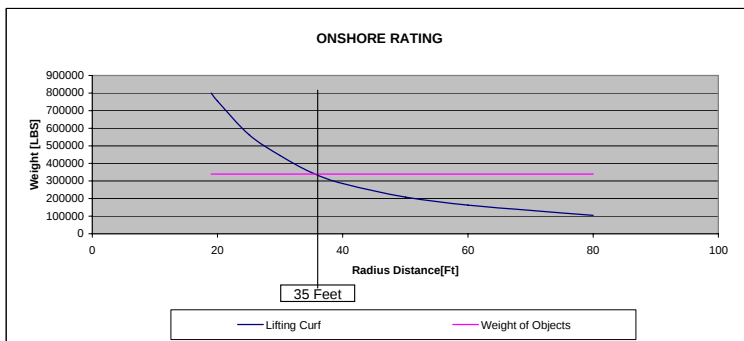
Dynamic Load 154.13433 mTon 339808 Pounds

Crane Specs

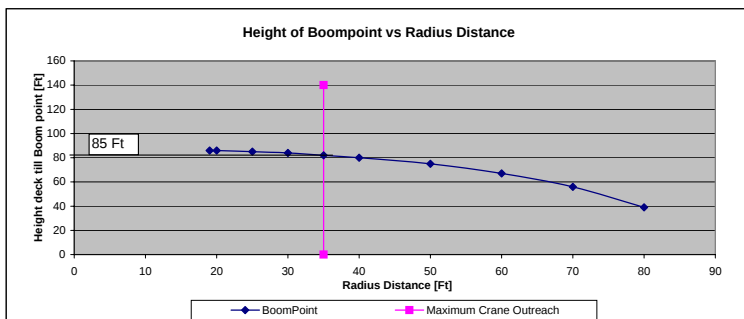
Boomlength	130 Feet	39.624 Meter
Over-all Length of Crawler	25 Feet	7.62 Meter

Minimum Distance to pick up 35 Feet 10.668 Meter **READ FROM CURF!**

Minimum Clearance 5.63648 Feet 1.718 Meter



Check Lifting Sling Angel



Height between Boompoint and Deck 85 Ft **READ FROM CURVE** 25.908 Meter

Angel of the Slings. Min. of 60 degrees 75 Degrees No problem!

Conclusion

The Distance between the Barge and the Piem is too small. At this stage the operation cannot done with a fender
A single Crane lift from another barge is not save there for other method is needed!

Comments

Lowering Calculation. Due to the lowering of the PLEM, an extra weight will be added. The result of this extra weight is due to the motion of the sea.

Morrison Equation

$$F_v = \frac{1}{2} \times \delta_w \times V^2 \times C_d \times A + W \times acc + V_d \times C_d \times acc$$

Waterproperties	$\delta_w =$	1025	m3/m		
Period Wave	T =	8	s		
Heave (swell)	h =	1.2	m	a =	0.6
Velocity Wave	V =	0.47	m/s		
Drag Coefficiencie	$C_d =$	1.5			
Effectife Area	A =	50	m2		
Volume Object	$V_d =$	150	m3		
Weight	W =	130	Mton		
acceleration	acc =	0.37	m/s2		

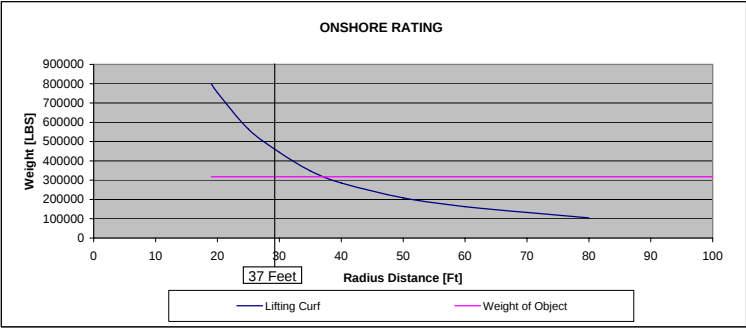
Extra Force by Morrison Equation	Fv =	14.0	mTon		
Total Force = M + Fw	Ftot =	144.0	mTon	317449	Pounds

Crane Specs

Boomlength	130	Feet	39.624	Meter
Over-all Length of Crawler	25	Feet	7.62	Meter

Minimum Distance to pick up	37	Feet	11.2776	Meter	READ FROM CURF!
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Minimum Clearance	7.63648	Feet	2.3276	Meter
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Conclusion

Lowering the Plem from the Barge with the extra force due the dynamicloads is no problem

LIFTING ANALYSIS AMERICAN HOIST 11320

Comments

The lift of the object consist of the dry self weight of all the components and rigging materialmultiplied by a "Design Safety factor" SF Value. The design safety factor SF shall be calculated in accordance with guidelines in Ref.[DNV] as follow:

SF = Dynamic Amplification Factor (DAF) x Skew Load Factor x Weight Contingency Factor x Center of Gravity (CoG) Uncertainty Factor

Where:

Dynamic Amplification Factor = 1.20
Skew Load Factor = 1.00
Weight Contingency Factor = 1.05
Center of gravity Uncertainty Factor = 1.00

$SF = 1.2 * 1.0 * 1.05 * 1.0 = 1.26$

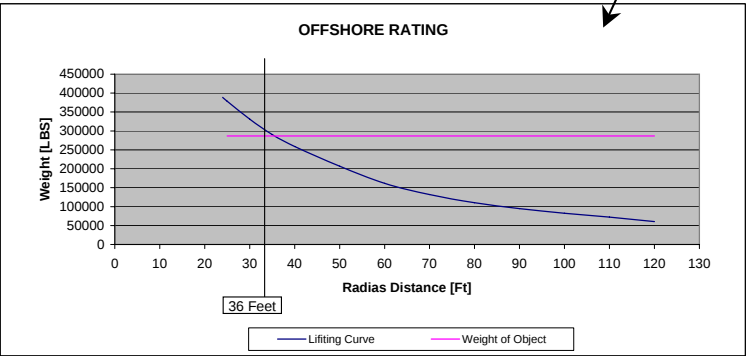
This first part is based on the Offshore Curve.

Object

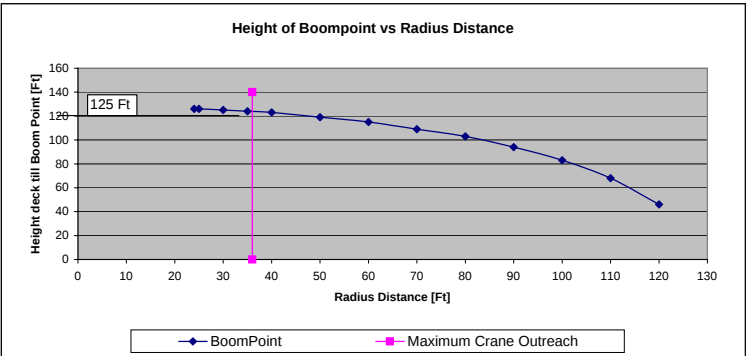
Weight	115	Metric Tonne	
Estimated ? (YES/NO)	Yes	5.75	Extra 5%
Lifting Equipment (shackles, Slings, Ect)	8.05	Metric Tonne	Add extra 7% ontop of it
Total Weight (W)	130	Metric Tonne	286601 Pounds
Width of the Object	10.28	Meter	
Length of The Object	10	Meter	

Crane Specs

Boomlength	120	Feet	36.576	Meter	
Over-all Length of Crawler	33	Feet	10.0584	Meter	
Maximum crane outreach	36	Feet	10.9728	Meter	READ FROM CURVE
Clearance crane and Object	2.63648 Feet	0.8036 Meter			



Check Lifting Sling Angel



Height between Boompoint and Deck 125 Ft READ FROM CURVE 38.1 Meter
Angel of the Slings. Min. of 60 degrees 79 Degrees No problem!

Conclusion

The Clearance is very small. Recommendation: rotate the crane crawlers or another crane or lift inshore.

Comments

This second part is based on the onshore curve. There for the Dynamic factors is not calculated.

Dynamic Lift

DAF = Dynamic Amplitude Factor

$$\begin{aligned}
 1) \quad & E_{KIN} = \frac{1}{2}mv^2 = E_{POT} = \frac{1}{2}ku^2 + mgu \\
 & \frac{1}{2}mv^2 = \frac{1}{2}ku^2 \\
 & u = v\sqrt{\frac{m}{k}} \\
 2) \text{ Implentation of 1) into 2) } & F_{DYN} = k \times u = v\sqrt{m \times k} \\
 & F_{STAT} = m \times g \\
 & F_{TOT} = m \times g + v\sqrt{m \times k} \\
 3) \quad & DAF = \frac{F_{TOT}}{F_{STAT}} = \frac{m \times g + v\sqrt{m \times k}}{m \times g} \\
 & DAF = 1 + \frac{V}{g} \sqrt{\frac{K}{m}} \quad \leftarrow V = a \times \frac{2\pi}{T}
 \end{aligned}$$

Heave (swell)	h = 1.2 m	a = 0.5*h = 0.6
Period Wave	T = 8 s	
Velocity Wave	V = 0.47 m/s	
Lift Speed Hook	V hook = 0.15 m/s	
Total Velocity	V tot = 0.62 m/s	
Vertical Spring rate	K = 3000 kN/m	
Weight	m = 130 mTon	

Dynamic Amplitude Factor **DAF = 1.304214** (Plus a safety factor of 1.1)

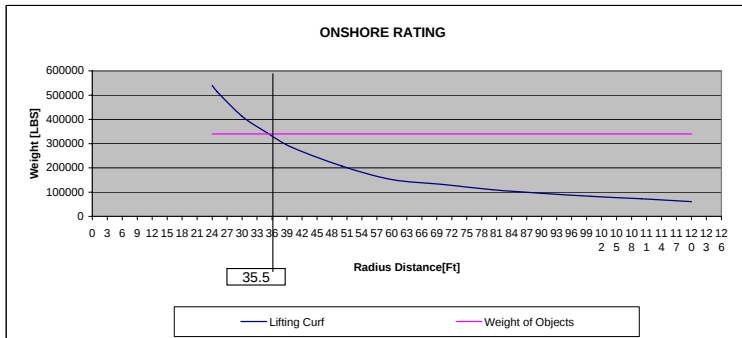
Dynamic Load 154.13433 mTon 339808 Pounds

Crane Specs

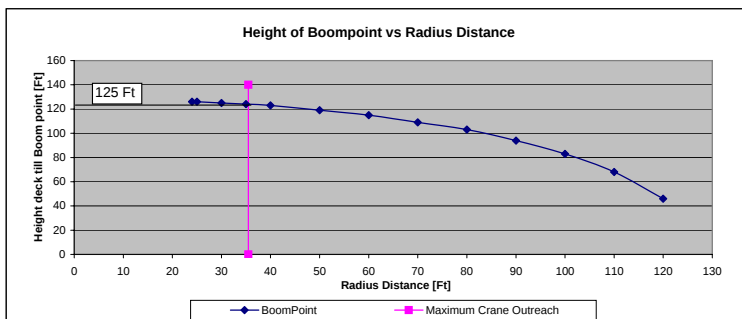
Boomlength	130 Feet	39.624 Meter
Over-all Length of Crawler	25 Feet	7.62 Meter

Minimum Distance to pick up 35.5 Feet 10.8204 Meter **READ FROM CURF!**

Minimum Clearance 6.13648 Feet 1.8704 Meter



Check Lifting Sling Angel



Height between Boompoint and Deck 125 Ft **READ FROM CURVE** 38.1 Meter
 Angel of the Slings. Min. of 60 degrees 79 Degrees No problem!

Conclusion

The Distance between the Barge and the Plem is too small. At this stage the operation cannot done with a fender
 A single Crane lift from another barge is not save there for other method is needed!

Comments

Lowering Calculation. Due to the lowering of the PLEM, an extra weight will be added. The result of this extra weight is due to the motion of the sea.

Morrison Equation

$$F_v = \frac{1}{2} \times \delta_w \times V^2 \times C_d \times A + W \times acc + V_d \times C_d \times acc$$

Waterproperties	$\delta_w =$	1025	m3/m		
Period Wave	T =	8	s		
Heave (swell)	h =	1.2	m	a =	0.6
Velocity Wave	V =	0.47	m/s		
Drag Coefficiencie	$C_d =$	1.5			
Effectife Area	A =	50	m2		
Volume Object	$V_d =$	150	m3		
Weight	W =	130	Mton		
acceleration	acc =	0.37	m/s2		

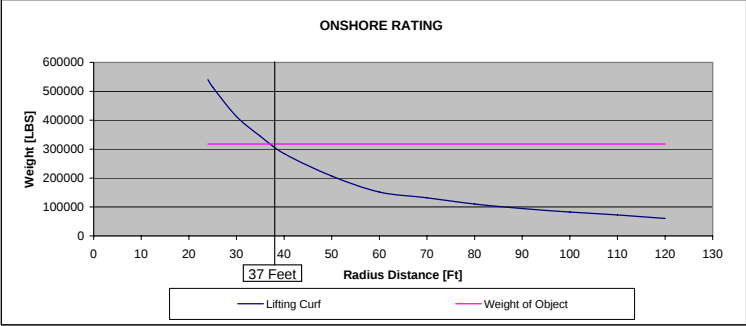
Extra Force by Morrison Equation	Fv =	14.0	mTon		
Total Force = M + Fw	Ftot =	144.0	mTon	317449	Pounds

Crane Specs

Boomlength	130	Feet	39.624	Meter
Over-all Length of Crawler	25	Feet	7.62	Meter

Minimum Distance to pick up	37	Feet	11.2776	Meter	READ FROM CURF!
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Minimum Clearance	7.63648	Feet	2.3276	Meter
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Conclusion

Lowering the Plem from the Barge with the extra force due the dynamicloads is no problem

LIFTING ANALYSIS AMERICAN HOIST 11320

Comments

The lift of the object consist of the dry self weight of all the components and rigging material multiplied by a "Design Safety factor" SF Value. The design safety factor SF shall be calculated in accordance with guidelines in Ref.[DNV] as follow:

SF = Dynamic Amplification Factor (DAF) x Skew Load Factor x Weight Contingency Factor x Center of Gravity (CoG) Uncertainty Factor

Where:

Dynamic Amplification Factor = 1.20
 Skew Load Factor = 1.00
 Weight Contingency Factor = 1.05
 Center of gravity Uncertainty Factor = 1.00

$$SF = 1.2 * 1.0 * 1.05 * 1.0 = 1.26$$

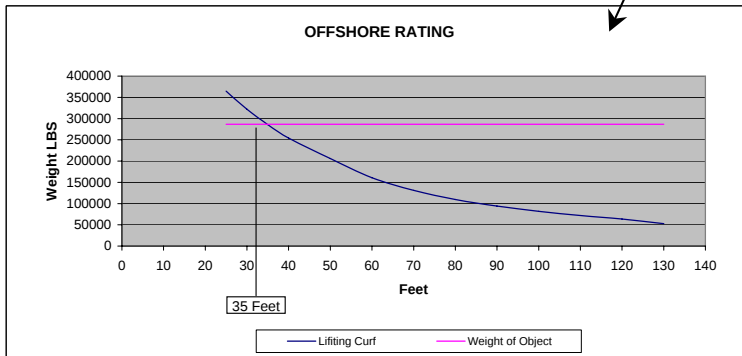
This first part is based on the Offshore Curve.

Object

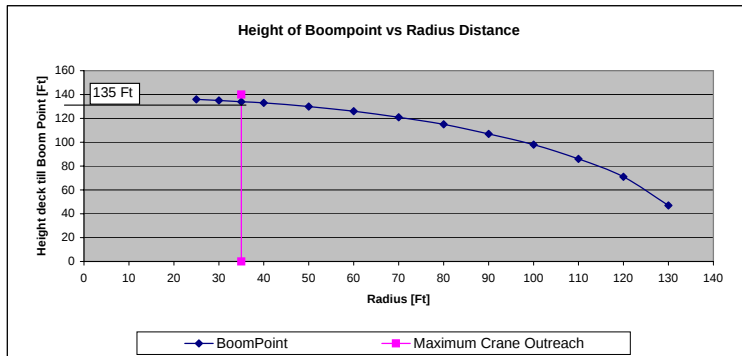
Weight	115	Metric Tonne	
Estimated ? (YES/NO)	Yes	5.75	Extra 5%
Lifting Equipment (shackles, Slings, Ect)	8.05	Metric Tonne	Add extra 7% ontop of it
Total Weight (W)	130	Metric Tonne	286601 Pounds
Width of the Object	10.28	Meter	
Length of The Object	10	Meter	

Crane Specs

Boomlength	130	Feet	39.624	Meter	
Over-all Length of Crawler	33	Feet	10.0584	Meter	
Maximum crane outreach	35	Feet	10.668	Meter	READ FROM CURVE
Clearance crane and Object	1.63648 Feet	0.4988 Meter			



Check Lifting Sling Angel



Height between Boompoint and Deck **135 Ft** **READ FROM CURVE** 41.148 Meter
 Angel of the Slings. Min. of 60 degrees 80 Degrees No problem!

Conclusion

The Clearance is very small. Recommendation: rotate the crane crawlers or another crane or lift inshore.

Comments

This second part is based on the onshore curve. There for the Dynamic factors is not calculated.

Dynamic Lift

DAF = Dynamic Amplitude Factor

$$\begin{aligned}
 1) \quad & E_{KIN} = \frac{1}{2}mv^2 = E_{POT} = \frac{1}{2}ku^2 + mgu \\
 & \frac{1}{2}mv^2 = \frac{1}{2}ku^2 \\
 & u = v\sqrt{\frac{m}{k}} \\
 2) \text{ Implentation of 1) into 2) } & F_{DYN} = k \times u = v\sqrt{m \times k} \\
 & F_{STAT} = m \times g \\
 & F_{TOT} = m \times g + v\sqrt{m \times k} \\
 3) \quad & DAF = \frac{F_{TOT}}{F_{STAT}} = \frac{m \times g + v\sqrt{m \times k}}{m \times g} \\
 & DAF = 1 + \frac{V}{g} \sqrt{\frac{K}{m}} \quad \leftarrow V = a \times \frac{2\pi}{T}
 \end{aligned}$$

Heave (swell)	h = 1.2 m	a = 0.5*h = 0.6
Period Wave	T = 8 s	
Velocity Wave	V = 0.47 m/s	
Lift Speed Hook	V hook = 0.15 m/s	
Total Velocity	V tot = 0.62 m/s	
Vertical Spring rate	K = 3000 kN/m	
Weight	m = 130 mTon	

Dynamic Amplitude Factor **DAF = 1.304214** (Plus a safety factor of 1.1)

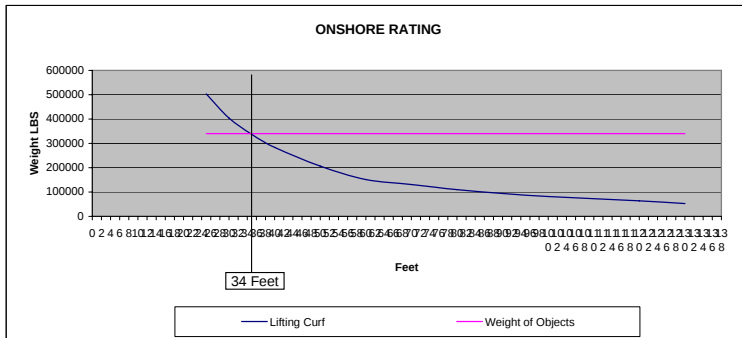
Dynamic Load 154.13433 mTon 339808 Pounds

Crane Specs

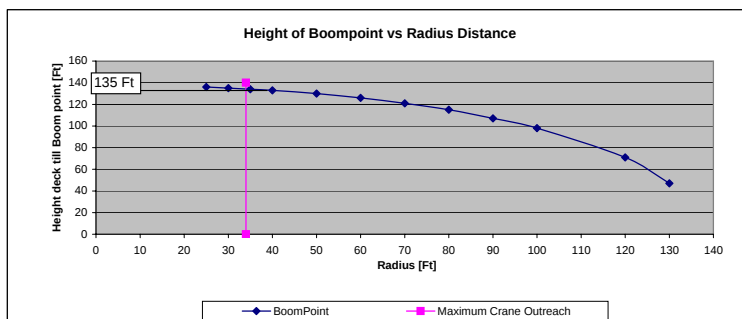
Boomlength	130 Feet	39.624 Meter
Over-all Length of Crawler	25 Feet	7.62 Meter

Minimum Distance to pick up 34 Feet 10.3632 Meter **READ FROM CURF!**

Minimum Clearance 4.63648 Feet 1.4132 Meter



Check Lifting Sling Angel



Height between Boompoint and Deck 125 Ft **READ FROM CURVE** 38.1 Meter
 Angel of the Slings. Min. of 60 degrees 79 Degrees No problem!

Conclusion

The Distance between the Barge and the Plem is on the small side. Rotating the crane is advisable
 A single Crane lift from another barge is not save there for other method is needed!

Comments

Lowering Calculation. Due to the lowering of the PLEM, an extra weight will be added. The result of this extra weight is due to the motion of the sea.

Morrison Equation

$$F_v = \frac{1}{2} \times \delta_w \times V^2 \times C_d \times A + W \times acc + V_d \times C_d \times acc$$

Waterproperties	$\delta_w =$	1025	m3/m		
Period Wave	T =	8	s		
Heave (swell)	h =	1.2	m	a =	0.6
Velocity Wave	V =	0.47	m/s		
Drag Coefficiencie	$C_d =$	1.5			
Effectife Area	A =	50	m2		
Volume Object	$V_d =$	150	m3		
Weight	W =	130	Mton		
acceleration	acc =	0.37	m/s2		

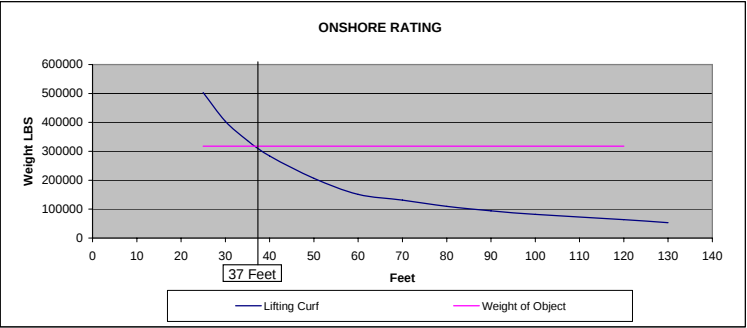
Extra Force by Morrison Equation	Fv =	14.0	mTon		
Total Force = M + Fw	Ftot =	144.0	mTon	317449	Pounds

Crane Specs

Boomlength	130	Feet	39.624	Meter
Over-all Length of Crawler	25	Feet	7.62	Meter

Minimum Distance to pick up	37	Feet	11.2776	Meter	READ FROM CURF!
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Minimum Clearance	7.63648	Feet	2.3276	Meter
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Conclusion

Lowering the Plem from the Barge with the extra force due the dynamicloads is no problem

APPENDIX F TABLE OF FRICTION FACTORS

Anchor Type (a)	SOFT SOILS (Soft clays and silts)		HARD SOILS (Sands and stiff clays)	
	H _R (kips)	b	H _R (kips)	b
Boss	210	0.94	270	0.94
BRUCE Cast	32	0.92	250	0.8
BRUCE Flat Fluke Twin Shank	250	0.92	(c)	(c)
BRUCE Twin Shank	189	0.92	210	0.94
Danforth	87	0.92	126	0.8
Flipper Delta	139	0.92	(c)	(c)
G.S. AC-14	87	0.92	126	0.8
Hook	189	0.92	100	0.8
LWT (Lightweight)	87	0.92	126	0.8
Moorfast	117	0.92 (f)	60	0.8
			100 (g)	0.8
NAVMOR	210	0.94	270	0.94
Offdrill II	117	0.92 (f)	60	0.8
			100 (g)	0.8
STATO	210	0.94	250 (e)	0.94
			190 (f)	0.94
STEVDIG	139	0.92	290	0.8
STEVFIX	189	0.92	290	0.8
STEVIN	139	0.92	165	0.8
STEVMUD	250	0.92	(g)	(g)
STEVPRIS (straight shank)	189	0.92	210	0.94
Stockless (fixed fluke)	46	0.92	70	0.8
			44 (h)	0.8
Stockless (movable fluke)	24	0.92	70	0.8
			44 (h)	0.8

(a) Fluke angles set for 50 deg in soft soils and according to manufacturer's specifications in hard soils, except when otherwise noted.

(b) "b" is an exponent constant.

(c) No data available.

(d) For 28-deg fluke angle.

(e) For 30-deg fluke angle.

(f) For dense sand conditions (near shore).

(g) Anchor not used in this seafloor condition.

(h) For 48-deg fluke angle.

(i) For 20-deg fluke angle (from API 2SK effective March 1, 1997).

Data from NCEL – Techdata Sheet 83-08R