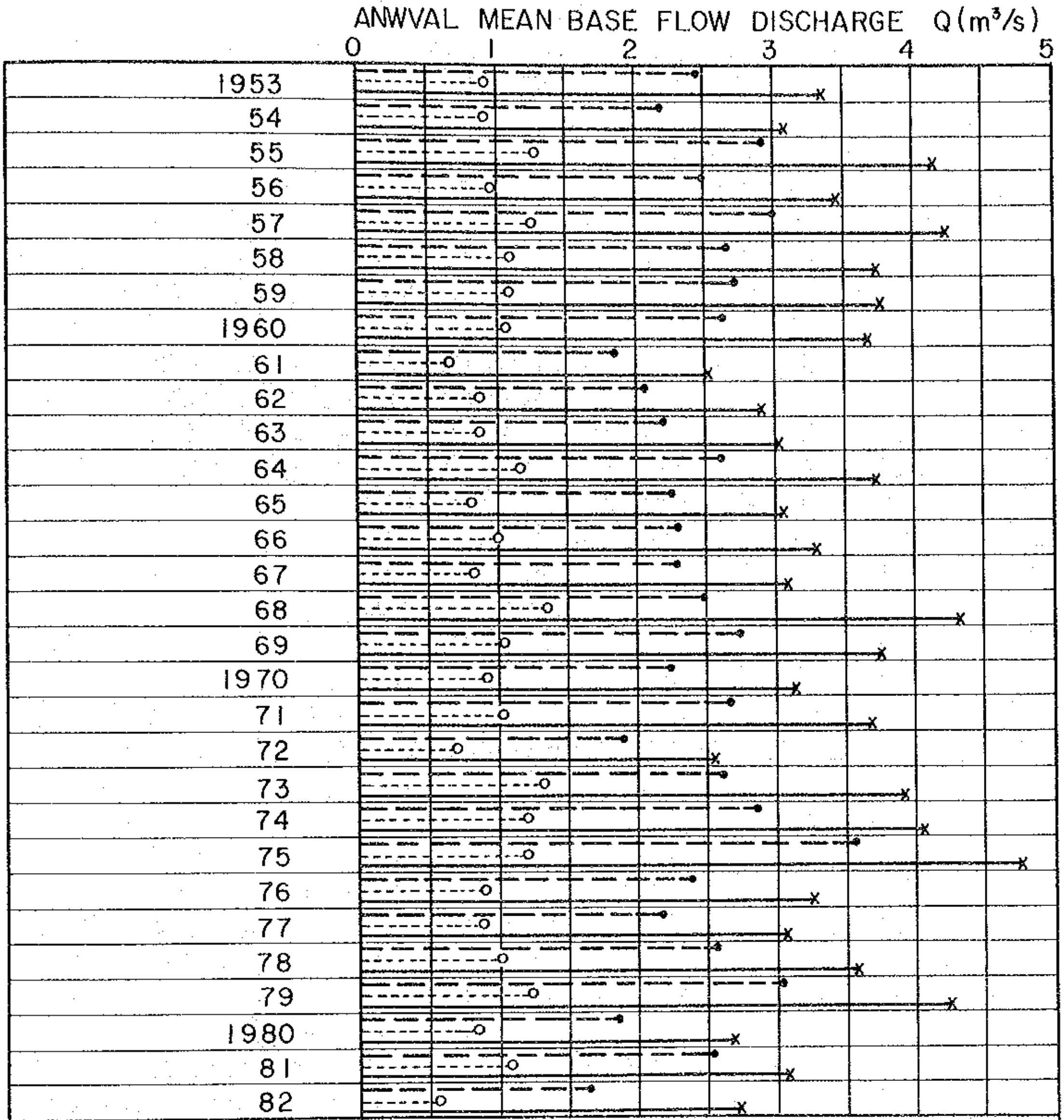
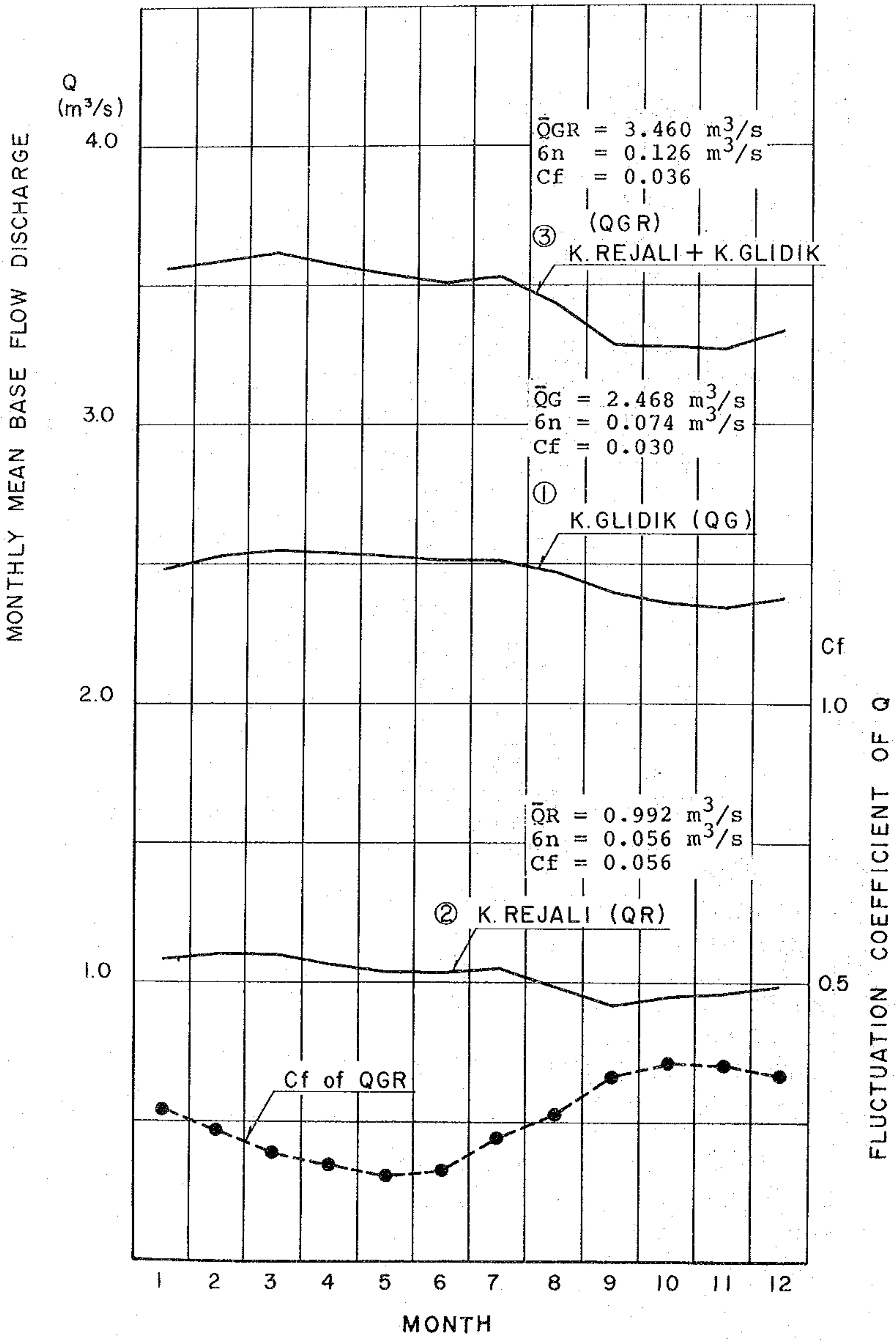
A P P E N D I X - 1

BASE FLOW DATA USED FOR

WATER CONSERVATION PLAN

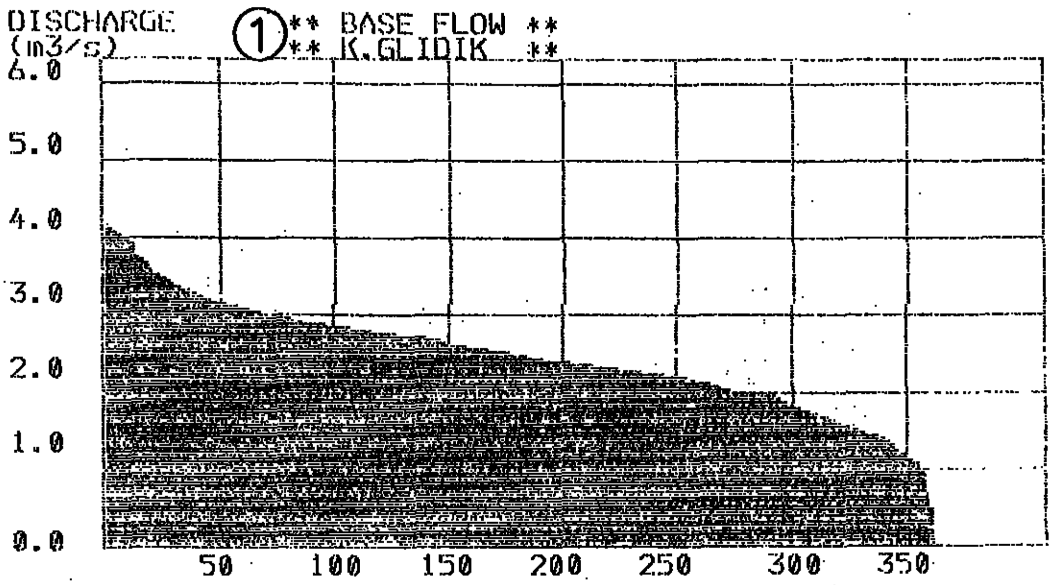


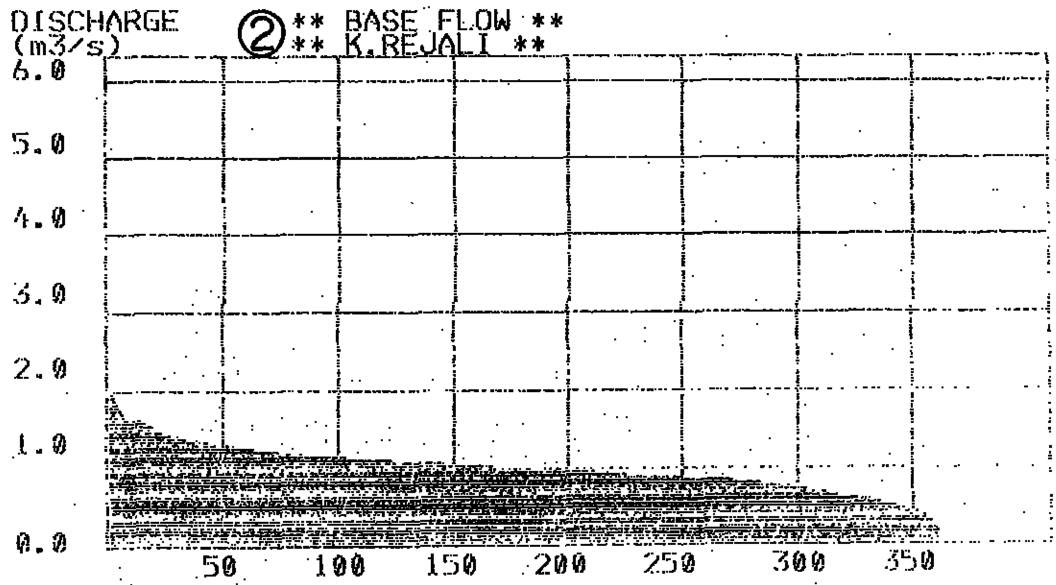
① K.GRIDIK PRONOJIWO DAM SITE	$\bar{Q}$	2.468 m³/s
	σ_n	0.411 m³/s
	Cf	0.167
② K.REJALI K.LERAK CHD NO.1 SITE	$\bar{Q}$	0.992 m³/s
	σ_n	0.195 m³/s
	Cf	0.196
① + ②	$\bar{Q}$	3.460 m³/s
	σ_n	0.564 m³/s
	Cf	0.163

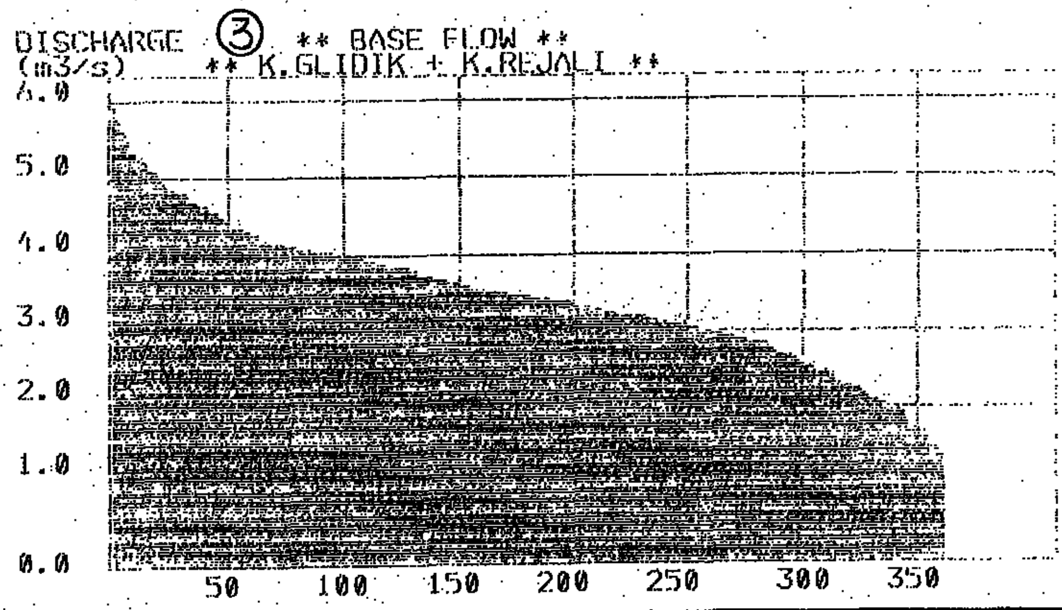


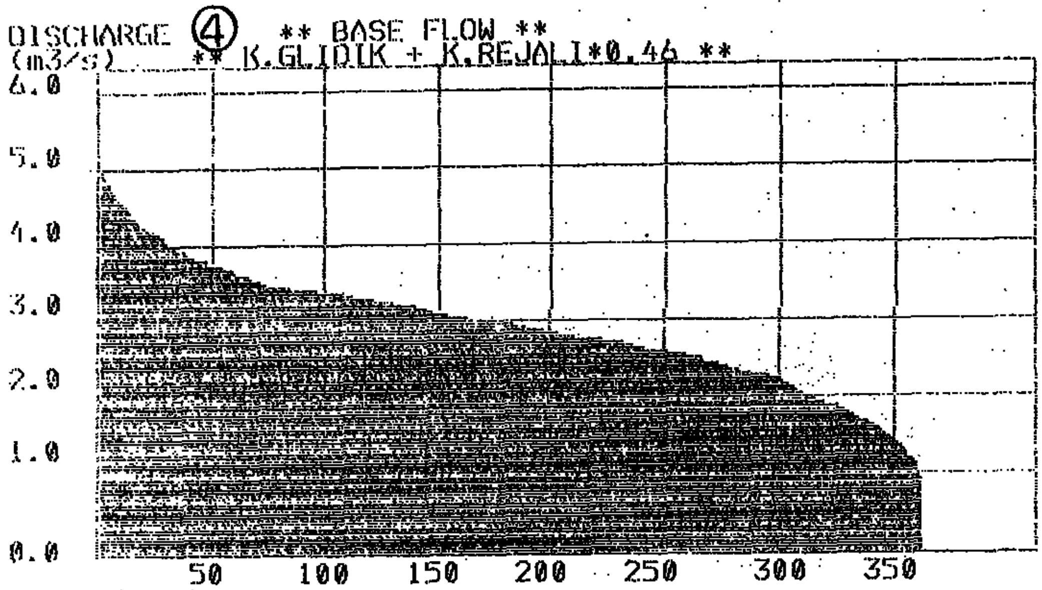
Q (m³/s)
MONTHLY MEAN BASE FLOW DISCHARGE
4.0
3.0
2.0
1.0
Q̄GR = 3.460 m3/s
6n = 0.126 m3/s
Cf = 0.036
③ (QGR) K. REJALI + K. GLIDIK
Q̄G = 2.468 m3/s
6n = 0.074 m3/s
Cf = 0.030
① K. GLIDIK (QG)
Cf
1.0
Q̄R = 0.992 m3/s
6n = 0.056 m3/s
Cf = 0.056
② K. REJALI (QR)
0.5
Cf of QGR
FLUCTUATION COEFFICIENT OF Q
1 2 3 4 5 6 7 8 9 10 11 12
MONTH

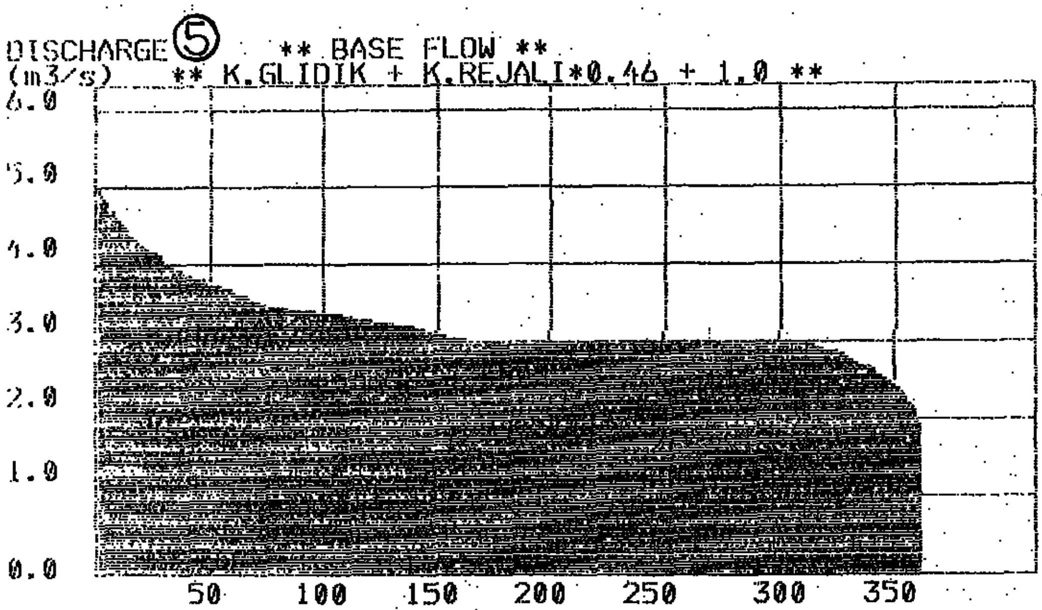
PAGE

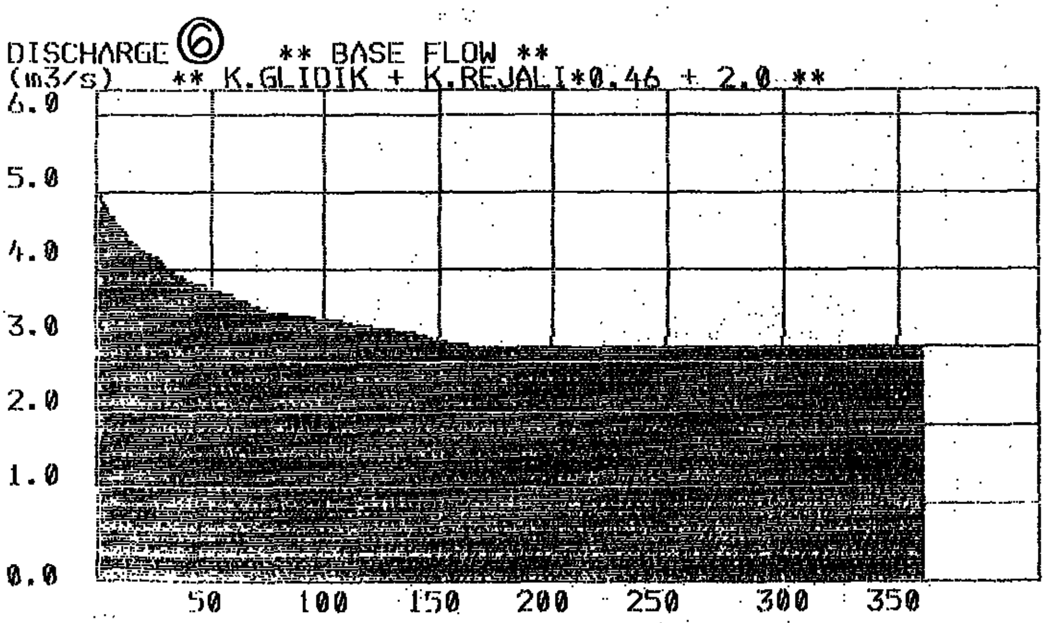

DISCHARGE
(m3/s)
① ** BASE FLOW **
** K.GLIDIK **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50
100
150
200
250
300
350


DISCHARGE
(m3/s)
② ** BASE FLOW **
** K.REJALI **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50
100
150
200
250
300
350


DISCHARGE
(m3/s)
③ ** BASE FLOW **
** K.GLIDIK + K.REJALI **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50
100
150
200
250
300
350


DISCHARGE ④ ** BASE FLOW **
(m3/s) ** K.GLIDIK + K.REJALI*0.46 **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50 100 150 200 250 300 350


DISCHARGE ⑤ ** BASE FLOW **
(m3/s) ** K.GLIDIK + K.REJALI*0.46 + 1.0 **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50 100 150 200 250 300 350


DISCHARGE ⑥ ** BASE FLOW **
(m3/s) ** K.GLIDIK + K.REJALI*0.46 + 2.0 **
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50 100 150 200 250 300 350

****
******* Table .   BASE FLOW DISCHARGE (K.GLIDIK,PLANNED PRONOJIWO DAM) ***************************** (1)
****

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	2.959	2.991	2.991	2.940	2.923	2.774	2.537	2.279	1.962	1.746	1.644	1.666	29.412	2.451
1954	1.818	1.972	2.006	2.104	2.131	2.249	2.331	2.415	2.353	2.224	2.176	2.291	26.070	2.173
1955	2.447	2.559	2.557	2.395	2.251	2.400	2.827	3.219	3.523	3.631	3.554	3.487	34.850	2.904
1956	3.317	3.177	2.955	2.668	2.385	2.145	2.130	2.202	2.207	2.222	2.207	2.319	29.934	2.495
1957	2.383	2.485	2.697	2.799	2.804	2.718	3.248	3.468	3.742	3.570	3.173	2.906	35.993	2.999
1958	2.705	2.592	2.581	2.527	2.372	2.433	2.500	2.773	2.841	2.883	2.785	2.748	31.740	2.645
1959	2.747	2.842	2.853	2.845	2.853	2.809	2.884	2.775	2.680	2.479	2.365	2.295	32.427	2.702
1960	2.375	2.436	2.635	2.670	2.668	2.841	2.846	2.898	2.761	2.589	2.406	2.246	31.371	2.614
1961	2.241	2.262	2.304	2.264	2.200	2.021	1.943	1.750	1.578	1.375	1.191	1.114	22.243	1.854
1962	1.174	1.347	1.551	1.748	1.892	2.048	2.351	2.522	2.575	2.549	2.374	2.357	24.488	2.041
1963	2.480	2.537	2.717	2.818	2.719	2.575	2.293	1.982	1.695	1.515	1.423	1.528	26.282	2.190
1964	1.672	1.859	2.118	2.337	2.723	2.878	2.928	2.808	2.753	2.900	3.053	3.115	31.144	2.595
1965	3.134	3.002	2.900	2.789	2.607	2.457	2.212	1.914	1.639	1.428	1.412	1.436	26.930	2.244
1966	1.594	1.785	2.041	2.244	2.476	2.549	2.493	2.390	2.219	2.332	2.549	2.816	27.488	2.291
1967	3.008	3.153	3.103	2.977	2.737	2.430	2.176	1.896	1.661	1.459	1.307	1.387	27.294	2.275
1968	1.517	1.716	1.952	2.181	2.545	2.786	3.421	3.751	4.104	4.117	3.916	3.689	35.695	2.975
1969	3.535	3.418	3.314	3.286	3.053	2.871	2.604	2.402	2.197	2.085	1.946	1.973	32.684	2.724
1970	1.033	2.051	2.061	2.070	2.163	2.298	2.406	2.390	2.333	2.209	2.257	2.360	26.604	2.217
1971	2.537	2.642	2.722	2.595	2.755	2.852	2.884	2.478	2.575	2.748	2.492	2.536	31.816	2.651
1972	2.528	2.454	2.453	2.334	2.314	2.199	2.005	1.709	1.381	1.063	0.958	0.952	22.350	1.863
1973	1.199	1.534	1.965	2.278	2.591	2.811	3.010	3.068	3.021	3.172	3.267	3.342	31.258	2.605
1974	3.333	3.244	3.059	2.864	2.619	2.313	2.007	2.136	2.255	2.969	3.454	3.931	34.184	2.849
1975	4.094	4.126	4.064	4.039	4.002	3.743	3.375	2.936	2.830	2.969	3.205	3.355	42.738	3.562
1976	3.333	3.218	3.098	2.954	2.705	2.397	1.994	1.633	1.335	1.464	1.983	2.355	28.469	2.372
1977	2.737	2.740	2.732	2.734	2.681	2.521	2.318	1.980	1.683	1.427	1.231	1.102	25.886	2.157
1978	1.069	1.009	1.258	1.467	1.818	2.296	2.826	3.274	3.686	3.979	4.044	3.945	30.751	2.563
1979	3.705	3.485	3.229	3.090	2.967	3.102	3.090	3.095	2.873	2.606	2.504	2.404	36.150	3.013
1980	2.369	2.297	2.134	2.010	1.901	1.743	1.582	1.547	1.439	1.580	1.708	1.851	22.161	1.847
1981	1.961	2.008	1.941	1.879	1.957	2.251	2.709	3.036	3.154	3.177	3.150	3.105	30.328	2.527
1982	2.950	2.746	2.543	2.326	2.062	1.784	1.484	1.204	0.929	0.685	0.498	0.485	19.696	1.641

Table . BASE FLOW DISCHARGE (K.REJALI) (2)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	1.251	1.158	1.176	1.119	1.141	0.974	0.801	0.766	0.596	0.547	0.595	0.715	10.839	0.903
1954	0.876	0.898	0.761	0.865	0.865	0.957	0.959	0.996	0.847	0.721	0.880	1.118	10.743	0.895
1955	1.126	1.040	0.980	0.817	0.756	1.178	1.657	1.615	1.554	1.576	1.425	1.335	15.059	1.255
1956	1.178	1.182	1.035	0.853	0.831	0.786	0.934	0.994	0.862	0.864	0.866	1.054	11.439	0.953
1957	0.999	1.014	1.293	1.235	1.066	0.979	1.966	1.741	1.497	1.229	0.961	1.045	15.025	1.252
1958	0.991	1.024	1.075	0.985	0.890	1.140	1.188	1.280	1.111	1.150	1.066	1.080	12.980	1.082
1959	1.155	1.267	1.167	1.116	1.227	1.166	1.221	1.006	0.961	0.858	0.881	0.935	12.960	1.080
1960	1.067	1.059	1.237	1.125	1.020	1.323	1.186	1.123	0.953	0.905	0.874	0.774	12.646	1.054
1961	0.967	0.986	0.940	0.848	0.621	0.651	0.643	0.511	0.427	0.341	0.297	0.388	7.820	0.652
1962	0.533	0.661	0.725	0.779	0.804	0.874	1.184	1.109	0.924	0.933	0.821	0.961	10.308	0.859
1963	1.172	1.079	1.214	1.256	1.000	0.845	0.657	0.506	0.404	0.490	0.566	0.735	9.924	0.827
1964	0.814	0.872	1.047	1.075	1.367	1.226	1.069	0.971	1.102	1.436	1.408	1.257	13.644	1.137
1965	1.285	1.158	1.118	1.047	0.890	0.834	0.690	0.547	0.454	0.412	0.580	0.600	9.615	0.801
1966	0.746	0.862	0.999	1.014	1.110	1.025	0.832	0.805	0.756	1.103	1.319	1.363	11.934	0.995
1967	1.353	1.398	1.217	1.015	0.858	0.699	0.667	0.577	0.516	0.460	0.400	0.662	9.822	0.819
1968	0.745	0.776	0.896	1.025	1.328	1.273	1.928	1.852	1.821	1.640	1.391	1.372	16.047	1.337
1969	1.376	1.395	1.336	1.398	1.152	1.030	0.907	0.812	0.709	0.748	0.707	0.850	12.420	1.035
1970	0.865	0.850	0.792	0.808	0.934	1.027	1.011	0.867	0.840	0.797	0.982	1.088	10.861	0.905
1971	1.192	1.197	1.136	0.940	1.078	1.151	0.974	0.827	0.883	0.988	1.025	0.962	12.353	1.029
1972	1.026	0.995	1.024	0.909	0.873	0.761	0.610	0.479	0.367	0.295	0.421	0.517	8.277	0.690
1973	0.829	0.936	1.087	1.143	1.302	1.397	1.550	1.365	1.657	1.636	1.481	1.333	15.716	1.310
1974	1.270	1.327	1.215	1.083	0.954	0.824	0.691	1.005	1.194	1.653	1.627	1.624	14.467	1.206
1975	1.637	1.493	1.456	1.377	1.255	1.080	0.886	0.908	0.994	1.110	1.076	1.078	14.350	1.196
1976	1.031	1.046	1.070	0.976	0.810	0.667	0.581	0.489	0.404	0.866	1.414	1.303	10.657	0.888
1977	1.374	1.291	1.300	1.301	1.099	0.920	0.803	0.639	0.559	0.492	0.440	0.598	10.816	0.901
1978	0.745	0.871	0.883	0.953	1.132	1.189	1.147	1.079	1.116	1.082	1.006	0.931	12.134	1.011
1979	0.970	1.154	1.081	1.078	1.112	1.706	1.527	1.556	1.319	1.071	1.164	1.123	14.861	1.238
1980	1.146	1.028	0.891	0.849	0.767	0.605	0.492	0.699	0.597	0.969	0.989	1.005	10.037	0.836
1981	0.850	0.883	0.941	0.873	0.728	0.599	0.469	0.378	0.289	0.221	0.161	0.196	6.588	0.549
1982	0.967	1.044	0.943	0.848	1.057	1.240	1.367	1.261	1.132	0.964	1.029	0.957	12.809	1.067

Table . BASE FLOW DISCHARGE (K.GLIDIK,PLANNED PRONOJIWO DAM + K.REJALI) ③

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	4.210	4.149	4.167	4.059	4.064	3.748	3.338	3.045	2.558	2.293	2.239	2.381	40.251	3.354
1954	2.694	2.870	2.767	2.969	2.996	3.206	3.290	3.411	3.200	2.945	3.056	3.409	36.813	3.068
1955	3.573	3.599	3.537	3.212	3.007	3.578	4.484	4.834	5.077	5.207	4.979	4.822	49.909	4.159
1956	4.495	4.359	3.990	3.521	3.216	2.931	3.064	3.196	3.069	3.086	3.073	3.373	41.373	3.448
1957	3.382	3.499	3.990	4.034	3.870	3.697	5.214	5.209	5.239	4.799	4.134	3.951	51.018	4.252
1958	3.696	3.616	3.656	3.512	3.262	3.573	3.688	4.053	3.952	4.033	3.851	3.828	44.720	3.727
1959	3.902	4.109	4.020	3.961	4.080	3.975	4.105	3.781	3.641	3.337	3.246	3.230	45.387	3.782
1960	3.442	3.495	3.872	3.795	3.688	4.164	4.032	4.021	3.714	3.494	3.280	3.020	44.017	3.668
1961	3.208	3.248	3.244	3.112	3.021	2.672	2.586	2.261	2.005	1.716	1.488	1.502	30.063	2.505
1962	1.707	2.008	2.276	2.527	2.696	2.922	3.535	3.631	3.499	3.482	3.195	3.318	34.796	2.900
1963	3.652	3.616	3.931	4.074	3.719	3.420	2.950	2.488	2.099	2.005	1.989	2.263	36.206	3.017
1964	2.486	2.731	3.165	3.412	4.090	4.104	3.997	3.779	3.855	4.336	4.461	4.372	44.788	3.732
1965	4.419	4.160	4.018	3.836	3.497	3.291	2.902	2.461	2.093	1.840	1.992	2.036	36.545	3.045
1966	2.340	2.647	3.040	3.258	3.586	3.574	3.325	3.195	2.975	3.435	3.868	4.179	39.422	3.285
1967	4.361	4.551	4.320	3.992	3.595	3.129	2.843	2.473	2.177	1.919	1.707	2.049	37.116	3.093
1968	2.262	2.492	2.848	3.206	3.873	4.059	5.349	5.603	5.925	5.757	5.307	5.061	51.742	4.312
1969	4.911	4.813	4.650	4.684	4.205	3.901	3.511	3.214	2.906	2.833	2.653	2.823	45.104	3.759
1970	2.863	2.901	2.853	2.886	3.097	3.325	3.417	3.257	3.173	3.006	3.239	3.448	37.465	3.122
1971	3.729	3.839	3.858	3.535	3.833	4.003	3.858	3.305	3.458	3.736	3.517	3.498	44.169	3.681
1972	3.554	3.449	3.477	3.243	3.187	2.960	2.615	2.188	1.748	1.358	1.379	1.469	30.627	2.552
1973	2.028	2.470	3.052	3.421	3.893	4.208	4.560	4.433	4.678	4.808	4.748	4.675	46.974	3.915
1974	4.603	4.571	4.274	3.947	3.573	3.137	2.698	3.141	3.449	4.622	5.081	5.555	48.651	4.054
1975	5.731	5.619	5.520	5.416	5.257	4.823	4.261	3.844	3.824	4.079	4.281	4.433	57.088	4.757
1976	4.364	4.264	4.168	3.930	3.515	3.064	2.575	2.122	1.739	2.330	3.397	3.658	39.126	3.261
1977	4.111	4.031	4.032	4.035	3.780	3.441	3.121	2.619	2.242	1.919	1.671	1.700	36.702	3.059
1978	1.814	1.960	2.141	2.420	2.950	3.485	3.973	4.353	4.802	5.061	5.050	4.876	42.885	3.574
1979	4.675	4.639	4.310	4.168	4.079	4.808	4.617	4.651	4.192	3.677	3.668	3.527	51.011	4.251
1980	3.515	3.325	3.025	2.859	2.668	2.348	2.074	2.246	2.036	2.549	2.697	2.856	32.198	2.683
1981	2.811	2.891	2.882	2.752	2.685	2.850	3.178	3.414	3.443	3.398	3.311	3.301	36.916	3.076
1982	3.917	3.790	3.486	3.174	3.119	3.024	2.851	2.465	2.061	1.649	1.527	1.442	32.505	2.709

Table . BASE FLOW DISCHARGE (K.GLIDIK,PLANNED PRONOJIWO DAM + K.REJALI*0.46) ④

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	3.534	3.524	3.532	3.455	3.448	3.222	2.905	2.631	2.236	1.998	1.918	1.995	34.398	2.867
1954	2.221	2.385	2.356	2.502	2.529	2.689	2.772	2.873	2.743	2.556	2.581	2.805	31.012	2.584
1955	2.965	3.037	3.008	2.771	2.599	2.942	3.589	3.962	4.238	4.356	4.210	4.101	41.777	3.481
1956	3.859	3.721	3.431	3.060	2.767	2.507	2.560	2.659	2.604	2.619	2.605	2.804	35.196	2.933
1957	2.843	2.951	3.292	3.367	3.294	3.168	4.152	4.269	4.431	4.135	3.615	3.387	42.905	3.575
1958	3.161	3.063	3.076	2.980	2.781	2.957	3.046	3.362	3.352	3.412	3.275	3.245	37.711	3.143
1959	3.278	3.425	3.390	3.358	3.417	3.345	3.446	3.238	3.122	2.874	2.770	2.725	38.389	3.199
1960	2.866	2.923	3.204	3.188	3.137	3.450	3.392	3.415	3.199	3.005	2.808	2.602	37.188	3.099
1961	2.686	2.716	2.736	2.654	2.578	2.320	2.239	1.985	1.774	1.532	1.328	1.292	25.840	2.153
1962	1.419	1.651	1.885	2.106	2.262	2.450	2.896	3.032	3.000	2.978	2.752	2.799	29.230	2.436
1963	3.019	3.033	3.275	3.396	3.179	2.964	2.595	2.215	1.881	1.740	1.683	1.866	30.847	2.571
1964	2.046	2.260	2.600	2.832	3.352	3.442	3.420	3.255	3.260	3.561	3.701	3.693	37.420	3.118
1965	3.725	3.535	3.414	3.271	3.016	2.841	2.529	2.166	1.848	1.618	1.679	1.712	31.353	2.613
1966	1.937	2.182	2.501	2.710	2.987	3.021	2.876	2.760	2.567	2.839	3.156	3.443	32.978	2.748
1967	3.630	3.796	3.663	3.444	3.132	2.752	2.483	2.161	1.898	1.671	1.491	1.692	31.812	2.651
1968	1.860	2.073	2.364	2.653	3.156	3.372	4.308	4.603	4.942	4.871	4.556	4.320	43.077	3.590
1969	4.168	4.060	3.929	3.929	3.583	3.345	3.021	2.776	2.523	2.429	2.271	2.364	38.397	3.200
1970	2.396	2.442	2.425	2.450	2.593	2.770	2.871	2.789	2.719	2.576	2.709	2.860	31.600	2.633
1971	3.085	3.193	3.245	3.027	3.251	3.381	3.332	2.858	2.981	3.202	2.964	2.979	37.498	3.125
1972	3.000	2.912	2.924	2.752	2.716	2.549	2.286	1.929	1.550	1.199	1.152	1.190	26.157	2.180
1973	1.580	1.965	2.465	2.804	3.190	3.454	3.723	3.696	3.783	3.925	3.948	3.955	38.487	3.207
1974	3.917	3.854	3.618	3.362	3.058	2.692	2.325	2.598	2.804	3.729	4.202	4.678	40.839	3.403
1975	4.847	4.813	4.734	4.672	4.579	4.240	3.783	3.354	3.287	3.480	3.700	3.851	49.339	4.112
1976	3.807	3.699	3.590	3.403	3.078	2.704	2.261	1.858	1.521	1.862	2.633	2.954	33.371	2.781
1977	3.369	3.334	3.330	3.332	3.187	2.944	2.687	2.274	1.940	1.653	1.433	1.377	30.861	2.572
1978	1.412	1.490	1.664	1.905	2.339	2.843	3.354	3.770	4.199	4.477	4.507	4.373	36.333	3.028
1979	4.151	4.016	3.726	3.586	3.479	3.887	3.792	3.811	3.480	3.099	3.039	2.921	42.986	3.582
1980	2.896	2.770	2.544	2.401	2.254	2.021	1.808	1.869	1.714	2.026	2.163	2.313	26.778	2.232
1981	2.352	2.414	2.374	2.281	2.292	2.527	2.925	3.210	3.287	3.279	3.224	3.195	33.359	2.780
1982	3.395	3.226	2.977	2.716	2.548	2.354	2.113	1.784	1.450	1.128	0.971	0.925	25.588	2.132

****** Table . BASE FLOW DISCHARGE (K.GLIDIK,PLANNED PRONOJIWO DAM + K.REJALI*0.46 + 1.0)****** ⑤

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	3.534	3.524	3.532	3.455	3.448	3.222	3.000	3.000	3.000	2.998	2.918	2.995	38.625	3.219
	0.000	0.000	0.000	0.000	0.000	0.000	0.095	0.369	0.764	1.000	1.000	1.000		
1954	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.779	0.615	0.644	0.498	0.471	0.311	0.228	0.127	0.257	0.444	0.419	0.195		
1955	3.000	3.037	3.008	3.000	3.000	3.000	3.589	3.962	4.238	4.356	4.210	4.101	42.501	3.542
	0.035	0.000	0.000	0.229	0.401	0.058	0.000	0.000	0.000	0.000	0.000	0.000		
1956	3.859	3.721	3.431	3.060	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	38.071	3.173
	0.000	0.000	0.000	0.000	0.233	0.493	0.440	0.341	0.396	0.381	0.395	0.196		
1957	3.000	3.000	3.292	3.367	3.294	3.168	4.152	4.269	4.431	4.135	3.615	3.387	43.111	3.593
	0.157	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1958	3.161	3.063	3.076	3.000	3.000	3.000	3.046	3.362	3.352	3.412	3.275	3.245	37.992	3.166
	0.000	0.000	0.000	0.020	0.219	0.043	0.000	0.000	0.000	0.000	0.000	0.000		
1959	3.278	3.425	3.390	3.358	3.417	3.345	3.446	3.238	3.122	3.000	3.000	3.000	39.020	3.252
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.126	0.230	0.275		
1960	3.000	3.000	3.204	3.188	3.137	3.450	3.392	3.415	3.199	3.005	3.000	3.000	37.989	3.166
	0.134	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.192	0.398		
1961	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.985	2.774	2.532	2.328	2.292	33.911	2.826
	0.314	0.284	0.264	0.346	0.422	0.680	0.761	1.000	1.000	1.000	1.000	1.000		
1962	2.419	2.651	2.885	3.000	3.000	3.000	3.000	3.032	3.000	3.000	3.000	3.000	34.987	2.916
	1.000	1.000	1.000	0.894	0.738	0.550	0.104	0.000	0.000	0.022	0.248	0.201		
1963	3.019	3.033	3.275	3.396	3.179	3.000	3.000	3.000	2.881	2.740	2.683	2.866	36.073	3.006
	0.000	0.000	0.000	0.000	0.000	0.036	0.405	0.785	1.000	1.000	1.000	1.000		
1964	3.000	3.000	3.000	3.000	3.352	3.442	3.420	3.255	3.260	3.561	3.701	3.693	39.683	3.307
	0.954	0.740	0.400	0.169	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1965	3.725	3.535	3.414	3.271	3.016	3.000	3.000	3.000	2.848	2.618	2.679	2.712	36.817	3.068
	0.000	0.000	0.000	0.000	0.000	0.159	0.471	0.834	1.000	1.000	1.000	1.000		
1966	2.937	3.000	3.000	3.000	3.000	3.021	3.000	3.000	3.000	3.000	3.156	3.443	36.556	3.046
	1.000	0.818	0.499	0.290	0.013	0.000	0.124	0.240	0.433	0.161	0.000	0.000		
1967	3.630	3.796	3.663	3.444	3.132	3.000	3.000	3.000	2.898	2.671	2.491	2.692	37.416	3.118
	0.000	0.000	0.000	0.000	0.000	0.248	0.517	0.839	1.000	1.000	1.000	1.000		
1968	2.860	3.000	3.000	3.000	3.156	3.372	4.308	4.603	4.942	4.871	4.556	4.320	45.987	3.832
	1.000	0.927	0.636	0.348	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1969	4.168	4.060	3.929	3.929	3.583	3.345	3.021	3.000	3.000	3.000	3.000	3.000	41.034	3.420
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.224	0.477	0.571	0.729	0.636		
1970	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.604	0.558	0.575	0.550	0.407	0.230	0.129	0.211	0.281	0.424	0.291	0.140		
1971	3.085	3.193	3.245	3.027	3.251	3.381	3.332	3.000	3.000	3.202	3.000	3.000	37.717	3.143
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.142	0.019	0.000	0.037	0.021		
1972	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.929	2.550	2.199	2.152	2.190	33.019	2.752
	0.000	0.088	0.076	0.248	0.284	0.451	0.714	1.000	1.000	1.000	1.000	1.000		
1973	2.580	2.965	3.000	3.000	3.190	3.454	3.723	3.696	3.783	3.925	3.948	3.955	41.219	3.435
	1.000	1.000	0.535	0.196	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1974	3.917	3.854	3.618	3.362	3.058	3.000	3.000	3.000	3.000	3.729	4.202	4.678	42.419	3.535
	0.000	0.000	0.000	0.000	0.000	0.308	0.675	0.402	0.196	0.000	0.000	0.000		
1975	4.847	4.813	4.734	4.672	4.579	4.240	3.783	3.354	3.287	3.480	3.700	3.351	49.339	4.112
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1976	3.807	3.699	3.590	3.403	3.078	3.000	3.000	2.858	2.521	2.862	3.000	3.000	37.818	3.152
	0.000	0.000	0.000	0.000	0.000	0.296	0.739	1.000	1.000	1.000	0.367	0.046		
1977	3.369	3.334	3.330	3.332	3.187	3.000	3.000	3.000	2.940	2.653	2.433	2.377	35.955	2.996
	0.000	0.000	0.000	0.000	0.000	0.056	0.313	0.726	1.000	1.000	1.000	1.000		
1978	2.412	2.490	2.664	2.905	3.000	3.000	3.354	3.770	4.199	4.477	4.507	4.373	41.151	3.429
	1.000	1.000	1.000	1.000	0.661	0.157	0.000	0.000	0.000	0.000	0.000	0.000		
1979	4.151	4.016	3.726	3.586	3.479	3.887	3.792	3.811	3.480	3.099	3.039	3.000	43.066	3.589
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.079		
1980	3.003	3.000	3.000	3.000	3.000	3.000	2.808	2.869	2.714	3.000	3.000	3.000	35.391	2.949
	0.104	0.230	0.456	0.599	0.746	0.979	1.000	1.000	1.000	0.974	0.837	0.687		
1981	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.210	3.287	3.279	3.224	3.195	37.195	3.100
	0.648	0.586	0.626	0.719	0.708	0.473	0.075	0.000	0.000	0.000	0.000	0.000		
1982	3.395	3.226	3.000	3.000	3.000	3.000	3.000	2.784	2.450	2.128	1.971	1.925	32.880	2.740
	0.000	0.000	0.023	0.284	0.452	0.646	0.987	1.000	1.000	1.000	1.000	1.000		

***** Table . BASE FLOW DISCHARGE (K.GLIDIK,PLANNED PRONOJIWO DAM + K.REJALI*0.46+ 2.0)****** ⑥

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	MEAN
1953	3.534	3.524	3.532	3.455	3.448	3.222	3.000	3.000	3.000	3.000	3.000	3.000	38.715	3.226
	0.000	0.000	0.000	0.000	0.000	0.000	0.095	0.369	0.764	2.000	2.000	2.000		
1954	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.779	0.615	0.644	0.498	0.471	0.311	0.228	0.127	0.257	0.444	0.419	0.195		
1955	3.000	3.037	3.008	3.000	3.000	3.000	3.589	3.962	4.238	4.356	4.210	4.101	42.501	3.542
	0.035	0.000	0.000	0.229	0.401	0.058	0.000	0.000	0.000	0.000	0.000	0.000		
1956	3.859	3.721	3.431	3.060	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	38.071	3.173
	0.000	0.000	0.000	0.000	0.233	0.493	0.440	0.341	0.396	0.381	0.395	0.196		
1957	3.000	3.000	3.292	3.367	3.294	3.168	4.152	4.269	4.431	4.135	3.615	3.387	43.111	3.593
	0.157	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1958	3.161	3.063	3.076	3.000	3.000	3.000	3.046	3.362	3.352	3.412	3.275	3.245	37.992	3.166
	0.000	0.000	0.000	0.020	0.219	0.043	0.000	0.000	0.000	0.000	0.000	0.000		
1959	3.278	3.425	3.390	3.358	3.417	3.345	3.446	3.238	3.122	3.000	3.000	3.000	39.020	3.252
	0.000	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.126	0.230	0.275		
1960	3.000	3.000	3.204	3.188	3.137	3.450	3.392	3.415	3.199	3.005	3.000	3.000	37.989	3.166
	0.134	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.192	0.398		
1961	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.314	0.284	0.264	0.346	0.422	0.680	0.761	2.000	2.000	2.000	2.000	2.000		
1962	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.032	3.000	3.000	3.000	3.000	36.032	3.003
	2.000	2.000	2.000	0.894	0.738	0.550	0.104	0.000	0.000	0.022	0.248	0.201		
1963	3.019	3.033	3.275	3.396	3.179	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.903	3.075
	0.000	0.000	0.000	0.000	0.000	0.036	0.405	0.785	2.000	2.000	2.000	2.000		
1964	3.000	3.000	3.000	3.000	3.352	3.442	3.420	3.255	3.260	3.561	3.701	3.693	39.663	3.307
	0.954	0.740	0.400	0.169	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1965	3.725	3.535	3.414	3.271	3.016	3.000	3.000	3.000	3.000	3.000	3.000	3.000	37.961	3.163
	0.000	0.000	0.000	0.000	0.000	0.159	0.471	0.834	2.000	2.000	2.000	2.000		
1966	3.000	3.000	3.000	3.000	3.000	3.021	3.000	3.000	3.000	3.000	3.156	3.443	36.619	3.052
	2.000	0.818	0.499	0.290	0.013	0.000	0.124	0.240	0.433	0.161	0.000	0.000		
1967	3.630	3.796	3.663	3.444	3.132	3.000	3.000	3.000	3.000	3.000	3.000	3.000	38.665	3.222
	0.000	0.000	0.000	0.000	0.000	0.248	0.517	0.839	2.000	2.000	2.000	2.000		
1968	3.000	3.000	3.000	3.000	3.156	3.372	4.308	4.603	4.942	4.871	4.556	4.320	46.127	3.844
	2.000	0.927	0.636	0.348	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1969	4.168	4.060	3.929	3.929	3.583	3.345	3.021	3.000	3.000	3.000	3.000	3.000	41.034	3.42
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.224	0.477	0.571	0.729	0.636		
1970	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.00
	0.604	0.558	0.575	0.550	0.407	0.230	0.129	0.211	0.281	0.424	0.291	0.140		
1971	3.085	3.193	3.245	3.027	3.251	3.381	3.332	3.000	3.000	3.202	3.000	3.000	37.717	3.14
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.142	0.019	0.000	0.037	0.021		
1972	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.000	0.088	0.076	0.248	0.284	0.451	0.714	2.000	2.000	2.000	2.000	2.000		
1973	3.000	3.000	3.000	3.000	3.190	3.454	3.723	3.696	3.783	3.925	3.948	3.955	41.674	3.473
	2.000	2.000	0.535	0.196	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1974	3.917	3.854	3.618	3.362	3.058	3.000	3.000	3.000	3.000	3.729	4.202	4.678	42.419	3.535
	0.000	0.000	0.000	0.000	0.000	0.308	0.675	0.402	0.196	0.000	0.000	0.000		
1975	4.847	4.813	4.734	4.672	4.579	4.240	3.783	3.354	3.287	3.480	3.700	3.851	49.339	4.112
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1976	3.807	3.699	3.590	3.403	3.078	3.000	3.000	3.000	3.000	3.000	3.000	3.000	38.577	3.215
	0.000	0.000	0.000	0.000	0.000	0.296	0.739	2.000	2.000	2.000	0.367	0.046		
1977	3.369	3.334	3.330	3.332	3.187	3.000	3.000	3.000	3.000	3.000	3.000	3.000	37.552	3.129
	0.000	0.000	0.000	0.000	0.000	0.056	0.313	0.726	2.000	2.000	2.000	2.000		
1978	3.000	3.000	3.000	3.000	3.000	3.000	3.354	3.770	4.199	4.477	4.507	4.373	42.680	3.557
	2.000	2.000	2.000	2.000	0.661	0.157	0.000	0.000	0.000	0.000	0.000	0.000		
1979	4.151	4.016	3.726	3.586	3.479	3.887	3.792	3.811	3.480	3.099	3.039	3.000	43.066	3.589
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.079		
1980	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	36.000	3.000
	0.104	0.230	0.456	0.599	0.746	0.979	2.000	2.000	2.000	0.974	0.837	0.687		
1981	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.210	3.287	3.279	3.224	3.195	37.195	3.100
	0.648	0.586	0.626	0.719	0.708	0.473	0.075	0.000	0.000	0.000	0.000	0.000		
1982	3.395	3.226	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.971	2.925	36.518	3.043
	0.000	0.000	0.023	0.284	0.452	0.646	0.887	2.000	2.000	2.000	2.000	2.000		

Table- Discharge - Duration (m^3/s)						
Duration	(1) K.Glidik	(2) K.Rejali	(3) (1) + (2)	(4) (1) + 0.46x(2)	(5) (4) + ($1m^3/s$)	(6) (4) + ($2m^3/s$)
1	4.126	1.966	5.925	4.942	4.942	4.942
2	4.117	1.928	5.757	4.871	4.871	4.871
3	4.104	1.852	5.731	4.847	4.847	4.847
4	4.094	1.821	5.619	4.813	4.813	4.813
5	4.064	1.741	5.603	4.734	4.734	4.734
6	4.044	1.706	5.555	4.678	4.678	4.678
7	4.039	1.657	5.520	4.672	4.672	4.672
8	4.002	1.657	5.416	4.603	4.603	4.603
9	3.979	1.653	5.349	4.579	4.579	4.579
10	3.945	1.640	5.307	4.556	4.556	4.556
11	3.931	1.637	5.257	4.507	4.507	4.507
12	3.916	1.636	5.239	4.477	4.477	4.477
13	3.751	1.627	5.214	4.431	4.431	4.431
14	3.743	1.624	5.209	4.373	4.373	4.373
15	3.742	1.615	5.207	4.356	4.356	4.356
16	3.705	1.576	5.081	4.320	4.320	4.320
17	3.689	1.556	5.077	4.308	4.308	4.308
18	3.686	1.554	5.061	4.269	4.269	4.269
19	3.631	1.550	5.061	4.240	4.240	4.240
20	3.570	1.527	5.050	4.238	4.238	4.238
21	3.554	1.497	4.979	4.210	4.210	4.210
22	3.535	1.493	4.911	4.202	4.202	4.202
23	3.523	1.481	4.876	4.199	4.199	4.199
24	3.487	1.456	4.834	4.168	4.168	4.168
25	3.485	1.436	4.823	4.152	4.152	4.152
26	3.468	1.425	4.822	4.151	4.151	4.151
27	3.454	1.414	4.813	4.135	4.135	4.135
28	3.421	1.408	4.808	4.101	4.101	4.101
29	3.418	1.398	4.808	4.060	4.060	4.060
30	3.375	1.398	4.802	4.016	4.016	4.016
31	3.355	1.397	4.799	3.962	3.962	3.962
32	3.342	1.395	4.748	3.955	3.955	3.955
33	3.333	1.391	4.684	3.948	3.948	3.948
34	3.333	1.377	4.678	3.929	3.929	3.929
35	3.317	1.376	4.675	3.929	3.929	3.929
36	3.314	1.374	4.675	3.925	3.925	3.925
37	3.286	1.372	4.651	3.917	3.917	3.917
38	3.274	1.367	4.650	3.887	3.887	3.887
39	3.267	1.367	4.639	3.859	3.859	3.859
40	3.248	1.365	4.622	3.854	3.854	3.854
41	3.244	1.363	4.617	3.851	3.851	3.851
42	3.229	1.353	4.603	3.811	3.811	3.811
43	3.219	1.336	4.571	3.807	3.807	3.807
44	3.218	1.335	4.560	3.796	3.796	3.796
45	3.205	1.333	4.551	3.792	3.792	3.792
46	3.177	1.328	4.495	3.783	3.783	3.783
47	3.177	1.327	4.484	3.783	3.783	3.783
48	3.173	1.323	4.461	3.770	3.770	3.770
49	3.172	1.319	4.433	3.729	3.729	3.729
50	3.154	1.319	4.433	3.726	3.726	3.726

Table- Discharge - Duration (l/s)

Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + (1m³/s)	⑥ ④ + (2m³/s)
51	3.153	1.303	4.419	3.725	3.725	3.725
52	3.150	1.302	4.372	3.723	3.723	3.723
53	3.134	1.301	4.364	3.721	3.721	3.721
54	3.115	1.300	4.361	3.701	3.701	3.701
55	3.105	1.293	4.359	3.700	3.700	3.700
56	3.103	1.291	4.353	3.699	3.699	3.699
57	3.102	1.285	4.336	3.696	3.696	3.696
58	3.098	1.280	4.320	3.693	3.693	3.693
59	3.095	1.273	4.310	3.663	3.663	3.663
60	3.090	1.270	4.281	3.630	3.630	3.630
61	3.090	1.267	4.274	3.618	3.618	3.618
62	3.068	1.261	4.264	3.615	3.615	3.615
63	3.059	1.257	4.261	3.590	3.590	3.590
64	3.053	1.256	4.210	3.589	3.589	3.589
65	3.053	1.255	4.208	3.586	3.586	3.586
66	3.036	1.251	4.205	3.583	3.583	3.583
67	3.021	1.240	4.192	3.561	3.561	3.561
68	3.010	1.237	4.179	3.535	3.535	3.535
69	3.008	1.235	4.168	3.534	3.534	3.534
70	3.002	1.229	4.168	3.532	3.532	3.532
71	2.991	1.227	4.167	3.524	3.524	3.524
72	2.991	1.226	4.164	3.480	3.480	3.480
73	2.977	1.221	4.160	3.480	3.480	3.480
74	2.969	1.217	4.149	3.479	3.479	3.479
75	2.969	1.215	4.134	3.455	3.455	3.455
76	2.967	1.214	4.111	3.454	3.454	3.454
77	2.959	1.197	4.109	3.450	3.450	3.450
78	2.955	1.194	4.105	3.448	3.448	3.448
79	2.954	1.192	4.104	3.446	3.446	3.446
80	2.950	1.189	4.090	3.444	3.444	3.444
81	2.940	1.188	4.080	3.443	3.443	3.443
82	2.936	1.186	4.079	3.442	3.442	3.442
83	2.928	1.184	4.079	3.431	3.431	3.431
84	2.923	1.182	4.074	3.425	3.425	3.425
85	2.906	1.178	4.064	3.420	3.420	3.420
86	2.900	1.178	4.059	3.417	3.417	3.417
87	2.900	1.176	4.059	3.415	3.415	3.415
88	2.898	1.172	4.053	3.414	3.414	3.414
89	2.884	1.167	4.035	3.412	3.412	3.412
90	2.884	1.166	4.034	3.403	3.403	3.403
91	2.883	1.164	4.033	3.396	3.396	3.396
92	2.878	1.158	4.032	3.395	3.395	3.395
93	2.873	1.158	4.032	3.392	3.392	3.392
94	2.871	1.155	4.031	3.390	3.390	3.390
95	2.864	1.154	4.021	3.387	3.387	3.387
96	2.853	1.152	4.020	3.381	3.381	3.381
97	2.853	1.151	4.018	3.372	3.372	3.372
98	2.852	1.150	4.003	3.369	3.369	3.369
99	2.846	1.147	3.997	3.367	3.367	3.367
100	2.845	1.146	3.992	3.362	3.362	3.362

Table- Discharge - Duration (m^3/s)						
Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + ($1m^3/s$)	⑥ ④ + ($2m^3/s$)
101	2.842	1.143	3.990	3.362	3.362	3.362
102	2.841	1.141	3.990	3.358	3.358	3.358
103	2.841	1.140	3.975	3.354	3.354	3.354
104	2.830	1.136	3.973	3.354	3.354	3.354
105	2.827	1.132	3.961	3.352	3.352	3.352
106	2.826	1.132	3.952	3.352	3.352	3.352
107	2.818	1.126	3.951	3.345	3.345	3.345
108	2.816	1.125	3.947	3.345	3.345	3.345
109	2.811	1.123	3.931	3.334	3.334	3.334
110	2.809	1.123	3.930	3.332	3.332	3.332
111	2.808	1.119	3.917	3.332	3.332	3.332
112	2.804	1.118	3.902	3.330	3.330	3.330
113	2.799	1.118	3.901	3.294	3.294	3.294
114	2.789	1.116	3.893	3.292	3.292	3.292
115	2.786	1.116	3.873	3.287	3.287	3.287
116	2.785	1.112	3.872	3.287	3.287	3.287
117	2.775	1.111	3.870	3.279	3.279	3.279
118	2.774	1.110	3.868	3.278	3.278	3.278
119	2.773	1.110	3.858	3.275	3.275	3.275
120	2.761	1.109	3.858	3.275	3.275	3.275
121	2.755	1.103	3.855	3.271	3.271	3.271
122	2.753	1.102	3.851	3.260	3.260	3.260
123	2.748	1.099	3.844	3.255	3.255	3.255
124	2.748	1.088	3.839	3.251	3.251	3.251
125	2.747	1.087	3.836	3.245	3.245	3.245
126	2.746	1.083	3.833	3.245	3.245	3.245
127	2.740	1.082	3.828	3.238	3.238	3.238
128	2.737	1.081	3.824	3.226	3.226	3.226
129	2.737	1.080	3.795	3.224	3.224	3.224
130	2.734	1.080	3.790	3.222	3.222	3.222
131	2.732	1.079	3.781	3.210	3.210	3.210
132	2.723	1.079	3.780	3.204	3.204	3.204
133	2.722	1.078	3.779	3.202	3.202	3.202
134	2.719	1.078	3.748	3.199	3.199	3.199
135	2.718	1.078	3.736	3.195	3.195	3.195
136	2.717	1.076	3.729	3.193	3.193	3.193
137	2.709	1.075	3.719	3.190	3.190	3.190
138	2.705	1.075	3.714	3.188	3.188	3.188
139	2.705	1.071	3.697	3.187	3.137	3.187
140	2.697	1.070	3.696	3.179	3.179	3.179
141	2.681	1.069	3.688	3.168	3.168	3.168
142	2.680	1.067	3.688	3.161	3.161	3.161
143	2.670	1.066	3.677	3.156	3.156	3.156
144	2.668	1.066	3.668	3.156	3.156	3.156
145	2.668	1.059	3.658	3.137	3.137	3.137
146	2.642	1.057	3.656	3.132	3.132	3.132
147	2.635	1.054	3.652	3.122	3.122	3.122
148	2.619	1.047	3.641	3.099	3.099	3.099
149	2.607	1.047	3.631	3.085	3.085	3.085
150	2.606	1.046	3.616	3.078	3.078	3.078

Table- Discharge - Duration (4/8)

Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + ($1m^3/s$)	⑥ ④ + ($2m^3/s$)
151	2.604	1.045	3.616	3.076	3.076	3.076
152	2.595	1.044	3.599	3.063	3.063	3.063
153	2.592	1.040	3.595	3.060	3.060	3.060
154	2.591	1.035	3.586	3.058	3.058	3.058
155	2.589	1.031	3.578	3.046	3.046	3.046
156	2.581	1.030	3.574	3.039	3.039	3.039
157	2.575	1.029	3.573	3.037	3.037	3.037
158	2.575	1.028	3.573	3.033	3.033	3.033
159	2.575	1.027	3.573	3.032	3.032	3.032
160	2.559	1.026	3.554	3.027	3.027	3.027
161	2.557	1.025	3.537	3.021	3.021	3.021
162	2.549	1.025	3.535	3.021	3.021	3.021
163	2.549	1.025	3.535	3.019	3.019	3.019
164	2.549	1.024	3.527	3.016	3.016	3.016
165	2.545	1.024	3.521	3.008	3.008	3.008
166	2.543	1.020	3.517	3.005	3.005	3.005
167	2.537	1.015	3.515	3.000	3.000	3.000
168	2.537	1.014	3.515	3.000	3.000	3.000
169	2.537	1.014	3.512	2.987	3.000	3.000
170	2.536	1.011	3.511	2.981	3.000	3.000
171	2.528	1.006	3.499	2.980	3.000	3.000
172	2.527	1.006	3.499	2.979	3.000	3.000
173	2.522	1.005	3.498	2.978	3.000	3.000
174	2.521	1.005	3.497	2.977	3.000	3.000
175	2.504	1.000	3.495	2.965	3.000	3.000
176	2.500	0.999	3.494	2.964	3.000	3.000
177	2.493	0.999	3.486	2.964	3.000	3.000
178	2.492	0.996	3.485	2.957	3.000	3.000
179	2.485	0.995	3.482	2.954	3.000	3.000
180	2.480	0.994	3.477	2.951	3.000	3.000
181	2.479	0.994	3.458	2.944	3.000	3.000
182	2.478	0.991	3.449	2.942	3.000	3.000
183	2.476	0.989	3.449	2.925	3.000	3.000
184	2.457	0.988	3.448	2.924	3.000	3.000
185	2.454	0.986	3.443	2.923	3.000	3.000
186	2.453	0.985	3.442	2.921	3.000	3.000
187	2.447	0.982	3.441	2.912	3.000	3.000
188	2.436	0.980	3.435	2.905	3.000	3.000
189	2.433	0.979	3.421	2.896	3.000	3.000
190	2.430	0.976	3.420	2.896	3.000	3.000
191	2.415	0.974	3.417	2.876	3.000	3.000
192	2.406	0.974	3.414	2.874	3.000	3.000
193	2.406	0.971	3.412	2.873	3.000	3.000
194	2.404	0.970	3.411	2.871	3.000	3.000
195	2.402	0.969	3.409	2.866	3.000	3.000
196	2.400	0.967	3.398	2.860	3.000	3.000
197	2.397	0.967	3.397	2.858	3.000	3.000
198	2.395	0.964	3.382	2.843	3.000	3.000
199	2.390	0.962	3.373	2.843	3.000	3.000
200	2.390	0.961	3.338	2.841	3.000	3.000

Table- Discharge - Duration (5/8)

Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + ($1m^3/s$)	⑥ ④ + ($2m^3/s$)
201	2.385	0.961	3.337	2.839	3.000	3.000
202	2.383	0.961	3.325	2.832	3.000	3.000
203	2.375	0.959	3.325	2.808	3.000	3.000
204	2.374	0.957	3.325	2.805	3.000	3.000
205	2.372	0.957	3.318	2.804	3.000	3.000
206	2.369	0.954	3.311	2.804	3.000	3.000
207	2.365	0.953	3.305	2.804	3.000	3.000
208	2.360	0.953	3.301	2.799	3.000	3.000
209	2.357	0.943	3.291	2.789	3.000	3.000
210	2.355	0.941	3.290	2.781	3.000	3.000
211	2.353	0.940	3.280	2.776	3.000	3.000
212	2.351	0.940	3.262	2.772	3.000	3.000
213	2.337	0.936	3.258	2.771	3.000	3.000
214	2.334	0.935	3.257	2.770	3.000	3.000
215	2.333	0.934	3.248	2.770	3.000	3.000
216	2.332	0.934	3.246	2.770	3.000	3.000
217	2.331	0.933	3.244	2.767	3.000	3.000
218	2.326	0.931	3.243	2.760	3.000	3.000
219	2.319	0.924	3.239	2.752	3.000	3.000
220	2.318	0.920	3.230	2.752	3.000	3.000
221	2.314	0.909	3.216	2.752	3.000	3.000
222	2.313	0.908	3.214	2.743	3.000	3.000
223	2.304	0.907	3.212	2.736	3.000	3.000
224	2.298	0.905	3.208	2.725	3.000	3.000
225	2.297	0.898	3.206	2.719	3.000	3.000
226	2.296	0.896	3.206	2.716	3.000	3.000
227	2.295	0.891	3.200	2.716	3.000	3.000
228	2.293	0.890	3.196	2.716	3.000	3.000
229	2.291	0.890	3.195	2.710	3.000	3.000
230	2.279	0.886	3.195	2.709	3.000	3.000
231	2.278	0.883	3.187	2.704	3.000	3.000
232	2.264	0.883	3.178	2.692	3.000	3.000
233	2.262	0.883	3.174	2.689	3.000	3.000
234	2.257	0.881	3.173	2.687	3.000	3.000
235	2.255	0.880	3.165	2.686	3.000	3.000
236	2.251	0.876	3.141	2.659	3.000	3.000
237	2.251	0.874	3.137	2.654	3.000	3.000
238	2.249	0.874	3.129	2.653	3.000	3.000
239	2.246	0.873	3.121	2.633	3.000	3.000
240	2.244	0.873	3.119	2.631	3.000	3.000
241	2.241	0.872	3.112	2.619	3.000	3.000
242	2.224	0.871	3.097	2.605	3.000	3.000
243	2.222	0.867	3.086	2.604	3.000	3.000
244	2.219	0.866	3.073	2.602	3.000	3.000
245	2.212	0.866	3.069	2.600	3.000	3.000
246	2.209	0.865	3.064	2.599	3.000	3.000
247	2.207	0.865	3.064	2.598	3.000	3.000
248	2.207	0.865	3.056	2.595	3.000	3.000
249	2.202	0.864	3.052	2.593	3.000	3.000
250	2.200	0.862	3.045	2.581	3.000	3.000

Table- Discharge - Duration (6/8)

Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + (1m³/s)	⑥ ④ + (2m³/s)
251	2.199	0.862	3.040	2.578	3.000	3.000
252	2.197	0.858	3.025	2.576	3.000	3.000
253	2.181	0.858	3.024	2.567	3.000	3.000
254	2.176	0.853	3.021	2.560	3.000	3.000
255	2.176	0.850	3.020	2.556	3.000	3.000
256	2.163	0.850	3.007	2.549	3.000	3.000
257	2.145	0.850	3.006	2.548	3.000	3.000
258	2.136	0.849	2.996	2.544	3.000	3.000
259	2.134	0.848	2.975	2.529	3.000	3.000
260	2.131	0.848	2.969	2.529	3.000	3.000
261	2.130	0.847	2.960	2.527	3.000	3.000
262	2.118	0.845	2.950	2.523	3.000	3.000
263	2.104	0.840	2.950	2.507	3.000	3.000
264	2.085	0.834	2.945	2.502	3.000	3.000
265	2.078	0.832	2.931	2.501	3.000	3.000
266	2.062	0.831	2.922	2.483	3.000	3.000
267	2.061	0.829	2.906	2.465	3.000	3.000
268	2.051	0.827	2.902	2.450	3.000	3.000
269	2.048	0.824	2.901	2.450	3.000	3.000
270	2.041	0.821	2.891	2.442	3.000	3.000
271	2.021	0.821	2.886	2.429	3.000	3.000
272	2.010	0.817	2.882	2.425	3.000	3.000
273	2.008	0.814	2.870	2.414	3.000	3.000
274	2.007	0.812	2.863	2.401	3.000	3.000
275	2.006	0.810	2.859	2.396	3.000	3.000
276	2.005	0.808	2.856	2.385	3.000	3.000
277	1.998	0.805	2.853	2.374	3.000	3.000
278	1.994	0.804	2.851	2.364	3.000	3.000
279	1.983	0.803	2.850	2.364	3.000	3.000
280	1.982	0.801	2.848	2.356	3.000	3.000
281	1.980	0.797	2.843	2.354	3.000	3.000
282	1.973	0.792	2.833	2.352	3.000	3.000
283	1.972	0.786	2.823	2.339	3.000	3.000
284	1.965	0.779	2.811	2.325	3.000	3.000
285	1.962	0.776	2.767	2.320	3.000	3.000
286	1.961	0.774	2.752	2.313	3.000	3.000
287	1.957	0.767	2.731	2.292	3.000	3.000
288	1.952	0.766	2.698	2.286	3.000	3.000
289	1.946	0.761	2.697	2.281	3.000	3.000
290	1.943	0.761	2.696	2.274	3.000	3.000
291	1.941	0.756	2.694	2.271	3.000	3.000
292	1.914	0.756	2.685	2.262	3.000	3.000
293	1.901	0.748	2.672	2.261	3.000	3.000
294	1.896	0.746	2.668	2.260	3.000	3.000
295	1.892	0.745	2.653	2.254	3.000	3.000
296	1.879	0.745	2.647	2.239	3.000	3.000
297	1.859	0.735	2.619	2.236	3.000	3.000
298	1.851	0.728	2.615	2.221	3.000	3.000
299	1.818	0.725	2.586	2.215	3.000	3.000
300	1.818	0.721	2.575	2.182	3.000	3.000

Table- Discharge - Duration (9/8)						
Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + ($1m^3/s$)	⑥ ④ + ($2m^3/s$)
301	1.785	0.715	2.558	2.166	3.000	3.000
302	1.784	0.709	2.549	2.163	3.000	3.000
303	1.750	0.707	2.527	2.161	3.000	3.000
304	1.748	0.699	2.492	2.113	3.000	3.000
305	1.746	0.699	2.488	2.106	3.000	3.000
306	1.743	0.691	2.486	2.073	3.000	3.000
307	1.716	0.690	2.473	2.046	3.000	3.000
308	1.709	0.667	2.470	2.026	3.000	3.000
309	1.708	0.667	2.465	2.021	3.000	3.000
310	1.695	0.662	2.461	1.998	2.998	3.000
311	1.683	0.661	2.420	1.995	2.995	3.000
312	1.672	0.657	2.381	1.985	2.985	3.000
313	1.666	0.651	2.348	1.965	2.965	3.000
314	1.661	0.643	2.340	1.940	2.940	3.000
315	1.644	0.639	2.330	1.937	2.937	3.000
316	1.639	0.610	2.293	1.929	2.929	3.000
317	1.633	0.605	2.276	1.918	2.918	3.000
318	1.594	0.600	2.263	1.905	2.905	3.000
319	1.582	0.599	2.262	1.898	2.898	3.000
320	1.580	0.598	2.261	1.885	2.885	3.000
321	1.578	0.597	2.246	1.881	2.881	3.000
322	1.551	0.596	2.242	1.869	2.869	3.000
323	1.547	0.595	2.239	1.866	2.866	3.000
324	1.534	0.581	2.188	1.862	2.862	3.000
325	1.528	0.580	2.177	1.860	2.860	3.000
326	1.517	0.577	2.141	1.858	2.858	3.000
327	1.515	0.566	2.122	1.848	2.848	3.000
328	1.484	0.559	2.099	1.808	2.808	3.000
329	1.467	0.547	2.093	1.784	2.784	3.000
330	1.464	0.547	2.074	1.774	2.774	3.000
331	1.459	0.533	2.061	1.740	2.740	3.000
332	1.439	0.517	2.049	1.714	2.714	3.000
333	1.436	0.516	2.036	1.712	2.712	3.000
334	1.428	0.511	2.036	1.692	2.692	3.000
335	1.427	0.506	2.028	1.683	2.683	3.000
336	1.423	0.492	2.006	1.679	2.679	3.000
337	1.412	0.492	2.005	1.671	2.671	3.000
338	1.387	0.490	2.005	1.664	2.664	3.000
339	1.381	0.489	1.992	1.653	2.653	3.000
340	1.375	0.479	1.989	1.551	2.551	3.000
341	1.347	0.469	1.960	1.618	2.618	3.000
342	1.335	0.460	1.919	1.580	2.580	3.000
343	1.307	0.454	1.919	1.550	2.550	3.000
344	1.258	0.440	1.840	1.532	2.532	3.000
345	1.231	0.427	1.814	1.521	2.521	3.000
346	1.204	0.421	1.748	1.491	2.491	3.000
347	1.199	0.412	1.739	1.490	2.490	3.000
348	1.191	0.404	1.716	1.450	2.450	3.000
349	1.174	0.404	1.707	1.433	2.433	3.000
350	1.114	0.400	1.707	1.419	2.419	3.000

Table- Discharge - Duration (8/8)

Duration	① K.Glidik	② K.Rejali	③ ① + ②	④ ① + 0.46x②	⑤ ④ + ($1m^3/s$)	⑥ ④ + ($2m^3/s$)
351	1.102	0.388	1.700	1.412	2.412	3.000
352	1.089	0.378	1.671	1.377	2.377	3.000
353	1.069	0.367	1.649	1.328	2.328	3.000
354	1.063	0.341	1.527	1.292	2.292	3.000
355	0.958	0.297	1.502	1.199	2.199	3.000
356	0.952	0.295	1.488	1.190	2.190	3.000
357	0.929	0.289	1.469	1.152	2.152	3.000
358	0.685	0.221	1.442	1.128	2.128	3.000
359	0.498	0.196	1.379	0.971	1.971	2.971
360	0.485	0.161	1.358	0.925	1.925	2.925
$\bar{Q}$ (m^3/s)	2.468	0.992	3.460	2.924	3.219	3.270
S.D.	0.681	0.309	0.913	0.781	0.489	0.430
Cf	0.276	0.312	0.264	0.267	0.152	0.132

A P P E N D I X - 2

PRELIMINARY STUDY ON

K.LEPRAK HYDRO-ELECTRIC POWER STATION

CONTENTS

Establishment of a small-scale hydro-power plant has been planned as an energy dissipator of irrigation water, attendant on the sabo/irrigation water plan at piedmonts of Mt. Semeru. This report was prepared in order to offer fundamental material to benefit calculation of construction of small-scale hydro-power plant.

1. PRECONDITIONS

1.1 POWER SYSTEM IN THE WESTERN PART OF JAVA ISLAND

The central city in the western part of Java Island is Surabaya. A greater portion of the power demand in the said area is concentrated on this city.

Power plants in the western Java district as of 1976 are as follows:

Hydro Power	147.84	
Steam Power	50.0	
Gas Turbine	27.5	97.68
Diesel	20.18	
Total	248.52 MW	

As shown above, hydro power and steam power account for 60% and 40% respectively of the total power output. Later, Gresik Gas No. 1 and No. 2 (60 MW x 2) as well as No. 2 and No. 4 were put in operation, which suggests that a greater importance has been placed on thermal power. These thermal plants are concentrated in Surabaya, the biggest consumer of power in the district, where 70 KV power-transmission lines are connected between the city and the plants. Figure-1 shows a power transmission system in the western part of Java. It shows that the

Leprak-hydro power plant covered by this investigation is located near the substation in Lumajang (30/6 KV, 3 MVA x 1) which receives power from the Probounggs Substation through 30 KV transmission wire (ACSR i/o...i,o equivalent to 40 mm^2) as long as some 40 km.

The Leprak hydro power plant has been planned so that it may be connected to the 30 KV system starting from Lumajang to Leoes and ending at Probounggo forming a T-shape branch nearby Lumajang. In other words, the Leprak-hydro power plant stands parallel with the newly established Surabaya thermal-power plants by way of 30 KV and 70 KV transmission lines.

Therefore, a substitutional power supply facility necessary for a benefit calculation, shall be supposed to use a new 100 MW class thermal-power plant, to be constructed in the Surabaya area in near future.

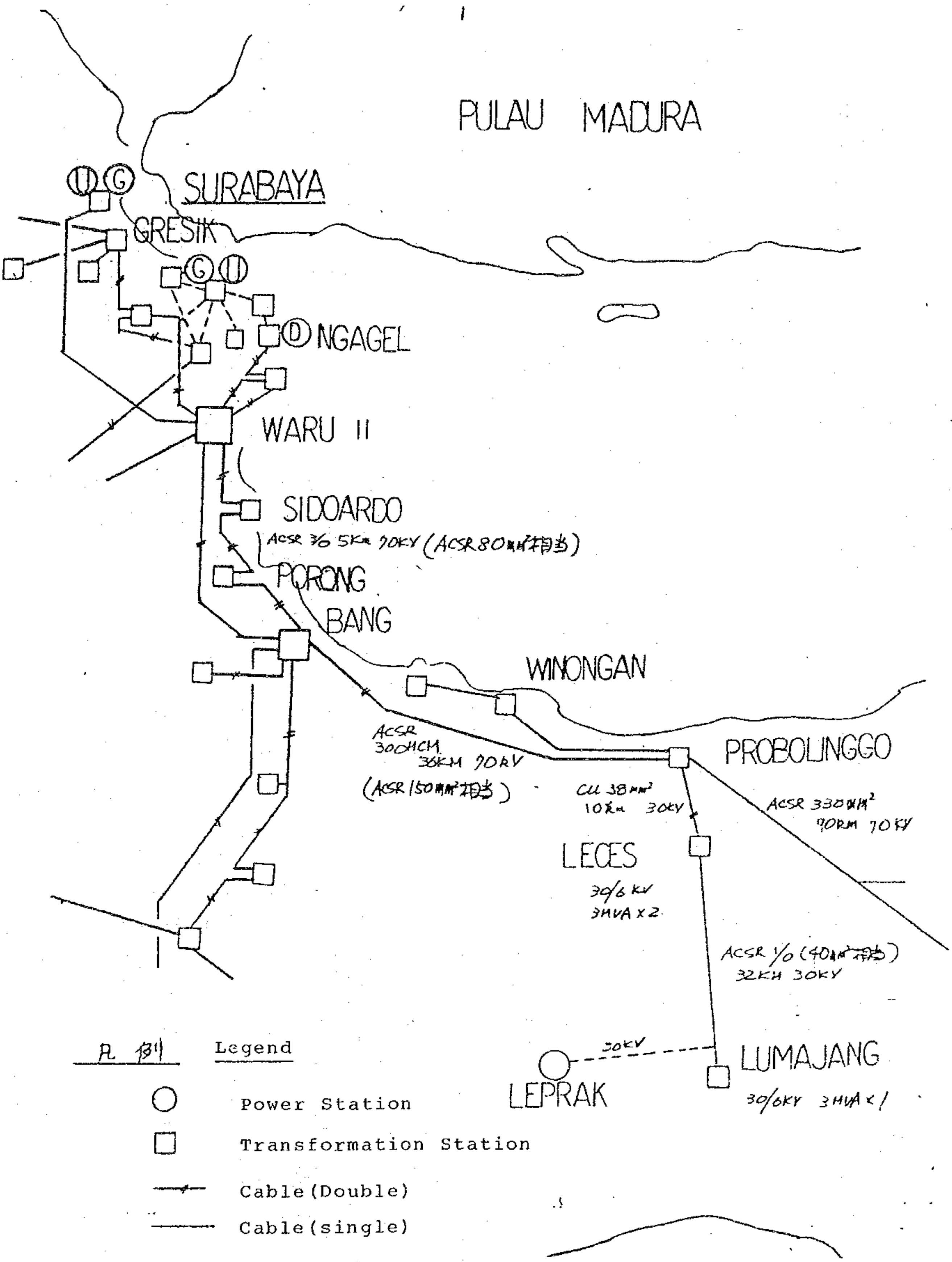


Fig.-1 Power Transmission System in the Western Part of Java

1.2 CONDITIONS OF TENTATIVE PLAN FOR HYDRO POWER PLANT

a) Hydrological regime:

The hydrological regime figures of basic flow of three cases, which were used in the irrigation plan, shall be used.

Fig.-2 shows a water use system drawing and Fig.-3 shows a hydrological regime drawing.

b) Effective head: 90 m in each case

c) Discharge:

The optimal scale shall be found by changing the maximum use water quantity upto 2.0 - 5 m /sec. on the basis of hydrological regime figures of three cases, mentioned above.

Case 1: K. Glidik + K. Rejali x 0.46

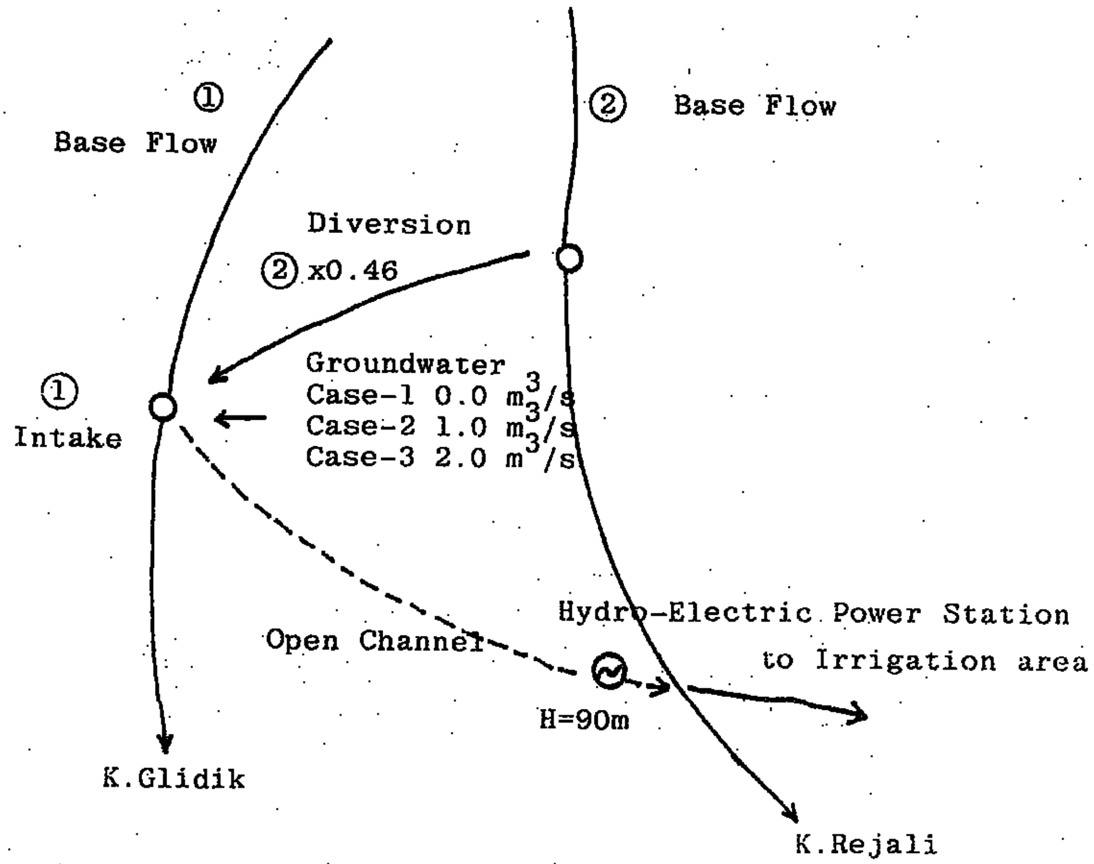
Case 2: K. Glidik + K. Rejali x 0.46 + 1.0

Case 3: K. Glidik + K. Rejali x 0.46 + 2.0

1.3 Exchange Rate

The construction cost, overhead expenses and fuel cost are based on the U.S. dollar. The current 1982 exchange rate was used.

1US$ = 650 Rp = 240 Yen



Case-1........ K.Glidik + K.Rejali x 0.46

Case-2........ K.Glidik + K.Rejali x 0.46 + 1.0
(with supply of Max. 1.0 m^3/s Groundwater)

Case-3........ K.Glidik + K.Rejali x 0.46 + 2.0
(with supply of Max. 2.0 m^3/s Groundwater)

Fig.-2 Water Use System

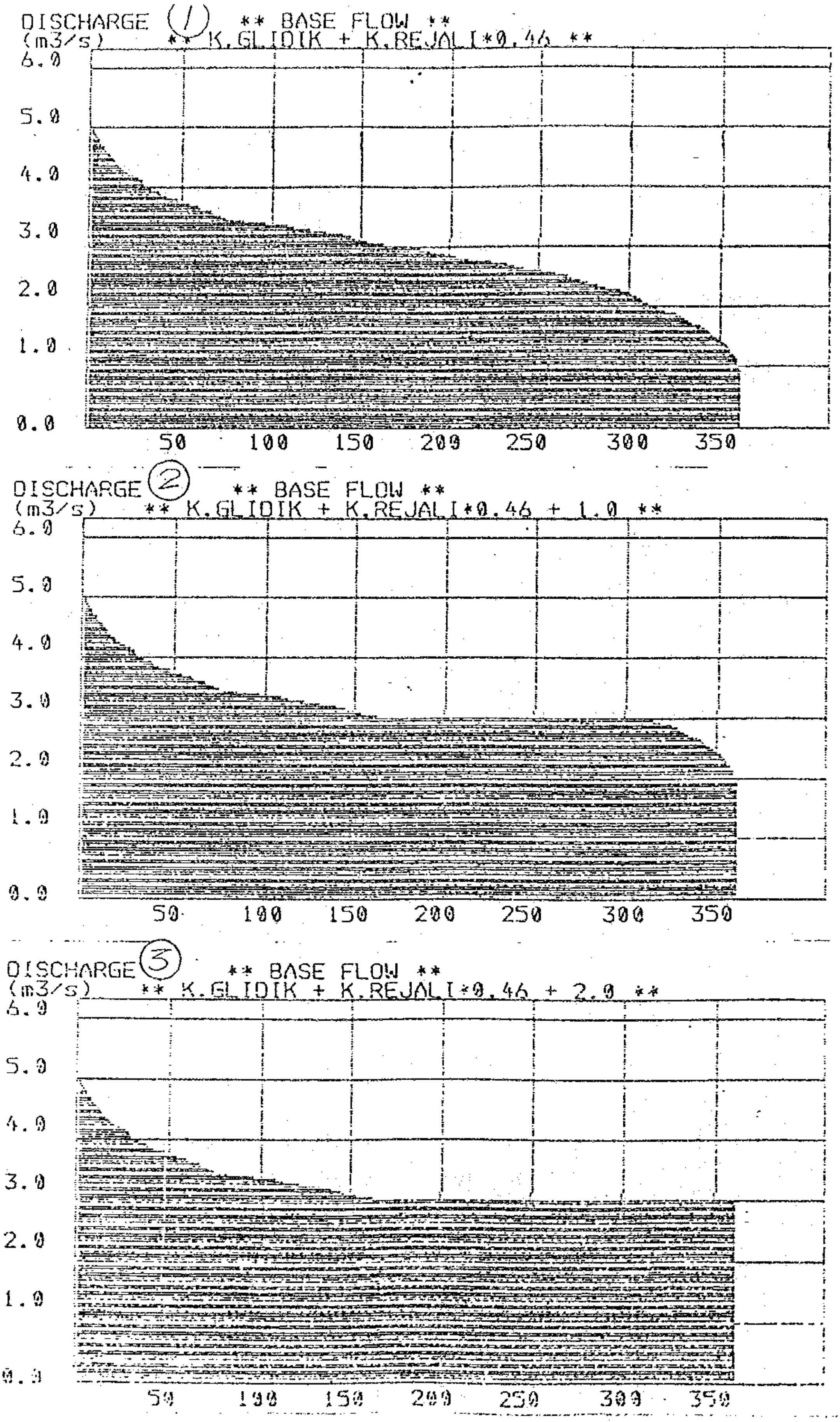


Fig.-3 Hydrological Regime

2. TENTATIVE PLAN FOR HYDRO POWER PLANT

2.1 SYSTEM OF POWER GENERATION

On the basis of the judgement that dam construction is impossible in view of topographical and geological features in the K. Leprak area, power generation shall be made by using the water flow-in method. The unit cost of construction power generated energy at the planned site was found by placing the target cost on 200 Yen/KWH.

2.2 ASSESSMENT OF OUTPUT AND MAXIMUM ELECTRIC ENERGY

a) Assessment of maximum electric energy was found by using the following formula:

$$P = g \times Q \times He \times n \qquad (1)$$

Where, P = Maximum output energy (KW)
g = Acceleration of gravity (m/sec^2)
Q = Maximum water use volume (m^3/s)
He = Efficient head (m)
n = Synthetic efficiency of hydraulic turbine
(n = 0.84 at this time)

Synthetic efficiency of hydraulic turbine grows higher in proportion to the scale of turbine, but normally the value of n = 0.84 is used in the tentative plan.

b) Calculation of Annual Available Generated Energy

The annual available generated energy was calculated using the following formula, however, since the basic flow for irrigation was used as discharge data, the river maintenance discharge (0 to 0.5 m^3/sec per 100 km^3) is not taken into consideration.

$$E = 8{,}760 \times p \times \alpha \times \beta \tag{2}$$

Where, E = Yearly generated electric energy (KWH)

P = Maximum output (KW)

α = Coefficient to be found by formula

β = Coefficient in view of efficiency deterioration: 0.9 but 1.0 was used at this time because the hydrological regime figure is flat.

$$\alpha = \frac{(\text{Acreage abceb}) - (\text{Acreage equivalent to river maintenance discharge})}{(\text{Acreage abed})}$$

= Discharge utilization ratio by the facility

C) Findings of the Calculation

The hydrological regime curve that was used for the calculation of the discharge utilization ratio is shown in Fig.-4. The discharge utilization ratio by facility and the river utilization ratio are shown in Table-1. The relationship between the maximum water use quantity and the discharge utilization ratio is shown in Fig.-5.

The maximum output and the annual available generated energy calculated by using the above data is shown in Table-2. The relationship between the water use quantity in each case is shown in Fig.-6, which tells that the increase rate of annual available generated energy hits highest in the maximum water use quantity ranging from 2.5 to 3.5 m^3/sec. It is, therefore, considered that the optimal scale of a hydro power plant falls within the above range.

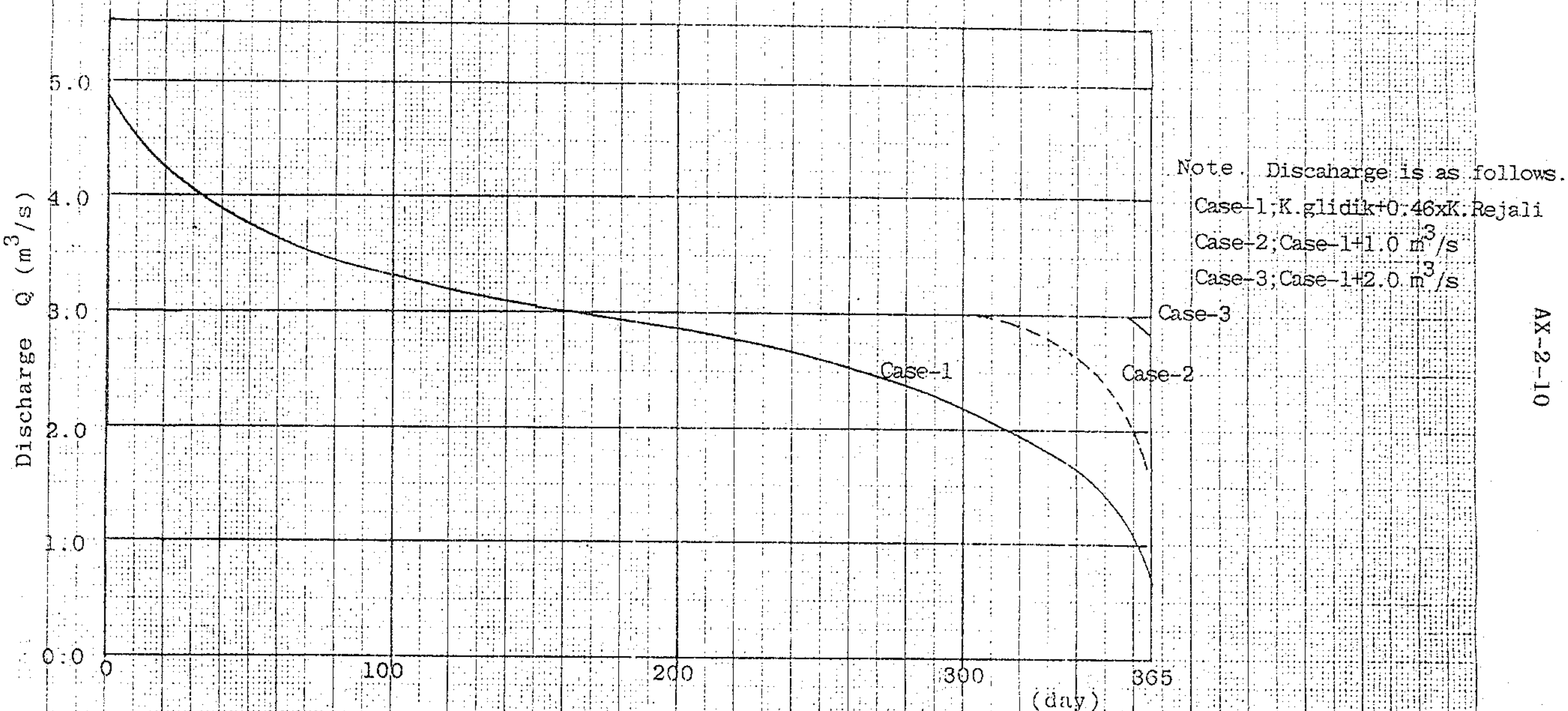


Fig.-4 Discharge Utilization Curve

Table-1 Discharge Utilization Rate by Facility and River Utilization Rate

	(m3/s) Discharge	B Ai+1-Ai	C	D B x C	E ZDi	G Ai x 365	H E/G	I E/F
Case 1								
Q 365	0.64	0.64	365	234	234	234	100	22
Q 355	1.119	0.559	360	201	435	438	99	41
Q 275	2.396	1.197	315	377	812	875	93	77
Q 185	2.923	0.527	230	121	933	1,067	87	89
Q 95	3.387	0.464	140	65	998	1,236	81	95
Q 35	3.929	0.542	65	35	1,033	1,434	72	98
Q 1	4.942	1.013	18	18	1,051	1,804	58	100
Case 2								
Q 365	1.500	1.500	265	548	548	548	100	47
Q 355	2.199	0.699	360	252	800	803	100	69
Q 275	3.000	0.801	315	252	1,052	1,095	96	91
Q 185	3.000	0	230	0	1,052	1,095	96	91
Q 95	3.387	0.387	140	54	1,106	1,236	87	95
Q 35	3.929	0.542	65	35	1,141	1,434	80	98
Q 1	4.942	1.013	18	18	1,159	1,804	64	100
Case 3								
Q 365	2.700	2.700	365	986	986	986	100	82
Q 355	3.000	0.300	360	108	1,094	1,095	100	91
Q 275	3.000	0	315	0	1,094	1,095	100	91
Q 185	3.60	0	230	0	1,094	1,095	100	91
Q 95	3.387	0.387	140	54	1,148	1,236	93	96
Q 35	3.929	0.542	65	35	1,183	1,434	82	99
Q 1	4.942	1.013	18	18	1,201	1,804	67	100

Note A; Discharge (m^3/s)
E; Available Discharge (day. m^3/s)
H; Discharge Utilization Rate (%)
I; River Utilization Rate (%)

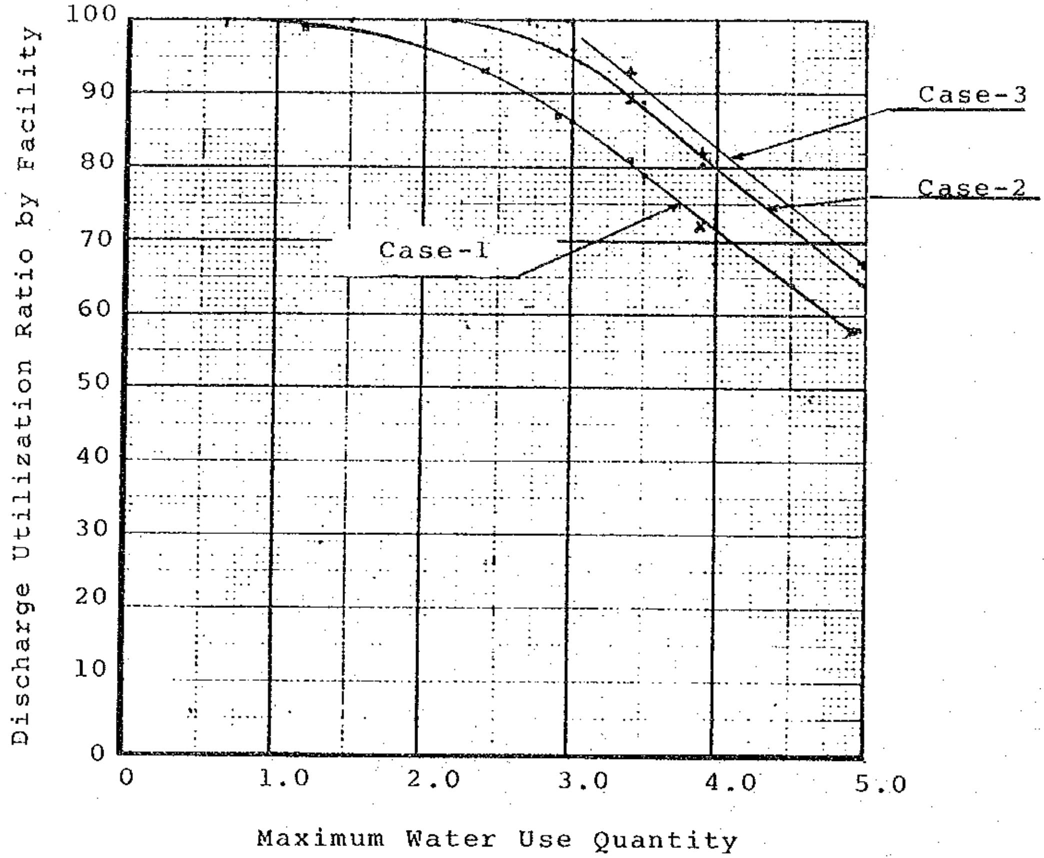


Fig. - 5 Relationship between Maximum Water Use and Discharge Utilization Ratio by Facility

Table-2 Maximum Output & Annual Potential Power Output

Effective Head (m)	Maximum Water Use Quantity (m^3/sec)	Maximum Output (KW)	Annual Available Generated Energy (MWH)		
		Case 1	Case 2	Case 3	
90	2.5	1,800 (1,852)	14,926	16.061	16.224
90	3.0	2,200 (2,223)	16.747	18,500	19,473
90	3.5	2,600 (2,593)	17,945	19,989	20,670
90	4.0	3,000 (2,964)	18,688	20,765	21,543
90	4.5	3,300 (3,334)	18,692	21,028	21,909

Notes: 1. Calculation of annual available generated energy was conducted by using the value bracketed ( ) in Table-2.

2. Calcuation of discharge utilization ratio by facility is made by approximating the hydrological regime curve to a tangential line. The finding is comparatively fit for the hydrological regime curve in Japan. However, such a hydrological regime curve is likely to produce errors because of the low water level. It is necessary that another calculation of incremental power energy by supply of groundwater be conducted.

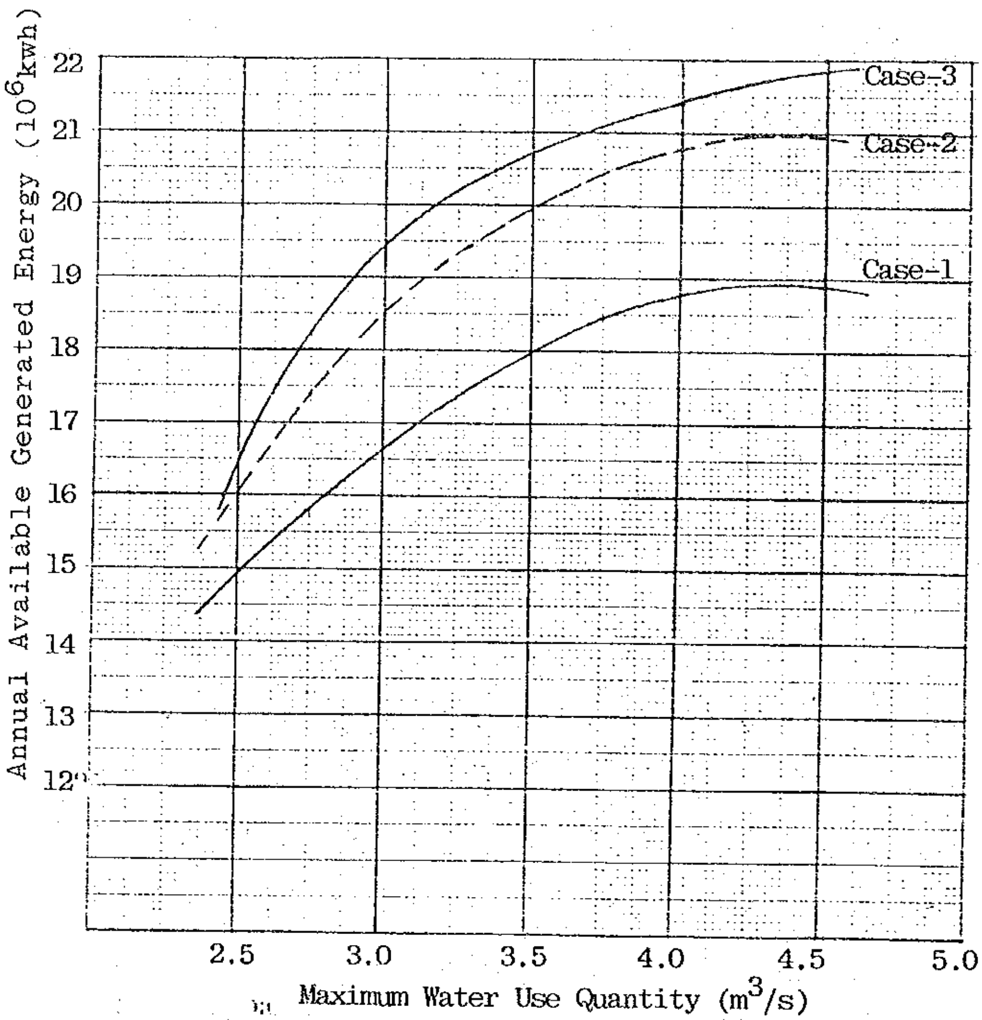


Fig.-6 Comparison of Annual Available Generated Energy

2.3 COMPARISON OF HYDRO PLANT CONSTRUCTION COST

a) Estimation of Hydro Plant Construction Cost

The direct construction cost was calculated by integrating the civil work cost and the electric work cost on the basis that the maximum water use quantity is 3.0 m^3/sec. Then further construction costs were calculated in the case that the maximum water use quantity is 2.5, 3.5, 4.0, 4.5 and 5 m^3/sec. The findings are shown in Table-3.

b) Comparison of Construction Unit Price

The construction unit price was calculated for each case where the maximum water use quantity ranges from 2.5 to 4.5 m^3/sec. on the basis of annual available generated energy and the total construction cost already calculated. The findings are shown in Table-4 and Fig.-7. According to the findings, the lowest construction unit cost per KWH was found in the case that the maximum water use quantity price amounts to ¥60.8/KWH, which is far less than the target unit cost of ¥200/KWH mentioned in Section 2.1.

Table-3 Comparison of Construction Costs for Hydro-Power Plant

Maximum water use quantity (m^3/s)	2.0	3.0	3.5	4.0	4.5	5.0
Penstock	73,401	78,926	83,662	88,397	92,343	95,550
Tailrace	135,279	150,300	165,330	178,857	190,881	202,905
Machinery foundation	41,387	45,480	49,118	52,529	55,667	58,715
Equipment	8,241	8,241	8,241	8,241	8,241	8,241
Temporary works	56,585	56,585	56,585	56,585	56,585	56,585
Hydraulic turbine generator, etc.	284,818	320,020	358,422	393,625	419,226	444,828
Building	49,068	54,000	61,020	66,960	71,820	76,680
Sub-total (10^3 Yen)	647,772	713,556	782,382	845,198	894,767	943,458
* 1 Power plant management expenses	97,166	107,033	117,357	126,780	134,215	141,519
* 2 Interest for the period of construction	41,457	45,667	50,072	54,093	57,265	60,381
* 3 Related expenses	6,478	7,136	7,824	8,452	8,948	9,435
* 4 Reserve fund	32,389	35,678	39,119	42,260	44,738	47,173
Total (10^3 Yen)	825,262	909,070	996,754	1,076,783	1,129,933	1,201,960
Construction cost (10^6 Yen)	825	909	997	1,077	1,140	1,202

Note *1; Sub-total x 0.15

*2; " x 0.4 x 0.08 x 2

*3; " x 0.01

Table-4 Comparison of Construction Cost

Case 1

Maximum water use quantity	2.5	3.0	3.5	4.0	4.5
Efficient head	90	90	90	90	90
Maximum output	1,806	2,200	2,600	3,000	3,300
Discharge utilization rate by facility	92	86	79	72	64
Annual generated energy	14,926	16,747	17,945	18,688	18,692
Construction cost	825	909	997	1,077	1,140
Construction unit cost	55.27	54.27	55.55	57.63	60.99
Priority	2	1	3	4	5

Case 2

Maximum water use quantity	2.5	3.0	3.5	4.0	4.5
Efficient head	90	90	90	90	90
Maximum output	1,806	2,200	2,600	3,000	3,300
Discharge utilization rate by facility	99	95	88	80	72
Annual generated energy	16,061	18,500	19,989	20,765	21,028
Construction cost	825	909	997	1,077	1,140
Construction unit cost	51.37	49.14	49.88	51.87	54.21
Priority	3	1	2	4	5

Case 3

Maximum water use quantity	2.5	3.0	3.5	4.0	4.5
Efficient head	90	90	90	90	90
Maximum output	1,806	2,200	2,600	3,000	3,300
Discharge utilization rate by facility	100	100	91	83	75
Annual generated energy	16,224	19,473	20,670	21,543	21,904
Construction cost	825	909	997	1,077	1,140
Construction unit cost	50.85	46.68	48.23	49.99	52.05
Priority	4	1	2	3	5

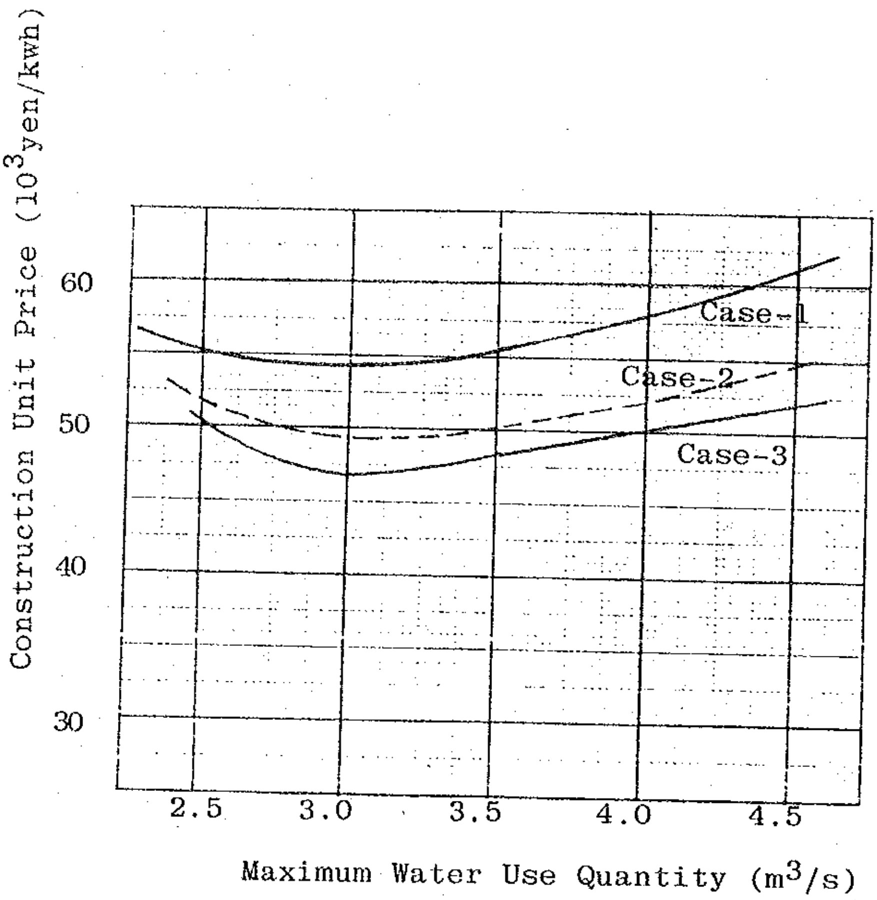


Fig.-7 Maximum Water Use Quantity and Construction Cost

2.4 DETERMINATION OF OPTIMAL DEVELOPMENT SCALE

The following two methods were considered in deciding the maximum water use quantity in small and medium run-of-river type power stations:

(1) The optimal scale is in the lowest construction unit price.

(2) Taking future increases of fuel and construction costs into account, as large a scale plant as practically possible must be adopted, as long as the generated unit cost per incremental generated energy comes under the cost of substitutional power source, even though the construction unit cost will become higher.

However, in this tentative plan, the plan lowest in the construction unit cost was regarded as an optimal scale because the accuracy plan as a whole is rather low. Therefore, the maximum water use quantity was set at 3.0 m^3/sec and the optimal scale of output was set at 2,200 KW. These outlines are shown in Table-5.

Table-5 Outline of K. Leprak Hydro-Power Plant

Category of development	Synthetic development	
Name of river system	K. Lengkong	
Name of intake river	K. Glidik	
Generation system	Channel System	
Maximum output	(KW)	2,200
Turbine discharge	(m^3/sec.)	3.0
Effective head	(m)	90
Annual available generated energy		
Case 4	(MWH)	16,747
" 5	"	18,500
" 6	"	19,413
Hydraulic turbine type	Horizontal shaft Francis	
Output	KW	2,400
Number of rotation	rpm	750
Characteristic speed	M-KW	133
Generated type	Horizontal shaft three phase synchronous alternating current	
Capacity	KVA	2,300
Power factor	%	95
Total construction cost	¥10^6 (yen)	909
	(\$$10^3$)	3,788
Annual expenses (Total construction cost x 2,37%)	\$$10^3$	90

3. CHARACTERISTICS OF SUBSTITUTIONAL STANDARD THERMAL PLANT

The substitutional standard thermal power plant adopts a unit corresponding to Gresik No. 1 and No. 2 thermal power plant (100 MW x 2) planned in Surabaya area in the 1980's, as a basis of economic analysis of this project. The current standard construction unit cost of a thermal power plant in Indonesia is as follows:

Content of Unit	Construction Unit Cost
50 MW	1,115,500 Rp/KW (412 x 10^3/KW)
100 MW	836,000 Rp/KW (308 x 10^3/KW)
	Exchange rate (1982)
	650 Rp/US$
	¥240/US$

However, the price of crude oil, the annual mean thermal efficiency and the fuel unit price were unavailable so they were, therefore estimated based on the past market price.

- Source - (Handbook of Electric Enterprice)

Construction cost in Japan

Noshiro Thermal Plant 1 - 3T	600 MW x 3 (255.6 x 10^3 yen/KW)
Matsuura Thermal Plan 1 - 3T	700 MW x 2 (256 x 10^3 yen/KW)

3.1 ESTIMATED PRICE OF CRUDE OIL

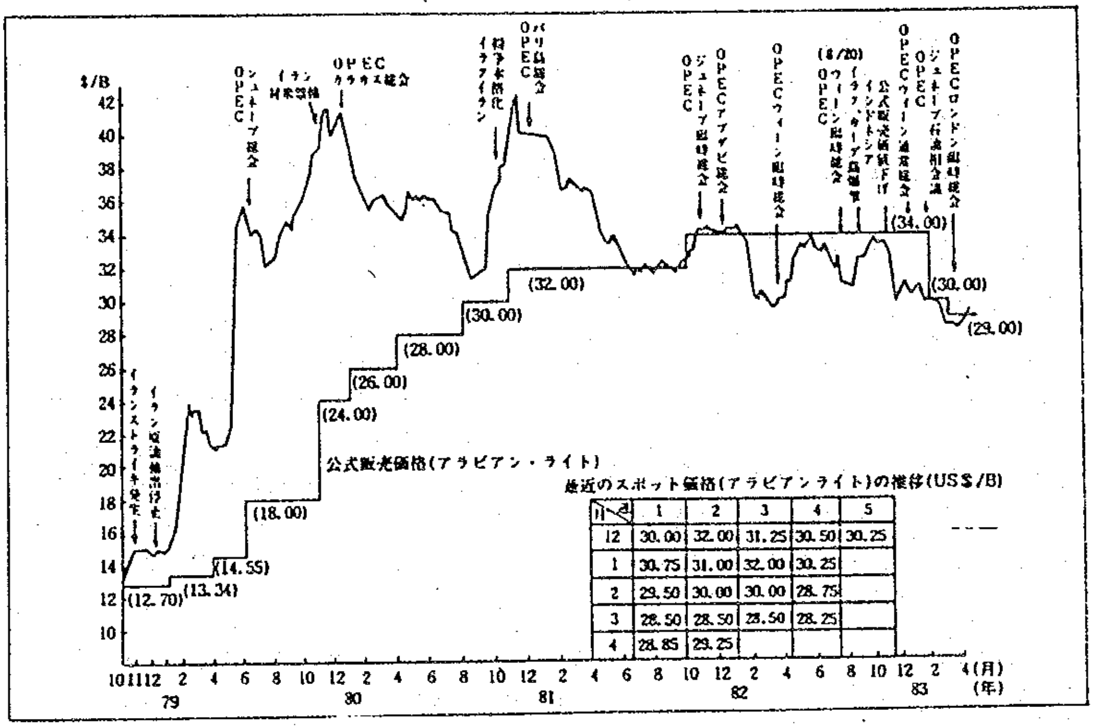
Since information on the current prices of crude oil in Indonesia was unavailable, the crude oil price for 1983 was estimated, considering the fluctuations of Arabian Light's official sales prices, on the basis of the actual crude oil price shown in "Survey Report on Bakaru Hydro-Power Plant Development Project in K. Sadau River System" prepared by the International Cooperation Agency in Japan in September, 1977.

Fluctuations in the Arabian Light's official sales price and the spot price are shown in Fig.-8. In addition, the fuel cost was estimated on the supposition that crude oil for the thermal power plant is imported and domestically produced crude oil is exported as it is known that the Republic of Indonesia is one of the oil-producing nations.

According to the above material, crude oil (medium fuel oil) was priced at 7.0 cent/ (29.05 Rp/) in 1977. On the other hand, the Arabian Light official price was 12.09 (US$/B) in the first and second quarters in 1977 and 12.70 (US$/B) in the third and last quarters in 1977. The Arabian Light official price in 1983 was 29.00 (US$/B) in the first quarter, up 2.3 times from 1977.

Therefore, the crude oil price in the western part of Indonesia was finally estimated as follows:

7.0 cent/ x 29.00/12.09 = 16.77 cent/
= 40.300 yen/k



月＼日	1	2	3	4	5
12	30.00	32.00	31.25	30.50	30.25
1	30.75	31.00	32.00	30.25	
2	29.50	30.00	30.00	28.75	
3	28.50	28.50	28.50	28.25	
4	28.85	29.25			

Fig.-8 Fluctuation in the Spot Price of Crude Oil (Arabian Light)

3.2 ESTIMATED FUEL COST IN STANDARD THERMAL POWER STATIONS

The annual average thermal efficiency and the station service ratio in Crude Oil Burning Thermal Power Stations in Japan are as follows:

Unit Capacity (MW)	Steam Condition (atg)	(C°)	At Site Thermal Efficiency	Station Service Ratio	Annual Utilization Ratio
			(%)	(%)	(%)
75	102	538/538	34.8	6.0	70
125	125	538/538	35.1	6.0	70

In the process of estimating the fuel cost in a standard thermal power station in Indonesia, an annual average thermal efficiency of 100 MW and 110 MW was established at 34.8% (the annual utilization ratio was 70%) based on the above data and taking into consideration that thermal efficiency may deteriorate due to a rise in the cooling water temperature in the Steam Condensor.

The price and quality of C crude oil are set up as follows:

Unit price of fuel ...... 16.79×10^{-2} US$/

Calorific value ..... 10.307 kcal/kg

Specific gravity ..... 0.9443 at 60°F

In-site thermal consume ratio = 860 (kcal/KWH)/0.347
= 2,478 x 1.06

Sending end thermal consume ratio = 2,478 x 1.06
= 2,626 (kcal/KWH)

Therefore, the annual average fuel unit price in the thermal power plant is as follows:

Unit cost of Fuel (at the sending end) =
16.76 (cent/) x 2,626 (kcal/KWH)/10.915 (kcal/)

= 4,039 (cent/KWH)

= 9.69 (yen/KWH)
(At the exchange rate $1 = ¥240)

3.3 CHARACTERISTICS OF STANDARD THERMAL POWER PLANT

Table-6 shows the characteristics, which were estimated on the basis of the aforementioned data, and assumed value of a standard thermal power plant covered by this economic efficiency. Table-7 shows the approximate power generation costs including the interest payable and corporation tax.

These tables show that the unit cost of a standard thermal power plant is ¥18.04/KWH and that the unit cost of a standard hydro-power plant is ¥6.83/KWH.

As seen above, the economic efficiency of this hydro plant construction project can be fully realised.

Fluctuations in the cost of thermal power generation, which provide the fundamental data of an economic efficiency comparison, are shown in Table-8.

Table-6 Outlines of Standard Thermal Power Plant

1. Unit Capacity (crude oil burning thermal power plant)	(MW)	100	100
2. Construction Cost	$\$10^3$	128,615	141,477
Construction unit cost	$/KWH	1,286.15	1,286.15
"	*(Rp/KWH)	(836,000)	(836,000)
3. Fuel Cost			
Fuel unit cost (sending end)	cent/kwh	4,039	4,039
Unit cost of crude oil	cent/kwh	16.79	16.79
Specific gravity 0.9413			
Calorific value 10,367 kcal/kg			
Oil brand Medium fuel oil			
4. Yearly mean thermal efficiency (%) (Heavy oil burning, annual utilization factor 70%)		34.8	34.8
5. Ratio of power for station service (%) (Heavy oil burning, annual facility utilization factor 70%)		6	6
6. Annual expenses (Construction cost x 3.64%)	($\$10^3$/year)	4,682	5,150

Note: (1) * The standard thermal power plant in Indonesia.

<u>Construction Cost</u>

100 MW 836,000 Rp/KW

50 MW 1,115,000 Rp/KW

Exchange rate (1980) 650 Rp/US$

(2) Classification of standard steam power plant

Gresik steam No. 1 and No. 2, each 100 MW

Thermal No. 1 - No. 4, each 110 MW

Table-7 Comparison of Power Generation Cost between Hydro-Plant and Thermal Plant

1. Power Generation Cost of Hydro Plant

Total construction cost	909 x 10 yen
Annual ratio of expense (longevity 40 years)	12.58%
Annual expenses $909 \times 10^6 \times 0.1258$ =	114.4 x 10 yen
Annual generated energy	
Case 1	16,747 MWH
Case 2	18,500 MWH
Case 3	19,437 MWH
Power generation cost	
Case 1	6.83 ¥/KWH
Case 2	6.18 ¥/KWH
Case 3	5.89 ¥/KWH

2. Power Generation Cost of Standard Thermal Plant

Total construction cost 128.615 US$\$10^3$ =	$30{,}868 \times$ ¥10^6
Annual ratio of expense (longevity 15 years)	16.23%
Annual expense $30{,}868 \times 10^6 \times 0.1623$ =	5,101 x 10 yen
Annual generated energy (Annual Utilization Factor 70%)	600 x 10 KWH

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Table.-8 Fluctuation in Fuel Price
(Increment Steam Power)

NO.	Year	with Hydro-Power		without Hydro-Power		Remarks
		Increment Steam Power KWH of Power Generated (10^6KWH)	Fuel Price (US$$10^3$)	Increment Steam Power KWH of Power Generated (10^6KWH)	Fuel Price (US$$10^3$)	
1	1984	0	0	0	0	
2	1985	0	0	0	0	
3	1986	600	24234	600	24234	Unit Price of
4	1987	600	24234	600	24234	Fuel
5	1988	600	24234	600	24234	(40.39us$/KWH)
6	1989	1200	48468	1200	48468	(at SENDING
7	1990	1200	48468	1200	48468	End)
8	1991	1200	48468	1200	48468	
9	1992	1860	75247	1183	47781	
10	1993	1863	75247	1843	74439	
11	1994	2640	106630	2623	105943	
12	1995	3300	133287	3283	132600	Increment
13	1996	3300	133287	3283	132600	Steam Power
14	1997	3960	159944	3943	15258	Gerisk NO.1
15	1998	3960	159944	3943	15258	NO.2
16	1999	3960	159944	3943	15128	(100MWx2)
17	2000	3960	159944	3943	15258	
18	2001	3960	159944	3943	15258	Thermal
19	2002	3960	159944	3943	15258	NO.1-NO.4
						(110MWx4)

Table-9 Estimated Power Supply and Demand

Consumption

Year	Maximum Power Supply		Annual Power Demand	
	Energy (MW)	Growth Rate (%)	Energy 10^6KWH	Growth rate (%)
1973	* 92	9.3	550	9.3
74	*101	"	600	"
75	*101	"	660	"
76	122	11.5	736	11.4
77	135	"	820	"
78	150	"	913	"
79	167	"	1,018	"
80	187	"	1,134	"
81	208	"	1,264	"
82	233	"	1,409	"
83	259	"	1,570	"
84	292	9.3	1,750	9.3
85	319	"	1,910	"
86	349	"	2,090	"
87	382	"	2,280	"
88	417	"	2,500	"
89	456	"	2,730	"
90	498	"	2,980	"
91	545	"	3,260	"
92	595	"	3,560	"
93	650	"	3,890	"
94	711	"	4,260	"
95	777	"	4,650	"
95	929	"	5,089	"
96	850	"	5,089	"
97	929	"	5,560	"

Note: * are actual records
Source is "Development Plan of Whngi Hydor-Power"

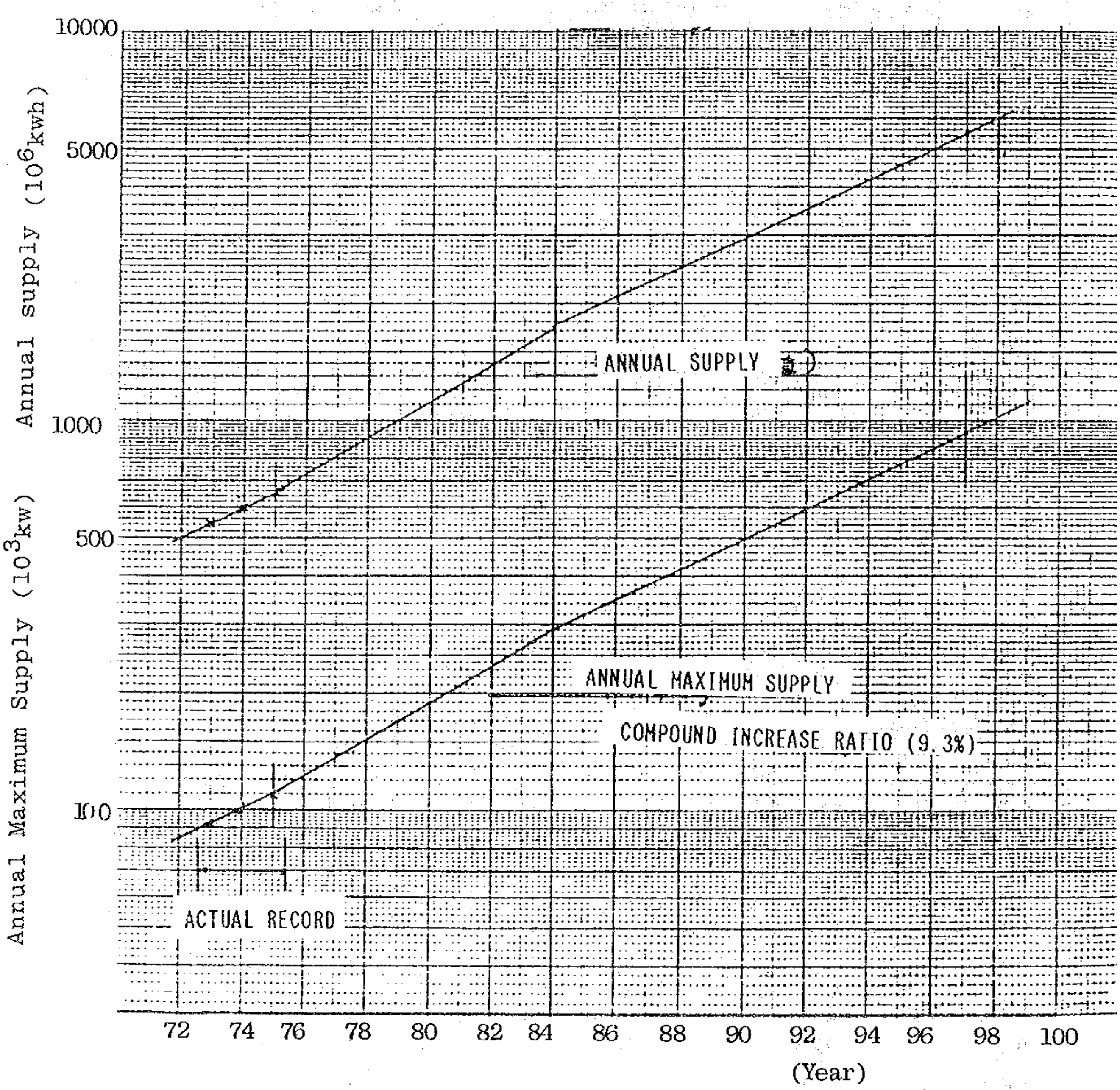

Fig.-9 Estimated power Supply and Demand

4. BALANCE OF SUPPLY AND DEMAND

4.1 ESTIMATED DEMAND

The power demand in the western part of Java Island was estimated as an object of the balance between supply and demand, for the purpose of being used for an economic efficienty comparison. The yealy mean increase rate of power demand from 1976 to 1983 was estimated as 11.5%, based on the actual growth rate from 1973 to 1975. As this is equivalent to that of Japan from 1951 to 1957, it is a rather optimistic estimate.

In regard to the increase of demand after 1984, the growth rate is considered to be slightly lower and was set at 9.3%, which was the actual annaul mean growth rate increase between 1983 and 1985.

The estimated maximum power supply of energy and the yearly mean total demand are shown in Table-9 and Fig.-9.

4.2 SUPPLY AND DEMAND BALANCE

In order to estimate economic efficiency, the followint two cases of the development plan were investigated:

1. In the case that the Leprak Hydro Plant is not developed. (Benefit)
2. In the case that the Leprak Hydro Plant is developed. (Cost)

a) Development Site

The sites of hydro plants and thermal plants to be developed after 1984, were planned as follows:

	Site		Out put (MW)	Year of Starting Operation
Thermal Plant	Gresik steam	No. 1	100	1986
	"	No. 2	100	1989
	Thermal	No. 1	110	91
		No. 2	110	94
		No. 3	110	95
		No. 4	110	97
Hydro Plant	Wringr	No. 2	35	86
	Sengruh	-	29	91
	Kesamben	1	32	95
	Leprak *		2	91

Note: * Not according to material.

b) Supply and Demand Balance

The balance between the supply and demand of power after 1984 was estimated on the basis of the power supply/demand and the development sites above. Preconditions for estimating the balance are as follows:

a. Since the daily load curve line is comparatively flat, the emphasis of power source development was placed on the expansion of KWH power suply capability. Therefore, the development plan as cenered on a thermal power plan.

b. The annual available thermal power energy was calculated on the basis that the annual utilization factor stands at 70%. As a result, the possible annual thermal power energy is estimated at 600 x 10^6 KWH in the 100 MW unit and at 660 x 10^6 KWH in the 110 MW unit.

c. The distribution of load among thermal power plants was made on the grounds that outworn gas turbine plants were put into service at peak times based on an output of 100 MW and 110 MW class where fuel consumption is rather low. Output from some of the wornout diesel power plants was also regarded as a reserve.

d. Since the capacity of a single equipment of the thermal plants is greater than that of the termal power system, the equipment of thermal power generation being less, reserve capacity is planned at 20% or more, at any time.

e. Output of the Leprak power plant to be newly constructed was estimated at 2 MW and the possible annual generated energy is estimated at 17, 18 and 19 x 10^6 KWH which were included in the supply and demand balance.

Further, output of the Leprak station accounts for only 2.4% or less of the total system capacity, therefore, construction of this hydro plant bears influence on the start of operation of any other hydro and thermal stations.

The power source facility expansion plan (maximum power balance) is shown in Fig.-10, and the power energy balance is shown in Fig. -11. In addition, the maximum power balance of the above two cases as well as the power energy balance are shown in Fig.-10 to Fig.-13.

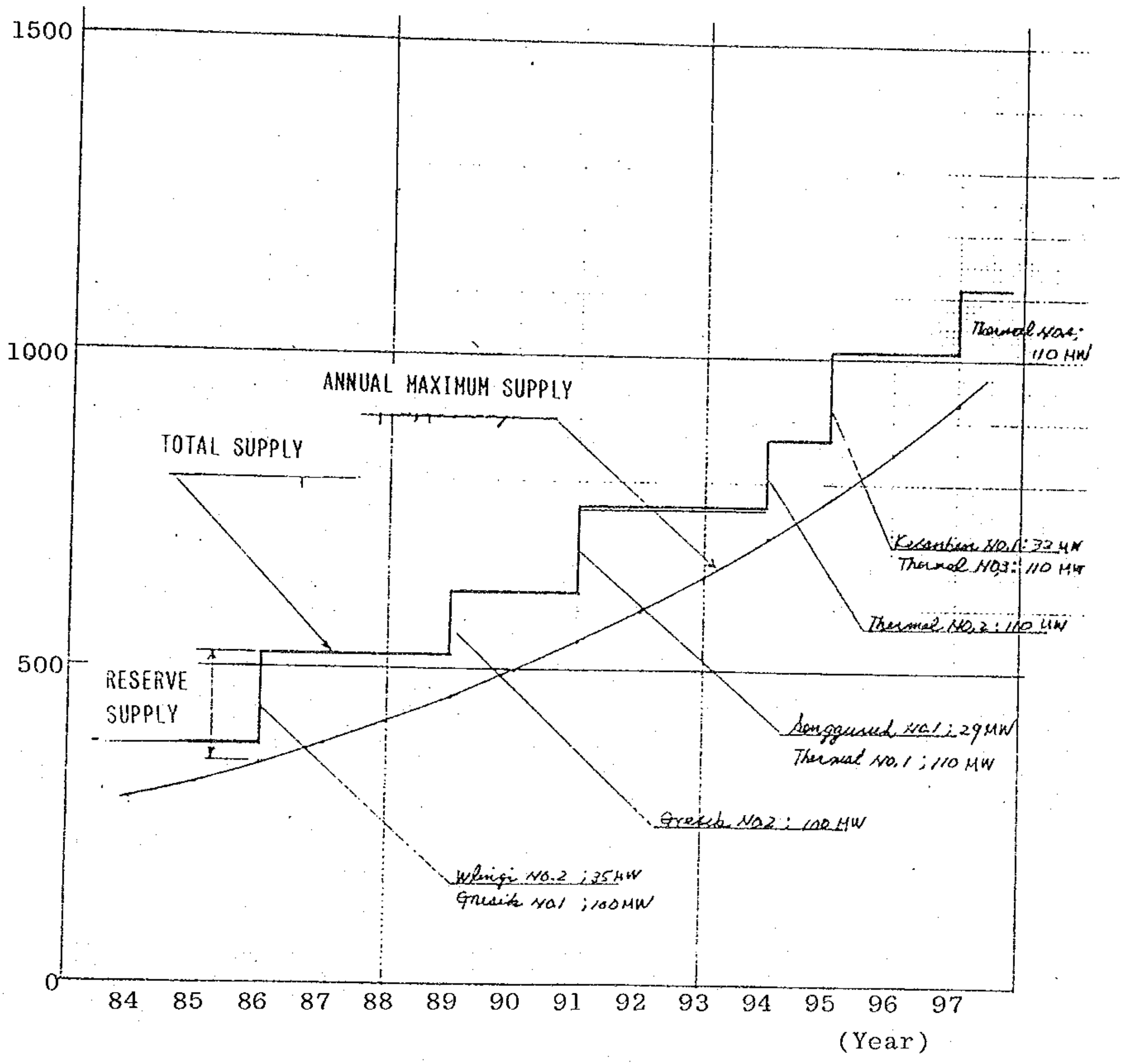

Fig.-10 Power Source Facility Expansion Plan

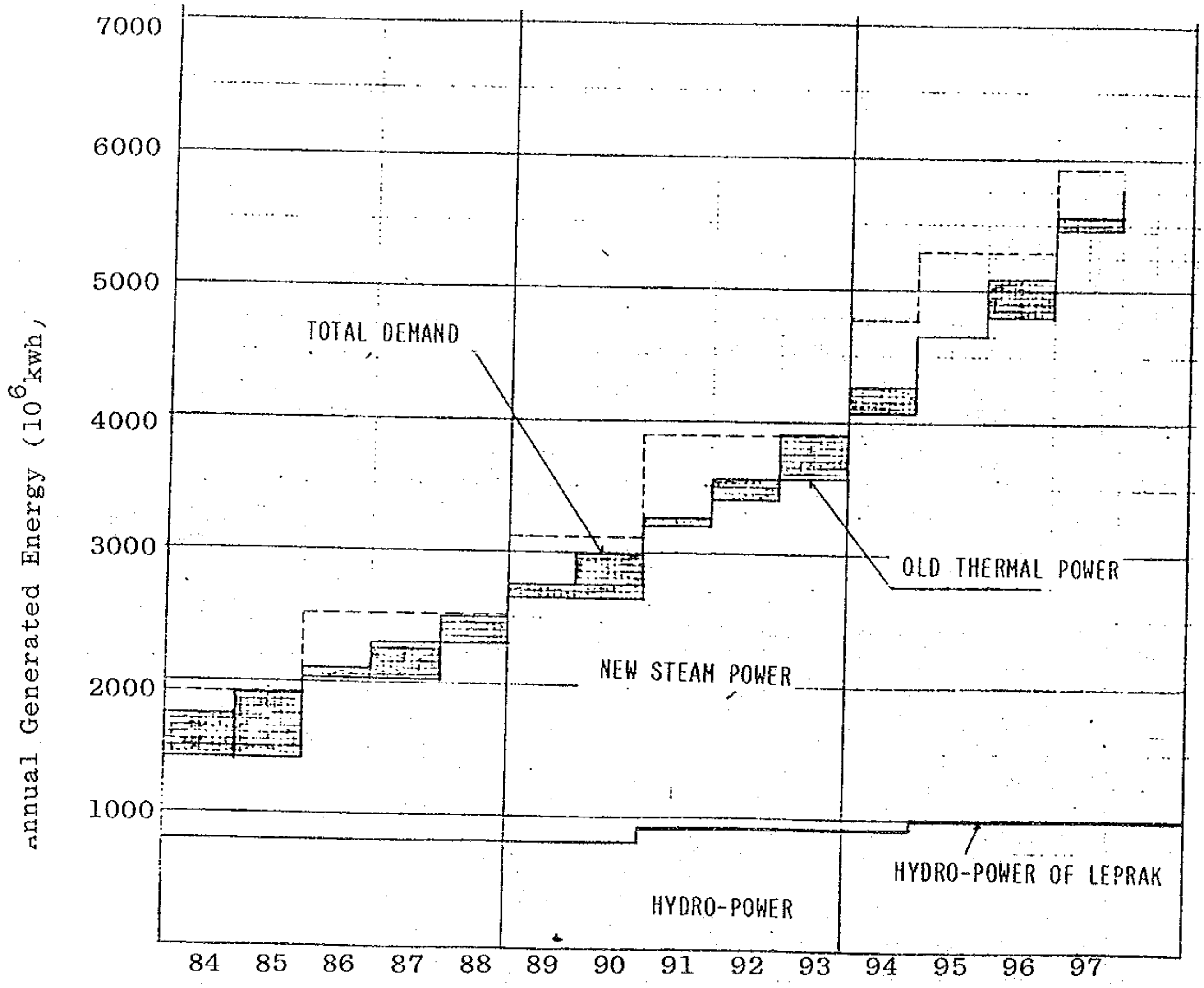

Fig.-11 Electric Energy Balance

Table-10 Maximum Power Balance (without Leprak Plant) unit:10^3kw

Year	84	85	86	87	88	89	90	91	92	93	94	95	96	97
Existing Load-carrying Capacity	387	387	387	387	387	387	387	387	387	387	387	387	387	387
Planned Load-Carrying Capacity														
Wling NO.2			35	35	35	35	35	35	35	35	35	35	35	35
Gresik NO.1			100	100	100	100	100	100	100	100	100	100	100	100
Gresik NO.2						100	100	100	100	100	100	100	100	100
Senguruh								29	29	29	29	29	29	29
Thermal NO.1								110	110	110	110	110	110	110
Kesampan NO.1												32	32	110
Thermal NO.2											110	110	110	110
Thermal NO.3												110	110	110
Thermal NO.4														110
Total Load-Carrying Capacity (sending end)	387	387	522	522	522	622	622	761	761	761	871	1013	1013	1013
Annual Maximum Power (sending end)	292	319	349	382	417	456	498	545	595	650	711	777	850	929
Reserve Capacity (MW)	95	68	173	140	105	166	124	216	166	111	160	236	163	194
Reserve Capacity (%)	30	21	50	37	25	36	25	40	28	17	23	30	19	21

Table-11 Maximum Power Balance (with Leprak Plant) unit:10^3kw

Year	84	85	86	87	88	89	90	91	92	93	94	95	96	97
Existing Load-carrying Capacity	387	387	387	387	387	387	387	387	387	387	387	387	387	387
Planned Load-Carrying Capacity														
Wling NO.2			35	35	35	35	35	35	35	35	35	35	35	35
Gresik NO.1			100	100	100	100	100	100	100	100	100	100	100	100
Gresik NO.2						100	100	100	100	100	100	100	100	100
Senguruh								29	29	29	29	29	29	29
Thermal NO.1								110	110	110	110	110	110	110
Kesampan NO.1												32	32	110
Thermal NO.2											110	110	110	110
Thermal NO.3												110	110	110
Thermal NO.4														110
Leprak (Hydro)								2	2	2	2	2	2	2
Total Load-Carrying Capacity (sending end)	387	387	522	522	522	622	622	763	763	763	873	1015	1015	1015
Annual Maximum Power (sending end)	292	319	349	382	417	456	498	545	595	650	711	777	850	929
Reserve Capacity (MW)	95	68	173	140	105	166	124	218	168	113	162	238	165	196
Reserve Capacity (%)	30	21	50	37	25	36	25	40	28	17	23	30	19	21

Table-12 Maximum Power Energy Balance (without Leprak Plant) unit:10^6 kwh

Year		1984	1985	1986	1957	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Hydro-Power Load-Carrying Capacity															
Existing Plant	(816)	816	816	816	816	816	816	816	816	816	816	816	816	816	816
Wlingi NO.2	(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sengguruh	(99)	0	0	0	0	0	0	0	99	99	99	99	99	99	99
Kesampan	(85)	0	0	0	0	0	0	0	0	0	0	0	85	85	85
Sub-Total		816	816	816	816	816	816	816	915	915	915	915	1000	1000	1000
Thermal-Power Load-Carrying Capacity															
Existing Plant	(285)	147	285	0	77	285	0	177	0	0	285	45	0	130	0
Gas turbine	(187)	187	187	74	187	187	114	187	75	185	187	180	0	170	120
diesel	(23)	0	22	0	0	12	0	0	0	0	23	0	0	0	0
Perak Steam NO.3	(300)	300	300	300	300	300	300	300	205	300	300	300	235	300	300
Perak Steam NO.4	(300)	300	300	300	300	300	300	300	205	300	300	300	235	300	300
Gresik Steam NO.1	(600)	0	0	600	600	600	600	600	600	600	600	600	600	600	600
Gresik Steam NO.2	(600)	0	0	0	0	0	600	600	600	600	600	600	600	600	600
Thermal NO.1	(660)	0	0	0	0	0	0	0	660	660	680	660	660	660	660
Thermal NO.2	(660)	0	0	0	0	0	0	0	0	0	0	660	660	660	660
Thermal NO.3	(660)	0	0	0	0	0	0	0	0	0	0	0	660	660	660
Thermal NO.4	(660)	0	0	0	0	0	0	0	0	0	0	0	0	0	660
Sub-Total		934	1094	1274	1464	1684	1914	2164	2345	2645	2975	3345	3650	4080	4560
Total Demand		1750	1910	2090	2280	2500	2730	2980	3260	3560	3890	4260	4650	5080	5560

Note. Figures in Parenthes are Available Generated Energy

Table-13 Maximum Power Energy Balance (with Leprak Plant) unit:10^6 kwh

Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Hydro-Power Load-Carrying Capacity															
Existing Plant	(816)	816	816	816	816	816	816	816	816	816	816	816	816	816	816
Wlingi NO.2	(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sengguruh	(99)	0	0	0	0	0	0	0	99	99	99	99	99	99	99
Leprak	(17)	0	0	0	0	0	0	0	17	17	17	17	17	17	17
Kesampen	(85)	0	0	0	0	0	0	0	0	0	0	0	85	85	85
Sub-Total		816	816	816	816	816	816	816	932	932	932	932	1017	1017	1017
Thermal-Power Load-Carrying Capacity															
Existing Plant	(285)	147	285	0	77	285	0	177	0	0	285	45	0	130	0
Gas turbine	(187)	187	187	74	187	187	114	187	75	185	187	180	0	170	120
diesel	(23)	0	22	0	0	12	0	0	0	0	23	0	0	0	0
Perak Steam NO.3	(300)	300	300	300	300	300	300	300	205	300	300	300	235	300	300
Perak Steam NO.4	(300)	300	300	300	300	300	300	300	205	300	300	300	235	300	300
Gresik Steam NO.1	(600)	0	0	600	600	600	600	600	600	600	600	600	600	600	600
Gresik Steam NO.2	(600)	0	0	0	0	0	600	600	600	600	600	600	600	600	600
Thermal NO.1	(660)	0	0	0	0	0	0	0	660	660	680	660	660	660	660
Thermal NO.2	(660)	0	0	0	0	0	0	0	0	0	0	660	660	660	660
Thermal NO.3	(660)	0	0	0	0	0	0	0	0	0	0	0	660	660	660
Thermal NO.4	(660)	0	0	0	0	0	0	0	0	0	0	0	0	0	660
Sub-Total		934	1094	1274	1464	1684	1914	2164	2345	2645	2975	3345	3650	4080	4560
Total Demand		1750	1910	2090	2280	2500	2730	2980	3277	3577	3907	4277	4667	5097	5577

Note. Figures in Parenthes are Available Generated Energy

Table-14 Fluctuation in Fuel Price (Increment Steam Power)

NO.	Year	Without Leprak Plant		With Leprak Plant					
				Case-1		Case-2		Case-3	
		A (10^6kwh)	B (10^3US$)	A (10^6kwh)	B (10^3US$)	A (10^6kwh)	B (10^3kwh)	A (10^6kwh)	B (10^3US$)
1	1984	0	0	0	0	0	0	0	0
2	1985	0	0	0	0	0	0	0	0
3	1986	600	24234	600	24234	600	24234	600	24234
4	1987	600	24234	600	24234	600	24234	600	24234
5	1988	600	24234	600	24234	600	24234	600	24234
6	1989	1200	48468	1200	48468	1200	48468	1200	48466
7	1990	1200	48468	1200	48468	1200	48468	1200	48468
8	1991	1200	48468	1183	47781	1182	47741	1181	47701
9	1992	1860	75247	1843	74439	1842	74398	1841	74358
10	1993	1863	75247	1843	74439	1842	74398	1841	74358
11	1994	2640	106630	2623	105943	2622	105903	2621	105862
12	1995	3300	133287	3283	132600	3282	132560	3281	132520
13	1996	3300	133287	3283	132600	3282	132560	3281	132520
14	1997	3960	159944	3943	159258	3942	159217	3941	159177
15	1998	3960	159944	3943	159258	3942	159217	3941	159177
16	1999	3960	159944	3943	159258	3942	159217	3941	159177
17	2000	3960	159944	3943	159258	3942	159217	3941	159177
18	2001	3960	159944	3943	159258	3942	159217	3941	159177
19	2002	3960	159944	3943	159258	3942	159217	3941	159177
20	2003	3960	159944	3943	159258	3942	159217	3941	159177

Note. (1) A= kwh of Power Generated (Increment Steam Power)
B= fuel Price
(2) Unit Price of Fuel;4,039cent/kwh)
(3) Annual Available Generated Energy;
A) Case-1... 16,747 mwh = 17 x10^6 kwh
B) Case-2... 18,500 mwh = 18 x10^6 kwh
C) Case-3... 19,413 mwh = 19 x10^6 kwh
(4) Fuel Expense Reduction by Hydro-Power
A) Case-1... 68 x 10^3 US$
B) Case-2... 72 x 10^3 US$
C) Case-3... 77 x 10^3 US$
(5) Increment Steam Power Plant
A) Gresik NO.1 and NO.2 (100 mw x 2)
B) Thermal NO.1 - NO.4 (110 mw x 4)

5. SYSTEMATIZED EXPENDITURE ACCOUNT OF CONSTRUCTION COST, ANNUAL EXPENSES AND FUEL COST

A systematized expenditure account for each expense, to be used for economic analysis of the Leprak hydro-plant development project, was estimated on the basis of the supply/demand balance, the construction cost of thermal/hydro power plant and the fuel cost (estimated in the earlier part of this report). In the estimation of a systematized expenditure account, the allocated assessment was conducted according to the following conditions.

a) Expenditure Systematization of Construction Cost

The total construction cost of hydro/thermal power plant was allocated for each year at the following ratio.

	Time Period of Construction	Allocation Ratio		
		1st Year	2nd Year	3rd Year
Thermal	3 years	25%	30%	45%
Hydro	2 Years	40%	60%	

b) Annual Expenses

Assessment of te annual expenses (equalized longevity) was conducted in accordance with the following equation.

(Annual expenses) = (Total construction cost) x (Annual expenses ratio)

However, the annual expense ratio (equalized longevity) was estimated as follows with reference to the actual performance record in Japan:

Hydro 2.37% (longevity 50 years)
Thermal 3.64% (" 25 years)

c) Fuel Cost

The fuel cost in each year was estimated for both of the following cases, (1) in the case that a hydro-power plant was developed and (2) in the case that a hydro-plant is not developed, on the basis of the fuel cost and the generated energy balance already estimated in earlier, and finally, those values were summed up to the systematized expenditure account. Fluctuations of the fuel cost in each case is shown in Table-14.

The systematized expenditure account (from 1983 to 2023), which is used for the interval economic earning ratio, of each expene if shown in Table-15 and 16.

Table-15 Systematized Expenditure Account (without Leprak Plant)

NO.	Year	Investment		Annual Expense		Fuel Cost
		Hydro-Power	Steam-Power	Hydro-Power	Steam-Power	Total
1	1984	0	45015	0	0	0
2	1985	0	57877	0	0	0
3	1986	0	25723	0	4681	24234
4	1987	0	45015	0	4681	24234
5	1988	0	86172	0	4681	24234
6	1989	0	49517	0	9362	48468
7	1990	0	63665	0	9362	48468
8	1991	0	28295	0	14512	48468
9	1992	0	77812	0	14512	75247
10	1993	0	113182	0	14512	75247
11	1994	0	91960	0	19624	106630
12	1995	0	45517	0	24813	133287
13	1996	0	63665	0	24813	133287
14	1997	0	0	0	29963	159944
15	1998	0	0	0	29963	159944
16	1999	0	0	0	29963	159944
17	2000	0	0	0	29963	159944
18	2001	0	0	0	29963	159944
19	2002	0	0	0	29963	159944
20	2003	0	0	0	29963	159944
21	2004	0	0	0	29963	159944
22	2005	0	0	0	29963	159944
23	2006	0	0	0	29963	159944
24	2007	0	0	0	29963	159944
25	2008	0	25725	0	29963	159944
26	2009	0	45015	0	29963	159944
27	2010	0	57877	0	29963	159944
28	2011	0	25723	0	29963	159944
29	2012	0	45015	0	29963	159944
30	2013	0	86172	0	29963	159944
31	2014	0	49517	0	29963	159944
32	2015	0	63665	0	29963	159944
33	2016	0	28295	0	29963	159944
34	2017	0	77812	0	29963	159944
35	2018	0	113182	0	29963	159944
36	2019	0	91960	0	29963	159944
37	2020	0	49517	0	29963	159944
38	2021	0	63665	0	29963	159944
39	2022	0	0	0	29963	159944
40	2023	0	0	0	29963	159944

unit:US$10^3

Table-16 Systematized Expenditure Account (with Leprak Plant)

NO.	Year	Investment			Annual Expense			Fuel Cost		
		Hydro-Power	Steam-Power	Total	Hydro-Power	Steam-Power	Total	Case-1	Case-2	Case-3
1	1984	0	45015	45015	0	0	0	0	0	0
2	1985	0	57877	57877	0	0	0	0	0	0
3	1986	0	25723	25723	0	4681	4681	24234	24234	24234
4	1987	0	45015	45015	0	4681	4681	24234	24234	24234
5	1988	1515	86172	86172	0	4681	4681	24234	24234	24234
6	1989	2273	49517	49517	0	9362	9362	48468	48468	48468
7	1990	0	63665	63665	0	9362	9362	48468	48468	48468
8	1991	0	28295	28295	90	14512	14602	47781	47741	47701
9	1992	0	77812	77812	90	14512	14602	74439	74398	74358
10	1993	0	113182	113182	90	14512	14602	75560	74398	74358
11	1994	0	91960	91960	90	19624	19714	105943	105903	105862
12	1995	0	45517	45517	90	24813	24903	132600	132560	132520
13	1996	0	63665	63665	90	24813	24903	132600	132560	132520
14	1997	0	0	0	90	29963	30053	159258	159217	159177
15	1998	0	0	0	90	29963	30053	159258	159217	159177
16	1999	0	0	0	90	29963	30053	159258	159217	159177
17	2000	0	0	0	90	29963	30053	159258	159217	159177
18	2001	0	0	0	90	29963	30053	159258	159217	159177
19	2002	0	0	0	90	29963	30053	159258	159217	159177
20	2003	0	0	0	90	29963	30053	159258	159217	159177
21	2004	0	0	0	90	29963	30053	159258	159217	159177
22	2005	0	0	0	90	29963	30053	159258	159217	159177
23	2006	0	0	0	90	29963	30053	159258	159217	159177
24	2007	0	0	0	90	29963	30053	159258	159217	159177
25	2008	0	25725	25725	90	29963	30053	159258	159217	159177
26	2009	0	45015	45015	90	29963	30053	159258	159217	159177
27	2010	0	57877	57877	90	29963	30053	159258	159217	159177
28	2011	0	25723	25723	90	29963	30053	159258	159217	159177
29	2012	0	45015	45015	90	29963	30053	159258	159217	159177
30	2013	0	86172	86172	90	29963	30053	159258	159217	159177
31	2014	0	49517	49517	90	29963	30053	159258	159217	159177
32	2015	0	63665	63665	90	29963	30053	159258	159217	159177
33	2016	0	28295	28295	90	29963	30053	159258	159217	159177
34	2017	0	77812	77812	90	29963	30053	159258	159217	159177
35	2018	0	113182	113182	90	29963	30053	159258	159217	159177
36	2019	0	91960	91960	90	29963	30053	159258	159217	159177
37	2020	0	49517	49517	90	29963	30053	159258	159217	159177
38	2021	0	63665	63665	90	29963	30053	159258	159217	159177
39	2022	0	0	0	90	29963	30053	159258	159217	159177
40	2023	0	0	0	90	29963	30053	159258	159217	159177

unit;US$10^3

A P P E N D I X - 3

COST ESTIMATION OF

WATER CONSERVATION FACILITY

STANDARD YEAR OF UNIT PRICE : 1982
EXCHANGE RATE : One US$ = 650 RP = 240 YEN

1. INTAKE AT PLANNED PRONOJIWO DAM SITE

(1) Direct Construction Cost

① Excavation (Hard Soil, By Man Power)
$3{,}000\ m^3 \times 1{,}740\ Rp/m^3 = 5{,}200 \times 10^3 Rp$

② Excavation (Hard Soil, By Machine Power)
$11{,}000\ m^3 \times 1{,}180\ Rp/m^3 = 12{,}980 \times 10^3 Rp$

③ Plain Concrete
$2{,}100\ m^3 \times 64{,}230\ Rp/m^3 = 134{,}883 \times 10^3 Rp$

④ Reinforced Concrete
$100\ m^3 \times 171{,}420\ Rp/m^3 = 17{,}142 \times 10^3 Rp$

⑤ Gate
$25\ t \times 2{,}708 \times 10^3\ Rp/t = 67{,}700 \times 10^3 Rp$

Total $= \underline{237.9 \times 10^3 Rp}$

(2) Land Acqusition

$2{,}000\ m^2 \times 390\ Rp/m^2 = \underline{0.8 \times 10^6 Rp}$

2. PUMPING WELL (1) AND PUMPING WELL (2)

Permeability condition: $K = 10^{-3} cm/s$

(1) Direct Constuction Cost

① Well Excavation (per well, 100 m, casing)
$100\ m \times 500{,}000\ Rp/m = \underline{50{,}000 \times 10^3 Rp}$

② Pumping and House (per well st.)

Pumping = $8,124 \times 10^3$ Rp (3.0×10^6 Yen)

House = $25\ m^2 \times 50,000\ Rp/m^2 = 1,250 \times 10^3 Rp$

Total = $9,374 \times 10^3 Rp$

TOTAL = $\underline{59.4 \times 10^3 Rp}$

(2) Land Acquisition

$10\ m \times 10\ m \times 390\ Rp/m^2$ = $\underline{39 \times 10^3 Rp}$

(3) Operation Cost

Well Capacity: $0.05\ m^2/s/well$

Pump : 45 KW/well

Annual EV

$= 45\ KW \times 244 \times 265 = 394.2 \times 10^3 KWH$

$O/C = 76.5 \times 10^{-3} US\$/KWH \times 394.2 \times 10^3\ KWH$

$= 30,156.3\ US\$$

$30,156.3\ US\$ \times 650\ Rp/US\$$ = $\underline{19.6 \times 10^6 Rp}$

(4) Spare Parts

$8,124 \times 10^3$ Rp/6 years = $\underline{1.4 \times 10^6\ Rp}$

(A) Pumping Wells (1) 20 wells

(1) Direct Construction Cost

59.4×10^6 Rp/well x 20 wells = $\underline{1{,}188.0 \times 10^6 \text{Rp}}$

(2) Land Acquisition Cost

0.039×10^6 Rp/well x 20 wells = $\underline{0.8 \times 10^6 \text{Rp}}$

(3) Operation Cost

19.6×10^6 Rp/well/yearl x 20 wells = $\underline{392.0 \times 10^6 \text{Rp/y}}$

(4) Spare Parts Cost

$8{,}124 \times 10^3$ Rp/well/year x 20 wells = $\underline{162.5 \times 10^6 \text{Rp/y}}$

(B) Pumping WElls (1) 40 wells

(1) Direct Construction Cost = $\underline{2{,}376.0 \times 10^6 \text{Rp}}$

(2) Land Acquisition Cost = $\underline{1.6 \times 10^6 \text{Rp}}$

(3) Operation Cost = $\underline{325.0 \times 10^6 \text{Rp/y}}$

(4) Spare Parts Cost = $\underline{325.0 \times 10^6 \text{Rp/y}}$

3. TUNNEL

= 9,160 m

Unit Price 600,000 YEN/m

= 1,625 x 10 Rp/m

Total Direct Construction Cost = $\underline{14,855 \times 10^6 \text{Rp}}$

4. OPEN CHANNEL

Direct Construction Cost

(1) Open Channel Type (1): ℓ = 10,150 m

Unit Price (per meter)

= 72,599 YEN /m + 266,056 Rp/m

= 196,598 Rp/m + 266,056 Rp/m

= 462,654 Rp/m

462,654 Rp/m x 10,150 m = $\underline{4,695.9 \times 10^6 \text{Rp}}$

(2) Open Channel Type (2): ℓ = 1,940 m

Unit Price (per meter)

= 25.929 YEN/m + 178,209 Rp/m

= 70,216 Rp.m + 178,209 Rp/m

= 248,425 Rp/m

248,425 Rp/m x 1,940 m = $\underline{481.9 \times 10^6 \text{Rp}}$

(3) Open Channel Type (3): ℓ = 4,050 m

Unit Price (per meter)

= 16.058 YEN/m + 154,880 Rp/m

= 43,485 Rp/m + 154,880 Rp/m

= 198,365 Rp/m

198,365 Rp/m + 4,050 m = $\underline{803.4 \times 10^6 \text{Rp}}$

(4) Siphon 8 pcs

Unit Price (per pc)

775,160 YEN/pc. + 8,833,260 Rp/pc

= 2,099,133 Rp/pc + 8,833,260 Rp/pc

= 10,932,393 Rp/pc

10,932,393 Rp/pc x 8 pcs = $\underline{87.5 \times 10^6 Rp}$

(5) Tunnel 2,770 m

Unit Price = 541,600 Rp/m (= 200,000 YEN/m)

541,600 Rp/m x 2,770 m = $\underline{1,500.2 \times 10^6 Rp}$

(6) Other Works (Lump Sum) = $\underline{225.0 \times 10^6 Rp}$

TOTAL (1)+(2)+(3)+(4)+(5)+(6) = $\underline{7,793.9 \times 10^6 Rp}$

Land Acquisition

(17.0 m x 10,150 m)+(15.6 m x 1.940 m)+ (15.0 m x 4.050m)

= 263,564 m^2

263,564 m^2 x 75 Rp/m^2 = $\underline{19.8 \times 10^6 Rp}$

5. POWER GEN. ST (1) Qmax = 3.0 m^3/s

(1) Direct Construction Cost

713,556 x 10^3 YEN = $\underline{1,932.3 \times 10^6 Rp}$

(2) Land Acquisition

(5 m x 330 m)+(50 m x 50 m)

= 4,150 m^2

4,150 m^2 x 75 Rp/m^2 = $\underline{0.3 \times 10^6 Rp}$

(3) Maintenance Cost (1) x 1.5%

1.932.3 x 10^6Rp x 0.015 = $\underline{29.0 \times 10^6 Rp}$

6. IRRIGATION OPEN CHANNEL

(1) Direct Construction Cost

① Excavation (Hard Soil, By Machine Power)

201,600 m^3 x 1,180 Rp/m^3 = 237.9 x 10^6 Rp

② Plain Concrete

30 m^3 x 64,230 Rp/m^3 = 1.9 x 10^6Rp

③ Reinforced Concrete

510 m^3 x 171,420 Rp/m^3 = 87.4 x 10^6Rp

④ Gate

15 t x 2,708 x 10^3 Rp/t = 40.6 x 10^6Rp

⑤ Tunnel

541,600 Rp/m x 430 m = 232.9 x 10^6Rp

TOTAL = 600.7 x 10^6Rp

(2) Land Acquisition

134,400 m^3 x 390 Rp/m^3 = 52.4 x 10^6Rp

7. CULTIVATED PADDY FIELD

Unit Price

Dry Field (Sugar Cone): 0

Dry Field(2), Maize, Soy Bean, Cassava: 20,000 Rp/ha

Forest : 420,000 Rp/ha

Devastated Field : 220,000 Rp/ha

Cultivated Field (1) Q = 3.5 m^3/s, 3,500 ha

① Dry Field (1) 303 ha x 0

② Dry Field (2) 2,170 ha x 20,000 Rp/ha = 43.4 x 10^6 Rp

③ Forest 341 ha x 420,000 Rp/ha = 143.2 x 10^6Rp

④ Devastated Field 686 ha x 220,000 Rp/ha = 150.9 x 10^6Rp

TOTAL = 337.5 x 10^6 Rp

Cultivated Field (2) $Q = 4.0\ m^3/s$, 4,000 ha

①	Dry Field (1)	365 ha x 0	
②	Dry Field (2)	2,608 ha x 20,000 Rp/ha	= 52.2 x 10^6Rp
③	Forest	341 ha x 420,000 Rp/ha	= 143.2 x 10^6Rp
④	Devastated Field	686 ha x 220,000 Rp/ha	= 150.9 x 10^6Rp
	TOTAL		= 346.3 x 10^6Rp

Cultivated Field (3) $Q = 4.5\ m^3/s$, 4,500 ha

①	Dry Field (1)	425 ha x 0	
②	Dry Field (2)	3,048 ha x 20,000 Rp/ha	= 61.0 x 10^6Rp
③	Forest	341 ha x 420,000 Rp/ha	= 143.2 x 10^6Rp
④	Devastated Field	686 ha x 220,000 Rp/ha	= 150.9 x 10^6Rp
	TOTAL		= 355.1 x 10^6Rp