表 12.1　ダニム発電所運転実績

年	発生 電力量 (GWh)	設備 稼働率 (%)	設備 停止率 (%)	貯水池 流入量 (10^6m3)
1979	926.5	95.4	4.6	592.2
1980	1,094.2	99.1	0.9	702.6
1981	1,022.1	92.9	7.1	742.0
1982	1,098.3	94.9	5.1	484.1
1983	815.7	76.7	23.3	704.2
1984	1,145.3	96.3	3.7	658.4
1985	1,067.6	92.6	7.4	554.7
1986	902.5	89.0	11.0	585.6
1987	998.4	92.3	7.7	473.4
1988	839.9	88.3	11.7	587.2
1989	781.1	83.0	17.0	626.6
1990	774.4	86.2	13.8	642.4
1991	806.8	82.0	18.0	382.8
1992	917.7	90.7	9.3	663.1
1993	958.3	90.5	9.5	746.5
平均	943.3	90.0	10.0	609.7

表　12.2　　月別発電機別運転時間及び発生電力量

年	月	運転時間（時間）										発生電力量	
		No.1		No.2		No.3		No.4		合計		電力量	利用
		時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	(MWh)	率(%)
1979	1	542	72.8	744	100.0	744	100.0	744	100.0	2,774	93.2	74,735	62.8
	2	346	51.5	358	53.3	671	99.9	590	87.8	1,965	73.1	56,220	52.3
	3	744	100.0	722	97.0	730	98.1	737	99.1	2,933	98.6	77,045	64.7
	4	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	82,652	71.7
	5	744	100.0	617	82.9	744	100.0	744	100.0	2,849	95.7	79,623	66.9
	6	720	100.0	720	100.0	484	67.2	489	67.9	2,413	83.8	53,525	46.5
	7	744	100.0	730	98.1	744	100.0	737	99.1	2,955	99.3	80,546	67.7
	8	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	85,126	71.5
	9	720	100.0	717	99.6	720	100.0	720	100.0	2,877	99.9	83,537	72.5
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	87,120	73.2
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	86,168	74.8
	12	704	94.6	744	100.0	744	100.0	744	100.0	2,936	98.7	80,180	67.4
合計		8,192	93.5	8,280	94.5	8,509	97.1	8,433	96.3	33,414	95.4	926,477	66.1
1980	1	735	98.8	744	100.0	744	100.0	744	100.0	2,967	99.7	85,471	71.8
	2	696	100.0	696	100.0	696	100.0	696	100.0	2,784	100.0	77,346	69.5
	3	744	100.0	738	99.2	744	100.0	744	100.0	2,970	99.8	90,866	76.3
	4	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	82,778	71.9
	5	744	100.0	654	87.9	744	100.0	744	100.0	2,886	97.0	78,083	65.6
	6	610	84.7	657	91.3	720	100.0	707	98.2	2,694	93.5	85,102	73.9
	7	744	100.0	742	99.7	744	100.0	744	100.0	2,974	99.9	98,670	82.9
	8	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	99,675	83.7
	9	720	100.0	702	97.5	720	100.0	720	100.0	2,862	99.4	98,128	85.2
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	106,374	89.4
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	104,308	90.5
	12	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	87,396	73.4
合計		8,665	98.6	8,605	98.0	8,784	100.0	8,771	99.9	34,825	99.1	1,094,197	77.9
1981	1	740	99.5	539	72.4	744	100.0	744	100.0	2,767	93.0	98,781	83.0
	2	668	99.4	668	99.4	526	78.3	672	100.0	2,534	94.3	85,258	79.3
	3	744	100.0	744	100.0	730	98.1	744	100.0	2,962	99.5	109,420	91.9
	4	632	87.8	629	87.4	629	87.4	629	87.4	2,519	87.5	88,263	76.6
	5	744	100.0	744	100.0	618	83.1	744	100.0	2,850	95.8	68,222	57.3
	6	717	99.6	717	99.5	668	92.8	498	69.2	2,599	90.3	67,828	58.9
	7	744	100.0	566	76.0	625	84.0	348	46.8	2,283	76.7	55,890	47.0
	8	744	100.0	735	98.8	596	80.1	744	100.0	2,819	94.7	81,463	68.4
	9	589	81.8	703	97.6	370	51.4	720	100.0	2,382	82.7	61,168	53.1
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	98,109	82.4
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	100,922	87.6
	12	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	106,804	89.7
合計		8,530	97.4	8,252	94.2	7,714	88.1	8,051	91.9	32,548	92.9	1,022,128	72.9
1982	1	744	100.0	737	99.1	738	99.2	744	100.0	2,963	99.6	93,937	78.9
	2	672	100.0	672	100.0	635	94.5	672	100.0	2,651	98.6	83,976	78.1
	3	744	100.0	744	100.0	744	100.0	682	91.7	2,914	97.9	86,898	73.0
	4	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	103,796	90.1
	5	689	92.6	744	100.0	555	74.6	740	99.5	2,728	91.7	94,834	79.7
	6	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	104,628	90.8
	7	744	100.0	722	97.0	744	100.0	679	91.3	2,889	97.1	103,177	86.7
	8	480	64.5	581	78.1	744	100.0	744	100.0	2,549	85.7	92,911	78.1
	9	682	94.7	720	100.0	720	100.0	693	96.3	2,815	97.7	94,349	81.9
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	106,790	89.7
	11	679	94.3	581	80.7	679	94.3	658	91.4	2,597	90.2	84,018	72.9
	12	744	100.0	441	59.3	473	63.6	744	100.0	2,402	80.7	49,014	41.2
合計		8,362	95.5	8,126	92.8	8,216	93.8	8,540	97.5	33,244	94.9	1,098,328	78.4
1983	1	744	100.0	67	9.0	152	20.4	744	100.0	1,707	57.4	39,174	32.9
	2	672	100.0	7	1.0	59	8.8	672	100.0	1,410	52.5	23,830	22.2
	3	624	83.9	119	16.0	157	21.1	442	59.4	1,342	45.1	29,374	24.7
	4	719	99.9	461	64.0	262	36.4	18	2.5	1,460	50.7	29,168	25.3
	5	188	25.3	0	0.0	650	87.4	744	100.0	1,582	53.2	35,683	30.0
	6	387	53.8	82	11.4	720	100.0	720	100.0	1,909	66.3	69,635	60.4
	7	744	100.0	744	100.0	706	94.9	744	100.0	2,938	98.7	89,685	75.3
	8	744	100.0	707	95.0	707	95.0	712	95.7	2,870	96.4	95,520	80.2
	9	720	100.0	704	97.8	720	100.0	720	100.0	2,864	99.4	107,236	93.1
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	113,063	95.0
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	106,829	92.7
	12	744	100.0	711	95.6	744	100.0	744	100.0	2,943	98.9	76,479	64.2
合計		7,750	88.5	5,066	57.8	6,341	72.4	7,724	88.2	26,881	76.7	815,676	58.2

表　12.2　　月別発電機別運転時間及び発生電力量

年	月	運転時間（時間）										発生電力量	
		No.1		No.2		No.3		No.4		合計		電力量	利用
		時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	(MWh)	率(%)
1984	1	744	100.0	743	99.9	744	100.0	744	100.0	2,975	100.0	88,145	74.0
	2	686	98.6	684	98.3	663	95.3	692	99.4	2,725	97.9	77,592	69.7
	3	647	86.9	742	99.7	744	100.0	744	100.0	2,877	96.7	80,864	67.9
	4	555	77.1	720	100.0	720	100.0	491	68.2	2,486	86.3	75,603	65.6
	5	439	59.0	744	100.0	744	100.0	720	96.8	2,647	88.9	91,781	77.1
	6	720	100.0	527	73.2	502	69.8	720	100.0	2,470	85.7	75,264	65.3
	7	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	113,910	95.7
	8	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	114,199	95.9
	9	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	110,294	95.7
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	114,604	96.3
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	102,549	89.0
	12	744	100.0	743	99.9	744	100.0	744	100.0	2,975	100.0	100,466	84.4
合計		8,207	93.4	8,575	97.6	8,533	97.1	8,527	97.1	33,842	96.3	1,145,271	81.5
1985	1	744	100.0	744	100.0	645	86.7	645	86.7	2,778	93.4	97,377	81.8
	2	672	100.0	672	100.0	0	0.0	225	33.5	1,569	58.4	61,079	56.8
	3	728	97.9	744	100.0	544	73.1	744	100.0	2,761	92.8	93,573	78.6
	4	720	100.0	716	99.4	720	100.0	720	100.0	2,876	99.9	94,312	81.9
	5	744	100.0	744	100.0	744	100.0	461	62.0	2,693	90.5	101,030	84.9
	6	550	76.4	720	100.0	720	100.0	720	100.0	2,710	94.1	101,855	88.4
	7	658	88.4	741	99.6	744	100.0	744	100.0	2,887	97.0	101,617	85.4
	8	744	100.0	634	85.2	744	100.0	744	100.0	2,866	96.3	81,943	68.8
	9	431	59.8	720	100.0	720	100.0	639	88.7	2,509	87.1	57,113	49.6
	10	736	98.9	744	100.0	744	100.0	744	100.0	2,968	99.7	104,651	87.9
	11	716	99.4	720	100.0	720	100.0	720	100.0	2,876	99.9	82,468	71.6
	12	744	100.0	744	100.0	742	99.7	740	99.5	2,970	99.8	90,601	76.1
合計		8,187	93.5	8,643	98.7	7,787	88.9	7,846	89.6	32,463	92.6	1,067,619	76.2
1986	1	609	81.9	741	99.6	744	100.0	744	100.0	2,838	95.4	70,431	59.2
	2	672	100.0	672	100.0	672	100.0	672	100.0	2,688	100.0	60,776	56.5
	3	572	76.9	673	90.5	744	100.0	744	100.0	2,733	91.8	74,535	62.6
	4	700	97.3	609	84.6	575	79.8	662	92.0	2,546	88.4	69,547	60.4
	5	744	100.0	485	65.2	651	87.5	429	57.6	2,309	77.6	55,052	46.2
	6	577	80.1	176	24.4	298	41.4	500	69.4	1,551	53.9	32,853	28.5
	7	631	84.8	247	33.2	701	94.2	381	51.2	1,960	65.9	38,975	32.7
	8	744	100.0	744	100.0	725	97.4	744	100.0	2,957	99.4	93,069	78.2
	9	705	97.9	720	100.0	698	96.9	720	100.0	2,843	98.7	88,260	76.6
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	116,869	98.2
	11	705	97.9	696	96.7	720	100.0	684	95.0	2,805	97.4	89,230	77.5
	12	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	112,854	94.8
合計		8,147	93.0	7,251	82.8	8,016	91.5	7,768	88.7	31,182	89.0	902,451	64.4
1987	1	737	99.1	740	99.5	744	100.0	744	100.0	2,965	99.6	97,088	81.6
	2	672	100.0	672	100.0	672	100.0	672	100.0	2,688	100.0	92,046	85.6
	3	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	101,576	85.3
	4	720	100.0	718	99.7	720	100.0	720	100.0	2,878	99.9	96,959	84.2
	5	277	37.2	302	40.6	682	91.7	659	88.6	1,920	64.5	61,442	51.6
	6	716	99.4	582	80.8	664	92.2	713	99.0	2,675	92.9	70,000	60.8
	7	489	65.7	582	78.2	744	100.0	603	81.1	2,417	81.2	52,292	43.9
	8	600	80.6	744	100.0	565	75.9	744	100.0	2,653	89.1	74,211	62.3
	9	531	73.8	720	100.0	720	100.0	457	63.5	2,428	84.3	80,385	69.8
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	102,375	86.0
	11	706	98.1	720	100.0	669	92.9	703	97.6	2,798	97.1	89,050	77.3
	12	744	100.0	744	100.0	744	100.0	737	99.1	2,969	99.8	81,022	68.1
合計		7,680	87.7	8,012	91.5	8,412	96.0	8,240	94.1	32,343	92.3	998,446	71.2
1988	1	744	100.0	744	100.0	712	95.7	744	100.0	2,944	98.9	76,198	64.0
	2	683	98.1	696	100.0	681	97.8	696	100.0	2,756	99.0	56,134	50.4
	3	730	98.1	723	97.2	672	90.3	672	90.3	2,797	94.0	60,587	50.9
	4	555	77.1	371	51.5	278	38.6	644	89.4	1,848	64.2	33,613	29.2
	5	252	33.9	504	67.7	44	5.9	744	100.0	1,544	51.9	25,357	21.3
	6	381	52.9	720	100.0	69	9.6	720	100.0	1,890	65.6	35,206	30.6
	7	707	95.0	744	100.0	656	88.2	744	100.0	2,851	95.8	83,685	70.3
	8	744	100.0	744	100.0	744	100.0	553	74.3	2,785	93.6	91,652	77.0
	9	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	96,121	83.4
	10	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	99,368	83.5
	11	720	100.0	720	100.0	678	94.2	671	93.2	2,789	96.8	84,057	73.0
	12	738	99.2	744	100.0	744	100.0	744	100.0	2,970	99.8	97,970	82.3
合計		7,718	87.9	8,174	93.1	6,742	76.8	8,396	95.6	31,030	88.3	839,948	59.8

表　12.2　　月別発電機別運転時間及び発生電力量

年	月	運転時間（時間）										発生電力量	
		No.1		No.2		No.3		No.4		合計		電力量	利用
		時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	時間	率(%)	(MWh)	率(%)
1989	1	740	99.5	730	98.1	744	100.0	744	100.0	2,958	99.4	93,606	78.6
	2	672	100.0	672	100.0	669	99.6	672	100.0	2,685	99.9	66,437	61.8
	3	744	100.0	744	100.0	729	98.0	744	100.0	2,961	99.5	84,147	70.7
	4	655	91.0	654	90.8	720	100.0	425	59.0	2,454	85.2	70,485	61.2
	5	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	79,503	66.8
	6	720	100.0	417	57.9	649	90.1	389	54.0	2,175	75.5	55,174	47.9
	7	744	100.0	400	53.8	780	104.8	711	95.6	2,635	88.5	90,541	76.1
	8	207	27.9	697	93.7	342	46.0	595	80.0	1,841	61.9	34,014	28.6
	9	439	60.9	190	26.4	588	81.6	265	36.8	1,481	51.4	19,325	16.8
	10	232	31.2	621	83.5	86	11.6	744	100.0	1,683	56.6	25,345	21.3
	11	720	100.0	426	59.2	445	61.8	720	100.0	2,311	80.2	63,872	55.4
	12	702	94.4	744	100.0	744	100.0	722	97.0	2,912	97.9	98,606	82.8
合計		7,319	83.6	7,039	80.4	7,240	82.7	7,475	85.3	29,074	83.0	781,055	55.7
1990	1	744	100.0	744	100.0	585	78.6	744	100.0	2,817	94.7	100,383	84.3
	2	672	100.0	672	100.0	672	100.0	672	100.0	2,688	100.0	98,940	92.0
	3	744	100.0	706	94.9	709	95.3	742	99.7	2,901	97.5	82,325	69.2
	4	629	87.4	720	100.0	615	85.4	720	100.0	2,684	93.2	60,521	52.5
	5	736	98.9	506	68.0	658	88.4	465	62.5	2,365	79.5	54,907	46.1
	6	594	82.5	720	100.0	299	41.5	701	97.4	2,314	80.3	63,409	55.0
	7	421	56.6	564	75.8	742	99.7	503	67.6	2,230	74.9	57,350	48.2
	8	443	59.5	361	48.5	736	98.9	744	100.0	2,284	76.7	35,875	30.1
	9	695	96.5	118	16.4	720	100.0	720	100.0	2,253	78.2	33,281	28.9
	10	159	21.3	655	88.0	738	99.2	704	94.6	2,256	75.8	34,047	28.6
	11	305	42.4	720	100.0	720	100.0	720	100.0	2,465	85.6	54,568	47.4
	12	734	98.6	726	97.6	736	98.9	742	99.7	2,938	98.7	98,775	83.0
合計		6,875	78.5	7,212	82.3	7,930	90.5	8,177	93.3	30,194	86.2	774,381	55.2
1991	1	737	99.1	728	97.8	737	99.1	744	100.0	2,946	99.0	81,760	68.7
	2	672	100.0	658	97.9	670	99.7	666	99.1	2,666	99.2	67,491	62.8
	3	689	92.6	729	98.0	744	100.0	744	100.0	2,906	97.6	96,602	81.2
	4	720	100.0	694	96.4	368	51.1	196	27.2	1,978	68.7	69,504	60.3
	5	700	94.1	744	100.0	744	100.0	744	100.0	2,932	98.5	92,681	77.9
	6	353	49.0	617	85.7	720	100.0	720	100.0	2,410	83.7	57,305	49.7
	7	275	37.0	309	41.5	315	42.3	744	100.0	1,643	55.2	35,931	30.2
	8	119	16.0	504	67.7	336	45.2	744	100.0	1,703	57.2	32,803	27.6
	9	418	58.1	505	70.1	171	23.8	715	99.3	1,809	62.8	32,852	28.5
	10	744	100.0	227	30.5	268	36.0	729	98.0	1,968	66.1	41,235	34.6
	11	720	100.0	673	93.5	720	100.0	720	100.0	2,833	98.4	94,145	81.7
	12	743	99.9	725	97.4	744	100.0	744	100.0	2,956	99.3	104,510	87.8
合計		6,890	78.7	7,113	81.2	6,537	74.6	8,210	93.7	28,750	82.0	806,819	57.6
1992	1	689	92.6	509	68.4	744	100.0	744	100.0	2,686	90.3	70,982	59.6
	2	241	34.6	696	100.0	696	100.0	696	100.0	2,329	83.7	55,049	49.4
	3	668	89.7	689	92.5	744	100.0	744	100.0	2,844	95.6	58,277	49.0
	4	632	87.8	600	83.3	81	11.3	104	14.4	1,417	49.2	32,560	28.3
	5	737	99.1	743	99.9	743	99.9	743	99.9	2,967	99.7	90,595	76.1
	6	714	99.2	714	99.2	717	99.6	720	100.0	2,865	99.5	108,970	94.6
	7	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	116,885	98.2
	8	744	100.0	743	99.9	743	99.9	743	99.9	2,974	99.9	93,276	78.4
	9	478	66.4	546	75.8	720	100.0	720	100.0	2,464	85.6	48,758	42.3
	10	332	44.6	744	100.0	744	100.0	744	100.0	2,564	86.2	49,919	41.9
	11	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	99,413	86.3
	12	744	100.0	682	91.7	744	100.0	744	100.0	2,914	97.9	93,048	78.2
合計		7,443	84.7	8,130	92.6	8,141	92.7	8,167	93.0	31,880	90.7	917,732	65.3
1993	1	661	88.9	744	100.0	744	100.0	739	99.4	2,889	97.1	51,866	43.6
	2	205	30.5	672	100.0	672	100.0	644	95.8	2,193	81.6	56,159	52.2
	3	287	38.6	334	44.9	734	98.6	730	98.1	2,085	70.1	68,764	57.8
	4	416	57.8	396	55.0	688	95.6	720	100.0	2,220	77.1	87,087	75.6
	5	738	99.2	744	100.0	744	100.0	744	100.0	2,970	99.8	112,588	94.6
	6	720	100.0	720	100.0	720	100.0	720	100.0	2,880	100.0	113,048	98.1
	7	744	100.0	732	98.4	744	100.0	744	100.0	2,964	99.6	109,815	92.3
	8	744	100.0	383	51.5	744	100.0	744	100.0	2,615	87.9	44,601	37.5
	9	705	97.9	307	42.6	713	99.0	713	99.1	2,438	84.7	46,714	40.6
	10	447	60.1	652	87.6	744	100.0	744	100.0	2,587	86.9	60,890	51.2
	11	720	100.0	720	100.0	720	100.0	717	99.5	2,877	99.9	89,347	77.6
	12	744	100.0	744	100.0	744	100.0	744	100.0	2,976	100.0	117,386	98.6
合計		7,132	81.4	7,148	81.6	8,711	99.4	8,703	99.4	31,694	90.5	958,265	68.4

表 12.3 経済的内部収益率

EIRR= 21.69%

Year	Cost					Benefit due to Additional Energy				Energy Loss	Benefit of Renewal		Total Benefit	Balance of Benefit and Cost	Present Worth Value	PWV Discount Rate
	Rehabilitation		Upgrade		Total	Rehabilitation		Upgrade			Rehabilitation					
	Invest.	O & M	Invest.	O & M		Add.Engy	Add.Sales	Add.Engy	Add.Sales		Renewal Benefit	O & M Benefit				21.69%
	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY1,000)	(GWh)	(JY 1,000)	(MWh)	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY 1,000)	(JY 1,000)	
1996	110,100	424,735	45,000	0	579,835							424,735	424,735	-155,100	-155,100	-155,100
1997	915,300	424,735	271,600	23,860	1,635,495							424,735	424,735	-1,210,760	-1,187,020	-994,946
1998	4,291,900	297,315	2,069,400	47,720	6,706,335			6,750	38,273	359,400		424,735	103,608	-6,602,727	-6,346,335	-4,458,683
1999	1,265,700	297,315		47,720	1,610,735	69.06	391,585	13,500	76,545	704,331		424,735	188,534	-1,422,200	-1,340,171	-789,198
2000		169,894		47,720	217,614	148.75	843,398	70,400	399,168			424,735	1,667,301	1,449,687	1,339,287	661,060
2001		169,894		47,720	217,614	159.37	903,627	130,540	740,162			424,735	2,068,524	1,850,910	1,676,426	693,575
2002		169,894		47,720	217,614	169.99	963,856	197,970	1,122,490			424,735	2,511,081	2,293,467	2,036,533	706,224
2003		169,894		47,720	217,614	180.61	1,024,085	269,790	1,529,709			424,735	2,978,529	2,760,915	2,403,543	698,626
2004		169,894		47,720	217,614	191.24	1,084,314	278,000	1,576,260			424,735	3,085,309	2,867,695	2,447,550	596,302
2005		169,894		47,720	217,614	201.86	1,144,543	278,000	1,576,260			424,735	3,145,538	2,927,924	2,449,956	500,305
2006		169,894		47,720	217,614	212.48	1,204,772	278,000	1,576,260			424,735	3,205,767	2,988,153	2,451,326	419,584
2007		169,894		47,720	217,614	223.10	1,265,001	278,000	1,576,260		76,500	424,735	3,342,496	3,124,882	2,513,227	360,572
2008	113,000	169,894		47,720	330,614	233.73	1,325,230	278,000	1,576,260		2,044,900	424,735	5,371,125	5,040,511	3,974,408	477,941
2009	1,472,000	169,894		47,720	1,689,614	244.35	1,385,459	278,000	1,576,260		6,597,400	297,315	9,856,433	8,166,819	6,313,217	636,347
2010	699,300	169,894		47,720	916,914	254.97	1,445,687	278,000	1,576,260		183,700	297,315	3,502,962	2,586,048	1,959,901	165,584
2011		169,894		47,720	217,614	265.59	1,505,916	278,000	1,576,260		27,500	169,894	3,279,570	3,061,956	2,275,079	161,110
2012		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	1,113,459	66,091
2013		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	1,091,626	54,311
2014		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	1,070,222	44,630
2015	1,498,100	169,894		47,720	1,715,714			278,000	1,576,260			169,894	1,746,154	30,440	20,895	730
2016		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	1,028,664	30,138
2017		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	1,008,494	24,766
2018		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	988,719	20,351
2019		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	969,333	16,724
2020		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	950,326	13,743
2021		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	931,692	11,293
2022		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	913,424	9,280
2023		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	895,514	7,626
2024		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	877,954	6,267
2025		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	860,740	5,150
2026		169,894		47,720	217,614			278,000	1,576,260		1,498,100	169,894	3,244,254	3,026,640	1,670,920	8,379
2027		169,894		47,720	217,614			278,000	1,576,260			169,894	1,746,154	1,528,540	827,316	3,478
2028		169,894		47,720	217,614							169,894	169,894	-47,720	-25,322	-89
2029		169,894		47,720	217,614							169,894	169,894	-47,720	-24,825	-73
2030	1,498,100	169,894		47,720	1,715,714							169,894	169,894	-1,545,820	-788,412	-1,952
2031		169,894		47,720	217,614							169,894	169,894	-47,720	-23,861	-50
2032		169,894		47,720	217,614							169,894	169,894	-47,720	-23,393	-41
2033		169,894		47,720	217,614							169,894	169,894	-47,720	-22,935	-33
2034		169,894		47,720	217,614							169,894	169,894	-47,720	-22,485	-27
2035		169,894		47,720	217,614							169,894	169,894	-47,720	-22,044	-23
2036		169,894		47,720	217,614							169,894	169,894	-47,720	-21,612	-19
2037		169,894		47,720	217,614							169,894	169,894	-47,720	-21,188	-15
2038		169,894		47,720	217,614							169,894	169,894	-47,720	-20,773	-13
2039		169,894		47,720	217,614							169,894	169,894	-47,720	-20,365	-10
2040		169,894		47,720	217,614							169,894	169,894	-47,720	-19,966	-8
2041		169,894		47,720	217,614						1,498,100	169,894	1,667,994	1,450,380	594,941	211
2042		169,894		47,720	217,614							169,894	169,894	-47,720	-19,191	-6
2043		169,894		47,720	217,614							169,894	169,894	-47,720	-18,814	-5
2044		169,894		47,720	217,614							169,894	169,894	-47,720	-18,446	-4
2045	1,498,100	169,894		47,720	1,715,714							169,894	169,894	-1,545,820	-585,802	-103
															36,926,630	0

表 12.4 財務的内部収益率

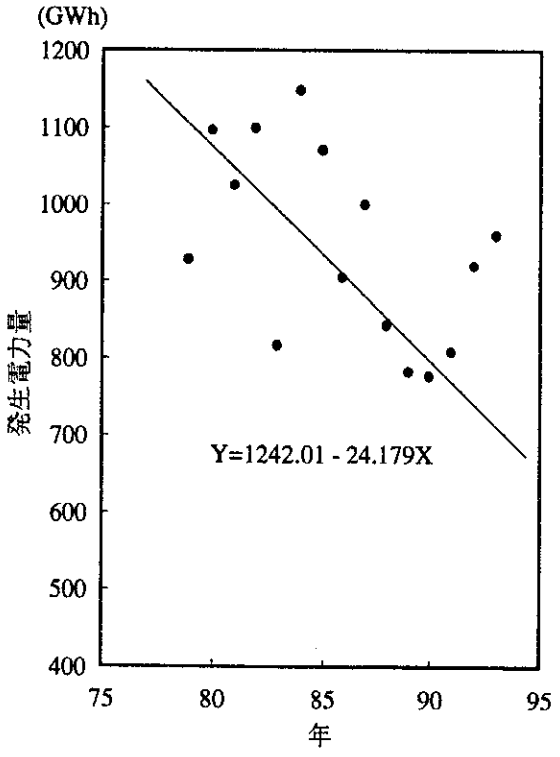
FIRR= 20.13%

Year	Cost: Rehabilitation Invest. (JY 1,000)	Cost: Rehabilitation O & M (JY 1,000)	Cost: Upgrade Invest. (JY 1,000)	Cost: Upgrade O & M (JY 1,000)	Tax (JY 1,000)	Total (JY 1,000)	Benefit due to Additional Energy: Rehabilitation Add.Engy (GWh)	Rehabilitation Add.Sales (JY 1,000)	Upgrade Add.Engy (MWh)	Upgrade Add.Sales (JY 1,000)	Energy Loss (JY 1,000)	Benefit of Renewal: Rehabilitation Renewal Benefit (JY 1,000)	Rehabilitation O & M Benefit (JY 1,000)	Total Benefit (JY 1,000)	Balance of Benefit and Cost (JY 1,000)	Present Worth Value (JY 1,000)	PWV Discount Rate 20.13%
1996	110,100	424,735	45,000	0	0	579,835							424,735	424,735	-155,100	-155,100	-155,100
1997	915,300	424,735	271,600	23,860	0	1,635,495							424,735	424,735	-1,210,760	-1,187,020	-1,007,854
1998	4,291,900	297,315	2,069,400	47,720	3,827	6,710,162			6,750	38,273	359,400		424,735	103,608	-6,606,554	-6,350,014	-4,577,770
1999	1,265,700	297,315		47,720	46,813	1,657,547	69.06	391,585	13,500	76,545	704,331		424,735	188,534	-1,469,013	-1,384,284	-847,314
2000		169,894		47,720	124,257	341,871	148.75	843,398	70,400	399,168			424,735	1,667,301	1,325,431	1,224,493	636,378
2001		169,894		47,720	164,379	381,993	159.37	903,627	130,540	740,162			424,735	2,068,524	1,686,531	1,527,543	674,049
2002		169,894		47,720	208,635	426,249	169.99	963,856	197,970	1,122,490			424,735	2,511,081	2,084,832	1,851,272	693,598
2003		169,894		47,720	255,379	472,993	180.61	1,024,085	269,790	1,529,709			424,735	2,978,529	2,505,536	2,181,220	693,868
2004		169,894		47,720	266,057	483,671	191.24	1,084,314	278,000	1,576,260			424,735	3,085,309	2,601,638	2,220,473	599,739
2005		169,894		47,720	272,080	489,694	201.86	1,144,543	278,000	1,576,260			424,735	3,145,538	2,655,844	2,222,291	509,633
2006		169,894		47,720	278,103	495,717	212.48	1,204,772	278,000	1,576,260			424,735	3,205,767	2,710,050	2,223,185	432,884
2007		169,894		47,720	284,126	501,740	223.10	1,265,001	278,000	1,576,260		76,500	424,735	3,342,496	2,840,756	2,284,715	377,718
2008	113,000	169,894		47,720	290,149	620,763	233.73	1,325,230	278,000	1,576,260		2,044,900	424,735	5,371,125	4,750,362	3,745,628	525,776
2009	1,472,000	169,894		47,720	296,172	1,985,786	244.35	1,385,459	278,000	1,576,260		6,597,400	297,315	9,856,433	7,870,647	6,084,266	725,143
2010	699,300	169,894		47,720	302,195	1,219,109	254.97	1,445,687	278,000	1,576,260		183,700	297,315	3,502,962	2,283,853	1,730,875	175,154
2011		169,894		47,720	308,218	525,832	265.59	1,505,916	278,000	1,576,260		27,300	169,894	3,279,570	2,753,739	2,046,068	175,798
2012		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	998,637	72,852
2013		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	979,055	60,643
2014		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	959,858	50,480
2015	1,498,100	169,894		47,720	157,626	1,873,340			278,000	1,576,260			169,894	1,746,154	-127,186	-87,304	-3,898
2016		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	922,586	34,978
2017		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	904,496	29,117
2018		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	886,761	24,237
2019		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	869,373	20,175
2020		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	852,327	16,794
2021		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	835,614	13,980
2022		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	819,230	11,637
2023		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	803,166	9,687
2024		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	787,418	8,063
2025		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	771,979	6,712
2026		169,894		47,720	157,626	375,240			278,000	1,576,260		1,498,100	169,894	3,244,254	2,869,014	1,583,899	11,693
2027		169,894		47,720	157,626	375,240			278,000	1,576,260			169,894	1,746,154	1,370,914	742,002	4,651
2028		169,894		47,720	0	217,614							169,894	169,894	-47,720	-25,322	-135
2029		169,894		47,720	0	217,614							169,894	169,894	-47,720	-24,825	-112
2030	1,498,100	169,894		47,720	0	1,715,714							169,894	169,894	-1,545,820	-788,412	-3,025
2031		169,894		47,720	0	217,614							169,894	169,894	-47,720	-23,861	-78
2032		169,894		47,720	0	217,614							169,894	169,894	-47,720	-23,393	-65
2033		169,894		47,720	0	217,614							169,894	169,894	-47,720	-22,935	-54
2034		169,894		47,720	0	217,614							169,894	169,894	-47,720	-22,485	-45
2035		169,894		47,720	0	217,614							169,894	169,894	-47,720	-22,044	-37
2036		169,894		47,720	0	217,614							169,894	169,894	-47,720	-21,612	-31
2037		169,894		47,720	0	217,614							169,894	169,894	-47,720	-21,188	-26
2038		169,894		47,720	0	217,614							169,894	169,894	-47,720	-20,773	-22
2039		169,894		47,720	0	217,614							169,894	169,894	-47,720	-20,365	-18
2040		169,894		47,720	0	217,614							169,894	169,894	-47,720	-19,966	-15
2041		169,894		47,720	0	217,614						1,498,100	169,894	1,667,994	1,450,380	594,941	377
2042		169,894		47,720	0	217,614							169,894	169,894	-47,720	-19,191	-10
2043		169,894		47,720	0	217,614							169,894	169,894	-47,720	-18,814	-9
2044		169,894		47,720	0	217,614							169,894	169,894	-47,720	-18,446	-7
2045	1,498,100	169,894		47,720	0	1,715,714							169,894	169,894	-1,545,820	-585,802	-193
																32,790,214	0

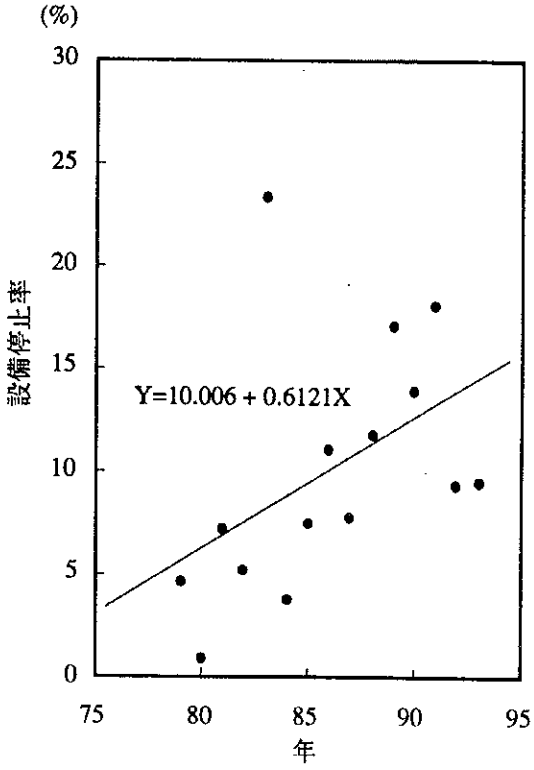
表 12.5　昇圧地域の電力需要予測

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Ninh Son	(GWh)	2.20	2.50	4.90	5.70	6.50	7.40	8.50	10.20	0.00									
	(MW)	0.70	0.80	1.40	1.60	1.80	2.10	2.40	2.80	0.00									
Thap Cham	(GWh)	31.60	40.50	49.80	51.40	65.00	79.30	90.00	101.30	113.46	127.07	141.05	156.56	172.22	189.44	206.49	225.08	245.33	264.96
	(MW)	8.00	10.30	11.90	13.60	16.00	18.80	21.00	24.00	26.88	30.11	33.42	37.09	40.80	44.88	48.92	53.33	58.12	62.77
Phan Ri	(GWh)	6.90	8.80	10.70	13.20	16.00	19.50	24.00	28.70	33.87	39.62	45.57	51.95	58.70	65.74	72.97	80.27	87.50	95.37
	(MW)	2.30	2.80	3.40	4.20	5.00	6.20	7.50	9.10	10.01	11.01	12.11	13.32	14.66	16.05	17.57	19.15	20.88	22.76
Phan Thiet	(GWh)	31.10	34.40	38.60	39.40	46.00	53.20	60.00	67.40	74.81	83.04	92.18	101.40	111.54	122.69	133.73	145.77	158.89	173.19
	(MW)	7.90	8.80	9.80	10.00	11.50	13.50	15.00	16.80	18.65	20.70	22.98	25.27	27.80	30.58	33.33	36.33	39.60	43.17
Cam Ranh	(GWh)	19.20	20.00	45.00	60.00	82.00	105.00	116.50	130.00	143.00	157.30	173.03	190.33	209.37	228.21	248.75	271.14	292.83	316.25
	(MW)	4.00	5.50	8.00	10.00	12.00	14.50	15.00	16.00	16.80	17.64	18.52	19.45	20.42	21.44	22.51	23.64	24.82	26.06
Dien Khanh	(GWh)	16.50	22.00	66.00	80.00	100.00	120.00	140.00	160.00	182.40	207.94	234.97	263.16	292.11	321.32	350.24	381.76	412.30	445.29
	(MW)	4.30	10.00	12.00	15.00	16.00	18.00	19.00	20.00	21.00	22.05	23.15	24.31	25.28	26.29	27.35	28.44	29.58	30.76
Total	(GWh)	107.50	128.20	215.00	249.70	315.50	384.40	430.50	487.40	547.54	614.97	686.79	763.40	843.93	927.41	1,012.19	1,104.01	1,196.85	1,295.06
	(MW)	27.20	38.20	46.50	54.40	62.30	73.10	77.50	85.90	93.34	101.51	110.18	119.45	128.96	139.25	149.69	160.89	173.00	185.52

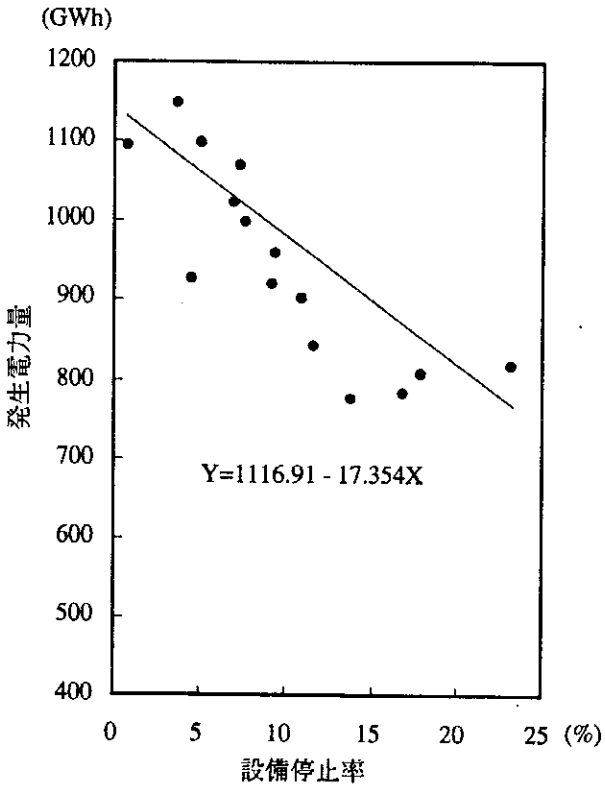
（1）散布図　年－発生電力量



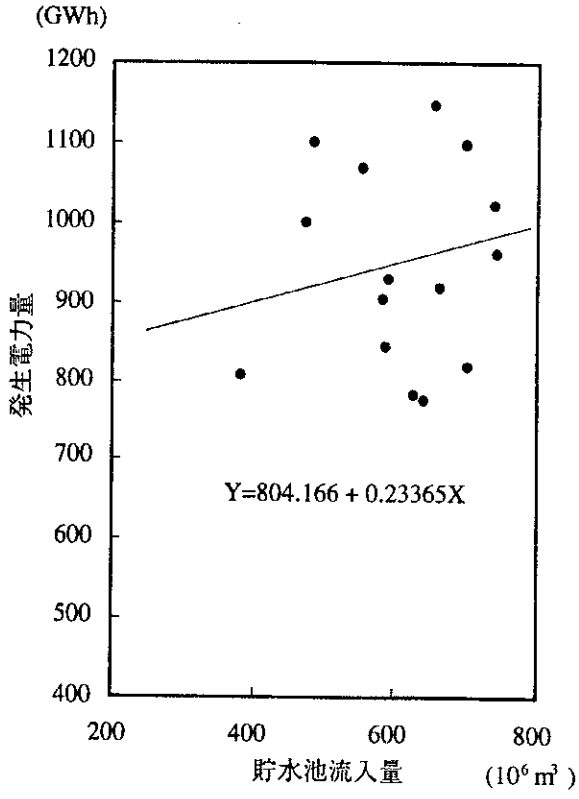
（2）散布図　年－設備停止率



（3）回帰直線　設備停止率－発生電力量



（4）回帰直線　貯水池流入量－発生電力量



ヴィエトナム社会主義共和国 ダニム電力システム改修計画調査	MINISTRY OF ENERGY 国際協力事業団	図　12.1 散布図および回帰直線

第 13 章

総合評価および提言

第１３章　総合評価および提言

ダニム電力システムは1964年に運転開始後30年を経過し諸設備の老化が著しいうえに純正の補修部品・機器の不足により設備本来の機能での運転に支障を来しつつある。同系統は現在においても依然ヴィエトナムの電力の安定供給に重要な位置を占めている。老朽化した施設の修復は緊急を要するものである。

カム・ラン、ファン・ラン、ファン・リ、ファン・チェットの諸都市の需要は近年急増しており、ダニム発電所からの 66kV 電力設備の容量増も緊急課題の一つである。

ヴィエトナム国政府は、1993年10月に日本政府に対しダニム 230 kV 電力設備の改修計画調査および 66kV 電力設備の昇圧計画の実施を要請した。日本政府は国際協力事業団を通じて事前調査団を派遣し日本側の調査内容およびヴィエトナム側の支援事項の確認を行った。

本調査団は施設の緊急改修のために両国政府の合意した内容に基づく調査を短期間に実施した。

調査団の現地調査および解析の結果、施設の老朽化が予想以上に進んでおり緊急に改修を必要とする。重要な機器・施設のうち幾つかは、このままの状態で運転継続することは機器・施設の損傷を伴う重大な事故をひき起こす惧れがあると判断された。また、既設 66kV 系統の需要増加は著しく既設 66kV 送電線容量限界に近くなっていることが判明した。

このように、同システムに対する改修計画と昇圧計画の実施は、技術的観点から緊急を要するものであるとともに、同国の逼迫している電力セクターの安定、インフラの復興・開発に必要不可欠である。ヴィエトナム政府の計画は技術的に妥当なものであると判断する。

調査団は調査結果に基づき、システムの緊急改修計画および既設設備の昇圧計画の具体的な実施案を策定した。その上、資金調達を円滑にし計画の実施を容易にするため、全計画を２期分けした実施代案も策定した。さらに、実施案に対する経済・財務評価を行い経済的内部収益率および財務的内部収益率を試算した。

ダニム電力システムの緊急改修ならびに昇圧計画に対する経済的内部収益率および財務的内部収益率は、それぞれ21.69％、20.13％であり、策定した計画は経済的にも、財務的にも妥当な計画であると判断される。一方計画の具体的実施にあたり全計画を2期分けし、第2期工事の開始を1年遅らせることが経済・財務的に有利と判断される。

従って、調査団は計画を緊急に実施すべきであることを提言するものである。

付属資料

Appendix 1 : Feasibility Study on Rehabilitation of Da Nhim Power System

Memorandum of Meeting

Date and Place of Meeting	:	June 29, 1994 at PC-2 Conference Room in Ho Chi Minh City
Attendance from PC-2	:	Mr. Nguyen Van Than : Deputy Director General Mrs. Ho Thu Bich Phuong : Director Mr. Luu Minh Chanh : Manager of Da Nhim Hydro Power Station Mr. Do Van Canh : Senior Programme Officer Mr. Huynh Ngoc Nguyen : Senior Hydro Power Engineer Mr. Nguyen Chi Dao : Senior Engineer of Saigon Substation
Attendance of JICA Team	:	Mr. K. Jin : JICA Head Office Mr. M. Kanda : Team Leader Mr. M. Mogi : Assistant Leader for Turbine Facilities Mr. K. Nakajima : Transmission Line Facilities Mr. S. Oikado : Hydromechanical Facilities Mr. N. Nakato : Substation & Switchgear Facilities Mr. O. Natsume : Economist Mr. T. Mori : Coordinator

Following were discussed between both parties in the kick-off meeting of the field investigation for the Study, after the general explanation on the Inception Report submitted by the Team.

(1) Accommodation to the Team:

One lodge is ready to use for 9 persons (5 rooms) in the Song Pha quarter. Another lodge in the quarter will be ready in 2 weeks time for 10 persons (5 rooms).
Such lodging arrangement conducted by the Da Nhim power station will meet the Teams working schedule.

Besides, a lodging facility is available at Dran although no water supply is expected.

(2) De-energizing Schedule for the Team's Investigation:

Following de-energizing and dewatering schedules were confirmed by PC-2, as mentioned in the Inception Report.

Da Nhim Power Station

Four units de-eneginzing	:	July 18 to 20, '94
No.1 and No.2 units de-energizing	:	July 18 to 31, '94
No.3 and No.4 units de-energizing	:	August 1, to 14, '94

Saigon Substation

No.1 bank de-energizing	:	August 8 to 9, '94
No.2 bank de-energizing	:	August 10 to 11, '94
Synchronous condensers de-energizing	:	August 1, to 14, '94

(3) PC-2's Assistance

PC-2 confirmed the following operation of facilities to be carried out by staffs and operators of PC-2.

(a) de-energizing and re-energizing of all electrical equipment at Da Nhim power station and Saigon substation,
(b) de-watering and watering of the waterway in Da Nhim site, and
(c) disassembling and re-assembling of electro and mechanical equipment.

(4) Overhaul Inspection for Synchronous Condensers:

Stating a longer period for de-energizing allowed to the condensers, PC-2 requested the Team to conduct the overhaul inspection on the machines.

The Team commented to have further discussion on the matter with staffs of the Saigon substation.

(5) List of Materials and Equipment necessary for Rehabilitation of 230kV Transmission Line and Saigon Substation:

PC-2 submitted to the Team a list of materials, equipment and tools required for rehabilitation of the 230kV transmission line and Saigon substation.
PC-2 mentioned that the similar list of materials and equipment required for upgrading the existing 66kV Da Nhim power system will be given to the Team in the Saigon substation.

(6) Counterparts of PC-2 to the Team:

PC-2 confirmed to provide the following counterparts to the Team.

(a) Engineers:
one (1) turbine, one (1) generator and one (1) waterway from the Da Nhim power station, and one (1) substation and transmission line from either the Da Nhim power station or the Saigon substation.

(b) Technicians:
twenty (20) for turbine and generator, and ten (10) waterway from the Da Nhim power station, and two (2) for substation and transmission line from either the Da Nhim power station or the Saigon substation

PC-2 agreed to appoint additional one (1) counterpart to the economist of the Team.

(7) Use of Radio Equipment:

The Team will use transceiver communication sets for operation of the field investigation of the waterway and reservoir. Frequency of the radio is 400 MHz band. PC-2 mentioned that the Team can use the radio sets on the frequency band without any restriction for the investigation purpose in the Da Nhim and Dran reservoir area.

(8) Technical Training of PC-2 Staff in Japan:

Upon the JICA's question on the training course mentioned in Minutes of Meeting of December 3, 1993(Hanoi), PC-2 answered that PC-2 has sent its application to the Ministry of Energy.

(9) Volume of the Final Report:

For PC-2's budgetary arrangement for translating the JICA's English version report into Vietnamese version, the Team promised to inform total number of the pages of the report before the end of March 1995.

(10) Air Cargoes of the Team:

The Team requested PC-2 to assist to smooth customs clearance of the air-cargoes of materials and equipment to be used for the field inspections. The Team submitted invoices of the cargoes to PC-2.

Because of the consignee of the cargoes is mentioned to be the Team, PC-2 requested the Team for quick clearance to submit 'Power of Attorney' for handling by PC-2. Besides, PC-2 requested the Team to separate the invoices into 'consumable goods' and 'returnable goods'.

The Team promised to submit the 'Power of Attorney' and the amended invoices to PC-2 in the morning of June 30.

PC-2

Nguyen Van Than
Deputy Director General

JICA Study Team

M. Kanda
Team Leader

Appendix 2

MINUTES OF MEETING

DATE & TIME : September 7, 1994 9:00 - 12:00

PLACE : Office Room of Saigon Substation

ATTENDANTS :

Transmission Department (PC-2)	:	Ms. Phuong	Director
	:	Mr. Ngoc	Deputy Director
	:	Mr. Huong	Maintenance Workshop
	:	Mr. Lang	Maintenance Workshop
	:	Mr. Thang	Construction Workshop
	:	Mr. Phuong	Construction Workshop
	:	Mr. Nhung	Operation Division
JICA Study Team	:	Mr. N. Nakato	Substation Equipment Group

RESULT OF DISCUSSION:

1. Result of Field Investigation on Saigon Substation Equipment

JICA Study Team (hereinafter referred to as "JICA") explained to the Transmission Department of PC-2 (hereinafter referred to as "Transmission Department") the summary of the results of the field investigation on the substation equipment in the Saigon Substation.

(1) Synchronous Condensers

Relatively serious damages and troubles were found out on the synchronous condensers as follows:

(a) All of the windings for both Unit 1 and Unit 2 were covered with heavy dust.

(b) Insulation resistance of each winding for both Unit 1 and Unit 2 was lowered. Especially, insulation resistance of the rotor winding for Unit 1 is too low (0.002 M-ohm; while the minimum required value is 0.1 M-ohm).

(c) Index of porosity (PI) for the stator winding was 1.0 to 1.12 for Unit 1 and 0.95 to 0.97 for Unit 2, while the required minimum value is not less than 1.5. This result shows that the stator windings have been deteriorated so as to easily absorb moisture.

(d) Fretting corrosion was observed on the shaft at the PMG side for Unit 1 only. The fretting corrosion may be caused by looseness of the connection between the shaft and the rotor spider, and may become worse to more serious damage in several years.

(e) The treads of the slip rings for both Unit 1 and Unit 2 have been worn down a lot especially at the center.

(f) The brush holder for Unit 1 was damaged by a ground fault. This shows that insulation of the brush holder support has been deteriorated.

(g) Almost all of the babbit metal linings of the bearings for both Unit 1 and Unit 2 have been separated. Some of them were separated deeply.

(h) A lot of oil leakage was observed from the cover and labyrinth parts of the bearings for both Unit 1 and Unit 2.

(i) A cooling water inlet pipe was broken at the inlet portion of the bearing at the exciter side for Unit 1.

(j) The 11 kV power cables for both Unit 1 and Unit 2 have been deteriorated and their cable heads in the 11 kV cubicles have been damaged.

(k) The automatic voltage regulators (AVR) for Unit 1 and Unit 2 was out of order. Only manual voltage regulation by the field resistor is available.

(l) The synchronous condensers often failed to start under the automatic control mode.

(2) Transformers

Some troubles and damages were found out on the transformers as follows:

(a) Oil leakage was observed on

i) Bushings for 1T, 2T, 5T, 6T and 9T

ii) Oil pumps for 1T, 2T and 4T

iii) Radiator valves for 1T and 2T

iv) Tank top covers for 5T and 7T

(b) The alarming functions of the following instruments were defected.

i) Buchholtz relay 1st stage for 1T, 2T and 9T (Each of 2nd stage relay for tripping was normal)

ii) Dial type thermometers for 1T and 2T

iii) Oil flow indicators for 1T and 2T

iv) Dial type oil level gauges for 1T, 2T and 9T

(c) Rust and corrosion were observed on the tanks and radiators for all of the transformers except 6T.

Besides the field investigation, 9 oil samples were taken from 1T (each phase), 2T (each phase), 3T, 4T and 6T for analysis on insulation degradation of the transformers.

(3) Switchgear Equipment

No serious damages and troubles were found out on the switchgear. The major problems on the switchgear equipment are summarized as follows:

(a) A lot of the steel parts of the switchgear equipment, steel structures and insulator strings have rusted.

Ie

(b) Most of the blades and contact surfaces of the 230 kV and 66 kV disconnecting switches and the 230 kV and 66 kV bus conductors have been discolored in black.

(c) Most of the control box instruments for the 230 kV and 66 kV switchgear have been corroded because of the dampness.

(d) Oil leakage was observed on

i) The dash-pot of each 230 kV ABB

ii) The lower tank of the 230 kV CT (B-phase) for 2T circuit

iii) The oil tank of each 66 kV OCB

iv) The oil tank of each 66 kV CT installed on the structures for the 66 kV ABB

v) Six of ten 15 kV OCB

vi) Two of three 11 kV OCB

(e) Two 15 kV DS were troubled.

(f) The 66 kV static condenser banks have been damaged as follows:

i) A 5,000 kVA bank was broken completely by the civil war.

ii) Four 10,000 kVA banks have damages on their post insulators.

iii) Some shunt reactors have oil leakage.

(4) Control and Relay Boards

No serious damages and troubles were found out on the control and relay boards. The remarkable problems on the control and relay boards are summarized as follows:

(a) As a whole, the interior of the control and relay boards were dirty and most of the instruments and relays were used beyond their standard lifetime.

(b) The panel surfaces have rusted and have been contaminated with soot and dust. Some access doors of the control desks were ill-fitting.

(c) The control wiring and their terminals were untidy and have been contaminated with soot and dust.

(d) A lot of the resistors for indication lamps has been discolored.

(e) Some ammeters were not consistent with the current transformer rating.

(f) A lot of the fault indicators had indication troubles.

(g) A recording instruments for voltage was broken.

(h) Most of the springs for the induction type protective relays have been deteriorated, so that the operating time characteristics of such protective relays were changed.

2. Scope of Rehabilitation Works for Saigon Substation

JICA and the Transmission Department discussed the scope of works for implementation of the rehabilitation of the Saigon Substation and concluded as follows:

(1) The following equipment will be included in the scope of rehabilitation works for the Saigon Substation.

(a) Two (2) synchronous condensers complete with their auxiliary equipment, AVR, 11 kV power cables, automatic control system and fire protection system.

The capacity of the synchronous condensers will be reviewed by PC-2 and be informed to JICA in time.

(b) Transformers; two (2) banks of main transformers (1T and 2T) including a spare transformer, three (3) local transformers (3T, 4T and 9T), two (2) house-service transformers (5T and 7T) and one (1) starting transformer (6T).

The capacity of each transformer will be reviewed by PC-2 and be informed to JICA in time.

The Transmission Department asked JICA that the main transformers should be equipped with fire protection system and oil sump tank.

(c) Switchgear; 66 kV switchgear, 15 kV switchgear and 11 kV switchgear

Rating of each switchgear will be reviewed by PC-2 and be informed to JICA in time.

(d) 66 kV static condensers

The capacity of the static condensers will be reviewed by PC-2 and be informed to JICA in time.

(e) Steel structures and busbars for 230 kV and 66 kV bays

The Transmission Department asked JICA to make a technical study of the preventive measures against rust on the steel structures and busbars.

(f) Control and relay boards

The Transmission Department asked JICA that the following equipment should be supplied under the rehabilitation works of the Da Nhim Power System.

i) Protective relays for the 230 kV transmission lines between the Saigon Substation and the Da Nhim Power Station.

ii) Fault locator

The fault locator should be renewed and be installed at the Long Binh Substation or at a convenient place.

(2) The following equipment will be excluded from the scope of rehabilitation works for the Saigon Substation.

(a) 230 kV switchgear

JICA confirmed to the Transmission Department that the 230 kV switchgear including CB, DS and CT would be replaced by the end of 1994.

(b) Communication equipment including PLC system between the Saigon Substation and the Da Nhim Power Station

However, the Transmission Department has an intension of rehabilitating the PLC system of the Da Nhim Power System. Therefore, the Transmission Department will propose PC-2 and the Dispatching Center that a study for the existing PLC system should be made additionally by JICA.

(3) Special tools for construction and maintenance works, testing instruments and spare parts for the rehabilitation equipment should be supplied under the Contract for the rehabilitation works.

- End -

Agreed and Signed by Parties:

N. Nakat

Naoji Nakato
Substation Equipment Group
JICA Study Team

Ho Thi Bich Phuong
Director
Transmission Department
Power Company No. 2

Appendix 3

Feasibility Study
on
Rehabilitation of Da Nhim Power System
Minutes of Meeting : No.1

Date : 17th November, 1994
place : Da Nhim Power Station

Present :

PC-2	JICA Team
Mr.Luu Minh Chanh	Mr.M.Kanda
Mr.Vy Liem Pha	Mr.M.Mogi
Mr.Nguyen Van Ba	Mr.H.Nakaseko
Mr.Nguyen Dung	Mr.Trinh Hoang Ngan
Mr.To Thuong	(Interpreter)
Mr.Tran Hoang Nhat	

Objective:

1. Confirmation of meeting schedule of the interim report
2. Meeting of chapter - 1 of Volume II (Water Turbine and Ancillary Facilities)
3. Meeting of chapter - 2 of Volume II (Generator and Ancillary Facilities)

1. Confirmation of meeting schedule of the interim report

The meeting was carried out on the basis of the work schedule agreed with the meeting held on 15th at PC-2 head office and the meeting schedule at the power station was decided as follows:

- Chapter 1 and 2 : 17th November
- Chapter 3 : 18th November
- Chapter 4 and 5 : 19th November
- Chapter 4 (if required) : 20th November

2. Meeting of chapter - 1 of Volume II

(1) Questions and answers on Chapter-1

Prior to the rehabilitation plan recommended by the study team, the following questions and answers on Chapter-1 were made:

(a) Parts to be repaired

PC-2 stated their question as to whether the parts to be repaired are available in Japan without any special order at the moment in view of the old model manufactured before thirty (30) years.

The study team confirmed that the parts to be repaired will be recommended after consideration economically and technically.

(b) Turbine Housing

PC-2 requested to instruct the repair method of turbine housing. The study team stated their recommended method that the buffle plate is re-welded.

(c) Governor system

PC-2 agreed with the application of the digital type governor provided that the provision of the testing equipment and staff trainning for the application will be considered.

It is noted that the matter will be discussed in the draft final report.

(2) Confirmation of draft plan of urgent rehabilitation

After discussion on the above, the draft plan of urgent rehabilitation meintioned in clause 1.3 of Chapter 1 were confirmed each other as follows:

(a) Clause 1.3.2 (Turbine)

i) The replacement items recommended were agreed by PC-2 except for the replacement issue of the runner bucket.

PC-2 stated their concern that they will accept the replacement of the runner bucket provided that the new design runner bucket can be ensured to increase the efficiency and decrease the noise and vibration due to the operation of the turbines.

PC-2 also stated that the existing six (6) runners will be used as spare, after reparing.

The study team confirmed that the issue of the runners will be discussed finally in the draft final report considering the PC-2 intention.

ii) The repair items recommended were agreed totally by PC-2.

iii) It is noted that the replacement of four (4) jet brakes with valves will be added in Clause 1.3.2 (1) of page II-1-10.

(b) Clause 1.3.3 (Inlet valve and bypass valve)

i) The replacement items recommended were agreed to change as follows:

- bypass valve with the related servomotor and pipes
- two (2) of drain valve as spare
- distributing valve for the above
- swivel joints for seat valve of inlet valve
- distributing system of seat valve for four (4) units

ii) The repair items recommended were agreed subject to the following:

One (1) set of additional inlet valve will be provided for achieving the overhaul of the inlet valve without suspension of the turbine operation. This valve shall be interchangeable for four units.

(c) Clause 1.3.4 (Governor)

The replacement items were agreed by PC-2 subject to the confirmation of the above item 2.(1).(c).

(d) Clause 1.3.5 (Oil pressure system)

The replacement items were agreed totally by PC-2.

(e) Clause 1.3.6(Water supply system)

The replacement items were agreed by PC-2 subject to the provision of four (4) new pumps with motors and all other necessary electrical equipment.

3. Meeting of chapter - 2 of Volume II

(1) Correction of wording

The words of " rotor winding" mentioned in pages II-2-6 and II-2-7 were agreed to replace with " stator winding'. It is noted that the correction of some other words will be required to be made in the draft final report.

(2) Confirmation of draft plan of urgent rehabilitation

As a results of the discussion with PC-2, the rehabilitation plan mentioned in Clauses 2.3 and 2.4 were agreed with the following revisions:

(a) Clause 2.3 (Draft plan of urgent rehabilitation)

- Item (3) will be deleted in its entirety as the existing shafts of No.2 and No.4 units are showing the good operational condition.
- Item (4) will be changed into the followings:

  "Replacement of the existing exciting system with the brushless exciting system (includintg AVR, drilling holes for leads into the main hafts)"

- Item (5) will be changed into the followings:

  "improvement of draw out method of the rotor (Refer to Figure II-2.3)
- Item (7) will be changed into the follows:

  " Renewal of the main bearing metal for all units"

- Item (9) will be changed into the following:

  " Renewal of the oil cooler with the large capacity one"

- Item (13) will be deleted in its entirety according PC-2 request.
- Item (18) will be deleted in its entirety as the lubricating oil can be procured by PC-2.

(b) Clause 2.4 (Draft plan of long term rehabilitation)
- Item (2) will be carried out by the plan of urgent rehabilitation.

4. Other matter

PC-2 stated that Chapter-3 will be discussed at the power station tomorrow.

Mr. Luu Minh Chanh
Director
Da Nhim Power Station

M.Kanda
JICA Team Leader

Appendix 4

Feasibility Study
on
Rehabilitation of Da Nhim Power System
Minutes of Meeting : No.2

Date : 18th November, 1994
place : Da Nhim Power Station

Present :

PC-2	JICA Team
Mr.Luu Minh Chanh	Mr.M.Kanda
Mr.Vy Liem Pha	Mr.M.Mogi
Mr.Nguyen Van Ba	Mr.H.Nakaseko
Mr.Nguyen Dung	Mr.Trinh Hoang Ngan
Mr.To Thuong	(Interpreter)
Mr.Tran Hoang Nhat	
Mr.Vo Thanh Ngon	

Objective:

- Meeting of chapter - 3 of Volume II (Waterway and Ancillary Facilities)

1. Confirmation of urgent rehabilitation plan

The urgent rehabilitation plan recommended in Table II-3.3 were reviewed and confirmed as follows:

(1) Spillway gates and hoists

i) As the paint of skin plate, main beam, arms mentioned in item No.1.1 (3) will be carried out by PC-2, the rehabilitation of the repainting works will be commented as PC-2 works.

ii) PC-2 agreed with the other rehabilitation works recommended.

(2) Spillway irrigation outlet

i) As the outlet valves is essential to discharge the water below top elevation of spillway crest, PC-2 agreed to recover the function of valve immediately after dewatering of the valve chamber.

ii) PC-2 agreed totally with the rehabilitation works recommended.

(3) Intake trash racks

i) PC-2 stated that they have plan to replace the upper screen panels (above EL.1,020.8 m) of trash rack with new panel next year by themselves as described in the last paragraph of page II-3-5.

ii) PC-2 agreed that the study team will recommend their independent rehabilitation plan in the draft final report , on the basis of the results of the stress analysis of screen bars.

(4) Movable trash racks

i) PC-2 stated that they can repair the upstream screen panel on the basis of the result of required analysis by the study team. Therefore, the study team confirmed to propose the recommendable repairing method of screen panel in the draft final report.

ii) The breakage of guide frame secondary concrete will be repaired after examination on the methods recommended by Clause 4.3.

iii) PC-2 agreed with the other rehabilitation works recommended.

(5) Intake caterpillar gate and hoist

i) As the paint of skin plate and main beam mentioned in item No.5.1 (1) will be carried out by PC-2, the rehabilitation of the repainting works will be commented as PC-2's works.

ii) PC-2 agreed with the other rehabilitation works recommended.

(6) Surge tank drain facilities

i) As the paint of surge tank drain facilities mentioned in item No.6 will be carried out by PC-2, the rehabilitation of the repainting works will be commented as PC-2's works.

(7) Butterfly valves

i) As the paint of outer surface of valves mentioned in item No.7.1 will be carried out by PC-2, the rehabilitation of the repainting works will be commented as PC-2's works.

ii) PC-2 agreed with the other rehabilitation works recommended.

(8) Penstocks

i) As the repair paint of penstocks mentioned in item Nos. 8.1, 8.2 (1), 8.3 (1) will be carried out by PC-2, the rehabilitation of the repainting works will be commented as PC-2's works.

ii) PC-2 requested that the repaire method of damaged ring girder mentioned in item 8.3 (2) will be described the welding method and the kind of welding lods.

iii) PC-2 agreed with the other rehabilitation works recommended

(9) Others

i) PC-2 agreed with the rehabilitation plan recommended.

ii) PC-2 stated that a standby diesel generator and auxiliary equipment have been already provided at the dam. Therefore, the study team agreed to delete the rehabilitation plan on item 9.2.

2. Data requested by the study team

The study team requested to PC-2 to provide the following data which are essential to carry out the basic design of the urgent rehabilitation plan,

(1) Water supply pumps (see item 2.2 of Table II-3.3 (2))

- Design data of the existing pumps and motors
- Design data and layout of the existing water pipes
- Layout drawing of water pipes in the pump chamber

(2) Damage of pressure gauge and its transmitter

- Design data of the existing pressure gauge and its transmitter
- Cable layout between the valve house and the power station
- Design data of the receiver located at the power station

It is noted as a result of the discussion with PC-2 that all the equipment will be discussed under the turbine and generator parts in the draft final report.

3. Other matter

(1) PC-2 expressed their preference that all the equipment and materials to be required by the urgent rehabilitation plan will be supplied by the reputable foreign contractor and installed by PC-2 under the supervision of the contractor.

(2) PC-2 stated that Chapter-4 and 5 will be discussed at the power station tomorrow.

Mr. Luu Minh Chanh
Director
Da Nhim Power Station

M.Kanda
JICA Team Leader

Appendix 5

Feasibility Study
on
Rehabilitation of Da Nhim Power System
Minutes of Meeting : No.3

Date : 19th November, 1994
place : Da Nhim Power Station

Present :

PC-2	JICA Team
Mr.Luu Minh Chanh	Mr.M.Kanda
Mr. Lien Thu	Mr.M.Mogi
Mr.Huynh Ngoc Nguyen	Mr.H.Nakaseko
Mr.Vy Liem Pha	Mr.Trinh Hoang Ngan
Mr.Nguyen Van Ba	(Interpreter)
Mr.Nguyen Dung	
Mr.Nguyen Dinh Cau	
Mr.To Thuong	
Mr.Tran Hoang Nhat	
Mr.Vo Thanh Ngon	
Mr. Luu Cong Hung	

Objective:

- Meeting of chapter - 4 of Volume II (Main and Civil Structures)
- Meeting of chapter - 5 of Volume II (Hydrological Data Aquision System)

1. Meeting of Chapter-4 of Volume II

Prior to the discussion on the Chapter-4, the study team informed that chapter-4 of draft interim report which have been sent early to PC-2 to enable them to translate into the Vietnamese have been revised and thus clause 4.5 (4) of chapter-4 of draft interim report has been deleted in view of the scope of work agreed between JICA and Viet Nam.

(1) Confirmation of urgent rehabilitation plan

The urgent rehabilitation plan mentioned in Clause 4.3 were reviewed and confirmed as follows:

(a) Spillway

PC-2 stated that the first paragraph will be carried out by the themselves and second paragraph will be studied in detailed by the study team.

(b) Intake structure

All the rehabilitation plan recommended by the study team will be carried out by PC-2.

(c) Penstock line

i) PC-2 agreed that all the rehabilitation plan recommended by the study team will be carried out by themselves.

ii) PC-2 expressed that they have the difficult maintenance work of the penstock line between the valve house and the upper crossing, because no proper carrying facilities are provided for the portion. In response to these, the study team stated that they have intention to do the basic design for provision of the carrying facilities for the penstock line maintenance.

The study team also stated that as there are many eroded condition of the ground surface at the penstock trench for the above portion, they requested to PC-2 to provide the sectional drawing of the existing penstock trench to enable them to achieve the proper design work of the carrying facilities. PC-2 confirmed to provide the sectional drawing of the penstock trench to the study team until end of December, 1994.

The study team confirmed that they will discuss the basic design of such carrying facilities in chapter 3 (Waterway and Ancillary Facilities) of the draft final report.

PC-2 stated that the provision of the facilities will be carried out under the foreign currency portion and will be classified as the urgent rehabilitation plan..

(d) Power house

PC-2 confirmed that the rehabilitation works required will be carried out by themselves.

(2) Others

(a) PC-2 requested that the basis of 300 Km^2 mentioned in item 3.b of clause 4.5 (3) shall be clarified in the draft final report.

(b) PC-2 requested that the study team shall be clarified the reason why the geotechnical investigation recommended in item 3.g of clause 4.5 (3) is required.

(c) PC-2 confirmed that they have no other comment on chapter-4 of the interim report.

2. Meeting of Chapter-5 of Volume-II

The study team confirmed that PC-2 have no comment on chapter-5.

3. Other Matters

PC-2 informed that the final meeting will be held at 8.30 am tomorrow.

Mr. Luu Minh Chanh
Director
Da Nhim Power Station

M.Kanda
JICA Team Leader

Appendix 6

Feasibility Study on Rehabilitation of Da Nhim Power System

Minutes of Meeting

Date and Place of Meeting	: November 25, 1994 at Conference Room of PC-2
Attendance from PC-2	: Mr. Luu Minh Chanh, Manager of Da Nhim P/S
	: Mr. Do Van Canh, Senior Programme Officer of External Economic Activites of PC-2
	: Mr. Vy Liem Pha, Manager of Maintenance and Workshop of Da Nhim P/S
	: Mr.Huynh Ngoc Nguyen, Programme Officer of Tech. Dept
	: Mr. Nguyen Van Hai, Programme Officer of Tech. Dept.
	: Mr. Pham Kim Son, Programme Officer of Power System Control Center
	: Mr. Mai Due Do, Programme Officer of Construction Dept.
	: Mr. Nguyen Van Ngoc, Deputy Director of Transmission Dept
Attendance from JICA Team	: Mr. M. Kanda, Team Leader
	: Mr. M.Mogi, Turbine Engineer
	: Mr. K. Nakajima, Transmission Line Engineer
	: Mr. H. Nakaseko, Hydromechanical Engineer
	: Mr. N. Nakato, Substation Engineer

Since the JICA Study Team arrived at Vietnam on November 14, 1994, PC-2 and the Team have discussed on the interim report for the captioned project.

Both parties have also discussed the specific plans of rehabilitation of the system and upgrade of the existing transmission facilities for the succeeding study of the plan.

The discussions were held in the head office of PC-2, the Da Nhim power station and the Saigon substation between the PC-2's engineers and the Team. Results of those fruitful discussions were recorded in the attached minutes and memorandum of meeting.

Additionally, in this meeting, following requests were made by PC-2 to the report. The JICA Team mentioned that detailed descriptions concerned the requests will be stated in the draft final report.

(1) Da Nhim P/S

(a) to specify the details of new goveners
(b) to clarify the reasons of replacement of runners
(c) to provide econmical comparison for replacement of inlet valve
(d) to provided economical comparison for the excitation system
(e) to renew the air compressor systems for outdoor and indoor switchgear
(f) to replace the storage batteries
(g) to replace the oil pumps for all main transformers

(2) Saigon S/S

(a) to provide dual voltage design of the new main transfomer (2T)
(b) to replace the air compressors for the 66 kV air-blast circuit breakers
(c) to amend the word " energy center " mentioned in item 4 (b) of the Memorandum of Nos. 17 to 19 to " load dispatching center "

(3) Others

PC-2 strongly expressed that the dam and spillway should be investigated separately in detail at the earliest time under assistance of the Government of Japan.

Now both parties accepted all descriptions in the following minutes and memorandum (enclosed herewith).

- Minutes of Nov. 15, 1994 at PC-2 Head Office
- Minutes of Nov. 17, 1994 at Da Nhim Power Station
- Minutes of Nov. 18, 1994 at Da Nhim Power Station
- Minutes of Nov. 19, 1994 at Da Nhim Power Station
- Memorandum of Nov. 17, 1994 at Saigon Substation
- Memorandum of Nov. 23, 1994 at PC-2 Head Office, and
- Memorandum of Nov. 24, 1994 at PC-2 Head Office

The JICA Team is to continue to prepare the draft final report of the study by the end of February 1995 on the basis of the discussions and visit PC-2 around the middle of March 1995 for the further discussions of the report.

Nguyen Van Than
Deputy Director General
Power Company No.2

M. Kanda
Leader of JICA Study Team

Appendix 7

JICA Feasibility Study on Rehabilitation of Da Nhim Power System

Memorandum of Discussion

DATE	:	November 17 to 19, 1994	
PLACE	:	Meeting Room of Transmission Department of PC-2	
ATTENDANTS	:		
PC-2	:	Mr. Nguyen Van Ngoc	Deputy Director
	:	Mr. Nguyen Tu Quy	Manager of Maintenance Workshop
	:	Mr. Huguh Van Nghiep	Manager of Construction Workshop
	:	Mr. Nguyen Nguyen Nhung	Deputy Manager of Operation Div.
	:	Mr. Nguyen Chi Dao	Planning and Technic Div.
	:	Mr. Quaeh Eam Huong	Maintenance Workshop
	:	Mr. Nguyen Ngoc Lang	Maintenace Workshop
	:	Mr. Bui Vinh Nhan	Transmission Line Div.
	:	Mr. Tran Thai Dung	Planning and Technic. Div.
	:	Mr. Ha Cong Minh	Transmission Line Div. (Highland)
JICA Team	:	Mr. K. Nakajima	Transmission Line Engineer
		Mr. N. Nakato	Substation Engineer

RESULT OF DISCUSSION:

The JICA Study Team (hereinafter referred to as "JICA") explained Chapters 6, 7 and 8 of the JICA's Interim Report to the Transmission Department of PC-2 (hereinafter referred to as "PC-2") and the both parties discussed the rehabilitation plans and the upgrading plans of the facilities described in the respective chapters. The result of the discussions is summarized below. The ammendments conluded in the discussions will be reflected in the Draft Final Report to be submitted by JICA in March 1995.

1. Chapter 6: Substation Facilities

(1) Rehabilitation of Synchronous Condensers

(a) JICA explained the necessity of the top urgent rehablitation work for the synchronous condensers as described in Paragraph (2) of Clause 6.2. PC-2 understood the critical condition of the synchronous condensers and agreed to cope with the top urgent rehabilitation work.

(b) PC-2 agreed to the urgent rehablitation plans described in Paragraph (1) of Clause 6.3.2, except the following points.

i) The two oil lift pumps for the main bearings should be replaced with new ones.

ii) The lubricating oils for all the main bearings should be changed thoroughly.

iii) The 11 kV power cables do not need to be replaced because they are still in good condition. Only their cable heads in the 11 kV cubicle should be replaced with new ones.

iv) As for the new excitation system, PC-2 prefers static thyrister type AVR to brushless type one, which needs making a bore hole on the existing main shaft for Unit 2, from the economical point of view.

(2) Rehabilitation of Transformers

PC-2 agreed that the urgent rehabilitation of the transformers should be modified as follows:

(a) Main transformers

i) A new three-phase transformer should preferably be installed as the main transformer "2T" instead of replacement of the two single-phase transformers of "1T-B" and "2T-C" whose insulation seem to be seriously deteriorated. The capacity of the new transformer should be 125,000 kVA.

In this connection, the main transformer "1T" consists of the existing three single-phase transformers plus one spare single-phase transformer.

ii) The following rehabilitation will be applied to the exsisting three single-phase transformers for "1T" and one spare single-phase transformer.

- Replacement of gaskets for all bushings
- Replacement of all oil circulating pumps
- Replacement of all radiator valves
- Replacement of all protective relays; namely, buchholtz relays, dial thermometers, oil flow relays and dial oil level gauges
- Renewal of oil preservation system
- Additional installation of oil sump tanks
- Repair paints

iii) The oils for all the existing single-phase transformers will be changed by PC-2 as required.

(b) House-service transformers

i) The house-service transformers of "5T" and "7T" should be renewed and their new capacity should be IEC standard 400 kVA instead of the existing 300 kVA.

ii) The primary winding for the new "7T" should be rated for 22 kV but tapped at 15 kV that is the present operational voltage of the distribution lines.

(c) Starting transformer

i) The oil for the starting transformer of "6T" will be changed as required by PC-2 following the results of oil test.

ii) The dial thermometer should be replaced with new one.

(d) 66 kV transformers

i) The 66 kV transformers of "3T" and "4T" should be renewed and their new capacity should be 31,500 kVA instead of 20,000 kVA.

ii) The 66 kV transformer bank of "9T", which consists of three single-phase transformers, should preferably be replaced with a new three-phase

transformer with IEC standard capacity of 12,500 kVA. The new three-phase transformer of "9T" should be equipped with an on-load tap changer.

iii) The secondary windings for all the new 66 kV transformers should be rated for 22 kV but tapped at 15 kV that is the present operational voltage of the distribution lines.

iv) All the new 66 kV transformers should be equipped with lightning arresters to be supported on the tanks at both sides of the 66 kV and 22 kV terminals. Lighting arresters on the secondary winding side is rated at 15 kV.

v) The study will be made for dual voltage rating of primary winding for use at rated at 66 kV or 110 kV.

(3) Rehabilitation of Switchgear Equipment

(a) 230 kV switchgear

PC-2 confirmed that all the 230 kV switchgear including circuit breakers, disconnecting switches, current transformers, capacitance voltage transformers and lightning arresters would be replaced with new ones by the end of 1994. That is why the 230 kV switchgear is out of scope for the urgent rehabilitation work.

(b) 66 kV switchgear

i) PC-2 agreed that the scope of the urgent rehabiliation plan for the 66 kV switchgear should be kept at minimum, considering the PC-2's plan to upgrade the 66 kV line voltage to 110 kV in the future.

ii) PC-2 commented that the following work should be added to the urgent rehabilitation of the 66 kV switchgear.

- Replacement of three current transformers for the Thu Duc No. 2 line (CB No.: 772)

The new current transformers should be rated at 1200-600//5/5 A, 0.5/5P20 and 40 VA/40VA.

- Replacement of three capacitance voltage transformers for the 66 kV busbar No. 1

The new voltage transformers should be rated at 66 kV/$\sqrt{3}$: 110 V/$\sqrt{3}$: 110 V/3, 1.0/3P and 400 VA/100 VA.

- Replacement of lightning arresters for eight feeders and additional installation of lightning arresters for two busbars

The new lightning arresters should be the zinc oxide gapless type with the discharge current of 10 kA.

(c) 15 kV switchgear

inPC-2 commented that six 15 kV disconnecting switches of "581-7", "579-7", "577-7", "581-1", "579-1" and "577-1" should be replaced with new ones because "581-7" and "577-7" were damaged and the others were seriously

deteriorated by aging. The new disconnecting switches should be rated for 22 kV stead of 15 kV.

(d) 11 kV switchgear

PC-2 commented to include the rehabilitation of the 11 kV switchgear in the scope of the urgent rehabilitation and agreed to the following plans:

i) The 11 kV switchgear cubicles should be replaced with new ones. The new 11 kV cubicles should be the outdoor use construction to accommodate the following equipment:

- Two voltage transformers for AVR
- Two current transformers
- Two surge absorbers

ii) The 11 kV circuit breakers "532, 561, 562, 563 and 536-B" should be replaced with new one. The new circuit breakers should preferably be of outdoor use and SF6 gas or vacuum type with the rated short-circuit breaking current of 20 kA or higher at 11 kV.

(e) 66 kV static condenser banks

PC-2 commented that No. 1 static condenser bank, which was broken and demolished, should be restored and renewed with a capacity of 10,000 kVA instead of 5,000 kVA. The new static condenser bank should be complete with 66 kV switchgear and all the necessary auxiliaries.

(4) Rehabilitation of Control and Relay Boards

(a) Control and relay boards

PC-2 agreed in principle to replace all the control and relay boards in the control room and all their control cables with new ones. PC-2 and JICA discussed the following two alternatives for the method of their replacement but have not yet come to conclusion.

i) Alternative 1: Installation in the existing control room

All the new control and relay boards will be installed at the same place as the existing ones in the existing control room. Since the replacement of the boards will be made panel by panel, it will take a long time to complete all the replacement works. During a period of the replacement, operation of the equipment for the related circuit will be made at the local control boxes without sufficient indication and protection or with temporary provisions for indication and protection.

ii) Alternative 2: Installation in the new control room

All the new control and relay boards will be installed in a new control room to be located separately from the existing control room. This alternative has the following advantages.

- A time required for the replacement works can be minimized because all the boards and cables can be installed at the same time in advance.

- Installation of the boards will not interfere with operation of the equipment from the existing control room.

PC-2 prefers the Alternative 2 and the JICA team will further study the plan.

(b) Transmission line protective relays

JICA proposed to apply the carrier relaying scheme, which needs to use one PLC channel for protection signalling, to the new transmission line protective relays for the 230 kV transmission line between the Saigon Substation and the Da Nhim Power Station.

The JICA team will further discuss on this matters with PC-2 and its ~~energy~~ load dispatching center.

(c) Fault locator

PC-2 commented that the new fault locator should be located at the Long Binh Substation. If the New Bao Loc Substation is constructed between the Long Binh Substation and the Da Nhim Power Station, another new fault locator would be provided at the Bao Loc Substation separately.

(d) Battery charger

PC-2 commented that the battery charger for the lead-acid storage batteries of 380 AH, 220 V D.C. should be replaced with new one.

(5) Rehabilitation of Overhead Traveling Crane

PC-2 pointed out that the overhead traveling crane in the repair shop should be rehabilitated because some troubles were found on the motor brakes and the control circuits. JICA explained that the rehabilitation plan for the overhead traveling crane will be prepared in the Draft Final Report.

(6) Spare Parts

PC-2 agreed to include the following spare parts in the scope of the urgent rehabilitation of the substation facilities:

(a) Spare parts for synchronous condensers

i) Two (2) sets of bearing metals

ii) Carbon brushes for ten (10) years' operation

iii) 200 liters of lubrication oils

(b) Spare parts for transformers

i) One (1) 230 kV phase bushing for the existing main transformers with necessary adapter for replacement

ii) One (1) 230 kV neutral bushing

iii) Two (2) 66 kV bushings for the existing main transformers with necessary adaper for replacement

iv) Two (2) 11 kV bushings for the existing main transformers with necessary adapter for replacement

(c) Spare parts for switchgear

i) Fifteen (15) phase sets of moving and fix contacts for the 66 kV air-blast circuit breakers
- Six for 1,000 A rating
- Three for 800 A rating
- Six for 400 A rating

ii) 40 kg of grease (Hita-Sol) for the 66 kV air-blast circuit breakers

2. Chapter 7: 230 kV Transmission Line Facilities

JICA submitted PC-2 the missing pages of Tale II-7.1. PC-2 agreed to all the descriptions in the Chapter except the following points.

(1) PC-2 confirmed that the zinc rich paint is now locally available and no procurement of the paint from abroad is necessary, accordingly.

(2) The word "more" on 4th line from top on Page II-7-17 should be amended to "less".

(3) Specifications for the suspension and tension insulator sets in Item No. M4 in Table II-7.1 should be amended from "Hardware only in complete set" to "Complete set with insulator units".

(4) Description "Complete Strain Clamp" of Item No. M10 in Table II-7.1 (Required Materials and Tools) was amended to "Complete Tension Set".

2. Chapter 8: Upgrade of Transmission Facilities

PC-2 agreed to all the contents in the Chapter except the following points.

(1) Diameters of the following power conductors stated in the table on Page II-8-10 were corrected as shown below:

ACSR 336.4 MCM	:	18.28 mm
ACSR 185 mm^2	:	18.80 mm

(2) Quantities and specifications in Table II-8.1 (Required Materials) were amended as follows:

M3.	Single suspension set	:	Q'ty amended from 200 to 100 sets
M4.	Strain clamp set	:	Q'ty amended from 50 to 100 sets
M5.	Dead end clamp	:	Q'ty amended from 100 to 50 sets
M7.	Power conductor (336.4 MCM)	:	Q'ty amended from 15 to 5 km
M8.	O.H. earthwire GSW 22 mm^2	:	Q'ty amended from 4.5 to 2 km
M9.	Galvanized steel materials	:	Unit length amended from 12 to 6 m, and Q'ty increased to be twice, accordingly
M11.	Crossarm set	:	Q'ty for suspension poles amended from 460 to 50 sets. Drawing No. amended to 0589 XD 07 & 08. Drawing No. 0790 XD 07 & 08 for tension poles amended to 0190 XD 07 & 08.

(3) One (1) set of the insulator replacer for double tension sets is added to Item No. T6 of Table II-8.3 (Required Tools).

It was explained by JICA that detailed descriptions for the 110 kV substation facilities would be compiled in the Draft Final Report.

- End -

Agreed and Signed by Parties:

PC-2	JICA Team	JICA Team
Ho Thi Bich Phuong Director Transmission Department	Ko Nakajima Transmission Line Engineer	Naoji Nakato Substation Engineer

JICA FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

MEMORANDUM OF DISCUSSION

Date and place of discussion:
November 21, 1994 at Power Transmission Department No.2 of PC-3 in Nha Trang City

Attendance from PC-3 :
Mr.DINH MIEN _ Diretor
Mr.NGUYEN DINH DOAN _ Vice Diretor
Mr.PHAN HO _ Technical Manager
Mrs.NGUYEN THI THAO THAO _ Vice chief of Technology Office

Attendance from JICA Team :
Mr.M.KANDA _ Team Leader
Mr.K.NAKAJIMA _ Transmission Line Engineer
Mr.N.NAKATO _ Substation Engineer

The JICA study Team submitted PC-3 two (2) copies of Interim Report for the Feasibility study and explained the contents of the Report.

Following the general explanation, chapter 8 " Upgrade of Transmission Facilities " was discussed. PC-3 agreed principaly with the descriptions in chapter 8 of the Interim Report except the following discussion.

Following were major items discussed among the attendance and amendment to be made in the draft final Report.

(1) New 110 KV Substations

The JICA Team explained that the design of new 110 KV substations at Cam Ranh and Dien Khanh ,would be compiled in the draft final Report and the design of the substations would be basically in the same practice for the Thap Cham, Phan Ri and Phan Thiet substaions.
Transformer capacity will be 16 MVA 110/22 KV for the Cam Ranh substation with 3 outgoing feeders of 110 KV, 4 outgoing feeders of 22 KV, and 16 MVA for the Dien Khanh substation with 2 outgoing feeders of 110 KV and 4 outgoing feeders of 22 KV.
Provision for the future extension of a 16 MVA, 110/22 KV transformer will be made in the Cam Ranh substation.
Each 110 KV outgoing feeder will be provided with a single phase CVT for the synchronizing purpose. in this connection, an automatic synchronizing relay will be provided at the Cam Ranh and the Dien Khanh substations.

(2) Confirmation on Transmission Line Materials (Table II-8.2)

Following were amended through the discussion.

(2-1) Thap Cham - Cam Ranh Section.

(a) M2 (galvanized steel pole) to be amended to 2 sets of type PA and 2 sets of type PA+2.

(b) M4 (Power conductor) to be amended to include necessary joints.

(c) M5 (Stay wire) to be added with complete fittings in 100 sets.

(d) M6 (Earthing Set) to be amended from 500 sets to 100 sets.

In addition to the above materials, tools for maintenance works are reguired as listed in the attached sheets.

(2-2) Cam Ranh - Dien Khanh Section.

(a) The new supports will be of local concrete poles, and accordingly ~~as~~ the galvanized steel poles will be eliminated from the table II-8.2.

(b) Items and quantities reguired for the upgrade plan will be estimated by the Study Team.

(3) Revision on Figure I-2.6.

System map for PC-3 region was revised for the present statics.

(4) Schedule of Study.

The JICA Team explained the schedule of the study as follows:

(a) Submission of the draft final report : By the middle of March'95

(b) Submission of the final report : By the end of June'95

(c) Submission of the technical specification: By the end of June'95

PC-3

DINH MIEN
Director of Power Transmission
Department No.2

JICA Study Team

Mr. KANDA
Team Leader

Appendix 9

JICA Feasibility Study on Rehabilitation of Da Nhim Power System

Memorandum of Discussion

DATE	:	November 23, 1994	
PLACE	:	Meeting Room of PC-2 Head Office	
ATTENDANTS	:		
PC-2	:	Mr. Luu Minh Chanh	Director of Da Nhim Power Station
	:	Mr. Vy Liem Pha	Da Nhim Power Station
	:	Mr. Do Van Canh	Senior Program Officer of PC-2
	:	Mr. Mai Duc Do	Construction Department
JICA Team	:	Mr. Masatoshi Kanda	Team Leader
	:	Mr. Motoo Mogi	Turbine Engineer
	:	Mr. Ko Nakajima	Transmission Line Engineer
	:	Mr. Hiroshi Nakaseko	Hydromechanical Engineer
	:	Mr. N. Nakato	Substation Engineer

RESULT OF DISCUSSION:

The JICA Study Team (hereinafter referred to as "JICA") explained Chapter 6 of the JICA's Interim Report to the Da Nhim Power Station of PC-2 (hereinafter referred to as "PC-2") and the both parties discussed the rehabilitation plans of the Substation Facilities for the Da Nhim Power Station. The result of the discussion is summarized below. The amendments concluded in the discussion will be reflected in the Draft Final Report to be submitted by JICA in March 1995.

1. Rehabilitation of Transformers

(1) Main Transformers

(a) Top urgent rehabilitation for main transformer "1T"

JICA explained that the main transformer "1T" should be overhauled immediately for detailed inside inspection and repair as described in Paragraph (1) of Clause 6.2 in the Interim Report.

PC-2 agreed to execute the inside inspection and necessary repair work for the main transformer "1T" as soon as possible.

(b) Replacement of bushings

PC-2 agreed to the replacement of all bushings for all the main transformers including "1T".

(c) Repair of vibration

PC-2 commented that the repair work for "2T", "3T" and "4T" would be done by PC-2 during a period of the urgent rehabilitation work for the turbine and generator, and that all the necessary replacement materials and the guidance engineer for the repair work should be provided.

In connection to the repair work, PC-2 requested to supply 120 % quantity of the transformer oil for "2T", "3T" and "4T" because the oil need to be changed after repair.

(d) Replacement of protective relays

PC-2 agreed to the replacement of the buchholtz relay, oil flow relay and water flow relay for all the main transformers including "1T".

(e) Renewal of oil preservation system

PC-2 agreed to the renewal of the oil preservation system for all the main transformers and commented that the new oil preservation system should be of air seal cell type.

(f) Oil sump tank and fire protection system

PC-2 commented that the oil sump tank and fire protection system would not be required for the main transformers.

(g) Repair painting

PC-2 commented that the repair painting work including procurement of the paint would be done by PC-2.

(h) Water coolers

PC-2 confirmed that the water coolers would not be replaced.

(2) House-Service Transformers

(a) Replacement of gaskets

PC-2 agreed to the replacement of the gaskets for the bushings and top covers.

(b) Change of transformer oil

PC-2 commented that 120 % quantity of the transformer oil should be supplied.

(c) Repair painting

PC-2 commented that the repair painting work including procurement of the paint would be done by PC-2.

(3) 31.5 kV Transformers

PC-2 commented that a new three-phase transformer with a capacity of 10,000 kVA should preferably be provided instead of the replacement of "6T" and "7T".

PC-2 confirmed that the winding connection for the new transformer should be same as "6T".

(4) 66 kV Transformers

PC-2 commented that "8T-A", "8T-B" and "8T-C" should be excluded from the scope of the urgent rehabilitation work because they would be removed after the 66 kV transmission line for the Thap Cham Substation is upgraded to 110 kV.

As for "5T", PC-2 agreed that the following rehabilitation would be done.

(a) Replacement of an air breather

(b) Repair painting

The repair painting work including procurement of the paint would be done by PC-2.

(c) Provision of two dial thermometers and a cooling fan control unit

(5) 110 kV Transformer

PC-2 commented that the repair of the 110 kV transformer "9T" should be excluded from the scope of the urgent rehabilitation work because it would be done by PC-2.

2. Rehabilitation of Switchgear

(1) 230 kV Air-Blast Circuit Breakers

PC-2 commented that the replacement of the 230 kV air-blast circuit breakers would not be required in the urgent rehabilitation stage and it should be included in the long term rehabilitation plan.

PC-2 agreed to the replacement of the pressure switches and the local control boxes for all the 230 kV air-blast circuit breakers. PC-2 confirmed that no other special rehabilitation would be required on the 230 kV air-blast circuit breakers in the urgent rehabilitation stage.

(2) 230 kV Disconnecting Switches

PC-2 commented that the replacement of the 230 kV disconnecting switches would not be required in the urgent rehabilitation stage and it should be included in the long term rehabilitation plan.

PC-2 agreed to the replacement of the spring washers on the contacts and the local control boxes for all the 230 kV disconnecting switches.

PC-2 confirmed that adjustment and repair of the six disconnecting switches of "231-1", "231-2", "271-2", "271-3", "200-1" and "200-2" would be done by PC-2.

(3) 230 kV Current Transformers

PC-2 commented that the replacement of the 230 kV current transformers would not be required in the urgent rehabilitation stage and it should be included in the long term rehabilitation plan.

PC-2 confirmed that no special rehabilitation would be required on the 230 kV current transformers in the urgent rehabilitation stage.

(4) 230 kV Capacitance Voltage Transformers

PC-2 commented that the three 230 kV capacitance voltage transformers should be replaced with new ones.

(5) 66 kV Circuit Breakers and Disconnecting Switches

PC-2 agreed to the replacement of the local control boxes for all the 66 kV circuit breakers and disconnecting switches.

PC-2 requested to supply one complete phase of circuit breaker and other spare parts for the 66 kV circuit breakers of "771" and "772".

A list of the required spare parts for "771" and "772" will be informed to JICA later.

(6) 13.2 kV Indoor Switchgear

PC-2 agreed to the replacement of the parallel resistor for Phase-C of the air-blast circuit breaker "543".

(7) 6.6 kV Indoor Switchgear

PC-2 commented that the replacement of the pilot contact for the magnetic-blast circuit breakers of "636" and "637" should be excluded from the scope of the urgent rehabilitation work because it would be done easily by PC-2

(8) Compressed Air Supply System

PC-2 commented that the compressed air supply systems for the outdoor and indoor switchgear should be renewed including two AC compressors for the outdoor switchgear and one AC compressor for the indoor switchgear.

PC-2 confirmed that the three DC air compressors for the outdoor switchgear and the two DC air compressors for the indoor switchgear would not be replaced.

The new air compressors should have the same capacity as the existing ones and the new air reservoirs should have a capacity of more than the existing ones.

3. Rehabilitation of Control and Relay Boards

PC-2 agreed in principle to renew all the control and relay boards including the automatic control boards and the automatic synchronizing panel and all their control cables.

PC-2 is of the opinion that the new control and relay boards can be installed in the existing control room.

PC-2 commented that the new control system should preferably be the computerized system with an operator console and the automatic control boards should employ the programmable controllers of micro-processor design.

JICA agreed to design the new control system to meet the PC-2's preference as far as possible and explained that the basic design for the control and relay boards would be prepared in the Draft Final Report.

PC-2 commented that the storage battery should be replaced with new one.

JICA explained that the DC supply system including the storage battery and the battery charger would be reviewed for DC power supply to the new control system equipment.

- End -

Appendix 10

JICA Feasibility Study on Rehabilitation of Da Nhim Power System

Memorandum of Discussion

DATE	:	November 24, 1994	
PLACE	:	Meeting Room of PC-2 Head Office	
ATTENDANTS	:		
PC-2	:	Mr. Vy Liem Pha	Da Nhim Power Station
	:	Mr. Do Van Canh	Senior Program Officer of PC-2
	:	Mr. Pham Kim Son	Load Dispatching Center
JICA Team	:	Mr. Masatoshi Kanda	Team Leader
	:	Mr. Motoo Mogi	Turbine Engineer
	:	Mr. Ko Nakajima	Transmission Line Engineer
	:	Mr. Hiroshi Nakaseko	Hydromechanical Engineer
	:	Mr. N. Nakato	Substation Engineer

RESULT OF DISCUSSION:

In connection with the rehabilitation of the 230 kV transmission line protective relays and the upgrading of the 66 kV transmission facilities, the JICA Study Team (hereinafter referred to as "JICA") and PC-2 discussed modification of the PLC system for the Da Nhim Power System. The result of the discussion is summarized below. The conclusion of the discussion will be reflected in the Draft Final Report to be submitted by JICA in March 1995.

(1) Rehabilitation of 230 kV Transmission Line Protective Relays

JICA proposed to apply the carrier protective relaying scheme to the new transmission line protective relays for the 230 kV transmission line sections of Da Nhim - Long Binh and Long Binh - Saigon. JICA explained that the carrier relaying scheme needs to use one PLC channel for carrier signal transmission.

PC-2 agreed to the JICA's proposal and commented that the existing PLC system was not suitable for the carrier signal tranmission purpose and therefore it needs to be modified.

PC-2 confirmed that the new Bao Loc Substation, which will be constructed between the Da Nhim Power Station and the Long Binh Substation, should not be included in the scope for the rehabilitation of the protective relays and the modification of the PLC system.

JICA explained that type of the new tranmission line protective relays would be determined by his further study and its basic design would be prepared in the Draft Final Report to be submitted by JICA in March 1995.

PC-2 commented that the grounding fault current flowing into the Da Nhim Power Station should be calculated for designing the new transmission line protective relay. JICA promised to try to make a rough calculation of the ground fault current.

(2) Modification of PLC System for 230 kV Line between Da Nhim and Long Binh

PC-2 suggested that the existing PLC equipment with 1 ch for Phase-B at both the Da Nhim P/S and the Long Binh S/S should be replaced with new one with 4 ch; that is, 3 ch for telephone and 1 ch for the carrier signal transmission for the protective relays.

PC-2 noted that the existing coupling equipment such as line traps, coupling capacitors and coupling filters could be used without any modification.

(3) Modification of PLC System for 230 kV Line between Long Binh and Saigon

PC-2 suggested that a new PLC equipment with 4 ch should be provided for Phase-A at both the Long Binh S/S and the Saigon S/S and that 1 ch out of 4 ch should be allocated for the carrier signal transmission for the protective relays.

PC-2 noted that the coupling equipment such as line traps, coupling capacitors and coupling filters have already been installed on Phase-A at the both substations.

(4) Modification of PLC System for Upgraded 110 kV Lines

PC-2 suggested that the PLC equipment for the upgraded 110 kV system should be renewed and the required number of the cannels of the PLC equipment should be as follows:

(a)	at Da Nhim Power Station	:	6 ch
(b)	at Thap Cham Substation		
	- for Phan Ri Substation	:	2 ch
	- for Cam Ranh Substation	:	2 ch
(c)	at Phan Ri Substation		
	- for Thap Cham Substation	:	2 ch
	- for Phan Thiet Substation	:	1 ch
(d)	at Phan Thiet Substation	:	1 ch
(e)	at Cam Ranh Substation		
	- for Thap Cham Substation	:	2 ch
	- for Dien Khanh Substation	:	1 ch
(f)	at Dien Khanh Substation	:	1 ch

PC-2 commented that a PABX should be provided at the Da Nhim Power Station.

PC-2 noted that the PLC equipment should be complete with the coupling equipment except the line traps which have already been installed.

- End -

Agreed and Signed by Parties:

PC-2	JICA Team
Luu Minh Chanh Director Da Nhim Power Station	Masatoshi Kanda Team Leader

Appendix 11

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-1

Date : **13th March, 1995**
Place : **PC-2 Head Office**

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Nguyen Van Ngoc	**Transmission Department Deputy Director**
	Mr.Nguyen Chi Dao	**Transmission Department Deputy Manager of Techincal Division**
	Mr.Drag Ngoc Chan	**Energy Center, Deputy Chief of Planning Section**
	Mr.Hoang Cong Huy	**Technical Department**
	Mr.Pham Van Thom	**Engineer, Foundamental Construction Dept.**
JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

1. Submission of draft final report
2. Confirmation of meeting schedule on draft final report

1. Submission of draft final report

The study team submitted twenty (20) copies of the draft final report to PC-2 in accordance with the inception report.

PC-2 confirmed that the study team will submit eight (8) copies of the report, out of the above report, to the Ministry of Energy (M.O.E) by themselves when they will visit to Hanoi for discussion with the M.O.E after completion of discussion with PC-2.

PC-2 also confirmed that they will be distributed the report to PC-3.

2. Confirmation of discussion schedule between PC-2 and study team

2.1 Agreed discussion schedule

The study team submitted to PC-2 their proposed schedule for discussion of the draft final report. On the basis of the proposed schedule, the discussion between PC-2 and the study team was made and the follows were confirmed:

(1) Technical matter with Da Nhim power station staff and Saigon substation staff will be discussed as follows, respectively :

(i)	Discussion on the Da Nhim power station	:	On 14th and 15th March, 1995 at the conference room of PC-2 with Da Nhim power station staff
(ii)	Discussion on Saigon substation	:	On 14th March, 1995 at the conference room of Saigon substation with transmission and substation staff

(2) The study team will assign the following person to respective discussion to cope with the above schedule.

(i)	Discussion on Da Nhim power station on 14th and 15th March	:	Mr. M.Kanda, Mr. M.Mogi and Mr. H.Nakaseko (Mr N. Nakato is to attend on 15th March)
(ii)	Discussion on Saigon substation on 14 th March	:	Mr. N. Nakato

(3) General matter will be discussed for the period between 16th and 19th March.

(4) The study team will visit to Hanoi to discuss with M.O.E from 22nd March after confirmation of minutes meeting between the PC-2 and the study team.

The agreed schedule is attached hereto.

PC-2 stated that the M.O.E have their schedule to attend to the above discussion while thire schedule will be confirmed at the afternoon of today. The study team agreed to discuss again the above agreed schedule to cope with the dispatching schedule of M.O.E staff.

2.2 Discussion with PC-3

The study team stated that the discussion with PC-3 is essential to confirm their comment on the upgrading plan of 66 kV transmission line at their area.

PC-2 confirmed that they will invite PC-3 staff to PC-2 head office during the period of dicussion between PC-2 and the study team.

3. Other

PC-2 requested that the study team will explain emphatically the different points from the interim report on the basis of the minutes of meeting prepared at the explanation and discussion of interim report on November, 1994.

The study team agreed with PC-2 request.

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

Discussion Schedule of Draft Final Report
On
Rehabilitation of Da Nhim Power System

Date		Work Schedule	Place
March 12	Sun	Tokyo- Osaka - H.C.M (by JL-749, Arrival at H.C.M: 17:40)	H.C.M
13	Mon	Submission of Draft Final Report to PC-2 General meeting for comfirmation of discussion schedule (at PC-2 office)	H.C.M
14	Tue	Explanation and discussion on the technical matter of Draft Final Report (at PC-2 office and Saigon substation)	H.C.M
15	Wed	Explanation and discussion on the technical matter of Draft Final Report (at PC-2 office)	H.C.M
16	Thu	Explanation and discussion on the general matter of Draft Final Report (at PC-2 office)	H.C.M
17	Fri	Explanation and discussion on the general matter of Draft Final Report (at PC-2 office)	H.C.M
18	Sat	Explanation and discussion on the general matter of Draft Final Report (at PC-2 office)	H.C.M
19	Sun	Explanation and discussion on the general matter of Draft Final Report (at PC-2 office)	H.C.M
20	Mon	Preparation of minutes of meeting (at PC-2 office)	H.C.M
21	Tue	Confirmation of minute of meeting (at PC-2 office)	H.C.M
22	Wed	H.C.M - Hanoi (by VN-216, arrival at Hanoi: 13:05) Visit to Embassy of Japan	Hanoi
23	Thu	Explanation of result of discussion on Draft Final Report (at M.O.E office or Electricity of Veit Nam)	Hanoi
24	Fri	Explanation of result of discussion on Draft Final Report (at M.O.E office or Electricity of Veit Nam)	Hanoi
25	Sat	Visit to Ministry of Energy and State Planning Commitee Hanoi - Bankok (by AF-171, Departure from Hanoi: 18:45) Bankok - Tokyo (by NH-916, Departure from Bangkok: 22:25)	
26	Sun	Arrival at Tokyo : 6:00	

Appendix 12

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-2

Date : 14th March, 1995
Place : PC-2 Head Office

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Luu Minh chanh	**Director of Da Nhim Power Station**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Nguyen Van Huone	**Expert of Technical Dept of PC-2**
JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**

Objective:

1. Handing over of documents
2. Explanation and discussion of technical matter on draft final report

1. Handing Over of documents

Prior to discussion, the study team handed over the following documents to PC-2 to explain efficiently the draft final report.

- Three (3) copies of draft technical document (for waterway and ancillary facilities, water tubine and ancillary facilities, genrator and ancillary facilities and tansmission line)
- Three (3) copies of draft data book of field investigation results (for waterway and ancillary facilities, water turbine and ancillary facilities and dam and civil structure)

2. Discussion of Chapter 1 (Water Turbine and Ancillary Facilities)

The study team clarified PC-2's requests which were mentioned in the minutes of meeting prepared on 25th November,1994 at conference room of PC-2. The clarification on each item are as follows:

(1) Details of new governers

The study team handed over a technical data of new governer to PC-2 and confirmed that PC-2 has no comment on such data.

(2) Reason of replacement of runners

The study team handed over a data showing replacement criteria on defected runner utilizing by the turbine manufacture and explained their concern about existing runner of the Da Nhim power station.

- As a result of the PT and MT applied during site investigation, it was reported that the crack condition of runner for each turbine is as follows:

Unit No.	Max. length of crack	Max. depth of cavitation
No.1	3 mm	5 mm
No.2	4 mm	4 mm
No.3	3 mm	2.5 mm
No.4	9 mm	3 mm

- As a result of estimation on the basis of the criteria, the remaining life of each runner was estimated as follows:

Unit No.	Remaining life of runner
No.1	7.8 years
No.2	7.1 years
No.3	7.8 years
No.4	2.0 years

According to above reason, the study team stated that the replacements of all the runners are recommendable.

PC-2 agreed with the recommendation of the study team.

The replacement criteria of runners is attached hereto.

(3) Replacement of inlet valves

In the previous minitues of meeting repared on 17th November 1994, PC-2 agreed to repair four (4) inlet valves and to provide one (1) additional valve for acheiving interchangeable replacement of four (4) valve unit as spare.

The study team reported as a result of examination of the above intention of PC-2 that the fixing condition and the flange clearance of each existing valve are not same and thus one (1) spare valve can not be provided as interchangeable replacement of four (4) valve unit.

PC-2 agreed that all the inlet valves will be renewed with the application of a new seal method while the project cost will be increased.

2. Discussion of Chapter 2 (Generator and Ancillary Facilities)

The discussion was carried out on the basis of the minutes of meeting repared on 25th November 1994 at PC-2 head office and 17th November 1994 at Da Nhim power station.

The following were confirmed:

(1) The study team stated that further economical comparision for the excitation system will be made and mentioned in the final report.

(2) PC-2 stated their concern that main shaft of generator unit Nos. 2 and 4 should be changed under the urgent rehabilitation plan to avoid occurence of crack in the furture as these shafts have not been replaced with new shafts since the commisioning.

The study team suggested that the replacement of these shafts is not yet required urgently and be carried out at the long term rehabilitation long as they did not detect any defect from these shafts during the field investigation.

PC-2 agreed with the suggestion of the study team.

3. Discussion of Chapter 5 (Waterway and Ancillary Facilities) and Chapter 6 (Dam and Civil Structure)

The study team explained these chapters on the basis of the minutes of meeting prepared on 18th and 19th November 1994 at the Da Nhim power station and confirmed that PC-2 has no comment on these chapters.

4. Others

(1) PC-2 informed that they had information from M.O.E in Hanoi that one (1) M.O.E staff will be despatched to Ho Chi Minh tomorrow to attend the discussion on the draft final report.

(2) PC-2 also informed that the discussion of the technical matter on Chapters 8 and 7 will be held at 8:30 am tomorrow.

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

Appendix 13

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No. F/D -3

DATE : **14th and 15th of March, 1995**

PLACE : **Control Room of Saigon Substation**

ATTENDANTS

PC-2	:	Mr. Nguyen Van Ngoc	Deputy Director
	:	Mr. Ho Kim Hoa	Manager of Operation Workshop
	:	Mr. Nguyen Chi Dao	Planning and Technical Division
	:	Mr. Quach Cam Huong	Maintenance Workshop
	:	Mr. Nguyen Ngoc Lang	Maintenance Workshop
	:	Mr. Phan Ta Tu	Safety Technic Office
JICA Team	:	Mr. Naoji Nakato	Substation Engineer

RESULT OF DISCUSSION:

The JICA Study Team (hereinafter referred to as "JICA") and the Transmission Department of PC-2 (hereinafter referred to as "PC-2") discussed the following parts of the JICA's Draft Final Report.

- Chapter 8, Substation Facilities
- Chapter 9, 230 kV Transmission Line Facilities
- Chapter 10, Upgrade of Transmission Facilities (only for the part of transmission line)

The result of the discussions is summarized below. The amendments concluded in the discussions will be reflected in the Final Report to be submitted by JICA in June 1995.

1. Clause 8.3.2, Plan of Urgent Rehabilitation for Saigon Substation

JICA explained the plan of the urgent rehabilitation for the Saigon Substation, especially for the items deviated from the results of the last meeting for the Interim Report.

(1) Rehabilitation of Synchronous Condensers

(a) JICA explained that the following items would be added to the scope of the urgent rehabilitation for the synchronous condensers.

i) Replacement of rotor coils for each unit, to insure a long service life of the synchronous condensers after the rehabilitation.

ii) Replacement of rotor spider for Unit 1, to enable the main shaft for Unit 1 to be replaced easily at the site.

iii) Replacement of 11 kV power cables for each unit, because there were traces of local heating on the cables.

PC-2 agreed to the above additional rehabilitation items.

(b) PC-2 confirmed that the scope of the rehabilitation of the overhead traveling crane was limited to the replacement of all the brake shoes and the limit switch circuits.

(c) PC-2 agreed to all the other items for the urgent rehabilitation plan of the synchronous condensers.

(2) Rehabilitation of Transformers

(a) JICA explained the replacement of the bushings and gaskets for the main transformer "1T" as follows.

i) For the 230 kV and 66 kV bushings, the replacement of only the gaskets will be sufficient for the urgent rehabilitation stage.

ii) For the 11 kV bushings, the replacement of the whole bushings will be required from the structural point of view.

PC-2 agreed to the above plan.

(b) PC-2 commented on the urgent rehabilitation plan for the main transformer "1T" as follows:

i) The insulating oil for each bushing should be changed after the gaskets are replaced.

ii) The repair paint on the main transformer "1T" should be applied not only to the damaged paint and rusted parts but also to the whole transformer tanks.

JICA agreed to amend the report in accordance with the above comments.

(c) PC-2 agreed to all the other items for the urgent rehabilitation plan of the transformers.

(3) Rehabilitation of Switchgear

(a) JICA explained the rehabilitation of the local control boxes for the 66 kV air-blast circuit breakers as follows.

Since the replacement of the whole local control boxes seems to be very difficult, only the pressure switches and door gaskets for the local control boxes are recommended to be replaced.

PC-2 agreed to this rehabilitation plan of the local control boxes.

(b) PC-2 commented that the three phases of the current transformer "777" should be replaced instead of the Phase-A only because all phases of the current transformer are required to have the same characteristics.

JICA agreed to amend the first sentence of Item iii) of Paragraph (3) for the 66 kV current transformers as follows.

"Three phases of the current transformer "777" are recommended to be replaced with new ones because the phase-A had excessive oil leakage and all the three phases are required to have the same characteristics."

(c) The quantity of the 66 kV lightning arresters should be amended from "eleven" to "thirty-three".

(d) PC-2 agreed to all the other items for the urgent rehabilitation plan for the switchgear.

(4) Rehabilitation of Control and Relay Boards

(a) JICA explained that the replacement of the transmission line protective relay board for the 230 kV Hoc Mon line should be excluded from the scope of the rehabilitation but that all the existing control boards including the 230 kV Hoc Mon line would be replaced with new ones.

PC-2 agreed that the said transmission line protective relay board should be excluded from the scope of the rehabilitation.

In this connection, the words "the transmission line protective relay for the 230 kV Hoc Mon line" should be amended to "the transmission line protective relay board for the 230 kV Hoc Mon line".

(b) PC-2 agreed to all the other items for the urgent rehabilitation plan for the control and relay boards.

2. Clause 8.4.2, Basic Design of Urgent Rehabilitation Plan for Saigon Substation

PC-2 and JICA discussed the basic design of the urgent rehabilitation plan for the Saigon Substations and concluded as follows.

(1) Basic Design for Synchronous Condensers

PC-2 agreed to the basic design for the synchronous condensers.

(2) Basic Design for Transformers

(a) PC-2 commented that the following sentences should be added to Item i) of Sub-paragraph (a).

"As for the existing bushings of the main transformer 1T", the insulating oil should be changed after the gaskets have been changed. The type and grade of the insulating oil should be suitable for the bushings."

(b) The rated secondary voltage of the main transformer "2T" should be amended to "69 kV/115 kV".

(c) JICA proposed that the rated secondary voltage of the house-service transformers "5T" and "7T" should be 400 V instead of 380 V, in compliance with the recommendation by IEC standard.

PC-2 agreed to change the rated secondary voltage to 400 V.

(d) PC-2 commented on the 66 kV transformer "9T" as follows.

i) The rated primary voltage should be amended to "69 kV/115 kV".

ii) The connection symbol should be amended to "D, yn 1".

JICA agreed to make the above amendments.

(e) PC-2 commented that tapping method should be reviewed for the transformers with dual rating of 22 kV and 15 kV and that the transformers should be designed to have full capacity at all taps.

JICA agreed to do so.

(f) PC-2 commented that all the ring-core type current transformers to be mounted in the bushings should have the rated secondary current of 1 ampere.

JICA agreed to the PC-2's comment.

(3) Basic Design of Switchgear

(a) The 66 kV current transformer "777 (Phase-A)" should be amended to "777".

(b) PC-2 commented that each new 66 kV current transformer should be provided with four cores and the rated current ratio should be amended as follows.

i) Current transformer "777" : 1,200-800/5-5-1-1 A

ii) Current transformer "772" : 1,200-600/5-5-1-1 A

JICA agreed to make the above amendments.

(c) The rated burden of the voltage transformers should be amended to 400 VA for measuring and 100 VA for protective relaying.

(d) The rated control voltage should be amended to DC 230 V.

(4) Basic Design of Control and Relay Boards

(a) PC-2 commented that the control system should be designed to permit each circuit breaker to be controlled remotely from the load dispatching center in the future.

JICA agreed to mention the above requirements in the report.

(b) PC-2 commented that the new control source supply equipment should be installed additionally to the existing equipment to permit the existing equipment to be used as stand-by.

JICA agreed to the PC-2's comment.

(c) The supply voltage should be amended to DC 230 V and AC 230 V.

3. Clause 8.5.2, Implementation Program of Urgent Rehabilitation Plan for Saigon Substation

PC-2 and JICA discussed the implementation program of the urgent rehabilitation plan for the Saigon Substations and concluded as follows.

(1) PC-2 confirmed that all the rehabilitation work would be executed by the staff of the Transmission Department of PC-2 under the guidance of the expatriate supervisors.

(2) The estimated period of power interruption caused by the replacement of each transformer of "2T", "3T", "4T" and "9T" should be amended to one and a half months including the time for the foundation work.

(3) PC-2 commented that the new control room should preferably be located in the area of the existing air compressor house for the 230 kV air-blast circuit breakers to be removed.

JICA agreed to make a layout drawing of the new control room and to compile it in the Final Report.

4. Clause 8.6, Plan of Long Term Rehabilitation

JICA explained the plan of the long term rehabilitation.

PC-2 agreed to the JICA's plan.

5. Clause 8.7, Recommendation of Operation and Maintenance

JICA explained his recommendation of the operation and maintenance for the equipment.

PC-2 agreed to JICA's recommendation.

6. Chapter 9, 230 kV Transmission Line Facilities

The following comments were given by PC-2 on Chapter 9.

(1) Clause 9.2.2, Paragraph (3)

The remote operating tube of the hydraulic compressor should be 20 to 25 meters long instead of 10 to 15 meters long.

(2) Clause 9.3.3, Paragraph (2)

"S-stranding" as direction of outermost layer for the power conductors should be clarified.

PC-2 agreed to all the other parts of Chapter 9.

JICA submitted to PC-2 four (4) copies of the draft technical specifications for the materials and equipment for the transmission lines (Chapter 6) and asked PC-2 to give his comments on the draft technical specifications as soon as possible.

7. Chapter 10, Upgrade of Transmission Facilities

PC-2 commented on the quantity of the materials shown on Table 10.1 as follows.

(1) Item M3, Insulator Sets

The supply number of the fog type (long creepage) insulator discs should be decreased from 1,000 units to 200 units, because the number of insulator discs have already been increased from 8 pieces to 9 pieces especially for the area near sea coast.

In this connection, the supply number of the standard insulator discs should be increased from 500 units to 1,300 units.

(2) Item M11, Crossarm Sets

All the crossarm sets should be deleted completely because they can be fabricated by PC-2.

- End -

Agreed and Signed by Parties:

PC-2	JICA Team
Nguyen Van Ngoc	Masatoshi Kanda
Deputy Director	JICA Team Leader
Transmission Department	

Appendix 14

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-4

Date : **15th March, 1995**
Place : **PC-2 Head Office**

Present :

PC-2:	**Mr.Luu Minh Chanh**	**Director of Da Nhim Power Station**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Hoang Cong Huy	**Technical Department**
JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

Explanation and discussion of technical matter on Chapter 7 (Hydrogical Data Acquision System), Chapter 8 (Substation Facilities) and Chapter 10 (Upgrade of Transmission Facilities)

1. General Discussion

(1) The study team informed that JICA head office proposed to assign additionally one (1) candidate of Vietnamese engineer for training of rehabilitation of Da Nhim power system in Japan.

PC-2 reply to the above information that they agreed with the proposal of JICA head office and to assign one (1) engineer immediately after receive of official request of JICA head office through the Government of Vite Nam.

(2) The study team explained overall the summary report before discussion of general matter on the report with PC-2.

2. Discussion of Chapter 7 (Hydrological Data Acquisition System)

The study team explained that the hydrological data acquisition system was reviewed and modified from the Interim Report as follows.

(1) The central station (CS) will be located in the existing dam control house. The central station will be provided to collect the rainfall and water level data and to announce the flood warning to the downstream area of the Da Nhim Dam.

All operation of the hydraulic data acquisition system and the flood warning will be done from the central station upon instruction from the powerhouse.

(2) The locations of the rainfall and water level gauging stations are not changed from the Interim Report. The data from the gauging stations will be transmitted to the central station by radio, except the water level gauging station No. 1 and No.4 that will be connected to the central station by cables.

(3) A new radio station (PS-S) will be provided in the powerhouse. A new multiplex radio link will be provided for the data transmission and radio communication between the central station and the powerhouse.

(4) All the gauged data will be collected to the central station by the polling method and then transmitted to the powerhouse by the radio communication line.

In case the rainfall amount or water level reaches the predetermined value, the data will be transmitted automatically to the central station and the powerhouse.

(5) All the rainfall and water level data and operating condition of the hydraulic data acquisition system and flood warning can be monitored in the powerhouse.

PC-2 agreed to the modified hydraulic data acquisition system.

3. Discussion of Chapter 8 (Substation Facilities)

The study team and PC-2 discussed Chapter 8 for the parts of the Da Nhim Power Station on the basis of the minutes of meeting for the Interim Report which were held on 23rd and 25th of November 1994 and concluded as follows.

(1) Clause 8.2, Recommendation of Top Urgent Rehabilitation

In connection with the top urgent rehabilitation required for the main transformer "1T" for the Da Nhim Power Station, the study team submitted to PC-2 three copies of the inspection sheets for the inside inspection of the main transformer for reference.

(2) Clause 8.3.1, Plan of Urgent Rehabilitation for Da Nhim Power Station

(a) The oil pumps for all the main transformers should be replaced with new ones as mentioned in the minutes of meeting on 25th November 1994.

The study team explained that the replacement cost of the oil pumps had already been included in the cost estimate shown in Table 11.6.

(b) PC-2 commented that a new air reservoir should be added to the compressed air supply system for the outdoor circuit breakers and that the capacity of the air reservoir should be 1 m^3.

The study team agreed to add the air reservoir.

(3) Clause 8.4.1, Basic Design of Urgent Rehabilitation Plan for Da Nhim Power Station

The study team explained the basic design of the urgent rehabilitation plan for the Da Nhim Power Station and PC-2 agreed to the basic design, except for the following point.

"The cables between the valve house and the powerhouse for the surge tank water level gauging system should be the control cables of self-supporting type, 2.5 mm^2 and 20 cores, to be supported along the penstock line."

(4) Clause 8.5.1, Implementation Program of Urgent Rehabilitation Plan for Da Nhim Power Station

The study team explained the implementation program of the urgent rehabilitation for Da Nhim Power Station and PC-2 agreed to the implementation program, except for the following points for the replacement of the 31.5 kV transformer (6T).

(a) The removal of the existing 31.5 kV transformer (7T) should be mentioned in the report.

(b) The period of power interruption caused by the replacement work should be amended to one and a half months.

(c) The words "for power supply to the Dallas district" should be amended to "for power supply to the Dong Duong district".

(5) Clause 8.6, Plan of Long Term Rehabilitation

PC-2 had no objection to the plan of the long term rehabilitation.

(6) Clause 8.7, Recommendation of Operation and Maintenance

PC-2 had no objection to the recommendation of operation and maintenance.

4. Discussion of Chapter 10 (Upgrade of Transmission Facilities)

The study team and PC-2 discussed the basic design of the substation facilities for the Da Nhim Power Station which is related to the upgrading plan of the 66 kV transmission facilities and concluded as follows.

(1) The study team explained the scope of the additional substation facilities as follows.

(a) Extension of 230 kV double-busbars

(b) Additional installation of a 63 MVA, 230/110 kV transformer

(c) Additional installation of 230 kV switchgear for the new 63 MVA transformer circuit

(d) Additional installation of 110 kV switchgear for the new 63 MVA transformer circuit and for the upgraded 110 kV transmission line circuit

(e) Additional installation of a 110 kV single busbar

(2) PC-2 commented that the existing 63 MVA should preferably be replaced with a new 125 MVA transformer because the replacement of the existing transformer will offer no extension of the 230 kV busbars and no additional transformer bay.

The study team replied that the replacement plan of the existing transformer will result in increasing the total equipment cost about 5 % as compared with the JICA's plan.

PC-2 concluded that the replacement of the existing transformer was preferred rather than the additional installation of a new transformer if the difference of the equipment cost is about 5 %.

(3) PC-2 commented that a 110 kV circuit breaker and a 230 kV lightening arrester should be added to the transformer circuit.

The study team agreed to try to arrange the 110 kV circuit breaker and the 230 kV lightning arrester on the transformer circuit.

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

Appendix 15

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-5

Date : **16th March, 1995**
Place : **PC-2 Head Office**

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Nguyen Van Tuc	**Director of Logistics Dept.**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi Liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Nguyen Van Huong	**Expert of Technical Dept. of PC-2**
	Miss.Nguyen Thu Huong	**External Econmic Activities**
	Mr.Hoang cong Huy	**Deputy head of technical Dept.**
	Mr.Nguyen Nhu Truong	**Engineer, Energy Center**
	Mr.Duong Doi This	**Engineer, Energy Center**

JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

Explanation and discussion of Chapter 11 (Implementation Schedule and Cost Estimate), Chapter 12 (Project Assessment) and Chapter 13 (Recommendation)

Prior to explanation on the Chapter, the study team informed their preference that they will concentrated only explanation on Chapter 11, 12 and 13 in the meeting of today to conduct efficiently the explanation of these chapters subject to detailed discussion of tomorrow.

PC-2 agreed the above preference.

1. Chapter 11 (Implementation Schedule and Cost Estimate)

The study team explained the chapter.

In response to the explanation, PC-2 stated their following comments on the chapter subject to detailed discussion of tomorrow.

(i) PC-2 consider that the rehabilitation of Da Nhim power system will be conducted under the Japanese found, early.

(ii) 15% of price contingency at local portion is high compared with 10% of price contingency applying usually to new water resource project in Viet Nam.

(iii) High total project cost was considered compared with those of other new project in south Viet Nam. PC-2 will hand over the project cost results for the other new project in the south of Viet Nam to the study team tomorrow to proof the high cost of the Da Nhim rehabilitation project.

(iv) All price indication with US dollar should be changed into Japanese yen in view of application of Japanese fund on the Project and the local currency portion should also be indicated with Japanese yen.

(v) The implementation schedule of the Project should be shorted as much as possible in view of future electrical supply condition in the south of Viet Nam and in order to avoid cancellation of the Project due to late implementation of the Project.

(vi) PC-2 express that they have strong intention to commence early the Project.

The study team replied on the above item (v) and stated that the implementation schedule showing in the report was established considering fund procurement schedule of OECF (Overseas Economic Cooperation Fund) and minimization of stoppage period of power generation to be required for the rehabilitation work.

2. Chapter 12 (Project Assessment) and Chapter 13 (Recommendation)

The study team explained these chapters.

In response to the explanation, PC-2 stated their following comments on the chapter subject to detailed discussion of tomorrow.

(i) PC-2 have their concern that the increase of the year - outage factor of the generating equipment from 1975 to 1995 showing on Fig.12.1 was caused mainly from the hydrological condition and power system operation condition in the south of Veit Nam.

(ii) The formula of the increased energy production after rehabilitation or renewal of the facilities is required to be discussed in detail.

(iii) Energy unit costs of 0.0561 US$/kWh for the financial evaluation and 0.07 US$/kWh for the economic evaluation are required to be discussed.

The study team stated in respose to the above item (i) that the cause of the outage of the facilities was estimated on the basis of the assumption as referred to paragraph 2 of page 12-2 of the report.

3. Others

(1) PC-2 confirmed that one (1) person of M.O.E staff will arrive at Ho Chi Minh in the afternoon from Hanoi to attend the discussion.

(2) The discussion on the general matter will be held at 8:30 am tomorrow.

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

Appendix 16

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-6

Date : 17th and 18th March, 1995
Place : PC-2 Head Office

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Dao Hieu	**Technical Dept., Ministry of Enargy (M.O.E)**
	Mr.Nguyen Van Tuc	**Director of Logistics Dept.**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi Liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Nguyen Van Huong	**Deputy head of technical Dept.**
	Mr.Nguyen Nhu Truong	**Engineer, Energy Center**
	Mr.Duong Duc Thinh	**Engineer, Energy Center**

JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

Discussion of Chapter 11 (Implementation Schedule and Cost Estimate) and Chapter 12 (Project Assessment)

1. Discussion of Chapter 11 (Implementation Schedule and Cost Estimate)

The discussion was made on the basis of the PC-2's comments raised at the meeting of yesterday and the followings were confirmed.

(1) Ratio of price contingency for foreign and local currencies

PC-2 presented the cost estimate of Phu My Thermal Project under the OECF and requested to apply to the following ratio of physical contingency showing in such cost estimate, for the Da Nhim rehabilitation project.

- 5 % for foreign currency
- 10% for local currency

The study team agreed to apply to the cost estimation of the Project.

In addition, PC-2 requested to estimate the price escalation of the Project using 3.3 % for both foreign and local currencies.

The study team also agreed with the request.

(2) High total project cost

PC-2 expressed their concern that the total project cost of Da Nhim rehabilitation was definitely high compared with those of the Thac Mo project in the south of Viet Nam.

In response to PC-2 concern, the study team replied that 44.1 million US$ of the total cost of the power generating equipment (turbine, generator and substation equipment) for Da Nhim rehabilitation are considered as low compared with about 50 million US$ of those of the Thac Mo project.

The study team stated that the project cost of Da Nhim rehabilitation can not be compared with the Thac Mo project as the design condition such as design head, type of power system equipment and turbine, and numbers of generating equipment of the Thac Mo project are definitely differed from those of the Da Nhim project.

However, PC-2 expressed again their concern of high total project cost.

The study team agreed to inform PC-2 intention on the total project cost and to request urgently their head office to do further investigation whether there is the points to be reduced from the present total project cost. The study team stated that they will inform the investigation result of their head office.

The study team also stated that there is possibility of canceling some rehabilitation items to reduce the project cost. In response to the statement of the study team, PC-2 stated that the price deduction should be considered without any cancellation.

(3) Price indication with Japanese yen

The study team stated that the indication of the project cost with Japanese yen will be considered after confirmation of JICA head office.

(4) Shortening of project implementation schedule

The study team stated again that the implementation schedule showing in the report was established considering fund procurement schedule of OECF (Overseas Economic Cooperation Fund) and minimization of stoppage period of power generation to be required for the rehabilitation work.

PC-2 stated that the early implementation of the project is most important for the south of Viet Nam.

2. Chapter 12 (Project Assessment)

The discussion was also made on the basis of the PC-2's comments raised at the meeting of yesterday and the followings were confirmed.

(i) Year - outage factor of the generating equipment

PC-2 expressed their concern that the increase of the year - outage factor of the generating equipment from 1975 to 1995 showing on Fig.12.1 was caused mainly from the hydrological condition and power system operation condition in the south of Veit Nam.

The study team agreed with PC-2 expression in view of paragraph 2 of page 12-2 of the report.

(ii) Formula of increased energy production after rehabilitation or renewal of the facilities

PC-2 agreed with the formula.

(iii) Energy unit costs of 0.0561 US$/kWh for the financial evaluation and 0.07 US$/kWh for the economic evaluation

Referring to the report of the World Bank, PC-2 commented that the energy unit cost of 0.07 US$/kWh should be applied for the economic and the financial evaluation.

However, M.O.E stated that they will sent the final comments on the energy unit costs and evaluation method of upgrading to the study team and the period of the comment to be required by M.O.E will be decided finally when the study team will discussed with the head office of Electric of Vietnam (E.V.N) at Hanoi.

M.O.E suggested that the evaluation for the rehabilitation should be made considering following energy loss:

- For economic evaluation : 19 %
- For financial evaluation : 19 %

In addition, PC-2 also suggested that the financial evaluation should be considered 2 % of water resources tax and 8 % of sales tax of revenue.

The study team agreed to evaluate again the Project with the above energy loss.

(iv) Renewal cost of Da Nhim power system

Referring to sub-clause 12.2.2 of page 12-3, the study team explained that the costs for renewal of facilities was estimated considering the cost of new power equipment and the prolongation of construction schedule to be required for overall replacement.

The construction schedule for the rehabilitation work and the overall replacement work is attached hereto.

3. Others

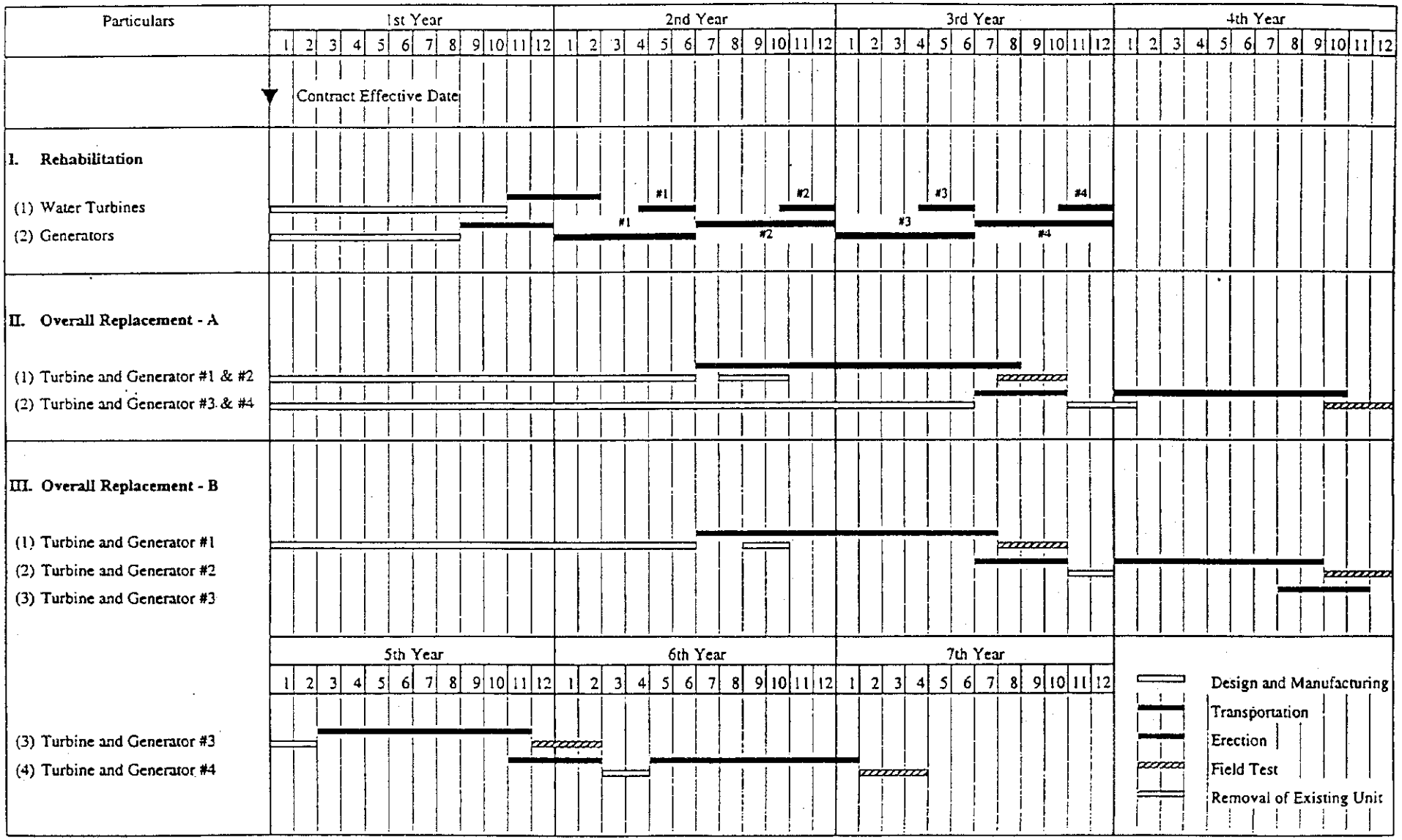
(1) The study team confirmed that the words shown in Table 11.3 shall be corrected as follows:

Words to be corrected	Words corrected
Painting at upstream of butterfly valves	Repair painting
Painting & Repair of No.1 Penstock	Repair of No.1 Penstock
Painting & Repair of No.2 Penstock	Repair of No.2 Penstock

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

CONSTRUCTION TIME SCHEDULE



Appendix 17

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-7

Date : **20th March, 1995**
Place : **PC-2 Head Office**

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Dao Hieu	**Technical Dept., Ministry of Energy (M.O.E)**
	Mr.Nguyen Van Tuc	**Director of Logistics Dept.**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi Liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Nguyen Van Huong	**Technical Dept.**
	Mr.Duong Duc Thinh	**Engineer, Energy Center**
	Mr. Nguyen Van Ngoc	**Deputy Director of Transmission Dept.**
	Mr. Nguyen Chi Dao	**Planning and Technical Division of Transmission Dept.**
	Mr.Hoang Cong Huy	**Technical Department**
PC-3 :	**Mr. Dinh Mien**	**Director of Power Transmission Dept. No.2**
	Mrs. Nguyen Thi Thao Thao	**Transmission Dept 2**
JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

1. Discussion on Saigon Subtation

2.Discussion of Substation Facilities for Upgrading

3.Total project cost

1. Discussion of Substation Facilities for Saigon Substation

PC-2 made his further comments on Chapter 8 for the substation facilities for the Saigon Substation as follows:

(1) Synchronous Condensers

PC-2 commented that the synchronous condensers were now not so important from the network system operational point of view and therefore the rehabilitation of the synchronous condensers would be not required.

The study team confirmed to PC-2 that the two units of the synchronous condensers should be excluded from the scope of the rehabilitation of the Da Nhim Power System.

(2) Type of Protective Relays

PC-2 commented that all the protective relays not only for the Saigon Substation but also for the Da Nhim Power Station and the 110 kV substations of Thap Cham, Phan Ri and Phan Thiet should preferably be of the static digital type to be consistent with those for other projects in the South Viet Nam. PC-2 stated that the type of the protective relays for the Cam Ranh and the Dien Khanh Substations would be confirmed to PC-3 by EVN and would be informed to the study team in time.

The study team agreed to employ the static digital type relays for all the circuits and suggested that the further discussion for the protective relays should be done in the detailed design stage in the future.

(3) Fault Locator

PC-2 commented that the fault locator should preferably be incorporated in the transmission line protective relay as an optional function of the relay instead of separate type.

The study team agreed to the PC-2's comment.

(4) Supervisory Control System

PC-2 commented that the supervisory control system should be designed to interface with the SCADA system that will be studied under the finance of the world bank.

The study team replied that all the necessary provisions for interface with the SCADA system would be made in the supervisory control system and that the further discussion on this matter should be made in the detailed design stage in the future.

(5) Location of New Control Room

PC-2 commented that the location of the new control room should be chosen after making the further study on several places.

The study team replied that a layout drawing of the new control room would be shown in the Final Report and suggested that the further discussion on this matter should be made in the detailed design stage in the future.

(6) Transformer Design

PC-2 commented that the new transformers with dual voltage rating of 115 kV and 69 kV

should be designed and constructed to enable the rated voltage to be switched over easily from the outside of the transformers, from 69 kV to 115 kV or vice versa and that the dual voltage rating of 22 kV and 15 kV should also be designed to permit switching - over easily from the outside of the transformers.

2. Discussion of Chapter 10 (Upgrade of Transmission Facilities)

(1) Substation Facilities for Thap Cham, Phan Ri and Phan Thiet Substations

PC-2 agreed technically to the contents of Chapter 10 "Upgrade of Transmission Facilities" for the part of the substation facilities for the Thap Cham, Phan Ri and Phan Thiet Substations.

(2) Transmission Line Facilities for PC-3 Section

PC-3 commented on the quantity of the materials shown on Table 10.2 as follows.

(a) Item M3, Insulator Units

The number of the insulator unit seems to be estimated only for the suspension type. However, all insulator units should preferably be replaced with new ones because all the metallic parts of the insulator units have been corroded. Accordingly, the number of the insulator unit should be amended as follows.

i) Standard type : from 6,000 units to 7,000 units
ii) Fog type : from 1,000 units to 3,000 units

(b) Item M4, Power Conductor

The supply quantity of the power conductors should be amended from 10 km to 102 ton.

PC-3 asked the study team to make cost estimate of the domestic products for the transmission line facilities.

(3) Substation Facilities for PC-3 Section

PC-3 commented on the basic design of the substation facilities as follows.

(a) The 110 kV bus for the Cam Ranh and the Dien Khanh Substations should preferably be of the single bus with a transfer bus (by-pass) scheme.

(b) One static condenser bank of 4 MVAR should be provided at the 22 kV bus for each of the Cam Ranh and the Dien Khanh Substations.

(c) One single-phase capacitance voltage transformer (CVT) should be provided on each 110 kV transmission line for the synchronizing purpose.

(d) Each 110 kV line circuit should be provided with an automatic reclosing feature. For this automatic reclosing purpose, an automatic synchronizing relay should be provided for each 110 kV circuit.

(f) One synchronizing panel including a synchronoscope, two voltmeters and two frequency meters should be provided in the control room for manual synchronizing

purpose of the transmission lines for each of the Cam Ranh and Dien Khan Substations.

(g) The 110 kV lightning arresters for the main transformer circuit should preferably be installed separately from the main transformer.

(h) The 110 kV disconnecting switches for the main transformer circuit should be equipped with two earthing switches at the both sides.

(i) The following testing equipment should be added to the list shown in Paragraph (8) of Clause 10.5.3.

i) One set of aquameter to measure the amount of moisture in the oil (BRVR Aquameter KFM 1000S or equivalent type)

ii) One set of visigraph with 12 channels suitable for circuit breaker test (Breaker Analyzer TM 1600 or equivalent type)

PC-3 asked the study team to follow the above comments although some above comments were deviated from the design philosophy for the other 110 kV substations for PC-2.

The study team agreed to the PC-3's comments.

3. Total project cost

The study team stated that they received the investigation result for the possible reduction of the total project cost from their head office and reported the investigation result that the project cost could be reduced approx. equiv. US $ 8.9 million from the amount of the present project cost as surplus costs allocated for each rehabilitation item were eliminated.

The content of cost reduction is as follows:

- For rehabilitation under present scope of work :	- US $ 5.8 million
- For reduction cost due to cancellation of Synchronous Condensers at Saigon Substation :	- US $ 4.6 million
- For reduction cost due to decrease of ratio of contingency :	- US $ 0.5 million
- For increase cost due to renewal of inlet valves:	+ US $ 2.0 million
Possible reduction cost	- US $ 8.9 million

It is noted that the cost increase of upgrading plan will be considered due to increase of upgrading item of PC-3 area provided that the cost increase will be estimated in Japan.

The study team stated their concern on the project cost that the sever estimation of the project cost is not beneficial for PC-2 at the moment in view of high quality implementation of the Project in future.

However, PC-2 requested that the possible cost reduction is considered further.

The study team agreed that they will pursue the further cost reduction in Japan.

Mr. Nguyen Van Than
Deputy Director General
PC-2

M.Kanda
JICA Team Leader

Appendix 18

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.8

Date : **20th March, 1995**
Place : **PC-2 Head Office**

Present :

PC-2:	**Mr.Nguyen Van Than**	**Deputy Director General**
	Mr.Dao Hieu	**Technical Dept., Ministry of Enargy (M.O.E)**
	Mr.Nguyen Van Tuc	**Director of Logistics Dept.**
	Mr.To Thuong	**Head of Techical Dept of Da Nhim Power Station**
	Mr.Vi Liem Pha	**Head of Repairing Dept of Da Nhim Power Station**
	Mr.Nguyen Van Huong	**Deputy head of technical Dept.**
	Mr.Duong Duc Thinh	**Engineer, Energy Center**
	Mr. Nguyen Van Ngoc	**Deputy Director of Transmission Dept.**
	Mr. Nguyen Chi Dao	**Planning and Technical Division of Transmission Dept.**
	Mr.Hoang Cong Huy	**Technical Department**
PC-3 :	**Mr. Dinh Mien**	**Director of Power Transmission Dept. No.2**
	Mrs. Nguyen Thi Thao Thao	**Transmission Dept 2**

JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Since the study team arrived at Vietnam on 12th March, 1994, M.O.E, PC-2, PC-3 and the study team have discussed on the draft final report for the captioned project.

The parties concerned have also discussed the specific plans of rehabilitation of the system and upgrade of the existing transmission facilities for the succeeding study of the plan.

The discussions were held in the head office of PC-2 and Saigon substation among the M.O.E engineer, the PC-2's and PC-3's engineers and the study team. Results of those fruitful discussions were recorded in the attached minutes of meeting.

Additionally, in this meeting, following matters were confirmed with the parties concerned. The study team mentioned that detailed descriptions concerned the matters will be stated in the final report.

- Corrections of the interim report were made on the basis of the result of meeting at last year.

- PC-2 concerned that the total project cost was high compared with the level of the international price and requested to consider possible reduction of the project cost.

- PC-2 requested to carry out further project evaluation.

- PC-2 requested that the implementation schedule of the project should be shortened as much as possible.

- PC-2 will made their final comments on the draft final report by 12th April, 1995 in accordance with agreement between the Minstry of Energy and JICA on 3rd December, 1993.

- Subject to approval of M.O.E and E.V.N in Hanoi, PC-2 agreed that the final report will be opened to the public without any limitation after registration into JICA.

- PC-2 will act as representative of the Feasibility Study on Rehabilitation of Da Nhim Power System until completion of the final report.

Now both parties accepted all descriptions in the following minutes and memorandum (enclosed herewith).

- No.F/D -1 of Minutes of 13th March, 1995 at PC-2 head office
- No.F/D -2 of Minutes of 14th March, 1995 at PC-2 head office
- No.F/D -3 of Minutes of 15th March, 1995 at Saigon substation
- No.F/D -4 of Minutes of 16th March, 1995 at PC-2 head office
- No.F/D -6 of Minutes of 17th and 18th March, 1995 at PC-2 head office
- No.F/D -7 of Minutes of 20th March, 1995 at PC-2 head office

The study team is to continue to prepare further the final report of the study by the end of May 1995 on the basis of the discussions.

Nguyen Van Than
Deputy Director General
Power Company No.2

Masatoshi. Kanda
Leader of JICA Study Team

Feasibility Study

on

Rehabilitation of Da Nhim Power System

Minutes of Meeting : No.F/D-9

Date : 23rd March, 1995
Place : Head Office of Electricity of Viet Nam

Present :

Electricity of Viet Nam (EVN):

	Mr. To Quoc Tru	**Director International Cooperation Dept.**
	Mr.Nguyen Ly Tinh	**Director of Power Sources Dept.**
	Mr.Kim Van Hoa	**Deputy Director of Power Sources Dept.**
	Mr.Nguyen Huu Duyen	**Deputy Director of International Cooperation Dept.**
	Mr.Dao Hieu	**Technical Dept., Ministry of Energy (M.O.E)**
	Mr. Do Dong Xuyen	Deputy Director of Project Appraisal Dept.
JICA Team :	**Mr. M.Kanda**	**Team Leader**
	Mr. M.Mogi	**Turbine Engineer**
	Mr. H.Nakaseko	**Hydromechanical Engineer**
	Mr. N.Nakato	**Substation Engineer**

Objective:

1.Submission of draft final report

2.Confirmation and clarification of meeting minutes with PC-2

1.Submission of draft final report

The study team submitted eight (8) copies of draft final report to EVN.

2.Confirmation and clarification of meeting minutes with PC-2

The discussion was made on the basis of the minutes of meeting agreed with the PC-2 and the study team in Ho Chi Minh city.

The followings will be confirmed subject to issuance of final comments of EVN to be scheduled by 20th April 1995.

2.1 Project assessment

(1) Energy unit price for the project evaluation

(2) Evaluation method of project

(3) Energy loss

(4) Water resources tax and sales tax

(5) Ratio of the standard conversion factor (refer to sub-clause 12.2.2 (4) of report)

2.2 Cost estimate

(1) Possible cost deduction

EVN requested to pursue possible cost deduction of the project cost as PC-2 commented.

The study team agreed with EVN request.

(2) EVN will inform the followings:

- Price contingency
- Price escalation for both foreign and local currencies

(3) The study team proposed in view of facilitation of future loan arrangement that they will study additionally to phase in the project implementation as an alternative plan and that the result will be mentioned in the final report.

EVN agreed with the proposed alternative study.

2.3 Implementation schedule

EVN stated their concern that the implementation schedule should be considered to ~~short~~ start rehabilitation work for first unit in 1999 and to complete it as earlier as possible in view of future electric supply conditions in the south of Viet Nam.

The study team agreed to consider the schedule to be shortened as much as possible.

3. New organization of EVN

The study team confirmed that they were handed over a copy of the new organization from EVN.

Due to change of the organization, EVN suggested that the name of current electricity companies such as PC-1, PC-2, PC-3, Hanoi PC and PC of HCM city shall be maintained provided that the description shall be made in the final report as these current companies will be controlled under EVN from 1st of April, 1995.

4. Renewal of power development program

EVN suggested referring to clause 2.3.5 of page 2-8 of summary report that Table of the power development program should be updated in the basis of the fourth power development master plan.

The study team agreed with the suggestion.

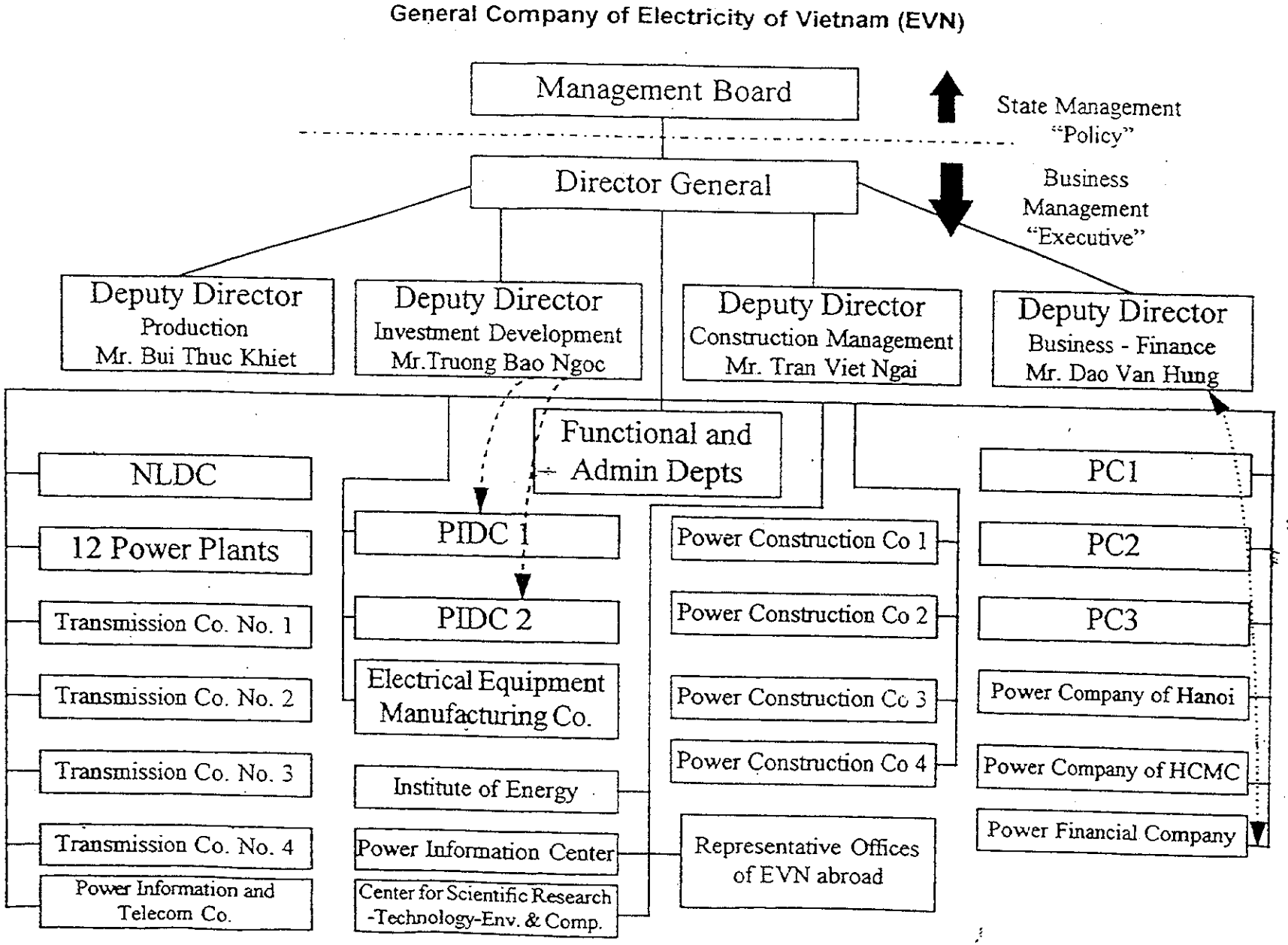
5. Open of final report

The study team stated referring to the minutes of meeting (No. F/D-8) that PC-2 agreed to open the final report of the Da Nhim power system to the public without any limitation after registration into JICA, subject to final approval of M.O.E and EVN.

EVN stated that they will comply with the JICA intention.

Mr. Truong Bao Ngoc
Deputy General Director
EVN

M.Kanda
JICA Team Leader


General Company of Electricity of Vietnam (EVN)
Management Board
State Management
"Policy"
Director General
Business
Management
"Executive"
Deputy Director
Production
Mr. Bui Thuc Khiet
Deputy Director
Investment Development
Mr.Truong Bao Ngoc
Deputy Director
Construction Management
Mr. Tran Viet Ngai
Deputy Director
Business - Finance
Mr. Dao Van Hung
Functional and
Admin Depts
NLDC
12 Power Plants
Transmission Co. No. 1
Transmission Co. No. 2
Transmission Co. No. 3
Transmission Co. No. 4
Power Information and
Telecom Co.
PIDC 1
PIDC 2
Electrical Equipment
Manufacturing Co.
Institute of Energy
Power Information Center
Center for Scientific Research
-Technology-Env. & Comp.
Power Construction Co 1
Power Construction Co 2
Power Construction Co 3
Power Construction Co 4
Representative Offices
of EVN abroad
PC1
PC2
PC3
Power Company of Hanoi
Power Company of HCMC
Power Financial Company

Appendix 20

To: Mr. Luu Minh Chanh
Director of Da Nhim Hydro Power Station

From: Mr. Masatoshi Kanda
Team Leader of JICA Study Team
Da Nhim Rehabilitation Project

September 17, 1994

Dear Sir,

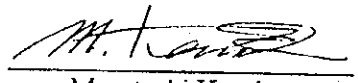
Subject: Handing Over JICA's Equipment and Materials

In the completion of the site investigation of the facilities in Da Nhim Power Station, with the consent of JICA head office, we hand over, at free of charge, you the equipment and materials for the for investigation for Feasibility Study on Rehabilitation of Da Nhim Power Station, listed in the attached sheets

- List of JICA's Equipment for Turbine Inspection	2 Sheets
- List of JICA's Equipment for Generator Inspection	1 Sheet
- List of JICA's Equipment for Penstock and Gate Inspection	4 Sheets
- List of JICA's Equipment for Civil Inspection	1 Sheet
- List of JICA's Equipment in Common	1 Sheet

We hope those equipment and materials will be useful for maintenance.

Sincerely yours,



Masatoshi Kanda
Team Leader
JICA Study Team

Incl.; List of JICA's Equipment

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Turbine Inspection

Nos.	Description of Goods	Quantity	
1	Powder Blower	1	pce
2	Cellophane Tape (50mm-wide)	3	pcs
3	Cellophane Tape (26mm-wide)	10	pcs
4	Solder Plate (300 x 25mm)	24	pcs
5	Convex Rule (5m)	1	pce
6	White Rags	20	kg
7	Cable Reel	2	pcs
8	Coller Electric Bulb (500W)	10	pcs
9	Receptacle	4	pcs
10	Gum Tape (50mm)	5	pcs
11	Hand Lamp	2	pcs
12	Spare Electric Bulb	25	pcs
13	Flash Light	2	pcs
14	Straight Rule (600mm)	1	pce
15	Straight Rule (300mm)	1	pce
16	Inside Calipers (250mm)	1	pce
17	Outside Calipers (250mm)	1	pce
18	Vernier Calipers (150mm)	2	pcs
19	SUMP Test Kit	1	lot
20	Dust Protective Goods	1	lot
21	Voltex Gasket (25A)	8	pcs
22	Voltex Gasket (35A)	8	pcs
23	Voltex Gasket (50A)	16	pcs
24	Voltex Gasket (100A)	8	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Turbine Inspection

Nos.	Description of Goods	Quantity
25	Sheet Packing (25A)	8 pcs
26	Sheet Packing (80A)	8 pcs
27	Sheet Packing (90A)	8 pcs
28	Sheet Packing (200A)	8 pcs
29	Round Rubber Packing (6DX21M)	4 pcs
30	Transformer	1 pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Generator Inspection

Nos.	Description of Goods	Quantity	
1	Rotor Bearers with accessories	2	sets
2	Wire-Rope (Ø12 mm - 5 m)	4	pcs
3	Wire-Rope (Ø18 mm - 5m)	4	pcs
4	Shackle (SC34)	4	pcs
5	Eye-Bolt (W 1-3/4)	4	pcs
6	Whet Stone (#500)	3	pcs
7	Sand Paper (#100)	20	pcs
8	Torque Wrench and Socket (920kg-cm)	1	set
9	Inspection Hammer	1	pcs
10	Thickness Gauge	2	pcs
11	Straight Rule (300 mm)	1	pce
12	Vernier Calliper (300mm)	1	pce
13	Convex Rule (2 m)	2	pcs
14	Assorted File (Eight pieces)	1	sets
15	Scraper	1	pcs
16	Hand Spring Balance (2 kg)	1	pce
17	Generator Windings Insulation Materials	4	lots
18	Cable Reel	1	pce
19	Electric Brush with Rod	2	pcs
20	Electrical Wire	2	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Penstock and Gate Inspection

Nos.	Description of Goods		Quantity	
1	Pipe Wrench (450 mm)		2	pcs
2	Puller (0.75 ton)		2	pcs
3	Moldering Putty		4	pcs
4	Clamp Tester		2	pcs
5	Lead wire with Clip		18	pcs
6	Open Ended Spanner	for I 1/2 inch	2	pcs
7	Hammer	2.2 kg	2	pcs
8	Lever Block	0.75 ton	2	pcs
9	Aluminum Ladder	4 m	6	pcs
10	Rope Ladder	10 m	4	pcs
11	Wire Rope	12 Ø x 200 m for Tirfor	3	pcs
12	Tirfor	1.6 ton	2	pcs
13	Safety Rope	18 Ø x 200 m	2	pcs
14	Movable Scaffolding with Bolts and Nuts		1	pcs
15	Aluminum Step Ladder	4 m	2	pcs
16	Electric Cable	(VCT 2.0 mm2 3 core 100 m)	3	pcs
17	Socket outlet with Cable		10	pcs
18	Table Tap		1	pcs
19	Portable Tool Set		1	pcs
20	Vinyl Tape		5	pcs
21	Lamp for Outdoor Use	(100V with 300W Bulb)	5	pcs
22	Spare Electric Bulb	(100V-300W)	5	pcs
23	Transformer	1 KVA	2	pcs
24	Disk Grinder	100 V 100 Ø	3	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Penstock and Gate Inspection

Nos.	Description of Goods		Quantity	
25	Abrasive Disk	100 Ø # 80	16	pcs
26	"	100 Ø #120	6	pcs
27	Sand Paper	# 80	34	pcs
28	"	#120	47	pcs
29	Straight Rule	150 mm	2	pcs
30	"	1000 mm	2	pcs
31	Scraper	300 mm	4	pcs
32	Wire Brush		4	pcs
33	White Rags		5	kg
34	Cable Reel	(VCT 2.0 mm2 100 m)	3	pcs
35	Glycerin		8	pcs
36	Brush	50 mm	3	pcs
37	"	S	4	pcs
38	Cutter Knife		1	pcs
39	Raincoat		5	pcs
40	Dust Goggle		10	pcs
41	Remover	Penetrant Test	17	pcs
42	Dye Penetrant	"	5	pcs
43	Developer	"	11	pcs
44	Measuring Tape	10 m	2	pcs
45	"	50 m	3	pcs
46	Convex Ruler	5 m	3	pcs
47	Measuring Tape	20 m Ribbon Rod	2	pcs
48	Straight Ruler	300 mm	2	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Penstock and Gate Inspection

Nos.	Description of Goods		Quantity	
49	Vernier Caliper	150 mm	2	pcs
50	"	300 mm	2	pcs
51	Hammer	900 kg	2	pcs
52	"	350 g	3	pcs
53	"	250 g	3	pcs
54	Taper Gauge		2	pcs
55	Thickness Gauge		2	pcs
56	Magnet Base	40 Ø	20	pcs
57	Magnet Sheet		8	pcs
58	Piano Wire with Reel		3	pcs
59	Tool Bag		2	pcs
60	Safety Belt		10	pcs
61	Rope Grip (Rorip)		10	pcs
62	Head Lamp		10	pcs
63	Flashing Light		8	pcs
64	Chisel		5	pcs
65	Plumb	400 g	5	pcs
66	Spatula		4	pcs
67	Cotton String		3	pcs
68	Nylon Rope	12 Ø x 50 m	5	pcs
69	Nylon Rope	9 Ø x 50 m	5	pcs
70	Stand for Manhole		2	pcs
71	Empty Can		2	pcs
72	Grease		2	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Penstock and Gate Inspection

Nos.	Description of Goods		Quantity	
73	Grease Gun with Hose		3	pcs
74	Manila Rope	16 Ø x 50 m	5	pcs
75	"	12 Ø x 50 m	5	pcs
76	Blue Sheet	Mid Size	18	pcs
77	Fire Extinguisher		5	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for Civil Inspection

Nos.	Description of Goods	Quantity	
1	Aluminium Stuff	2	pce
2	Unipole	3	pcs
3	Curvimeter	1	pcs
4	Life Jacket	5	pcs
5	Tool set	1	set
6	Cable and Connector	1	lot
7	Battery (12V)	1	pcs
8	Transformer	1	pcs

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment in Common

Nos.	Description of Goods	Quantity
1	Plug Adapter	10 pcs
2	Facsimile Machine	1 pcs
3	Transformer	3 pcs
4	Cell Unit 1	160 pce
5	Cell Unit 2	20 pce

Received Date 17 Sep. '94

Da Nhim Power Station

Appendix 21

To: Ms. Ho Thi Bich Phuong
Director of Transmission Department

From: Mr. Masatoshi Kanda
Team Leader of JICA Study Team
Da Nhim Rehabilitation Project

September 19, 1994

Dear Sir,

Subject: Handing Over JICA's Equipment and Materials

In completion of the site investigation of the facilities in Saigon Substation, with the consent of JICA head office, we hand over, at free of charge, you the equipment and materials for the for investigation for Feasibility Study on Rehabilitation of Da Nhim Power System, listed in the attached sheet.

- List of JICA's Equipment for Saigon S/S 1 Sheet

We hope those equipment and materials will be useful for maintenance.

Sincerely yours,

Masatoshi Kanda
Team Leader
JICA Study Team

Incl.; List of JICA's Equipment for Saigon S/S

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM

List of JICA's Equipment for SAIGON S/S

Nos.	Description of Goods	Quantity	
1	Cable Reel (NDN-EB34)	2	pcs
2	Table Tap	2	pcs
3	Flash Light	3	pcs
4	Convex Rule	1	pce
5	Test Hammer	1	pce
6	Thickness Gauge	1	pce
7	Vernier Caliper	1	pce
8	Assorted File	1	set
9	Electrician Knife	2	pcs
10	Brush	1	pce
11	Insulating Vinyl Tape	10	pcs
12	Compressed Terminals	1	lot
13	Scissors	2	pcs
14	Insulating Materials for Terminals	1	lot
15	Chisel	11	pcs
16	Tangaroy Scraper	5	pcs
17	Plastic Hammer	3	sets
18	Cutting Knife	11	pcs
19	Convex Rule (5 m)	3	pce

Received Date 20/9/1994

Saigon Substation