Appendix 8 Pipeline for Expansion Stage

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The existing pipeline of ϕ 1200mm can convey 45 MCM water per year. In this appendix, the pipeline is analyzed to cope with the planned increased water of 90 MCM/year in the future.

In the expansion stage to convey 90 MCM/year,.it will obviously involve duplicating the existing system components; No.1 to No.5 pumping stations, conveyance pipe and treatment plant. However, this idea is not necessarily obvious for the pipes. Therefore, the following alternatives are considered;

Alternative H (Twin System): Additional 1,200 mm pipeline is installed beside the existing pipeline.
Alternative I (Single System): The existing pipeline is used without additional pipeline

The construction cost is higher but the O/M cost is cheaper in the alternative H than the alternative I. Therefore, we have compared the alternatives, using "Net Present Value" method.

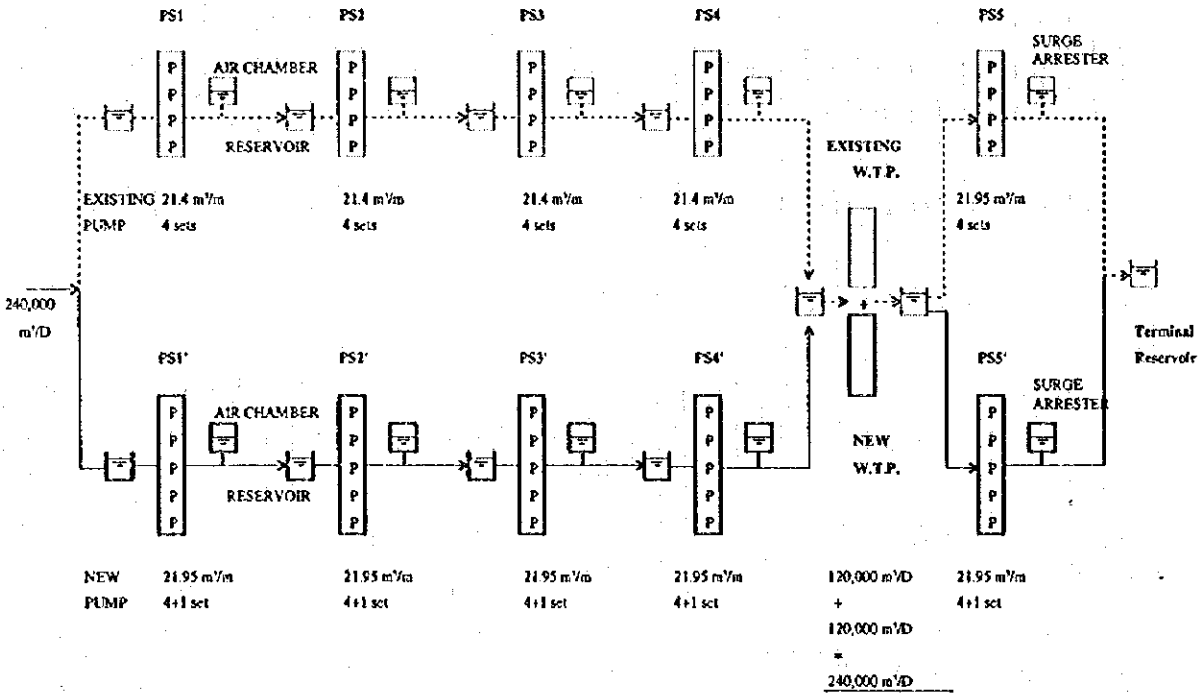
(1) Facilities

Item	Alternative H	Alternative I
Pumping Station (Mechanical)	additional five pumps including one stand-by. pump's capacity is 21.95 m3/min. same as the existing	Replace the existing 21.95 m3/min. pump with 43.5 m3/min. pump
Pumping Station (Electrical)	additional five motors including one stand-by. motor's capacity is 1,200 kw same as the existing	Replace the existing 1,200 kw motor with 3,000 to 3,500 kw motor
Pumping Station (Civil)	pump house for five additional pump	pump house for one additional pump
Pipeline *	additional pipeline of 1,200 mm between intake to Zai treatment plant	-

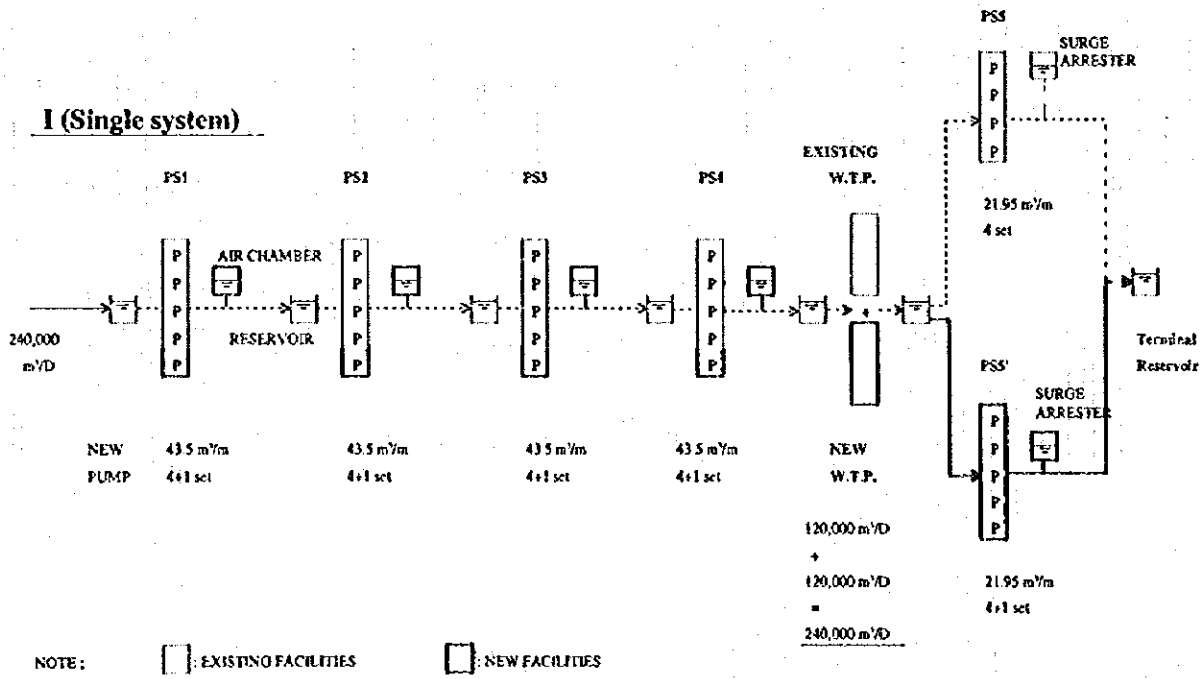
* The additional pipeline is required after Zai treatment plant to Dabouk reservoir in the both alternatives.

ALTERNATIVES

H (Twin system)



I (Single system)



(2) Capital cost

Unit: million dinar

Item	Alternative H	Alternative I
Pumping station (Mechanical and Electrical)	20	18
Pumping station (Civil and architecture)	2	0.5
Pipeline (up to Zai treatment plant)	11	-
Pipeline (after Zai treatment plant)	13	13
Total	46	31.5

(3) Power cost

Unit: million dinar

Item	Alternative H	Alternative I
Annual power cost	12.6	13.4

(4) Life time

Item	Alternative H			Alternative I		
	Facilities	Year	Cost	Facilities	Year	Cost
Pumping station (Mechanical and Electrical) 15 years	Existing	2000	20	Existing	-	-
	Improved	2015	20	Improved	2015	18
Pumping station (Civil and architecture) 50 years	Existing	2035	2	Existing	2035	2
	Improved	2050	2	Improved	2050	0.5
Pipeline 30 years	Existing	2015	11	Existing	2015	24
	Improved	2030	13	Improved	2030	13

(5) Construction schedule

3 years

For the first year, 60% of the capital cost will be invested (27.6 million dinar in the alternative H and 18.9 million dinar in the alternative I).

For the second and third years, each 20% of the capital cost will be invested.

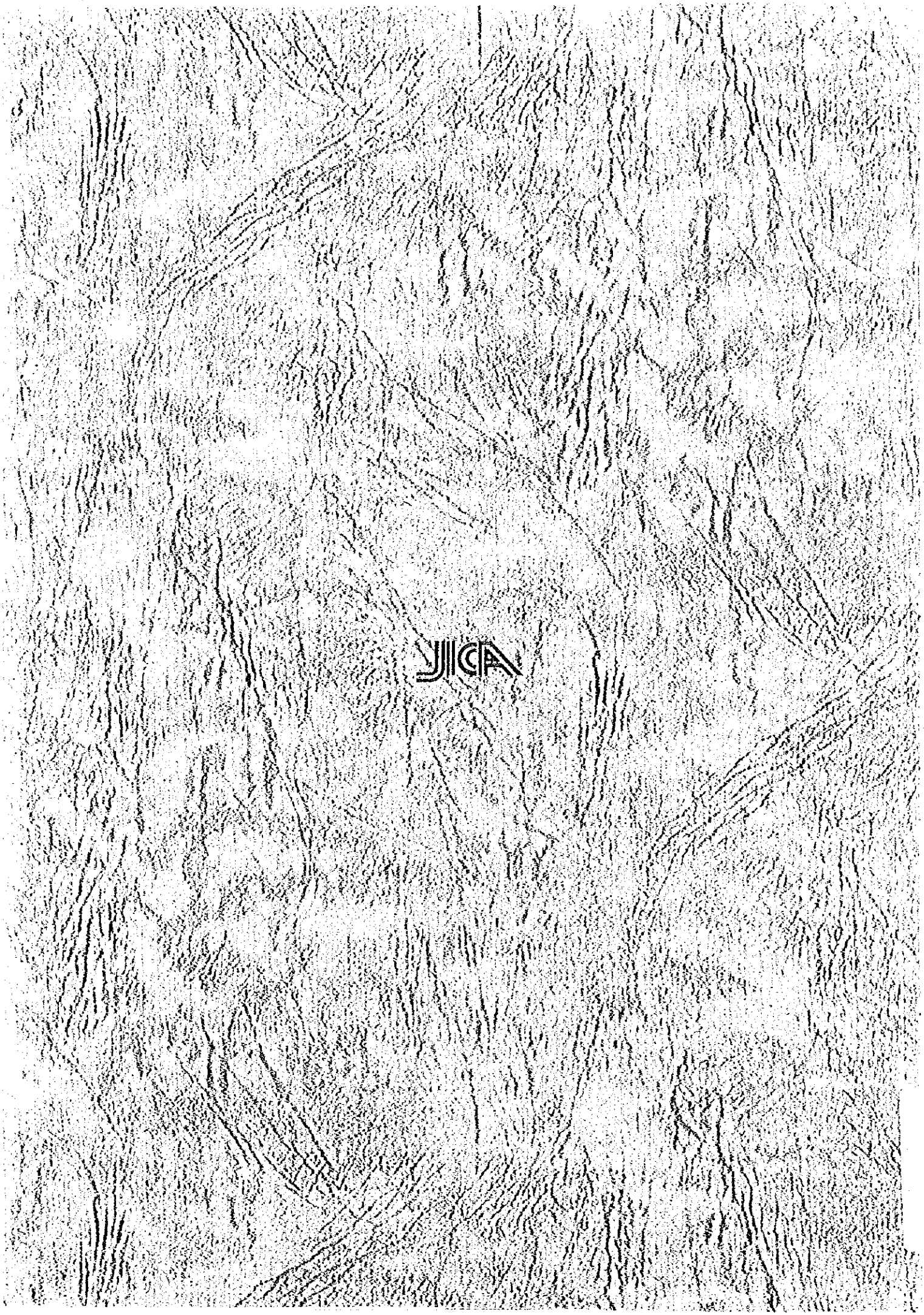
(6) NPV results

(Unit: million Dinar)

year	Alternative H			Alternative I		
	Capital Cost	Operation Cost	Total Cost	Capital Cost	Operation Cost	Total Cost
2001	47.6		47.6	18.9		18.9
2002	9.2		9.2	6.3		6.3
2003	9.2		9.2	6.3		6.3
2004		12.6	12.6		13.4	13.4
2005		12.6	12.6		13.4	13.4
2006		12.6	12.6		13.4	13.4
2007		12.6	12.6		13.4	13.4
2008		12.6	12.6		13.4	13.4
2009		12.6	12.6		13.4	13.4
2010		12.6	12.6		13.4	13.4
2011		12.6	12.6		13.4	13.4
2012		12.6	12.6		13.4	13.4
2013		12.6	12.6		13.4	13.4
2014		12.6	12.6		13.4	13.4
2015	44.0	12.6	56.6	24.0	13.4	37.4
2016		12.6	12.6		13.4	13.4
2017		12.6	12.6		13.4	13.4
2018	20.0	12.6	32.6	18.0	13.4	31.4
2019		12.6	12.6		13.4	13.4
2020		12.6	12.6		13.4	13.4
2021		12.6	12.6		13.4	13.4
2022		12.6	12.6		13.4	13.4
2023		12.6	12.6		13.4	13.4
2024		12.6	12.6		13.4	13.4
2025		12.6	12.6		13.4	13.4
2026		12.6	12.6		13.4	13.4
2027		12.6	12.6		13.4	13.4
2028		12.6	12.6		13.4	13.4
2029		12.6	12.6		13.4	13.4
2030		12.6	12.6		13.4	13.4
Total	130.0	340.2	470.2	73.5	361.8	435.3
NPV		5%	354.1		5%	313.6
		6%	303.2		6%	265.2
		7%	262.9		7%	226.9
		8%	230.8		8%	196.3
		9%	204.9		9%	171.8
		10%	183.9		10%	151.8
		15%	121.6		15%	92.9

(7) Conclusion

NPV in the alternative I is superior to NPV in the alternative H for any discount rates between 5 to 10%.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