2.4 Cost Estimates and Present Value

To determine the method of project implementation, project costs are estimated as summarized in Tables L-2 for Option A and L-3 for Option B. Initial investment costs required for Steps-1 and 3 of Option A are US$ 6.9 million and US$ 41.1 million respectively. The Option B investment cost is estimated at US$ 46.4 million. The Option B is slightly moderate in initial investment cost. These tables also show replacement costs of the instruments and equipment, required when they outlive their durable years.

Table L-4 shows an annual investment plan for these two options, which are developed on the basis of the initial investment and replacement costs estimated, a tentative construction schedule and expected design life of materials and equipment.

Present value method is applied to evaluate options. Discounts rates employed are 5, 10, 12 and 15%. Present values estimated from annual investment plans for coming 20 years up to 2010 are also shown in Table L-4.

2.5 Recommendations

As clearly seen in Table L-4, "Option A" excels in every percentage of discount rates. Difference in the net present value ranges from US$ 8.7 million to 13.5 million. The table also suggests that the higher the discount rates are employed, the larger the deviation are seen. Since benefits accrued from these options can be considered almost similar, it may be concluded that "Option A" is a more feasible solution for Phase I Project implementation.

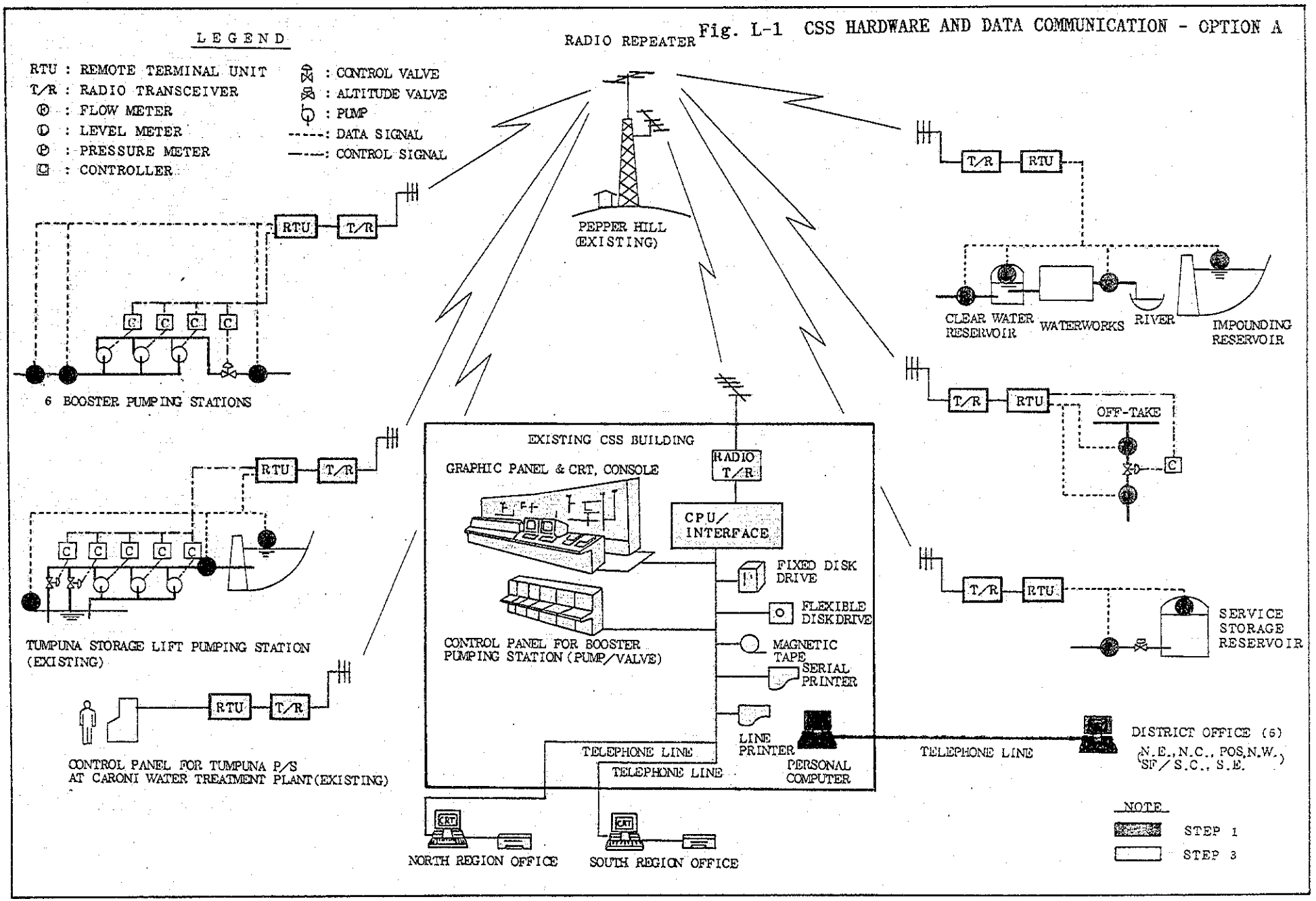

Fig. L-1 CSS HARDWARE AND DATA COMMUNICATION - OPTION A

Table I.-1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (1)

NOTE: AN; ANNUBAR, F ; FLOAT TYPE, Av ; AVENUE, WW ; WATERWORKS, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, O ; ORIFICE PLATE, HW ; HIGH WAY, OT ; OFF-TAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, P ; PROPELLAR TYPE, SH ; SHEET, JCT; JUNCTION, "¥"; EXISTINGS(REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, PF; PARSHALL FLUME, ST ; STREET, IC ; INTERCONNECTION, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, V ; VENTURI TUBE, RES; RESERVOIR, BPS; BOOSTER PUMPING STATION,
CV; CONE VALVE, RD; ROAD, IT ; INTAKE, D ; DIFFERENTIAL PRESSURE TYPE,

NUMBER & NAME OF RTU STAT. TO BE INSTALLED (STEP 2)	NAME OF MONITORING POINT	PHASE I																
		STEP 1							STEP 3									
		EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
1 NORTH OROPOUCHE WW								5								5				
	RAW WATER	F		¥ PF	1		1			1		1								
	CLEAR WATER RESERVOIR	* D·2			2					2										
	DISTRIBUTION (1050)			AN			1					1								
2 HOLLIS WW								3								3				
	IMPOUNDING RESERVOIR	F			1					1										
	RAW WATER (300)			AN			1					1								
	DISTRIBUTION (600)			AN			1					1								
3 GILL TRACE								11								15				
	QUARE WATER TANK	D			1					1										
	QUARE DISTRIBUTION (300)		¥ B	¥ V		1	1				1	1								
	GILL TRACE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	QUARE(1) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	QUARE(2) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	TO SANGRE GRANDE OT (400)		B	AN		1	1		BU		1	1	1						1	SITE
4 ARIPO BPS								12								15				
	ARIPO(NEW) RAW WATER (300)			¥ O			1					1								
	ARIPO(OLD) RAW WATER (250)			AN			1					1								
	FORT READ RESERVOIR (250)	D		AN	1		1			1		1								
	FORT READ RESERVOIR (300)	D		AN	1		1			1		1								
	ARIPO BPS (300)		B	¥ V		1	1		BU		1	1	1						1	SITE
	CUMOTO(1) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	CUMOTO(2) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
5 GUANAPO JUNCTION								8								11				
	GUANAPO RAW WATER (300)			AN			1					1								
	GUANAPO RESERVOIR (300)	D			1					1										
	GUANAPO WW DIST. (300)		B	AN		1	1		BU		1	1	1						1	SITE
	DOUBLE BRIDGE OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	GUANAPO JUNCTION OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
6 DEMERARA JUNCTION								4								6				
	DEMERARA JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TUMPUNA JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
7 ARIMA OLD RESERVOIR								13								17				
	ARIMA NEW RESERVOIR (375)	F		AN	1		1			1		1								
	ARIMA OLD RESERVOIR (200)	D		AN	1		1			1		1								
	TO MORENO ST OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	QUESNEL ST OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	OMERA JCT OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	ARIMA BPS (300)		B	AN		1	1		BU		1	1	1						1	SITE
	ARIMA WELL (200)			AN			1					1								
	ARIMA B/PUMPS																			
8 MAUSICA JUNCTION								12								18				
	OLTON RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	BOYS LANE OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MAUSICA JCT OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	CARAPO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MAUSICA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MALONEY JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
9 AROUCA WW								6								9				
	CLEAR WATER TANK	D			1					1										
	DISTRIBUTION (200)			AN			1		BU			1	1						1	SITE
	BORNE AREA #1 OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	LOPINOT IC OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
10 CAURA WW								4								5				
	RAW WATER (400)			AN			1					1								
	CLEAR WATER TANK	D			1					1										
	DISTRIBUTION (400)		B	AN		1	1		BU		1	1	1						1	SITE
11 TACARIGUA WW								9								12				
	CLEAR WATER RESERVOIR	¥ D			1					1										
	DISTRIBUTION(1) (300)		B	AN		1	1		BU		1	1	1						1	SITE
	DISTRIBUTION(2) (400)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CAURA BPS OT (225)		B	AN		1	1		BU		1	1	1						1	SITE
	PASEA RD OT (175)		B	AN		1	1				1	1								

Table L-1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (2)

NOTE: AN; ANNUBAR, AP; AIR PURGE TYPE, AV; ALTITUDE VALVE, B ; BOURDON TUBE, BU; BUTTERFLY VALVE, CV; CONE VALVE, F ; FLOAT TYPE, O ; ORIFICE PLATE, P ; PROPELLAR TYPE, PF; PARSHALL FLUME, V ; VENTURI TUBE, RD; ROAD, Av ; AVENUE, HW ; HIGH WAY, SH ; SHEET, ST ; STREET, RES; RESERVOIR, IT ; INTAKE, WW ; WATERWORKS, OT ; OFF-TAKE, JCT; JUNCTION, IC ; INTERCONNECTION, BPS; BOOSTER PUMPING STATION, D ; DIFFERENTIAL PRESSURE TYPE, (300); PIPE DIAMETER(MM), "*"; EXISTINGS TO BE USED, "¥"; EXISTINGS(REPLACEMENT PERIPHERALS), "#"; INSTALLATION OF CONTROL EQUIPMENT,

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I STEP 1 EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				PHASE I STEP 3 INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
12 FLOW CONTROL STATION								7								11				
	PIARCO JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	BY-PASS OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	FLOW CONTROL STATION(800)		B·2	¥ V		2	1		# CV·2		2	1	2						2	SITE
13 ST AUGUSTINE RESERVOIR								10								10				
	RESERVOIR (750)	F		AN	1		1		AV	1		1								
	ST JOHN RD OT (300)		B	AN		1	1				1	1								
	TO TUNAPUNA OT (150)		B	AN		1	1				1	1								
	RABIR ST OT (200)		B	AN		1	1				1	1								
	RIVERSIDE RD OT (100)		B	AN		1	1				1	1								
14 TUNAPUNA BPS								12								48				
	TUNAPUNA(1) (150)		B	AN		1	1		BU		1	1	1						1	CSS
	TUNAPUNA(2) (200)		B	AN		1	1		BU		1	1	1						1	CSS
	TUNAPUNA(3) (525)		B	AN		1	1				1	1								
	PASEA ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA RIVER (1) (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA RIVER (2) (525)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA B/PUMPS													6	25		3	CSS		
15 ST JOSEPH RESERVOIR								11								15				
	RESERVOIR	F			1					1										
	TO ST JOSEPH OT (225)		B	AN		1	1		BU		1	1	1						1	SITE
	TO RIDER MAIN OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MENDEZ STEEL SH. OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MATERNITY HP. OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	ST JOSEPH(1) (175)			AN			1					1								
	ST JOSEPH(2) (300)			AN			1					1								
16 VALSAYN WW								8								41				
	RAW WATER (750)			¥ V			1					1								
	CLEAR WATER RESERVOIR	¥ D			1					1										
	DISTRIBUTION (750)		¥ B	¥ V		1	1		BU		1	1	1						1	SITE
	BOOSTER SUCTION (450)		¥ B	¥ AN		1	1				1	1								
	BOOSTER DELIVERY (450)		¥ B	AN		1	1		BU		1	1	1						1	CSS
	VALSAYN B/PUMPS													6	25		3	CSS		
17 URIAH BUTLER HW JUNCTION								2								3				
	STAG/NESTL OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
18 MT. HOPE RESERVOIR								16								23				
	RESERVOIR (600)	D		AN	1		1		AV	1		1								
	CARIB(1) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	CARIB(2) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MT. HOPE OT (300)																			
	GORDON ST (1) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	GORDON ST (2) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	GORDON ST (3) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	BROOM ST OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	TO SANTA CRUZ OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
19 MALICK RESERVOIR								8								11				
	RESERVOIR (750)	D		AN	1		1		AV	1		1								
	TO BARATARIA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	SIXTH Av. OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LADY YOUNG Av. OT (450)		B	AN		1	1		BU		1	1	1						1	SITE
20 EL SOCORRO WW								13								49				
	RAW WATER (750)			¥ V			1					1								
	CLEAR WATER RESERVOIR	¥ AP			1					1										
	BOOSTER SUCTION (900)		¥ B			1					1									
	BOOSTER DELIVERY (600)		¥ B	¥ AN		1	1		BU		1	1	1						1	CSS
	DISTRIBUTION (400)		¥ B	¥ AN		1	1		BU		1	1	1						1	SITE
	EL SOCORRO RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	DON MIGUEL RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	ELEVENTH ST OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	EL SOCORRO B/PUMPS													6	25		3	CSS		
21 LAVENTILLE								2								3				
	TO LAVENTILLE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
22 BLACK RIVER								8								12				

Table L-1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (3)

NOTE: AN; ANNUBAR, F ; FLOAT TYPE, Av ; AVENUE, WW ; WATERWORKS, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, O ; ORIFICE PLATE, HW ; HIGH WAY, OT ; OFF-TAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, P ; PROPELLAR TYPE, SH ; SHEET, JCT; JUNCTION, "¥"; EXISTINGS(REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, PF; PARSHALL FLUME, ST ; STREET, IC ; INTERCONNECTION, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, V ; VENTURI TUBE, RES; RESERVOIR, BPS; BOOSTER PUMPING STATION,
CV; CONE VALVE, RD; ROAD, IT ; INTAKE, D ; DIFFERENTIAL PRESSURE TYPE.

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I																	
		STEP 1							STEP 3										
		EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP		VALVE	
																	NO.	PLACE	NO.	PLACE
	BLACK RIVER (1) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	BLACK RIVER (2) OT (450)		B	AN		1	1		BU		1	1	1						1	SITE
	BLACK RIVER (3) OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LADY YOUNG RD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
23 PICTON NO.3 RESERVOIR								13								16				
	PICTON #1 RESERVOIR (400)	* D		AN	1		1		AV	1		1								
	PICTON #2 RESERVOIR (750)	* D-2		AN	2		1		AV-2	2		1								
	PICTON #3 RESERVOIR (900)	* D		AN	1		1		AV	1		1								
	MASALLAH ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	PRIZAR LANDS ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	KERR RD OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
24 SERVOL LIFE CENTER								6								9				
	BEETHAM DUMP OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	SERVOL LIFE C. OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LAVENTILLE OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
25 KNAGGS HILL								15								19				
	RESERVOIR (525)	* D-2		AN	2		1		* AV-2	2		1								
	TO BELMONT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CASCADE OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
	TO ST CLAIR OT (350)		B	AN		1	1		BU		1	1	1						1	SITE
	WESTERN MAIN ROAD (525)		B	AN		1	1		BU		1	1	1						1	SITE
	FROM SAVANNAH WELLS (300)		B	AN		1	1				1	1								
	BARRACK (750)		B	AN		1	1				1	1								
26 NATIONAL FLOUR MILL								2								3				
	NFM OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	PORT AUTHORITY (300)																			
	POST OFFICE (300)																			
	NATIONAL STADIUM (300)																			
27 TUMPUNA STORAGE LIFT PS								4								77				
	ARENA IMPOUNDING RES.	¥ AP			1					1										
	TUMPUNA WEIR	F			1					1										
	TO/FROM RESERVOIR (1200)			¥ V-2			2					2								
	RIVER DISCH. VALVE (1200)								¥ BU-2				2						2	CARONI
	TUMPUNA S.L./PUMPS													12	59		6	CARONI		
28 CARONI WTP								7								9				
	RAW WATER	¥ AP		¥ PF	1		1			1		1								
	CLEAR WATER RESERVOIR	¥ AP			1					1										
	CARONI NORTH (900)		* B	¥ AN		1	1		¥ BU		1	1	1						1	CARONI
	CARONI SOUTH (1200)		* B	¥ AN		1	1		¥ BU		1	1	1						1	CARONI
29 KELLY VILLAGE								2								3				
	KELLY VILLAGE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
30 SCALE YARD								4								6				
	SCALE YARD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	HINGKING RD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
31 LAS LOMAS WW								4								5				
	RAW WATER (600)			¥ O			1					1								
	CLEAR WATER RESERVOIR	D			1					1										
	DISTRIBUTION (600)		¥ B	¥ V		1	1		BU		1	1	1						1	SITE
32 JERNINGHAM JUNCTION								4								5				
	TO LAS LOMAS OT (600)		B	AN		1	1				1	1								
	JERNINGHAM JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
33 CHAGUANAS								4								6				
	CHAGUANAS OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	LANGE PARK OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
34 CARLSEN FIELD WW								5								7				
	CLEAR WATER RESERVOIR	F			1					1										
	DISTRIBUTION(1) (200)		B	AN		1	1		BU		1	1	1						1	SITE
	DISTRIBUTION(2) (250)		B	AN		1	1		BU		1	1	1						1	SITE
35 CARAPICHAIMA								6								7				
	CARAPICHAIMA OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CARLSEN FIELD OT (300)		B	AN		1	1				1	1								
	TO FREEPORT WW OT (300)		B	AN		1	1				1	1								
36 WARDEN OFFICE								6								9				

Table L-1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (4)

NOTE: AN; ANNUBAR, AP; AIR PURGE TYPE, AV; ALTITUDE VALVE, B ; BOURDON TUBE, BU; BUTTERFLY VALVE, CV; CONE VALVE,
F ; FLOAT TYPE, O ; ORIFICE PLATE, P ; PROPELLAR TYPE, PF; PARSHALL FLUME, V ; VENTURI TUBE, RD; ROAD,
Av ; AVENUE, HW ; HIGH WAY, SH ; SHEET, ST ; STREET, RES; RESERVOIR, IT ; INTAKE,
WW ; WATERWORKS, OT ; OFF-TAKE, JCT; JUNCTION, IC ; INTERCONNECTION, BPS; BOOSTER PUMPING STATION, D ; DIFFERENTIAL PRESSURE TYPE,
(300); PIPE DIAMETER(MM), "*"; EXISTINGS TO BE USED, "¥"; EXISTINGS(REPLACEMENT PERIPHERALS), "#"; INSTALLATION OF CONTROL EQUIPMENT,

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I STEP 1 EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				PHASE I STEP 3 INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
	WARDEN OFFICE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	COUVA LANE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	POINT LISAS OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
37 TRINGEN II								2								3				
	TRINGEN II OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
38 CALIFORNIA RESERVOIR								2								2				
	RESERVOIR (900)	D		AN	1		1		AV	1		1								
39 TCL								2								3				
	TCL OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
40 MARAVELLA								2								3				
	MARAVELLA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
41 SAN FERNANDO BPS								14								49				
	SAN F'DO RESERVOIR (750)	¥ D		AN	1		1		AV	1		1								
	MARRYAT RESERVOIR (600)	¥ D		AN	1		1			1		1								
	NAPARIMA RESERVOIR	¥ D			1					1										
	BOOSTER SUCTION (900)		¥ B	¥ AN		1	1				1	1								
	BOOSTER DELIVERY (900)		¥ B			1			* BU		1		1						1	CSS
	ROUND ABOUT(1) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	ROUND ABOUT(2) OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
	FIRE BRIGADE OT (375)		B	AN		1	1		BU		1	1	1						1	SITE
	SAN F'DO B/PUMPS													6	25		3	CSS		
42 MOSQUITO CREEK								2								3				
	TO MOSQUITO CR. OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
43 ST CLEMENT								4								6				
	ST CLEMENT (1) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	ST CLEMENT (2) OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
44 DAISY								2								3				
	DAISY OT (400)		B	AN		1	1		BU		1	1	1						1	SITE
45 MALGRETOUTE BPS								9								64				
	BOOSTER SUCTION (900)		¥ B	¥ V		1	1				1	1								
	BOOSTER DELIVERY (900)		¥ B			1			BU		1		1						1	CSS
	BUEN INTENTO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO PRINCESS TOWN OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO MALGRETOUTE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MALGRETOUTE B/PUMPS													10	41		5	CSS		
46 BROTHER ROAD								6								9				
	BROTHER ROAD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	TO PIPARO/ARCH OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
	TO ST JULIAN OT (375)		B	AN		1	1		BU		1	1	1						1	SITE
47 TCO BPS								5								68				
	BOOSTER SUCTION (900)		¥ B			1					1									
	BOOSTER DELIVERY (900)		¥ B	¥ V		1	1		BU		1	1	1						1	CSS
	RIO CLARO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TCO B/PUMPS													12	49		6	CSS		
48 NAVET WW								9								9				
	HIGH DAM	F			1					1										
	LOW DAM	F			1					1										
	STORAGE LIFT PS (1200)			AN			1					1								
	RAW WATER (450)			AN-4			4					4								
	CLEAR WATER RESERVOIR	F			1					1										
	DISTRIBUTION (900)			AN			1					1								
	TOTAL	38	127	160	38	127	160	325	124	38	127	160	113	58	249	745	29		113	
	= LIST OF ITEMS =	¥AP 4 D 11 *D 8 ¥D 5 F 10	¥B 14 B 111 *B 2	¥AN 6 AN139 ¥O 2 ¥PF 2 ¥V 11					AV 9 *AV 2 BU106 *BU 1 ¥BU 4 ¥CV 2								6 23	CARONI CSS	102 7 4	SITE CSS CARONI

Table L-2 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (1)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I-STEP 1										PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)	
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION			PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION		
[1]	CONSTRUCTION WORKS																				
	[CSS]																				
	FLOW METER	494.2	1,870.2	2,364.4	1,438.4	---	1,004.9	2,443.3	201.0	2,644.3	2,986.6	---	---	---	---	---	---	---	---	---	---
	CONTROL VALVE	---	---	---	---	---	---	---	---	---	---	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1
	LEVEL METER	32.5	380.9	413.4	---	---	175.7	175.7	35.1	210.8	463.0	---	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	988.9	988.9	---	---	420.3	420.3	84.1	504.3	1,107.6	---	---	---	---	---	---	---	---	---	---
	CSS's CENTRAL EQUIP	---	---	---	---	---	---	---	---	---	---	---	5,861.9	5,861.9	---	385.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7
	REGIONAL OFFICE	---	---	---	---	---	---	---	---	---	---	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9
	REPEATER STATION	---	---	---	---	---	---	---	---	---	---	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	---	---	---	---	---	---	---	---	---	---	11,832.0	11,832.0	---	2,219.5	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1
	BOOSTER P/S	---	---	---	---	---	---	---	---	---	---	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9
	SPARE PARTS	---	---	---	---	---	---	---	---	---	---	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	526.7	3,240.0	3,766.7	1,438.4	---	1,600.8	3,039.3	320.2	3,359.4	4,557.1	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
	[DISTRICT OFFICE]																				
	PC & PRINTER	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---	---
	T O T A L	526.7	3,352.0	3,878.7	1,438.4	---	1,600.8	3,039.3	322.4	3,361.7	4,669.7	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
[2]	ENGINEERING SERVICES	---	---	489.4	---	---	---	---	---	382.6	579.4	---	---	2,823.9	---	---	---	---	---	1,788.4	3,244.7
	TOTAL OF ITEMS [1] & [2]	526.7	3,352.0	4,368.1	1,438.4	---	1,600.8	3,039.3	322.4	3,744.3	5,249.1	2,156.4	22,380.3	27,360.6	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	17,491.1	31,476.2
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	3,346.3	787.4	---	---	---	---	---	---	---	---	20,066.1	4,721.4
[4]	CONTINGENCY	---	---	655.2	---	---	---	---	---	561.6	787.4	---	---	4,104.1	---	---	---	---	---	2,623.7	4,721.4
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	111.5	26.2	---	---	---	---	---	---	---	---	668.9	157.4
	GRAND-TOTAL	526.7	3,352.0	5,023.3	1,438.4	---	1,600.8	3,039.3	322.4	7,763.8	6,850.1	2,156.4	22,380.3	31,464.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	40,849.7	41,076.4

NOTE: EQUIP.; EQUIPMENT. P/S; PUMPING STATION. F-M/C-V; FLOW METER AND CONTROL VALVE. VAT; VALUE ADDED TAX. EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25.

Table L-2 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (2)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	REPLACEMENT COST OF PHASE I-STEP 1										REPLACEMENT COST OF PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1]	CONSTRUCTION WORKS																				
	[CSS]																				
	FLOW METER	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4	---	---	---	---	---	---	---	---	---	---
	CONTROL VALVE	---	---	---	---	---	---	---	---	---	---	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1	---	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	---	---	---	---	---	---	---	---	---
	CSS's CENTRAL EQUIP	---	---	---	---	---	---	---	---	---	---	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	---	---	---	---	---	---	---	---	---	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	---	---	---	---	---	---	---	---	---	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	---	---	---	---	---	---	---	---	---	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SPARE PARTS	---	---	---	---	---	---	---	---	---	---	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
	[LSS]																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	T O T A L	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[2]	ENGINEERING SERVICES	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL OF ITEMS [1] & [2]	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	1,553.7	365.6	---	---	---	---	---	---	---	---	11,041.9	2,598.1
[4]	CONTINGENCY	---	---	326.4	---	---	---	---	---	166.5	365.6	---	---	2,323.1	---	---	---	---	---	1,168.9	2,598.1
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	51.8	12.2	---	---	---	---	---	---	---	---	368.1	86.6
	GRAND-TOTAL	---	2,176.0	2,502.4	---	---	924.8	924.8	185.0	2,881.7	3,180.4	---	15,487.1	17,810.2	---	---	6,476.1	6,476.1	1,316.4	20,371.3	22,603.4

NOTE: EQUIP.; EQUIPMENT, P/S; PUMPING STATION, F-M/C-V; FLOW METER AND CONTROL VALVE, VAT; VALUE ADDED TAX, EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table L-3 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVOSORY SYSTEM (OPTION B)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I										REPLACEMENT COST OF PHASE I									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1]	CONSTRUCTION WORKS																				
	[CSS]																				
	FLOW METER	494.2	1,329.8	1,824.0	1,438.4	---	775.2	2,213.6	155.0	2,368.7	2,381.3	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4
	CONTROL VALVE	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	32.5	279.6	312.0	---	---	132.6	132.6	26.5	159.1	349.5	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7
	CSS's CENTRAL EQUIP	---	5,861.9	5,861.9	---	385.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	11,832.0	11,832.0	---	2,219.5	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9	---	---	---	---	---	---	---	---	---	---
	SPARE PARTS	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
	[LSS]																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	T O T A L	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[2]	ENGINEERING SERVICES	---	---	3,437.0	---	---	---	---	---	2,109.3	3,933.3	---	---	---	---	---	---	---	---	---	---
	TOTAL OF ITEMS [1] & [2]	2,683.1	24,556.3	30,676.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	20,628.7	35,530.2	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	22,650.5	5,329.5	---	---	---	---	---	---	---	---	12,595.6	2,963.7
[4]	CONTINGENCY	---	---	4,601.5	---	---	---	---	---	3,094.3	5,329.5	---	---	2,649.5	---	---	---	---	---	1,335.3	2,963.7
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	755.0	177.7	---	---	---	---	---	---	---	---	419.9	98.8
	GRAND-TOTAL	2,683.1	24,556.3	35,277.9	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	47,128.6	46,367.0	---	17,663.1	20,312.6	---	---	7,400.9	7,400.9	1,501.4	23,253.0	25,783.9

NOTE: EQUIP.: EQUIPMENT, P/S: PUMPING STATION, F-M/C-V: FLOW METER AND CONTROL VALVE, VAT: VALUE ADDED TAX, EXCHANGE RATES: 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table L-4 NET PRESENT VALUE FOR OPTIONS A AND B

UNIT: IN X US$ 1,000

DESCRIPTION / YEAR / ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
OPTION A	PHASE I - STEP 1				PHASE I - STEP 2 & 3					REPLACEMENT OF STEP 1					REPLACEMENT OF STEP 3					
[1] CONSTRUCTION	---	---	1,981	2,688	---	---	---	11,979	16,253	---	---	---	1,034	1,403	---	---	---	7,349	9,971	52,659
[2] ENGINEERING SERVICES	85	193	107	194	---	477	1,082	599	1,088	---	---	---	---	---	---	---	---	---	---	3,824
SUB-TOTAL	85	193	2,088	2,883	---	477	1,082	12,578	17,340	---	---	---	1,034	1,403	---	---	---	7,349	9,971	56,483
[3] TAX (VAT)	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[4] CONTINGENCY	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[5] ADMINISTRATION	0	1	10	14	---	2	5	63	87	---	---	---	5	7	---	---	---	37	50	282
TOTAL	111	252	2,725	3,762	---	622	1,411	16,414	22,629	---	---	---	1,349	1,831	---	---	---	9,591	13,013	73,710
			TOTAL =	6,850				TOTAL =	41,076				TOTAL =	3,180				TOTAL =	22,603	
NET PRESENT VALUE																				
5% [43,722]																				
10% [27,981]																				
12% [23,816]																				
15% [18,995]																				
OPTION B	PHASE I									REPLACEMENT OF PHASE I										
[1] CONSTRUCTION	---	---	13,407	18,190	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	51,355
[2] ENGINEERING SERVICES	578	1,311	726	1,319	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3,933
SUB-TOTAL	578	1,311	14,133	19,509	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	55,288
[3] TAX (VAT)	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[4] CONTINGENCY	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[5] ADMINISTRATION	3	7	71	98	---	---	---	---	---	---	---	---	41	58	---	---	---	---	---	276
TOTAL	754	1,711	18,443	25,459	---	---	---	---	---	---	---	---	10,775	15,009	---	---	---	---	---	72,151
			TOTAL =	46,367									TOTAL =	25,784						
NET PRESENT VALUE																				
5% [52,442]																				
10% [40,418]																				
12% [36,885]																				
15% [32,505]																				

NOTE: EXCHANGE RATES; 1 US$ = TT$ 4.25 AND 1 US$ = ¥ 135. %; DISCOUNT RATE

3. REMOTE CONTROL BOOSTER PUMPING STATION

3.1 Outline of Existing Booster Pumping Stations

As described in the Part I of the Main Report, booster pumping stations in Trinidad and Tobago are summed up to 58 in number including high lift pumping stations.

There are three types of pumping stations constructed so far in Trinidad and Tobago. They are booster pumping stations, high lift pumping stations and storage lift pumping stations. Difference of the former two is whether the pumping well exists or not in the pumping station. The latter aims to lift raw water from the downstream river/low dam to the water resource reservoir when water level is quite low in the reservoir.

Most of the pumping stations, although some pumps are dismantled for repair, are working normally. Table I-4.3 given in the context of the Main Report presents the working conditions of booster pumps with some technical information.

3.2 Method of Selection

It is difficult to select some alternatives beforehand due to lack of data and information on actual pump capacity and transmission/distribution system.

In view of the objectives of the Phase I project to be followed by Phase II Expansion Project, it is desirable that several key pumping stations are monitored and controlled from the CSS building during the period of the Phase I Project. After collation and analyses of the compiled data, the number of pumping stations will be increased according to the requirements during Phase II Project.

Hence, it seems rather reasonable to select several pumping stations out of 58, which are located along the transmission/distribution mains from four large scale water supply systems. Evaluation of each pumping station will, then, be made from viewpoints of cost, scale, number of operators, etc.

3.3 Selected Booster Pumping Stations

The selected booster pumping stations for remote control during the period of Phase I Project are following six booster pumping stations and one storage lift pumps, which are also listed in Table L-5:

Booster Pumping Stations

1) Tunapuna BPS
2) Valsayn BPS
3) El Socorro BPS
4) San Fernando BPS
5) Malgretoute BPS
6) TCO BPS

Storage Lift Pumps

1) Tumpuna SLP

3.4 Recommendation

Following are the JICA Team's recommendations related to remote control operation of the pumping stations:

1) Initiation of remote control operation will require repair works of pumping facilities in advance. It is minimum requirements that all pumps installed for standby should be overhauled and any dismantled pumps for repair should be also restored as originally designed.

2) After initiation of the remote control operation by the CSS, periodical maintenance of pumps and the appurtenances will be indispensable to operate the system as longer period as possible.

Table L-5 SELECTION OF BOOSTER PUMPING STATIONS

NAME OF STATION	NUMBER OF[1] PUMPS	CAPACITY (CMD)	NUMBER OF OPERATORS	DISTRICT[2]	COST OF[3] INSTLLTN	EVALUATION[3]
Tunapuna	3(1)	15,300	4	NC	III	II
Valsayn	3(1)	36,300	4	NC	II	II
El Socorro	3(1)	90,700	4	NW	II	I
San Fernando	3(1)	68,300	4	SF/SC	I	I
Malgretoute	5(2)	67,000	4	SE	II	I
TCO	6(2)	77,184	4	SE	II	I
Aripo	2(1)	4,600	1	NE	II	III
Arima	2(1)	4,600	1	NE	II	III
Tumpuna	6(2)	257,000	0	NC	I	I
Navet	6(2)	90,700	1	SE	II	II

Note:
1) Number in parentheses means number of stand-by.
2) Abbreviation of districts are as follows:
   NE: North East
   NC: North central
   NW: North west
   SF: San Fernando
   SC: South central
   SE: South east
3) Priority(I, II and III) evaluated in the table means as follows:
   I: Most effective or reasonable
   II: Priority between I and III
   III: not effective at the moment

M: EXISTING CSS FACILITIES

M: EXISTING CSS FACILITIES

C O N T E N T S

M. EXISTING CSS FACILITIES

FACILITIES

1. Background

a) The CSS was commissioned in November 1980 with the following components:

Two (2) computer systems and peripheral devices.
Twelve (12) Remote Terminal Units (RTU) at the following places:

Mallic Reservoir
El Socorro Booster Pump Station
San Fernando Booster Pump Station
Mt Hope Reservoir
Caroni Water Treatment Plant
Valsayn Booster Pump Station
Loango/Naranjo Waterworks
Acono Waterworks
Caura Waterworks
Subero St. Booster Pump Station
Aripo Waterworks
Flow Control Station

b) The following RTUs were installed by the end of 1980.

Picton Reservoir
Morvant Reservoir
St Joseph Reservoir

c) The following RTUs were installed in 1981.

Tunapuna Booster Pump Station
Tumpuna Pump Station
Valley View Reservoir
Arima Reservoir
North Oropouche Waterworks

d) The following RTUs were installed in 1986.

Knaggs Hill Reservoir
California Reservoir

e) The RTU was installed at Pepper Hill Reservoir in 1987.

f) The RTU at Subero St. Booster Pump Station was removed in 1989 due to removal of booster pump.

2. Existing CSS Facilities

The existing CSS facilities consist of four main system blocks such as (a) Central Processing Unit, Peripheral and Auxiliary Equipment, (b) Data Radio Communication, (c) Remote Terminal Units and (d) Field Instruments and Equipment as shown on Fig. M-1. The details of those systems are described below.

a) Central Processing Unit and Peripherals

A computer is always carrying out the real time monitoring of the water system functions. Whenever this computer fails, the stand by was to be switched to carry out the said functions of monitoring the water system.

The Central Processing Unit and Peripherals consist of the following components.

Uninterrupted Power Supply	1	Topaz 81415-17
Central Processing Unit	2	DEC PDP 11/34
Fixed Disk Drive	2	DEC RK05-F
Cartridge Disk Drive	2	DEC RK05-j
Magnetic Disk Drive	2	DEC TS03
High Speed Printer	1	DEC LA 180 PA
Graphic Printer	1	HP 7202 A
Video Terminal	1	DEC VT52
Printer Terminal	1	DEC LA 36 CE
Color Video Terminal	2	ISC 8100
MODEM	2	Racal/Vadic VA 1230 K
Switch Panel	1	

Note: DEC ; Digital Equipment Corporation
HP ; Hewlett Packard
ISC ; Intelligence Systems Corporation

b) Data Radio Communication

The Data Radio Communication Link is made up of the following (ref. Fig. M-2).

Data Radio Transceiver at the Central Supervisory System Building
Data Radio Repeater at Pepper Hill
Data Radio Transceiver at each RTU

The Data Radio Communication Link consists of the following components.

Transceivers	2	Master II VC 55 RAD 77B
Repeaters	2	Master II SC 55 RAL 77B
Repeaters	2	Master II SC 76 RAD 66A
Transceivers	6	Custom MVP CT 56 AAP with duplex
Transceivers	19	Custom MVP CT 56 AAP without duplex

c) Remote Terminal Unit (RTU)

Presently there are twenty two (22) RTUs at water supply facilities. The following are type, quantities and manufacturers of components in a typical RTU. The components are more or less standard in each RTU except that there are different quantities of input/output interfaces in each RTU.

Modem Watch Dog Timer	1	SCI PC 737315
Micro Processor Unit	1	MTR M 68 MM 01 A
AC/DC Power Supply	1	R/O Model 750
DC/DC Power Supply(Input/Output Interfaces)	1	SCI AD 757340
Two States Input PC Card		SCI AD 7573505
Relay Driver Output Card		SCI AD 7573510
Multiplexed		
Analog Input PC Card		SCI AD 7573500
Analog Output PC Card		SCI AD 753520-2

Note: SCI; System Control Incorporated
MTR; Motorola
R/O; R.O.Associated Incorporated

d) Field Instruments and Equipment

The field instruments and equipment are classified into four (4) main categories as follows:

Analog Input Devices
Analog Output Devices
Discrete Input Devices
Discrete Output Devices

The analog input and output devices are instruments and discrete input and output devices are relay or two state switches.

The list of instruments, type and manufacturers is shown in Table M-1.

3. Function of the Components of the Central Processing Unit and Peripherals

The each function of the components of the Central Processing Unit and Peripherals is described below.

a) Uninterrupted Power Supply (UPS)

The UPS supplies power even during the time it takes between loss of utility electrical power and supply of electrical power supply from stand by electrical power generating plant. The Central Processing Unit and Peripherals are supplied with electrical power through the UPS.

b) Central Processing Unit (CPU)

The Central Processing Unit is the main intelligence of the Central Supervisory System. It communicates with all the other peripherals to control them. It uses a number of computer programs designed to operate on available data.

c) Fixed Disk Drive

The fixed disk located in the Fixed Disk Drive stores the programs which make up the operating system, indefinitely. When the computer system is being placed "on-line", the operating system is loaded from the Fixed Disk Drive into the CPU's main memory where it may communicate faster with the processor, the main controlling components of the CPU. The fixed disk also store indefinitely, the program which monitoring and data logging of water system information.

d) Cartridge Disk Drive

The Cartridge Disk is removable from the cartridge disk drive and stores the information from water system obtained through data logging by the Central Supervisory System.

e) Magnetic Tape Drive

The magnetic tape in the Magnetic Tape Drive is removable and performs the same functions as the Cartridge Disks.

f) High-Speed Printer

The High-Speed Printer is a unidirectional machine to man communication link. It prints out alphanumeric information regarding the activities taking place within the central processing unit on paper, as directed by the CPU. It is a one-way communication link since man cannot communicate with the equipment in the Central Supervisory System through this printer.

g) Graphic Printer

The Graphic Printer is a unidirectional machine to man communication link. The graphic printer prints out graphical information on paper as directed by the CPU.

h) Video Terminal

The Video Terminal is a bidirectional man/machine intercommunication link. It is the intercommunication link between man and computer and provides the features for writing, running and editing programs via a key-board. Through this terminal new program can be written and old programs modified.

i) Printer Terminal

The four (4) printer terminals are all bidirectional man/machine intercommunication links. Two (2) of the terminals are programmer's terminals communicate with the Central Processing Unit in the same manner as the Video Terminal. They perform functions similar to the Video Terminal, and in addition they print out on paper all the intercommunication. There are two other printer terminals called Operator's Terminal which mainly log errors, alarms or significant events as they occur within the water system.

j) Color Video Terminal

The two (2) color video terminals provide bidirectional man/machine intercommunication with the water system. They communicate information from the water system to the operator via the screen in both graphic and alphanumeric symbols.

k) MODEM

There are two modem cards in the modem card cage through which all data communication between the Central Computer at the CSS Building and the Remote Terminal Units take place. One of the modem cards is connected to each of the CPU's. The modem which effectively modulates and demodulates data signals, converts data signal from standard two level voltages used in the computer for digital data manipulation to two level frequency used in telephone line transmission of digital data. The modem also converts two level frequency received as digital data from the Remote Terminal Units via the data radio transceivers to two level voltages used in the computer for digital data manipulation.

l) Switch Panel

This is basically a panel with switches on it to enable manual switching of certain equipment within the CSS Building between CPU's.

4. Function of the Data Radio Communication Equipment

The each function of the Data Communication Equipment is described below.

a) Transceivers

These two way radio transceivers located at the CSS Building are used to transmit digital signals from the Central Computer to the Remote Terminal Units via the repeaters. They are also used to receive digital signals from the RTU's via the repeaters. The digital signals which reach the transceiver from the Central Computer are a train of two level discrete frequencies. The frequencies are 1200 cycles per second and 2200 cycles per second. The transceivers radio transmission through the air via the antenna is modulated by the two-level frequency received from the computer. The level of radio transmission (carrier) is ultra high frequency (UHF), being 418.025 million cycles per second. The level of radio reception carrier is also UHF being 413.250 million cycles per second.

b) Repeaters

TRANSCEIVERS (Master II SC 55 PAL 77B)

This repeater receives a train of digital signals on UHF radio waves entering through the antenna from the transceivers at the CSS Building. The digital signals are then extracted from the UHF waves and transmitted to the very high frequency (VHF) repeaters to modulate the VHF radio waves and so transmit signals to the transceivers at the RTU. It also receive a train of digital signals transmitted by the VHF repeater from the RTU's which modulates its UHF carrier transmission through its antenna to the

transceiver at the Central Computer.

TRANSCEIVERS (Master II SC 76 RAD 66A)

The repeater receives a train of digital signals transmitted by the UHF repeater which are then used to modulate the VHF repeater transmission (carrier) to the Remote Terminal Units (RTU's) via the antenna and air medium. It also receives a train of digital signals on the VHF radio waves entering through the antenna from the transceiver at the RTU. The digital signals are then extracted from the carrier and transmitted to the ultra high frequency (UHF) repeater, which will modulate UHF carrier and so transmit signals to the transceivers at the Central Computer.

TRANSCEIVERS (Custom MVP 56 AAP 66A)

These two way radio transceivers located in the RTU's are used to receive digital radio signals from the Central Computer via the repeater. These signals enter the transceivers on VHF carrier via the antenna and are transmitted to the microprocessor unit in the RTU. These transceivers are also used to transmit digital signals from the microprocessor unit in the RTU to the Central Computer via the repeater. The digital signals which reach the transceiver from the Remote Terminal Unit's microprocessor are a series of two level discrete frequencies. These frequencies are 1200 cycles per second and 2200 cycles per second. The transceivers radio transmission through the air via the antenna is modulated by the two level frequency received from the microprocessor unit of the RTU. The level of radio transmission (carrier) is very high frequency (VHF) being 153.950 million cycle per second. The level of radio reception through the antenna is also VHF being 159.960 million cycles per second.

5. Function of the Remote Terminal Unit Component

The each function of the Remote Terminal Unit Component is described below.

a) Remote Terminal Unit (RTU)

The Remote Terminal Units are microprocessor controlled units which perform the function of interpreter between the Central Computer and Field Equipment or instruments. All communication transmitted from the RTU to the Central Computer and all communication received by the RTU from the Central Computer must pass through the Microprocessor Unit (MPU), and Modem and Watchdog Timer Printed Circuit (PC) cards in the RTU. The instruction and request from the Central Computer are decoded and understood by these two modules in the RTU. The microprocessor unit then sends signals via input/output printed circuit cards to the field instruments and equipment. It also receives signals via the said input/output PC Cards (Modules) from the field instruments and equipment.

b) Modem and Watchdog Timer

All communication from the Central Computer to the RTU enter the RTU via the modem and watchdog timer printed circuit card. Within this module the train of two level discrete frequency digital data are converted to two level discrete voltage levels of the type used by microprocessor. The data transmission train received by the modem and watchdog timer card is decoded to some extent and the information received is transmitted to the microprocessor unit.

c) Microprocessor Unit

The Microprocessor Unit (printed circuit card) contains the main intelligence of the Remote Terminal Unit. It contains computer programs for scanning the field instruments and equipment based on instructions or request from the Central Computer.

d) AC/DC Power Supply

The RTU receives its electrical power from Electric Utility Company which supplies alternating current (AC) electricity. Computer equipment needs direct current (DC) electrical power for data manipulation. As such an AC to DC converter is needed to supply the required DC voltages and hence the need and function of the AC/DC power converter.

e) DC/DC Power Converter

The AC/DC power supply provides only a +12 volts referenced to ground (zero volts). However, the components of the RTU utilizes several level of DC voltages. These voltages are +5 volts, -12 volts, +12 volts, +24 volts. As a result the DC to DC power converter is utilized to produce the various levels of DC voltages.

f) Batteries

The batteries are used to provide the 12 volts to the DC/DC power converter when there is a loss of Electric Utility Company electrical power supply. These batteries are sized to power the RTU for only a limited time. The time limit is based on a reasonable time for the electrical power to be restored by the utility company.

g) Two Status Input PC Card

This card is used for the microprocessor unit to receive signals from field instrument or equipment indicating that they are in one of two possible status.

h) Relay Driver Output PC Card

This card is used for the microprocessor unit to send signals to field instrument or equipment to drive them into one of two possible status.

i) Multiplexed Analog Input PC Card

This card is used for the microprocessor unit to receive signals from field instrument or equipment indicating that they are in one of several possible states or positions.

j) Analog Output PC Card

This card is used for the microprocessor unit to send signals to field instrument or equipment to drive them into one of several possible states.

6. Data on CSS

The monitoring data at CSS building are described below.

Water Level	:	34
Flow Rate	:	25
Water Pressure	:	17
Others	:	14
(pump and valve status,etc.)		

The list of those data is shown in Table M-2.

7. Data Processing

a) Supervisory Control and Data Acquisition (SCADA) System

In general, a SCADA system is comprised of the following subsystems:

i) remote sensor data acquisition
ii) data transmission channel to the central control site
iii) data input multiplexing at the central site
iv) data base control and usage

In addition a SCADA system requires off-line software utilities that support on-line operation and creation of the data base in main memory and on disk. In the Central Supervisory System remote sensing and data transmission are provided by the Remote Terminal Unit which collect water system data through transducers, pack the data into a data stream using a geometric coding scheme and transmit that data by radio link to the central site, on-line PDP 11/34 computer. The system controls the input of that data, incorporates the data into its data base in main memory and on disk, and provides a man/machine interface with which operators and engineers can monitor the sensor environment, handle alarms as they arise, and make correction and improvements to the system as required.

b) System Software

This supervisory system provides three basic functions: data acquisition, alarm notification and generation of a historical data base. As data is acquired, pre-defined checks are made for alarm conditions which will produce an alarm message and activate the alarm horn. All analog information is saved on disk at 6-minutes intervals and processed each day at midnight to provide a complete history of the system on magnetic tape.

There are seven (7) subsystems which function independently using the system data base. These are:

- Input/Output to RTU's
- Alarm Processing
- Process Control
- Historical Database
- Fail-over
- Message Facility
- Man/Machine Interface

The man/Machine Interface (MMI) tasks provide functions which can be classed into four general categories.

- Display functions : system status and database display
- Modification functions : control of system through database changes
- Process Control functions: output to RTU's
- Operating system function: for privileged operator only

Fig. M-3 shows a diagram of the major executable program units, called tasks, for on-line system. The major features are the global common database, the remote terminal unit I/O processor, the man/machine interface tasks and controller, the historical database tasks and point alarm notification task.

The hardware, tasks and data base are interconnected in such a way that inter-task control information and inter-task data movement is minimized. Only one task, PIOX, handles input and output for the RTU's.

Remote point data moves directly from remote input channels to the data base in global common (a memory partition in the CPU) by way of the RTU I/O processor. PIOX in turn receives all requests for changes to the RTU channels, and verifies the result of the command output.

All software tasks, including PIOX, must follow a global common access protocol to use certain parts of the data base. The protocol allows sharing of the data and of direct access files. Sharing is accomplished through the employment of software lock devices. When data base access is allowed, global parameters facilitate efficient conversion of input data and movement into the proper location in global common.

c) Global Common Blocks

A global common partition, PCSCOM, is defined in this system to occupy a specific area in physical memory. PCSCOM is currently allocated 6K words of memory of which all but 32 words are currently being used. All tasks must set aside 8K words of their 32K words virtual address space in order to access this global common partition. This means that the maximum task size is 24K words.

Tasks CKPGCM and RSTGCM are used to save and restore an image of entire global common partition in the file PCSCOM DAT. The Fortran block data program PCSCOM is used to initialize global common. PCSCO.TSK and PCSCOM.STB (symbol table) which are produced by the PCSCOM task build must be on DK2: under UIC = [1,101]. Any change to the structure of PCSCOM will require that all tasks referencing PCSCOM be compiled (or assembled)

and task built with the new global common installed. This is accomplished by using the command file PCSBUILD.CMD which will build all task in the system.

The followings are the summary of global common blocks.

AAACOM - size of global common
ALRCOM - alarm message file data
CRTCOM - CRT communication
DATCOM - PIODMP data buffer and flag
DDBCOM - digital device descriptor blocks
EUTCOM - engineering units table - all point information
FLGCOM - logical system flags
HSTCOM - system history information
IDXCOM - point indices for process tasks
PCVCOM - process control variables
RTUCOM - RTU attributes
SUMCOM - daily and yearly integrated values
SYSCOM - system configuration information
UNTCOM - definition of variable units
VPPCOM - virtual point interpolation tables

d) Function of the Task

The followings are the functions of the major tasks in the system.

AAACOM (Global Common Partition Size)

This global common block is placed at the beginning of the partition so that the tasks CKPGCM and PSTGCM can access an address for copying global common into PCSCOM.DAT disk file. The contents of GCSIZE refer to the number of 32 word blocks. The system generation of 2.July '79 produced a global common of 191 blocks (192 max for 6K word common partition).

ALRCOM (Alarm Message Common)

The ALRCOM task write the alarm message in record AINDEX of the direct access file ALARMS.DAT, then bumps AINDEX by one. If AINDEX is greater than ALSIZE it is reset to 1. ALS uses AINDEX to determine where to start checking ALMAPS for an active alarm in reverse chronological order. ALMAP is zero if the alarm is not active and one if an active alarm message.

DATCOM (RTU Input Data Buffer)

DATCOM consists of DATAIN, DATFLG tasks. DATAIN is used as an intermediate buffer when the dump bit is set in RTUTS (RTUCOM). Whenever this RTU is scanned the input bytes will be transferred to DATAIN if DATFLG=0 and task PIODMP will be activated. When PIODMP finishes printing the buffer DATFLG will be reset to zero indicating PIODMP is ready for more data in DATAIN.

DDBCOM (Digital Device Description Block)

A digital device (i.e. pump or valve) may have 2 or 3 digital input points used to describe the state of the device. In order to display the state of this device on CRT a mapping must be made from the input points to a device state name. If a digital input point is part of a device the device name (DDNAME) is stored in EUCKHI (EUTCOM) of the point. In order to map from any point to the other points in a device DDPTNR is used. DDMAP provides an index to the device state name given the states of the 3 digital input points associated with the device (e.g. pump on, off and fail status inputs). DDSTAT is used to disable a device so that process control tasks will not attempt to control the device.

IDXCOM (Point Indices for Process Tasks)

This array is used by the Caroni/Tumpuna control task PROCS3 so that the point indices need be looked up only once. When PROCS3 is first run the task IDXSET is activated. IDXSET fills INDEX with 102 indices which PROCS3 will use. The additional entries in INDEX1 are reserved for future expansion of PROCS3 control functions.

HSTCOM (System History Information)

HSTCOM is divided into 3 parts which are used by SCANSV, HISTRY and TAPESV tasks. HISTCOM is initialized by the utility task HSTINI which fills the array SCHA with point indices for all analog points. Currently the history system is limited to 125 analog values. The MMI task DCM can be used to display all values in HSTCOM.

PCVCOM (Process Control Variables)

Three parameters are provided for up to 5 elementary process control loops in the global common block PCVCOM. PCVMIN and PCVMAX are used as minimum and maximum set point values and PCVDBD is used as an absolute deadband value.

SUMCOM (Daily and Year to Date Integrated Values)

All analog points which must be integrated on a daily and yearly basis have their names defined in the global common array INAMES. Currently these points are all system flows (integrated to volume) and the 2 rainfall measurements. PROCS4 does the summing and places the integrated values into PTSUMS. The task HSTRY resets the daily and yearly sums and moves the array PTSUMS into the appropriate location in the daily history file. The array INAMES is filled by the task HSTINI from the edit file SUMNAME.TXT which contains a list of up to 508 character point name.

SYSCOM (System Configuration Common)

SYSCOM allows the operator through the MMI task CON to change the physical device assigned to a logical device, e.g., if the LA-18 printer is down, the logical printer devices may be reassigned to port 5, which is a LA-36 terminal.

UNTCOM (Units Definition)

The units code associated with each analog point can be modified by the task CPA and stored in EUSTAT (EUTCOM).

VPPCOM (Virtual Point Interpolation Tables)

The common block VPPCOM allows up to 5 table to be defined with a maximum of 20 pairs of points to be used for calculating virtual points using empirical data. The task CVP allows the operator to add, delete or modify these tables. The subroutine LGINTR contained in PROCS4.FTN is used to perform quadratic interpolation using these tables. The utility task VPPCRE will create these tables from the source file TABLES.TXT.

FOV (CPU Failure Detection Task)

This task sends a pulse to the DR11 watchdog timer bit every 5 seconds. If FOV fails to send this pulse he CPU fail light and CPU fail alarm will be activated. In general, FOV only indicates that the on-line CPU is still executing the task FOV, FOV will detect a failure of the RTU communication task, PIOX. PIOX sets a flag (RTUFLG(2)) every second in its mark time AST service routine. FOV checks if the flag is set and then clears the flag. If it is not set FOV will turn on the alarm horn and log the message "PIOX STALLED". FOV also checks the status of the two switch panel power supply bits in the DR-11 status register. If either bit is off, a message is logged and the system alarm horn is enabled.

PIOX (RTU Interface Task)

PIOX is a memory resident task written in assembly language which handles all communications with the remote terminal units. PIOX is divided into an input section and an output section which share common subroutines for message formatting.

ALARM (Alarm Notification Program)

ALARM is activated when ALRCON finds either an alarm condition or no alarm and the message printed bit set an any input point. ALARM then scans all valid points to determine which points have an alarm flag set. If a flag is set and the message printed bit is not set, a message is formatted and entered into the ALARMS.DAT file and printed on the alarm logging device. If the alarm flag is not set but the message printed bit is on an "out of alarm" message is printed on the alarm device and the message printed bit is cleared. All other conditions are ignored. After checking all points, if any alarm condition has been detected the alarm horn is turned on by sending a message to the DR11 I/O task. If no alarm have been detected the alarm horn is turned off through the DR11 I/O task.

ALRCON (Alarm Activation Task)

ALRCON is a small memory resident task which checks all points in EUTCOM every 5 second. ALRCON will activate the ALARM task under the following conditions.

- The alarm bit is set and the message printed bit is clear in EUSTAT for any point. ALARM will then print a point in alarm state message.

- The alarm bit is not set and the message printed bit is set. ALARM will print the point out of alarm message and clear the message printed bit.

Any task which changes the condition under which an alarm is detected must make the initial alarm checks itself and set the alarm bit if required.

CRTCON (Man/Machine Interface Control Task)

This task controls the man/machine interface (MMI), i.e. the interface between the system operator at the CRT and the tasks which allow the operator to interact with the system.

The services which are provided by CRTCON are:

- Add/remove a CRT from the system
- Pass a character and or function key input to the active task
- Activate tasks as requested by function index task or function keys
- Provide means of exiting from a running task and activating a successor task
- Provide screen freeze enable/disable control for copy page function
- Provide clock enable/disable control

All input from the CRT to MMI tasks must pass through CRTCON. This is accomplished by using the logical function GETINP which will place the input into a line buffer for the attached CRT. MMI tasks are attached to a given CRT by including the block of code "GETCRT.TXT" at the beginning of the program. All output to the CRT may be done with the usual write statements and formats. CRTCON traps all incoming data from the CRT by using an AST service routine.

HISTRY (Calculate and Save Daily System History)

HISTRY runs at midnight each day to compress the previous 24 hours of scan data saved in the file SCANSAVE.DAT. HISTRY calculate for each analog variables the following parameters.

- minimum value
- time of minimum value
- maximum value
- time of maximum value
- daily average
- 24 hourly average
- integrated daily value (selected points)
- integrated yearly value (selected points)

The name of points which are integrated on a daily and yearly basis are in the global common SUMCOM in the array INAMES. After writing the daily history file HISTRY DAT, HISTRY zeros all daily sums, saved the current rainfall pulse count in EUCKLD (EUTCOM) and zeros the yearly sums of the date is January 1.

MESSAG (Message Format and Output Task)

All system message are logged on the logging device by the task MESSAG. A task requests a message to be logged by issuing a send data directive and then an activation request to MESSAG. The send data buffer contains the message number, the number of parameters and up to 12 words of parameter data. MESSAG reads the message template from the disk file MESSAG,DAT. and fills in the blanks with the parameter from the send data directive. The message is then printed on the logging device along with the system date and time, the message number, the operator name (if an MMI task) and the name of requesting task.

e) CRT Display

The operator can monitor the data of various kind by CRT display at CSS building. The list of CRT display is shown in Table M-3.

8. Remote Manual Control of Pump and Valve

The six (6) storage lift pumps and two (2) river discharge valves at Tumpuna Pumping Station are controlled at Caroni Water Treatment Plant by start/stop pushbuttons and open/close pushbuttons through CSS (Caroni Water Treatment Plant/Tumpuna Pumping Station Pump and Valve Control).

Table M-1 List of Field Instruments

STATION	DATA NAME	FIELD INSTRUMENT
Picton	Picton I Level	L/T - F/P D/P Cell
	Picton II Level	" " " "
	Picton III Level	" " " "
Mallick	Reservoir Level	L/T - R/S 160-B1
EL Socorro	Clearwell Level 1	P/D - F/P 50 DP 2000
	" " 2	" " " " "
	Picton II Out Pressure	P/T - F/P 50 EP 1000
	Picton III Out Pressure	" " " " "
	Picton II Out Flow	S/R - R/M 1151 D/P
	Picton III Out Flow	" " " "
	Caroni WTP In Flow	" " " "
	Clearwell Flow	" " " "
	Wellfield Flow	" " " "
	Spill over Flow	" " " "
San Fernando	San F'do Res. Level	L/T - R/M 1151 DP
	Marryat Res. Level	" " " "
	Naparima Res. Level	" " " "
	Chacon Res. Level	" " " "
	Caroni WTP In pres.	P/T - F/P 50 EP 1000C
	Pump ST Out Pressure	" " " " "
	Caroni WTP In Flow	S/R - F/P 50 ES 3000
	Navet Line In Flow	" " " " "
	Navet Line Out Flow	" " " " "
	Pump Status 1 2 3	
Mt.Hope	Reservoir Level	L/T - R/S 160-B1
Caroni	River Level	L/T - F/P D/P
	Clearwell Level	" " "
	North Pipeline Pres.	P/T " "
	South Pipeline Pres.	" " "
	North Pipeline Flow	" "
	South Pipeline Flow	" "
Tumpuna	Arena Res. Level	
	Channel Level	L/T - F/P
	Tumpuna Weir Level	" "
	Flow to Reservoir	F/P
	Flow to River	"
	Pump Status 1 - 6	
	River Discharge Valve	
	Weir AC Fail	F/P Position Indicator
	PS AC Fail	Relay Contact
California	Reservoir Level	L/T - R/S 160 B1

Table M-1 (cont'd)

STATION	DATA NAME	FIELD INSTRUMENT
Valsayn	Clearwell Level	L/T - R/S 160 B1
	Mt Hope Out Pressure	P/T - F/P 50 EP 1000
	Caroni WTP In Pres.	" " " " "
	St Augustine Out Pres.	" " " " "
	Caroni WTP In Flow	S/R - R/M 1151 D/P
	St Augustine Out Flow	" " " "
	Wellfield Flow	" " " "
Knaggs Hill	North Res. Level	L/T - S/T 1333 TF
	South Res Level	" " " "
Loango/ Naranjo	Treated Water Pres.	P/D - S/T 1333 TF
	Treated Water Flow	S/R - S/T 1336 NA
Acono	Raw Water Level	L/T - Euroguage 3664-50
	Treated Water Pres.	P/T - S/T 1333 TF
	Treated Water Flow	S/R - S/T 1336 NA
Caura	Clearwell Level	L/T - D/B 506-6000
	Raw Water Sump Level	" " " "
	Treated Water Pres.	P/T - F/P 50 DP 2000
	Treated Water Flow	S/R - F/P 50 ES 3000
Arima	Reservoir Level	L/T - L/S 160 B1
Aripo	Raw Water Pump Level	L/T - Euroguage 3664-50
	Treated Water Flow	S/R - S/T 1336 NA
N.Oropuche	Reservoir 1 Level	L/T - F/P
	Reservoir 2 Level	" "
	Raw Water Flow	F/P
Flow Control	Pipeline Pressure	P/T - F/P
	Pipeline Flow	F/P
Pepper Hill	Reservoir Level	L/T - R/M 1151 D/P
	Radio Room Temp.	R/M 444

Note;
L/T : Level Transmitter
P/T : Pressure Transmitter
S/R : Square Root Extractor
P/D : Pressure Difference Transmitter
R/S : Robertshow
F/P : Fisher & Porter
R/M : Rosemount
S/T : Sybron Taylor
D/B : Drexblook

Table M-2 List of Data Obtained By CSS

	LOCATION	DATA OBTAINED
1.	Picton Reservoir	Picton I Level/Picton II Level/ Picton III Level
2.	Morvant Reservoir	Reservoir Level
3.	Mallick Reservoir	Reservoir Level
4.	El Socorro WTP/BPS	Clearwell Level 1/Clearwell Level 2 Picton II Out Pressure/Picton III out Pressure Caroni WTP In Pressure/Picton II Out Flow Picton III Out Flow/Caroni WTP In Flow Clearwell Flow/Wellfield Flow/Spillover Flow
5.	San Fernando BPS	San Fernando Reservoir Level Marryat Reservoir Level/Naparima Reservoir Level Chacon Reservoir Level/Caroni WTP In Pressure Navet Line In Flow/Navet Line Out Flow Pump 1 Status/Pump 2 Status/Pump 3 Status
6.	Mt Hope Reservoir	Reservoir Level
7.	St Joseph Reservoir	Reservoir Level
8.	Tunapuna BPS	Inlet Pressure/Outlet Pressure/Outlet Flow
9.	Caroni WTP	River Level/Clearwell Level North Pipeline Pressure South Pipeline Pressure North Pipeline Flow/South Pipeline Flow
10.	Tumpuna PS	Arena Reservoir Level/Channel Level Tumpuna Weir Level/Flow to Reservoir Pump Status 1 - 6/River Discharge Valve 1,2 Weir AC Fail/PS AC Fail
11.	California Reservoir	Reservoir Level
12.	Valsayn WTP/BPS	Clearwell Level/Mt Hope Out pressure Caroni WTP In Pressure St Augustine Out Pressure/Caroni WTP In Flow St Augustine Out Flow/Wellfield Flow
13.	Knaggs Hill Reservoir	North Reservoir Level/South Reservoir Level
14.	Loango/Naranjo WTP	Treated Water Pressure/Treated Water Flow
15.	Acono WTP	Raw Water Level/Treated Water Pressure Treated Water Flow

Table M-2 (cont'd)

LOCATION	DATA OBTAINED
16. Valley View Reservoir	Reservoir Level
17. Caura WTP	Clearwell Level/Raw Water Sump Level Treated Water Pressure/Treated Water Flow
18. Arima Reservoir	Reservoir Level/Fort Read Reservoir Level
19. Aripo WTP	Raw Water Sump Level/Treated Water Flow
20. North Oropuche WTP	River Level/Reservoir 1 Level Reservoir 2 Level
21. Flow Control Station	Pipeline Pressure/Pipeline Flow
22. Pepper Hill Reservoir	Reservoir Level/Radio Room Temperature

Note; WTP : Water Treatment Plant
BPS : Booster Pump Station
PS : Pump Station

Table M-3 List of CRT Display

1. function index
2. alarm summary
3. digital output and analog output
4. change configuration example
5. configuration display
6. change points attributes, analog point description
7. analog points units
8. analog points limits and I/O specification
9. analog point range
10. add new analog point
11. delete point, modify analog output point
12. modify digital output point
13. change trending defaults
14. change point value, analog input and output point
15. change value of digital input and output point
16. change virtual point interpolation table
17. display global common EUTCOM
18. display global common HISTCOM and CRTCOM
19. display global common IDXCOM
20. display global common RTUCOM
21. digital device commands
22. digital device, modify points
23. digital device, modify state names
24. digital device modification
25. display integrated values
26. display integrated values, modify integrated value
27. display group log
28. display point name
29. display RTU status, scan hold
30. display RTU status, scan enabled
31. display point values, analog and digital
32. event flag service
33. execute a task
34. log message on logging device
35. print point log
36. operator password service
37. RTU specification modify
38. trend analog point value on CRT
39. CRT trend, one variable
40. CRT trend with two variables
41. trend hourly average over 10 days on CRT
42. CRT trend of hourly average
43. trend output to line printer
44. picture display index
45. El Socorro - Picton System
46. Valsayn System
47. Caroni - Mallick System
48. North Oropuche System
49. Caroni - Arena System
50. Caroni WTP - San Fernando System
51. San Fernando - Marryat System
52. Maracas Valley - St Joseph System

Table M-3 (cont'd)

53. Caura - St Augustine System
54. Aripo - Arima System
55. Hollis System
56. Navet System
57. display legend
58. system block diagram
59. North Caroni System Status
60. South Caroni System Status
61. Caroni/Tumpuna System Status
62. North Range Valley Project
63. reservoir status display
64. RTU #11 input point display
65. Tumpuna PS detail
66. character color combination
67. map of Trinidad
68. test picture
69. system parameters

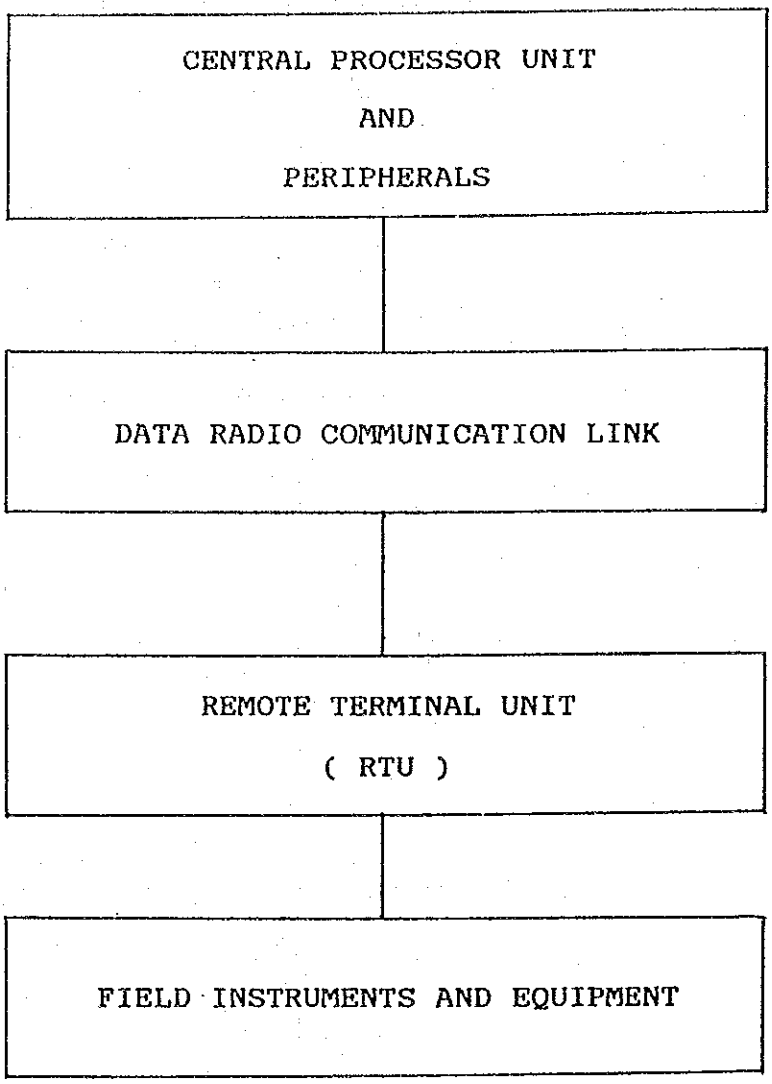

Fig. M-1 BLOCK DIAGRAM OF CENTRAL SUPERVISORY SYSTEM HARDWARE

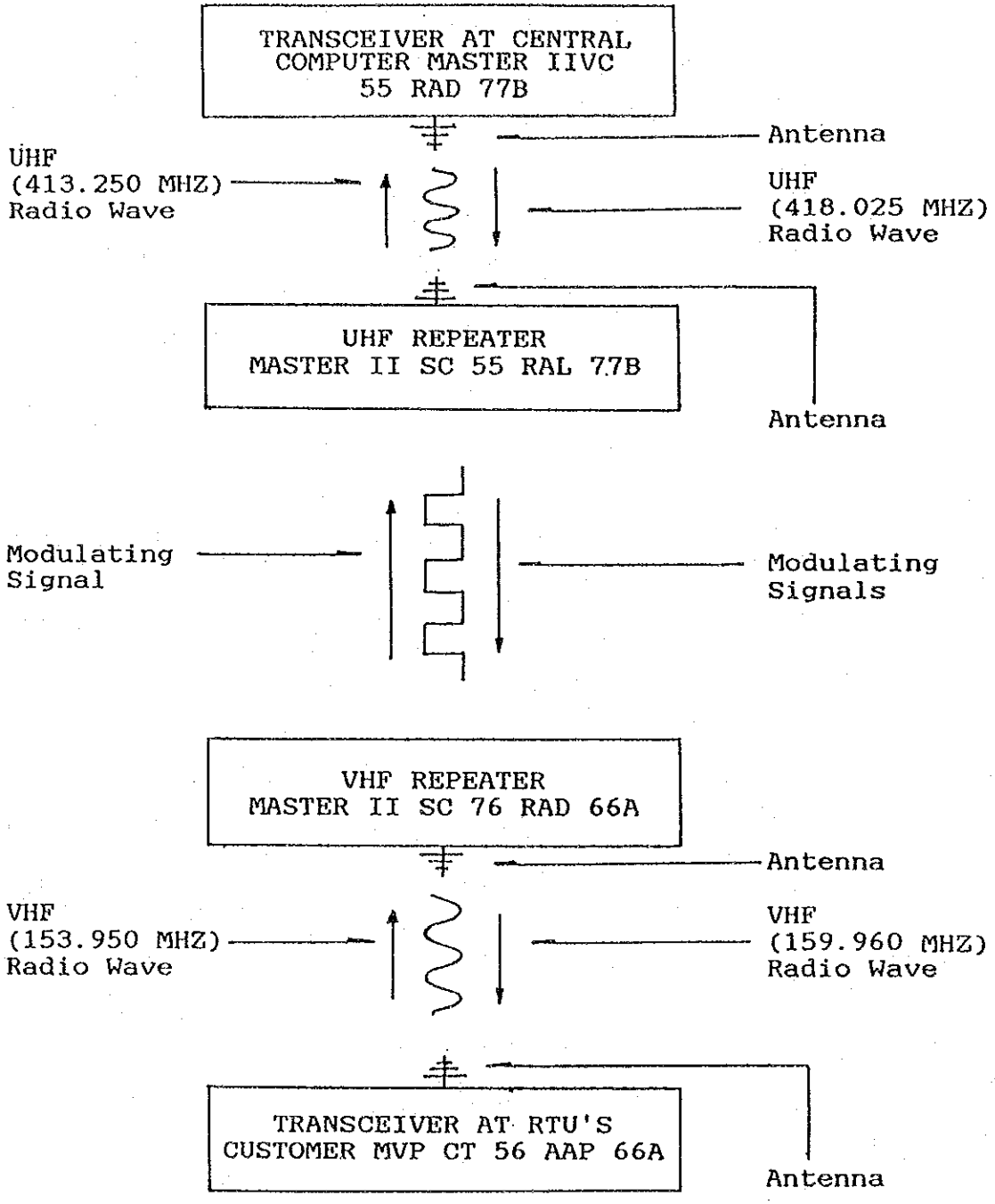

Fig. M-2 DATA RADIO SIGNAL MODULATION

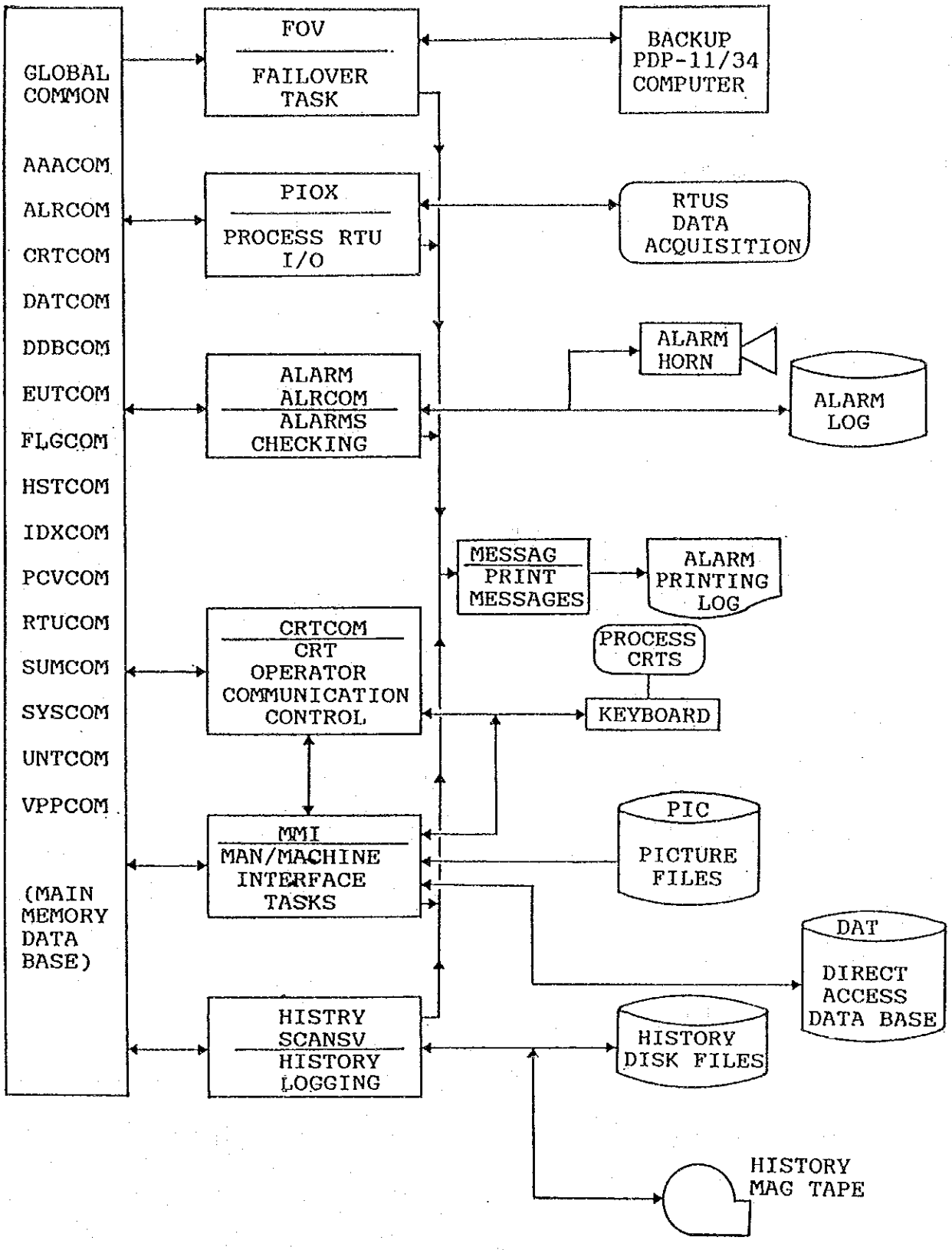

Fig. M-3 SUPERVISORY SYSTEM BLOCK DIAGRAM

N: DATA ON COST ESTIMATE

LIST OF TABLES

Table N-1.1 SUMMARY OF COST ESTIMATE FOR WATER SUPPLY SUPERVOSORY SYSTEM

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I										PHASE II									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1]	CONSTRUCTION WORKS																				
	(CSS)																				
	FLOW METER	494.2	1,329.8	1,824.0	1,438.4	---	775.2	2,213.6	155.0	2,368.7	2,381.3	4.4	1,363.0	1,367.4	10.1	---	581.1	591.2	116.2	707.4	1,533.8
	CONTROL VALVE	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1	296.2	1,620.7	1,916.9	115.0	---	814.7	929.7	162.9	1,092.6	2,174.0
	LEVEL METER	32.5	279.6	312.0	---	---	132.6	132.6	26.5	159.1	349.5	6.5	312.8	319.3	---	---	135.7	135.7	27.1	162.8	357.6
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	593.9	593.9	---	---	252.4	252.4	50.5	302.9	665.1
	CSS's CENTRAL EQUIP	---	5,861.9	5,861.9	---	386.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	11,832.0	11,832.0	---	2,219.5	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9	---	---	---	---	---	0.0	0.0	0.0	0.0	0.0
	SPARE PARTS	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3	---	249.3	249.3	---	---	0.0	0.0	21.2	21.2	254.3
	SUB-TOTAL	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	307.1	18,135.4	18,443.4	125.1	---	7,732.5	7,857.6	1,567.7	9,425.3	20,661.1
	(LSS)																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	328.4	1,279.9	1,608.3	1,444.6	---	683.5	2,128.1	136.7	2,264.8	2,141.2
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	328.4	1,279.9	1,608.3	1,444.6	---	683.5	2,128.1	136.7	2,264.8	2,141.2
	T O T A L	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	635.4	19,416.3	20,051.7	1,569.7	---	8,416.0	9,985.7	1,704.4	11,690.1	22,802.3
[2]	ENGINEERING SERVICES	---	---	3,437.0	---	---	---	---	---	2,109.3	3,933.3	---	---	6,311.1	---	---	---	---	---	3,809.3	7,297.4
	TOTAL OF ITEMS [1] & [2]	2,683.1	24,556.3	30,676.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	20,628.7	35,530.2	635.4	19,416.3	26,362.8	1,569.7	---	8,416.0	9,985.7	1,704.4	15,499.4	30,099.7
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	22,650.5	5,329.5	---	---	---	---	---	---	---	---	19,131.2	4,501.5
[4]	CONTINGENCY	---	---	4,601.5	---	---	---	---	---	3,094.3	5,329.5	---	---	3,954.4	---	---	---	---	---	2,324.9	4,501.5
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	755.0	177.7	---	---	---	---	---	---	---	---	637.7	150.0
	GRAND-TOTAL	2,683.1	24,556.3	35,277.9	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	47,128.6	46,367.0	635.4	19,416.3	30,317.2	1,569.7	---	8,416.0	9,985.7	1,704.4	37,593.2	39,162.7

NOTE: EQUIP.; EQUIPMENT, P/S; PUMPING STATION, F-M/C-V; FLOW METER AND CONTROL VALVE, VAT; VALUE ADDED TAX, EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.2 DISBURSEMENT SCHEDULE IN PHASE I PROJECT

UNIT: IN x 1,000

NO.	YEAR / ITEM	PHASE I															
		1992			1993			1994			1995			TOTAL		
		F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)
[1]	CONSTRUCTION - SUPPLY	---	---	---	---	---	---	10,895.8	879.0	11,102.6	16,343.6	1,318.6	16,653.9	27,239.4	2,197.6	27,756.5
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	9,793.1	2,304.3	---	6,528.7	1,536.2	---	16,321.9	3,840.4
	SUB-TOTAL	---	---	---	---	---	---	10,895.8	10,672.2	13,406.9	16,343.6	7,847.3	18,190.1	27,239.4	18,519.5	31,596.9
[2]	ENGINEERING SERVICES	511.1	283.3	577.8	1,140.7	724.1	1,311.1	629.6	409.3	725.9	1,155.6	692.6	1,318.5	3,437.0	2,109.3	3,933.3
SUB-TOTAL		511.1	283.3	577.8	1,140.7	724.1	1,311.1	11,525.4	11,081.4	14,132.8	17,499.2	8,539.9	19,508.6	30,676.4	20,628.7	35,530.2
[3]	TAX (VAT)	---	368.3	86.7	---	835.8	196.7	---	9,009.6	2,119.9	---	12,436.7	2,926.3	---	22,650.5	5,329.5
[4]	CONTINGENCY	76.7	42.5	86.7	171.1	108.6	196.7	1,728.8	1,662.2	2,119.9	2,624.9	1,281.0	2,926.3	4,601.5	3,094.3	5,329.5
[5]	ADMINISTRATION	---	12.3	2.9	---	27.9	6.6	---	300.3	70.7	---	414.6	97.5	---	755.0	177.7
	TOTAL	587.8	706.4	754.0	1,311.9	1,696.4	1,711.0	13,254.2	22,053.6	18,443.3	20,124.1	22,672.2	25,458.7	35,277.9	47,128.6	46,367.0

NOTE: EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.3 DISBURSEMENT SCHEDULE FOR PHASE II PROJECT - (1)

UNIT: IN x 1,000

NO.	STAGE	PHASE II STAGE I															
	YEAR	1996			1997			1998			1999			2000			
	ITEM	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	
[1]	CONSTRUCTION - SUPPLY	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
[2]	ENGINEERING SERVICES	948.1	566.7	1,081.5	948.1	566.7	1,081.5	---	---	---	488.9	283.3	555.6	488.9	283.3	555.6	
	SUB-TOTAL	948.1	566.7	1,081.5	948.1	566.7	1,081.5	---	---	---	488.9	283.3	555.6	488.9	283.3	555.6	
[3]	TAX (VAT)	---	689.4	162.2	---	689.4	162.2	---	---	---	---	354.2	83.3	---	354.2	83.3	
[4]	CONTINGENCY	142.2	85.0	162.2	142.2	85.0	162.2	---	---	---	73.3	42.5	83.3	73.3	42.5	83.3	
[5]	ADMINISTRATION	---	23.0	5.4	---	23.0	5.4	---	---	---	---	11.8	2.8	---	11.8	2.8	
	TOTAL	1,090.4	1,364.1	1,411.3	1,090.4	1,364.1	1,411.3	---	---	---	562.2	691.8	725.0	562.2	691.8	725.0	

NOTE: EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.3 DISBURSEMENT SCHEDULE FOR PHASE II PROJECT - (2)

UNIT: IN x 1,000

NO.	STAGE / YEAR / ITEM	PHASE II STAGE II 2001 F/C (US$)	2001 L/C (TT$)	2001 TOTAL (US$)	2002 F/C (US$)	2002 L/C (TT$)	2002 TOTAL (US$)	2003 F/C (US$)	2003 L/C (TT$)	2003 TOTAL (US$)	2004 F/C (US$)	2004 L/C (TT$)	2004 TOTAL (US$)	2005 F/C (US$)	2005 L/C (TT$)	2005 TOTAL (US$)	TOTAL F/C (US$)	TOTAL L/C (TT$)	TOTAL (US$)
[1]	CONSTRUCTION - SUPPLY	---	---	---	---	---	---	---	---	---	8,020.7	681.8	8,181.1	12,031.0	1,022.6	12,271.6	20,051.7	1,704.4	20,452.7
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	---	---	---	5,991.4	1,409.7	---	3,994.3	939.8	---	9,985.7	2,349.6
	SUB-TOTAL		---	---	---	---	---	---	---	---	8,020.7	6,673.2	9,590.8	12,031.0	5,016.9	13,211.5	20,051.7	11,690.1	22,802.3
[2]	ENGINEERING SERVICES	---	---	---	511.1	283.3	577.8	1,140.7	724.1	1,311.1	629.6	409.3	725.9	1,155.6	692.6	1,318.5	6,311.1	3,809.3	7,207.4
	SUB-TOTAL	---	---	---	511.1	283.3	577.8	1,140.7	724.1	1,311.1	8,650.3	7,082.4	10,316.8	13,186.6	5,709.5	14,530.0	26,362.8	15,499.4	30,009.7
[3]	TAX (VAT)	---	---	---	---	368.3	86.7	---	835.8	196.7	---	6,576.9	1,547.5	---	9,262.9	2,179.5	---	19,131.2	4,501.5
[4]	CONTINGENCY	---	---	---	76.7	42.5	86.7	171.1	108.6	196.7	1,297.5	1,062.4	1,547.5	1,978.0	856.4	2,179.5	3,954.4	2,324.9	4,501.5
[5]	ADMINISTRATION	---	---	---	---	12.3	2.9	---	27.9	6.6	---	219.2	51.6	---	308.8	72.6	---	637.7	150.0
	TOTAL	---	---	---	587.8	706.4	754.0	1,311.9	1,696.4	1,711.0	9,947.9	14,941.0	13,463.4	15,164.6	16,137.6	18,961.6	30,317.2	37,593.2	39,162.7

NOTE: EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.4 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE I) - (1)

NOTE: AN; ANNUBAR, PF; PARSHALL FLUME, F/C; FOREIGN CURRENCY, INSTRUMENT; INSTRUMENTATION, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS),
O ; ORIFICE PLATE, V ; VETURI TUBE, L/C; LOCAL CURRENCY, PRIMARY; PRIMARY SENSOR,

PIPE DIA-METER (MM)	FLOW METER													
	COST (¥1,000)													
	TYPE	NO.	UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
			PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
1200	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
1200	AN	1	686.8	935.0	824.2	1,122.0	1,946.2	38.9	194.6	547.1	409.0	1,946.2	1,189.6	3,135.8
1050	AN	1	653.7	935.0	784.4	1,122.0	1,906.4	38.1	190.6	504.3	395.9	1,906.4	1,129.0	3,035.4
900	¥ AN	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
900	AN	3	621.4	935.0	2,236.9	3,366.0	5,602.9	112.1	560.3	1,390.5	1,149.9	5,602.9	3,212.7	8,815.6
900	---	---	---	---	---	---	---	---	---	---	---	---	---	---
800	---	---	---	---	---	---	---	---	---	---	---	---	---	---
750	AN	5	588.2	935.0	3,529.2	5,610.0	9,139.2	182.8	913.9	2,123.2	1,853.9	9,139.2	5,073.7	14,212.9
600	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
600	AN	7	555.9	935.0	4,669.6	7,854.0	12,523.6	250.5	1,252.4	2,713.7	2,511.0	12,523.6	6,727.5	19,251.1
525	AN	7	539.8	935.0	4,533.9	7,854.0	12,387.9	247.8	1,238.8	2,589.2	2,469.5	12,387.9	6,545.2	18,933.1
450	AN	7	523.6	935.0	4,398.2	7,854.0	12,252.2	245.0	1,225.2	2,467.9	2,428.6	12,252.2	6,366.7	18,618.9
450	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
400	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
400	AN	6	512.6	935.0	3,690.4	6,732.0	10,422.4	208.4	1,042.2	2,047.5	2,058.1	10,422.4	5,356.3	15,778.6
375	AN	3	506.6	935.0	1,823.8	3,366.0	5,189.8	103.8	519.0	1,007.0	1,022.9	5,189.8	2,652.7	7,842.5
350	AN	1	501.5	935.0	601.8	1,122.0	1,723.8	34.5	172.4	330.1	339.1	1,723.8	876.1	2,599.9
300	AN	49	490.5	935.0	28,838.5	54,978.0	83,816.5	1,676.3	8,381.6	15,643.2	16,427.6	83,816.5	42,128.8	125,945.2
250	AN	6	220.2	935.0	1,585.1	6,732.0	8,317.1	166.3	831.7	1,851.3	1,675.0	8,317.1	4,524.3	12,841.3
225	AN	2	213.4	935.0	512.0	2,244.0	2,756.0	55.1	275.6	606.5	554.0	2,756.0	1,491.2	4,247.3
200	AN	15	205.7	935.0	3,702.6	16,830.0	20,532.6	410.7	2,053.3	4,470.5	4,120.1	20,532.6	11,054.5	31,587.1
175	AN	2	198.9	935.0	477.4	2,244.0	2,721.4	54.4	272.1	585.7	545.0	2,721.4	1,457.3	4,178.7
150	AN	15	191.3	935.0	3,442.5	16,830.0	20,272.5	405.5	2,027.3	4,315.8	4,053.1	20,272.5	10,801.6	31,074.1
100	AN	9	98.6	935.0	1,064.9	10,098.0	11,162.9	223.3	1,116.3	2,498.4	2,250.1	11,162.9	6,088.0	17,250.9
600	¥ O	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
300	¥ O	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
---	¥ PF	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
1200	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
900	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
800	¥ V	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
750	¥ V	3	---	935.0	---	3,366.0	3,366.0	67.3	336.6	---	565.5	3,366.0	969.4	4,335.4
600	¥ V	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
525	---	---	---	---	---	---	---	---	---	---	---	---	---	---
400	---	---	---	---	---	---	---	---	---	---	---	---	---	---
300	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
	TOTAL	160			66,715.1	179,520.0	246,235.1	4,924.7	24,623.5	45,691.7	48,221.3	246,235.1	123,461.2	369,696.3

Table N-1.4 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE I) - (2)

NOTE: AV; ALTITUDE VALVE, BU; BUTTERFLY VALVE, CIR'T; CIRCUIT, F/C; FOREIGN CURRENCY, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS), "*"; EXISTINGS TO BE USED,
CV; CONE VALVE, CNT; CONTROL, R-CNT; REMOTE CONTROL, L/C; LOCAL CURRENCY, "#"; INSTALLATION OF CONTROL EQUIPMENT,

PIPE DIA-METER (MM)	CONTROL VALVE																	
	COST (¥1,000)																	
	TYPE	NO.	UNIT PRICE				CIF T & T					TRANS-PORTATION	INSTAL-LATION	VALVE CHAMBER	TAX (VAT)	TOTAL		
			VALVE	CNT PANEL	CNT CIR'T	R-CNT CIR'T	VALVE	CNT PANEL	CNT CIR'T	R-CNT CIR'T	TOTAL					F/C	L/C	TOTAL
1200	¥ BU	3	2,305.6	2,550.0	170.0	1,105.0	8,300.2	9,180.0	510.0	3,978.0	21,968.2	439.4	2,196.8	---	3,690.7	21,968.2	6,326.8	28,295.0
1200	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1050	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
900	BU	2	4,059.2	2,550.0	170.0	1,105.0	9,742.1	6,120.0	340.0	2,652.0	18,854.1	377.1	1,885.4	1,354.1	3,370.6	18,854.1	6,987.2	25,841.2
900	¥ BU	1	1,606.4	2,550.0	170.0	1,105.0	1,927.7	3,060.0	170.0	1,326.0	6,483.7	129.7	648.4	---	1,089.3	6,483.7	1,867.3	8,351.0
900	* BU	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
800	# CV	2	1,160.0	2,550.0	170.0	1,105.0	2,784.0	6,120.0	340.0	2,652.0	11,896.0	237.9	1,189.6	---	1,998.5	11,896.0	3,426.0	15,322.0
750	BU	1	3,163.2	2,550.0	170.0	1,105.0	3,795.8	3,060.0	170.0	1,326.0	8,351.8	167.0	835.2	604.8	1,493.8	8,351.8	3,100.8	11,452.7
600	BU	5	2,410.4	2,550.0	170.0	1,105.0	14,462.4	15,300.0	850.0	6,630.0	37,242.4	744.8	3,724.2	2,685.9	6,659.6	37,242.4	13,814.6	51,057.0
600	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
525	BU	5	2,148.8	2,550.0	170.0	1,105.0	12,892.8	15,300.0	850.0	6,630.0	35,672.8	713.5	3,567.3	2,525.5	6,371.9	35,672.8	13,178.1	48,850.9
450	BU	3	1,944.0	2,550.0	170.0	1,105.0	6,998.4	9,180.0	510.0	3,978.0	20,666.4	413.3	2,066.6	1,422.4	3,685.3	20,666.4	7,587.7	28,254.1
450	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
400	BU	5	1,684.8	2,550.0	170.0	1,105.0	10,108.8	15,300.0	850.0	6,630.0	32,888.8	657.8	3,288.9	2,270.5	5,865.9	32,888.8	12,083.1	44,971.9
400	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
375	BU	2	1,608.8	2,550.0	170.0	1,105.0	3,861.1	6,120.0	340.0	2,652.0	12,973.1	259.5	1,297.3	888.6	2,312.8	12,973.1	4,758.1	17,731.2
350	BU	1	1,532.0	2,550.0	170.0	1,105.0	1,838.4	3,060.0	170.0	1,326.0	6,394.4	127.9	639.4	434.6	1,139.4	6,394.4	2,341.3	8,735.7
300	BU	42	1,392.8	2,550.0	170.0	1,105.0	70,197.1	128,520.0	7,140.0	55,692.0	261,549.1	5,231.0	26,154.9	17,452.0	46,558.1	261,549.1	95,396.0	356,945.1
250	BU	4	1,276.8	2,550.0	170.0	1,105.0	6,128.6	12,240.0	680.0	5,304.0	24,352.6	487.1	2,435.3	1,587.8	4,329.4	24,352.6	8,839.6	33,192.2
225	BU	2	1,243.2	2,550.0	170.0	1,105.0	2,983.7	6,120.0	340.0	2,652.0	12,095.7	241.9	1,209.6	775.7	2,148.4	12,095.7	4,375.6	16,471.3
200	BU	12	1,209.6	2,550.0	170.0	1,105.0	17,418.2	36,720.0	2,040.0	15,912.0	72,090.2	1,441.8	7,209.0	4,546.5	12,793.1	72,090.2	25,990.5	98,080.7
175	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
150	BU	14	1,147.2	2,550.0	170.0	1,105.0	19,273.0	42,840.0	2,380.0	18,564.0	83,057.0	1,661.1	8,305.7	5,057.7	14,712.2	83,057.0	29,736.8	112,793.7
100	BU	8	1,084.8	2,550.0	170.0	1,105.0	10,414.1	24,480.0	1,360.0	10,608.0	46,862.1	937.2	4,686.2	2,753.0	8,285.8	46,862.1	16,662.3	63,524.3
600	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
300	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1200	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
900	AV	2	11,664.0	---	---	---	27,993.6	---	---	---	27,993.6	559.9	2,799.4	---	4,702.9	27,993.6	8,062.2	36,055.8
800	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
750	AV	5	8,184.0	---	---	---	49,104.0	---	---	---	49,104.0	982.1	4,910.4	---	8,249.5	49,104.0	14,142.0	63,246.0
600	AV	1	6,236.0	---	---	---	7,483.2	---	---	---	7,483.2	149.7	748.3	---	1,257.2	7,483.2	2,155.2	9,638.4
525	* AV	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
400	AV	1	2,840.0	---	---	---	3,408.0	---	---	---	3,408.0	68.2	340.8	---	572.5	3,408.0	981.5	4,389.5
300	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL	124					291,115.2	342,720.0	19,040.0	148,512.0	801,387.2	16,027.7	80,138.7	44,359.1	141,286.9	801,387.2	281,812.5	1,083,199.7

Table N-1.4 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE I) - (3)

NOTE: AP; AIR PURGE, D; DIFFERENTIAL PRESSURE TYPE, F/C; FOREIGN CURRENCY, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS),
F ; FLOAT TYPE, PRIMARY; PRIMARY SENSOR, L/C; LOCAL CURRENCY,
B ; BOURDON TUBE. INSTRUMENT; INSTRUMENTATION. "*"; EXISTINGS TO BE USED.

LEVEL METER

COST (¥1,000)

TYPE	NO.	UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
		PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
¥ AP	4	---	2,295.0	---	11,016.0	11,016.0	220.3	1,101.6	---	1,850.7	11,016.0	3,172.6	14,188.6
D	11	---	807.5	---	10,659.0	10,659.0	213.2	1,065.9	---	1,790.7	10,659.0	3,069.8	13,728.8
* D	8	---	---	---	---	---	---	---	---	---	---	---	---
¥ D	5	---	807.5	---	4,845.0	4,845.0	96.9	484.5	---	814.0	4,845.0	1,395.4	6,240.4
F	10	365.5	935.0	4,386.0	11,220.0	15,606.0	312.1	1,560.6	---	2,621.8	15,606.0	4,494.5	20,100.5
TOTAL	38			4,386.0	37,740.0	42,126.0	842.5	4,212.6	---	7,077.2	42,126.0	12,132.3	54,258.3

PRESSURE GAUGE

COST (¥1,000)

TYPE	NO.	UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
		PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
* B	2	---	---	---	---	---	---	---	---	---	---	---	---
¥ B	14	---	510.0	---	8,568.0	8,568.0	171.4	856.8	---	1,439.4	8,568.0	2,467.6	11,035.6
B	111	---	510.0	---	67,932.0	67,932.0	1,358.6	6,793.2	---	11,412.6	67,932.0	19,564.4	87,496.4
TOTAL	127			---	76,500.0	76,500.0	1,530.0	7,650.0	---	12,852.0	76,500.0	22,032.0	98,532.0

Table N-1.5 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE II) - (1)

NOTE: AN; ANNUBAR, PF; PARSHALL FLUME, F/C; FOREIGN CURRENCY, INSTRUMENT; INSTRUMENTATION, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS),
O ; ORIFICE PLATE, V ; VENTURI TUBE, L/C; LOCAL CURRENCY, PRIMARY; PRIMARY SENSOR, P; PROPELLAR TYPE,

PIPE DIA-METER (MM)	FLOW METER COST (¥ 1,000)													
	TYPE	NO.	UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
			PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
1200	¥ AN	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
1050	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
900	¥ AN	5	---	935.0	---	5,610.0	5,610.0	112.2	561.0	---	942.5	5,610.0	1,615.7	7,225.7
800	---	---	---	---	---	---	---	---	---	---	---	---	---	---
750	¥ AN	5	---	935.0	---	5,610.0	5,610.0	112.2	561.0	---	942.5	5,610.0	1,615.7	7,225.7
600	¥ AN	8	---	935.0	---	8,976.0	8,976.0	179.5	897.6	---	1,508.0	8,976.0	2,585.1	11,561.1
600	---	---	---	---	---	---	---	---	---	---	---	---	---	---
525	¥ AN	7	---	935.0	---	7,854.0	7,854.0	157.1	785.4	---	1,319.5	7,854.0	2,262.0	10,116.0
450	¥ AN	8	---	935.0	---	8,976.0	8,976.0	179.5	897.6	---	1,508.0	8,976.0	2,585.1	11,561.1
400	¥ AN	7	---	935.0	---	7,854.0	7,854.0	157.1	785.4	---	1,319.5	7,854.0	2,262.0	10,116.0
375	¥ AN	3	---	935.0	---	3,366.0	3,366.0	67.3	336.6	---	565.5	3,366.0	969.4	4,335.4
350	¥ AN	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
300	¥ AN	49	---	935.0	---	54,978.0	54,978.0	1,099.6	5,497.8	---	9,236.3	54,978.0	15,833.7	70,811.7
300	AN	1	490.5	935.0	588.5	1,122.0	1,710.5	34.2	171.1	319.2	335.3	1,710.5	859.8	2,570.3
250	¥ AN	6	---	935.0	---	6,732.0	6,732.0	134.6	673.2	---	1,131.0	6,732.0	1,938.8	8,670.8
225	¥ AN	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
200	¥ AN	15	---	935.0	---	16,830.0	16,830.0	336.6	1,683.0	---	2,827.4	16,830.0	4,847.0	21,677.0
200	---	---	---	---	---	---	---	---	---	---	---	---	---	---
175	¥ AN	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
150	¥ AN	15	---	935.0	---	16,830.0	16,830.0	336.6	1,683.0	---	2,827.4	16,830.0	4,847.0	21,677.0
150	---	---	---	---	---	---	---	---	---	---	---	---	---	---
100	¥ AN	9	---	935.0	---	10,098.0	10,098.0	202.0	1,009.8	---	1,696.5	10,098.0	2,908.2	13,006.2
100	---	---	---	---	---	---	---	---	---	---	---	---	---	---
600	¥ O	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
300	¥ O	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
300	¥ P	3	---	935.0	---	3,366.0	3,366.0	67.3	336.6	---	565.5	3,366.0	969.4	4,335.4
---	¥ PF	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
1200	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
900	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
800	¥ V	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
750	¥ V	3	---	935.0	---	3,366.0	3,366.0	67.3	336.6	---	565.5	3,366.0	969.4	4,335.4
600	¥ V	1	---	935.0	---	1,122.0	1,122.0	22.4	112.2	---	188.5	1,122.0	323.1	1,445.1
525	---	---	---	---	---	---	---	---	---	---	---	---	---	---
400	---	---	---	---	---	---	---	---	---	---	---	---	---	---
300	¥ V	2	---	935.0	---	2,244.0	2,244.0	44.9	224.4	---	377.0	2,244.0	646.3	2,890.3
	TOTAL	164			588.5	184,008.0	184,596.5	3,691.9	18,459.7	319.2	31,060.1	184,596.5	53,530.9	238,127.5

Table N-1.5 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE II) - (2)

NOTE: AV; ALTITUDE VALVE, BU; BUTTERFLY VALVE, CIR'T; CIRCUIT, F/C; FOREIGN CURRENCY, "#"; INSTALLATION OF CONTROL E NO.; NUMBER,
CV; CONE VALVE. CNT; CONTROL, R-CNT; REMOTE CONTROL, L/C; LOCAL CURRENCY, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS).

PIPE DIA-METER (MM)	CONTROL VALVE																	
	COST (¥1,000)																	
	TYPE	NO.	UNIT PRICE				CIF T & T					TRANS-PORTATION	INSTAL-LATION	VALVE CHAMBER	TAX (VAT)	TOTAL		
			VALVE	CNT PANEL	CNT CIR'T	R-CNT CIR'T	VALVE	CNT PANEL	CNT CIR'T	R-CNT CIR'T	TOTAL					F/C	L/C	TOTAL
1200	# BU	3	---	---	170.0	1,105.0	---	---	612.0	3,978.0	4,590.0	91.8	459.0	---	771.1	4,590.0	1,321.9	5,911.9
1050	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
900	# BU	4	---	---	170.0	1,105.0	---	---	816.0	5,304.0	6,120.0	122.4	612.0	---	1,028.2	6,120.0	1,762.6	7,882.6
800	# CV	2	---	---	170.0	1,105.0	---	---	408.0	2,652.0	3,060.0	61.2	306.0	---	514.1	3,060.0	881.3	3,941.3
750	# BU	1	---	---	170.0	1,105.0	---	---	204.0	1,326.0	1,530.0	30.6	153.0	---	257.0	1,530.0	440.6	1,970.6
600	BU	1	2,410.4	2,550.0	170.0	1,105.0	2,892.5	3,060.0	204.0	1,326.0	7,482.5	149.6	748.2	537.2	1,337.6	7,482.5	2,772.7	10,255.2
600	# BU	5	---	---	170.0	1,105.0	---	---	1,020.0	6,630.0	7,650.0	153.0	765.0	---	1,285.2	7,650.0	2,203.2	9,853.2
525	# BU	5	---	---	170.0	1,105.0	---	---	1,020.0	6,630.0	7,650.0	153.0	765.0	---	1,285.2	7,650.0	2,203.2	9,853.2
450	# BU	3	---	---	170.0	1,105.0	---	---	612.0	3,978.0	4,590.0	91.8	459.0	---	771.1	4,590.0	1,321.9	5,911.9
400	# BU	5	---	---	170.0	1,105.0	---	---	1,020.0	6,630.0	7,650.0	153.0	765.0	---	1,285.2	7,650.0	2,203.2	9,853.2
375	# BU	2	---	---	170.0	1,105.0	---	---	408.0	2,652.0	3,060.0	61.2	306.0	---	514.1	3,060.0	881.3	3,941.3
350	# BU	1	---	---	170.0	1,105.0	---	---	204.0	1,326.0	1,530.0	30.6	153.0	---	257.0	1,530.0	440.6	1,970.6
300	# BU	45	---	---	170.0	1,105.0	---	---	9,180.0	59,670.0	68,850.0	1,377.0	6,885.0	---	11,566.8	68,850.0	19,828.8	88,678.8
300	BU	4	1,392.8	2,550.0	170.0	1,105.0	6,685.4	12,240.0	816.0	5,304.0	25,045.4	500.9	2,504.5	1,662.1	4,456.9	25,045.4	9,124.7	34,169.1
250	# BU	4	---	---	170.0	1,105.0	---	---	816.0	5,304.0	6,120.0	122.4	612.0	---	1,028.2	6,120.0	1,762.6	7,882.6
225	# BU	2	---	---	170.0	1,105.0	---	---	408.0	2,652.0	3,060.0	61.2	306.0	---	514.1	3,060.0	881.3	3,941.3
200	# BU	12	---	---	170.0	1,105.0	---	---	2,448.0	15,912.0	18,360.0	367.2	1,836.0	---	3,084.5	18,360.0	5,287.7	23,647.7
200	BU	1	1,209.6	2,550.0	170.0	1,105.0	1,451.5	3,060.0	204.0	1,326.0	6,041.5	120.8	604.2	378.9	1,071.8	6,041.5	2,175.7	8,217.2
175	BU	1	1,178.4	2,550.0	170.0	1,105.0	1,414.1	3,060.0	204.0	1,326.0	6,004.1	120.1	600.4	370.0	1,064.2	6,004.1	2,154.7	8,158.8
150	BU	1	1,147.2	2,550.0	170.0	1,105.0	1,376.6	3,060.0	204.0	1,326.0	5,966.6	119.3	596.7	361.3	1,056.6	5,966.6	2,133.8	8,100.5
150	# BU	14	---	---	170.0	1,105.0	---	---	2,856.0	18,564.0	21,420.0	428.4	2,142.0	---	3,598.6	21,420.0	6,169.0	27,589.0
100	BU	1	1,084.8	2,550.0	170.0	1,105.0	1,301.8	3,060.0	204.0	1,326.0	5,891.8	117.8	589.2	344.1	1,041.4	5,891.8	2,092.6	7,984.3
100	# BU	8	---	---	170.0	1,105.0	---	---	1,632.0	10,608.0	12,240.0	244.8	1,224.0	---	2,056.3	12,240.0	3,525.1	15,765.1
600	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
300	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
300	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1200	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
900	¥ AV	2	2,916.0	---	---	---	6,998.4	---	---	---	6,998.4	140.0	699.8	---	1,175.7	6,998.4	2,015.5	9,013.9
800	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
750	¥ AV	5	2,046.0	---	---	---	12,276.0	---	---	---	12,276.0	245.5	1,227.6	---	2,062.4	12,276.0	3,535.5	15,811.5
600	¥ AV	1	1,559.0	---	---	---	1,870.8	---	---	---	1,870.8	37.4	187.1	---	314.3	1,870.8	538.8	2,409.6
525	¥ AV	2	1,196.0	---	---	---	2,870.4	---	---	---	2,870.4	57.4	287.0	---	482.2	2,870.4	826.7	3,697.1
400	¥ AV	1	710.0	---	---	---	852.0	---	---	---	852.0	17.0	85.2	---	143.1	852.0	245.4	1,097.4
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL	136					39,989.5	27,540.0	25,500.0	165,750.0	258,779.5	5,175.6	25,878.0	3,653.6	44,023.0	258,779.5	78,730.1	337,509.6

Table N-1.5 COST ESTIMATE OF MONITORING AND CONTROL EQUIPMENT TO BE INSTALLED FOR CENTRAL SUPERVISORY SYSTEM (PHASE II) - (3)

NOTE: AP; PIR PURGE, PRIMARY; PRIMARY SENSOR, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS), L/C; LOCAL CURRENCY,
F ; FLOAT TYPE, INSTRUMENT; INSTRUMENTATION, D; DIFFERENTIAL PRESSURE TYPE,
B ; BOURDON TUBE, "*"; EXISTINGS TO BE USED, F/C; FOREIGN CURRENCY,

LEVEL METER

TYPE	NO.	COST (¥ 1,000) UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
		PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
¥ AP	2	---	2,295.0	---	5,508.0	5,508.0	110.2	550.8	---	925.3	5,508.0	1,586.3	7,094.3
D	13	---	807.5	---	12,597.0	12,597.0	251.9	1,259.7	---	2,116.3	12,597.0	3,627.9	16,224.9
¥ D	11	---	807.5	---	10,659.0	10,659.0	213.2	1,065.9	---	1,790.7	10,659.0	3,069.8	13,728.8
¥ F	10	---	935.0	---	11,220.0	11,220.0	224.4	1,122.0	---	1,885.0	11,220.0	3,231.4	14,451.4
F	2	365.5	935.0	877.2	2,244.0	3,121.2	62.4	312.1	---	524.4	3,121.2	898.9	4,020.1
TOTAL	38			877.2	42,228.0	43,105.2	862.1	4,310.5	---	7,241.7	43,105.2	12,414.3	55,519.5

PRESSURE GAUGE

TYPE	NO.	COST (¥ 1,000) UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTALL-TION	METER CHAMBER	TAX (VAT)	TOTAL		
		PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
B	20	---	510.0	---	12,240.0	12,240.0	244.8	1,224.0	---	2,056.3	12,240.0	3,525.1	15,765.1
¥ B	111	---	510.0	---	67,932.0	67,932.0	1,358.6	6,793.2	---	11,412.6	67,932.0	19,564.4	87,496.4
TOTAL	131			---	80,172.0	80,172.0	1,603.4	8,017.2	---	13,468.9	80,172.0	23,089.5	103,261.5

Table N-1.6 COST EATIMATE OF NEW CENTRAL SUPERVISORY SYSTEM (PHASE I AND II)

NOTE: F/C: FOREIGN CURRENCY, L/C: LOCAL CURRENCY.

NAME OF FACILITIES AND EQUIPMENT	PHASE I										PHASE II									
	COST (¥ 1,000)										COST (¥ 1,000)									
	NO.	UNIT PRICE	PRICE BUILDING	PRICE CIF T&T	TRANS-PORTATION	INSTAL-LATION	TAX (VAT)	TOTAL F/C	TOTAL L/C	TOTAL TOTAL	NO.	UNIT PRICE	PRICE BUILDING	PRICE CIF T&T	TRANS-PORTATION	INSTAL-LATION	TAX (VAT)	TOTAL F/C	TOTAL L/C	TOTAL TOTAL
[1] CSS BUILDING																				
MASTER TERMINAL UNIT	2	34,000	---	81,600	1,632	8,160	13,709	81,600	23,501	105,101	2	34,000	---	81,600	1,632	8,160	13,709	81,600	23,501	105,101
CENTRAL PROCESSING UNIT	2	102,000	---	244,800	4,896	24,480	41,126	244,800	70,502	315,302	2	102,000	---	244,800	4,896	24,480	41,126	244,800	70,502	315,302
INPUT/OUTPUT INTERFACE	1	10,200	---	12,240	245	1,224	2,056	12,240	3,525	15,765	1	10,200	---	12,240	245	1,224	2,056	12,240	3,525	15,765
SYSTEM CONSOLE	1	1,700	---	2,040	41	204	343	2,040	588	2,628	1	1,700	---	2,040	41	204	343	2,040	588	2,628
LINE PRINTER	1	3,825	---	4,590	92	459	771	4,590	1,322	5,912	1	3,825	---	4,590	92	459	771	4,590	1,322	5,912
SERIAL PRINTER	2	2,125	---	5,100	102	510	857	5,100	1,469	6,569	2	2,125	---	5,100	102	510	857	5,100	1,469	6,569
GRAPHIC PANEL	1	110,500	---	132,600	2,652	13,260	22,277	132,600	38,189	170,789	--	---	---	---	---	---	---	---	---	---
CRT DISPLAY	2	17,850	---	42,840	857	4,284	7,197	42,840	12,338	55,178	2	17,850	---	42,840	857	4,284	7,197	42,840	12,338	55,178
UNINTERRUPTABLE POWER SUPPLY	1	47,600	---	57,120	1,142	5,712	9,596	57,120	16,451	73,571	1	47,600	---	57,120	1,142	5,712	9,596	57,120	16,451	73,571
PUMP REMOTE CONTROL PANEL	1	17,850	---	21,420	428	2,142	3,599	21,420	6,169	27,589	--	---	---	---	---	---	---	---	---	---
VALVE REMOTE CONTROL PANEL	---	---	---	---	---	---	---	---	---	---	1	17,000	---	20,400	408	2,040	3,427	20,400	5,875	26,275
SOFTWARE	1	187,000	---	187,000	---	---	28,050	187,000	28,050	215,050	--	---	---	---	---	---	---	---	---	---
BUILDING	1	170	12,240	---	---	---	1,836	---	14,076	14,076	--	---	---	---	---	---	---	---	---	---
TOTAL			12,240	791,350	12,087	60,435	131,417	791,350	216,179	1,007,529			---	470,730	9,415	47,073	79,083	470,730	135,570	606,300
[2] REGIONAL OFFICE																				
WORK STATION WITH CRT	2	11,900	---	28,560	571	2,856	4,798	28,560	8,225	36,785	3	11,900	---	42,840	857	4,284	7,197	42,840	12,338	55,178
TOTAL			---	28,560	571	2,856	4,798	28,560	8,225	36,785			---	42,840	857	4,284	7,197	42,840	12,338	55,178
[3] REPEATER STATION																				
REPEATER SYSTEM	2	4,250	---	10,200	204	1,020	1,714	10,200	2,938	13,138	2	4,250	---	10,200	204	1,020	1,714	10,200	2,938	13,138
UNINTERRUPTABLE POWER SUPPLY	1	16,150	---	19,380	388	1,938	3,256	19,380	5,581	24,961	1	16,150	---	19,380	388	1,938	3,256	19,380	5,581	24,961
TOTAL			---	29,580	592	2,958	4,969	29,580	8,519	38,099			---	29,580	592	2,958	4,969	29,580	8,519	38,099
[4] RTU STATION																				
REMOTE TERMINAL UNIT	48	13,600	---	783,360	15,667	78,336	131,604	783,360	225,608	1,008,968	48	13,600	---	783,360	15,667	78,336	131,604	783,360	225,608	1,008,968
INSTRUMENT PANEL	41	5,100	---	250,920	5,018	25,092	42,155	250,920	72,265	323,185	--	---	---	---	---	---	---	---	---	---
UNINTERRUPTABLE POWER SUPPLY	48	9,775	---	563,040	11,261	56,304	94,591	563,040	162,156	725,196	48	9,775	---	563,040	11,261	56,304	94,591	563,040	162,156	725,196
RTU'S BUILDING	48	102	70,502	---	---	---	10,575	---	81,078	81,078	--	---	---	---	---	---	---	---	---	---
TOTAL			70,502	1,597,320	31,946	159,732	278,925	1,597,320	541,106	2,138,426			---	1,346,400	26,928	134,640	226,195	1,346,400	387,763	1,734,163
[5] BOOSTER PUMPING STATION																				
IMPROVEMENT OF CONTROL PANEL	6	4,250	---	30,600	612	3,060	5,141	30,600	8,813	39,413	--	---	---	---	---	---	---	---	---	---
TOTAL			---	30,600	612	3,060	5,141	30,600	8,813	39,413			---	---	---	---	---	---	---	---
[6] SPARE PARTS																				
SPARE PARTS		25,500	---	33,660	673	---	5,150	33,660	5,823	39,483		25,500	---	33,660	673	---	5,150	33,660	5,823	39,483
TOTAL			---	33,660	673	---	5,150	33,660	5,823	39,483			---	33,660	673	---	5,150	33,660	5,823	39,483
GRAND TOTAL			82,742	2,511,070	46,481	229,041	430,400	2,511,070	788,665	3,299,735			---	1,923,210	38,464	188,955	322,594	1,923,210	550,014	2,473,224

Table N-1.7 COST ESTIMATE OF MONITORING EQUIPMENT TO BE INSTALLED FOR LOCAL SUPERVISORY SYSTEM (PHASE II)

NOTE: AN ; ANNUBAR, PRIMARY; PRIMARY SENSOR, F/C; FOREIGN CURRENCY, "¥"; EXISTINGS (REPLACEMENT PERIPHRALS),
NO. ; NUMBER, INSTRUMENT; INSTRUMENTATION, L/C; LOCAL CURRENCY,

PIPE DIA-METER (MM)	FLOW METER													
	COST (¥1,000)													
	TYPE	NO.	UNIT PRICE		CIF T & T			TRANS-PORTATION	INSTAL-LATION	METER CHAMBER	TAX (VAT)	TOTAL		
			PRIMARY	INSTRUMENT	PRIMARY	INSTRUMENT	TOTAL					F/C	L/C	TOTAL
400	¥ (AN)	7	513	935	4,305.4	7,854.0	12,159.4	243.2	1,215.9	2,388.8	2,401.1	12,159.4	6,249.0	18,408.4
300	¥ (AN)	16	490	935	9,416.6	17,952.0	27,368.6	547.4	2,736.9	5,108.0	5,364.1	27,368.6	13,756.3	41,125.0
250	¥ (AN)	10	220	935	2,641.8	11,220.0	13,861.8	277.2	1,386.2	3,085.4	2,791.6	13,861.8	7,540.4	21,402.2
200	¥ (AN)	12	206	935	2,962.1	13,464.0	16,426.1	328.5	1,642.6	3,576.4	3,296.0	16,426.1	8,843.6	25,269.7
150	¥ (AN)	11	191	935	2,524.5	12,342.0	14,866.5	297.3	1,486.7	3,164.9	2,972.3	14,866.5	7,921.2	22,787.7
125	¥ (AN)	1	123	935	147.9	1,122.0	1,269.9	25.4	127.0	282.6	255.7	1,269.9	690.8	1,960.7
100	¥ (AN)	15	99	935	1,774.8	16,830.0	18,604.8	372.1	1,860.5	4,163.9	3,750.2	18,604.8	10,146.7	28,751.5
50	¥ (AN)	1	49	935	59.2	1,122.0	1,181.2	23.6	118.1	267.7	238.6	1,181.2	648.0	1,829.1
675	AN	1	626	935	750.7	1,122.0	1,872.7	37.5	187.3	405.9	375.5	1,872.7	1,006.1	2,878.9
300	AN	12	490	935	7,062.5	13,464.0	20,526.5	410.5	2,052.6	3,831.0	4,023.1	20,526.5	10,317.2	30,843.7
250	AN	2	220	935	528.4	2,244.0	2,772.4	55.4	277.2	617.1	558.3	2,772.4	1,508.1	4,280.4
200	AN	33	206	935	8,145.7	37,026.0	45,171.7	903.4	4,517.2	9,835.1	9,064.1	45,171.7	24,319.8	69,491.6
150	AN	2	191	935	459.0	2,244.0	2,703.0	54.1	270.3	575.4	540.4	2,703.0	1,440.2	4,143.2
125	AN	2	123	935	295.8	2,244.0	2,539.8	50.8	254.0	565.3	511.5	2,539.8	1,381.5	3,921.3
100	AN	26	99	935	3,076.3	29,172.0	32,248.3	645.0	3,224.8	7,217.5	6,500.3	32,248.3	17,587.6	49,836.0
50	AN	3	49	935	177.5	3,366.0	3,543.5	70.9	354.3	803.0	715.8	3,543.5	1,944.0	5,487.4
TOTAL		154			44,328.2	172,788.0	217,116.2	4,342.3	21,711.6	45,888.0	43,358.7	217,116.2	115,300.7	332,416.8

Table N-1.8 ASSOCIATED COST SCHEDULE FOR IMPLEMENTING LEAKAGE REDUCTION AND UNIVERSAL METERING

UNIT: IN x 1,000

PROGRAM COMPONENT	ESTIMATED COST (1992-1999) FOREIGN CURRENCY (US$)	LOCAL CURRENCY (TT$)	TOTAL (US$)	DISBURSEMENT SCHEDULE 1992 F/C (US$)	1992 L/C (TT$)	1992 TOTAL (US$)	1993 F/C (US$)	1993 L/C (TT$)	1993 TOTAL (US$)	1994 F/C (US$)	1994 L/C (TT$)	1994 TOTAL (US$)	1995 F/C (US$)	1995 L/C (TT$)	1995 TOTAL (US$)	1996 - 1999 (*) F/C (US$)	1996 - 1999 (*) L/C (TT$)	1996 - 1999 (*) TOTAL (US$)
LEAKAGE REDUCTION																		
1. CONSULTING & ADVISORY SERVICES	3,348	1,581	3,720	675	319	750	1,134	536	1,260	459	217	510	216	102	240	216	102	240
2. LABOUR COST	---	11,050	2,600	---	2,975	700	---	2,975	700	---	850	200	---	850	200	---	850	200
3. REPLACEMENT OF SERVICE MAINS	2,496	5,712	3,840	312	714	480	312	714	480	312	714	480	312	714	480	312	714	480
4. REPLACEMENT OF CONNECTIONS	1,560	3,570	2,400	195	446	300	195	446	300	195	446	300	195	446	300	195	446	300
5. EQUIPMENT	1,000	---	1,000	1,000	---	1,000	---	---	---	---	---	---	---	---	---	---	---	---
6. VALVE REPAIR	650	1,488	1,000	325	744	500	325	744	500	---	---	---	---	---	---	---	---	---
7. LEAK REPAIR	5,250	52,063	17,500	300	2,975	1,000	600	5,950	2,000	600	5,950	2,000	750	7,438	2,500	750	7,438	2,500
SUB-TOTAL	14,304	75,463	32,060	2,807	8,173	4,730	2,566	11,365	5,240	1,566	8,177	3,490	1,473	9,550	3,720	1,473	9,550	3,720
8. TAX (VAT)	---	20,438	4,809	---	3,015	710	---	3,341	786	---	2,225	524	---	2,372	558	---	2,372	558
9. PHYSICAL CONTENGIENCIES	2,861	15,093	6,412	561	1,635	946	513	2,273	1,048	313	1,635	698	295	1,910	744	295	1,910	744
10. ADMINISTRATION	---	681	160	---	101	24	---	111	26	---	74	17	---	79	19	---	79	19
TOTAL	17,165	111,675	43,441	3,368	12,923	6,409	3,079	17,089	7,100	1,879	12,111	4,729	1,768	13,910	5,041	1,768	13,910	5,041

PROGRAM COMPONENT	ESTIMATED COST (1992-1995) FOREIGN CURRENCY (US$)	LOCAL CURRENCY (TT$)	TOTAL (US$)	DISBURSEMENT SCHEDULE 1992 F/C (US$)	1992 L/C (TT$)	1992 TOTAL (US$)	1993 F/C (US$)	1993 L/C (TT$)	1993 TOTAL (US$)	1994 F/C (US$)	1994 L/C (TT$)	1994 TOTAL (US$)	1995 F/C (US$)	1995 L/C (TT$)	1995 TOTAL (US$)	1996 F/C (US$)	1996 L/C (TT$)	1996 TOTAL (US$)
UNIVERSAL METER																		
1. UNIVERSAL METER	5,926	37,778	14,815	1,482	9,445	3,704	1,482	9,445	3,704	1,482	9,445	3,704	1,482	9,445	3,704	---	---	---
2. TAX (VAT)	---	9,445	2,222	---	2,361	556	---	2,361	556	---	2,361	556	---	2,361	556	---	---	---
3. PHYSICAL CONTINGENCY	889	5,667	2,222	222	1,417	556	222	1,417	556	222	1,417	556	222	1,417	556	---	---	---
4. ADMINISTRATION	---	315	74	---	79	19	---	79	19	---	79	19	---	79	19	---	---	---
TOTAL	6,815	53,204	19,334	1,704	13,301	4,833	1,704	13,301	4,833	1,704	13,301	4,833	1,704	13,301	4,833	---	---	---

NOTE: ABOVE COSTS EXCLUDE ADMINISTRATION COST AND ESCLATION COST.
(*); FIGURES PRESENTED ARE ANNUAL COST ESTIMATED FROM 1996 TO 1999.
EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.9 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (1)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I-STEP 1										PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION			PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION		
[1] CONSTRUCTION WORKS																					
	[CSS]																				
	FLOW METER	494.2	1,870.2	2,364.4	1,438.4	---	1,004.9	2,443.3	201.0	2,644.3	2,986.6	---	---	---	---	---	---	---	---	---	---
	CONTROL VALVE	---	---	---	---	---	---	---	---	---	---	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1
	LEVEL METER	32.5	380.9	413.4	---	---	175.7	175.7	35.1	210.8	463.0	---	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	988.9	988.9	---	---	420.3	420.3	84.1	504.3	1,107.6	---	---	---	---	---	---	---	---	---	---
	CSS's CENTRAL EQUIP	---	---	---	---	---	---	---	---	---	---	---	5,861.9	5,861.9	---	385.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7
	REGIONAL OFFICE	---	---	---	---	---	---	---	---	---	---	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9
	REPEATER STATION	---	---	---	---	---	---	---	---	---	---	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	---	---	---	---	---	---	---	---	---	---	11,832.0	11,832.0	---	2,219.5	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1
	BOOSTER P/S	---	---	---	---	---	---	---	---	---	---	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9
	SPARE PARTS	---	---	---	---	---	---	---	---	---	---	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	526.7	3,240.0	3,766.7	1,438.4	---	1,600.8	3,039.3	320.2	3,359.4	4,557.1	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
	[DISTRICT OFFICE]																				
	PC & PRINTER	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---	---
	TOTAL	526.7	3,352.0	3,878.7	1,438.4	---	1,600.8	3,039.3	322.4	3,361.7	4,669.7	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
[2] ENGINEERING SERVICES		---	---	489.4	---	---	---	---	---	382.6	579.4	---	---	2,823.9	---	---	---	---	---	1,788.4	3,244.7
TOTAL OF ITEMS [1] & [2]		526.7	3,352.0	4,368.1	1,438.4	---	1,600.8	3,039.3	322.4	3,744.3	5,249.1	2,156.4	22,380.3	27,360.6	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	17,491.1	31,476.2
[3] TAX (VAT)		---	---	---	---	---	---	---	---	3,346.3	787.4	---	---	---	---	---	---	---	---	20,066.1	4,721.4
[4] CONTINGENCY		---	---	655.2	---	---	---	---	---	561.6	787.4	---	---	4,104.1	---	---	---	---	---	2,623.7	4,721.4
[5] ADMINISTRATION		---	---	---	---	---	---	---	---	111.5	26.2	---	---	---	---	---	---	---	---	668.9	157.4
GRAND-TOTAL		526.7	3,352.0	5,023.3	1,438.4	---	1,600.8	3,039.3	322.4	7,763.8	6,850.1	2,156.4	22,380.3	31,464.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	40,849.7	41,076.4

NOTE: EQUIP.; EQUIPMENT, P/S; PUMPING STATION, F-M/C-V; FLOW METER AND CONTROL VALVE, VAT; VALUE ADDED TAX, EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table N-1.9 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (2)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	REPLACEMENT COST OF PHASE I-STEP 1										REPLACEMENT COST OF PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1]	CONSTRUCTION WORKS																				
	[CSS]																				
	FLOW METER	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4	---	---	---	---	---	---	---	---	---	---
	CONTROL VALVE	---	---	---	---	---	---	---	---	---	---	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1	---	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	---	---	---	---	---	---	---	---	---
	CSS's CENTRAL EQUIP	---	---	---	---	---	---	---	---	---	---	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,305.3
	REGIONAL OFFICE	---	---	---	---	---	---	---	---	---	---	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	---	---	---	---	---	---	---	---	---	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	---	---	---	---	---	---	---	---	---	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SPARE PARTS	---	---	---	---	---	---	---	---	---	---	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
	[LSS]																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[2]	ENGINEERING SERVICES	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL OF ITEMS [1] & [2]	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	1,553.7	365.6	---	---	---	---	---	---	---	---	11,041.9	2,598.1
[4]	CONTINGENCY	---	---	326.4	---	---	---	---	---	166.5	365.6	---	---	2,323.1	---	---	---	---	---	1,168.9	2,598.1
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	51.8	12.2	---	---	---	---	---	---	---	---	368.1	86.6
	GRAND-TOTAL	---	2,176.0	2,502.4	---	---	924.8	924.8	185.0	2,881.7	3,180.4	---	15,487.1	17,810.2	---	---	6,476.1	6,476.1	1,316.4	20,371.3	22,693.4

NOTE: EQUIP.; EQUIPMENT, P/S; PUMPING STATION, F-M/C-V; FLOW METER AND CONTROL VALVE, VAT; VALUE ADDED TAX, EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25.

Table N-10 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVOSORY SYSTEM (OPTION B)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I										REPLACEMENT COST OF PHASE I									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1] CONSTRUCTION WORKS																					
	[CSS]																				
	FLOW METER	494.2	1,329.8	1,824.0	1,438.4	---	775.2	2,213.6	155.0	2,368.7	2,381.3	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4
	CONTROL VALVE	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	32.5	279.6	312.0	---	---	132.6	132.6	26.5	159.1	349.5	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7
	CSS's CENTRAL EQUIP	---	5,861.9	5,861.9	---	385.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	11,832.0	11,832.0	---	2,219.6	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9	---	---	---	---	---	---	---	---	---	---
	SPARE PARTS	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
	[LSS]																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	TOTAL	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[2] ENGINEERING SERVICES		---	---	3,437.0	---	---	---	---	---	2,109.3	3,933.3	---	---	---	---	---	---	---	---	---	---
TOTAL OF ITEMS [1] & [2]		2,683.1	24,556.3	30,676.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	20,628.7	35,530.2	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[3] TAX (VAT)		---	---	---	---	---	---	---	---	22,650.5	5,329.5	---	---	---	---	---	---	---	---	12,595.6	2,963.7
[4] CONTINGENCY		---	---	4,601.5	---	---	---	---	---	3,094.3	5,329.5	---	---	2,649.5	---	---	---	---	---	1,335.3	2,963.7
[5] ADMINISTRATION		---	---	---	---	---	---	---	---	755.0	177.7	---	---	---	---	---	---	---	---	419.9	98.8
GRAND-TOTAL		2,683.1	24,556.3	35,277.9	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	47,128.6	46,367.0	---	17,663.1	20,312.6	---	---	7,400.9	7,400.9	1,501.4	23,253.0	25,783.9

NOTE: EQUIP.: EQUIPMENT, P/S: PUMPING STATION, F-M/C-V: FLOW METER AND CONTROL VALVE, VAT: VALUE ADDED TAX, EXCHANGE RATES: 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25.

Table N-1.11 DISBURSEMENT SCHEDULE AND NET PRESENT VALUE FOR OPTIONS A AND B

UNIT: IN X US$ 1,000

DESCRIPTION / YEAR / ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
OPTION A	PHASE I - STEP 1				PHASE I - STEP 2 & 3					REPLACEMENT OF STEP 1					REPLACEMENT OF STEP 3					
[1] CONSTRUCTION	---	---	1,981	2,688	---	---	---	11,979	16,253	---	---	---	1,034	1,403	---	---	---	7,349	9,971	52,659
[2] ENGINEERING SERVICES	85	193	107	194	---	477	1,082	599	1,088	---	---	---	---	---	---	---	---	---	---	3,824
SUB-TOTAL	85	193	2,088	2,883	---	477	1,082	12,578	17,340	---	---	---	1,034	1,403	---	---	---	7,349	9,971	56,483
[3] TAX (VAT)	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[4] CONTINGENCY	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[5] ADMINISTRATION	0	1	10	14	---	2	5	63	87	---	---	---	5	7	---	---	---	37	50	282
TOTAL	111	252	2,725	3,762	---	622	1,411	16,414	22,629	---	---	---	1,349	1,831	---	---	---	9,591	13,013	73,710
			TOTAL =	6,850				TOTAL =	41,076				TOTAL =	3,180				TOTAL =	22,603	
NET PRESENT VALUE																				
5% [43,722]																				
10% [27,981]																				
12% [23,816]																				
15% [18,995]																				
OPTION B	PHASE I									REPLACEMENT OF PHASE I										
[1] CONSTRUCTION	---	---	13,407	18,190	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	51,355
[2] ENGINEERING SERVICES	578	1,311	726	1,319	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3,933
SUB-TOTAL	578	1,311	14,133	19,509	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	55,288
[3] TAX (VAT)	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[4] CONTINGENCY	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[5] ADMINISTRATION	3	7	71	98	---	---	---	---	---	---	---	---	41	58	---	---	---	---	---	276
TOTAL	754	1,711	18,443	25,459	---	---	---	---	---	---	---	---	10,775	15,009	---	---	---	---	---	72,151
			TOTAL =	46,367									TOTAL =	25,784						
NET PRESENT VALUE																				
5% [52,442]																				
10% [40,418]																				
12% [36,885]																				
15% [32,505]																				

NOTE: EXCHANGE RATES; 1 US$ = TT$ 4.25 AND 1 US$ = ¥ 135, %; DISCOUNT RATE

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (1)

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
EXCAVATION AND EARTHWORK							
=MEASURED RATES=							
HAND EXCAVATION AND DISPOSAL							
(All hand excavation rates are applicable to excavation under normal conditions and in medium clay or heavy soil.)							
Excavate oversite to remove top soil average 150mm deep, convey a distance not exceeding(n.e.) 100m and deposit in soil heaps.	m2	6.60	5.80	5.80	5.80	5.80	5.80
Excavate oversite to reduce level.	m3	37.35	32.80	32.80	32.80	32.80	32.80
Excavate trench or pit starting at ground level and n.e. 1.5m deep.	m3	45.20	39.70	39.70	39.70	39.70	39.70
Ditto over 1.5m but n.e. 3.0m deep.	m3	59.95	50.90	50.90	50.90	50.90	50.90
Return fill in & compact selected excavated material around foundations.	m3	28.50	25.00	25.00	25.00	25.00	25.00
Load up and remove surplus excavated materials from site.	m3	45.45	43.30	43.30	43.30	43.30	43.30
MECHANICAL EXCAVATION AND DISPOSAL-USING EXCAVATOR WITH 0.29 M3 BUCKET							
Excavate oversite to remove top soil average 150mm deep, convey a distance n.e.100m and deposit in soil heaps.	m2	4.20	3.10	3.10	3.10	3.00	3.00
Excavate oversite to reduce level.	m3	17.25	12.10	12.10	12.10	12.10	12.10
Excavate trench or pit starting at ground level and n.e.1.5m deep.	m3	24.25	17.20	17.20	17.20	17.20	17.20
Ditto over 1.5m but n.e.3.0m deep.	m3	29.55	21.00	21.00	21.00	21.00	21.00
Load up and remove surplus excavated materials from site.	m3	19.10	19.10	19.10	19.10	19.10	19.10
FILL							

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
Pitrun fill in making up levels and spread level and consolidate.	m3	75.65	62.60	66.05	50.00	46.00	48.80
Pitrun bed 100mm thick and well roll, water and consolidate and level and ram ground under.	m2	9.65	7.75	8.10	6.45	6.05	6.35
SAND BLINDING							
Sand bed 50mm thick spread and compacted to receive polythene sheeting.	m2	4.90	4.15	3.85	3.20	2.90	3.20
DAMP-PROOF MEMBRANE							
500 gauge polythene and lay on sand blinding to receive concrete.	m2	3.65	4.35	3.95	4.05	6.15	6.15
CONCRETE WORK							
=MARKET PRICE=							
Ordinary Portland Cement-42kg bag	No.	12.00	12.45	12.45	12.45	17.95	17.95
Guanapo Gravel(Delivered to the site)	m3	66.50	53.40	53.40	41.35	35.95	35.95
Melajo Gravel(Delivered to the site)	m3	56.55	49.05	46.85	40.05	29.45	29.45
Sharp Sand(Delivered to the site)	m3	59.15	53.40	52.10	45.30	39.25	39.25
3/4" Aggregate(Delivered to the site)	m3	64.40	57.85	55.35	48.55	42.50	49.05
Packaged dry concrete mix-100 lb bag	No.	8.50	8.50	8.50	8.50	11.00	11.00
PRE-MIXED CONCRETE WITHIN 8 KM RADIUS OF CONCRETE PLANT							
21 N/mm2	m3	221.85	206.00	202.00	202.00	258.00	258.00
26 N/mm2	m3	232.00	221.00	221.00	221.00	275.00	275.00
Mild steel bar reinforce.n.e.Dia 12mm	kg	1.65	1.60	1.55	1.50	1.75	1.80
Ditto Dia.20mm	kg	2.35	2.35	2.40	2.40	2.85	2.95
Ditto Dia.25mm	kg	2.40	2.35	2.45	2.45	2.90	3.05
High tensile steel bar reinforcement n.e.Dia.25mm.	kg	1.80	1.80	2.15	2.15	3.10	3.10
Steel-wire square mesh fabric 150*150*3.2mm(BRC No.610)45m roll.	No.	275.00	269.65	256.35	256.35	321.35	327.65
Ditto 150*150*5.38mm(BRC No.65)45m roll.	No.	641.00	630.65	584.35	584.35	713.65	728.65
=MEASURED RATES=							
(All concrete reinforced exept where described as "plain"and mixed on site by machine.)							

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (2)

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
POLTLAND CEMENT CONCRETE 21 N/MM2-MACHINE MIXED ON SITE							
Plain blinding (1:8) 50mm thick	m2	23.45	19.40	19.40	18.30	20.20	20.20
Foundation in trenches over 150mm but n.e.300mm thick	m3	295.00	286.65	283.05	271.20	314.05	323.45
Bed 150mm thick	m2	53.05	52.20	51.65	49.90	53.15	54.55
Suspended floor&roof slab 100mm thick	m2	38.75	36.15	35.80	34.60	36.60	37.50
Wall 150mm thick	m2	64.00	59.65	59.15	57.35	59.20	60.60
Beam over 0.05m2 but n.e. 0.15m2 sectional area	m3	321.25	344.15	340.55	328.70	365.80	375.20
Column over 0.05m2 but n.e.0.15m2 sectional area	m3	321.25	344.15	340.55	328.70	365.80	375.20
PRE-MIXED CONCRETE 21 N/MM2							
Add. ($10.00 per m3) to the foregoing rates		(10 $/m3)	(10 $/m3)	(16 $/m3)	(10 $/m3)	(35 $/m3)	(35 $/m3)
REINFORCEMENT							
Mild steel bar n.e.Dia.12mm	kg	2.40	2.65	2.60	2.55	3.65	3.70
Ditto Dia.20mm	kg	3.25	3.60	3.65	3.65	5.00	5.15
Ditto Dia.25mm	kg	3.30	3.60	3.75	3.75	5.05	5.20
High tensile steel Dia.25mm	kg	2.60	2.95	3.45	3.45	5.45	5.45
Steel-wire mesh reinforcement 150*150 *3.2mm in foundations and beds	m2	6.05	5.40	5.20	5.20	6.15	6.20
Steel-wire mesh reinforcement 150*150 *5.38mm ditto	m2	13.25	11.95	11.30	11.30	13.20	13.40
FORMWORK (FOUR(4) USES ASSUMED)							
Rough formwork to horizontal soffit or suspended slab	m2	88.05	86.00	85.70	86.30	87.15	88.20
Ditto vertical sides of column	m2	90.85	91.60	91.25	91.90	91.15	92.15
DRESSED FORMWORK							
No addition required for dressed formwork							
BLOCKWORK							
=MARKET PRICES=							
CONCRETE BLOCKS (ROUGH TEXTURED) EX-FACTORY							
100*200*400mm	No.	1.40	1.35	1.40	1.35	1.45	1.40
150*200*400mm	No.	1.85	1.90	1.90	1.90	1.85	1.85
200*200*400mm	No.	2.60	2.50	2.40	2.40	2.40	2.35
California Split 100*100*400mm	No.	2.20	2.45	2.45	2.50	2.45	2.45
CLAY BLOCKS (SCORED)							
100*200*300mm	No.	1.60	1.50	1.50	1.50	1.25	1.25
150*200*400mm	No.	2.90	3.00	3.00	2.50	2.25	2.25
Sand for blockwork(Delivered to the site)	m3	51.00	45.55	41.65	32.85	28.45	32.70
Packaged dry mortar-mix-100 lb bag	No.	8.50	8.50	8.50	8.50	11.00	11.00
=MEASURED RATES=							
HOLLOW CONCRETE BLOCK IN PLASTICISED CEMENT MORTAR (1:4)							
Wall of 100*200*400mm blocks	m2	45.40	45.25	45.40	44.80	47.70	47.40
Wall of 150*200*400mm blocks	m2	62.50	59.90	59.55	58.90	61.10	61.15
Wall of 200*200*400mm blocks	m2	87.75	75.85	73.65	73.50	77.00	76.20
Wall of decorative blocks 100*100*400 mm (P.C.price($2.2)exfactory) built fair face one side	m2	141.45 ($2.20)	130.30 ($2.45)	129.45 ($2.45)	130.25 ($2.50)	120.80 ( )	121.05 ( )
HOLLOW CLAY BLOCKS IN PLASTICISED CEMENT MORTAR (1:4)							
Wall of 100*200*300mm blocks	m2	62.85	61.25	60.45	60.15	48.80	48.95
Wall of 150*200*400mm blocks	m2	76.70	78.65	76.00	69.20	66.15	66.35
ROOFING							
=MARKET PRICES=							
Galvanized iron corrugated sheet 26 gauge 0.60m wide (nominal)	m	9.95	10.40	10.60	10.60	17.90	20.45
Corrugated Alluminium sheet 25' wide	m	---	---	---	---	13.25	---
=MEASURED RATES=							
26 gauge corrugated iron roof sheeting with 1.5 corrugations side lap in continuous lengths fixed to timber purlins.	m2	41.70	38.45	38.95	38.95	49.20	55.10
Ditto fixed to metal framing	m2	51.75	47.65	48.15	48.15	59.00	64.95

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (3)

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
CARPENTRY AND JOINERY							
=MARKET PRICES=							
Pitch Pine 50*75mm	dm3	1.30	1.45	1.40	1.40	1.90	1.90
Pitch Pine 50*100mm	dm3	1.45	1.45	1.40	1.40	1.90	1.90
Pitch Pine 100*100mm	dm3	1.25	1.45	1.45	1.45	1.90	1.90
Pitch Pine 50*150mm	dm3	1.30	1.50	1.45	1.55	1.90	1.90
Pitch Pine 50*200mm	dm3	1.30	1.50	1.45	1.55	1.90	1.90
Ditto 25*100mm;25*150mm tongued and grooved boarding	dm3	1.45	1.45	1.40	1.40	1.85	1.85
Pitch pine 25*300mm straight edge boarding	dm3	---	1.60	1.60	1.60	2.10	2.10
Pitch pine 38*300mm straight edge boarding	dm3	1.60	---	---	---	---	---
White pine 25*300mm boarding	dm3	1.60	1.60	1.60	1.60	2.15	2.15
Canadian Ceder 25*200mm tongued and grooved boarding.	dm3	---	---	1.30	1.30	---	---
Canadian Ceder 25*200mm tongued, grooved, reeded and beaded.	dm3	---	---	1.60	1.60	2.20	2.20
Plywood 6*1200*2400mm sheet	No.	46.45	47.45	53.35	56.65	72.00	80.00
Formply 17*1200*2400mm sheet	No.	119.90	129.90	133.00	138.00	168.35	178.35
Hollow core flush door 750*2000*45mm	No.	65.00	65.00	65.00	68.65	94.00	87.00
=MEASURED RATES=							
PITCH PINE TREATED							
Rafter, purline or ceiling joist 50*100mm	m	17.35	14.45	14.25	14.25	17.15	17.15
Ditto 50*150mm	m	---	20.29	20.02	20.80	23.70	23.70
Ditto 50*200mm	m	31.10	27.20	26.85	27.90	30.10	30.10
Eaves and ceiling boarding of (17mm) softwood, tongued, grooved, reeded and beaded and fixed to rafters	m2	64.55 (17mm)	78.35 (25mm)	76.50 (25mm)	76.50 (25mm)	94.75 (25mm)	94.75 (25mm)
Skeleton framed timber flush door 750*2000*45mm faced both sides with 6mm thick internal quality plywood	No.	120.75	109.25	109.25	113.47	142.60	134.55
PLUMBING INSTALLATIONS							
=MARKET PRICES=							
SANITARY APPLIANCES							
Wash hand basin 560*405mm of white vitreous china	No.	211.65	238.35	295.00	295.00	423.15	423.15
Ditto coloured	No.	275.00	257.50	257.00	260.00	491.15	491.15
W.C. low down suite of white vitreous china	No.	577.00	661.65	760.00	647.50	895.00	895.00
Ditto coloured	No.	1,073.35	1,093.35	895.00	895.00	1,170.00	1,195.00
PIPEWORK							
Galvanized iron pipe Dia.12mm	m	3.60	3.50	4.00	4.00	7.50	7.50
Galvanized iron pipe Dia.50mm	m	16.95	19.90	17.65	17.65	30.75	32.40
PVC pipe Dia.12mm	m	0.90	1.85	1.85	2.00	3.50	3.50
PVC pipe Dia.50mm (Drainage, waste & vent quality)	m	6.30	6.40	6.40	7.80	11.95	11.95
PVC pipe Dia.110mm (Drainage, waste & vent quality)	m	14.35	15.00	15.00	15.00	34.65	28.95
CPVC Hotwater Pipe Dia.12mm	m	---	7.00	---	9.70	8.80	8.80
Ditto Dia.17mm	m	---	9.70	---	---	12.15	12.15
Ditto Dia.20mm	m	---	---	---	9.70	---	---
=MEASURED RATES=							
SANITARY APPLIANCES							
Wash hand basin 560*405mm of white vitreous china(Prime cost price ($211.65) ex-store)	No.	323.90 ($211.65)	354.60 ($238.33)	419.75 ($295.00)	419.75 ($295.00)	624.60 ($423.13)	624.60 ($423.13)
Ditto coloured(Prime cost price ($275) ex-store)	No.	396.75 ($275)	376.65 ($257.5)	376.65 ($257.00)	379.50 ($260.00)	702.80 ($491.13)	702.80 ($491.13)
W.C. low down suite of white vitreous china(Prime cost price ($577.0) ex-store)	No.	832.60 ($577)	958.70 ($661.67)	1,071.80 ($760.00)	942.43 ($647.50)	1,276.50 ($895.00)	1,276.50 ($895.00)
Ditto coloured(Prime cost price ($1,073.35) ex-store)	No.	1,403.40 (1073.35)	1,455.15 (1093.33)	1,227.05 ($895.00)	1,227.05 ($895.00)	1,592.75 ($1170.0)	1,621.50 ($1195.0)
PIPEWORK							
Galvanized mild steel pipe Dia.12mm with screwed and socketed joints fixed blockwork	m	16.45	12.15	12.75	12.75	17.50 (G.I.P.)	17.50 (G.I.P.)
Galvanized mild steel pipe Dia.50mm ditto	m	40.85	34.70	32.00	32.00	48.45 (G.I.P.)	50.40 (G.I.P.)

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (4)

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
PVC pipe Dia.15mm with solvent cement joints fixed to blockwork	m	7.95	---	---	---	---	---
PVC pipe Dia.12mm ditto	m	---	8.90	8.90	9.12	11.50	11.50
PVC pipe Dia.50mm ditto	m	19.70	16.90	16.90	18.60	24.15	24.15
PVC pipe Dia.100mm ditto	m	35.15	32.20	32.20	32.20	56.50	49.65
ELECTRICAL INSTALLATIONS							
=MARKET PRICES=							
Four jaws metal water proofed meter socket of 200 A rating four wire 115/230 V	No.	370.00	318.20	318.20	318.20	381.20	381.20
Main distribution panel of metal cabinet with locking cover of 20 way load centre*, three phase four wire, 115/230 V with bus bar rating of 200A as manufactured by T.Y.E., E.I.L., or other equal and approved including main and miniature circuit breakers	No.	1,624.00	1,760.15	1,760.15	1,760.15	2,232.00	2,232.00
Sub-distribution panel of metal cabinet with locking cover of 24 way load centre*, three phase, four wire, 115/230 V with bus bar rating of 100 A ditto	No.	1,574.10	1,653.45	1,653.45	1,653.45	2,048.50	2,048.50
PVC armoured main cable 3.5*185mm2	m	224.30	244.50	244.50	244.50	331.95	331.95
PVC armoured main cable 3.5*95mm2	m	120.00	---	---	---	---	---
PVC armoured subfeeder cable3.5*95mm2	m	---	132.65	132.65	132.65	239.10	239.10
Single core PVC sub-circuit cable 2.5mm2	m	0.70	0.75	0.75	0.75	1.25	1.25
Ditto 4mm2	m	1.00	1.10	1.10	1.10	1.90	1.90
EMT conduit Dia.12mm	m	3.00	3.55	3.55	3.55	4.30	4.30
Ditto Dia.17mm	m	4.25	5.10	5.10	5.10	6.05	6.05
* NOTE:Four the 20 way load centre 5 double pole and single pole circuit breakers were adopted for cost calculations. Similarly for the 24 way load centre 6 double and 12 single pole circuit breakers were used. Prices quoted in previous bulletins were in relation to a 300 A rating main panel.							
=MEASURED RATES=							
Four jaws metal water proofed meter socket of 200 A rating four wire 115/230 V and fix	No.	520.00	442.40	442.40	442.40	518.20	518.20

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
Main distribution panel of metal cabinet with locking cover of 20 way load centre, three phase four wire, 115/230 V with bus bar rating of 200A as manufactured by T.Y.E., E.I.L., or other equal and approved including main and miniature circuit breakers and assemble and install	No.	2,275.00	2,445.00	2,445.00	2,445.00	3,088.00	3,088.00
Sub-distribution panel of metal cabinet with locking cover of 24 way load centre, three phase, four wire, 115/230 V with bus bar rating of 100 A ditto	No.	2,205.00	2,279.15	2,279.15	2,279.15	2,830.60	2,830.60
PVC armoured main cable 3.5*185mm2 & fix w/ clips to concrete or blockwork	m	315.00	358.70	358.70	358.70	456.65	456.65
PVC armoured subfeeder cable 3.5*95 mm2 ditto	m	170.00	181.50	181.50	181.50	281.95	281.95
Single core PVC sub-circuit cable 2.5 mm2 and drawn into conduit	m	1.00	1.50	1.50	1.50	1.90	1.90
Ditto 4mm2 and drawn into conduit	m	1.40	2.20	2.20	2.20	3.00	3.00
EMT conduit Dia.12mm and fix in chase of blockwork or concrete	m	4.20	6.40	6.40	6.40	8.00	8.00
Ditto Dia.17mm	m	5.95	8.75	8.75	8.75	10.60	10.60
FLOOR, WALL AND CEILING FINISHINGS							
=MARKET PRICES=							
Sand for plastering(Delivered to the site)	m3	51.00	45.55	41.65	32.85	28.45	32.70
Blue limestone Metal(ex-quarry)7mm	m3	65.00	38.10	38.10	---	---	---
Ditto 20mm to 30mm	m3	68.00	38.10	38.10	56.90	56.95	61.05
Ditto 40mm	m3	60.00	35.60	35.60	50.36	53.65	57.80
Terrazzo Chips	m3	190.00	196.20	196.20	196.20	117.70	117.70
Black Cement	kg	4.50	5.05	4.85	5.55	7.70	7.70
White Cement	kg	3.90	4.00	3.50	4.25	5.30	5.35
Adhesive Tile Grout (100 lb bag)	No.	49.00 (100 lb)	49.00 (50 lb)	49.00 (50 lb)	49.00 (50 lb)	65.00 (50 lb)	65.00 (50 lb)
Tuck Pointing Tile Grout-50 lb bag	No.	75.00	75.00	75.00	75.00	95.00	95.00
Plastic dividing strip 17*4 mm	m	1.70	1.45	1.20	1.90	1.75	1.95

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (5)

DESCRIPTION	UNIT	COST (UNIT:TT $)						DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89			AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
Vinyl Floor Tile(imported)300*300*2mm	No.	3.10	3.10	3.10	3.10	3.45	4.20								
Terrazzo floor tiles with Italian Marble Chips 300*300*25mm thick(ex-factory)	No.	11.55	10.50	10.50	10.50	10.50	10.50	Wall tiling of white glazed ceramic tiles 150*150*15mm on backing(measured separately) and neatly pointed with maching cement	m2	150.00	121.85	129.20	129.35	140.40	140.60
Ditto with local chips (and ordinary Portland Cement) 200*200*20mm thick (ex-factory)	No.	1.65	1.40	1.40	1.40	1.95	1.95	Ditto but of coloured ceramic tiles	m2	160.00	134.10	137.40	137.50	153.20	153.35
Non-skid white ceramic floor tiles of local manufacture 150*150*15mm thick	No.	1.80	1.80	1.85	1.85	2.35	2.80	Rendering of plasticised cement and sand(1:5) 15mm thick on concrete or block walls	m2	20.00	17.80	17.70	17.50	18.35	18.40
Glazed white ceramic wall tiles 150*150*15mm thick	No.	1.60	1.60	1.75	1.75	2.05	2.05	Ditto on concrete soffit	m2	28.50	26.15	26.05	25.75	26.90	27.05
Ditto coloured	No.	1.85	1.85	1.90	1.90	2.30	2.30	**PAINTING AND DECORATING**							
=MEASURED RATES=								=MARKET PRICES=							
(RIGID TILES ARE BEDED IN CEMENT MORTAL (1:4))								Emulsion Paint(ex-factory)4 litre tin	No.	65.00	63.20	63.20	63.20	79.40	79.40
								Oil Paint(ex-factory)4 litre tin	No.	80.00	78.15	78.15	78.15	98.30	98.30
Floor paving of polished granolithic (2:5) 17mm thick on screeded bed (Measured separately)	m2	60.00	75.00	75.00	75.00	79.00	79.00	Zinc chromate primer for metalwork (ex-factory)4 litre tin	No.	88.00	89.70	89.70	89.70	107.10	107.10
Ditto but of polished terrazzo(2:5) with (imported) chips.	m2	70.00 (import)	90.00 (local)	90.00 (local)	90.00 (local)	98.00 (local)	98.00 (local)	Anti-corrasive paint Red Oxide(ex-factory)4 litre tin	No.	81.50	82.80	82.80	82.80	100.80	100.80
Floor paving of semivitreous non-skid white ceramic tiles 150*150*12.5mm of local manufacture neatly pointed with matching cement	m2	145.00	135.95	139.20	139.30	155.65	176.60	=MEASURED RATES=							
								(RATES ARE INCLUSIVE OF ALL SURFACE PREPARATIONS)							
Ditto but of terrazzo tiles 300*300 *25mm with imported marble chips and neatly pointed with matching cement	m2	200.00	192.10	192.35	192.15	191.80	192.65	One coat primer,one undercoat and one finishing coat emulsion paint on rendered walls internally or externally	m2	16.00	16.95	17.00	17.00	18.65	18.65
Ditto but of terrazzo tiles 200*200 *20mm with local chips	m2	95.00	99.35	99.50	99.35	115.15	115.95	One coat primer,one undercoat and one finishing coat emulsion paint on rendered soffit	m2	20.00	21.80	21.85	21.85	23.45	23.45
Ditto but of imported vinyl tiles 300 *300*5mm fixed w/an approved adhesive	m2	45.00	48.15	46.75	46.75	50.90	60.50	Zinc chromate primer,one undercoat & two finishing coats oil gloss paint on general surfaces of metal work	m2	28.75	30.35	30.35	30.35	34.00	34.00
Screeded bed of cement mortar(1:4) 17mm thick to receive floor finish	m2	20.00	19.60	19.50	19.25	18.95	18.80	Ditto not exceeding 75mm girth	m	2.30	2.45	2.45	2.45	2.75	2.75
Plastic dviding strip 17*4mm bedded in paving		3.20	2.30	2.05	2.90	4.05	4.25	Etching primer,one undercoat and two finishing coats oil paint on general surfaces of galvanized metal work	m2	30.25	32.05	32.55	32.55	37.40	37.40

Table N-2.1 LIST OF LABOUR RATES AND MARKET PRICES MATERIALS & MEASURED RATES IN TRINIDAD AND TOBAGO (6)

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
Ditto not exceeding 75mm girth	m	2.45	2.60	2.60	2.60	3.00	3.00
Knot, prime, stop and apply one under-							
coat and two finishing coats oil							
paint on general surfaces of woodwork	m2	22.60	25.20	25.20	25.20	29.30	29.30
Ditto not exceeding 75mm girth	m	1.85	2.10	2.10	2.10	2.35	2.35
PLANT HIRE							
D4 tractor	Hour	86.25	74.15	74.15	74.15	66.25	66.25
D6 tractor	Hour	100.00	108.75	101.00	101.00	108.25	118.75
D8 tractor	Hour	200.00	216.65	200.00	200.00	216.65	220.85
613 Cat Motor scraper	Hour	125.00	150.00	150.00	150.00	150.00	150.00
112F Motor Grader	Hour	100.00	---	---	---	---	---
120G Motor Grader	Hour	---	117.50	115.85	115.85	114.40	115.65
Dump Truck 6.0m3	Hour	45.00	45.00	45.00	45.00	49.15	49.15
Backhoe(pneumatic type)	Hour	65.00	55.00	55.00	55.00	59.15	58.35
Backhoe(track type)	Hour	70.00	95.00	103.35	103.35	102.50	102.50

DESCRIPTION	UNIT	COST (UNIT:TT $)					
		AUG.'86	JUN.'87	SEP.'87	NOV.'87	DEC.'88	APR.'89
LABOUR RATES							
Craftsman (excluded living allowance)	Hr	12.45	10.00	10.00	10.00	10.00	10.00
Labourer (excluded living allowance)	Hr	10.70	7.50	7.50	7.50	7.50	7.50

SOURCE : CONSTRUCTION BULLETIEN (CARIBBEAN INDUSTRIAL RESERCH INSTITUTE (CARIRI))

Table N-2.2 LIST OF CONSTRUCTION MACHINE RATES AND LABOUR COST

SOURCE: FUJIKO CARIBBEAN LTD.

ITEM	DESCRIPTION	UNIT	PRICE	ITEM	DESCRIPTION	UNIT	PRICE
=CONSTRUCTION MACHINE=				CONCRETE MIXER TRUCK		HOUR	100 - 80
				OIL JACK (PIPE DRIVING)		HOUR	---
BULLDOZER	CAT D8	HOUR	180 - 220	CONCRETE/ASPHALT CUTTER		HOUR	40 - 30
BULLDOZER	CAT D7	HOUR	160 - 200	DRAIN PUMP	2 INCH	HOUR	6 - 3
BULLDOZER	CAT D6	HOUR	110 - 140	DRAIN PUMP	3 INCH	HOUR	10 - 5
BULLDOZER	CAT D4	HOUR	70 - 90	DRAIN PUMP	4 INCH	HOUR	16 - 8
BACKHOE	TYRE	HOUR	55 - 65	PICK HUMMER		HOUR	10 - 5
TRACTOR SHOVEL	CAT 977	HOUR	130 - 150	SOIL BORING MACHINE		HOUR	40 - 30
POWER SHOVEL	CAT 966	HOUR	130 - 150				
POWER SHOVEL	CAT 950	HOUR	120 - 90	=LABOUR COST=			
POWER SHOVEL	CAT 930	HOUR	90 - 70				
POWER SHOVEL	CAT 920	HOUR	60 - 80	COMMON WORKER		DAY	70 - 50
TRUCK CRANE	170 TON	HOUR	200 - 250	SPECIAL WORKER		DAY	110 - 80
TRUCK CRANE	70 TON	HOUR	100 - 120	RAINFORCEMENT		DAY	110 - 80
VIBRO HUMMER		HOUR	---	FORM WORKER		DAY	110 - 80
DUMP TRUCK	10 CY	HOUR	55 - 45	CARPENTER		DAY	110 - 80
DUMP TRUCK	7 CY	HOUR	40 - 50	WELDER		DAY	110 - 80
TRAILER		HOUR	150 - 100	PAINTER		DAY	110 - 80
SCRAPER		HOUR	150 - 120	PLUMBER		DAY	110 - 80
ROAD ROLLER		HOUR	50 - 70	MASON		DAY	110 - 80
TAMPER		HOUR	10 - 5	CONSTRUCTION EQUIPMENT OPERATER		DAY	150 - 100
VIBRATOR		HOUR	10 - 5	SURVEROR		DAY	150 - 100
CONCRETE MIXER (MANUAL)		HOUR	10 - 5	ENGINEER		DAY	250 - 150

Table N-2.3 LIST OF CONSTRUCTION MATERIALS COST

SOURCE: FUJIKO CARIBBEAN LTD.

NAME OF MATERIAL	SIZE (MM)	FIXED CASH PRICE (TT $) MINIMUM 1 CY - 29 CY			5% OFF CASH PRICE (TT $) ADVANCE 30 CY - 99 CY			10% OFF CASH PRICE (TT $) ADVANCE 100 CY - 999 CY		
		BASIC	VAT	AMOUNT	BASIC	VAT	AMOUNT	BASIC	VAT	AMOUNT
STONE DUST FINE	3 - 0	70.00	10.50	80.50	66.50	9.98	76.48	63.00	9.45	72.45
STONE DUST	6 - 0	40.00	6.00	46.00	38.00	5.70	43.70	36.00	5.40	41.40
TERRAZO CHIPPING 1/4" (BLUE)	6 - 3	120.00	18.00	138.00	114.00	17.10	131.10	108.00	16.20	124.20
TERRAZO CHIPPING 3/8" (BLUE)	10 - 0	200.00	30.00	230.00	190.00	28.50	218.50	180.00	27.00	207.00
TERRAZO CHIPPING 3/8"	10 - 0	120.00	18.00	138.00	114.00	17.10	131.10	108.00	16.20	124.20
TERRAZO CHIPPING 1/2"	13 - 6	100.00	15.00	115.00	95.00	14.25	109.25	90.00	13.50	103.50
SINGLE SIZE 3/4"	20 - 13	50.00	7.50	57.50	47.50	7.13	54.63	45.00	6.75	51.75
SINGLE SIZE 1"	25 - 13	45.00	6.75	51.75	42.75	6.41	49.16	40.50	6.08	46.58
SINGLE SIZE 1 - 1/2"	40 - 13	45.00	6.75	51.75	42.75	6.41	49.16	40.50	6.08	46.58
SINGLE SIZE 3"	80 - 40	40.00	6.00	46.00	38.00	5.70	43.70	36.00	5.40	41.40
RED BLOCK CHIPS 3/4"	20 - 13	120.00	18.00	138.00	114.00	17.10	131.10	108.00	16.20	124.20
RED BLOCK CHIPS 3/8"	10 - 0	200.00	30.00	230.00	190.00	28.50	218.50	180.00	27.00	207.00
CRUSHER RUN 40 - 0	40 - 0	40.00	6.00	46.00	38.00	5.70	43.70	36.00	5.40	41.40
CRUSHER RUN 80 - 0	80 - 0	35.00	5.25	40.25	33.25	4.99	38.24	31.50	4.73	36.23
3" INCH OVER BOULDERS (BLUE)	250 - 80	60.00	9.00	69.00	57.00	8.55	65.55	54.00	8.10	62.10
3" INCH OVER BOULDERS	250 - 80	40.00	6.00	46.00	38.00	5.70	43.70	36.00	5.40	41.40
BOULDERS	250 - UP	35.00	5.25	40.25	33.25	4.99	38.24	31.50	4.73	36.23
SPECIAL BLUE BOULDERS	---	50.00	7.50	57.50	47.50	7.13	54.63	45.00	6.75	51.75
SPECIAL WHITE BOULDERS	---	200.00	30.00	230.00	190.00	28.50	218.50	180.00	27.00	207.00
FINE 80 - 0 by load	80 - 0	80.00	12.00	92.00	76.00	11.40	87.40	72.00	10.80	82.80
FINE FILL 80 - 0 by load	13 - 0	50.00	7.50	57.50	47.50	7.13	54.63	45.00	6.75	51.75
QUARRY RUN 80 - 0 by load	300 - 0	40.00	6.00	46.00	38.00	5.70	43.70	36.00	5.40	41.40

NOTE: 1. The above prices are valid from January 1, 1990 to March 31, 1990.
2. A 5% discount will be granted, if over 30 cy/Loads of material is purchased on a Cash basis.
3. A 10% discount will be granted, if over 100 cy/Loads of material is purchased on a Cash basis.
4. If over 1,000 cy/Loads of material is required prices are negotiable.
5. For any Credit granted there will be a 1.5% finance charge per month on all past due accounts.
6. 1 CY = 0.7645 M3

Table N-2.4 LIST OF RATES AND CHARGES

SIURCE: TRINIDAD AND TOBAGO INDUSTRIAL DEVELOPMENT CORPORATION

DESCRIPTION	UNIT	PRICE (TT$)
=WAGE RATES=		
(AS AT MAY, 1987)		
MECHANIC	HOUR	10.93 - 23.64
MACHINE OPERATOR	HOUR	5.72 - 20.69
ELECTRICIAN	HOUR	11.77 - 23.64
WELDER	HOUR	11.28 - 16.77
CARPENTER	HOUR	13.60 - 15.46
MASON	HOUR	13.60 - 15.46
LABOURER	HOUR	5.13 - 16.38
DRIVER	HOUR	7.75 - 17.90
WATCHMAN	HOUR	7.27 - 8.57
=CONSTRUCTION COST=		
(AS AT JUNE, 1987)		
CONCRETE BLOCKS		
100*200*400 MM	EACH	1.35
150*200*400 MM	EACH	1.80
200*200*400 MM	EACH	2.35
CLAY BLOCKS		
100*200*300 MM	EACH	1.40
150*200*300 MM	EACH	2.50
PIPEWORK		
PVC PIPE 12MM	M	2.05
PVC PIPE 50MM	M	8.25
PVC PIPE 110MM	M	20.20
ELECTRICL INSTALLATIONS		
PVC ARMOURED MAIN CABLE 3 1/2*185 MM2	M	267.25
PVC ARMOURED SUBFEEDER CABLE 3 1/2*95 MM2	M	151.35
SINGLE CORE PVC SUBCIRCUIT CABLE 2.5 MM2	M	1.00
SINGLE CORE PVC SUBCIRCUIT CABLE 4 MM2	M	1.50
EMT CONDUIT 12 MM	M	3.90
EMT CONDUIT 17 MM	M	5.50
REINFORCEMENT		
MILE STEEL BAR REINFORCEMENT 12 MM	KG	2.60
MILE STEEL BAR REINFORCEMENT 20 MM	KG	3.70
MILE STEEL BAR REINFORCEMENT 25 MM	KG	3.70
STEEL WIRE SQUARE MESH FABLIC 150*159*3.2 MM	M2	5.30
STEEL WIRE SQUARE MESH FABLIC 150*150*5.38 MM	M2	11.55

DESCRIPTION	UNIT	PRICE (TT$)
CONCRETE WORK		
ORDINARY PORTLAND CEMENT - 42 KG. BAG	BAG	14.66
GUANAPO GRAVEL	M3	45.15
SHARP SAND	M3	47.40
3/4" BOULDERS	M3	49.40
PRE-MIXED CONCRETE		
(1) WITHIN 8 KM RADIUS OF A CONCRETE PLANT		
21 N/MM2	M3	226.20
26 N/MM2	M3	248.50
BLUE LIME STONE METAL 20 MM TO 30 MM	M3	56.90
BLUE LIME STONE METAL 40 MM	M3	50.36
TERRAZZO CHIPS	M3	196.20
PLASTIC DIVIDING STRIP 17*4 MM	M3	1.90
(2) AN ADDITIONAL TT$ 1.24 PER KM IS PAYABLE FOR AREAS OUTSIDE THE RADIUS.		
PAINTING AND DECORATING		
EMULSION PAINT - 4 LITRE	TIN	63.20
OIL PAINT - 4 LITRE	TIN	78.15
ZINC CHROMATE PRIMER FOR METAL WORK - 4 LITRE	TIN	89.70
ANTI-CORROSIVE PAINT - RED OXIDE - 4 LITRE	TIN	82.80
=ELECTRICITY CHARGE=		
(AS AT JANUARY, 1988)		
DEMAND CHARGE	KW	10.00 - 15.00
ENERGY CHARGE	KWH	0.015 - 0.065
FUEL CHARGE		
For every TT one cent increase above TT 0.77 cents in the average gross price per 1,055,100 kilojoules of fuel in a month, the charge per KWH for the following month will be increased by TT 0.014 cents.		
Consumers of electricity are also required to pay a electricity tax of five percent (5%) on all billings. The tax is collected by the Electricity Commission on behalf of the Government.		