Online Supplements: The Stochastic Production Routing Problem with Adaptive Routing and Service Level Constraints

Ali Kermani, Jean-François Cordeau, Raf Jans

HEC Montréal, CIRRELT, and GERAD, 3000 chemin de la Côte-Sainte-Catherine, Montréal, H3T 2A7, Canada

ali.kermani@hec.ca, jean-francois.cordeau@hec.ca, raf.jans@hec.ca

This file contains supplementary tables for the paper titled "The Stochastic Production Routing Problem with Adaptive Routing and Service Level Constraints." These materials comprise detailed tables presenting results on various service level measures across different granularity levels. Specifically, Section 1, Section 2, and Section 3 present the results for Customer Level-Global, Plant Level-Single Period, and Plant Level-Global, respectively. For a comprehensive overview of the results, please visit https://github.com/AliK094/online_supplements_sprpar_sl.

1   Customer Level-Global

In this section, we provide detailed tables for the service levels considered at the customer level for the entire planning horizon. We present eight tables, with two tables per type of service level for the $\mathscr{S}$ and $\mathscr{L}$ datasets. Specifically, Tables 1 and 2 present the results for $\alpha_p^{customer}$, Tables 3 and 4 provide the results for $\beta^{customer}$, Tables 5 and 6 contain the detailed results for $\gamma^{customer}$, and Tables 7 and 8 display the detailed results for $\gamma^{customer}$.

Table 1: Summary of the results for the $\alpha_p^{customer}$ service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
			70%	6	1,342.1	5,885.6	0.3	8,271.9	5.6	-0.7	-5.8	-10.1	-15.5
			75%	6	569.7	6,927.8	1.9	7,776.1	6.3	-0.4	-4.8	-6.9	-14.5
3	1	100	80%	6	1,692.7	6,622.8	2.3	8,900.6	6.0	-0.5	-3.5	-4.3	-12.1
			85%	6	2,380.9	6,702.8	1.5	9,585.8	5.2	-0.6	-2.6	-3.2	-9.7
			90%	6	531.3	6,434.1	1.5	7,734.8	4.6	-0.4	-6.7	-6.3	-12.0
			95%	6	490.5	6,952.2	1.2	7,695.2	7.1	-0.1	-9.1	-9.7	-17.1
			70%	6	1,854.9	7,202.8	8.6	9,057.3	7.5	-1.2	-9.3	-7.0	-21.5
			75%	6	1,553.4	7,203.0	7.7	8,761.4	7.5	-1.2	-7.3	-4.8	-18.7
3	2	100	80%	6	2,819.6	7,204.1	12.1	10,021.8	7.1	-1.4	-11.3	-2.6	-20.3
			85%	6	3,544.7	7,205.5	15.4	10,747.9	6.9	-1.3	-13.3	-1.3	-21.7
			90%	6	2,405.4	7,156.4	8.6	9,610.3	7.5	-1.2	-7.7	-1.4	-16.6
			95%	6	2,613.9	7,202.0	5.6	9,817.7	9.5	-0.2	-8.1	-4.2	-18.2
			70%	6	3,513.7	7,202.3	14.2[1]	10,719.1	10.2	-1.3	-10.2	-4.9	-26.8
			75%	6	2,904.7	6,437.1	11.4[1]	10,107.3	10.1	-1.3	-8.8	-2.3	-22.1
3	3	100	80%	6	3,972.6	7,202.1	12.7[2]	11,177.9	9.9	-1.2	-9.5	-1.2	-21.6
			85%	6	3,889.9	7,201.4	18.6[2]	11,093.0	10.2	-1.1	-13.3	-0.4	-24.7
			90%	6	3,842.3	6,019.5	17.8[1]	11,048.4	11.0	-1.2	-13.1	-0.6	-24.8
			95%	6	3,762.1	7,201.4	16.8[1]	10,966.0	13.7	-0.2	-12.4	-1.6	-26.2
Total				108	2,426.9	6,881.1	8.3	9,616.3	8.1	-0.8	-8.5	-4.2	-18.7

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 2: Summary of the results for the $\alpha_p^{customer}$ service level (on dataset $\mathcal{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	6,116.2	13,319.2	19.9	0.0
			75%	6	6,347.5	13,561.4	21.6	-0.1
			80%	6	6,061.1	13,264.4	24.5	-0.3
			85%	6	6,037.1	13,239.7	20.2	-0.3
			90%	6	6,744.6	13,946.3	16.4	0.0
			95%	6	6,140.5	13,342.1	12.9	0.0
6	2	100	70%	6	6,663.6	13,866.6	31.3	-0.1
			75%	6	6,452.4	13,655.1	33.1	0.0
			80%	6	6,133.8	13,336.6	35.6	-0.1
			85%	6	6,017.1	13,220.0	34.6	-0.1
			90%	6	6,413.8	13,616.6	31.4	0.0
			95%	6	6,091.2	13,294.1	28.9	0.0
6	3	100	70%	4	6,662.8	13,865.1	34.5	-0.1
			75%	4	6,254.6	13,456.8	35.8	-0.1
			80%	4	5,946.1	13,148.4	36.8	-0.3
			85%	4	6,005.2	13,207.4	36.1	-0.2
			90%	4	6,256.5	13,458.9	34.1	-0.2
			95%	4	6,126.5	13,328.8	31.2	-0.1
9	1	100	70%	6	6,162.2	13,364.4	44.6	-0.4
			75%	6	5,924.5	13,126.6	44.4	-0.7
			80%	6	6,187.9	13,390.0	40.3	-0.2
			85%	6	5,550.8	13,005.4	43.0	-0.7
			90%	6	5,798.5	13,000.5	33.4	-0.3
			95%	6	6,433.7	13,636.0	27.7	-0.6
9	2	100	70%	4	6,398.7	13,601.1	52.4	-0.1
			75%	4	6,118.4	13,320.7	52.0	-0.1
			80%	3	6,480.8	13,682.9	43.9	-0.1
			85%	4	6,002.6	13,405.3	54.6	-0.3
			90%	4	5,948.9	13,151.2	44.4	-0.4
			95%	4	6,780.7	13,983.0	37.2	-0.3
Total				155	6,200.7	13,421.3	33.3	-0.2

Table 3: Summary of the results for the $\beta^{customer}$ service level (on dataset $\mathscr{S}$)

					IMH	FR-BC		BC					
T	K	S	SL	#INS	CPU (secs)	CPU (secs)	Gap (%)	CPU (secs)	Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
3	1	100	70%	6	5,929.3	4,916.7	14.5	13,182.4	16.0	0.0	-14.4	-2.9	-29.2
			75%	6	5,820.2	6,121.3	7.2	13,029.1	13.2	0.0	-7.8	-2.6	-21.3
			80%	6	6,096.8	7,063.5	6.0	13,303.0	11.6	-0.1	-6.3	-2.3	-18.2
			85%	6	5,844.6	6,508.5	7.8	12,353.8	9.7	-0.1	-7.3	-1.9	-17.1
			90%	6	6,030.3	7,204.4	3.2	13,236.0	7.8	-0.1	-3.4	-1.8	-12.4
			95%	6	6,011.3	6,340.3	3.0	13,212.9	5.1	-0.1	-2.0	-0.7	-8.5
3	2	100	70%	6	6,281.2	6,980.9	22.0	13,484.6	18.3	-0.8	-17.6	-3.3	-34.9
			75%	6	6,161.0	7,202.6	19.5	13,364.5	16.3	-0.8	-14.5	-1.9	-31.3
			80%	6	6,165.0	6,805.8	18.0	13,376.8	15.1	-0.6	-11.2	-0.8	-27.3
			85%	6	6,273.7	7,080.6	10.1	13,475.5	13.1	-0.5	-5.2	-0.8	-19.2
			90%	6	6,530.5	7,202.0	11.5[2]	13,507.3	11.7	-0.4	-7.5	-0.8	-20.6
			95%	6	5,711.5	6,564.9	14.8	12,914.2	9.4	-0.2	-8.0	0.0	-19.7
3	3	100	70%	6	6,520.5	7,131.3	27.6	13,729.0	21.7	-0.8	-17.2	-1.0	-37.8
			75%	6	6,700.7	7,203.2	20.1[2]	13,904.0	21.3	-0.6	-14.7	-0.7	-33.7
			80%	6	6,526.6	7,201.0	19.9[2]	13,728.7	19.7	-0.5	-14.5	-0.3	-32.6
			85%	6	6,615.6	7,207.0	30.9[2]	13,838.9	18.0	-0.7	-21.9	-1.1	-39.8
			90%	6	6,551.0	7,201.3	18.9[3]	13,755.0	16.8	-0.5	-10.7	0.0	-25.5
			95%	6	5,879.2	6,634.9	5.9[4]	13,081.9	16.1	-0.2	-4.7	0.0	-16.5
Total				108	6,202.7	6,770.4	14.2	13,359.9	14.5	-0.4	-10.4	-1.4	-24.5

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 4: Summary of the results for the $\beta^{customer}$ service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	5,993.6	13,152.0	35.9	-0.2
			75%	6	6,426.7	13,628.7	32.3	-0.2
			80%	6	6,212.9	13,415.8	27.0	-0.1
			85%	6	5,881.0	13,082.8	22.3	-0.1
			90%	6	5,904.8	13,106.6	19.0	-0.1
			95%	6	6,285.0	13,488.0	13.4	0.0
6	2	100	70%	6	6,300.6	13,503.5	41.4	-0.3
			75%	6	6,335.6	13,538.7	39.5	-0.3
			80%	6	6,607.1	13,810.1	36.8	-0.4
			85%	6	5,854.0	13,057.0	32.8	-0.2
			90%	6	5,989.0	13,191.8	28.6	-0.3
			95%	6	6,809.9	14,012.8	24.2	-0.2
6	3	100	70%	4	6,720.3	13,923.0	45.6	-0.5
			75%	4	6,833.0	14,035.5	43.4	-0.5
			80%	4	6,737.5	13,940.0	40.4	-0.5
			85%	4	6,430.7	13,634.9	35.7	-0.6
			90%	4	6,440.8	13,643.4	33.1	-0.4
			95%	4	6,939.8	14,142.1	28.4	-0.2
9	1	100	70%	6	6,533.0	13,735.8	52.6	-1.0
			75%	6	6,515.1	13,717.7	50.1	-1.0
			80%	6	6,242.9	13,445.7	45.9	-0.5
			85%	6	6,374.3	13,576.9	41.7	-0.2
			90%	6	6,063.9	13,266.5	32.1	-0.1
			95%	6	6,294.2	13,496.9	23.5	-0.1
9	2	100	70%	4	7,093.7	14,298.0	58.8	-0.7
			75%	4	6,814.2	14,016.8	57.6	-0.5
			80%	4	7,013.7	14,216.4	53.4	-0.5
			85%	4	6,924.1	14,126.8	49.3	-0.5
			90%	4	6,516.5	13,719.1	42.1	-0.3
			95%	4	6,733.9	13,936.8	33.7	-0.2
Total				156	6,413.7	13,614.7	36.4	-0.3

Table 5: Summary of the results for the $\gamma^{customer}$ service level (on dataset $\mathscr{S}$)

					IMH	FR-BC		BC					
T	K	S	SL	#INS	CPU	CPU	Gap	CPU	Gap	IMH ∇	PostOpt ∇	LB(FR-BC) ∇	UB(FR-BC) ∇
					(secs)	(secs)	(%)	(secs)	(%)	(%)	(%)	(%)	(%)
3	1	100	70%	6	1,925.1	179.9	0.0	8,939.3	3.8	-0.1	-1.7	-3.9	-7.6
			75%	6	2,498.3	212.7	0.0	9,215.8	4.5	0.0	-1.6	-3.3	-7.7
			80%	6	2,548.3	212.1	0.0	9,694.5	3.9	-0.1	-2.0	-3.3	-7.1
			85%	6	1,922.7	60.4	0.0	9,127.1	3.2	-0.1	-1.5	-2.3	-5.4
			90%	6	2,489.5	79.1	0.0	9,489.1	3.2	-0.1	-1.2	-3.1	-6.3
			95%	6	2,600.4	79.1	0.0	9,519.1	3.0	-0.1	-0.8	-1.9	-4.9
3	2	100	70%	6	2,176.0	619.2	0.0	9,380.9	8.8	-1.1	-1.5	-3.7	-12.1
			75%	6	2,782.4	1,087.4	0.0	9,603.4	8.7	-1.1	-1.4	-3.3	-11.7
			80%	6	3,238.0	943.9	0.0	10,443.0	7.9	-1.2	-1.8	-3.0	-10.7
			85%	6	2,778.8	793.2	0.0	9,991.2	5.1	-1.1	-1.8	-2.7	-7.7
			90%	6	3,415.3	2,791.8	4.2	10,621.4	5.9	-0.7	-4.2	-2.0	-11.7
			95%	6	3,576.6	4,004.4	1.1	10,779.6	6.5	-0.2	-1.7	-1.4	-8.8
3	3	100	70%	6	3,162.4	3,219.3	0.0	10,366.9	10.5	-1.2	-2.0	-4.2	-14.3
			75%	6	3,581.3	3,489.8	5.0	10,784.2	11.1	-1.1	-6.2	-3.1	-18.2
			80%	6	4,026.1	4,296.4	4.6	11,214.6	11.3	-0.8	-4.2	-2.2	-16.5
			85%	6	3,483.5	4,023.4	6.0	10,687.7	8.3	-0.9	-4.9	-1.8	-14.6
			90%	6	4,215.7	4,864.6	13.2	11,420.4	9.4	-0.8	-8.4	-1.5	-20.3
			95%	6	4,092.0	4,395.6	9.8[1]	11,298.5	11.4	-0.3	-5.8	-0.8	-16.4
Total				108	3,028.5	1,958.9	2.4	10,143.1	7.0	-0.6	-2.9	-2.7	-11.2

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 6: Summary of the results for the $\gamma^{customer}$ service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	5,803.1	13,005.8	7.4	0.0
			75%	6	6,046.0	13,247.6	8.5	0.0
			80%	6	6,265.1	13,469.6	8.6	0.0
			85%	6	5,830.3	13,031.8	7.8	0.0
			90%	6	6,229.2	13,431.8	8.9	-0.1
			95%	6	6,057.3	13,259.0	7.2	0.0
6	2	100	70%	6	6,079.9	13,282.4	13.0	-0.5
			75%	6	6,501.2	13,703.3	14.3	-0.6
			80%	6	6,353.6	13,556.4	14.3	-0.4
			85%	6	6,607.9	13,812.7	14.3	-0.5
			90%	6	6,420.7	13,623.3	15.9	-0.4
			95%	6	6,251.3	13,453.9	15.2	-0.2
6	3	100	70%	4	6,450.9	13,653.0	18.6	-0.3
			75%	4	6,464.1	13,667.2	17.9	-0.6
			80%	4	6,524.4	13,727.3	17.6	-0.5
			85%	4	6,484.6	13,686.9	18.4	-0.8
			90%	4	6,547.9	13,750.1	20.2	-0.6
			95%	4	6,582.3	13,786.1	19.3	-0.4
9	1	100	70%	6	5,868.5	13,071.3	8.9	0.0
			75%	6	5,874.6	13,076.6	10.6	-0.1
			80%	6	6,121.6	13,326.2	10.2	-0.1
			85%	6	6,037.6	13,239.8	9.5	-0.1
			90%	6	6,005.9	13,208.0	9.5	-0.1
			95%	6	6,036.8	13,240.7	10.5	-0.1
9	2	100	70%	4	6,267.1	13,469.4	18.6	-0.4
			75%	4	6,463.2	13,665.4	19.6	-0.5
			80%	4	6,040.2	13,242.4	19.4	-0.5
			85%	4	6,117.6	13,319.8	19.1	-0.3
			90%	4	6,135.7	13,338.0	19.3	-0.2
			95%	4	6,033.4	13,235.6	19.9	-0.2
Total				156	6,197.4	13,400.0	13.4	-0.3

Table 7: Summary of the results for the $\delta^{customer}$ service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
3	1	100	70%	6	3,364.6	186.5	0.0	10,569.5	8.5	-0.6	-27.2	-33.7	-39.5
			75%	6	3,380.0	184.9	0.0	9,771.9	9.4	-0.9	-20.3	-25.0	-32.2
			80%	6	3,185.2	175.4	0.0	10,388.9	7.9	-1.8	-10.9	-16.0	-22.7
			85%	6	2,720.1	156.7	0.0	9,922.0	5.9	-1.3	-5.4	-6.9	-12.5
			90%	6	2,104.7	172.2	0.0	9,306.9	4.0	-0.5	-2.1	-4.4	-8.2
			95%	6	2,022.1	60.6	0.0	9,225.7	4.0	-0.1	-1.6	-2.4	-6.2
3	2	100	70%	6	3,426.6	846.0	0.0	10,205.9	19.8	-0.8	-27.4	-34.0	-47.3
			75%	6	3,265.9	2,982.5	0.8	10,474.0	17.3	-1.5	-18.8	-23.8	-37.5
			80%	6	3,367.9	2,157.7	0.0	10,570.8	13.4	-1.4	-10.6	-15.3	-26.7
			85%	6	3,059.9	611.1	0.0	10,271.1	9.0	-1.5	-5.8	-7.2	-15.6
			90%	6	2,490.3	782.4	0.0	9,693.6	8.7	-1.2	-1.7	-3.8	-12.1
			95%	6	2,858.0	872.5	0.0	10,060.0	5.0	-1.1	-2.1	-2.9	-7.7
3	3	100	70%	6	3,734.8	3,748.0	12.4	10,740.2	22.6	-0.6	-30.1	-29.4	-52.7
			75%	6	3,149.2	3,982.5	15.3	10,355.3	20.1	-1.1	-23.3	-19.0	-45.9
			80%	6	3,106.6	3,639.7	1.4	10,308.5	15.6	-1.3	-9.4	-13.0	-27.6
			85%	6	3,053.2	1,771.5	0.0	10,255.6	12.4	-1.4	-3.6	-4.8	-16.7
			90%	6	3,188.0	2,825.1	0.0	10,392.9	10.3	-1.1	-2.1	-4.2	-14.0
			95%	6	3,580.0	4,829.9	5.3	10,786.9	8.2	-1.0	-4.1	-1.6	-13.4
Total				108	3,058.7	1,665.8	2.0	10,183.3	11.2	-1.1	-11.4	-13.7	-24.3

Table 8: Summary of the results for the $\delta^{customer}$ service level (on dataset $\mathscr{L}$)

					IMH	BC		
T	K	S	SL	#INS	CPU (secs)	CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	5,930.8	13,131.8	4.1	-0.6
			75%	6	6,027.6	13,228.7	8.1	-0.5
			80%	6	5,934.8	13,137.8	6.8	-0.4
			85%	6	5,970.9	13,174.0	5.5	-0.1
			90%	6	5,675.5	12,876.8	4.3	0.0
			95%	6	6,207.5	13,409.4	7.6	0.0
6	2	100	70%	6	6,359.4	13,560.3	18.1	-0.9
			75%	6	6,068.9	13,269.8	14.5	-0.7
			80%	6	6,346.7	13,549.2	11.5	-1.1
			85%	6	6,126.3	13,329.1	10.4	-0.7
			90%	6	6,182.9	13,385.6	12.4	-0.7
			95%	6	6,161.2	13,363.4	13.6	-0.4
			95%	6	6,251.3	13,453.9	15.2	-0.2
6	3	100	70%	4	5,631.8	12,834.6	21.4	-1.0
			75%	4	5,794.1	12,996.3	14.9	-0.6
			80%	4	5,958.9	13,161.3	14.9	-0.8
			85%	4	5,932.1	13,135.4	14.7	-0.8
			90%	4	6,037.5	13,243.4	15.4	-0.7
			95%	4	6,857.2	14,058.5	15.9	-0.4
9	1	100	70%	6	5,940.9	13,142.1	4.7	-0.2
			75%	6	6,137.9	13,340.2	10.9	0.0
			80%	6	5,885.4	13,087.0	9.4	-0.1
			85%	6	5,891.1	13,094.1	15.3	-0.1
			90%	6	5,229.2	12,430.4	17.7	-0.1
			95%	6	5,167.8	12,369.9	16.7	-0.3
9	2	100	70%	4	6,293.0	13,495.2	10.6	-0.9
			75%	4	5,804.4	13,006.7	14.2	-0.3
			80%	4	6,150.0	13,352.2	14.3	-0.2
			85%	4	6,097.8	13,298.9	18.3	-0.2
			90%	4	5,141.4	12,349.8	22.2	-0.6
			95%	4	4,733.9	11,936.2	34.9	-0.2
Total				156	5,930.7	13,133.0	13.1	-0.4

2 Plant Level-Single Period

In this section, we present the results for the plant-level granularity level while considering the service level constraints for each period. Specifically, Tables 9 and 10 detail the outcomes for α_c^{plant} pertaining to datasets $\mathscr{S}$ and $\mathscr{L}$, respectively. Additionally, Tables 11 and 12 present the results for β_c^{plant}, while Tables 13 and 14 provide insights into γ_c^{plant}. Lastly, Tables 15 and 16 showcase the results for δ_c^{plant}.

Table 9: Summary of the results for the α_c^{plant} service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	BC IMH ∇ (%)	BC PostOpt ∇ (%)	BC LB(FR-BC) ∇ (%)	BC UB(FR-BC) ∇ (%)
3	1	100	70%	6	106.6	531.3	0.0	6,336.3	2.0	0.0	-4.1	-16.5	-18.2
			75%	6	149.4	357.3	0.0	7,207.3	2.3	0.0	-3.5	-13.7	-15.7
			80%	6	201.9	3,351.2	0.5	5,880.9	2.7	0.0	-9.4	-18.0	-20.6
			85%	6	202.0	2,513.6	0.4	6,968.6	2.6	0.0	-9.4	-15.8	-18.3
			90%	6	201.0	1,662.4	0.1	6,746.8	3.6	-0.3	-10.0	-14.4	-17.5
			95%	6	203.4	1,189.7	0.0	6,719.4	3.2	-0.3	-10.4	-12.6	-15.4
3	2	100	70%	6	1,878.2	6,037.1	5.3	8,935.0	5.5	-0.1	-7.4	-15.3	-24.4
			75%	6	2,156.4	5,091.3	4.8	9,360.1	5.7	0.0	-7.4	-12.9	-21.9
			80%	6	2,472.6	4,878.4	7.8	9,351.0	5.7	-0.3	-12.3	-13.2	-24.8
			85%	6	2,239.6	4,855.9	8.1	9,378.6	5.9	-0.2	-11.5	-10.6	-23.0
			90%	6	2,655.2	5,005.0	4.6	9,636.3	6.9	-0.1	-9.4	-9.9	-20.2
			95%	6	2,523.5	4,880.2	4.3	9,272.6	6.5	0.0	-9.7	-8.9	-18.6
3	3	100	70%	6	3,458.5	5,886.6	11.8[1]	10,667.6	8.4	-0.2	-11.8	-12.7	-29.9
			75%	6	3,472.3	5,369.9	13.8	10,680.9	8.8	-0.1	-13.2	-10.0	-29.8
			80%	6	3,713.2	4,989.9	13.5[1]	10,916.7	9.2	-0.3	-14.7	-10.0	-29.7
			85%	6	3,968.7	4,916.3	16.7[1]	11,171.9	9.3	-0.1	-16.8	-7.3	-30.6
			90%	6	3,665.8	5,742.7	11.4[1]	10,872.0	10.5	-0.1	-12.4	-6.2	-26.0
			95%	6	3,889.1	4,977.7	11.8	11,093.1	9.8	-0.1	-12.4	-4.7	-23.7
Total				108	2,064.3	3,960.4	6.1	8,955.3	6.0	-0.1	-10.2	-11.9	-22.4

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 10: Summary of the results for the α_c^{plant} service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	5,009.8	12,211.3	15.1	0.0
			75%	6	4,843.6	12,054.1	11.0	0.0
			80%	6	5,190.7	12,401.0	10.4	0.0
			85%	6	5,941.7	13,144.5	8.7	-0.1
			90%	6	5,114.8	12,316.4	9.0	0.0
			95%	6	4,989.5	12,191.6	7.7	0.0
6	2	100	70%	6	5,283.6	12,486.9	27.4	-0.1
			75%	6	5,247.4	12,451.5	21.9	0.0
			80%	6	5,411.2	12,614.0	22.3	-0.3
			85%	6	6,132.6	13,335.2	19.9	-0.5
			90%	6	5,272.3	12,475.6	18.6	-0.1
			95%	6	5,479.7	12,683.7	16.5	0.0
6	3	100	70%	4	5,882.9	13,085.1	28.2	-0.3
			75%	4	5,644.2	12,849.3	23.9	-0.3
			80%	4	6,113.4	13,315.6	23.6	-0.1
			85%	4	6,047.2	13,254.1	22.8	-0.4
			90%	4	5,722.2	12,924.5	22.7	-0.2
			95%	4	5,752.3	12,955.6	20.4	-0.1
9	1	100	70%	6	5,394.6	13,597.2	26.4	-0.1
			75%	6	5,441.7	12,643.9	23.4	-0.1
			80%	6	6,254.3	13,456.4	23.9	-0.1
			85%	6	6,331.1	13,579.7	21.7	-0.3
			90%	6	5,551.2	12,753.3	18.9	-0.1
			95%	6	5,513.9	12,716.1	15.6	0.0
9	2	100	70%	4	4,540.6	13,128.4	35.3	-0.1
			75%	4	5,159.3	12,361.7	29.4	-0.2
			80%	4	6,449.9	13,652.3	28.7	-0.2
			85%	4	6,475.2	13,677.7	28.5	-0.3
			90%	4	5,946.9	13,149.2	26.9	-0.2
			95%	4	5,648.4	12,880.8	21.5	-0.2
Total				156	5,563.8	12,836.6	20.1	-0.1

Table 11: Summary of the results for the β_c^{plant} service level (on dataset $\mathscr{S}$)

					IMH	FR-BC		BC					
T	K	S	SL	#INS	CPU	CPU	Gap	CPU	Gap	IMH ∇	PostOpt ∇	LB(FR-BC) ∇	UB(FR-BC) ∇
					(secs)	(secs)	(%)	(secs)	(%)	(%)	(%)	(%)	(%)
3	1	100	70%	6	5,124.6	7,202.2	12.3	12,330.0	13.4	0.0	-7.7	-0.7	-20.8
			75%	6	5,055.6	7,202.4	14.9[1]	11,301.3	12.4	0.0	-10.2	0.0	-22.6
			80%	6	5,119.4	7,203.7	18.6	12,322.3	10.6	-0.1	-11.1	0.0	-23.0
			85%	6	5,300.9	7,201.9	19.1	12,000.4	9.5	0.0	-12.7	-0.2	-23.5
			90%	6	5,362.3	7,202.5	11.3[1]	12,563.9	8.7	-0.1	-8.0	-1.7	-16.9
			95%	6	3,533.4	7,202.5	5.1[1]	10,691.0	9.3	0.0	-2.2	-0.2	-11.5
3	2	100	70%	6	4,726.8	7,205.7	22.9[2]	11,928.6	17.9	-0.6	-13.2	-0.6	-31.5
			75%	6	4,958.4	7,200.3	18.8[3]	12,160.5	16.7	-0.5	-11.1	0.0	-27.5
			80%	6	4,918.7	7,208.5	6.5[3]	12,120.9	15.9	-0.4	-3.3	-0.4	-18.6
			85%	6	4,967.4	7,201.7	6.8[3]	12,169.3	15.0	-0.3	-3.9	-0.5	-17.6
			90%	6	5,328.8	7,201.1	20.0[2]	12,530.6	14.1	-0.3	-15.8	-2.1	-26.5
			95%	6	3,527.3	6,341.9	12.9[2]	10,730.4	12.8	-0.1	-8.4	0.0	-20.3
3	3	100	70%	6	4,934.9	7,202.3	26.5[3]	12,137.2	24.2	-0.7	-15.5	-0.1	-37.3
			75%	6	5,333.1	7,201.9	25.6[4]	12,535.8	22.4	-0.9	-11.5	0.0	-30.4
			80%	6	5,191.3	7,200.7	36.0[3]	12,395.3	22.1	-0.7	-26.1	0.0	-43.5
			85%	6	5,359.2	7,200.3	20.0[3]	12,163.9	22.5	-0.5	-10.7	0.0	-28.3
			90%	6	4,983.1	6,448.4	20.7[3]	12,185.6	21.5	-0.2	-14.6	-0.9	-30.4
			95%	6	4,201.4	7,201.5	17.9[3]	11,403.4	19.5	-0.3	-9.5	0.0	-26.0
Total				108	4,884.8	7,122.2	16.8	11,981.7	16.0	-0.3	-10.5	-0.4	-24.2

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 12: Summary of the results for the β_c^{plant} service level (on dataset $\mathcal{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	6,408.1	13,609.9	34.6	-0.2
			75%	6	6,608.5	13,810.2	29.3	-0.1
			80%	6	6,438.4	13,641.3	25.1	-0.3
			85%	6	6,398.5	13,600.3	21.7	-0.2
			90%	6	6,893.8	14,096.5	20.0	-0.1
			95%	6	6,265.9	13,467.9	14.8	-0.2
6	2	100	70%	6	6,535.6	13,738.6	39.4	-0.1
			75%	6	6,594.6	13,797.7	35.2	-0.2
			80%	6	6,049.4	13,252.3	31.8	-0.2
			85%	6	6,385.0	13,587.9	28.6	-0.1
			90%	6	6,827.2	14,030.0	26.5	-0.1
			95%	6	6,006.8	13,209.9	22.4	0.0
6	3	100	70%	4	6,457.6	13,660.4	40.2	-0.2
			75%	4	6,962.0	14,164.3	36.5	-0.1
			80%	4	6,297.4	13,499.6	32.6	-0.2
			85%	4	6,479.0	13,681.3	29.2	0.0
			90%	4	7,026.4	14,228.7	27.6	-0.2
			95%	4	6,575.4	13,777.8	25.0	-0.2
9	1	100	70%	6	6,656.6	13,859.3	35.6	-0.7
			75%	6	6,632.0	13,835.9	32.0	-0.5
			80%	6	6,550.6	13,753.2	28.9	-0.6
			85%	6	6,873.5	14,076.3	26.9	-0.3
			90%	6	7,063.4	14,266.1	23.2	-0.2
			95%	6	6,238.7	13,441.1	20.1	-0.1
9	2	100	70%	4	6,365.8	13,886.4	36.7	-0.1
			75%	4	6,942.6	14,145.3	37.1	-0.3
			80%	4	6,929.2	13,970.5	30.6	-0.1
			85%	4	7,189.1	14,391.9	33.5	-0.1
			90%	4	6,679.7	13,882.2	31.0	-0.2
			95%	4	5,853.8	13,056.5	27.6	-0.1
Total				156	6,561.5	13,766.0	29.0	-0.2

Table 13: Summary of the results for the γ_c^{plant} service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	Gap (%)	BC CPU (secs)	Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
3	1	100	70%	6	1,187.5	190.6	0.0	8,393.3	3.6	-0.6	-1.4	-1.4	-4.5
			75%	6	1,154.5	165.8	0.0	8,110.1	3.6	-0.2	-2.7	-2.7	-5.7
			80%	6	1,422.7	182.2	0.0	8,626.5	2.8	-0.3	-2.0	-2.0	-4.4
			85%	6	1,077.5	214.5	0.0	8,293.9	3.2	-0.2	-1.0	-1.0	-3.9
			90%	6	1,590.0	166.5	0.0	8,363.3	4.3	-0.6	-0.9	-0.9	-4.5
			95%	6	1,525.4	192.7	0.0	8,728.2	3.9	-0.1	-0.5	-0.5	-4.1
3	2	100	70%	6	2,835.5	2,786.6	1.6	10,039.6	10.2	-0.4	-1.2	-0.7	-11.4
			75%	6	2,902.0	2,969.6	3.1	10,113.2	10.3	-0.4	-3.8	-2.1	-13.4
			80%	6	3,210.3	3,809.4	2.7	10,412.8	9.8	-0.3	-2.6	-1.6	-12.1
			85%	6	3,319.8	4,119.3	2.4	10,531.2	9.6	-0.2	-2.5	-1.8	-11.8
			90%	6	2,996.8	4,295.5	3.6	9,310.3	8.7	-0.3	-2.9	-1.0	-11.4
			95%	6	3,388.6	4,824.3	4.0	10,593.7	7.2	-0.2	-4.5	-1.7	-11.5
3	3	100	70%	6	3,784.6	4,959.0	10.1	10,988.4	16.4	-0.8	-4.2	-1.6	-19.9
			75%	6	3,927.5	4,443.1	9.1[1]	10,457.1	15.2	-0.6	-5.5	-1.4	-19.2
			80%	6	3,933.6	4,960.2	12.4	11,137.0	15.6	-0.5	-6.9	-1.1	-21.4
			85%	6	3,726.4	4,929.2	11.3	10,929.8	15.3	-0.3	-5.8	-0.9	-20.3
			90%	6	3,731.8	4,888.2	12.1	10,555.1	13.3	-0.3	-6.3	-0.5	-19.0
			95%	6	3,679.5	4,924.3	11.4	10,887.8	12.1	-0.2	-6.2	-1.1	-17.7
Total				108	2,744.1	2,931.6	4.6	9,803.9	9.2	-0.4	-3.4	-1.3	-11.9

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 14: Summary of the results for the γ_c^{plant} service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
			70%	6	5,433.8	12,386.2	9.3	0.0
			75%	6	5,572.4	12,774.8	8.7	0.0
6	1	100	80%	6	5,228.0	12,429.5	10.3	0.0
			85%	6	5,278.4	12,480.5	10.7	0.0
			90%	6	5,039.2	12,242.0	10.1	0.0
			95%	6	5,556.2	12,757.6	8.0	0.0
			70%	6	5,683.9	12,886.5	14.3	-0.1
			75%	6	5,713.1	12,917.2	14.1	-0.1
6	2	100	80%	6	5,496.3	12,698.9	16.3	-0.1
			85%	6	5,510.0	12,712.4	16.5	-0.1
			90%	6	5,484.0	12,686.6	16.8	-0.1
			95%	6	5,584.8	12,787.5	16.2	-0.1
			70%	4	5,670.0	12,872.4	17.4	-0.4
			75%	4	5,921.9	13,126.4	18.0	-0.3
6	3	100	80%	4	5,959.1	13,161.5	19.7	-0.2
			85%	4	5,929.9	13,132.4	20.0	-0.2
			90%	4	5,927.3	13,129.9	20.2	-0.2
			95%	4	5,918.5	12,952.9	19.7	-0.2
			70%	6	5,965.3	13,167.7	10.6	-0.1
			75%	6	6,480.3	13,682.4	10.8	-0.1
9	1	100	80%	6	6,026.7	13,230.3	10.9	-0.1
			85%	6	5,870.2	13,072.3	11.4	-0.1
			90%	6	6,064.4	13,271.5	11.7	-0.1
			95%	6	5,758.3	12,960.5	10.8	0.0
			70%	4	6,513.8	13,716.0	19.6	-0.3
			75%	4	6,080.3	13,282.4	19.3	-0.3
9	2	100	80%	4	5,735.7	13,015.7	16.8	-0.2
			85%	4	5,754.4	12,956.7	21.0	-0.2
			90%	4	5,741.2	12,943.3	20.8	-0.2
			95%	4	5,731.1	12,933.2	20.9	-0.1
Total				156	5,730.8	12,920.9	14.3	-0.1

Table 15: Summary of the results for the δ_c^{plant} service level (on dataset $\mathscr{S}$)

					IMH	FR-BC		BC					
T	K	S	SL	#INS	CPU (secs)	CPU (secs)	Gap (%)	CPU (secs)	Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
3	1	100	70%	6	521.9	318.9	0.0	7,312.3	12.2	-1.8	-2.4	-2.4	-13.5
			75%	6	726.6	597.1	0.0	6,402.9	10.8	-0.4	-2.2	-1.9	-10.3
			80%	6	680.7	1,240.7	0.0	7,887.4	7.0	-0.9	-2.6	-2.6	-9.3
			85%	6	925.1	655.3	0.0	8,128.5	6.0	-1.0	-1.4	-1.4	-7.2
			90%	6	688.5	702.9	0.0	7,631.3	6.1	-0.7	-1.5	-1.5	-6.8
			95%	6	799.3	249.9	0.0	7,135.7	5.7	0.0	-0.9	-0.9	-6.0
3	2	100	70%	6	1,588.5	1,363.2	0.0	8,791.0	17.3	-2.9	-1.9	-2.0	-17.8
			75%	6	2,401.0	2,523.7	0.4	9,587.6	13.5	-2.7	-2.0	-2.0	-13.9
			80%	6	2,320.5	3,659.8	0.9	8,942.7	12.7	-1.6	-2.3	-2.2	-14.6
			85%	6	2,807.3	3,822.1	2.9	10,012.7	12.2	-0.8	-2.8	-1.4	-14.0
			90%	6	2,545.4	3,553.8	1.9	9,687.4	11.3	-0.6	-0.8	-0.6	-11.5
			95%	6	2,756.0	4,742.5	3.3	9,958.7	8.7	-0.3	-3.2	-1.4	-11.5
3	3	100	70%	6	3,953.2	2,855.8	0.0	11,159.0	19.2	-1.1	-1.5	-1.5	-16.9
			75%	6	4,151.3	3,963.2	2.8	11,354.2	17.8	-0.1	-1.3	-0.9	-16.5
			80%	6	3,961.0	4,497.6	6.8	10,462.3	19.5	-0.4	-1.8	-0.8	-20.2
			85%	6	4,015.6	4,784.1	5.5	11,219.9	16.5	-0.8	-0.9	-0.9	-15.9
			90%	6	3,728.9	4,897.7	8.6	10,932.1	14.7	-0.8	-3.4	-1.4	-17.2
			95%	6	3,797.6	4,860.7	11.3	10,282.3	13.0	-0.2	-5.3	-0.7	-18.1
Total				108	2,353.8	2,738.3	2.5	9,298.4	12.5	-1.0	-2.1	-1.5	-13.4

Table 16: Summary of the results for the δ_c^{plant} service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
			70%	6	3,653.8	10,855.8	9.6	-1.3
			75%	6	4,311.9	11,516.4	5.9	-1.7
6	1	100	80%	6	4,254.8	10,894.8	8.3	-0.1
			85%	6	4,924.1	12,125.9	8.8	-0.1
			90%	6	5,198.3	12,400.6	11.2	-0.2
			95%	6	5,132.1	11,885.5	11.0	0.0
			70%	6	5,273.7	12,479.2	8.7	-1.6
			75%	6	5,518.4	12,721.4	11.0	-1.0
6	2	100	80%	6	5,485.4	12,688.8	14.9	-1.0
			85%	6	5,633.3	12,835.8	14.2	-0.8
			90%	6	5,544.5	12,747.0	15.9	-0.3
			95%	6	5,530.3	12,732.7	16.4	-0.1
			70%	4	6,155.0	13,359.8	13.2	-1.1
			75%	4	5,872.0	12,507.7	11.5	-1.3
6	3	100	80%	4	5,455.6	12,663.1	12.4	-0.7
			85%	4	5,796.3	12,999.7	15.3	-1.0
			90%	4	5,620.9	12,827.9	18.4	-0.6
			95%	4	5,603.3	12,805.4	17.9	-0.4
			70%	6	4,747.0	11,949.2	10.9	-0.7
			75%	6	5,337.1	12,542.6	9.9	-0.4
9	1	100	80%	6	5,435.9	12,638.0	11.6	-0.4
			85%	6	5,255.3	12,458.3	11.5	-0.1
			90%	6	5,425.6	12,627.7	12.6	-0.1
			95%	6	5,419.7	12,622.9	13.2	-0.1
			70%	4	5,696.6	12,899.0	15.6	-0.3
			75%	4	5,477.0	12,680.5	15.7	-0.5
9	2	100	80%	4	5,851.6	13,053.8	17.9	-0.3
			85%	4	6,106.4	13,308.6	18.5	-0.4
			90%	4	6,215.8	13,418.0	19.6	-0.4
			95%	4	5,874.1	13,076.3	21.2	-0.4
Total				156	5,329.4	12,479.1	13.0	-0.6

3 Plant Level-Global

The highest level of flexibility observed among different granularity levels in our study is at the plant level when applying the service level constraints across the entire planning horizon. Tables 17 to 24 offer detailed insights into the outcomes for each type of service level under this strategy, encompassing both the $\mathscr{S}$ and $\mathscr{L}$ datasets.

Table 17: Summary of the results for the α_p^{plant} service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	BC IMH ∇ (%)	BC PostOpt ∇ (%)	BC LB(FR-BC) ∇ (%)	BC UB(FR-BC) ∇ (%)
3	1	100	70%	6	725.9	293.7	0.0	7,738.4	2.7	-0.2	-1.6	-6.3	-8.8
			75%	6	610.8	111.4	0.0	7,821.1	2.6	-0.3	-1.2	-5.1	-7.6
			80%	6	508.0	69.7	0.0	7,713.1	1.9	-3.3	-1.0	-4.0	-5.9
			85%	6	303.1	160.5	0.0	7,508.0	2.1	-0.4	-0.7	-2.9	-4.9
			90%	6	136.3	321.1	0.0	7,345.0	2.5	0.0	-4.5	-5.8	-8.2
			95%	6	185.5	1,471.8	0.1	6,671.1	2.6	-0.1	-9.2	-11.1	-13.6
3	2	100	70%	6	1,492.9	4,872.6	7.3	7,936.1	3.6	-0.2	-7.0	-6.2	-16.3
			75%	6	1,635.9	4,858.6	5.1	8,748.7	4.4	-0.5	-6.0	-5.3	-11.8
			80%	6	1,987.1	4,845.2	2.9	8,619.4	7.3	-0.3	-4.1	-2.9	-10.3
			85%	6	2,213.8	5,003.8	3.2	8,906.2	4.9	-0.1	-5.8	-4.4	-12.1
			90%	6	2,407.9	4,884.3	4.4	8,801.2	5.8	0.0	-7.2	-4.3	-9.5
			95%	6	2,360.4	4,864.2	4.9	9,572.5	5.8	0.0	-10.0	-6.9	-16.7
3	3	100	70%	6	3,367.6	6,192.6	16.0	10,574.8	5.8	-0.4	-15.2	-4.5	-24.8
			75%	6	3,349.7	5,114.9	14.8	10,554.4	8.4	0.0	-13.3	-2.2	-24.2
			80%	6	3,795.6	5,308.9	13.5	10,999.5	9.1	-0.1	-11.6	-2.7	-23.5
			85%	6	3,967.7	6,114.0	14.8	11,171.4	9.6	0.0	-13.6	-3.0	-24.3
			90%	6	3,732.2	5,851.0	14.6	10,945.7	8.5	0.0	-13.9	-2.7	-23.3
			95%	6	3,890.6	5,224.0	14.5	11,095.1	9.6	0.0	-15.0	-3.6	-24.8
Total				108	2,037.3	3,642.3	6.5	9,051.5	5.4	-0.3	-7.9	-4.7	-15.0

Table 18: Summary of the results for the α_p^{plant} service level (on dataset $\mathscr{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	6,152.6	13,354.0	15.2	0.0
			75%	6	6,341.2	13,543.1	15.7	0.0
			80%	6	6,108.4	13,309.9	14.4	-0.1
			85%	6	6,169.2	13,372.2	13.7	-0.2
			90%	6	6,221.3	13,430.2	12.2	0.0
			95%	6	5,354.2	12,555.8	9.6	0.0
6	2	100	70%	6	6,056.4	13,259.4	27.9	0.0
			75%	6	6,477.8	13,681.0	28.0	0.0
			80%	6	6,689.4	13,892.4	28.0	-0.1
			85%	6	6,751.3	13,954.0	27.2	-0.1
			90%	6	6,300.7	13,503.3	25.1	0.0
			95%	6	5,632.4	12,835.1	23.7	0.0
6	3	100	70%	4	6,673.8	13,876.8	31.9	-0.1
			75%	4	6,722.1	13,925.2	31.1	-0.1
			80%	4	6,479.4	13,683.6	32.3	-0.2
			85%	4	6,953.5	14,157.6	31.4	-0.1
			90%	4	6,409.4	13,611.4	29.0	-0.1
			95%	4	5,826.0	13,028.3	26.7	-0.1
9	1	100	70%	6	6,366.5	13,568.7	37.5	-0.1
			75%	6	5,969.9	13,172.1	37.5	-0.1
			80%	6	6,309.9	13,513.0	34.4	-0.1
			85%	6	5,317.3	13,453.4	35.0	-0.1
			90%	6	6,406.6	13,609.5	30.8	-0.1
			95%	6	6,381.6	13,583.6	23.9	-0.1
9	2	100	70%	4	6,265.3	13,467.5	45.4	-0.1
			75%	4	6,080.7	13,283.0	46.6	-0.2
			80%	4	6,558.6	13,761.0	45.3	-0.2
			85%	4	5,540.9	12,743.1	42.6	-0.2
			90%	4	6,947.3	14,149.7	40.3	-0.3
			95%	4	6,459.3	13,661.6	33.6	-0.2
Total				156	6,241.7	13,480.6	28.1	-0.1

Table 19: Summary of the results for the β^{plant} service level (on dataset $\mathscr{S}$)

					IMH	FR-BC		BC					
T	K	S	SL	#INS	CPU (secs)	CPU (secs)	Gap (%)	CPU (secs)	Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
			70%	6	5,333.5	6,508.8	8.5	12,536.1	20.1	-0.6	-1.7	-0.9	-22.4
			75%	6	5,236.2	7,202.2	9.3	11,434.4	17.5	-0.9	-3.8	-1.4	-20.9
3	1	100	80%	6	5,478.1	7,129.8	11.3	11,690.2	14.3	0.0	-6.7	-0.5	-20.0
			85%	6	5,469.2	7,201.6	6.9	12,506.6	10.8	-0.2	-3.9	-0.2	-13.4
			90%	6	5,664.4	7,138.6	1.8	12,867.4	8.6	-0.1	-0.9	-1.9	-10.0
			95%	6	4,542.3	7,203.3	1.8	11,744.8	5.5	-0.1	-1.5	-0.4	-6.6
			70%	6	5,391.0	7,202.0	19.9	11,711.1	22.3	-1.3	-8.0	-0.6	-28.7
			75%	6	5,304.6	7,114.9	10.5[1]	12,506.9	21.5	-1.6	-3.3	-0.7	-24.1
3	2	100	80%	6	5,226.3	7,053.0	19.6[1]	12,428.4	18.5	-1.0	-11.0	0.0	-28.4
			85%	6	5,732.3	7,202.8	16.2[1]	12,318.3	15.6	-0.7	-8.1	-0.3	-23.1
			90%	6	5,590.1	5,699.2	9.6[2]	12,185.9	12.7	-0.5	-5.5	-0.4	-18.0
			95%	6	4,847.5	7,203.8	7.5[1]	11,465.8	9.8	-0.6	-4.9	0.0	-14.6
			70%	6	5,371.0	7,201.5	18.1[2]	12,573.5	28.2	-1.1	-9.9	-0.4	-33.9
			75%	6	5,640.9	6,111.8	20.0[2]	12,843.4	25.7	-0.8	-7.0	0.0	-30.2
3	3	100	80%	6	5,921.7	7,203.6	13.5[3]	13,124.1	22.3	-0.7	-5.8	0.0	-24.1
			85%	6	5,689.8	7,202.6	14.3[3]	12,529.2	21.4	-0.6	-8.3	-0.1	-24.8
			90%	6	5,565.6	7,202.9	16.2[3]	12,770.0	18.6	-0.6	-10.5	-0.1	-26.5
			95%	6	5,319.2	7,201.8	10.0[3]	12,522.1	15.6	-0.4	-6.5	-0.7	-19.9
Total				108	5,406.9	7,010.2	11.4	12,319.9	17.2	-0.7	-5.6	-0.5	-20.9

The number inside [-] indicates the number of instances where the BC could not find a feasible solution for the SPRP-FR

Table 20: Summary of the results for the β^{plant} service level (on dataset $\mathcal{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
			70%	6	5,778.0	12,979.9	39.1	-2.6
			75%	6	6,267.3	13,471.5	34.7	-1.7
6	1	100	80%	6	6,051.6	13,253.3	29.8	-2.1
			85%	6	5,913.1	13,124.8	25.8	-0.2
			90%	6	6,697.9	13,899.7	19.1	-0.1
			95%	6	6,456.1	13,659.5	13.7	-0.1
			70%	6	6,071.8	13,274.7	43.2	-2.8
			75%	6	6,474.6	13,677.5	41.7	-0.3
6	2	100	80%	6	6,555.8	13,758.6	39.4	-0.4
			85%	6	6,675.9	13,878.8	34.6	-0.2
			90%	6	6,646.0	13,848.9	29.9	-0.1
			95%	6	6,379.6	13,582.3	23.8	0.0
			70%	4	6,338.8	13,541.0	47.3	-0.4
			75%	4	6,601.0	13,803.3	43.8	-0.4
6	3	100	80%	4	6,670.0	13,872.3	41.4	-0.4
			85%	4	6,793.5	13,995.7	38.4	-0.3
			90%	4	6,840.8	14,043.0	33.8	-0.2
			95%	4	6,392.6	13,594.8	27.6	0.0
			70%	6	6,404.3	13,606.9	53.0	-0.5
			75%	6	6,353.2	13,555.8	49.6	-1.2
9	1	100	80%	6	6,327.9	13,530.5	46.2	-0.2
			85%	6	6,507.7	13,710.3	40.6	-0.2
			90%	6	6,660.3	13,863.2	30.6	-0.1
			95%	6	6,737.2	13,939.7	20.1	0.0
			70%	4	6,876.2	14,078.8	59.3	-0.8
			75%	4	6,974.1	14,176.6	57.4	-1.7
9	2	100	80%	4	6,894.9	14,097.4	54.8	-0.1
			85%	4	6,976.9	14,179.4	50.1	-0.1
			90%	4	6,477.0	13,679.4	42.5	-0.2
			95%	4	7,052.5	14,255.8	31.4	-0.1
Total				156	6,495.5	13,698.5	37.2	-0.6

Table 21: Summary of the results for the γ^{plant} service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	IMH ∇ (%)	PostOpt ∇ (%)	LB(FR-BC) ∇ (%)	UB(FR-BC) ∇ (%)
3	1	100	70%	6	1,561.4	263.9	0.0	8,765.1	5.8	-1.6	-1.0	-1.0	-6.8
			75%	6	1,101.5	192.2	0.0	8,305.6	4.4	-1.5	-0.4	-0.4	-4.8
			80%	6	1,448.4	184.8	0.0	7,862.3	3.7	-0.9	-1.0	-1.0	-4.6
			85%	6	1,773.0	148.4	0.0	8,314.2	2.8	-0.5	-1.5	-1.5	-4.1
			90%	6	2,006.9	129.9	0.0	9,214.9	3.4	-0.1	-0.9	-0.9	-4.1
			95%	6	2,548.9	118.2	0.0	9,749.6	3.5	-0.1	-0.2	-0.6	-3.3
3	2	100	70%	6	1,486.3	977.7	0.0	8,516.3	10.7	-2.7	-0.7	-0.7	-11.3
			75%	6	1,574.0	703.9	0.0	8,162.0	9.6	-2.0	-0.9	-0.9	-10.2
			80%	6	2,561.3	1,110.8	0.0	9,060.3	8.8	-1.3	-1.0	-1.0	-9.2
			85%	6	2,838.4	1,892.3	0.0	10,048.3	9.0	-0.5	-0.5	-0.5	-8.7
			90%	6	3,144.6	2,518.5	0.6	10,349.1	8.3	-0.4	-0.9	-0.6	-8.8
			95%	6	3,390.0	4,003.8	1.1	10,592.7	7.9	-0.2	-1.3	-0.6	-9.0
3	3	100	70%	6	2,184.6	2,850.1	0.1	8,803.9	12.0	-1.8	-1.1	-1.1	-13.0
			75%	6	3,099.6	3,228.5	0.6	10,309.4	11.2	-0.8	-1.7	-1.3	-12.6
			80%	6	3,731.3	3,869.0	0.9	10,518.5	10.4	-1.2	-1.9	-1.6	-11.9
			85%	6	3,923.2	4,770.2	4.4	11,126.1	12.3	-0.9	-2.5	-0.7	-14.1
			90%	6	4,096.6	4,900.4	7.1	11,303.0	11.6	-0.7	-3.1	-0.1	-14.5
			95%	6	4,069.4	4,851.2	9.0	10,570.0	13.2	-0.2	-4.5	-0.5	-17.1
Total				108	2,585.5	2,039.7	1.3	9,529.7	8.3	-1.0	-1.4	-0.8	-9.3

Table 22: Summary of the results for the γ^{plant} service level (on dataset $\mathcal{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	5,691.2	12,232.1	2.2	0.0
			75%	6	5,772.3	12,997.3	3.2	0.0
			80%	6	6,143.6	13,345.6	5.3	-0.1
			85%	6	5,811.2	13,013.2	7.2	0.0
			90%	6	5,990.9	13,192.6	8.2	-0.1
			95%	6	5,842.3	13,043.9	6.8	0.0
6	2	100	70%	6	6,338.6	13,544.0	8.7	-0.7
			75%	6	6,491.1	13,696.2	9.8	-0.6
			80%	6	6,397.5	13,599.9	11.7	-0.6
			85%	6	6,353.8	13,556.2	13.0	-0.7
			90%	6	6,476.1	13,678.5	14.3	-0.5
			95%	6	6,573.2	13,775.6	13.5	-0.1
6	3	100	70%	4	5,982.6	13,184.8	13.2	-1.1
			75%	4	5,974.2	13,176.3	13.2	-0.7
			80%	4	6,132.0	13,334.2	16.3	-0.6
			85%	4	6,221.7	13,424.0	16.4	-1.4
			90%	4	6,148.0	13,351.0	18.8	-0.9
			95%	4	6,604.2	13,806.6	18.5	-0.4
9	1	100	70%	6	6,025.9	13,228.1	7.9	-0.1
			75%	6	6,050.5	13,252.5	8.5	-0.1
			80%	6	6,127.5	13,331.7	8.0	-0.1
			85%	6	6,067.1	13,269.0	10.0	0.0
			90%	6	6,181.0	13,382.9	10.3	-0.1
			95%	6	6,004.1	13,210.0	8.6	-0.1
9	2	100	70%	4	6,003.9	13,206.0	17.7	-0.5
			75%	4	6,636.2	13,838.3	18.0	-0.5
			80%	4	5,765.3	12,967.6	18.4	-0.5
			85%	4	6,054.0	13,256.1	18.6	-0.2
			90%	4	6,324.1	13,526.3	19.3	-0.4
			95%	4	6,066.6	13,268.8	18.7	-0.5
Total				156	6,139.0	13,317.0	11.4	-0.4

Table 23: Summary of the results for the δ^{plant} service level (on dataset $\mathscr{S}$)

T	K	S	SL	#INS	IMH CPU (secs)	FR-BC CPU (secs)	FR-BC Gap (%)	BC CPU (secs)	BC Gap (%)	BC IMH ∇ (%)	BC PostOpt ∇ (%)	BC LB(FR-BC) ∇ (%)	BC UB(FR-BC) ∇ (%)
			70%	6	3,425.0	118.0	0.0	9,553.7	4.3	-2.0	-2.3	-2.3	-6.4
			75%	6	3,060.9	209.5	0.0	10,263.5	8.1	-1.7	-4.5	-4.5	-12.4
3	1	100	80%	6	3,091.6	393.7	0.0	10,115.0	7.2	-1.4	-3.5	-3.5	-10.5
			85%	6	1,439.1	197.9	0.0	8,645.6	5.7	-1.7	-1.1	-1.1	-6.7
			90%	6	1,472.8	202.7	0.0	8,363.2	3.9	-0.9	-1.0	-1.0	-4.8
			95%	6	1,944.0	128.2	0.0	9,149.2	3.4	-0.1	-0.9	-0.9	-4.1
			70%	6	3,379.2	278.6	0.0	10,581.5	17.8	-3.1	-3.2	-3.2	-20.7
			75%	6	3,114.7	1,248.3	0.0	10,320.1	15.0	-2.6	-3.6	-3.6	-18.2
3	2	100	80%	6	3,204.1	3,442.9	0.4	10,415.1	14.5	-3.6	-3.0	-2.6	-17.2
			85%	6	1,576.8	940.5	0.0	8,784.8	10.6	-2.7	-0.7	-0.7	-11.3
			90%	6	2,491.6	976.8	0.0	9,696.9	8.8	-1.5	-1.1	-1.1	-9.3
			95%	6	3,124.8	2475.0	0.6	10,329.1	8.3	-0.4	-0.9	-0.6	-8.8
			70%	6	3,711.5	664.5	0.0	10,396.4	27.4	-1.2	-2.9	-2.9	-29.8
			75%	6	3,228.1	2,812.8	0.0	10,433.7	18.9	-2.0	-3.7	-3.7	-22.1
3	3	100	80%	6	3,189.2	3,859.9	1.8	9,927.0	15.2	-2.3	-3.8	-2.7	-18.6
			85%	6	2,444.8	3,563.8	0.2	9,287.3	12.7	-0.8	-1.1	-1.1	-12.9
			90%	6	3,831.9	4,100.1	1.5	11,034.6	10.6	-0.9	-2.0	-1.4	-12.4
			95%	6	4,096.0	4,906.2	6.1	11,299.6	12.4	-0.7	-2.2	-0.1	-14.4
Total				108	2,879.2	1,695.5	0.6	9,922.0	11.4	-1.6	-2.3	-2.1	-13.4

Table 24: Summary of the results for the δ^{plant} service level (on dataset $\mathcal{L}$)

T	K	S	SL	#INS	IMH CPU (secs)	BC CPU (secs)	Gap (%)	IMH ∇ (%)
6	1	100	70%	6	2,458.7	6,063.4	6.2	-0.7
			75%	6	5,876.4	13,078.3	10.8	-0.5
			80%	6	6,249.8	13,460.1	9.4	-1.1
			85%	6	5,548.2	12,556.1	5.0	-0.3
			90%	6	5,805.2	12,903.6	2.2	-0.1
			95%	6	5,981.3	13,183.3	6.2	-0.6
6	2	100	70%	6	2,534.2	6,146.6	5.8	-1.6
			75%	6	5,759.5	12,962.3	15.3	-1.7
			80%	6	6,001.0	13,204.4	13.7	-0.7
			85%	6	6,078.0	13,280.9	11.5	-0.5
			90%	6	6,263.1	13,468.7	8.3	-0.7
			95%	6	6,293.4	13,497.2	13.3	-0.5
6	3	100	70%	4	3,057.9	6,668.8	6.1	-0.8
			75%	4	5,548.3	12,751.3	17.2	-0.9
			80%	4	5,553.9	12,756.9	16.0	-0.7
			85%	4	6,168.2	13,370.4	15.6	-0.6
			90%	4	6,048.6	13,250.8	13.0	-0.6
			95%	4	6,354.2	13,557.3	16.9	-0.7
9	1	100	70%	6	5,902.5	13,105.2	8.0	-0.7
			75%	6	5,936.3	13,138.6	4.7	-0.2
			80%	6	6,028.2	13,230.3	7.5	-0.3
			85%	6	6,065.9	13,268.1	8.8	0.0
			90%	6	6,391.7	13,593.8	7.8	-0.1
			95%	6	6,116.8	13,320.2	8.5	-0.1
9	2	100	70%	4	5,899.8	13,030.3	13.3	-1.6
			75%	4	6,601.5	13,803.8	10.1	-1.4
			80%	4	6,737.0	13,939.1	12.8	-0.4
			85%	4	5,924.5	13,126.5	14.9	-0.3
			90%	4	6,507.3	13,709.4	16.1	-0.4
			95%	4	6,236.5	13,438.7	18.3	-0.5
Total				156	5,707.0	12,524.8	10.2	-0.6