

Table 11-12-3(1) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 1  
 TIDAL LEVEL AT ESTUARY : -0. WL=1.524m(H.H.W.L)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KENUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.358	145.494	2.876	143.885	3.100	142.807	5.160	139.356
1	2.361	143.745	2.871	142.662	3.095	141.750	5.162	140.027
2	2.363	142.736	2.867	141.666	3.091	140.981	5.166	141.142
3	2.361	142.442	2.864	141.046	3.088	140.595	5.172	142.584
4	2.356	142.496	2.862	140.862	3.087	140.638	5.180	144.215
5	2.349	142.630	2.860	141.089	3.087	141.096	5.188	145.897
6	2.342	142.775	2.860	141.664	3.089	141.911	5.196	147.508
7	2.337	142.975	2.861	142.516	3.902	142.996	5.203	148.946
8	2.333	143.286	2.863	143.569	3.096	144.255	5.210	150.134
9	2.332	143.726	2.867	144.743	3.100	145.586	5.215	151.023
10	2.333	144.231	2.871	145.953	3.106	146.893	5.218	151.582
11	2.337	144.595	2.876	147.110	3.111	148.091	5.220	151.799
12	2.347	144.683	2.881	148.118	3.116	149.103	5.221	151.679
13	2.359	144.989	2.886	148.912	3.121	149.871	5.219	151.234
14	2.370	145.956	2.891	149.507	3.125	150.372	5.217	150.486
15	2.376	147.403	2.896	149.939	3.128	150.609	5.213	149.460
16	2.379	148.854	2.899	150.198	3.130	150.590	5.207	148.189
17	2.378	149.957	2.901	150.235	3.131	150.314	5.201	146.715
18	2.375	150.584	2.901	150.006	3.130	149.776	5.193	145.105
19	2.372	150.745	2.899	149.497	3.127	148.986	5.185	143.455
20	2.368	150.497	2.896	148.723	3.124	147.970	5.177	141.900
21	2.364	149.891	2.892	147.723	3.119	146.774	5.170	140.595
22	2.360	148.928	2.887	146.553	3.113	145.470	5.165	139.687
23	2.358	147.508	2.882	145.284	3.107	144.145	5.161	139.282

Table 11-12-3(2) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 1  
 TIDAL LEVEL AT ESTUARY : =0.01-1.524m(H.H.W.L)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LENAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L. (m)	Q (m <sup>3</sup> /s)	W.L. (m)	Q (m <sup>3</sup> /s)	W.L. (m)	Q (m <sup>3</sup> /s)	W.L. (m)	Q (m <sup>3</sup> /s)
0	2.359	145.618	2.876	144.990	3.101	142.901	5.160	139.425
1	2.362	143.861	2.871	142.757	3.096	141.838	5.162	140.091
2	2.364	142.844	2.867	141.755	3.091	141.064	5.167	141.203
3	2.362	142.542	2.864	141.130	3.089	140.673	5.173	142.641
4	2.357	142.590	2.862	140.941	3.087	140.711	5.180	144.268
5	2.350	142.719	2.861	141.163	3.087	141.165	5.188	145.946
6	2.343	142.859	2.861	141.734	3.089	141.976	5.196	147.553
7	2.337	143.053	2.862	142.582	3.092	143.057	5.203	148.988
8	2.334	143.360	2.864	143.631	3.096	144.312	5.210	150.174
9	2.332	143.796	2.867	144.801	3.101	145.639	5.215	151.059
10	2.333	144.297	2.871	146.007	3.106	146.943	5.218	151.615
11	2.338	144.656	2.876	147.160	3.111	148.137	5.220	151.830
12	2.347	144.740	2.881	148.164	3.116	149.145	5.222	151.707
13	2.359	145.042	2.886	148.955	3.121	149.911	5.220	151.261
14	2.370	146.005	2.892	149.546	3.125	150.408	5.217	150.510
15	2.377	147.449	2.896	149.975	3.128	150.642	5.213	149.483
16	2.379	148.896	2.900	150.232	3.130	150.621	5.207	148.210
17	2.378	149.996	2.901	150.266	3.131	150.342	5.201	146.735
18	2.375	150.620	2.901	150.035	3.130	149.802	5.193	145.123
19	2.372	150.779	2.900	149.524	3.128	149.011	5.185	143.472
20	2.368	150.528	2.897	148.784	3.124	147.992	5.177	141.916
21	2.364	149.919	2.892	147.746	3.119	146.795	5.170	140.610
22	2.360	148.954	2.887	146.575	3.113	145.489	5.165	139.701
23	2.358	147.532	2.882	145.304	3.107	144.164	5.161	139.296
0	2.359	145.641	2.876	144.005	3.101	142.918	5.161	139.437

Table 11-12-3(4) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 1  
 TIDAL LEVEL AT ESTUARY : =0. WL=0.762m(L.L.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.366	147.379	2.880	143.978	3.103	142.854	5.160	139.425
1	2.357	146.512	2.874	142.967	3.097	141.870	5.162	140.091
2	2.348	145.484	2.868	142.131	3.092	141.169	5.167	141.203
3	2.341	144.416	2.863	141.554	3.089	140.819	5.173	142.641
4	2.335	143.369	2.859	141.292	3.086	140.854	5.180	144.268
5	2.333	142.270	2.857	141.365	3.086	141.270	5.188	145.946
6	2.336	141.094	2.857	141.742	3.087	142.020	5.196	147.554
7	2.343	140.416	2.859	142.380	3.090	143.028	5.203	148.988
8	2.349	140.759	2.863	143.269	3.095	144.214	5.210	150.174
9	2.353	141.968	2.868	144.393	3.101	145.501	5.215	151.059
10	2.355	143.552	2.874	145.668	3.107	146.806	5.218	151.615
11	2.354	145.123	2.897	146.963	3.113	148.034	5.220	151.830
12	2.354	146.511	2.884	148.155	3.118	149.101	5.221	151.707
13	2.354	147.670	2.889	149.156	3.123	149.939	5.220	151.260
14	2.354	148.598	2.892	149.910	3.126	150.507	5.217	150.510
15	2.356	149.280	2.895	150.389	3.128	150.784	5.213	149.482
16	2.358	149.651	2.897	150.579	3.129	150.763	5.207	148.210
17	2.361	149.534	2.898	150.468	3.129	150.449	5.201	146.735
18	2.368	148.850	2.898	150.043	3.128	149.848	5.193	145.123
19	2.377	148.133	2.897	149.315	3.126	148.979	5.185	143.472
20	2.383	147.897	2.896	148.370	3.123	147.887	5.177	141.916
21	2.384	148.045	2.894	147.317	3.119	146.646	5.170	140.610
22	2.381	148.168	2.890	146.217	3.114	145.341	5.165	139.701
23	2.374	147.974	2.886	145.096	3.109	144.054	5.161	139.296
0	2.366	147.402	2.880	143.996	3.103	142.872	5.161	139.437

Table 11-12-3(5) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 2  
 TIDAL LEVEL AT ESTUARY : -0. WL=1.524m(H.H.W.L)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.364	147.066	2.885	146.233	3.111	145.304	5.164	139.499
1	2.368	145.563	2.881	144.904	3.106	143.963	5.160	138.960
2	2.371	144.644	2.877	143.583	3.101	142.680	5.158	138.953
3	2.370	144.264	2.872	142.436	3.096	141.585	5.160	139.473
4	2.364	144.060	2.868	141.566	3.091	140.789	5.163	141.458
5	2.356	143.779	2.864	141.010	3.088	140.361	5.169	141.800
6	2.347	143.384	2.861	140.778	3.086	140.325	5.176	143.368
7	2.339	142.960	2.858	140.872	3.085	140.675	5.184	145.024
8	2.333	142.619	2.857	141.283	3.086	141.371	5.191	146.644
9	2.328	142.434	2.857	141.978	3.088	142.350	5.199	148.121
10	2.327	142.390	2.859	142.901	3.092	143.528	5.206	149.371
11	2.329	142.326	2.862	143.972	3.096	144.807	5.211	150.337
12	2.336	142.130	2.867	145.083	3.101	146.086	5.215	150.984
13	2.348	142.312	2.872	146.147	3.107	147.272	5.218	151.296
14	2.358	143.316	2.879	147.145	3.113	148.301	5.218	151.272
15	2.365	144.945	2.885	148.079	3.118	149.139	5.218	150.921
16	2.368	146.695	2.890	148.904	3.123	149.759	5.215	150.263
17	2.368	148.191	2.894	149.542	3.126	150.132	5.212	149.323
18	2.367	149.280	2.897	149.923	3.128	150.230	5.207	148.129
19	2.366	149.951	2.898	150.011	3.128	150.042	5.200	146.723
20	2.364	150.236	2.898	149.800	3.127	149.572	5.193	145.162
21	2.362	150.163	2.896	149.304	3.125	148.837	5.185	143.533
22	2.361	149.708	2.893	148.544	3.122	147.867	5.178	141.959
23	2.361	148.739	2.890	147.550	3.117	146.706	5.170	140.591

Table 11-12-3(6) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 2  
 TIDAL LEVEL AT ESTUARY : -0.WL=1.524m(H.H.W.L)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.364	147.213	2.886	146.351	3.112	145.412	5.164	139.577
1	2.369	145.699	2.881	145.014	3.106	144.064	5.160	139.033
2	2.372	144.769	2.877	143.685	3.101	142.775	5.159	139.022
3	2.370	144.380	2.873	142.532	3.096	141.674	5.160	139.539
4	2.365	144.168	2.869	141.656	3.092	140.873	5.163	140.519
5	2.356	143.881	2.865	141.094	3.088	140.440	5.169	141.857
6	2.348	143.479	2.861	140.857	3.086	140.400	5.176	143.421
7	2.340	143.050	2.859	140.947	3.085	140.745	5.184	145.074
8	2.333	142.704	2.857	141.353	3.086	141.437	5.192	146.691
9	2.329	142.513	2.858	142.044	3.088	142.412	5.199	148.163
10	2.327	142.465	2.859	142.964	3.092	143.585	5.206	149.410
11	2.329	142.396	2.863	144.030	3.096	144.860	5.211	150.374
12	2.337	142.196	2.867	145.137	3.102	146.136	5.215	151.018
13	2.348	142.374	2.873	146.198	3.107	147.319	5.218	151.327
14	2.358	143.374	2.879	147.192	3.113	148.344	5.219	151.301
15	2.365	144.998	2.885	148.122	3.119	149.179	5.218	150.948
16	2.368	146.745	2.890	148.944	3.123	149.796	5.216	150.288
17	2.368	148.237	2.894	149.579	3.126	150.166	5.212	149.346
18	2.368	149.323	2.897	149.957	3.128	150.261	5.207	148.151
19	2.366	149.990	2.898	150.043	3.129	150.071	5.201	146.743
20	2.364	150.273	2.898	149.830	3.128	149.599	5.193	144.932
21	2.363	150.197	2.896	149.331	3.125	148.862	5.186	143.550
22	2.361	149.739	2.894	148.569	3.122	147.890	5.178	141.976
23	2.361	148.768	2.890	147.573	3.117	146.727	5.170	140.606
0	2.364	147.240	2.886	146.372	3.112	145.432	5.164	139.591

Table 11-12-3(7) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 2  
 TIDAL LEVEL AT ESTUARY : =0, WL=0.762m(I.L.W.I)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.371	148.832	2.889	146.224	3.113	145.257	5.164	139.499
1	2.363	148.215	2.883	145.114	3.108	143.995	5.160	138.960
2	2.356	147.284	2.877	143.961	3.101	142.785	5.153	138.952
3	2.349	146.143	2.871	142.864	3.096	141.733	5.160	139.473
4	2.343	144.846	2.865	141.921	3.090	140.935	5.163	140.458
5	2.339	143.336	2.860	141.214	3.086	140.467	5.169	141.800
6	2.340	141.621	2.857	140.786	3.084	140.370	5.176	143.368
7	2.344	140.316	2.855	140.667	3.083	140.645	5.184	145.025
8	2.348	140.003	2.856	140.916	3.085	141.271	5.191	146.644
9	2.350	140.592	2.858	141.566	3.088	142.211	5.199	148.121
10	2.348	141.637	2.862	142.560	3.092	143.390	5.206	149.371
11	2.346	142.789	2.866	143.775	3.098	144.705	5.211	150.337
12	2.343	143.901	2.870	145.075	3.103	146.042	5.215	150.984
13	2.342	144.940	2.875	146.346	3.109	147.300	5.218	151.296
14	2.342	145.903	2.879	147.505	3.114	148.398	5.218	151.272
15	2.344	146.764	2.884	148.487	3.118	149.277	5.218	150.921
16	2.346	147.438	2.887	149.246	3.122	149.898	5.215	150.263
17	2.352	147.722	2.891	149.741	3.125	150.236	5.212	149.323
18	2.360	147.507	2.893	149.931	3.126	150.275	5.207	148.129
19	2.371	147.312	2.895	149.805	3.127	150.012	5.200	146.723
20	2.380	147.621	2.897	149.428	3.127	149.469	5.193	145.162
21	2.383	148.306	2.897	148.880	3.125	148.690	5.185	143.533
22	2.382	148.934	2.896	148.190	3.123	147.721	5.179	141.959
23	2.378	149.189	2.894	147.344	3.119	146.597	5.170	140.591

Table 11-12-3(8) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 2  
 TIDAL LEVEL AT ESTUARY : -0.672m(L.L.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.371	148.978	2.889	146.342	3.114	145.366	5.164	139.577
1	2.364	148.350	2.884	145.224	3.108	144.096	5.160	139.033
2	2.357	147.410	2.878	144.064	3.102	142.880	5.159	139.022
3	2.349	146.260	2.872	142.960	3.096	141.822	5.160	139.538
4	2.343	144.955	2.866	142.012	3.091	141.018	5.163	140.519
5	2.340	143.438	2.861	141.299	3.087	140.546	5.169	141.857
6	2.341	141.716	2.857	140.866	3.084	140.444	5.176	143.421
7	2.345	140.405	2.856	140.742	3.084	140.715	5.184	145.074
8	2.349	140.087	2.856	140.986	3.095	141.337	5.192	146.691
9	2.305	140.671	2.859	141.632	3.088	142.273	5.199	148.164
10	2.349	141.711	2.862	142.622	3.093	143.448	5.206	149.410
11	2.346	142.859	2.866	143.833	3.098	144.759	5.211	150.374
12	2.051	144.100	2.871	145.129	3.104	146.092	5.125	151.018
13	2.342	145.002	2.875	146.397	3.109	147.347	5.218	151.327
14	2.342	145.961	2.880	147.552	3.114	148.441	5.219	151.301
15	2.344	146.818	2.884	148.530	3.118	149.317	5.218	150.948
16	2.347	147.488	2.888	149.286	3.122	149.935	5.216	150.288
17	2.352	147.768	2.891	149.778	3.125	150.270	5.212	149.346
18	2.361	147.550	2.893	149.965	3.126	150.307	5.207	148.151
19	2.371	147.352	2.895	149.837	3.127	150.041	5.201	146.743
20	2.380	147.657	2.897	149.458	3.127	149.496	5.193	145.180
21	2.384	148.340	2.897	148.907	3.125	148.715	5.186	143.550
22	2.382	148.965	2.896	148.215	3.123	147.744	5.178	141.976
23	2.378	149.218	2.894	147.367	3.119	146.619	5.170	140.606
0	2.372	149.004	2.889	146.364	3.114	145.386	5.164	139.591

Table 11-12-3(9) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 3  
 TIDAL LEVEL AT ESTUARY : F=0, WL=1.524m(H.H.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.349	143.371	2.864	141.687	3.089	140.689	5.157	139.180
1	2.352	141.639	2.860	140.706	3.085	139.970	5.162	140.367
2	2.354	140.741	2.857	140.042	3.082	139.618	5.168	141.860
3	2.352	140.641	2.855	139.815	3.081	139.687	5.176	143.520
4	2.348	140.956	2.855	140.046	3.082	140.178	5.184	145.209
5	2.342	141.396	2.855	140.673	3.084	141.035	5.192	146.806
6	2.337	141.870	2.857	141.597	3.087	142.165	5.200	148.213
7	2.333	142.392	2.860	142.717	3.092	143.460	5.206	149.360
8	2.330	142.994	2.863	143.942	3.097	144.813	5.211	150.198
9	2.330	143.670	2.867	145.185	3.102	146.126	5.214	150.702
10	2.332	144.339	2.872	146.364	3.107	147.317	5.216	150.864
11	2.338	144.785	2.877	147.401	3.112	148.315	5.216	150.690
12	2.347	144.873	2.882	148.216	3.117	149.067	5.215	150.196
13	2.630	145.106	2.886	148.763	3.120	149.535	5.212	149.402
14	2.370	145.933	2.891	149.074	3.123	149.711	5.207	148.337
15	2.376	147.189	2.894	149.203	3.125	149.618	5.202	147.033
16	2.377	148.410	2.896	149.153	3.126	149.276	5.195	145.532
17	2.376	149.260	2.896	148.886	3.125	148.690	5.187	143.902
18	2.372	149.619	2.895	148.369	3.122	147.870	5.179	142.246
19	2.367	149.512	2.892	147.598	3.119	146.835	5.171	140.704
20	2.362	149.005	2.888	146.602	3.114	145.629	5.164	139.437
21	2.357	148.163	2.883	145.440	3.108	144.321	5.159	138.590
22	2.352	147.004	2.877	144.192	3.102	143.006	5.156	138.263
23	2.349	145.443	2.871	142.944	3.095	141.789	5.155	138.492



Table 11-12-3(10) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 3  
 TIDAL LEVEL AT ESTUARY : t=0, WL=1.524m(H.H.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.349	143.483	2.865	141.779	3.090	140.774	5.158	139.242
1	2.352	141.744	2.860	140.792	3.085	140.050	5.162	140.425
2	2.354	140.838	2.857	140.123	3.082	139.693	5.169	141.915
3	2.353	140.732	2.856	139.891	3.081	139.758	5.176	143.571
4	2.348	141.041	2.855	140.118	3.082	140.245	5.184	145.256
5	2.343	141.477	2.856	140.741	3.084	141.098	5.192	146.850
6	2.337	141.946	2.857	141.660	3.088	142.224	5.200	148.254
7	2.333	142.464	2.860	142.777	3.092	143.505	5.206	149.397
8	2.331	143.062	2.863	143.998	3.097	144.864	5.211	150.232
9	2.331	143.734	2.868	145.237	3.102	146.174	5.214	150.734
10	2.333	144.399	2.872	146.412	3.107	147.361	5.216	150.894
11	2.338	144.840	2.877	147.446	3.112	148.356	5.216	150.718
12	2.348	144.924	2.882	148.257	3.117	149.105	5.215	150.221
13	2.660	145.154	2.886	148.801	3.120	149.569	5.212	149.426
14	2.370	145.977	2.891	149.110	3.123	149.910	5.207	148.359
15	2.376	147.229	2.894	149.235	3.125	149.648	5.202	147.053
16	2.378	148.448	2.896	149.183	3.126	149.303	5.195	145.551
17	2.376	149.294	2.897	148.914	3.125	148.716	5.187	143.920
18	2.372	149.651	2.895	148.394	3.123	147.894	5.179	142.263
19	2.367	149.541	2.892	147.621	3.119	146.857	5.171	140.720
20	2.362	149.032	2.888	146.624	3.114	145.649	5.164	139.451
21	2.357	148.188	2.883	145.461	3.108	144.340	5.159	138.603
22	2.352	147.027	2.877	144.211	3.102	143.024	5.156	138.276
23	2.349	145.465	2.871	142.962	3.096	141.806	5.156	138.504
0	2.349	143.504	2.865	141.796	3.090	140.790	5.158	139.254

Table 11-12-3(11) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 3  
 TIDAL LEVEL AT ESTUARY : t=0, WL=0.762m(L.L.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.356	145.134	2.868	141.678	3.091	140.643	5.157	139.180
1	2.347	144.290	2.863	140.914	3.087	140.001	5.162	140.366
2	2.338	143.372	2.858	140.414	3.083	139.720	5.168	141.860
3	2.331	142.501	2.854	140.233	3.081	139.829	5.176	143.520
4	2.326	141.723	2.852	140.393	3.081	140.318	5.184	145.209
5	2.325	140.941	2.852	140.872	3.082	141.138	5.192	146.806
6	2.330	140.101	2.853	141.605	3.085	142.209	5.200	148.214
7	2.338	139.758	2.857	142.518	3.090	143.432	5.206	149.360
8	2.346	140.403	2.862	143.584	3.096	144.717	5.211	150.198
9	2.352	141.853	2.868	144.780	3.102	144.780	5.214	150.702
10	2.354	143.601	2.875	146.026	3.108	146.181	5.216	150.864
11	2.354	145.257	2.880	147.205	3.114	148.213	5.216	150.690
12	2.354	146.648	2.885	148.208	3.118	149.022	5.215	150.196
13	2.354	147.737	2.889	148.965	3.122	149.563	5.212	149.402
14	2.354	148.529	2.891	149.439	3.124	149.811	5.207	148.337
15	2.355	149.023	2.893	149.618	3.125	149.761	5.202	147.033
16	2.356	149.167	2.893	149.501	3.125	149.418	5.195	145.532
17	2.359	148.798	2.893	149.089	3.123	148.797	5.187	143.902
18	2.365	147.848	2.891	148.377	3.121	147.916	5.179	142.246
19	2.372	146.863	2.889	147.388	3.117	146.804	5.171	140.704
20	2.377	146.371	2.887	146.225	3.113	145.523	5.164	139.437
21	2.377	146.288	2.884	145.012	3.108	144.173	5.159	138.590
22	2.373	146.218	2.879	143.835	3.103	142.859	5.156	138.263
23	2.365	145.886	2.874	142.737	3.097	141.681	5.155	138.492

Table 11-12-3(12) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 3  
 TIDAL LEVEL AT ESTUARY : (L=0, WL=0.762m(L.L.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KENUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.356	145.246	2.869	141.770	3.092	140.729	5.158	139.242
1	2.347	144.394	2.863	141.000	3.087	140.081	5.162	140.425
2	2.339	143.470	2.858	140.495	3.083	139.796	5.169	141.915
3	2.332	142.593	2.855	140.310	3.081	139.901	5.176	143.571
4	2.327	141.810	2.853	140.465	3.081	140.385	5.184	145.256
5	2.326	141.022	2.852	140.940	3.083	141.201	5.192	146.850
6	2.330	140.177	2.854	141.668	3.086	142.268	5.200	148.254
7	2.338	139.830	2.857	142.577	3.090	143.487	5.206	149.397
8	2.347	140.470	2.863	143.639	3.096	144.768	5.211	150.233
9	2.352	141.916	2.869	144.832	3.102	146.038	5.214	150.734
10	2.354	143.660	2.875	146.074	3.108	147.225	5.216	150.894
11	2.355	145.311	2.881	147.249	3.114	148.254	5.216	150.718
12	2.354	146.699	2.885	148.249	3.119	149.060	5.125	150.221
13	2.354	147.784	2.889	149.003	3.122	149.598	5.212	149.426
14	2.355	148.573	2.892	149.474	3.124	149.843	5.207	148.359
15	2.355	149.064	2.893	149.651	3.125	149.791	5.202	147.053
16	2.356	149.205	2.894	149.531	3.125	149.446	5.195	145.551
17	2.359	148.833	2.893	149.117	3.123	148.823	5.187	143.920
18	2.365	147.881	2.892	148.402	3.121	147.940	5.179	142.263
19	2.372	146.893	2.890	147.412	3.117	146.825	5.171	140.720
20	2.377	146.399	2.887	146.247	3.113	145.544	5.164	139.451
21	2.378	146.313	2.884	145.033	3.108	144.192	5.159	138.603
22	2.373	146.241	2.880	143.854	3.103	142.877	5.156	138.276
23	2.366	145.908	2.874	142.755	3.097	141.697	5.156	138.504
0	2.356	145.266	2.869	141.787	3.092	140.744	5.158	139.254

Table 11-12-3(13) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 4  
 TIDAL LEVEL AT ESTUARY : (t=0, WL=1.524m(H.H.W.L))  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.341	141.751	2.856	140.156	3.081	139.245	5.154	138.712
1	2.344	140.077	2.852	139.332	3.077	138.719	5.160	140.058
2	2.347	139.277	2.850	138.849	3.075	138.575	5.167	141.634
3	2.346	139.302	2.849	138.811	3.075	138.844	5.175	143.302
4	2.342	139.760	2.849	139.220	3.077	139.510	5.183	144.934
5	2.336	140.347	2.851	139.997	3.080	140.499	5.190	146.421
6	2.332	140.961	2.853	141.031	3.084	141.712	5.197	147.681
7	2.328	141.607	2.856	142.217	3.089	143.035	5.203	148.656
8	2.327	142.305	2.860	143.459	3.094	144.366	5.207	149.312
9	2.327	143.045	2.864	144.675	3.099	145.613	5.209	149.632
10	2.329	143.741	2.869	145.788	3.104	146.702	5.210	149.617
11	2.335	144.176	2.873	146.728	3.109	147.574	5.210	149.277
12	2.344	144.219	2.878	147.425	3.113	148.184	5.207	148.631
13	2.356	144.381	2.882	147.839	3.116	148.503	5.204	147.705
14	2.366	145.117	2.886	148.012	3.118	148.531	5.199	146.525
15	2.372	146.267	2.889	148.002	3.119	148.295	5.192	145.130
16	2.373	147.372	2.890	147.818	3.119	147.819	5.185	143.572
17	2.371	148.101	2.890	147.427	3.118	147.114	5.177	141.935
18	2.366	148.342	2.888	146.800	3.115	146.193	5.169	140.340
19	2.361	148.122	2.884	145.938	3.110	145.083	5.162	138.942
20	2.355	147.516	2.880	144.880	3.105	143.837	5.156	137.895
21	2.349	146.595	2.874	143.694	3.099	142.537	5.152	137.321
22	2.344	145.382	2.868	142.466	3.093	141.282	5.150	137.288
23	2.341	143.801	2.862	141.289	3.087	140.179	5.151	137.793

Table 11-12-3(14) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATTERN CASE 4  
 TIDAL LEVEL AT ESTUARY : t=0, WL=1.524m(H.H.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LENAL. (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.342	141.856	2.857	140.243	3.082	139.325	5.155	138.771
1	2.345	140.176	2.853	139.413	3.078	138.795	5.160	140.113
2	2.347	139.368	2.850	138.926	3.076	138.646	5.167	141.686
3	2.346	139.388	2.849	138.883	3.076	138.912	5.175	143.350
4	2.342	139.840	2.850	139.288	3.077	139.573	5.183	144.978
5	2.337	140.423	2.851	140.060	3.080	140.559	5.191	146.462
6	2.332	141.033	2.853	141.091	3.084	141.767	5.197	147.719
7	2.329	141.674	2.856	142.273	3.089	143.087	5.203	148.691
8	2.327	142.369	2.860	143.512	3.094	144.414	5.207	149.344
9	2.327	143.105	2.865	144.724	3.099	145.658	5.209	149.662
10	2.329	143.797	2.869	145.833	3.104	146.743	5.210	149.645
11	2.335	144.228	2.874	146.779	3.109	147.612	5.210	149.303
12	2.344	144.267	2.878	147.463	3.113	148.219	5.207	148.655
13	2.357	144.426	2.882	147.875	3.116	148.535	5.204	147.727
14	2.367	145.158	2.886	148.045	3.118	148.561	5.199	146.546
15	2.372	146.304	2.889	148.032	3.119	148.323	5.193	145.149
16	2.373	147.407	2.890	147.846	3.119	147.844	5.185	143.590
17	2.371	148.133	2.890	147.453	3.118	147.138	5.177	141.951
18	2.366	148.372	2.888	146.823	3.115	146.215	5.169	140.356
19	2.361	148.150	2.885	145.960	3.111	145.103	5.162	138.957
20	2.355	147.542	2.880	144.901	3.105	143.856	5.156	137.908
21	2.350	146.618	2.874	143.713	3.099	142.555	5.152	137.334
22	2.344	145.405	2.868	142.484	3.093	141.298	5.150	137.300
23	2.341	143.822	2.862	141.306	3.087	140.195	5.151	137.804
0	2.342	141.876	2.857	140.259	3.082	139.340	5.155	138.781

Table 11-12-3(15) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION  
 LEBIR DAM DISCHARGE PATIERN CASE 4  
 TIDAL LEVEL AT ESTUARY : (t=0, WL=0.762m(L.L.W.L.)  
 (Consecutive Periodical Discharge) (Data on the 6th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KENUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.348	143.517	2.860	140.147	3.083	139.199	5.154	138.712
1	2.339	142.727	2.855	139.537	3.079	138.749	5.160	140.058
2	2.331	141.902	2.851	139.218	3.076	138.675	5.559	141.898
3	2.324	141.145	2.848	139.226	3.075	138.985	5.175	143.302
4	2.320	140.519	2.847	139.563	3.076	139.647	5.183	144.934
5	2.320	139.886	2.847	140.194	3.078	140.601	5.190	146.421
6	2.325	139.187	2.849	141.039	3.082	141.755	5.197	147.681
7	2.334	138.974	2.854	142.019	3.087	143.008	5.203	148.656
8	2.342	139.720	2.859	143.103	3.093	144.271	5.207	149.312
9	2.348	141.235	2.865	144.272	3.099	145.478	5.209	149.632
10	2.351	143.008	2.872	145.452	3.105	146.567	5.210	149.617
11	2.351	144.651	2.877	146.533	3.110	147.473	5.210	149.277
12	2.351	145.997	2.881	147.416	3.114	148.140	5.207	148.631
13	2.351	147.014	2.885	148.040	3.117	148.531	5.204	147.704
14	2.351	147.713	2.887	148.376	3.119	148.630	5.199	146.525
15	2.351	148.099	2.888	148.416	3.119	148.437	5.192	145.130
16	2.532	148.127	2.888	148.165	3.118	147.961	5.185	143.572
17	2.354	147.638	2.886	147.629	3.116	147.221	5.177	141.935
18	2.359	146.569	2.884	146.808	3.113	146.239	5.169	140.341
19	2.366	145.473	2.882	145.730	3.109	145.052	5.162	138.942
20	2.371	144.885	2.879	144.505	3.104	143.733	5.156	137.895
21	2.370	144.724	2.875	143.268	3.099	142.390	5.152	137.322
22	2.366	144.660	2.871	142.111	3.094	141.137	5.150	137.288
23	2.358	144.247	2.866	141.084	3.089	140.072	5.151	137.792

Table 11-12-3(16) RESULT OF UNSTEADY FLOW ANALYSIS OF PUMPING STATION

LEBIR DAM DISCHARGE PATTERN CASE 4

TIDAL LEVEL AT ESTUARY : T=0, WL=0.672m(L.L.W.)

(Consecutive Periodical Discharge) (Data on the 7th Day)

P.S. (HR)	PASIR MAS. (15.0km)		LEMAL (20.0km)		SALOR (22.0km)		KEMUBU (33.0km)	
	W.L.	Q	W.L.	Q	W.L.	Q	W.L.	Q
	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)	(m)	(m <sup>3</sup> /s)
0	2.349	143.622	2.860	140.234	3.084	139.280	5.155	138.771
1	2.340	142.825	2.855	139.619	3.080	138.825	5.160	140.113
2	2.331	141.994	2.851	139.295	3.077	138.747	5.167	141.686
3	2.325	141.240	2.848	139.298	3.076	139.052	5.175	143.350
4	2.320	140.601	2.847	139.631	3.076	139.711	5.183	144.978
5	2.320	139.963	2.847	140.258	3.079	140.660	5.191	146.462
6	2.325	139.260	2.850	141.099	3.082	141.811	5.197	147.719
7	2.334	139.041	2.854	142.075	3.087	143.059	5.203	148.692
8	2.343	139.783	2.859	143.155	3.093	144.319	5.207	149.344
9	2.348	141.294	2.866	144.321	3.099	145.523	5.209	149.662
10	2.351	143.063	2.872	145.497	3.105	146.608	5.210	149.645
11	2.352	144.703	2.877	146.575	3.111	147.511	5.210	149.303
12	2.351	146.045	2.882	147.455	3.115	148.175	5.207	148.655
13	2.351	147.058	2.885	148.076	3.118	148.564	5.204	147.727
14	2.351	147.754	2.887	148.409	3.119	148.660	5.199	146.546
15	2.351	148.138	2.888	148.446	3.119	148.465	5.193	145.149
16	2.352	148.162	2.888	148.194	3.118	147.987	5.185	143.590
17	2.354	147.671	2.887	147.655	3.116	147.244	5.177	141.951
18	2.359	146.599	2.885	146.832	3.113	146.261	5.169	140.356
19	2.366	145.501	2.882	145.752	3.109	145.073	5.162	138.957
20	2.371	144.910	2.879	144.525	3.104	143.752	5.156	137.908
21	2.371	144.747	2.875	143.287	3.099	142.408	5.152	137.334
22	2.366	144.622	2.871	142.129	3.094	141.153	5.150	137.300
23	2.358	144.267	2.866	141.101	3.089	140.088	5.151	137.804
0	2.349	143.641	2.860	140.250	3.084	139.295	5.155	138.781

Table 13-1

## UNIT RATE BUILD-UP

1. Quarry rock extraction (V=4,090,000m3)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)	REMARKS
(1). Drilling equipment						
(1)-1	Crawler drill	hr	45,444.00	72.15	3,278,784.60	
(1)-2	Compressor	hr	45,444.00	21.87	993,860.28	
(1)-3	Allowance	(1)-1*3%			98,363.54	
	Subtotal (1)				4,371,008.42	
(2). Heavy equipment						
(2)-1	Tractor shovel 988B	hr	4,085.00	137.31	560,911.35	
(2)-2	Dump truck 769B	hr	70,466.00	108.02	7,611,737.32	
(2)-3	Bulldozer D8	hr	18,836.00	86.67	1,632,516.12	
	Subtotal (2)				9,805,164.79	
(3). Blasting materials						
(3)-1	Dynamite	kg	286,000.00	14.08	4,026,880.00	
(3)-2	An-Fo	kg	1,146,000.00	0.96	1,100,160.00	
(3)-3	Detonator (electric)	No	114,520.00	1.70	194,684.00	
	Subtotal (3)				5,321,724.00	
(4). Fuel Lubricant & Electricity						
(4)-1	Fuel	liter	3,375,915.60	0.40	1,350,366.24	
(4)-2	Lubricant	(5)-1*20%			270,073.25	
	Subtotal (4)				1,620,439.49	
(5). Labour						
(5)-1	Foreman	hr	3,351.00	10.04	33,644.04	
(5)-2	Ganger	hr	13,404.00	4.81	64,473.24	
(5)-3	Crawler drill Operator	hr	45,444.00	5.23	237,672.12	
(5)-4	Ditto ,Assistant	hr	22,722.00	3.03	68,847.66	
(5)-5	Operator (Equipment)	hr	25,239.00	4.81	121,399.59	
(5)-6	Ditto ,Assistant	hr	4,085.00	3.44	14,052.40	
(5)-7	General labour	hr	25,239.00	2.48	62,592.72	
	Subtotal (5)				602,681.77	
(6). Subtotal	(1) to (5)				21,721,018.47	
(7). Rock production total	(6)/4,700,000				4.62	



2. Aggregate production							REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)		
(1). Rock material		m3	1.20	4.62	5.54		
(2). Crushing plant	300t/hr						
(2)-1	Aggregate production equipment	hr	1.00	194.58	194.58		
(2)-2	Allowance	(2)-1*2%			3.89		
(2)-3	Submergible pump (50kw, ø 150)	hr	1.00	1.97	1.97		
(2)-4	Turbine pump (55kw, ø 150)	hr	2.00	1.79	3.58		
(2)-5	Tractor shovel 988B	hr	0.50	137.31	68.66		
	Subtotal (2)				272.68		
(3). Fuel, Lubricant & Electricity							
(3)-1	Fuel	liter	37.50	0.40	15.00		
(3)-2	Lubricant	(3)-1*20%			3.00		
(3)-3	Electricity	kwh	400.00	0.20	80.00		
	Subtotal (3)				98.00		
(4). Labour							
(4)-1	Foreman	hr	0.25	10.04	2.51		
(4)-2	Ganger	hr	1.00	4.81	4.81		
(4)-3	Assistant	hr	3.00	3.44	10.32		
(4)-4	General labour	hr	5.00	2.48	12.40		
	Subtotal (4)				30.04		
(5). Allowance (2) to (4) *5%					20.04		
(6). Subtotal (2) to (5)					420.76		
(7). Aggregate production cost							
	(6)/270 t/hr	(per ton)			4.33		for aggregate & filter
	(6)/135 m3/hr	(per m3)			8.66		for rockfill

























13. Embankment , core - 1							REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)		
(1). Equipment - (1)							
(1)-1	Tractor shovel 988B 375HP	hr	2,003.00	137.31	275,031.93	Including disposal of overburden V=53,100m3	
(1)-2	Dump truck 769B 415HP	hr	16,506.00	108.02	1,782,978.12		
(1)-3	Bulldozer D8 300HP	hr	5,178.00	86.57	448,777.26		
	Subtotal (1)				2,506,787.31		
	(Subtotal (1)/702,900)				3.57		
(2). Fuel & Lubricant - (1)							
(2)-1	Fuel	liter	1,830,903.00	0.40	732,361.20		
(2)-2	Lubricant	(2)-1*20%			146,472.24		
	Subtotal (2)				878,833.44		
	(Subtotal (2)/702,900)				1.25		
(3). Labour - (1)							
(3)-1	Foreman	hr	268.00	10.01	2,682.68		
(3)-2	Ganger	hr	1,071.00	4.81	5,151.51		
(3)-3	Operator (Equipment)	hr	23,687.00	4.81	113,934.47		
(3)-4	Ditto , Assistant	hr	5,108.00	3.44	17,571.52		
(3)-5	General labour	hr	417.00	2.48	1,034.16		
	Subtotal (3)				140,374.34		
	(Subtotal (3)/702,900)				0.20		
(4). Equipment - (2)							
(4)-1	Bulldozer	hr	2,405.00	86.67	208,441.35		
(4)-2	Tamping roller	hr	194.00	17.79	3,451.26		
	Subtotal (4)				211,892.61		
	(Subtotal (4)/391,600)				0.54		
(5). Fuel & Lubricant							
(5)-1	Fuel	liter	104,269.20	0.40	41,707.68		
(5)-2	Lubricant	(5)-1*20%			8,341.54		
	Subtotal (5)				50,049.22		
	(Subtotal (5)/391,600)				0.13		











17. Tunnel excavation - 1							REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)		
1. Upper half							
(1). Equipment (V=94,600m3)							
(1)-1 Tractor shovel 915H 185HP		hr	415.00	81.62	33,872.30		
(1)-2 Bulldozer D8 300HP		hr	415.00	86.67	35,968.05		
(1)-3 Dump truck 769E 415HP		hr	2,956.00	108.02	319,307.12		
Subtotal (1)					389,147.47		
(Subtotal (1)/94,600)					4.11		
(2). Fuel & Lubricant							
(2)-1 Fuel		liter	285,603.00	0.40	114,241.20		
(2)-2 Lubricant		(4)-1*20%			22,848.24		
Subtotal (2)					137,089.44		
(Subtotal (2)/94,600)					1.45		
(3). Drilling equipment (V=468m3)							
(3)-1 Jumbo drill		hr	6.77	990.99	6,709.00		
(3)-2 Allowance		((3)-1+(3)-2)*5%			335.45		
Subtotal (3)					7,044.45		
(Subtotal (3)/468)					15.05		
(4). Other equipment (1 day)							
(4)-1 Blower		day	1.00	167.72	167.72		
(4)-2 Water pump		day	1.00	10.01	10.01		
Subtotal (4)					177.73		
(Subtotal (4)/468)					0.38		
(5). Electricity							
(5)-1 Pump, Blower & Lighting		day	4,479.25	0.20	895.85		
Subtotal (5)					895.85		
(Subtotal (5)/468)					1.91		

17. Tunnel excavation -2							REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)		
(6). Labour							
(6)-1	Foreman	hr	208.00	10.01	2,082.08		
(6)-2	Ganger	hr	830.00	4.81	3,992.30		
(6)-3	Crawler operator	hr	1,395.00	5.23	7,295.85		
(6)-4	Ditto ,Assistant	hr	697.00	3.03	2,111.91		
(6)-5	Operator (Equipment)	hr	3,786.00	4.81	18,210.66		
(6)-6	Ditto ,Assistant	hr	1,245.00	3.44	4,282.80		
(6)-7	General labour	hr	830.00	2.48	2,058.40		
	Subtotal (6)				40,034.00		
	(Subtotal (6)/94,600)				0.42		
	Upper half total				23.32		
2. Lower half	(V=94,600m3)						
(1). Equipment							
(1)-1	Tractor shovel 915H	hr	415.00	81.62	33,872.30		
(1)-2	Bulldozor D8	hr	415.00	86.67	35,968.05		
(1)-3	Dump truck 769B	hr	2,956.00	108.02	319,307.12		
	Subtotal (1)				389,147.47		
	(Subtotal (1)/94,600)				4.11		
(2). Fuel & Lubricant							
(2)-1	Fuel	liter	285,603.00	0.40	114,241.20		
(2)-2	Lubricant	(4)-1*20%			22,648.24		
	Subtotal (2)				137,089.44		
	(Subtotal (2)/94,600)				1.45		
(3). Drilling equipment (V=468m3)							
(3)-1	Jumbo drill	hr	4.40	990.99	4,360.36		
(3)-2	Allowance	((3)-1+(3)-2)*2%			87.21		
	Subtotal (3)				4,447.57		
	(Subtotal (3)/468)				9.50		

17. Tunnel excavation -3

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)	REMARKS
(4). Other equipment (1 day)						
(4)-1	Blower	day	1.00	167.72	167.72	
(4)-2	Water pump	day	1.00	10.01	10.01	
	Subtotal (4)				177.73	
	(Subtotal (4)/468)				0.38	
(5). Electricity						
(5)-1	Pump, Blower & Lighting	day	4,479.25	0.20	895.85	
	Subtotal (5)				895.85	
	(Subtotal (5)/468)				1.91	
(6). Labour						
(6)-1	Foreman	hr.	208.00	10.01	2,082.08	
(6)-2	Ganger	hr	830.00	4.81	3,992.30	
(6)-3	Crawler operator	hr	889.00	5.23	4,649.47	
(6)-4	Ditto, Assistant	hr	445.00	3.03	1,348.35	
(6)-5	Operator (Equipment)	hr	3,786.00	4.81	18,210.66	
(6)-6	Ditto, Assistant	hr	1,245.00	3.44	4,282.80	
(6)-7	General labour	hr	830.00	2.48	2,058.40	
	Subtotal (6)				36,624.06	
	(Subtotal (6)/94,600)				0.39	
	Lower half total				17.74	
3. Total of ( Upper half + Lower half ) *1/2						
	= ( 23.32 + 17.74 ) *1/2 =				20.53	
4. Blasting materials						
4-(1)	Dynamite	kg	702.00	14.08	9,884.16	
4-(2)	Detonator	No	287.00	1.70	487.90	
	Subtotal 3				10372.06	
	(Subtotal 3/468)				22.16	
5. Allowance ( 3.+ 4.)*2%						
					0.85	
6. General Overhead ( 3.+ 4.+ 5.)*35%						
					15.24	
	TOTAL				58.78	



19. Concrete, open						REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)	
(1) Materials						
(1)-1	Concrete	m3	1.00	94.86	94.86	
(1)-2	Formwork	m2	0.55	12.77	7.02	
	Subtotal (1)				101.88	
(2) Equipment						
	30m3/hr					
(2)-1	Truck mixer (4.5m3)	hr	3.33	21.15	70.43	
(2)-2	Concrete pump 60m3/hr	hr	1.00	66.05	66.05	
(2)-3	Truck crane (25t)	hr	0.50	57.81	28.91	
(2)-4	Allowance	((2)-1+(2)-2)*5%			6.82	
	Subtotal (2)				172.21	
	(Subtotal (2)/30)				5.74	
(3) Labour						
(3)-1	Foreman	hr	0.20	10.01	2.00	
(3)-2	Ganger	hr	1.00	4.81	4.81	
(3)-3	Concrete and concrete vibrator	hr	3.00	3.58	17.90	
(3)-4	General labour	hr	3.00	2.48	7.44	
(3)-5	Mechanician	hr	0.20	5.23	1.05	
(3)-6	Electrician	hr	0.20	5.23	1.05	
(3)-7	Operator	hr	3.33	4.81	16.02	
(3)-8	Operator (Crane)	hr	0.50	6.19	3.10	
	Subtotal (3)				53.37	
	(Subtotal (3)/30)				1.78	
(4) Fuel & Lubricant						
(4)-1	Fuel	liter	248.40	0.40	99.36	
(4)-2	Lubricant	((4)-1*20%)			19.87	
	Subtotal (4)				119.23	
	(Subtotal (4)/30)				3.97	
(5) General Overhead	(1) to (4) *35%				39.68	
	Total				153.05	

20. Concrete, tunnel - I						REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)	
<b>(1). Materials</b>						
(1)-1	Concrete	m3	1.00	94.86	94.86	
(2)-1	Form works	m3	1.00	12.09	12.09	
	Subtotal (1)				106.95	
<b>(2). Equipment (30m3/hr)</b>						
(2)-1	Truck mixer	hr	4.44	21.15	93.91	
(2)-2	Concrete pump	hr	1.00	66.05	66.05	
(2)-3	Truck crane (25t)	hr	0.50	57.81	28.91	
(2)-4	Allowance	((2)-1) to (2)-3)*5%			9.44	
	Subtotal (2)				198.31	
	(Subtotal (2)/30)				6.61	
<b>(3). Other equipment (per 453m3)</b>						
(3)-1	Blower	day	3.00	167.72	503.16	
(3)-2	Water pump	day	3.00	10.01	30.03	
(3)-3	Allowance	((2)-1) to (2)-3)*5%			53.32	
	Subtotal (3)				586.51	
	(Subtotal (3)/453)				1.29	
<b>(4). Fuel &amp; Lubricant</b>						
(4)-1	Fuel	liter	310.64	0.40	124.26	
(4)-2	Lubricant	(4)-1*20%			24.85	
	Subtotal (4)				149.11	
	(Subtotal (4)/30)				4.97	
<b>(5). Electricity</b>						
(5)-1	Pump, Blower & Lighting	kwh	8,868.00	0.20	1,773.60	
	Subtotal (5)				1,773.60	
	(Subtotal (5)/453)				3.92	





21. Re-bar Works							REMARKS
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT RATE (Ringgit)	AMOUNT (Ringgit)		
<b>(1). Materials</b>							
(1)-1	Re-bar (site)	ton	1.00	901.00	901.00		
(1)-2	Miscellaneous	kg	4.50	1.40	6.30		
	Subtotal (1)				907.30		
<b>(2). Labour</b>							
(2)-1	Foreman	hr	2.50	10.01	25.03		
(2)-2	Ganger	hr	10.00	4.81	48.10		
(2)-3	Steel bar bender/steel fixer	hr	50.00	3.30	165.00		
(2)-4	Ditto, Assistant	hr	25.00	3.03	75.75		
(2)-5	General labour	hr	25.00	2.48	62.00		
	Subtotal (2)				375.88		
<b>(3). Miscellaneous Equipment</b>							
(3)-1	Truck with crane	hr	0.50	13.14	6.57		
	Subtotal (3)				6.57		
<b>(4). Allowance (3)*(5%)</b>							
					0.33		
<b>(5). Subtotal</b>							
					1,290.08		
<b>(6). General Overhead</b>							
			Subtotal(5)*35%		451.53		
<b>(7). Subtotal</b>							
					1,741.61		
<b>(8). Loss (10%)</b>							
					174.16		
<b>(9). Total unit price</b>							
			Final adjusted		1,915.77		
					1,920.00		













## **ATTACHMENTS**





JICA STUDY TEAM

c/o The New Japan Engineering Consultants, Inc.,  
20 - 19, Shimanouchi Ichome, Minami-ku,  
Osaka, Japan.

Mr. Th'ng Yong Huat,  
Chief Engineer for Hydro Projects,  
National Electricity Board,  
129, Jalan Bangsar,  
Kuala Lumpur,  
MALAYSIA.

March 12, 1988

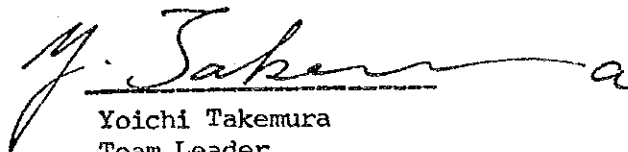
Dear Sir,

Re: Submission of Minutes of Meeting  
for the feasibility study for the Lebir Dam Project

We are pleased to submit herewith a copy of the Minutes of Meeting which was held on March 7, 1988 regarding the Interim Report of Feasibility Study for the captioned project prepared by us as a record of the meeting.

Thank you for your kind attention.

Yours faithfully,



Yoichi Takemura  
Team Leader  
JICA STUDY TEAM  
for the Lebir Dam Project

MINUTES OF MEETING

ON

INTERIM REPORT

THE FEASIBILITY STUDY FOR THE LEBIR DAM PROJECT

MARCH 7, 1988

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

1. A Technical Committee Meeting has been held at NEB Head Office on March 7, 1988 regarding the Interim Report of Feasibility Study for the Lebir Dam Project which was submitted to the authorities concerned through NEB in February 1988 by Japan International Cooperation Agency (JICA).

2. Participants of the Meeting are as per attached attendance list.

3. The following points have been raised and discussed in the meeting.

1) Results of Seismic Prospecting

No weak zone nor major faults have been found through the seismic prospecting.

Deep weathering at the Saddle Dam No. 1 is a major concern among the results.

In the survey site, the rock is, in general, lightly weathered and fresh.

2) Rocks in Tuff Group

- This type of rock usually contains sulphides which are harmful to concrete. Therefore, tests should be made when this type of rock was planned to be used for concrete aggregate.

3) Matrix System in Environmental Assessment

- A utilization of the matrix system in the screening process on the environmental items which are not applied to the Interim Report was recommended to be adopted by D.O.E.

4) Environmental Impact Statement by JICA

- The Environmental Impact Statement which was submitted to NEB does not cover medico-ecological aspects being handled by IMR (Institute for Medical Research), except which the statement is the final.

5) Regulation of Generation Discharge

- The reregulating pondage site studied by JICA Team has a limited storage capacity of approx. 1,000,000 m<sup>3</sup> at WL 27 m which corresponds to the tailrace water level at the proposed Lebir Hydro Power Station.

- It is difficult to regulate the generation discharge with this limited storage which is one sixth of the required storage for a complete regulation.

- JICA Team is studying on the flow of the generation discharge towards the downstream area where the pump stations are operated for their use of water by an analytical method. The preliminary result indicates rather levelized flow in these area.
- JICA Team is also studying on the necessity of the establishment of a downstream discharge warning system to make downstream inhabitants up to Kuala Krai take precaution against the generation discharge.
- DID recommended to study a bank erosion problem due to the peak generation discharge.

#### 6) Flood Analysis

- DID pointed out that the contribution of the Dabong Dam to the flood mitigation at the Guillemard Bridge is almost the same extent as the Lebir Dam in the Interim Report. This is somewhat inconsistent with their catchment areas, the former having three times as much as the latter.
- JICA Team commented that the possible reason for that seems due to lesser rainfalls in the Dabong Dam catchment area.

#### 7) Dam Break Analysis

- JKR questioned whether a dam break analysis is necessary or not.
- JICA Team stated that the modern dam construction techniques and the foundations in the Lebir Dam Project would permit to construct very safe dams in this Project. Therefore, such analysis appears unnecessary.

ATTENDANCE LIST

<u>NAME</u>	<u>ASSIGNMENT &amp; FUNCTION</u>	<u>ORGANIZATION</u>
Y. Takemura	Team Leader	JICA Study Team
Y. Tsurumaki	Flood Control	JICA Study Team
R. Kobayashi	Hydrology	JICA Study Team
S. Yamada	Agricultural Eng.	JICA Study Team
M. Kawahara	Geologist	JICA Study Team
A. Muramatsu	Environmental Analyst	JICA Study Team
S. Ogawa	Power Economist	JICA Study Team
T. Kimura	Coordinator	JICA Study Team
S. Shibata		JICA HQ
T. Sugawara		MITI
Th'ng Yong Hua t	Chief Engineer, Hydro Projects.	NEB
Soh Chak Yuen	Senior Planning Eng.	NEB
Lam Sit Chi		NEB
Sanusi Paijan		Water Supply Branch, PWD HQ
V. R. Vijayan		GSD
Chow Weng Sum	Acting Principal Geologist	GSD
Rahmah Tahir		Environmental Control Office, DOE
Lim Teik Keat	Senior Engineer	DID HQ
T. Matsuishi	Colombo Plan Expert	DID

MINUTES OF MEETING  
ON  
INTERIM REPORT  
FOR THE  
FEASIBILITY STUDY OF THE LEBIR DAM PROJECT

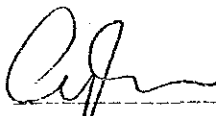
A Steering Committee Meeting was held on 8 March, 1988 at EPU in Kuala Lumpur, attended by participants listed attached herewith, to discuss the Interim Report for the above project. This Minutes of Meeting is to endorse the proceedings of the meeting.

11 March 1988  
Kuala Lumpur.

On behalf of the  
Econ. Planning Unit  
Prime Minister's Dept  
the Government of  
Malaysia.

On behalf of  
Japan International  
Cooperation Agency


On behalf of  
National Electricity  
Board.



Leon So Seh  
Principal Assistant  
Director,  
Economic Planning Unit.



Yoichi Takemura  
Team Leader  
JICA STUDY TEAM



Th'ng Yong Huat  
Chief Engineer  
Hydro Projects.

1. Coordination between Lebir Dam Project Study and Kelantan River Basin Flood Control Master Plan Study.

- Since the Kelantan River Basin Flood Control Master Plan Study is expected to be commenced around April 1988, it is necessary to coordinate the Lebir Dam Project Study with the Master Plan Study.
- Interim results of the Master Plan Study in relation with the Lebir Dam Project are expected to be available around August, 1988. Therefore, the submittal of the draft final report on the Lebir Dam Project Study originally scheduled in August, 1988 should be extended for some three months towards November or December 1988.

2. Briefing to the State Government of Kelantan

- EPU requested JICA Team to brief relevant Kelantan State agencies on the Interim Report and JICA Team agreed to do so.

3. Optimization of Project

- EPU queried on the low cost-benefit ratio of the Project, and asked whether a FIRR analysis would also be undertaken to assess the financial viability of the project. JICA Team explained that the results at this stage are preliminary and steps would be taken to optimize the project through possible reduction of costs. JICA Team also confirmed that FIRR analysis will be carried out.



4. Environmental Impact Statement by JICA

- JICA Team was asked whether the Environmental Impact Statement Report submitted by JICA Team at this stage is the finalised report. JICA Team responded affirmatively except for medico-ecological aspects which would be incorporated later.

5. Potential Relocation Area

- SEPU questioned whether potential relocation areas have been identified or not and whether consideration have been made to relocate affected FELDA and KESEDAR settlers to the future planned land schemes so as to minimise cost.
- JICA Team replied that according to the USM Sub-Study Report, potential areas scattered in and outside of the Lebir River catchment for future development of agriculture were surveyed and their total areas were about 55,000 ha. Among these areas, several small plots south of Gua Musang appear to be suitable for the Lebir riverine settlers while a large area extended in the north of Ciku land scheme area is attractive for the land scheme settlers. The USM report also looked into the possibility of accomodating the FELDA and KESEDAR settlers to the planned land schemes.

6. Potential of Granite used as Construction Material

- GSD questioned JICA Team whether consideration has been made on the use of granite as a potential construction material. JICA Team responded that the Team does not consider granite for the concrete aggregate since the weathered granite layer in the region is estimated to be 25-40 metres deep. JICA Team recommended that volcanic tuff (greenrock) could be used as concrete aggregate. The rock has to be tested for sulphide content.

7. Rainfall distribution Analysis

- JICA stated that the 1983 rainfall distribution pattern was used for the flood mitigation study; from this distribution, the flood volume of Lebir is about the same as that of Sg. Galas even though the latter's drainage basin is 3 times that of Lebir. DID pointed out that for the 1967 floods, the runoff of Sg. Galas was about double that of Sg. Lebir.

8. Field Investigation

- JICA Team explained that at present 22 drilling holes have been made covering 780 metres. It was found that the rock foundation condition is competent to support the project. So far, there is no major fault or weak zone identified. JICA Team reiterated that there is a low probability of defects in the area and the volume of investigation work done by them is sufficient.

9. Comments on the Interim Report

- JICA Team expects to have comments on the Interim Report within two months.

ATTENDANCE LIST

FEASIBILITY STUDY OF THE LEBIR DAM PROJECT

	<u>Government Officials</u>	<u>Agency</u>
1.	Leong So Seh (Chairman)	EPU
2.	Noraini bte Ismail	EPU
3.	Wan Norma Wan Daud	EPU
4.	Abd. Aziz Abd. Rahman	SEPU
5.	Tadatoshi Matsuishi	DID
6.	Lim Teck Keat	DID
7.	Ho Yuen Chuen	DOE
8.	V.R. Vijayan	GSD
9.	Chow Weng Sum	GSD
10.	Soh Chak Yuen	LLN
11.	Th'ng Yong Huet	LLN
12.	Lam Sit Chi	LLN
 <u>JICA Study Team</u>		
13.	T. Sugawara	MITI
14.	S. Shibata	JICA Tokyo
15.	Y. Takemura	JICA Team (Leader)
16.	Y. Tsurumaki	JICA Team
17.	R. Kobayashi	JICA Team
18.	S. Yamada	JICA Team
19.	M. Kawahara	JICA Team
20.	A. Muramatsu	JICA Team
21.	S. Ogawa	JICA Team
22.	T. Kimura	JICA Team

Notes of Discussions  
for  
Technical Committee Meeting  
on  
Lebir Dam Project

The meeting was held to explain to and discuss with on the results presented in the Draft Final Report for Lebir Dam Project, the agencies concerned, mostly on the technical aspects, prior to the Steering Committee Meeting to be held at EPU on February 28, 1989.

The meeting commenced at 9.00 am at NEB on February 25, 1989 by the participants listed in the attached attendance list, and adjourned at 11.45 am.

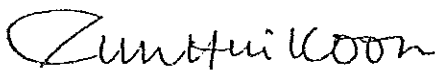
As a memorandum of what have been discussed in the meeting, NEB and JICA Study Team concluded this Note of Discussions.

We the undersigned hereby certify that the contents of the note attached herewith are correct and authentic.

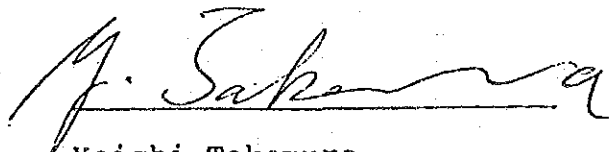
Kuala Lumpur, February 25, 1989.

On behalf of  
National Electricity Board

On behalf of  
JICA Study Team



Lim Hui Koon  
Hydro Projects  
National Electricity Board



Yoichi Takemura  
Team Leader  
JICA Study Team

1. Following the welcoming speech of the chairman, Mr Lim Hui Koon, NEB, Mr Y. Takemura, Team Leader for Lebir Dam Project gave a briefing of the Lebir Dam Project on the development size, flood control effects, inundation area and designs of the major project components such as dams, spillway, waterways and powerhouse.
2. JICA Team further explained on the findings during the course of feasibility grade design, and the benefits derived from the Lebir Dam Project are referred in the monetary terms as follows.

- 1) Power Generation

The benefit of M\$64 million/year can be expected from the power generation.

- 2) Flood Control

M\$16 million/year (based on the estimate made by Lebir Team from the past records) are kept as a flood control benefit. If calculated based on the figures referred in the Interim Report for Kelantan River Basin - Wide Flood Mitigation Study, M\$27 million/year can be expected as a benefit derived from the flood mitigation effect. In the draft final report, JICA Team referred this M\$27 million/year for economic evaluation. Because this seems to be more accurate since the figure has been obtained based on the detailed field survey.

- 3) Agricultural Irrigation Benefit

By having the Lebir Dam, the seasonal river flow fluctuations shall be leveled to a certain extent at the downstream area where irrigation pumping stations exist.

As a nett benefit derived from the stabilized water supply, M\$15 million/year can be enumerated.

- 4) Potentiality on aquacultural development

As a secondary benefit arising from the implementation of the project, JICA Team suggested that there are much potentialities on aquacultural development, because the proposed reservoir area is very flat and suitable for such development.

Furthermore, it was suggested that the industrial development in the downstream area of the Kelantan River, if the flood control was achieved, could produce another secondary benefit.

3. JICA Team explained about the results of economic evaluation referring the figures of EIRR as stated in the report, and the difference of the project cost between the one estimated in the interim stage (M\$800 million) and the draft final stage (M\$640 million).
4. As the results of the base-line study conducted by USM and the field survey and study made by JICA Team, the JICA Team finally concluded that there are no serious impacts found except for the inundation area of agricultural plantations. For minimizing the impacts, JICA Team proposed and designed the following structures and facilities to be adopted as measures other than relocation measures.
  - 1) Fish ladder for migrating fish species.
  - 2) Reregulating pondage for regulating the peak generation discharge and supplying the minimum discharge to the downstream course of the Lebir River.
  - 3) Discharge warning systems to let the inhabitants know the water release from the powerhouse and the spillway.
5. Detail discussions on the technical aspects:-
  - 1) DOE raised the questions and replied by JICA Team:
    - i. Whether the agricultural, logging and mining losses were considered for compensation or not?
      - JICA Team explained about the basic concept on the compensation considered for the agricultural plantation, i.e. only to compensate the development cost for the relocated plantation area to ensure continuous productions. However, no compensation on the logging loss is considered because valuable timbers will be logged prior to the impoundment. JICA Team agreed, however, to consider certain compensation for loss on the future opportunity for logging.
      - For mining loss, no compensation is considered. However, should the valuable mineral deposit be found to exist during the future stages the extraction of such deposit should be considered taking priority of the implementation of the Project.
    - ii. What kind of arrangement or measures have been considered for management of catchment area?

- JICA Team suggested that the preservation of the forest around the reservoir area is a significant measure to protect shoreline erosion of the reservoir and to minimize the production of sediment materials in the basin. And the necessity of water quality monitoring was emphasized following determination of the responsible agency to handle these matters.
- iii. Is the relocation plan included in the report?
- JICA Team replied that these plans should be prepared in the next stage, however, the decision on the implementation of the project should precede.
- iv. Are there any plans of abandonment of the project?
- JICA Team and NEB jointly explained that no such abandonment can be expected because the plant will be operated forever at the maximum extent by rehabilitating when required.
- DOE asked, however, to comment these in the final report.
- 2) DID expressed their comments on the draft final report;
- DID has no major points on the method and figures adopted for the Lebir Project since most of the figures referred in the report is consistent with the figures reported in the Kelantan River Basin - Wide Flood Mitigation Study even though the agricultural benefit seems rather optimistic and also DID expressed his intention to share a part of the project cost for the multi-purpose scheme.
- 3) JKR raised a question on the impact caused by the power generation discharge on bank erosion in the downstream course of the river.
- JICA Team explained that no major impact on the river bank erosion is expected according to the river flow analysis although the minor erosion may occur in the limited area, just downstream of the dam site.
- 4) GSD raised the following questions and suggestions.
- i. GSD suggested to mention about the mineral potentiality in the Summary of the Report.



ii. GSD raised the question whether the occurrence of reservoir-induced-earthquake was considered in the dam design or not.

- JICA Team replied that it has been considered.

iii. GSD further asked about the location of the Lebir Fault.

- JICA Team replied that the Lebir Fault is located outside the reservoir area. Even though the topography shows the potential existence of fault zone near the project area, as the result of field reconnaissance by JICA's Geologist, no outcrops of such fault zone were found in the reservoir area.

iv. GSD raised the question on the alkaline-silical reaction of the aggregate.

- JICA Team replied that at no alkaline silical reaction is expected to occur according to the judgement of JICA's Geologist, however, it is recommended to carry out the laboratory test during the detailed design stage.

5. JICA Team stressed the necessity of renewal of aerophoto map covering the reservoir area in order to measure the accurate inundation area and for other planning purposes, and it should be prepared in the detailed design stage.

NEB understood that it would be essential to the determination of compensation area and the planning of the relocation road.

The meeting was closed at 11.45 am.

Technical Committee Meeting

February 25, 1989

ATTENDANCE LIST

No.	Name	Position	Department	
1.	Y. Takemura	Team Leader	JICA	
2.	R. Kebayashi	Hydrologist	JICA	
3.	M. Doi	Civil	"	
4.	S. Ogawa	Economic Analysis	JICA	
5.	Y. Kawakami	Ele. Mech. Eng.	JICA	
6.	T. Kimura	Coordinator	"	
7.	Chow Weng Sum	Geologist	Geological Survey Dgpt.	
8.	Nordin Abu Bakar	Civil Engineer	Ibu Pejabat JKR (Bekalan Air)	
9.	Lim Teik Keat	Engineer	JFT	
10.	Lim Hui Koon	"	LIN	
11.	Lam Sit Chi	"	LIN	
12.	Omar Md. Zain	ENV. Control Officer.	DOE	


MINUTES OF MEETING  
ON  
DRAFT FINAL REPORT  
FOR THE  
FEASIBILITY STUDY OF THE LEBIR DAM PROJECT

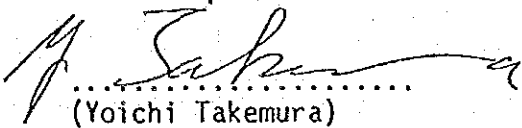
A Steering Committee Meeting was held on 28 February 1989 at EPU in Kuala Lumpur, attended by participants listed on Appendix A, to discuss the Draft Final Report of the above-stated project. These minutes of meeting record the proceedings of the meeting.

1 March 1989  
Kuala Lumpur


Economic Planning Unit  
Prime Minister's Dept.

Japan International  
Cooperation Agency

  
.....  
(Siti Hajar Ismail)  
Director, Energy Division

  
.....  
(Yoichi Takemura)  
JICA Study Team Leader

National Electricity Board  
(Project Executing Agency)

  
.....  
(Th'ng Yong Huat)  
Chief Engineer (Hydro Projects)

## Lebir Dam Project Feasibility Report

### Minutes of Joint Meeting Between the Steering Committee and JICA Study Team

#### 1. Briefing to Steering Committee

The JICA Study Team briefed the meeting on the findings of the study as contained in the Draft Final Report. The aspects touched on included the optimisation of Lebir dam, changes in design and cost estimates, and the economic evaluation of the proposed project.

The project with an investment cost of M\$640 million will provide significant power generation, irrigation and flood mitigation benefits. The major significant impacts are the flooding of 10,000 ha. of agricultural plantation and the displacement of 4,700 inhabitants from 775 families.

Viewed solely as a power project, Lebir is assessed to be sub-economic (EIRR = 6%). However taking into agricultural and flood mitigation benefits, the rate of return is considered to be satisfactory (EIRR = 11%). If the decision to proceed is made in 1989, then the project can be completed by 1998.

#### 2. Other Briefings and Discussions

The meeting noted that the JICA Study Team briefed the Kelantan SEPU on 20 February 1989. It was also reported that the Technical Committee deliberated on the technical and environmental aspects of the report on 25 February 1989.

### 3. Request by Kelantan SEPU

Kelantan SEPU suggested that the project study report should include a plan for resettlement of displaced inhabitants. It was noted that this matter is outside the scope of works. However it was pointed out that the USM socio-economic study did identify possible resettlement areas.

The JICA Study Team also clarified that the Lebir reservoir could provide some potential for aquaculture development. If developed, this industry could be expected to support the livelihood of an appreciable number of displaced inhabitants.

### 4. Other Technical Aspects

The following technical aspects were also briefly discussed by the Steering Committee:-

- a) The need for a detailed Environmental Impact Statement (EIS) was requested by DOE if the project were to proceed. The meeting agreed that this matter would be reviewed at the appropriate time.
- (b) The State Government of Kelantan was requested to initiate action on further mineralogical exploration in order to determine the extent of mineral resources.
- (c) The method of economic evaluation could be made more equitable by comparison with both combined cycle and gas turbine plants instead of only combined cycle plant.
- (d) The meeting noted that Lebir as a multipurpose project should be reviewed together with the Masterplan Study for Flood Mitigation currently under study and scheduled for completion later this year.

## 5. Steering Committee's Conclusions

In the review of the Draft Final Report of the Lebir Dam Project, the Steering Committee reached the following conclusions:-

- (a) The JICA Study Team was requested to consider the comments and incorporate agencies' suggestions into the final Feasibility Report,
- (b) It was noted that the JICA Study Team has complied with study requirements as detailed in the Scope of Works document,
- (c) The study findings were noted, and it was clarified that more detailed reviews would be made after the completion of the Kelantan River Basin-Wide Flood Mitigation Study, and
- (d) It was noted that the final Feasibility Report is scheduled to be submitted in March 1989.

## 6. Acknowledgements

The Steering Committee gratefully acknowledges the technical assistance given by JICA and the Study Team in the fulfillment of the Lebir project study.

Appendix A. Attendance List  
Lebir Steering Committee Meeting  
on 28 February 1989

Malaysian Government Representatives

Agency

1. Siti Hadzar Ismail (Chairperson)	EPU
2. Leong So-Seh	EPU
3. Mohd. Yazi Mohd. Zin	EPU
4. Wan Norma Wan Daud	EPU
5. Abdul Aziz Abdul Rahim	SEPU
6. Ishak Manaf	KTTP
7. Th'ng Yong Huat	LLN
8. Lim Hui Koon	LLN
9. Lam Sit Chi	LLN
10. Lim Teik Kiat	DID
11. Chow Weng Sum	GSD
12. Omar Md. Zain	DOE

JICA Representatives/Study Team

13. Yoichi Takemura	Team Leader
14. Hirofumi Ohnishi	Japanese Embassy
15. Yoshiyuki Kita	JICA Tokyo
16. Keizo Kagawa	JICA KL
17. Moboyuki Doi	Study Team
18. Rokuro Kobayashi	Study Team
19. Yukio Kawakami	Study Team
20. Shuhei Ogawa	Study Team
21. Tomokazu Kimura	Coordinator

TECHNICAL SPECIFICATION FOR TOPOGRAPHIC SURVEY



## Technical Specification

### Objective of the Works

The objective of the Works is to produce topographic maps required for the Feasibility Study. The location of the Site is shown in Exhibit - 1.

### 1. Scope of the Works

The Works comprise the following items:-

- (1) to execute datum point surveys as horizontal control survey for each proposed mapping site which include determination of coordinates of datum points to be newly constructed and construction of monuments for the datum points.
- (2) to execute main traversing in each proposed mapping site as horizontal control survey.
- (3) to execute levelling as vertical control survey in each proposed mapping site for the new datum points, and the existing temporary bench marks.
- (4) to execute filling in details or situation survey in each proposed mapping site.
- (5) to carry out plotting and produce maps for each mapping site
- (6) to carry out tracing of maps and prepare reports
- (7) to execute river cross section survey in the river course downstream of the main dam.
- (8) to execute determination of coordinates and ground heights of all the boring holes.

The Works comprise mapping for three (3) areas whose locations and estimated areas are shown in Exhibit 2. The locations of the river cross section survey are shown in the Exhibit-1. It should be understood, however, that the locations of the proposed mapping sites and river cross sections are shown approximately in the Exhibits and exact locations of them will be indicated by the Employer on the spot.

## 2. Datum Point Surveying & Construction of Monuments

### 2.1. Existing Datum Points to be referred to

The coordinates and elevations of the existing datum points and bench marks are shown in Tables-1 and 2 attached hereto.

### 2.2. Datum Points to be newly Constructed

Datum points to be newly constructed at each proposed mapping site are shown in Exhibit-2.

Monuments shall be made of concrete piles with a square cross-section of 15 cm x 15 cm or more and an appropriate length, and shall be driven in the ground and fixed with concrete to prevent movement. Foundations of the monuments shall be made from by cobble stone, etc. Special care should be taken for construction at the points of weak foundation.

### 2.3. Datum Point Surveying

Datum point surveying shall be executed by the Contractor in order to determine coordinates of newly constructed datum points. Methods of the surveying shall be traversing with use of transit and electro optical distance meter.

### 3. Main Traversing

- 3.1. The Contractor shall set out and measure a main traverse which will provide a basic skeleton for further surveying works in each proposed mapping site. The above mentioned datum points shall be determined of its coordinates by this main traversing.
- 3.2. North star or solar observation as the direction of reference shall be carried out at the starting point (known point: G060) and other adequate point in main traverse route.
- 3.3. Measuring the horizontal angle shall be by the two-pair observation. Ratio of closure of coordinates value shall be less than 1 : 20,000.

### 4. Primary, Secondary & Tertiary Traversing

- 4.1. The Contractor shall set out and measure primary, secondary and tertiary traversing from control point of the main traverse in accordance with local conditions for controls of further detailed surveying.
- 4.2. Nodal point in these travers route shall be selected as the supplementary control point for the topographical detail surveys. The supplementary control points shall be included more than one in a sheet (map scale: 1 : 500, sheet size 40 x 30 cm).
- 4.3. Marker of nodal point shall be made of wooden pillar with a square cross-section of 10 cm x 10 cm on more and an appropriate length, and shall be driven in the ground.

4.4. Measuring the horizontal angle and ratio of closure of coordinates value is to be made as follows.

Primary Traverse	Horizontal	2 pair	1/5,000
	Vertical	2 pair	
Secondary Traverse	Horizontal	2 pair	1/3,000
	Vertical	2 pair	
Tertiary Traverse	Horizontal	1 pair	1/2,000
	Vertical	1 pair	

## 5. Levelling

- 5.1. Reference shall be made to the existing datum points in direct levelling for vertical control of all the datum points to be newly constructed.
- 5.2. Levelling shall also be made in order to define height of each control points in the primary traverse and vertical control shall be made referring to the new datum points.
- 5.3. Levelling shall be made by reciprocating observations. The accuracy of levelling shall be made within  $20 \text{ mm} \sqrt{S} \text{ (km)}$ .
- 5.4. Instruments to be used for levelling shall be Wild NKA 2 or equal.
- 5.5. Reading distance of levelling staff shall be within 70 m and reading unit shall be one (1) millimeter.
- 5.6. If a course of levelling (a stretch between one datum point and another) becomes longer than 1 km, the Contractor shall construct a temporary bench mark(s) made of concrete at every 500 m interval.

## 6. River Cross Section Survey

- 6.1. The width of a cross section shall be principally 100 m from the river shore line on each bank, or upto 30 m high above the river bed, whichever smaller. However, the exact width shall be determined by the Employer's field supervisor on the spot.
- 6.2. The Contractor shall establish a bench mark at an appropriate location on both bank at every survey section as a control point. The Contractor shall execute levelling to define the height of the bench mark with reference to the existing bench mark.
- 6.3. The Contractor shall execute river cross section survey with due care of changes in slopes of the ground. The river shore lines should be defined. Sounding shall be taken with a sound rod or line on the stream.

The water level at the time of sounding shall be determined in relation to the graduated staff gauge at the Tualang gauging station. The date and time of the sounding shall be recorded and reported.

## 7. Topographic Detail Surveys

- 7.1. The Contractor shall carry out topographic detail surveys based on the above control points by longitudinal and cross-sectional survey, plane-table survey, etc. in accordance with the actual conditions of the site.
- 7.2. Contour line interval shall be 2 m distance at mapping scale 1:500. Necessary supplemental contour (1 m) shall not be omitted especially in case of very flat area.

- 7.3. Soundings shall be taken in surveying at the proposed mapping site of Dam area with a sounding rod or line.

The water level at the time of sounding shall be determined in relation to the graduated staff gauge at the Tualang gauging station. The date and time of the sounding shall be recorded and reported.

## 8. Plotting of Maps and River Cross Section

- 8.1. The Contractor shall describe the following matters into each maps.

- (1) North direction
- (2) Longitudinal and horizontal mesh (A tick shall be entered per every 50 m (10 cm on the map) on the neat line and cross mark shall be entered at every intersection of the 50 m grid lines).
- (3) Location and height of the datum points and bench marks.
- (4) Location and height of control points in main and supplemental traverses.
- (5) Planimetric features such as, creek, stream, road, foot path, dry field, sand deposit, houses, etc. with adequate symbols.

- 8.2. The Contractor shall describe the following matters into each river cross section.

- (1) Bench marks
- (2) River profile (including river bottom) at the scales of 1:500 in horizontal and 1:100 in vertical directions.

- (3) Water surface
- (4) Boring holes, where exist (3 holes at Section No.9-d)
- (5) Heights and horizontal distances of all surveyed points in the river cross sections.

9. Tracing of Maps and River Cross Sections

- 9.1. The Contractor shall carry out tracing, in ink, of maps and sections originally plotted, on polyester tracing film which shall be free from expansion and shirinkage in changes of humidity and temperature to an allowable extent.

10. Contractor's Working Program

The Contractor shall submit to the Employer, for his approval, his Working Program including descriptions of the sequence of Work, equipment, personnel and operator/labour to be employed, and rate of progress of the survey work well in advance min. two weeks before he starts his field operation.

11. Supervision of Work by the Employer

An Employer's field supervisor will supervise the Works. The supervision shall include inspection and examination of method of Works, workmanship and progress of Works.

12. Data to be submitted by the Contractor

12.1. Datum Point Survey including Levelling

- (1) Survey net-work and route map
- (2) Observation records  
(distance, horizontal/vertical angle, levelling)
- (3) Computation notes
- (4) Final result table
- (5) Point descriptions  
This shall include the following information:
  - name of point
  - date of construction
  - name of azimuth point and angle
  - sketch map of access to the point
  - photos of the monument
- (6) Working report

12.2. Topo Mapping

- (1) Survey net-work and route map
- (2) Observation records
- (3) Computation notes
- (4) Final results table
- (5) Point descriptions of monument with photo.



(6) The coordinate, heights of all boring holes

a. Main dam site	7
b. Saddle dam site	6
c. Quarry site	4
Total	17 holes

(7) Topographic Mapping (Scale 1:500)

a. Main dam site	1.9 km <sup>2</sup>
b. Saddle dam site	0.4 km <sup>2</sup>
c. Quarry site	0.9 km <sup>2</sup>
Total	3.2 km <sup>2</sup>

All on polyester tracing film.

(8) Original map drawings

(9) Working report

### 12.3. River Cross Section

(1) Survey net-work and route map

(2) Observation records  
(distance, horizontal/vertical angle, levelling)

(3) Computation notes

(4) Final result table

(5) Point descriptions

This shall include the following information:

- name of point
- date of construction

- name of azimuth point and angle
- sketch map of access to the point
- photos of the monument

(6) Working report

(7) River cross section

- No.1 to No.26, No.9a to No.9d            30 sections
- scale    vertical    1:100
- horizontal 1:500
- all on polyester tracing film

(8) Plan showing location of surveyed section on a 1/50,000 scale topo map

(9) Original section drawings

ATTACHMENT 4-2

TECHNICAL SPECIFICATION FOR CORE DRILLING

## Technical Specification of Core Drilling

### (1) Location

The work sites are at the main dam site, two saddle dam sites, quarry site, borrow area and reregulating pondage site, as shown on the Location Maps attached hereto.

### (2) Access to the Sites

The means of access from Tualang Bridge to the Main Dam Site and its surroundings is by motorized river boat along the Lebir River. The access from Kg. Lalok to the Saddle Dam (I), (II) Sites, Quarry Site and Borrow Area (A) is an existing logging road.

### (3) Geologic Conditions of the Sites

#### Main Dam Site

Rocks underlying this site are "Green Rock Group" i.e. alternations of Shalstein, lapilli-tuff with andesitic lava, sandstone (quartzite) and clay-slate.

#### Saddle Dam Site (I) & (II)

Rocks underlying these sites are mainly tuff-breccia.

#### Quarry Site

Rocks beneath the site are "Green Rock Group" as observed at the Main Dam Site.

#### Borrow Area (A)

Rocks underlying the area are disintegrated granite.

### Re-regulating Pondage

Rocks beneath the site are "Green Rock Group" as found at the Main Dam Site and the Quarry Site.

#### (4) Number of Core Drilling

	Location	No. of holes	Length (m)	Sub Total (m)
Main Dam site	Along dam center line	3	60, 70, 60	
	Along spillway line	3	60, 40, 30	
	Power-house site	1	20	340
Saddle Dam (I) site	Along dam center line	4	40, 40, 45, 40	165
Saddle Dam (II) site	Along dam center line	2	25, 25	50
Quarry site		4	40, 40, 40, 40	160
Borrow Area (A)		2	20, 20	40
Reregulating pondage	Along dam center line	3	10, 10, 10	30
Total		22		785

#### (5) Drilling bits to be used

Drilling bits of 66 mm size or NX type should be used for all rock portions. The Contractor shall attain as much a good core recovery as possible.

#### (6) Permeability Tests (Water Pressure Tests)

Permeability tests will be carried out in all drilled holes except the holes on the Quarry Sites and Borrow Area. An interval of testing should be five (5) meters as a rule. Water pressure for the testing should be regulated as follows:-

$$(kgf/cm^2)$$
$$0 \rightleftharpoons 1 \rightleftharpoons 2 \rightleftharpoons 4 \rightleftharpoons 6 \rightleftharpoons 8 \rightleftharpoons 10$$

Water levels in all drilled holes should be recorded every day before the start of daily work.

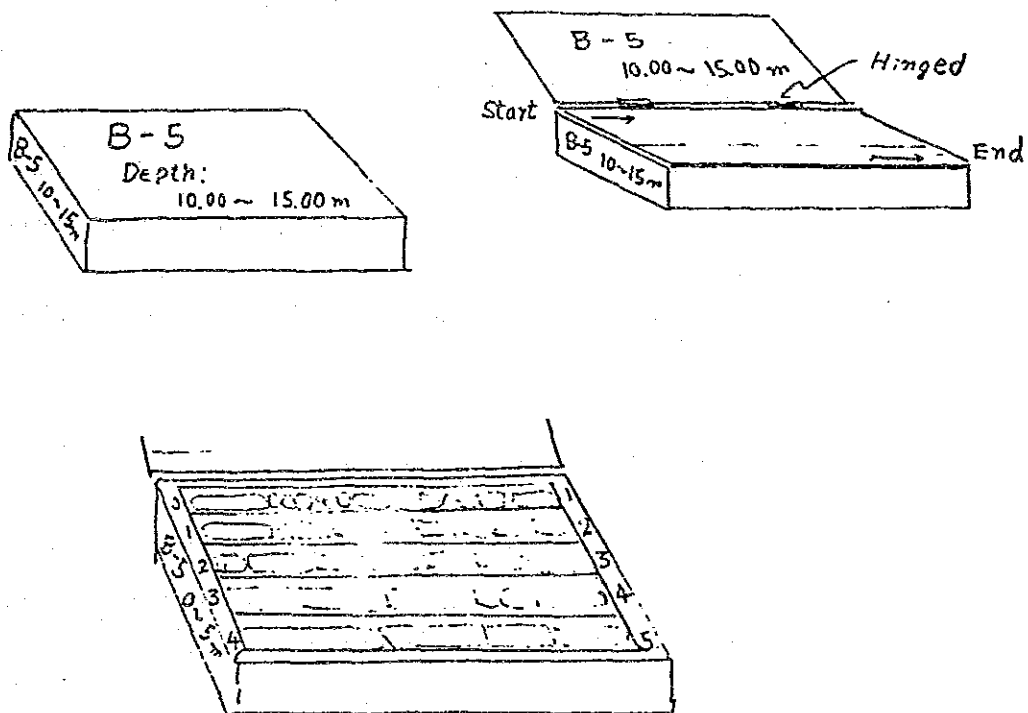
(7) Standard Penetration Tests

Standard penetration tests (S.P.T.) should be done every two (2) meters of depth in drilled holes at the Borrow Area (A).

(8) Arrangement of drilled core

Drilled cores should be carefully arranged in core cases immediately after they are lifted from the underground.

The name (Number) of hole and depth should be described on the cover, back and both sides of case.



(9) Interface with seismic refraction works

Another contractor will carry out seismic refraction work at the Main Dam Site, Saddle Dam (I) and Quarry Site during the period from September 1987 to October 1987.

The drilling holes of D-1, D-4, Q-1, Q-2, Q-3, Q-4, S-1, S-2, S-3 and S-4 will be affected by the seismic refraction work.

The Contractor should establish his working program to avoid interface with the seismic refraction works problems as far as possible.

(10) Transportation of core boxes

The Contractor shall transport core boxes filled with drilled cores from time to time as instructed by the Employer to a core storage designated by the Employer.

(11) Contractor's working program

The Contractor shall submit to the Employer for his approval his working program including descriptions of the sequence of works, equipment, personnel and operator/labour to be employed, and rate of progress of the works well in advance before he starts his field operation.

(12) Supervision of works by the Employer

An Employer's field supervisor will supervise the works. The supervision shall include inspection and examination of method, qualities, workmanship and progress of works.

(13) Documents to be submitted by the Contractor

The Contractor shall submit to the Employer the following documents during and/or upon completion of the works;