The Dynamic Bowser Routing Problem

Electronic Addendum 4

In this electronic addendum we provide detailed results of our computational study carried out using our BILP and MILP models (Tables 1 and 2), and the myopic heuristic (Table 3).

			MILP					BILP				
B	T	M	Obj	Distance	Shortages	Gap %	sec	Obj	Distance	Shortages	Gap %	sec
500	A	5	0	0	0		0.374	0	0	0		0.531
500	B	5	0	0	0		0.842	0	0	0		1.185
500	C	5	400	0	4		2.559	400	0	4		62.229
500	D	5	1965.86	465.86	15		77.486	1965.86	465.86	15		201.912
500	E	5	3273.97	1573.97	17		451.373	3273.97	1573.97	17		2514.19
500	F	5	2524.16	1624.16	9		244.048	2524.16	1624.16	9		945.71
500	A	10	100	0	1		0.843	100	0	1		0.905
500	B	10	1379.23	479.23	9		6.848	1379.23	479.23	9		29.188
500	C	10	967.217	867.217	1		9.235	1130	1030	1	46.6113	3604.18
500	D	10	1174.74	674.74	5		13.712	1174.74	674.74	5		86.55
500	E	10	1971.92	1571.92	4		163.099	1971.92	1571.92	4	4.88677	3600.46
500	F	10	6338.54	2338.54	40		800.394	6338.54	2338.54	40		1663.11
500	A	15	0	0	0		1.701	0	0	0		2.185
500	B	15	496.117	496.117	0		3.51	496.117	496.117	0		16.271
500	C	15	851.6	751.6	1		32.541	851.6	751.6	1		558.671
500	D	15	1178.6	1078.6	1		20.451	1178.6	1078.6	1		216.545
500	E	15	9220.67	2320.67	69	48.7846	3604.68	17030.3	2630.3	144	74.9833	3600.46
500	F	15	9882.08	3882.08	60	56.5618	3602.08	12396.2	3796.21	85.9999	68.2907	3600.6
1000	A	5	0	0	0		0.344	0	0	0		0.515
1000	B	5	0	0	0		1.014	-1.4629E-09	-1.4629E-09	0		9.64
1000	C	5	400	0	4		2.886	400	0	4		93.397
1000	D	5	1965.86	465.86	15		49.328	1965.86	465.86	15		627.436
1000	E	5	3273.97	1573.97	17		312.408	3273.97	1573.97	17	14.9906	3600.36
1000	F	5	2524.16	1624.16	9		465.288	2524.16	1624.16	9		1303.25
1000	A	10	100	0	1		0.998	100	0	1		0.936
1000	B	10	1379.23	479.23	9		7.488	1379.23	479.23	9		25.303
1000	C	10	967.217	867.217	1		9.423	1595.73	1495.73	1	58.4076	3602.2
1000	D	10	1174.74	674.74	5		17.847	1174.74	674.74	5		82.525
1000	E	10	1971.92	1571.92	4		225.141	2671.92	1571.92	11	30.8586	3600.44
1000	F	10	6338.54	2338.54	40		899.58	6338.54	2338.54	40		2086.09
1000	A	15	0	0	0		1.826	0	0	0		2.325
1000	B	15	496.117	496.117	0		3.338	496.117	496.117	-9.21541E-13		15.085
1000	C	15	851.6	751.6	1		38.267	851.6	751.6	1		651.975
1000	D	15	1178.6	1078.6	1		27.128	1178.6	1078.6	1		223.877
1000	E	15	9192.45	3092.45	61	38.5822	3601.14	11331.4	2831.4	85	59.5785	3600.6
1000	F	15	8425.69	2825.69	56	26.3554	3602.08	9790.47	3290.47	65	54.5633	3600.74
2000	A	5	0	0	0		0.343	0	0	0		0.515
2000	B	5	0	0	0		0.92	0	0	0		6.162
2000	C	5	400	0	4		2.512	400	0	4		88.53
2000	D	5	1965.86	465.86	15		62.135	1965.86	465.86	15		147.765
2000	E	5	3273.97	1573.97	17		312.314	3555.91	1155.91	24	14.3969	3600.35
2000	F	5	2524.16	1624.16	9		370.128	2524.16	1624.16	9		1262.81
2000	A	10	100	0	1		0.983	100	0	1		1.17
2000	B	10	1379.23	479.23	9		9.516	1379.23	479.23	9		30.311
2000	C	10	967.217	867.217	1		11.076	967.217	867.217	1		1869.53
2000	D	10	1174.74	674.74	5		8.253	1174.74	674.74	5		145.377
2000	E	10	1971.92	1571.92	4		225.905	1971.92	1571.92	4		3357.67
2000	F	10	6338.54	2338.54	40		527.814	6338.54	2338.54	40		1035.85
2000	A	15	0	0	0		2.059	0	0	0		2.355
2000	B	15	496.117	496.117	0		3.276	496.117	496.117	-1.27105E-13		16.271
2000	C	15	851.6	751.6	1		24.71	851.6	751.6	1		989.904
2000	D	15	1178.6	1078.6	1		27.721	1178.6	1078.6	1		251.146
2000	E	15	8780.88	2180.88	66	32.4827	3601.44	10846.8	3346.8	75	56.8454	3600.56
2000	F	15	8369.1	2769.1	56		3154.29	10980	3080	79	61.0722	3600.91

Table 1: MILP and BILP results $p = 100$

			MILP					BILP				
B	T	M	Obj	Distance	Shortages	Gap %	sec	Obj	Distance	Shortages	Gap %	sec
500	A	5	0	0	0		0.39	0	0	0		0.593
500	B	5	0	0	0		0.858	0	0	0		0.78
500	C	5	449.705	449.705	0		3.088	449.705	449.705	0		58.438
500	D	5	5550.57	1550.57	8		39.578	5550.57	1550.57	8		277.963
500	E	5	9170	3170	12		257.916	9170	3170	12		1570.32
500	F	5	5969.94	2469.94	7		251.442	5969.94	2469.94	7		839.363
500	A	10	500	0	1		0.874	500	0	1		0.951
500	B	10	3867.54	867.54	6		10	3867.54	867.54	6		21.357
500	C	10	1367.22	867.22	1		17.488	1934.99	1434.99	1	53.4874	3600.39
500	D	10	2883.62	883.62	4		15.99	2883.62	883.62	4		132.273
500	E	10	3571.92	1571.92	4		348.179	3571.92	1571.92	4		3155.59
500	F	10	21550	2550	38		1099.68	21550	2550	38		1574.47
500	A	15	0	0	0		1.685	0	0	0		2.262
500	B	15	496.117	496.117	0		3.385	496.117	496.117	0		13.229
500	C	15	1251.6	751.6	1		6.895	1251.6	751.6	1		457.847
500	D	15	1209.66	1209.66	0		25.256	1209.66	1209.66	0		252.02
500	E	15	31417.6	3917.6	55	0.239768	3601.13	96860.9	4860.9	184	86.9555	3600.53
500	F	15	37155	3655	67	0.527669	3602.08	61186.7	4686.7	113	74.4619	3600.6
1000	A	5	0	0	0		0.39	0	0	0		0.624
1000	B	5	0	0	0		0.843	0	0	0		8.222
1000	C	5	449.705	449.705	0		2.714	449.705	449.705	0		266.949
1000	D	5	5550.57	1550.57	8		34.539	5550.57	1550.57	8		275.217
1000	E	5	9170	3170	12		322.454	9170	3170	12		1467.35
1000	F	5	5969.94	2469.94	7		265.388	5969.94	2469.94	7		603.459
1000	A	10	500	0	1		0.873	500	0	1		1.061
1000	B	10	3867.54	867.54	6		5.476	3867.54	867.54	6		26.13
1000	C	10	1367.22	867.22	1		17.878	1718.99	1218.99	1	36.598	3600.33
1000	D	10	2883.62	883.62	4		8.954	2883.62	883.62	4		33.868
1000	E	10	3571.92	1571.92	4		503.259	3571.92	1571.92	4		3555.06
1000	F	10	21550	2550	38		1177.67	21550	2550.05	37.9999		1458.81
1000	A	15	0	0	0		1.888	0	0	0		2.2
1000	B	15	496.117	496.117	0		3.541	496.117	496.117	0		16.006
1000	C	15	1251.6	751.6	1		21.185	1251.6	751.6	1		1019.72
1000	D	15	1209.66	1209.66	0		25.584	1209.66	1209.66	0		248.775
1000	E	15	29308	3808	51	0.242177	3601.02	35886	4386.05	62.9999	51.7697	3600.6
1000	F	15	36834.3	3834.3	66	0.463376	3602.3	37549.4	4049.4	67	51.3077	3600.75
2000	A	5	0	0	0		0.359	0	0	0		0.749
2000	B	5	0	0	0		0.858	0	0	0		6.287
2000	C	5	449.705	449.705	0		2.917	449.705	449.705	0		91.885
2000	D	5	5550.57	1550.57	8		37.331	5550.57	1550.57	8		201.304
2000	E	5	9170	3170	12		267.027	9170	3170	12		1421.17
2000	F	5	5969.94	2469.94	7		208.012	5969.94	2469.94	7		746.044
2000	A	10	500	0	1		0.842	500	0	1		1.108
2000	B	10	3867.54	867.54	6		8.799	3867.54	867.54	6		30.28
2000	C	10	1367.22	867.22	1		13.135	1367.22	867.22	1	13.6041	3600.25
2000	D	10	2883.62	883.62	4		12.855	2883.62	883.62	4		78.032
2000	E	10	3571.92	1571.92	4		359.926	3571.92	1571.92	4	18.4075	3600.96
2000	F	10	21550	2550	38		496.692	21550	2550	38		1341.42
2000	A	15	0	0	0		1.856	0	0	0		1.981
2000	B	15	496.117	496.117	0		3.635	496.117	496.117	0		14.211
2000	C	15	1251.6	751.6	1		6.583	1251.6	751.6	1		829.286
2000	D	15	1209.66	1209.66	0		28.018	1209.66	1209.66	0		215.733
2000	E	15	30186.5	4186.5	52	0.373638	3601.02	55258	2758	105	73.6123	3600.47
2000	F	15	33918.4	3918.4	60	0.369208	3602.72	70996.9	4496.9	133	78.2121	3600.66

Table 2: MILP and BILP results $p = 500$

			Asset refueling threshold R (% of tank capacity)											
			25				10				0			
B	T	M	Distance	% Reduction	Shortages	% Reduction	Distance	% Reduction	Shortages	% Reduction	Distance	% Reduction	Shortages	% Reduction
500	A	5	5231.71	100	0	0	5231.71	100	0	0	1421.22	100	0	0
500	B	5	4626.31	100	3	100	4626.31	100	3	100	4224.79	100	3	100
500	C	5	4769.31	100	31	87	4769.31	100	31	87	4686.41	100	31	87
500	D	5	4509.69	90	39	62	4509.69	90	39	62	4509.69	90	39	62
500	E	5	5018.9	69	34	50	5018.9	69	34	50	5018.9	69	34	50
500	F	5	5258.96	69	17	47	5258.96	69	17	47	5258.96	69	17	47
500	A	10	4949.35	100	0	0	4949.35	100	0	0	3481.78	100	4	75
500	B	10	4408.26	89	2	-350	4408.26	89	2	-350	3548.68	86	23	61
500	C	10	4646.77	81	31	97	4646.77	81	31	97	4326.16	80	17	94
500	D	10	4774.13	86	8	38	4774.13	86	8	38	4617.65	85	8	38
500	E	10	4843.26	68	49	92	4843.26	68	49	92	4843.26	68	49	92
500	F	10	5435.16	57	137	71	5435.16	57	137	71	5435.16	57	137	71
500	A	15	4956.41	100	13	100	4956.41	100	13	100	1700.84	100	0	0
500	B	15	4682.18	89	36	100	4682.18	89	36	100	4682.18	89	36	100
500	C	15	4785.66	84	44	98	4785.66	84	44	98	4785.66	84	44	98
500	D	15	4715.95	77	62	98	4715.95	77	62	98	4292.83	75	59	98
500	E	15	4934.31	49	205	67	4934.31	49	205	67	4934.31	49	205	67
500	F	15	5017.14	26	212	72	5017.14	26	212	72	5017.14	26	212	72
1000	A	5	5231.71	100	0	0	5231.71	100	0	0	1421.22	100	0	0
1000	B	5	4626.31	100	3	100	4626.31	100	3	100	4224.79	100	3	100
1000	C	5	4769.31	100	31	87	4769.31	100	31	87	4686.41	100	31	87
1000	D	5	4509.69	90	39	62	4509.69	90	39	62	4509.69	90	39	62
1000	E	5	5018.9	69	34	50	5018.9	69	34	50	5018.9	69	34	50
1000	F	5	5258.96	69	17	47	5258.96	69	17	47	5258.96	69	17	47
1000	A	10	4949.35	100	0	0	4949.35	100	0	0	3481.78	100	4	75
1000	B	10	4408.26	89	2	-350	4408.26	89	2	-350	3548.68	86	23	61
1000	C	10	4646.77	81	31	97	4646.77	81	31	97	4326.16	80	17	94
1000	D	10	4774.13	86	8	38	4774.13	86	8	38	4617.65	85	8	38
1000	E	10	4843.26	68	49	92	4843.26	68	49	92	4843.26	68	49	92
1000	F	10	5435.16	57	137	71	5435.16	57	137	71	5435.16	57	137	71
1000	A	15	4956.41	100	13	100	4956.41	100	13	100	1700.84	100	0	0
1000	B	15	4682.18	89	36	100	4682.18	89	36	100	4682.18	89	36	100
1000	C	15	4785.66	84	44	98	4785.66	84	44	98	4785.66	84	44	98
1000	D	15	4715.95	77	62	98	4715.95	77	62	98	4292.83	75	59	98
1000	E	15	4934.31	44	205	70	4934.31	44	205	70	4934.31	44	205	70
1000	F	15	5017.14	26	212	72	5017.14	26	212	72	5017.14	26	212	72
2000	A	5	5231.71	100	0	0	5231.71	100	0	0	1421.22	100	0	0
2000	B	5	4626.31	100	3	100	4626.31	100	3	100	4224.79	100	3	100
2000	C	5	4769.31	100	31	87	4769.31	100	31	87	4686.41	100	31	87
2000	D	5	4509.69	90	39	62	4509.69	90	39	62	4509.69	90	39	62
2000	E	5	5018.9	69	34	50	5018.9	69	34	50	5018.9	69	34	50
2000	F	5	5258.96	69	17	47	5258.96	69	17	47	5258.96	69	17	47
2000	A	10	4949.35	100	0	0	4949.35	100	0	0	3481.78	100	4	75
2000	B	10	4408.26	89	2	-350	4408.26	89	2	-350	3548.68	86	23	61
2000	C	10	4646.77	81	31	97	4646.77	81	31	97	4326.16	80	17	94
2000	D	10	4774.13	86	8	38	4774.13	86	8	38	4617.65	85	8	38
2000	E	10	4843.26	68	49	92	4843.26	68	49	92	4843.26	68	49	92
2000	F	10	5435.16	57	137	71	5435.16	57	137	71	5435.16	57	137	71
2000	A	15	4956.41	100	13	100	4956.41	100	13	100	1700.84	100	0	0
2000	B	15	4682.18	89	36	100	4682.18	89	36	100	4682.18	89	36	100
2000	C	15	4785.66	84	44	98	4785.66	84	44	98	4785.66	84	44	98
2000	D	15	4715.95	77	62	98	4715.95	77	62	98	4292.83	75	59	98
2000	E	15	4934.31	48	205	68	4934.31	48	205	68	4934.31	48	205	68
2000	F	15	5017.14	25	212	73	5017.14	25	212	73	5017.14	25	212	73

Table 3: Myopic heuristics results