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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

OPERATIONS EVALUATION REPORT: ELECTRIC POWER

CASE STUDY: PUB, SINGAPORE

March 24, 1972

Programming and Budgeting Department
Operations Evaluation Division

DECLASSIFIED

DATE 11/17/01

BY 60324 JAL/STW

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

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CURRENCY EQUIVALENTS

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March 1971

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

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I. INTRODUCTION

1.01 The Public Utilities Board of Singapore is an autonomous public corporation solely responsible for the electricity, water and gas utilities of Singapore. It was established on May 1, 1963 by the Public Utilities Ordinance of 1963 as a body corporate with a perpetual concession. Although a single financial entity, it is required to keep three separate accounts for its Electricity, Water and Gas Departments.

1.02 The installed capacity of the Electricity Department increased more than four times from 150 MW in 1958 to 644 MW by the end of 1970, of which 240 MW were financed by IBRD; electricity generation has been entirely thermal from the three main stations called Pasir Panjang A, Pasir Panjang B and Jurong. There is no significant transmission system and power is distributed at 66 kv, 22 kv and 6.6 kv through mainly underground networks.

1.03 Singapore has long been, and still is, basically a trading community. A structural change in the economy is in progress; manufacturing for both home and export markets is presently the leading growth sector. Production in steel, textiles, metal fabricating and electronics has developed at an increasing rate during the last years; the electrical load growth in this sector is expected to compensate rapidly for the loss of demand resulting from the withdrawal of the British forces from the island during 1971 and 1972. The per capita gross national product reached an estimated US\$900 per annum in 1970.

1.04 Singapore has no natural fossil fuel resources of its own, but it is located near an area (Indonesia) with large resources of oil and natural gas. Three oil refineries, two of them located on adjacent islets, are already established in Singapore. These refineries are presently the PUB's largest consumers of electricity.

II. THE ASSOCIATION BETWEEN THE BANK AND THE BOARD BOARD

2.01 The PUB received five loans from the Bank totalling US\$75.3 million equivalent, of which US\$60.5 million were for power.

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln)		Interest	Period (years)	
				Committed	Disbursed ^{a/}		Grace	Term
337-SI	5/63	12/63	5/67	15.00	14.4 <u>b/</u>	5.5%	3	20
405-MA (water)	2/65	2/65		6.80	6.8 <u>b/</u>	5.5%		
473-SI	11/66	11/66	6/68	10.0	9.5 <u>b/</u>	6%	1	20
503-SI (power)	7/67	7/67	12/71	15.0	14.9	6%	3	20
(water)	7/67	7/67	12/71	15.0	14.9	6%	3	20
	7/67	7/67	12/72	8.0	5.8	6%	5	20
595-SI	4/69	6/69	9/72	<u>20.5</u>	<u>16.7</u>	6.5%	3½	20
Total				<u>75.3</u>	<u>68.1</u>			

^{a/} As of December 31, 1971.

^{b/} The difference between the amount shown in this column and the amount shown in the preceding commitments column was cancelled.

The first two loans 337-SI and 473-SI were made for the Pasir Panjang B thermal station (4 x 60 MW), the third loan 405-MA for water supply, and the last two loans 503-SI and 595-SI mainly for expansion of electricity distribution.

2.02 Prior to the establishment of the PUB, the electricity, water and gas undertakings supplying the island were owned and operated by the City Council. The Government decided in 1959 to disband the Council and transfer these departments to a Public Utilities Board, which was established in 1963 by the Public Utilities Ordinance; the various public utility undertakings together with all related functions, services, assets, and liabilities, were transferred from the Singapore City Council to the PUB. The organizations, duties, responsibilities and powers of the PUB as prescribed

in the Ordinance were established prior to the first power loan in consultation with the Bank. The Bank was concerned that the PUB would lack sufficient freedom in the appointment and control of its staff and in some aspects of its operations, requiring Government approval. The draft was amended with the Government's agreement and the provisions of the Ordinance have been generally satisfactory.

2.03 Loan 337-SI was made in May 1963, under the guaranty of the U.K., to the state of Singapore which in turn relented it to PUB. The project financed by the Bank was the first stage of the Pasir Panjang B thermal station (P.P.B.) with an initial installed capacity of 120 MW. The station was designed for an ultimate capacity of 240 MW, many features being suitable for the ultimate capacity. It was expected to be completed by May 1965. At the Bank's request, the Government gave assurances that the Board would use its best efforts to:

- a) recruit a competent and experienced General Manager;
- b) retain the services of experienced staff then holding key positions in the departments transferred to it;
- c) promptly fill any vacancies in such positions with qualified staff.

The Government also gave assurances to cause the accounts of the PUB to be regularly audited by independent auditors at least once a year and recognized the imperative need to organize the accounting system of the PUB in accordance with sound commercial accounting practices and to recruit additional qualified personnel required for this purpose. In addition, a supplementary letter was obtained from the Government on a rate covenant requiring a minimum return of 8% on the Board's total net fixed assets in operation.

2.04 In August 1964 the PUB started the construction of the second stage of the Pasir Panjang B station and applied for a loan covering it. However, the position of General Manager was held by a civil servant and this temporary measure had proved unsatisfactory. The Bank delayed consideration of a second loan and expressed also its concern regarding both the number of senior posts then vacant in the Electricity Department and the delay in reorganizing the PUB's accounting system. After discussion of the problem with PUB and the Government, the Bank proposed that PUB engage a firm of management consultants to make a comprehensive study of the organization and to prepare recommendations aimed at improving PUB's efficiency. The PUB

and the Government agreed in early 1965 to the proposal and the foreign exchange cost of the consultants' services was included in the Water Supply Loan 405-MA (1965). The consultants' report was submitted in October 1965, but consideration of its recommendations was deferred until a General Manager acceptable to the Bank was appointed in July 1966. The second stage of the P.P.B. station was financed in 1964-66 by Government loans and temporary overdrafts on commercial banks.

2.05 The Bank made the second power loan, 473-SI, in November 1966, to cover the foreign exchange expenditures which had been incurred during the 120 MW expansion of the Pasir Panjang B station which was then almost completed. The loan was made to the PUB itself under the guaranty of the Government. Assurances were obtained from the Board that:

- a) it would consult the Bank before replacing the Chief Finance Officer who was about to retire and before making subsequent appointments to this post and the posts of General Manager and Chief Electrical Engineer;
- b) the reorganization of the accounting system would be completed "as soon as possible";
- c) it would consult the Bank regularly on the actions to be taken on the recommendations of the management consultants.

The Government, prior to negotiations, had agreed with PUB to cancel partly the increase in fuel and property taxes imposed on PUB in 1965 and 1966, so that the Board would be able to achieve a minimum return of 8% for 1967 and onwards.

2.06 High voltage transmission has been up to now unnecessary in Singapore, and until 1963 power was transmitted at 22 kv from the generators to main step-down substations where it was connected for distribution over the 6.6 kv primary distribution system. With the increase in load density this arrangement grew inadequate and a 66 kv network to connect the main distribution centers with the generating stations was developed while the 22 kv network was largely converted to supplement the primary distribution. The Bank made in July 1967 a loan, 503-SI, to cover, in addition to a water supply project, the foreign exchange cost of a power project consisting of the expansion of the distribution system during the two-year period 1967-68, representing the first half of a program which the PUB had devised for the four years 1967-1970 to meet the load growth forecast for that period. This

expansion program was planned and designed by the PUB, seeking the advice of consultants with respect to particular problems. During negotiations for the loan, the Board agreed to continue the covenants adopted in the previous loans regarding maintaining tariffs sufficient to give an overall return of at least 8% per annum and consultations with the Bank before the appointment of senior officers. Moreover, following the Bank's recommendation, the Board agreed to engage consultants to review:

- a) its tariff structure which had been inadequately spread over the whole range of consumers and needed rationalization and simplification; and
- b) the basic distribution development program, given the fact that the load density would continue to increase markedly and that a system voltage higher than 66 kv might become necessary in the early 1970s.

2.07 Consulting firms were engaged to undertake the tariff structure review and the study of the basic distribution development program. A first report on the tariff structure was submitted in May 1968, recommending the elimination of the two-meter system of the PUB and the replacement of the existing eight main tariffs with four tariffs; these recommendations were examined by the PUB with little action at that time. The other consultants' preliminary report on long-term system development was submitted in February 1969, and its recommendations were accepted by the PUB. The Bank made its fourth power loan, 595-SI, to the PUB in April 1969 to cover part of the foreign exchange cost of the expansion of the distribution system for the three-year period 1969-1971, excluding the carry-over from the 1967-1968 program which was partly financed from Bank loan 503-SI of 1967. This program had been revised to include the additional work recommended in the consultants' report. The covenants adopted in the previous loans regarding the appointment of senior officers and the rate of return were repeated; moreover, the Board gave assurances that:

- a) immediate steps would be taken to appoint a Commercial Engineer (to supervise the introduction of the proposed new tariffs), a Planning and Development Engineer, and a Load Dispatch Engineer;
- b) the PUB would consult the Bank in regard to the actions it proposed to take on the consultants' recommendations on network development; and,

- c) tariffs revised substantially in accordance with the recommendations contained in the consultants' report would be introduced within three years from the date of the loan agreement.

2.08 The General Manager did not apply for a renewal of his contract which expired in July 1969 and the Chief Electrical Engineer started acting as General Manager. The PUB then applied for a fifth Bank loan to cover part of the foreign exchange cost of the extension of the Jurong Power station with two units of 120 MW each; the first stage of this station had comprised four 60 MW sets financed by supplier credits. Appraisal of the project took place in December 1969, and negotiations in May 1970. During negotiations, the covenants of the previous loan were adopted and agreement was reached on the need to appoint as soon as possible a Load Dispatch Engineer, a Commercial Engineer and a Statistician; the Bank proposed three alternative solutions to the problem of top management, requiring that it be solved before December 31, 1970. In January 1971, the Bank decided to drop the loan because PUB did not find a solution along any of the three proposed alternative lines and because it considered it unreasonable to present the loan to the Executive Directors beyond the end of the calendar year 1970.

III. THE FORMAL MANAGEMENT PROBLEM OF THE PUB

3.01 The Ordinance establishing the Board in 1963 provided for the existing staff previously operating under the City Council to be transferred to PUB. This enabled the utilities to be operated without interruption, but with difficulty due to a shortage of experienced senior staff. When the first loan was made (1963), a person suitable for appointment as General Manager was not available locally and previous efforts by the Government to recruit such a person overseas had been unsuccessful.

3.02 With the appointment of a General Manager from Singapore in 1966, it was hoped that the Chairman and the Board, who had necessarily assumed the administrative responsibilities, would allow the General Manager to exercise his duties and responsibilities. This, however, did not take place due to the Chairman's inability to delegate and to the Board's lack of confidence in the General Manager. Additional maintenance and operating staff were still urgently required by the end of 1966 and arrangements were made to train PUB staff overseas. Moreover, the organizational changes recommended in the report submitted by the management consultants in 1965 were slow due to the poor staff relations and more particularly to the continuing shortage of experienced staff. But some progress was achieved. Training was put under the direct authority of the General Manager and designed to yield rapid results and improve gradually the staff situation, particularly in the Electricity Department where the replacement of expatriates by not fully experienced local personnel had led to a chronic shortage of competent senior staff. (In particular it was necessary to retain the services of engineers of the firms which manufactured the boilers of the Pasir Panjang B station to ensure proper supervision and maintenance). The Electricity Department was reorganized to include a planning division and a load dispatching section; a Budget Officer was appointed and management reporting greatly improved.

3.03 The Board's independent auditors, which were appointed as required by Loan 337-SI (1963), reviewed PUB's accounting system and were assisting PUB's staff to implement the changes which they had recommended to reorganize the system along sound lines; the 1966 annual report presented the accounts for the first time on a commercial basis properly reflecting operating costs and depreciation charges.

3.04 The lack of clear and effective management resulted in a lack of coordination between the various departments and poor staff relations; due to the Board's lack of confidence, the General Manager indicated that he would not apply for a renewal of his contract which expired in July 1969.

Notwithstanding some progress due to the training program, the staff shortage persisted, delaying further organizational changes, and was aggravated by the need to staff new sections such as the Planning and Load Dispatch Sections and the new Jurong thermal station which was partially commissioned in 1969. The Board had also tried without success to replace the Chief Financial Officer who retired in 1967, but the former Chief Accountant who had been acting as Chief Financial Officer was then permanently appointed to the post. After the General Manager had decided to leave, the post was advertised world-wide; this action was unsuccessful due mainly to the low level of the salary offered for this important post. The former Chief Electrical Engineer of the PUB acted as General Manager but the Chairman and the Board were still undertaking the overall administrative responsibilities.

3.05 During the 1970 negotiations between the Bank and the Board for a further loan, no acceptable solution was found to the problem of top management. The Bank insisted on the creation of the post of Deputy General Manager to be groomed for the post of General Manager since the acting General Manager was expected to reach retirement age within about three years; the PUB rejected this idea on the grounds that it would impair morale among the top executives of the PUB. In view of the ability of the part-time Chairman of the Board, the Bank suggested also to the Government that it recognize the existing situation in which the Chairman was in effect the Chief Executive of the PUB and appoint him as full-time Chairman with proper salary and remuneration. This suggestion was adopted by the Government, but failed because the Chairman made exorbitant salary demands in view of the Bank's expression of confidence in him. At the same time the acting General Manager left Singapore.

3.06 After the Bank decided early in 1971 not to go ahead with the new loan, the PUB indicated that a new Chairman had been appointed to its Board, that a Statistician was recruited and that two of its engineers had been sent overseas for training as Commercial Engineer and Load Dispatch Engineer respectively with a view to filling these appointments by mid-1971. The post of General Manager with a relatively more attractive salary was again advertised world-wide and numerous applications received; none of the applicants, however, were acceptable to PUB.

IV. DEMAND FORECASTING AND INVESTMENT PLANNING

4.01 It has been the practice of the PUB to do distribution planning and design itself (seeking the advice of consultants with respect to particular problems), and to employ consultants to plan, design, and supervise the construction of its thermal generating plants. The Bank has used in its reports the forecasts made by the PUB or its consultants without significant modifications; these forecasts generally cover six-year periods.

4.02 The annual peak-demand on the PUB electrical network had increased over the period 1958-1962 by 7.1% p.a. on the average, reaching 139 MW in 1962; the actual effective-peak^{1/} spare capacity had been 13 MW in 1960 and 35 MW in 1962. The projections made for the first loan (1963) covered the period 1963-68 and forecast an average increase of the annual peak-demand by 9.8% p.a. (Table II-A.1). Planning for additional capacity (27 MW in 1964 and 120 MW in 1965) was based on the concept of firm capacity (installed capacity less the capacity of the largest unit in each plant in service). According to the forecast, the firm capacity reserve would have grown from 16 MW in 1963 to about 70 MW in 1968, with a minimum of 7 MW in 1964 (these figures including 30 MW spinning reserve obtained by operating two 60 MW units close to their most efficient rating of about 80%). The annual peak-demand actually grew by 13.4% p.a. on the average. To keep abreast of this higher growth rate more capacity was installed than forecast (120 MW in 1965 and 120 MW in 1966), but in larger increments than the increase in the demand; as a result, the average spare capacity as well as the actual effective-peak spare capacity were always higher than forecast. The growth of total sales (Gwh) was also underestimated, in particular that of industrial sales which increased substantially after 1965 when large chemical and other industries were established in the Jurong industrial estate.

4.03 Although the forecasts for large industrial consumers, prepared by the Electricity Department, had been scaled down, the annual peak-demand was expected in the second appraisal report (1966) to grow on average by 19% p.a. over the period 1966-1970 (Table II-A.2). Total sales forecasts were in line with actual sales, but the load factor rose much higher than forecast (0.67 as against 0.50 in 1970), so that the peak-demand grew along the past trends at 14% p.a. on average and was in 1970 100 MW less than expected. The firm capacity reserve was expected to reach 140 MW in 1966 and 1968 and to decline to about 80 MW in 1969 and 1970 (these figures including 60 MW spinning reserve on the four 60 MW units). Because planning for additional capacity was based on a more conservative concept (firm capacity

^{1/} Effective-peak: critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

after deducting the spinning reserve -- see paragraph 4.04) and because the actual demand was lower than expected, the average spare capacity was again higher than had been forecast by large amounts. The forecasts made in the third appraisal report (1967) are a slightly scaled down version of those in the second, and much the same conclusions as described above apply; peak-demand in 1970 was 60 MW less than projected in 1967.

4.04 As the Singapore load has no seasonal variation, there is no period of the year when maintenance can be carried out without causing problems of availability and it therefore has to be spread uniformly throughout the year. In order to safeguard the continuity of supply in case of breakdown, according to Singapore's strategy for attracting foreign private investments and legislation requiring annual equipment inspections, the policy stated by the PUB's Electricity Department and its consultants has been since 1965 to allow for two units (25 and 60 MW) out of service for maintenance and overhaul in addition to the 60 MW spinning reserve mentioned above. This large provision for capacity out of service was justified by the maintenance problem mentioned above and the condition of the Pasir Panjang A station where some units were long overdue for major overhaul. As a matter of fact, a substantial portion of the installed capacity, averaging 115 MW in 1967 and 120 MW in 1969 and 1970, has been out of service since 1966 for maintenance and repairs as shown in the following table by the difference between installed capacity and average capacity actually available.

<u>MW</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
1. Installed capacity	464	464	464	584	644
2. Average available capacity	413	349	392	463	523
3. Peak-demand	223	248	283	320	377
4. Reserve capacity (2 - 3)	190	101	109	143	146
5. Spinning reserve	60	60	60	60	60
6. Net spare capacity (4 - 5)	130	41	49	83	86

Moreover, the actual reserve capacity (after deducting spinning reserve) during the most critical times in each year after 1965 reached about 15 MW in 1966-67 and more than 40 MW in 1968 and again in 1970.

4.05 The large amount of capacity out of service, outgrowing the 85 MW allowance planned for it, was due to worse than average conditions; as a result of the maintenance policy followed prior to 1966, substantial capacity was taken out of service for major overhaul in P.P.A. station and for breakdowns in the P.P.B. station which contributed itself about 70% in 1967-68

and 40% in 1969-70 to the total capacity out of service. Even under these conditions, the average net spare capacity (after allowing for spinning reserve) has amounted to more than 60 MW in 1969-70. Though it is difficult to reach definitive conclusions in this matter without further investigation, it appears that there has been some over-investment since the Jurong station, not directly financed by the Bank (paragraph 2.08), was commissioned. The ongoing installation of two 120 MW units (with possible addition of a third) to be commissioned by 1973-74 in this station and a possible reduction of maintenance requirements could reinforce this preliminary conclusion, unless future demand grows at a much faster rate than the 14% p.a. average increase of the past four years.

V. PROJECT CONSTRUCTION AND COST

Generation

5.01 The most important project financed by the Bank in the PUB's Electrical Department has been the Pasir Panjang B Thermal station with a final capacity of 240 MW consisting of four generating units of 60 MW each. The first loan 337-SI (1963) covered the first phase of the plant erection, i.e., the major civil works and the installation of the first two units; the second power loan 473-SI (1968) provided for retroactive financing of the installation of the third and fourth units.

5.02 Construction for the first phase started in January 1963, and the first two units were commissioned in June and July 1965 respectively, two months behind schedule. The second phase was initiated in October 1964, more than two years before loan 473-SI was made, and the last two units went into operation in August and December 1966 respectively.

5.03 The cost of the first phase was slightly lower (6.5%) than expected (Table III) and the actual foreign exchange cost was US\$13.6 million, leaving US\$1.4 million savings from the loan, of which US\$0.8 million were withdrawn with the Bank's consent for purchasing spare parts, supervisory control equipment, and transformers. As work on site for the second phase was nearing completion at the time of the second loan appraisal, the estimated costs were very close to the actual cost of US\$12.86 million (1% lower than forecast), with a foreign exchange cost of US\$9.56 million leading to US\$0.44 million savings from the loan. The total cost of the whole plant reached US\$33 million which is equal to a unit cost of US\$138 per kw installed, as compared to US\$144 forecast in the appraisal reports. This compares favorably with the Jurong Thermal station, financed without Bank help, which had a total cost of US\$36 million, corresponding to a unit cost of US\$150 per kw installed.

Distribution

5.04 The power part of loan 503-SI (1967) was made to cover the US\$15 million foreign exchange cost of the 1967-68 expansion program of the PUB's distribution network. This program was expected to consist mainly in the installation of 232 km of cables and 430 MVA in transformer capacity, with a total cost of US\$25 million. Due, however, to the long delays in supply of equipment from the manufacturers the major part of the loan was

actually used to finance the foreign exchange cost of the 1968-69 distribution investment program; this program consisted mainly in the installation of 315 km of cables and 432 MVA transformer capacity with a total cost of US\$19.1 million, of which US\$13.1 million for foreign exchange, resulting in a unit cost of US\$60,800/km of cable (including transformer capacity) as against US\$104,700/km forecast. Both unit costs appear relatively high, probably as a result of ample, if not excessive, dimensioning of the network designed to provide a very reliable supply (see paragraph 4.04).

Procurement and Disbursement

5.05 The PUB has traditionally purchased equipment on the basis of international competitive tendering and bidding, and specifications for equipment required for all its projects have been prepared with this in view. Procurement actions which have been taken by the PUB are in accordance with the Bank's guidelines.

5.06 Disbursements were made against presentation of the usual documents evidencing expenditures of foreign exchange. In the case of retroactive financing (second power loan 473-SI for the second stage of the P.P.B. station) bids on an international competitive basis had been obtained for the works and all related contracts had been awarded with Bank approval.

VI. FORECASTING THE FINANCIAL ASPECTS

6.01 The financial projections made in the first appraisal report (1963) underestimated substantially the future investments to be made by the PUB during the period 1963-66. These investments were projected to be US\$43.3 million, half of it for the first stage of the Pasir Panjang B station (Table II-B); the PUB actually invested US\$68.4 million, half of it in both stages of Pasir Panjang B, in order to meet the faster than expected load growth. Due to higher sales revenues, the rate of return on the net fixed assets in operation was higher than expected, except in 1965 and 1966 when a temporary rise in fuel and property taxes added to the operating costs (Table II-A.1).

6.02 Financing of the investments was different from the forecast for the 1963-66 period; about 65% of total funds were expected to come from net internal cash generation and the remainder from the Bank loan. Due mainly to the poor results of 1965 and 1966, net internal cash contributed only 35% to the total requirements, while foreign borrowing contributed 32% and domestic contribution was 33% (Table II-B). Because of the delay in Bank lending due to the absence of a General Manager, the expenditures incurred on the second stage of P.P.B. in 1964 and 1965 were partly financed by long-term loans from the Singapore Government and at the expense of working capital.

6.03 Total applications of funds as forecast in the second appraisal report (1966) for the period 1966-1970 were lower by 19% than the US\$127 million applications actually made in the same period, of which US\$104 million for fixed investments; the major discrepancy came from the working capital forecasts while fixed investments forecasts were off only by 4%. While net internal cash contributed about 40% to the total requirements as expected, total foreign borrowing was three times the forecast amount because of greater contributions from the suppliers and from the Bank itself; on the other hand, the Government stopped lending to PUB after 1968, reducing the domestic contribution from an expected 36% to 11% (Table II-B). Moreover, gross and net fixed assets in service, as well as the operating costs, were overestimated in the forecasts, while the sales revenues were underestimated due to the tariff increases introduced in November 1966; as a result, the rate of return on the net fixed assets was higher than expected. Forecasts made in the third appraisal report (1967) for the Electricity Department's cash flow for the period 1967-70 were similar to the previous ones; net internal cash was expected to contribute 37% to the total requirements, Government loans 31% and foreign borrowing 31%, most of it from the Bank.

6.04 There has been a strong complementarity between Government and Bank loans to PUB. During the period 1963-66, the necessity to invest more than expected and the delay in Bank lending obliged the Government to make loans which were not foreseen by the Bank. Conversely, during 1966-70, the Government withdrew its aid to PUB and the Bank took over with lending in 1966, 1967 and 1969 successively; as a result, the contribution from the Bank has been considerably higher than originally foreseen.

VII. INSTITUTIONAL DEVELOPMENT

The Consultants

7.01 After the installation of unsatisfactory free piston units, Messrs. Merz and McLellan became the PUB's permanent consultants in 1963 and have since been working on the planning, design and construction supervision of the new thermal generating plants of the PUB. Management consultants, R. W. Beck and Associates of Seattle, who were selected with Bank approval, made in 1965 a comprehensive study of the PUB's organization and made a large number of recommendations which were partly implemented (paragraph 3.02). According to the requirements under the first Loan Agreement (1963), the PUB engaged external auditors, Messrs. Turquand, Youngs and Co., and appointed them to make recommendations for a proper system of accounts on a commercial basis; the PUB was also assisted by its auditors in carrying out the necessary reorganization. Under the covenants of the third power Loan Agreement (1967), the PUB engaged Electrowatt of Switzerland to review the tariff structure and to determine a rate suitable for domestic service which would eliminate the Singaporean two-meter system; Electrowatt submitted its first report and recommendations in April 1968 and its final report in June 1971. In 1968 the PUB engaged the Montreal Engineering Company Ltd. of Canada to undertake the study suggested by the Bank of the basic distribution program and to submit recommendations for long-term system network development; the consultants' report was delivered in February 1969.

7.02 The PUB's experience with these consultants has taken various forms. The general technical consultants, Merz and McLellan of London, have not fulfilled any educational or expertise-building function within the PUB (except for some training of operating staff), and they have worked out their generation planning and design without close collaboration with PUB's staff; their terms of reference did not mention training. The quality of their planning and studies, relying on conservative methods based on a pragmatic approach, has not appeared, in the PUB's opinion, very satisfactory, because of the lack of long-range perspective and modern methodology. Discussions between the PUB and these consultants were held to allow the PUB to obtain adequate training and planning services in the future as well as lower fees than in the past; the PUB engaged in 1971 Montreal Engineering Company to design its future plant (see paragraph 7.04). The management study made in 1965 did not solve the formal management problem but may have contributed to the improvement of performance that has occurred. Though the PUB agrees that outside views are in general helpful, its opinion on this matter is that recommendations of the consultants should have been adjusted to the local administrative and political conditions and environment, particularly with respect to the phasing in implementing these recommendations.

7.03 On the other hand, the reorganization of the PUB's accounting system yielded positive results, although the recommendations of the internal auditors were implemented slowly. Since 1966, accounts have been presented on a commercial basis and progressively refined; management reporting, which virtually did not exist before 1967, was geared to the new commercial system and has greatly improved, resulting in a meaningful budget control and a further improvement in the PUB's management. The PUB has been keeping separate accounts for the water, gas, electricity, and service departments. Water, gas and electricity meters are read once per month, and the bill prepared on the computer (introduced in 1964) is sent out for the three services; non-payment of a bill results in prompt cut-off of one or more of the services. This procedure works well and there is no problem concerning uncollected accounts.

7.04 Electrowatt's recommendations on electricity tariff structure were agreed upon by the PUB which is implementing them gradually and expects to complete their implementation by April 1972 as required by the last Loan Agreement (1969). Experience with the Montreal Engineering Company has been very fruitful, in the PUB's opinion. Long-range planning was introduced for the first time in the study of the distribution development programs; though their terms of reference did not mention it, these consultants have fulfilled successfully the educational and expertise-building function, involving staff from PUB's different departments in their studies and having them work together on new methods and approaches, thus resulting in improved staff relations and coordination between the different departments. As mentioned above, the PUB recently engaged these consultants for the design of its new power station and it is likely that they will be retained for planning of future generation expansion.

Operations Efficiency

7.05 The PUB has succeeded in increasing over time its average profit/kwh sold while reducing substantially its average price/kwh sold; this was made possible by reducing more substantially its average cost/kwh sold, as shown in the following table:

	<u>PUB: AVERAGE UNIT COST (US¢ per kwh sold)</u>							
	<u>1960</u>	<u>1962</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Depreciation	0.55	0.51	0.45	0.47	0.57	0.48	0.44	0.37
Administration	0.14	0.16	0.17	0.16	0.13	0.09	0.11	0.09
Fuel	0.59	0.48	0.66 ^{a/}	0.56	0.40	0.39	0.39	0.32
Other Oper. Costs	<u>0.40</u>	<u>0.41</u>	<u>0.46</u>	<u>0.40</u>	<u>0.36</u>	<u>0.30</u>	<u>0.27</u>	<u>0.26</u>
Total	<u>1.68</u>	<u>1.56</u>	<u>1.74</u>	<u>1.59</u>	<u>1.46</u>	<u>1.26</u>	<u>1.21</u>	<u>1.04</u>

Decrease over the previous year of:

Fuel Cost/kwh, % (35) 15 29 3 - 18

Due to:

Fuel Cost/ton, % (30) 13 26 (3) - 17

Operations Efficiency^{b/}% (5) 2 3 6 - 1

a/ Includes 0.15¢ for fuel tax which was exceptionally high in 1965.

b/ As reflected by the number of fuel tons/Gwh generated and by distribution losses.

PUB's depreciation costs per unit have declined sharply, presumably mainly as a result of the larger generating units added since 1965, with lower cost/kw installed. Fuel cost/kwh has also fallen sharply, at an average rate of some 16% p.a. over 1965-1970, of which 13% is due to decrease in fuel prices and 3% to increasing operational efficiency in thermal plants and to decreasing distribution losses.

Observance of Loan Agreements Covenants

7.06 The Bank's ordinary covenants on rate of return and long-term debt incurrence were easily observed by the PUB through the period 1963-1970 (except in 1965). These covenants actually have been less restrictive than the PUB's own Ordinance regulations drafted by the Government in 1963 with the Bank's assistance and revised after 1968. Other covenants were generally respected. Those covenants specifically designed to build up the internal management were implemented with delays, in particular the reorganization of the accounting system (337-SI) and the recruitment of specialized engineers (595-SI); the covenant relating to the latter was eventually fulfilled (paragraph 7.03) by promoting staff after training of about one year in Europe.

VIII. CONCLUSION

8.01 The PUB's past performance has been on the whole satisfactory. After 1966, this was due, in the Bank's opinion, to the ability of the Board's Chairman rather than to the inherent strength of the PUB's management which suffered from the Chairman's apparent inability to delegate and to build up a responsible senior staff. However, the records suggest that performance was as good before 1966 as after (Table I).

8.02 On the technical side, distribution losses, averaging 7% over 1963-1970, have been improving and are acceptable; the major concern has been the maintenance operations which were insufficient before 1967 and led afterwards to substantial amounts of capacity out of service (paragraph 4.04), although without causing failure to meet the demand. The financial rate of return of the whole PUB on its average net fixed assets in operation has been steadily over 9%, except in 1965 and 1966 (4.9% and 7.4% respectively) when fuel and property taxes were temporarily increased. The financial rate of return of the Electricity Department has been higher, growing from 11.8% in 1962 to 14.5% in 1970, with a drastic fall in 1965 and 1966 when it reached 6.1% and 7.2% respectively; it recovered, however, in 1967, reaching 9.3% that year and growing afterwards. The average cost per kwh sold decreased steadily, except in 1965 (see paragraph 7.05); part of the benefits of these economies was given to the customers, essentially to the industrial customers. Average revenue per kwh sold decreased from US¢2.42 in 1961 to US¢2.19 in 1970, less percentagewise than the unit cost because of tariff increases in 1966. The productivity of labor in the Electricity Department, defined very globally, has shown an average increase of 5.9% p.a. over the period 1960-1970, growing from 236 Mwh per employee to 418 Mwh; during the same period, the number of meters per employee, about twice the number of customers per employee (paragraph 2.07), increased from 67 to 110. The debt service coverage on an annual basis has always been higher than 2.0 (except in 1965: 1.8) with a maximum of 2.9 in 1963, and the debt/equity ratio reached a maximum of 57/43 in 1966.

8.03 The PUB's Electricity Department has been growing impressively during the last decade and operating satisfactorily on the whole. It has been gaining an increasing importance within Singapore's economy; its fixed investments have represented a significant part -- between 6% and 11% -- of the country's gross fixed capital formation, and the proportion of households supplied with electricity has grown from 32% in 1960 to 70% in 1970. The quality of its services has been satisfactory and no prolonged outage was recorded during this period; new connections are made presently without unreasonable delays (two weeks to one month) except in the small rural areas, where important efforts are nevertheless being made for rural

electrification. Its internal management of financial and technical operations has been built up with considerable help and guidance from the Bank and some consultants, and in recent years the PUB has been studying and planning continuously its future operations: network development, design for civil works, feasibility studies for its future stations. It envisages the erection of a nuclear plant by about 1980 (the feasibility study is being financed by the UNDP) and feels able in future years to act itself as consultant to other utilities. The PUB expects to finance from its own resources half of its future investments, and, on the basis of its creditworthiness, to borrow the other half from the Asian Development Bank, equipment suppliers, the Bank, and the Government if necessary. Supplier credits would be used mainly for heavy equipment; the Bank, being cheaper than suppliers for financing of smaller equipment, would be asked to finance designated projects of the distribution type.

LOAN 337-SI (May, 1963)

	1962	1963	1964	1965	1966	1967	1968	Av. an. inc. rate-% 1963-68
<u>LOAD FORECASTS (MW)</u>								
1. Installed Capacity		197	224	344	344	344	405	15.5
2. Firm Capacity ^{a/}		172	172	257	257	257	317	13.0
3. Annual Peak Demand		156	165	183	194	237	249	9.8
4. Spare Capacity (2-3)		16	7	74	63	20	68	33.0
<u>ACTUAL LOAD (MW)</u>								
5. Installed Capacity	202	224	224	344	464	464	464	15.7
6. Average available capacity	181	197	205	318	413	349	392	14.7
7. Annual Peak Demand	139	151	169	192	223	248	283	13.4
8. Average spare capacity (6-7)	42	46	36	126	190	101	109	21.0
9. Effective-Peak Capacity ^{b/}	171	170	207	221	286	310	367	16.6
10. Effective-Peak Demand ^{b/}	136	150	168	177	208	238	266	12.1
11. Effective-Peak Spare Capacity (9-10)	35	20	39	44	78	72	101	38.0
<u>LOAD FORECAST ACCURACY^{a/}</u>								
12. Firm Capacity		87	84	81	62	74	81	
13. Annual Peak Demand		103	98	95	87	96	88	
14. Spare Capacity		35	19	59	33	20	62	
<u>SALES FORECASTS (GWh)</u>								
15. Gross Generation		900	945	1038	1135	1438	1510	9.0
16. Sales: Residential ^{d/}		366	391	417	443	469	496	5.2
Public Lighting		14	15	15	16	17	18	4.3
Industrial Use ^{e/}		402	416	470	528	765	798	12.1
Total		782	822	902	987	1251	1312	10.9
<u>ACTUAL SALES (GWh)</u>								
17. Gross Generation	794	823	914	1047	1236	1424	1639	14.8
18. Sales: Residential ^{d/}	345	382	436	424	471	496	518	6.3
Public Lighting	13	14	15	18	21	23	26	13.2
Industrial Use ^{e/}	n.a.	334	377	470	583	720	903	22.0
Total	689	730	828	912	1075	1239	1447	14.7
<u>SALES FORECAST ACCURACY^{c/}</u>								
19. Gross Generation		109	103	99	92	101	92	
20. Sales: Residential		96	90	98	94	94	96	
Industrial Use		120	110	100	91	106	88	
Total		107	99	99	92	101	91	
<u>RETURN FORECAST (S \$ mln)</u>								
21. Operating Revenues ^{f/}		58.3	60.7	65.5	70.4	80.8	85.1	7.8
22. less: Operating Costs ^{g/}		36.9	40.0	42.5	45.7	50.9	51.9	7.1
23. Operating Income		21.4	20.7	23.0	24.7	29.9	33.2	9.2
24. Financial Rate of Return on Average Net Fixed Assets in Operation (%)		11.7	10.7	10.4	10.2	12.1	13.1	
<u>ACTUAL RETURN (S \$ mln)</u>								
25. Operating Revenues ^{f/}	53.3	56.5	62.6	67.6	76.6	89.6	102.6	12.7
26. less: Operating Costs ^{g/}	34.2	35.7	40.2	53.7	53.9	60.3	62.3	11.8
27. Operating Income	19.1	20.8	22.4	13.9	22.7	29.3	40.3	14.1
28. Financial Rate of Return on Average Net Fixed Assets in Operation (%)	11.8	12.1	11.3	6.1	7.2	9.3	12.4	
<u>RETURN FORECAST ACCURACY^{c/}</u>								
29. Operating Revenues		103	97	97	92	90	83	
30. Operating Costs		103	100	79	85	84	83	
31. Operating Income		103	92	165	109	102	82	

^{a/} Installed capacity less 25, 52, 87 MW allowed as standby in 1963, 1964 and 1965 onwards respectively. Planning concept used in projections.

^{b/} Effective Peak: critical time in year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

^{c/} Defined by the ratio: Forecast/Actual.

^{d/} Lighting and Fans and Domestic Power.

^{e/} Commercial and Industrial and Large Industrial Power.

^{f/} Total Revenues of the Department, not including indirect taxes.

^{g/} Including depreciation and direct taxation on utility, but excluding interest.

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SINGAPORE PUBLIC UTILITY BOARD-ELECTRICITY DEPARTMENT

TABLE I

	UNIT	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Av. an. inc. rate(%) 1958-1963 1963-1970		
OPERATIONS																	
1.	Installed Capacity (year-end)																
	Thermal	MW	150	150	150	150	175	197	197	317	437	437	557	617			
	Diesel	MW	--	--	27	27	27	27	27	27	27	27	27	27			
	Total	MW	150	150	177	177	202	224	224	344	464	464	584	644	8.3	16.3	
	Total as % Total in Country ^{a/}	%	98.7	98.7	99.4	97.8	98.1	98.2	98.2	98.8	99.1	99.1	99.1	99.3			
2.	Peak Demand	MW	106	113	118	128	139	151	169	192	223	248	283	320	377	7.3	14.0
3.	Gross Reserves	MW	44	37	59	49	63	73	55	152	241	216	181	264	267	10.6	20.4
4.	Reserves as % of Peak Demand	%	41.5	32.7	50.0	38.3	45.3	48.3	32.5	79.2	108.1	87.1	64.0	82.5	70.8		
5.	Effective-Peak Spare Capacity	MW	9	1	40	33	35	20	39	44	78	101	80	109	17.3	27.4	
6.	Gross Generation	GWh	571	616	659	720	794	823	914	1047	1236	1424	1639	1876	2206	7.6	15.1
7.	Generation Sent-out	GWh	536	576	624	684	749	784	870	993	1166	1346	1553	1774	2077	7.9	14.9
8.	Total Sales	GWh	492	525	578	637	691	730	828	912	1075	1238	1447	1653	1942	8.2	15.0
9.	Number of Customers	000's	86.6	93.1	98.2	106.5	118.7	133.1	146.5	169.3	186.0	202.3	218.8	244.4	267.6	9.0	10.5
10.	Number of Employees	No.	2220	2190	2450	2633	2721	2963	3119	3304	3648	3750	3855	4237	4650	5.9	6.6
FINANCES																	
11.	Sales Revenues ^{b/}	S\$mln	37.06	39.45	42.17	47.19	50.29	53.74	59.84	64.69	75.16	88.82	101.30	122.72	141.50	7.7	14.8
12.	Operating Costs ^{c/}	S\$mln	25.94	25.99	29.12	32.09	32.41	33.89	38.40	47.56	50.99	54.11	55.31	59.93	61.52	5.5	8.9
13.	Average Revenue/kwh Sold	S¢	7.53	7.51	7.31	7.41	7.29	7.36	7.23	7.09	6.99	7.17	7.00	6.87	6.71	-0.4	-1.3
14.	Average Cost/kwh Sold	S¢	5.27	4.95	5.04	5.04	4.69	4.64	4.64	5.21	4.74	4.37	3.82	3.62	3.17	-2.6	-5.6
15.	Average Revenue/kwh Sold ^{d/}	US¢	2.46	2.45	2.39	2.42	2.38	2.41	2.39	2.32	2.28	2.34	2.29	2.25	2.19		
16.	Average Cost/kwh Sold ^{e/}	US¢	1.76	1.65	1.68	1.68	1.56	1.52	1.52	1.70	1.55	1.43	1.25	1.21	1.04		
17.	Net Revenues (11 - 12)	S\$mln	11.12	13.46	13.05	15.10	17.88	19.85	21.44	17.13	24.17	34.71	45.99	62.79	79.98	12.3	22.0
18.	Gross Fixed Investments	S\$mln	16.71	20.83	9.38	15.27	18.98	35.87	67.11	53.22	49.09	40.88	80.56	56.40	84.29	11.5	13.0
19.	Av. Net Fixed Assets in Operation	S\$	145.00	155.70	161.30	163.65	162.12	171.48	198.94	246.10	297.57	315.98	324.17	374.64	422.28	3.4	13.7
MANAGEMENT INDICATORS																	
20.	Rate of Return (17 as % of 19)	%	7.7	8.6	8.1	9.2	11.0	11.6	10.8	7.0	8.1	11.0	14.2	16.8	18.9		
21.	Financial Rate of Return	%	8.2	9.2	8.7	9.1	11.8	12.1	11.3	6.1	7.2	9.3	12.4	12.8	14.5		
22.	Financial Rate of Return of PUB	%				8.9	10.6	9.3	9.6	4.9	7.4	9.2	11.6	11.5			
23.	Self-financing Rate ^{f/}	%	30.6	67.6	83.2	87.3	67.7	92.4	32.7	28.8	23.5	45.7	35.5	57.9	38.0		
24.	Debt Service Coverage ^{g/}	times	1.6	1.7	1.8	2.0	2.3	2.9	2.8	1.8	2.1	2.0	2.1	2.3	2.1		
25.	Debt/Equity Ratio	./.	n.a.	n.a.	n.a.	63/37	56/44	48/52	52/48	55/45	57/43	56/44	56/44	52/48	53/47		
26.	Energy Sales per Employee	MWh	221.6	239.7	235.9	241.9	253.9	246.4	265.5	276.0	294.7	330.1	375.3	390.1	417.6	2.1	7.8
27.28	Residential Customers as % of Households	%	28.8	30.6	31.8	34.1	37.6	41.6	45.2	51.6	56.0	58.9	61.6	66.5	70.4		
28.29	Distribution Losses (7-8/7)	%	8.3	8.9	7.4	6.9	7.8	6.9	4.8	8.1	7.8	8.0	6.8	6.8	6.5		
29.30	Average Capacity Out of Service as % of Installed Capacity	%	16.5	17.8	13.1	9.4	10.3	12.2	8.4	7.6	11.0	24.9	15.5	20.7	18.8		
30.31	PUB's Investments in Distribution as % of Total	%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	45.5	57.0	41.7	52.3	34.2	55.2	65.7		
31.32	PUB's Investment as % of Total Investments in Country	%	n.a.	n.a.	6.6	6.5	7.2	11.0	15.9	11.2	10.4	7.9	11.3	5.7	6.0		

a/ Includes captive plants.

b/ Revenues from sales of electric power only, including indirect taxes starting in 1969.

c/ Including depreciation, but excluding interest and direct taxation on utility.

d/ Net revenues after taxes as % of average net fixed assets in operation.

e/ Net internal cash generation as % of total applications of funds. See tables II-B.

f/ Times debt service was covered by operating income (including non-power revenues) and depreciation.

g/ Constant exchange rate US \$ 1 = S \$ 3.

h/ Provisional.

31.1	Number of meters per employee	no.	67	75	71	72	78	81	87	95	96	102	108	110	110	3.9	4.5
32.	Number of customers per employee	no.	39	43	40	40	44	45	47	51	51	54	57	58	58	2.9	3.6

SINGAPORE PUBLIC UTILITY BOARD - ELECTRICITY DEPARTMENT

TABLE II-A.1

LOAN 337-SI (May, 1963)

	1962	1963	1964	1965	1966	1967	1968	Av. an. inc. rate-% 1963-68
<u>LOAD FORECASTS (MW)</u>								
1. Installed Capacity		197	224	331 344	334 344	331 344	405	15.5
2. Firm Capacity ^{a/}		172	172	257	257	257	317	13.0
3. Annual Peak Demand		156	165	183	194	237	249	9.8
4. Spare Capacity (2-3)		16	7	74	63	20	68	33.0
<u>ACTUAL LOAD (MW)</u>								
5. Installed Capacity	202	224	224	344	464	464	464	15.7
6. Average available capacity	181	197	205	318	413	349	392	14.7
7. Annual Peak Demand	139	151	169	192	223	248	283	13.4
8. Average spare capacity (6-7)	42	46	36	126	190	101	109	21.0
9. Effective-Peak Capacity ^{b/}	171	170	207	221	286	310	367	16.6
10. Effective-Peak Demand ^{b/}	136	150	168	177	208	238	266	12.1
11. Effective-Peak Spare Capacity (9-10)	35	20	39	44	78	72	101	38.0
<u>LOAD FORECAST ACCURACY</u>								
12. Firm Capacity		87	84	81	62	74	81	
13. Annual Peak Demand		103	98	95	87	96	88	
14. Spare Capacity		35	19	59	33	20	62	
<u>SALES FORECASTS (Gwh)</u>								
15. Gross Generation		900	945	1038	1135	1438	1510	9.0
16. Sales: Residential ^{d/}		366	391	417	443	469	496	5.2
Public Lighting		14	15	15	16	17	18	4.3
Industrial Use ^{e/}		402	416	470	528	765	798	12.1
Total		782	822	902	987	1251	1312	10.9
<u>ACTUAL SALES (Gwh)</u>								
17. Gross Generation	794	823	914	1047	1236	1424	1639	14.8
18. Sales: Residential ^{d/}	345	382	436	424	471	496	518	6.3
Public Lighting	13	14	15	18	21	23	26	13.2
Industrial Use ^{e/}	n.a.	334	377	470	583	720	903	22.0
Total	689	730	828	912	1075	1239	1447	14.7
<u>SALES FORECAST ACCURACY^{c/}</u>								
19. Gross Generation		109	103	99	92	101	92	
20. Sales: Residential		96	90	98	94	94	96	
Industrial Use		120	110	100	91	106	88	
Total		107	99	99	92	101	91	
<u>RETURN FORECAST (S \$ mln)</u>								
21. Operating Revenues ^{f/}		58.3	60.7	65.5	70.4	80.8	85.1	7.8
22. less: Operating Costs ^{g/}		36.9	40.0	42.5	45.7	50.9	51.9	7.1
23. Operating Income		21.4	20.7	23.0	24.7	29.9	33.2	9.2
24. Financial Rate of Return on Average Net Fixed Assets in Operation (%)		11.7	10.7	10.4	10.2	12.1	13.1	
<u>ACTUAL RETURN (S \$ mln)</u>								
25. Operating Revenues ^{f/}	53.3	56.5	62.6	67.6	76.6	89.6	102.6	12.7
26. less: Operating Costs ^{g/}	34.2	35.7	40.2	53.7	53.9	60.3	62.3	11.8
27. Operating Income	19.1	20.8	22.4	13.9	22.7	29.3	40.3	14.1
28. Financial Rate of Return on Average Net Fixed Assets in Operation (%)	11.8	12.1	11.3	6.1	7.2	9.3	12.4	
<u>RETURN FORECAST ACCURACY^{c/}</u>								
29. Operating Revenues	103	97	97	92	90	83		
30. Operating Costs	103	100	79	85	84	83		
31. Operating Income	103	92	165	109	102	82		

a/ Installed capacity less 25, 52, 87 MW allowed as standby in 1963, 1964 and 1965 onwards respectively. Planning concept used in projections.

b/ Effective Peak: critical time in year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

c/ Defined by the ratio: Forecast/Actual.

d/ Lighting and Fans and Domestic Power.

e/ Commercial and Industrial and Large Industrial Power.

f/ Total Revenues of the Department, not including indirect taxes.

g/ Including depreciation and direct taxation on utility, but excluding interest.

TABLE II-A.2

SINGAPORE PUBLIC UTILITY BOARD - ELECTRICITY DEPARTMENT

LOAN 473-SI (Nov. 1966)

	1965	1966	1967	1968	1969	1970	Av.An.Inc. Rate (%) 1966-1970
<u>LOAD FORECASTS (MW)</u>							
1. Installed Capacity		464	464	584	584	644	8.5
2. Firm Capacity <u>a/</u>		379	379	499	499	559	10.2
3. Annual Peak Demand		240	287	359	418	481	19.0
4. Spare Capacity (2-3)		139	92	140	81	78	-15.5
<u>ACTUAL LOAD (MW)</u>							
5. Installed Capacity	344	464	464	464	584	644	8.5
6. Average available capacity	318	413	349	392	463	523	6.1
7. Annual Peak Demand	192	223	248	283	320	377	14.0
8. Average spare capacity (6-7)	126	190	101	109	143	146	-6.8
9. Effective-Peak Capacity <u>b/</u>	221	286	310	367	379	455	12.3
10. Effective-Peak Demand <u>b/</u>	177	208	238	266	299	346	13.6
11. Effective-Peak Spare Capacity (9-10)	44	78	72	101	80	109	8.7
<u>LOAD FORECAST ACCURACY c/</u>							
12. Firm Capacity		92	108	127	108	107	
13. Annual Peak Demand		108	116	127	131	128	
14. Spare Capacity		73	91	128	57	53	
<u>SALES FORECASTS (Gwh)</u>							
15. Gross Generation		1207	1374	1642	1911	2123	15.1
16. Sales: Residential <u>d/</u>		451	478	505	534	565	5.8
17. Public Lighting		20	22	23	25	26	6.8
Industrial Use <u>e/</u>		586	702	909	1113	1267	21.3
Total		1057	1202	1437	1672	1858	15.1
<u>ACTUAL SALES (Gwh)</u>							
17. Gross Generation	1047	1236	1424	1639	1876	2206	15.6
18. Sales: Residential <u>d/</u>	424	471	496	518	567	638	7.9
Public Lighting	18	21	23	26	28	31	10.2
Industrial Use <u>e/</u>	470	583	720	903	1058	1273	21.6
Total	912	1075	1239	1447	1653	1942	15.9
<u>SALES FORECAST ACCURACY c/</u>							
19. Gross Generation		98	96	100	102	96	
20. Sales: Residential		96	96	97	94	89	
Industrial Use		101	97	101	105	100	
Total		98	97	99	101	96	
<u>RETURN FORECAST (S \$ mln)</u>							
21. Operating Revenues <u>f/</u>		75.8	88.6	100.7	113.1	123.0	12.9
22. less: Operating Costs <u>g/</u>		56.9	59.2	66.0	74.8	81.8	9.5
23. Operating Income		18.9	29.4	34.7	38.3	41.2	21.0
24. Financial Rate of Return on Average Net Fixed Assets in Operation (%)		6.1	8.4	8.8	8.6	8.8	
<u>ACTUAL RETURN (S \$ mln)</u>							
25. Operating Revenues <u>f/</u>	67.6	76.6	89.6	102.6	115.1	131.9	14.6
26. less: Operating Costs <u>g/</u>	53.7	53.9	60.3	62.3	67.3	70.5	6.9
27. Operating Income	13.9	22.7	29.3	40.3	47.8	61.4	28.0
28. Financial Rate of Return on Average Net Fixed Assets in Operation (%)	6.1	7.2	9.3	12.4	12.8	14.5	
<u>RETURN FORECAST ACCURACY c/</u>							
29. Operating Revenues		99	99	98	98	93	
30. Operating Costs		105	98	106	111	116	
31. Operating Income		83	100	86	80	67	

- a/ Installed capacity less 1-60 MW and 1-25 MW units out of commission for inspection and overhaul.
- b/ Effective Peak: critical time in year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).
- c/ Defined by the ratio: Forecast/Actual.
- d/ Lighting and fans, and domestic power.
- e/ Commercial and Industrial, and Large Industrial power.
- f/ Total Revenues of the Department, not including indirect taxes.
- g/ Including depreciation and direct taxation on utility, but excluding interest.

SINGAPORE PUBLIC UTILITY BOARD - ELECTRICITY DEPARTMENT

TABLE II-A.3

LOAN 503-SI (July, 1967)

	1965	1966	1967	1968	1969	1970	1966-1970
<u>LOAD FORECASTS (MW)</u>							
1. Installed Capacity		464	464	584	557	617	7.4
2. Firm Capacity ^{a/}		379	379	499	472	532	8.8
3. Annual Peak Demand		223	281	331	383	440	18.4
4. Spare Capacity (2-3)		156	98	168	89	92	-14.1
<u>ACTUAL LOAD (MW)</u>							
5. Installed Capacity	344	464	464	464	584	644	8.5
6. Average available capacity	318	413	349	392	463	523	6.1
7. Annual Peak Demand	192	223	248	283	320	377	14.1
8. Average spare Capacity (6-7)	126	190	101	109	143	146	-6.8
9. Effective-Peak Capacity ^{b/}	221	286	310	367	379	455	12.3
10. Effective-Peak Demand ^{b/}	177	208	238	266	299	346	13.6
11. Effective-Peak Spare Capacity (9-10)	44	78	72	101	80	109	8.7
<u>LOAD FORECAST ACCURACY^{c/}</u>							
12. Firm Capacity		92	108	127	102	102	
13. Annual Peak Demand		100	113	117	120	117	
14. Spare Capacity		82	97	154	62	63	
<u>SALES FORECASTS (GWh)</u>							
15. Gross Generation		1223	1394	1668	1919	2153	15.2
16. Sales: Residential ^{d/}		470	501	534	570	608	6.7
Public Lighting		21	23	25	26	28	7.5
Industrial Use ^{e/}		580	702	909	1093	1259	21.0
Total		1071	1227	1468	1689	1895	15.3
<u>ACTUAL SALES (GWh)</u>							
17. Gross Generation	1047	1236	1424	1639	1876	2206	15.6
18. Sales: Residential ^{d/}	424	471	496	518	567	638	7.9
Public Lighting	18	21	23	26	28	31	10.2
Industrial Use ^{e/}	470	583	720	903	1058	1273	21.6
Total	912	1075	1239	1447	1653	1942	15.9
<u>SALES FORECAST ACCURACY^{c/}</u>							
19. Gross Generation		99	98	102	102	98	
20. Sales: Residential		100	101	103	100	95	
Industrial Use		99	97	101	103	99	
Total		100	99	101	102	98	
<u>RETURN FORECAST (S \$ mln)</u>							
21. Operating Revenues ^{f/}		77.7	91.4	104.7	117.3	129.1	13.5
22. less: Operating Costs ^{g/}		52.4	59.5	67.9	75.6	85.6	13.1
23. Operating Income		25.3	31.9	36.8	41.7	43.5	14.5
24. Financial Rate of Return on Average Net Fixed Assets in Operation (%)		8.2	9.0	9.8	9.7	8.9	
<u>ACTUAL RETURN (S \$ mln)</u>							
25. Operating Revenues ^{f/}	67.6	76.6	89.6	102.6	115.1	131.9	14.6
26. less: Operating Costs ^{g/}	53.7	53.9	60.3	62.3	67.3	70.5	6.9
27. Operating Income	13.9	22.7	29.3	40.3	47.8	61.4	28.0
28. Financial Rate of Return on Average Net Fixed Assets in Operation (%)	6.1	7.2	9.3	12.4	12.8	14.5	
<u>RETURN FORECAST ACCURACY^{c/}</u>							
29. Operating Revenues		101	102	102	102	98	
30. Operating Costs		97	99	109	112	121	
31. Operating Income		111	109	91	87	71	

^{a/} Installed Capacity less 1-60 MW and 1-25 MW units out of commission for inspection and overhaul.

^{b/} Effective Peak: the critical time in year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

^{c/} Defined by the ratio: Forecast/Actual.

^{d/} Lighting and fans, and domestic power.

^{e/} Commercial and Industrial, and Large Industrial Power.

^{f/} Total Revenues of the Department, excluding indirect taxes.

^{g/} Including depreciation and direct taxation on utility, but excluding interest.

SINGAPORE PUBLIC UTILITY BOARD - ELECTRICITY DEPARTMENT
 UTILITY INVESTMENT PROGRAMS PARTLY FINANCED BY IBRD (U.S. \$ Million)

TABLE II-B

	LOAN 337-SI (1963) PERIOD 1963-1966				LOAN 473-SI (1966) PERIOD 1966-1970				LOAN 503-SI (1967) PERIOD 1967-1970			
	FORECAST		ACTUAL		FORECAST		ACTUAL		FORECAST		ACTUAL	
	Total	% of total	Total	% of total	Total	% of total	Total	% of total	Total	% of total	Total	% of total
<u>SOURCES OF FUNDS</u>												
1. Net Internal Cash Generation	28.50	64	23.20	35	45.17	43	50.18	39	35.49	37	45.36	43
2. Domestic Contribution:												
from public sector ^{a/}	-		19.63	31	35.30	34	10.66	8	29.33	31	5.66	5
from private sector	.80	2	1.61	2	2.02	2	3.23	3	1.23	1	2.71	3
Total	.80	2	21.24	33	37.32	36	13.89	11	30.56	32	8.37	8
3. Foreign Borrowing:												
Suppliers Credits ^{b/}	-		.03	-	7.83	8	22.33	18	10.10	11	22.30	21
IBRD	15.01	34	20.70	32	13.49	13	40.79	32	18.78	20	30.67	28
Total	15.01	34	20.73	32	21.32	21	63.12	50	28.88	31	52.97	49
4. Total Sources	44.31	100	65.17	100	103.81	100	127.19	100	94.93	100	106.70	100
<u>APPLICATIONS OF FUNDS</u>												
5. Total Fixed Investments	43.30	98	68.43	105	98.99	95	103.74	82	89.45	94	87.38	82
6. Changes in Working Capital and Net Cash Accrual	1.01	2	-3.26	5	4.82	5	23.45	18	5.48	6	19.32	18
7. Total Applications	44.31	100	65.17	100	103.81	100	127.19	100	94.93	100	106.70	100
8. Debt Service	16.57		18.06		41.62		48.85		43.09		42.51	

	Terms of Loans:	Interest (%)	Amortization (yrs)
a/	Government loans	5 3/4	20
b/	Suppliers credits	6	3 - 15

SINGAPORE PUBLIC UTILITY BOARD-ELECTRICITY DEPARTMENT

TABLE III

I.B.R.D. PROJECTS IMPLEMENTATION

		Start Construct.	Commis-sioning Date	Construct. Period (months)	Project Scope	CONSTRUCTION COST (US\$ million)			COST/KW US\$
						L.C.	F.X.	Total	
<u>LOAN 337-SI (US\$ 15 million)</u> (Signed May 1963)									
Pasir Panjang "B" Station 1st Stage	Forecast	Jan. 1963	May 1965	29	2x60 MW Thermal	6.48	15.08	21.56	179.7
	Actual	Jan. 1963	Jul. 1965	31	2x60 MW	6.57	13.59	20.16	168.0
<u>LOAN 473-SI (US\$ 10 million)</u> (Signed Nov. 1966)									
Pasir Panjang "B" Station 2nd Stage	Forecast	Oct. 1964	Oct. 1966	24	2x60 MW Thermal	3.00	10.00	13.00	108.3
	Actual	Oct. 1964	Dec. 1966	26	2x60 MW	3.30	9.56	12.86	107.2
<u>LOANS 337-SI & 473-SI</u> (US\$ 15 mln and US\$ 10 mln)									
Total Pasir Panjang "B" Station	Forecast	Jan. 1963	Oct. 1966	46	4x60 MW Thermal	9.48	25.08	34.56	144.0
	Actual	Jan. 1963	Dec. 1966	48	4x60 MW	9.47	23.55	33.02	137.5
<u>LOAN 503-SI (US\$ 23 million)</u> (Signed July 1967)									
Distribution System Expansion	Forecast	1967-1968	program	24	232 km & 430MVA	10.0	14.30	24.30	104.7
	Actual	1966-1969	program	24	315 km & 432MVA	6.06	13.08	19.14	60.8

COST/Km (US\$ 000's)

PROJECTS NOT COVERED BY IBRD LOANS

Jurong Thermal Station	Actual	Sept. 1967	Apr. 1971	40	4x60 MW Thermal	11.92	24.09	36.01	150.0
<i>Distribution Expansion</i>	<i>Actual</i>	<i>1966-1967</i>	<i>program</i>	<i>24</i>	<i>205 km & 543MVA</i>	<i>2.58</i>	<i>9.83</i>	<i>12.41</i>	<i>60.5</i>

LOAN DISBURSEMENT PATTERN

LOAN	Forecast:	Amount (US\$ mln)	1963	1964	1965	1966	1967	1968	1969	1970	Undisbursed 12/31/70	1971
			% of Total	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total			
LOAN 337-SI	Forecast:	Amount (US\$ mln)	2.13	10.31	2.15	.41						
		% of Total	14.2	68.8	14.3	2.7						
		Cumulative %	14.2	83.0	97.3	100.0						
	Actual:	Amount (US\$ mln)	.24	7.91	2.19	2.68	1.38					6.8
		% of Total	1.7	54.9	15.2	18.6	9.6					
		Cumulative %	1.7	56.6	71.8	90.4	100.0					
LOAN 473-SI	Forecast:	Amount (US\$ mln)			9.39	.61						
		% of Total			93.9	6.1						
		Cumulative %			93.9	100.0						
	Actual:	Amount (US\$ mln)			7.57	1.59	.84					5.8
		% of Total			75.7	15.9	8.4					
		Cumulative %			75.7	91.6	100.0					
LOAN 503-SI	Forecast:	Amount (US\$ mln)				5.94	7.37	1.70				
		% of Total				39.6	49.1	11.3				
		Cumulative %				39.6	88.7	100.0				
	Actual:	Amount (US\$ mln)					4.87	4.34	4.42			0.13
		% of Total					32.5	28.9	29.5			1.24
		Cumulative %					32.5	61.4	90.9			8.3

1.24
8.3
99.2

Project scope is Megawatts (MW) of installed capacity and source of energy in the case of Generation projects, and kilometers of lines erected (6.6 kv, 22 kv, 66 kv) and MVA capacity of substations in the case of distribution items. For comparative purposes only. Canceled.

DEB 5

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CHAPTER VIII - PUB - SINGAPORE

I. Introduction

1.01 The Public Utilities Board of Singapore is an autonomous public corporation solely responsible for the electricity, water and gas utilities of Singapore. It was established on May 1, 1963 by the Public Utilities Ordinance of 1963 as a body corporate with a perpetual concession. Although a single financial entity, it is required to keep three separate accounts for its Electricity, Water and Gas Departments.

1.02 The installed capacity of the Electricity Department increased more than four times from 150 MW in 1958 to 644 MW by the end of 1970, of which 240 MW were financed by IBRD; electricity generation has been entirely thermal from the three main stations called Pasir Panjang A, Pasir Panjang B and Jurong. There is no significant transmission system and power is distributed at 66 kv, 22 kv and 6.6 kv through mainly underground networks.

1.03 Singapore has long been, and still is, basically a trading community. A structural change in the economy is in progress; manufacturing for both home and export markets is presently the leading growth sector. Production in steel, textiles, metal fabricating and electronics has developed at an increasing rate during the last years; the electrical load growth in this sector is expected to compensate rapidly for the loss of demand resulting from the withdrawal of the British forces from the island during 1971 and 1972. The per capita gross

national product reached an estimated US\$ ⁹⁰⁰~~700~~ per annum in ¹⁹⁷⁰1968.

1.04 Singapore has no natural fossil fuel resources of its own, but it is located near an area (Indonesia) with large resources of oil and natural gas. Three oil refineries, two of them located on adjacent islets, are already established in Singapore. These refineries are presently the PUB's largest consumers of electricity.

II. The Association Between the Bank and the Board

2.01 The PUB received five loans from the Bank totalling US\$ 75.3 million equivalent, of which US\$ 60.5 million were for power.

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln)		Interest	Period (years)	
				Committed	Disbursed a/		Grace	Term
337 SI	5/63	12/63	5/67	15.00	14.40 b/	5.5%	3	20
405 MA (water)	2/65	2/65		6.80	6.80 b/	5.5%		
473 SI	11/66	11/66	6/68	10.00	9.50 b/	6%	1	20
503 SI (power)	7/67	7/67	12/71	15.00	13.63 14.9	6%	3	20
(water)	7/67	7/67	12/72	8.00	5.80 5.80	6%	5	20
595 SI	4/69	6/69	9/72	<u>20.50</u>	11.46 16.7	6.5%	3-1/2	20
Total				<u>75.3</u>	<u>68.10</u>			

a/ As of December 31, 1970 1

b/ The difference between the amount shown in this column and the amount shown in the preceding commitments column was cancelled.

The first two loans 337 and 473 SI were made for the Pasir Panjang B thermal station (4 x 60 MW), the third loan 405 MA for water supply, and the last two loans 503 and 595 SI mainly for expansion of electricity distribution.

2.02 Prior to the establishment of the PUB, the electricity, water and gas undertakings supplying the island were owned and operated by the City Council. The Government decided in 1959 to disband the Council and transfer these departments to a Public Utilities Board, which was established in 1963 by the Public Utilities Ordinance; the various public utility undertakings, together with all related functions, services, assets, and liabilities, were transferred from the Singapore City Council to the PUB. The organizations, duties, responsibilities and powers of the PUB as prescribed in the Ordinance were established prior to the first power loan in consultation with the Bank. The Bank was concerned that the PUB would lack sufficient freedom in the appointment and control of its staff and in some aspects of its operations, requiring Government approval. The draft was amended with the Government's agreement and the provisions of the Ordinance have been generally satisfactory.

2.03 Loan 337 SI was made in May 1963, under the guaranty of the U. K., to the state of Singapore which in turn relented it to PUB. The project financed by the Bank was the first stage of the Pasir Panjang B thermal station (P.P.B.) with an initial installed capacity of 120 MW.

The station was designed for an ultimate capacity of 240 MW, many features being suitable for the ultimate capacity. It was expected to be completed by May 1965. At the Bank's request, the Government gave assurances that the Board would use its best efforts to:

- a) recruit a competent and experienced General Manager;
- b) retain the services of experienced staff then holding key positions in the departments transferred to it;
- c) promptly fill any vacancies in such positions with qualified staff.

The Government also gave assurances to cause the accounts of the PUB to be regularly audited by independent auditors at least once a year and recognized the imperative need to organize the accounting system of the PUB in accordance with sound commercial accounting practices and to recruit additional qualified personnel required for this purpose. In addition, a ^{supplementary} ~~side~~ letter was obtained from the Government on a rate covenant requiring a minimum return of 8% on the Board's total net fixed assets in operation.

2.04 In August 1964 the PUB started the construction of the second stage of the Pasir Panjang B station and applied for a loan covering it. However, the position of General Manager was held by a civil servant and this temporary measure had proved unsatisfactory. The Bank delayed consideration of a second loan and expressed also its concern regarding both the number of senior posts then vacant in the Electricity Department and the delay in reorganizing the PUB's accounting system.

After discussions of the problem with PUB and the Government, the Bank proposed that PUB engage a firm of management consultants to make a comprehensive study of the organization and to prepare recommendations aimed at improving PUB's efficiency. The PUB and the Government agreed in early 1965 to the proposal and the foreign exchange cost of the consultants' services was included in the Water Supply loan 405 MA (1965). The consultants' report was submitted in October 1965, but consideration of its recommendations was deferred until a General Manager acceptable to the Bank was appointed in July 1966. The second stage of the P.P.B. station was financed in 1964-1966 by Government loans and temporary overdrafts on commercial banks.

2.05 The Bank made the second power loan, 473 SI, in November 1966, to cover the foreign exchange expenditures which had been incurred during the 120 MW expansion of the Pasir Panjang B station which was then almost completed. The loan was made to the PUB itself under the guaranty of the Government. Assurances were obtained from the Board that:

- a) it would consult the Bank before replacing the Chief Finance Officer who was about to retire and before making subsequent appointments to this post and to the post of General Manager and Chief Electrical Engineer;
- b) the reorganization of the accounting system would be completed "as soon as possible";
- (c) it would consult the Bank regularly on the actions

to be taken on the recommendations of the management consultants. The Government, prior to negotiations, had agreed with PUB to cancel partly the increase in fuel and property taxes imposed on PUB in 1965 and 1966, so that the Board would be able to achieve a minimum return of 8% for 1967 and onwards.

2.06 High voltage transmission has been up to now unnecessary in Singapore, and until 1963 power was transmitted at 22 kv from the generators to main step-down substations where it was connected for distribution over the 6.6 kv primary distribution system. With the increase in load density this arrangement grew inadequate and a 66 kv network to connect the main distribution centers with the generating stations was developed while the 22 kv network was largely converted to supplement the primary distribution. The Bank made in July 1967 a loan, 503 SI, to cover, in addition to a water supply project, the foreign exchange costs of a power project consisting of the expansion of the distribution system during the two-year period 1967-68, representing the first half of a program which the PUB had devised for the four years 1967-70 to meet the load growth forecast for that period. This expansion program was planned and designed by the PUB, seeking the advice of consultants with respect to particular problems. During negotiations for the loan, the Board agreed to continue the covenants adopted in the previous loans regarding maintaining tariffs sufficient to give an overall return of at least 8% per annum and consultations with the Bank before the appointment of senior officers. Moreover, following the Bank's recommendation,

the Board agreed to engage consultants to review:

- a) its tariff structure which had been inadequately spread over the whole range of consumers and needed rationalization and simplification; and
- b) the basic distribution development program, given the fact that the load density would continue to increase markedly and that a system voltage higher than 66 kv might become necessary in the early 1970's.

2.07 Consulting firms were engaged to undertake the tariff structure review and the study of the basic distribution development program. *A first* ~~The~~ report on the tariff structure was submitted in May 1968, recommending the elimination of the two-meter system of the PUB and the replacement of the existing eight main tariffs with four tariffs; these recommendations were examined by the PUB with little action at that time. The other consultants' preliminary report on long-term system development was submitted in February 1969, and its recommendations were accepted by the PUB. The Bank made its fourth power loan, 595 SI, to the PUB in April 1969 to cover part of the foreign exchange cost of the expansion of the distribution system for the three-year period 1969-1971, excluding the carry-over from the 1967-1968 program which was partly financed from Bank loan 503 SI of 1967. This program had been revised to include the additional work recommended in the consultants' report. The covenants adopted in the previous loans regarding the appointment of senior officers and the rate of return were repeated; moreover, the Board gave assurances

that:

- a) immediate steps would be taken to appoint a Commercial Engineer (to supervise the introduction of the proposed new tariffs), a Planning and Development Engineer, and a Load Dispatch Engineer;
- b) the PUB would consult with the Bank in regard to the actions it proposed to take on the consultants' recommendations on network development;
- c) tariffs revised substantially in accordance with the recommendations contained in the consultants' report would be introduced within three years from the date of the loan agreement.

2.08 The General Manager did not apply for a renewal of his contract which expired in July 1969 and the Chief Electrical Engineer resumed as acting General Manager. The PUB then applied for a fifth Bank loan to cover part of the foreign exchange cost of the extension of the Jurong Power station with two units of 120 MW each; the first stage of this station had comprised four 60 MW sets financed by supplier credits. Appraisal of the project took place in December 1969, and negotiations in May 1970. During negotiations, the covenants of the previous loan were adopted and agreement was reached on the need to appoint as soon as possible a Load Dispatch Engineer, a Commercial Engineer and a Statistician; the Bank proposed three alternative solutions to the problem of top management, requiring that it be solved before December 31, 1970. In January 1971, the Bank decided to drop the loan because PUB did not find a solution along any of the three proposed alternative lines and because it considered it unreasonable to present the loan to the Executive Directors beyond the end of the calendar year 1970.

III. The Formal Management Problem of the PUB

3.01 The Ordinance establishing the Board in 1963 provided for the existing staff previously operating under the City Council to be transferred to PUB. This enabled the utilities to be operated without interruption, but with difficulty due to a shortage of experienced senior staff. When the first loan was made (1963), a person suitable for appointment as General Manager was not available locally and previous efforts by the Government to recruit such a person overseas had been unsuccessful.

3.02 With the appointment of a General Manager from Singapore in 1966, it was hoped that the Chairman and the Board, who had necessarily assumed the administrative responsibilities, would allow the General Manager to exercise his duties and responsibilities. This, however, did not take place due to the Chairman's inability to delegate and to the Board's lack of confidence in the General Manager. Additional maintenance and operating staff were still urgently required by the end of 1966 and arrangements were made to train PUB staff overseas. Moreover, the organizational changes recommended in the report submitted by the management consultants in 1965 were slow due to the poor staff relations and more particularly to the continuing shortage of experienced staff. But some progress was achieved. Training was put under the direct authority of the General Manager and designed to yield rapid results and improve gradually the staff situation, particularly in the Electricity Department where the replacement of expatriates by not fully experienced local personnel had led to a chronic shortage of competent senior staff. (In

particular it was necessary to retain the services of engineers of the firms which manufactured the boilers of the Pasir Panjang B station to ensure proper supervision and maintenance). The Electricity Department was reorganized to include a planning division and a local dispatching section; a Budget Officer was appointed and management reporting greatly improved.

3.03 The Board's independent auditors, which were appointed as required by loan 337 SI (1963), reviewed PUB's accounting system and were assisting PUB's staff to implement the changes which they had recommended to reorganize the system along sound lines; the 1966 annual report presented the accounts for the first time on a commercial basis properly reflecting operating costs and depreciation charges.

3.04 The lack of clear and effective management resulted in a lack of coordination between the various departments and poor staff relations; due to the Board's lack of confidence, the General Manager indicated that he would not apply for a renewal of his contract which expired in July 1969. Notwithstanding some progress due to the training program, the staff shortage persisted, delaying further organizational changes, and was aggravated by the need to staff new sections such as the Planning and Load Dispatch Sections and the new Jurong Thermal station which was partially commissioned in 1969. The Board had also tried without success to replace the Chief Financial Officer who retired in 1967, but the former Chief Accountant who had been acting as Chief Financial Of-

ficer was then permanently appointed to the post. After the General Manager had decided to leave, the post was advertised world-wide; this action was unsuccessful due mainly to the low level of the salary offered for this important post. The former Chief Electrical Engineer of the PUB acted as General Manager but the Chairman and the Board were still undertaking the overall administrative responsibilities.

3.05 During the 1970 negotiations between the Bank and the Board for a further loan, no acceptable solution was found to the problem of top management. The Bank insisted on the creation of the post of Deputy General Manager to be groomed for the post of General Manager since the acting General Manager was expected to reach retirement age within about three years; the PUB rejected this idea on the ground that it would impair morale among the top executives of the PUB. In view of the ability of the part-time Chairman of the Board, the Bank suggested also to the Government that it recognize the existing situation in which the Chairman was in effect the Chief Executive of the PUB and appoint him as full-time Chairman with proper salary and remuneration. This suggestion was adopted by the Government, but failed because the Chairman made exorbitant salary demands in view of the Bank's expression of confidence in him. At the same time the acting General Manager left Singapore.

3.06 After the Bank decided early in 1971 not to go ahead with the new loan, the PUB indicated that a new Chairman had been appointed to

its Board, that a Statistician was recruited and that two of its Engineers had been sent overseas for training as Commercial Engineer and Load Dispatch Engineer respectively with a view to filling these appointments by mid-1971. The post of General Manager with a relatively more attractive salary was again advertised world-wide and numerous applications received; *none of the applicants, however, were acceptable to PUB.*

IV. Demand Forecasting and Investment Planning

4.01 It has been the practice of the PUB to do distribution planning and design itself (seeking the advice of consultants with respect to particular problems), and to employ consultants to plan, design, and supervise the construction of its thermal generating plants. The Bank has used in its reports the forecasts made by the PUB or its consultants without significant modifications; these forecasts generally cover six-year periods.

4.02 The annual peak-demand on the PUB electrical network had increased over the period 1958-1962 by 7.1% p.a. on the average, reaching 139 MW in 1962; the actual effective-peak^{1/} spare capacity had been 13 MW in 1960 and 35 MW in 1962. The projections made for the first loan (1963) covered the period 1963-1968 and forecast an average increase of the annual peak-demand by 9.8% p.a. (Table II-A.1). Planning for addi-

^{1/} Effective-peak: critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

(27 MW in 1964 and 120 MW in 1965)

tional capacity was based on the concept of firm capacity (installed capacity less the capacity of the largest unit in each plant in service). According to the forecast, the firm capacity reserve would have grown from 16 MW in 1963 to about 70 MW in 1968, with a minimum of 7 MW in 1964 (these figures including 30 MW spinning reserve ^{obtained by} ~~resulting from~~ operating two 60 MW units ^{close to} ~~at~~ ^{most efficient} their ^{about} optimal rating of (80%). The annual peak-demand actually grew by 13.4% p.a. on the average. ^{To keep abreast of this higher growth rate} ~~However,~~ more capacity ^{(120 MW in 1965 and 120 MW in 1966), but} was installed than forecast ~~and~~ in larger increments than the increase in the demand; as a result, the average spare capacity as well as the actual effective-peak spare capacity were always higher than forecast. The growth of total sales (Gwh) was also underestimated, in particular that of industrial sales which increased substantially after 1965 when large chemical and other industries were established in the Jurong industrial estate.

4.03 Although the forecasts for large industrial consumers, prepared by the Electricity Department, had been scaled down, the annual peak-demand was expected in the second appraisal report (1966) to grow on average by 19% p.a. over the period 1966-1970 (Table II-A.2). Total sales forecasts were in line with actual sales, but the load factor ^{rose} ~~increased~~ much higher than forecast (0.67 as against 0.50, in 1970), so that the peak-demand grew along the past trends at 14% p.a. on average and was in 1970 100 MW less than expected. The firm capacity reserve was expected to reach 140 MW in 1966 and 1968 and to decline to about 80 MW in 1969 and 1970 (these figures including 60 MW spinning reserve on the four 60 MW units). Because planning for additional capacity was based on a more conservative concept (firm capacity ^{- see para 4.04} after deducting the spinning reserve) and because the actual demand was lower than expected, the average spare capacity was

again higher than had been forecast by ~~very~~ large amounts. The forecasts made in the third appraisal report (1967) are a slightly scaled down version of those in the second, and much the same conclusions as described above apply; peak-demand in 1970 was 60 MW less than projected in 1967.

4.04 As the Singapore load has no seasonal variation, there is no period of the year when maintenance can be carried out without causing problems of availability and it therefore has to be spread uniformly throughout the year. In order to safeguard the continuity of supply in case of breakdown, according to Singapore's strategy for attracting foreign private investments and ~~related~~ legislation requiring annual ~~over-~~^{equipment} ~~hauls of equipment,~~^{inspections,} the policy stated by the PUB's Electricity Department and its consultants has been since 1965 to allow for two units (25 and 60 MW) out of service for maintenance and overhaul in addition to the 60 MW spinning reserve mentioned above. This large provision for capacity out of service was justified by the maintenance problem mentioned above and the condition of the Pasir Panjang A station where some units were long overdue for major overhaul. As a matter of fact, a substantial portion of the installed capacity, averaging 115 MW in 1967 and 120 MW in 1969 and 1970, has been out of service since 1966 for maintenance and repairs as shown in the following table by the difference between installed capacity and average capacity actually available.

<u>MW</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Installed Capacity	464	464	464	584	644
Average available capacity	413	349	392	463	523
Peak-demand	223	248	283	320	377
Reserve Capacity	190	101	109	143	146
Spinning Reserve	60	60	60	60	60
Net Spare Capacity	130	41	49	83	86

Moreover, the ^{actual} ~~amount~~ of reserve capacity (after deducting spinning reserve) during the most critical times in each year after 1965 reached about 15 MW in 1966-1967 and more than 40 MW in 1968 and again in 1970.

4.05 The large amount of capacity out of service, outgrowing the 85 MW allowance planned for it, was due to worse than average conditions; as a result of the maintenance policy followed prior to 1966, substantial capacity was taken out of service for major overhaul in P.P.A. station and for breakdowns in the P.P.B. station which contributed itself about 70% in 1967-68 and 40% in 1969-70 to the total capacity out of service. Even under these conditions, the average net spare capacity (after allowing for spinning reserve) has amounted to more than 60 MW in 1969-70. Though it is difficult to reach definitive conclusions in this matter without further investigation, it appears that there has been some over-investment since the Jurong station, not directly financed by the Bank (para. 2.08), was commissioned. The ongoing installation of two 120 MW units (with possible addition of a third) to be commissioned by 1973-74 in this station and a possible reduction of maintenance requirements could reinforce this preliminary conclusion, unless future demand grows at a much faster rate than the 14% p.a. average increase of the past four years.

V. Project Construction and Cost

Generation

5.01 The most important project financed by the Bank in the PUB's Electrical Department has been the Pasir Panjang B Thermal station with

a final capacity of 240 MW consisting of four generating units of 60 MW each. The first loan 337 SI (1963) covered the first phase of the plant erection, i.e., the major civil works and the installation of the first two units; the second power loan 473 SI (1968) provided for retroactive financing of the installation of the third and fourth units.

5.02 Construction for the first phase started in January 1963, and the first two units were commissioned in June and July 1965 respectively, two months behind schedule. The second phase was initiated in October 1964, more than two years before loan 473 SI was made, and the last two units went into operation in August and December 1966 respectively.

5.03 The cost of the first phase was slightly lower (6.5%) than expected (Table III) and the actual foreign exchange cost was US\$ 13.6 million, leaving US\$ 1.4 million savings from the loan, of which US\$ 0.8 million were withdrawn with the Bank's consent for purchasing spare parts, supervisory control equipment, and transformers. As work on site for the second phase was nearing completion at the time of the second loan appraisal, the estimated costs ^{were} ~~had been~~ very close to the actual cost of US\$ 12.86 million (1% lower than forecast), with a foreign exchange cost of US\$ 9.56 million leading to US\$ 0.44 million savings from the loan. The total cost of the whole plant reached US\$ 33 million which is equal to a unit cost of US\$ 138 per kw installed, as compared to \$144 forecast in the appraisal reports. This compares favorably

with the Jurong Thermal station, financed without Bank help, which had a total cost of US\$ 36 million, corresponding to a unit cost of US\$ 150 per kw installed.

Distribution

5.04 The power part of loan 503 SI (1967) was made to cover the US\$ 15 million foreign exchange cost of the 1967-68 expansion program of the PUB's distribution network. This program was expected to consist mainly in the installation of 232 km of cables and 430 MVA ⁱⁿ transformer capacity, with a total cost of US\$ 25 million. Due, however, to the long delays in supply of equipment from the manufacturers the major part of the loan was actually used to finance the foreign exchange cost of the 1968-69 distribution investment program; this program consisted mainly in the installation of 315 km of cables and 432 MVA transformer capacity with a total cost of US\$ 19.1 million, of which US\$ 13.1 million for foreign exchange, resulting ⁱⁿ a unit cost of US\$ 60,800/km of ~~line~~ ^{cable including transformer} (with associated sub-
~~stations~~ ^{Capacity}) as against US\$ 104,700/km forecast. Both unit costs appear *relatively* high, probably as a result of ample, if not excessive, dimensioning of the network. *designed to provide a very reliable supply (see para 4.04), and possibly to service future higher loads without large further investments.*

Procurement and Disbursement

5.05 The PUB has traditionally purchased equipment on the basis of international competitive tendering and bidding, and specifications for equipment required for all its projects have been prepared with this in view. Procurement actions which have been taken by the PUB are in accordance with the Bank's guidelines.

5.06 Disbursements were made against presentation of the usual documents evidencing expenditures of foreign exchange. In the case of re-

troactive financing (second power loan 473 SI for the second stage of the P.P.B. station) bids on an international competitive basis had been obtained for the works and all related contracts had been awarded with Bank approval.

VI. Forecasting the Financial Aspects

6.01 The financial projections made in the first appraisal report (1963) underestimated substantially the future investments to be made by the PUB during the period 1963-66. These investments were projected to be \$43.3 million, half of it for the first stage of the Pasir Panjang B station (Table II-B); the PUB actually invested \$68.4 million, half of it in both stages of Pasir Panjang B in order to meet the faster than expected load growth. Due to higher sales revenues, the rate of return on the net fixed assets in operation was higher than expected, except in 1965 and 1966 when a temporary rise in fuel and property taxes added to the operating costs (Table II-A.1).

6.02 Financing of the investments was different from the forecast for the 1963-66 period; about 65% of total funds were expected to come from net internal cash generation and the remainder from the Bank loan. Due mainly to the poor results of 1965 and 1966, net internal cash contributed only 35% to the total requirements, while foreign borrowing contributed 32% and domestic contribution was 33% (Table II-B). Because of the delay in Bank lending due to the absence of a General Manager, the expenditures incurred on the second stage of P.P.B. in 1964 and 1965

were partly financed by long-term loans from the Singapore Government and at the expense of working capital.

6.03 Total applications of funds as forecast in the second appraisal report (1966) for the period 1966-1970 were lower by 19% than the US\$ 127 million applications actually made in the same period, of which US\$ 104 million for fixed investments; the major discrepancy came from the working capital forecasts while fixed investments forecasts were off only by 4%. While net internal cash contributed about 40% to the total requirements as expected, total foreign borrowing was three times the forecast amount because of greater contributions from the suppliers and from the Bank itself; on the other hand, the Government stopped lending to PUB after 1968, reducing the domestic contribution from an expected 36% to 11% (Table II-B). Moreover, gross and net fixed assets in service, as well as the operating costs, were overestimated in the forecasts, while the sales revenues were underestimated due to the tariff increases introduced in November 1966; as a result, the rate of return on the net fixed assets was higher than expected. Forecasts made in the third appraisal report (1967) for the Electricity Department's cash flow for the period 1967-70 were similar to the previous ones; net internal cash was expected to contribute 37% to the total requirements, Government loans 31% and foreign borrowing 31%, most of it from the Bank.

6.04 There has been a strong complementarity between Government and Bank loans to PUB. During the period 1963-66, the necessity to in-

vest more than expected and the delay in Bank lending obliged the Government to make loans which were not foreseen by the Bank. Conversely, during 1966-70, the Government withdrew its aid to PUB and the Bank took over with lending in 1966, 1967 and 1969 successively; as a result, the contribution from the Bank has been considerably higher than originally foreseen.

VII. Institutional Development

The Consultants

7.01 After the installation of unsatisfactory free piston units, Messrs. Merz and McLellan became the PUB's permanent consultants in 1963 and have since been working on the planning, design and construction supervision of the new thermal generating plants of the PUB. Management consultants, R. W. Beck and Associates of Seattle, who were selected with Bank approval, made in 1965 a comprehensive study of the PUB's organization and made a large number of recommendations. *which were partly implemented (para 3.02)* According to the requirements under the first Loan Agreement (1963), the PUB engaged external auditors, Messrs. Turquand, Youngs and Co., and appointed them to make recommendations for a proper system of accounts on a commercial basis; the PUB was also assisted by its auditors in carrying out the necessary reorganization. Under the covenants of the third power Loan Agreement (1967), the PUB engaged Electro-watt of Switzerland to review the tariff structure and to determine a rate suitable for domestic service which would eliminate the Singaporean two-meter system; Electro-watt submitted its ^{first} report and recommendations in *and its final report in June 1971* April 1968. In 1968 the PUB engaged the Montreal Engineering Company Ltd. *suggested by the Bank of the basic distribution* of Canada to undertake the study ~~of the basic distribution development pro-~~

~~Development Program~~
gram suggested by the Bank and to submit recommendations for long-term system network development; the consultants' report was delivered in February 1969.

7.02 The PUB's experience with these consultants has taken various forms. The general technical consultants, Merz and McLellan of London, have not fulfilled any educational or expertise-building function within the PUB (except for some training of operating staff), and they have worked out their generation planning and design without close collaboration with PUB's staff; their terms of reference did not mention training. The quality of their planning and studies, relying on conservative methods based on a pragmatic approach, has not appeared, in the PUB's opinion, very satisfactory, because of the lack of long-range perspective and modern methodology. ~~Ongoing~~ Discussions between the PUB and these consultants

were held to
would allow the PUB to obtain adequate training and planning services in the future as well as lower fees than in the past; *The PUB engaged in 1971 Montreal Engineering Company to design its future plant (see para 7.04).* The management study made in 1965 did not *solve the formal management problem* bring very positive improvements in ~~the PUB's situation, insofar as the formal management problem is still~~

may ~~the PUB's situation, insofar as the formal management problem is still~~ *but* have contributed to the improvement of performance that has occurred, ~~unsolved.~~ Though the PUB agrees that outside views are in general helpful, its opinion on this matter is that recommendations of the consultants should have been adjusted to the local administrative and political conditions and environment, particularly with respect to the phasing in implementing these recommendations.

PUB did not implement all the recommendations of the consultants
contribute as much as it can have done to improvement, but only some because the recommendations were not implemented.

7.03 On the other hand, the reorganization of the PUB's accounting system yielded positive results, although the recommendations of the internal auditors were implemented slowly. Since 1966, accounts have been presented on a commercial basis and progressively refined; management reporting, which virtually did not exist before 1967, was geared to the new commercial system and has greatly improved, resulting in a meaningful budget control and a further improvement in the PUB's management. The PUB has been keeping separate accounts for the water, gas, electricity, and service departments. Water, gas and electricity meters are read once per month, and the bill prepared on the computer (introduced in 1964) is sent out for the three services; non-payment of a bill results in prompt cut-off of one or more of the services. This procedure works well and there is no problem concerning uncollected accounts.

7.04 Electro-watt's recommendations on electricity tariff structure were agreed upon by the PUB which is implementing them gradually and expects to complete their implementation by April 1972 as required by the last Loan Agreement (1969). Experience with the Montreal Engineering Company has been very fruitful, in the PUB's opinion. Long-range planning was introduced for the first time in the study of the ~~generation~~ and distribution development programs; though their terms of reference did not mention it, these consultants have fulfilled successfully the educational and expertise-building function, involving staff from PUB's different departments in their studies and having them work together on new

methods and approaches, thus resulting in improved staff relations and coordination between the different departments. *As mentioned above, the PUB engaged recently ~~these~~ these consultants for the design of its new power station and it is likely that they will be retained for planning of future generation expansion.*

7.05 The PUB has succeeded in increasing over time its average profit/kwh sold while reducing substantially its average price/kwh sold; this was made possible by reducing more substantially its average cost/kwh sold, as shown in the following table:

PUB: Average unit cost (US¢ per kwh sold)

	<u>1960</u>	<u>1962</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Depreciation	0.55	0.51	0.45	0.47	0.57	0.48	0.44	0.37
Administration	0.14	0.16	0.17	0.16	0.13	0.09	0.11	0.09
Fuel	0.59	0.48	0.66 ^{a/}	0.56	0.40	0.39	0.39	0.32
Other Operating Costs	<u>0.40</u>	<u>0.41</u>	<u>0.46</u>	<u>0.40</u>	<u>0.36</u>	<u>0.30</u>	<u>0.27</u>	<u>0.26</u>
Total	<u>1.68</u>	<u>1.56</u>	<u>1.74</u>	<u>1.59</u>	<u>1.46</u>	<u>1.26</u>	<u>1.21</u>	<u>1.04</u>

Decrease over the previous year of:

Fuel cost/kwh, %	(35) ^{a/}	15	29	3	-	18
due to: Fuel cost/ton, %	(30) ^{a/}	13	26	(3)	-	17
Operations Efficiency ^{b/} , %	(5)	2	3	6	-	1

a/ includes 0.15¢ for fuel tax which was exceptionally high in 1965.

b/ as reflected by the number of Fuel tons/Gwh generated and by distribution losses.

PUB's depreciation costs per unit have declined sharply, presumably mainly as a result of the larger generating units added since 1965, with lower

cost/kw installed. Fuel cost/kwh has also fallen sharply, at an average rate of some 16% p.a. over 1965-1970, of which 13% is due to decrease in fuel prices and 3% to increasing operational efficiency in thermal plants and to decreasing distribution losses.

Observance of Loan Agreements Covenants

7.06 The Bank's ordinary covenants on rate of return and long-term debt incurrence were easily observed by the PUB through the period 1963-1970 (except in 1965). These covenants actually have been less restrictive than the PUB's own Ordinance regulations drafted by the Government in 1963 with the Bank's assistance and revised after 1968. Other covenants were generally respected. Those covenants specifically designed to build up the internal management were implemented with delays, in particular the reorganization of the accounting system (337-SI) and the recruitment of specialized engineers (595-SI); ^{*the covenant relating to the latter was*} ~~but were~~ eventually fulfilled (paragraphs 7.03 and 3.06) *by promoting staff after training of about one year in Europe.*

VIII. Conclusion

8.01 The PUB's past performance has been reasonably satisfactory. After 1966, this was due, in the Bank's opinion, to the ability of the Board's Chairman rather than to the inherent strength of the PUB's management which suffered from the Chairman's apparent inability to delegate and to build up a responsible senior staff. However, the records suggest that performance was as good before 1966 as after (Table I).

8.02 On the technical side, distribution losses, averaging 7% over 1963-70, have been improving and are acceptable; the major concern has

been the maintenance operations which were insufficient before 1967 and led afterwards to substantial amounts of capacity out of service (paragraph 4.04), although without causing failure to meet the demand. The financial rate of return of the whole PUB on its average net fixed assets in operation has been steadily over 9%, except in 1965 and 1966 (4.9% and 7.4%, respectively) when fuel and maintenance taxes were temporarily increased. The financial rate of return of the Electricity Department has been higher, growing from 11.8% in 1962 to 14.5% in 1970, with a drastic fall in 1965 and 1966 when it reached 6.1% and 7.2%, respectively; it recovered, however, in 1967, reaching 9.3% that year and growing afterwards. The average cost per kwh sold decreased steadily, except in 1965 (see para. 7.05); part of the benefits of these economies was given to the customers, *essentially to the industrial customers.* Average revenue per kwh sold decreased from US¢ 2.42 in 1961 to US¢ 2.19 in 1970, less percentagewise than the unit cost because of tariff increases in 1966. The productivity of labor in the Electricity Department, defined very globally, has shown an average increase of 5.9% p.a. over the period 1960-1970, growing from 236 Mwh/per employee to 418 Mwh; The debt service coverage on an annual basis has always been higher than 2.0 (except in 1965: 1.8) with a maximum of 2.9 in 1963, and the debt/equity ratio reached a maximum of 57/43 in 1966.

8.03 The PUB's Electricity Department has been growing impressively during the last decade and operating satisfactorily on the whole. It has been gaining an increasing importance within Singapore's economy; its fixed investments have represented a significant part -- between

during the same period, the number of consumers per employee increased from 40 to 58 which, however, is still rather low.

6% and 11% -- of the country's gross fixed capital formation, and the proportion of households supplied with electricity has grown from 32% in 1960 to 70% in 1970. The quality of its services has been satisfactory and no prolonged outage was recorded during this period; new connections are made presently without unreasonable delays (two weeks to one month) except in the small rural areas, where important efforts are ^{nevertheless} being made for rural electrification. Its internal management of financial and technical operations has been built up with considerable help and guidance from the Bank and some consultants, and in recent years the PUB has been studying and planning continuously its future operations: network development, design for civil works, feasibility studies for its future stations. It envisages the erection of a nuclear plant by about 1980 (the feasibility study is being financed by the UNDP) and feels able in future years to act itself as consultant to other utilities. The PUB expects to finance from its own resources half of its future investment, and, on the basis of its creditworthiness, to borrow the other half from the Asian Development Bank, equipment suppliers, the Bank, and the Government, if necessary. Suppliers credits would be used mainly for heavy equipment; the Bank, being cheaper than suppliers for financing of smaller equipment, would be asked to finance ^{designated} ~~earmarked~~ projects of the distribution type.

Meeting with U.S. E.D. (Thursday March 22nd, 1972):

Q: [Glossy is desirable; (load shedding?)
"Ratchet" provision.]

Too much cosmetics.

C: Areas which deserve more attention: agricultural aspects; influence on urbanization, on development of industry

C: - more attention to be given to the number of people which were served by the projects.
- Comparison between these projects and other projects financed by separate agencies;
- procurement and performance of consultants and supplies.

Specific comments:

p. 4, para 1.11:

p. 13, — 2.14:

p. 22, last line of para. 3.06:

p. 35, footnote 1] Denis Anderson's paper should be distributed.

p. 46, para 5.03: 66%?

p. 49, Table 5.3: put date information before signing date.

p. 51, para 5.17: Sales participation.

p. 65, para 7.06: Bank / other foreign lenders.

p. 68, para 7.09, 5th line:

p. 69, — 7.11, : the whole para should be lengthened.

p. 76, para 7.27: Sales participations.
is it feasible?

p. 77: last sentence of para 7.28:

p. 77: para 7.29: procurement ^{not} covered is a pity.

Utility Efficiency Indicators:

Ginn's
EVERYTHING FOR THE OFFICE

C: Report is too much shortened. Need for more ample and basic information.

Ch. VIII

PUB

me

Sheehan

OFFICE MEMORANDUM

TO: Mr. Mervyn L. Weiner

DATE: March 10, 1972

FROM: Christopher R. Willoughby *CRW*

SUBJECT: Operations Evaluation Report on Power.

Following our memo dated March 7, 1972, please find attached the revised draft of the 'case' study chapter on PUB part of the Power Review.

For the reasons given previously we would appreciate it if any further comments your department might have were to reach us by Friday, March 17th.

CHAPTER VIII - PUB - SINGAPORE

I. Introduction

1.01 The Public Utilities Board of Singapore is an autonomous public corporation solely responsible for the electricity, water and gas utilities of Singapore. It was established on May 1, 1963 by the Public Utilities Ordinance of 1963 as a body corporate with a perpetual concession. Although a single financial entity, it is required to keep three separate accounts for its Electricity, Water and Gas Departments.

1.02 The installed capacity of the Electricity Department increased more than four times from 150 MW in 1958 to 644 MW by the end of 1970, of which 240 MW were financed by IBRD; electricity generation has been entirely thermal from the three main stations called Pasir Panjang A, Pasir Panjang B and Jurong. There is no significant transmission system and power is distributed at 66 kV, 22 kV and 6.6 kV through mainly underground networks.

1.03 Singapore has long been, and still is, basically a trading community. A structural change in the economy is in progress; manufacturing for both home and export markets is presently the leading growth sector. Production in steel, textiles, metal fabricating and electronics has developed at an increasing rate during the last years; the electrical load growth in this sector is expected to compensate rapidly for the loss of demand resulting from the withdrawal of the British forces from the island during 1971 and 1972. The per capita gross

Better update to 1970

national product reached an estimated US\$ 700 per annum in 1968.

1.04 Singapore has no natural fossil fuel resources of its own, but it is located near an area (Indonesia) with large resources of oil and natural gas. Three oil refineries, two of them located on adjacent islets, are already established in Singapore. These refineries are presently the PUB's largest consumers of electricity.

II. The Association Between the Bank and the Board

2.01 The PUB received five loans from the Bank totalling US\$ 75.3 million equivalent, of which US\$ 60.5 million were for power.

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln)		Interest	Period (years)	
				Committed	Disbursed a/		Grace	Term
337 SI	5/63	12/63	5/67	15.00	14.40 b/	5.5%	3	20
405 MA (water)	2/65	2/65		6.80	6.80 b/	5.5%		
473 SI	11/66	11/66	6/68	10.00	9.54	6%	1	20
503 SI (power)	7/67	7/67	12/71	15.00	13.63	6%	3	20
(water)	7/67	7/67	12/72	8.00	5.36	6%	5	20
595 SI	4/69	6/69	9/72	<u>20.50</u>	<u>11.46</u>	6.5%	3-1/2	20
Total				<u>75.3</u>	<u>61.77</u>			

a/ As of December 31, 1970

b/ The difference between the amount shown in this column and the amount shown in the preceding commitments column was cancelled.

The first two loans 337 and 473 SI were made for the Pasir Panjang B thermal station (4 x 60 MW), the third loan 405 MA for water supply, and the last two loans 503 and 595 SI mainly for expansion of electricity distribution.

2.02 Prior to the establishment of the PUB, the electricity, water and gas undertakings supplying the island were owned and operated by the City Council. The Government decided in 1959 to disband the Council and transfer these departments to a Public Utilities Board, which was established in 1963 by the Public Utilities Ordinance; the various public utility undertakings, together with all related functions, services, assets, and liabilities, were transferred from the Singapore City Council to the PUB. The organizations, duties, responsibilities and powers of the PUB as prescribed in the Ordinance were established prior to the first power loan in consultation with the Bank. The Bank was concerned that the PUB would lack sufficient freedom in the appointment and control of its staff and in some aspects of its operations, requiring Government approval. The draft was amended with the Government's agreement and the provisions of the Ordinance have been generally satisfactory.

2.03 Loan 337 SI was made in May 1963, under the guaranty of the U. K., to the state of Singapore which in turn relented it to PUB. The project financed by the Bank was the first stage of the Pasir Panjang B thermal station (P.P.B.) with an initial installed capacity of 120 MW.

The station was designed for an ultimate capacity of 240 MW, many features being suitable for the ultimate capacity. It was expected to be completed by May 1965. At the Bank's request, the Government gave assurances that the Board would use its best efforts to:

- a) recruit a competent and experienced General Manager;
- b) retain the services of experienced staff then holding key positions in the departments transferred to it;
- c) promptly fill any vacancies in such positions with qualified staff.

The Government also gave assurances to cause the accounts of the PUB to be regularly audited by independent auditors at least once a year and recognized the imperative need to organize the accounting system of the PUB in accordance with sound commercial accounting practices and to recruit additional qualified personnel required for this purpose. In addition, a side letter was obtained from the Government on a rate covenant requiring a minimum return of 8% on the Board's total net fixed assets in operation.

2.04 In August 1964 the PUB started the construction of the second stage of the Pasir Panjang B station and applied for a loan covering it. However, the position of General Manager was held by a civil servant and this temporary measure had proved unsatisfactory. The Bank delayed consideration of a second loan and expressed also its concern regarding both the number of senior posts then vacant in the Electricity Department and the delay in reorganizing the PUB's accounting system.

After discussions of the problem with PUB and the Government, the Bank proposed that PUB engage a firm of management consultants to make a comprehensive study of the organization and to prepare recommendations aimed at improving PUB's efficiency. The PUB and the Government agreed in early 1965 to the proposal and the foreign exchange cost of the consultants' services was included in the Water Supply loan 405 MA (1965). The consultants' report was submitted in October 1965, but consideration of its recommendations was deferred until a General Manager acceptable to the Bank was appointed in July 1966. The second stage of the P.P.B. station was financed in 1964-1966 by Government loans and temporary overdrafts on commercial banks.

2.05 The Bank made the second power loan, 473 SI, in November 1966, to cover the foreign exchange expenditures which had been incurred during the 120 MW expansion of the Pasir Panjang B station which was then almost completed. The loan was made to the PUB itself under the guaranty of the Government. Assurances were obtained from the Board that:

- a) it would consult the Bank before replacing the Chief Finance Officer who was about to retire and before making subsequent appointments to this post and to the post of General Manager and Chief Electrical Engineer;
- b) the reorganization of the accounting system would be completed "as soon as possible";
- (c) it would consult the Bank regularly on the actions

to be taken on the recommendations of the management consultants. The Government, prior to negotiations, had agreed with PUB to cancel partly the increase in fuel and property taxes imposed on PUB in 1965 and 1966, so that the Board would be able to achieve a minimum return of 8% for 1967 and onwards.

2.06 High voltage transmission has been up to now unnecessary in Singapore, and until 1963 power was transmitted at 22 kV ~~from the generators~~ to main step-down substations where it was connected for distribution over the 6.6 kv primary distribution system. With the increase in load density this arrangement grew inadequate and a 66 kV network to connect the main distribution centers with the generating stations was developed while the 22 kV network was largely converted to supplement the primary distribution. The Bank made in July 1967 a loan, 503 SI, to cover, in addition to a water supply project, the foreign exchange costs of a power project consisting of the expansion of the distribution system during the two-year period 1967-68, representing the first half of a program which the PUB had devised for the four years 1967-70 to meet the load growth forecast for that period. This expansion program was planned and designed by the PUB, seeking the advice of consultants with respect to particular problems. During negotiations for the loan, the Board agreed to continue the covenants adopted in the previous loans regarding maintaining tariffs sufficient to give an overall return of at least 8% per annum and consultations with the Bank before the appointment of senior officers. Moreover, following the Bank's recommendation,

the Board agreed to engage consultants to review:

- a) its tariff structure which ~~had been inadequately spread over the whole range of consumers and~~ needed rationalization and simplification; and
- b) the basic distribution development program, given the fact that the load density would continue to increase markedly and that a system voltage higher than 66 kv might become necessary in the early 1970's.

2.07 Consulting firms were engaged to undertake the tariff structure review and the study of the basic distribution development program. ^{first draft} The report on the tariff structure was submitted in May 1968, recommending the elimination of the two-meter system of the PUB and the replacement of the existing eight main tariffs with four tariffs; these recommendations were examined by the PUB with little action at that time. The other consultants' preliminary report on long-term system development was submitted in February 1969, and its recommendations were accepted by the PUB. The Bank made its fourth power loan, 595 SI, to the PUB in April 1969 to cover part of the foreign exchange cost of the expansion of the distribution system for the three-year period 1969-1971, excluding the carry-over from the 1967-1968 program which was partly financed from Bank loan 503 SI of 1967. This program had been revised to include the additional work recommended in the consultants' report. The covenants adopted in the previous loans regarding the appointment of senior officers and the rate of return were repeated; moreover, the Board gave assurances

that:

- a) immediate steps would be taken to appoint a Commercial Engineer (to supervise the introduction of the proposed new tariffs), a Planning and Development Engineer, and a Load Dispatch Engineer;
- b) the PUB would consult with the Bank in regard to the actions it proposed to take on the consultants' recommendations on network development;
- c) tariffs revised substantially in accordance with the recommendations contained in the consultants' report would be introduced within three years from the date of the loan agreement.

2.08 The General Manager did not apply for a renewal of his contract which expired in July 1969 and the Chief Electrical Engineer resumed as acting General Manager. The PUB then applied for a fifth Bank loan to cover part of the foreign exchange cost of the extension of the Jurong Power station with two units of 120 MW each; the first stage of this station had comprised four 60 MW sets financed by supplier credits. Appraisal of the project took place in December 1969, and negotiations in May 1970. During negotiations, the covenants of the previous loan were adopted and agreement was reached on the need to appoint as soon as possible a Load Dispatch Engineer, a Commercial Engineer and a Statistician; the Bank proposed three alternative solutions to the problem of top management, requiring that it be solved before December 31, 1970. In January 1971, the Bank decided to drop the loan because PUB did not find a solution along any of the three proposed alternative lines and because it considered it unreasonable to present the loan to the Executive Directors beyond the end of the calendar year 1970.

III. The Formal Management Problem of the PUB

3.01 The Ordinance establishing the Board in 1963 provided for the existing staff previously operating under the City Council to be transferred to PUB. This enabled the utilities to be operated without interruption, but with difficulty due to a shortage of experienced senior staff. When the first loan was made (1963), a person suitable for appointment as General Manager was not available locally and previous efforts by the Government to recruit such a person overseas had been unsuccessful.

3.02 With the appointment of a General Manager from Singapore in 1966, it was hoped that the Chairman and the Board, who had necessarily assumed the administrative responsibilities, would allow the General Manager to exercise his duties and responsibilities. This, however, did not take place due to the Chairman's inability to delegate and to the Board's lack of confidence in the General Manager. Additional maintenance and operating staff were still urgently required by the end of 1966 and arrangements were made to train PUB staff overseas. Moreover, the organizational changes recommended in the report submitted by the management consultants in 1965 were slow due to the poor staff relations and more particularly to the continuing shortage of experienced staff. But some progress was achieved. Training was put under the direct authority of the General Manager and designed to yield rapid results and improve gradually the staff situation, particularly in the Electricity Department where the replacement of expatriates by not fully experienced local personnel had led to a chronic shortage of competent senior staff. (In

particular it was necessary to retain the services of engineers of the firms which manufactured the boilers of the Pasir Panjang B station to ensure proper supervision and maintenance). The Electricity Department was reorganized to include a planning division and a local dispatching section; a Budget Officer was appointed and management reporting greatly improved.

3.03 The Board's independent auditors, which were appointed as required by loan 337 SI (1963), reviewed PUB's accounting system and were assisting PUB's staff to implement the changes which they had recommended to reorganize the system along sound lines; the 1966 annual report presented the accounts for the first time on a commercial basis properly reflecting operating costs and depreciation charges.

3.04 The lack of clear and effective management resulted in a lack of coordination between the various departments and poor staff relations; due to the Board's lack of confidence, the General Manager indicated that he would not apply for a renewal of his contract which expired in July 1969. Notwithstanding some progress due to the training program, the staff shortage persisted, delaying further organizational changes, and was aggravated by the need to staff new sections such as the Planning and Load Dispatch Sections and the new Jurong Thermal station which was partially commissioned in 1969. The Board had also tried without success to replace the Chief Financial Officer who retired in 1967, but the former Chief Accountant who had been acting as Chief Financial Of-

ficer was then permanently appointed to the post. After the General Manager had decided to leave, the post was advertised world-wide; this action was unsuccessful due mainly to the low level of the salary offered for this important post. The former Chief Electrical Engineer of the PUB acted as General Manager but the Chairman and the Board were still undertaking the overall administrative responsibilities.

3.05 During the 1970 negotiations between the Bank and the Board for a further loan, no acceptable solution was found to the problem of top management. The Bank insisted on the creation of the post of Deputy General Manager to be groomed for the post of General Manager since the acting General Manager was expected to reach retirement age within about three years; the PUB rejected this idea on the ground that it would impair morale among the top executives of the PUB. In view of the ability of the part-time Chairman of the Board, the Bank suggested also to the Government that it recognize the existing situation in which the Chairman was in effect the Chief Executive of the PUB and appoint him as full-time Chairman with proper salary and remuneration. This suggestion was adopted by the Government, but failed because the Chairman made exorbitant salary demands in view of the Bank's expression of confidence in him. At the same time the acting General Manager left Singapore.

3.06 After the Bank decided early in 1971 not to go ahead with the new loan, the PUB indicated that a new Chairman had been appointed to

its Board, that a Statistician was recruited and that two of its Engineers had been sent overseas for training as Commercial Engineer and Load Dispatch Engineer respectively with a view to filling these appointments by mid-1971. The post of General Manager with a relatively more attractive salary was again advertised world-wide and numerous applications received. *None of the applicants were acceptable to PUB.*

IV. Demand Forecasting and Investment Planning

4.01 It has been the practice of the PUB to do distribution planning and design itself (seeking the advice of consultants with respect to particular problems), and to employ consultants to plan, design, and supervise the construction of its thermal generating plants. The Bank has used in its reports the forecasts made by the PUB or its consultants without significant modifications; these forecasts generally cover six-year periods.

4.02 The annual peak-demand on the PUB-electrical network had increased over the period 1958-1962 by 7.1% p.a. on the average, reaching 139 MW in 1962; the actual effective-peak^{1/} spare capacity had been 13 MW in 1960 and 35 MW in 1962. The projections made for the first loan (1963) covered the period 1963-1968 and forecast an average increase of the annual peak-demand by 9.8% p.a. (Table II-A.1). Planning for addi-

^{1/} Effective-peak: critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

(60MW in 1965 and 60MW in 1966)

tional capacity was based on the concept of firm capacity (installed capacity less the capacity of the largest unit in each plant in service).

According to the forecast, the firm capacity reserve would have grown from 16 MW in 1963 to about 70 MW in 1968, with a minimum of 7 MW in

1964 (these figures including 30 MW spinning reserve resulting from operating two 60 MW units at their ^{most efficient} ~~optimal~~ rating of 80%).

The annual peak-demand actually grew by 13.4% p.a. on the average. However, ^{To keep abreast of this higher growth rate} more capacity

was installed than forecast, and in larger increments than the increase in the demand; as a result, ^(to total 120MW in 1965 and 120MW in 1966) the average spare capacity as well as the actual

effective-peak spare capacity were always higher ^{than forecast} ~~than forecast~~. The growth

of total sales (GWh) was also underestimated, in particular that of industrial sales which increased substantially after 1965 when large chemical

and other industries were established in the Jurong industrial estate.

4.03 Although the forecasts for large industrial consumers, prepared by the Electricity Department, had been scaled down, the annual peak-demand

was expected in the second appraisal report (1966) to grow on average by 19% p.a. over the period 1966-1970 (Table II-A.2). Total sales forecasts

were in line with actual sales, but the load factor increased much higher than forecast (.67 as against .50, in 1970), so that the peak-demand grew

along the past trends at 14% p.a. on average and was in 1970 100 MW less than expected. The firm capacity reserve was expected to reach 140 MW

in 1966 and 1968 and to decline to about 80 MW in 1969 and 1970 (these figures including 60 MW spinning reserve on the four 60 MW units). Be-

cause planning for additional capacity was based on a more conservative ^(see § 4.04) concept (firm capacity after deducting the spinning reserve) and because

the actual demand was lower than expected, the average spare capacity was

Attention: this over-estimate is an appraisal

15/1962

the earlier

(see § 4.04)

again higher than had been forecast by ~~very~~ ^{substantial} large amounts. The forecasts made in the third appraisal report (1967) are a slightly scaled down version of those in the second, and much the same conclusions as described above apply; peak-demand in 1970 was 60 MW less than projected in 1967.

4.04 As the Singapore load has no seasonal variation, there is no period of the year when maintenance can be carried out without causing problems of availability and it therefore has to be spread uniformly throughout the year. In order to safeguard the continuity of supply in case of breakdown, according to Singapore's strategy for attracting foreign private investments and related legislation requiring annual overhauls of equipment, the policy stated by the PUB's Electricity Department and its consultants has been since 1965 to allow for two units (25 and 60 MW) out of service for maintenance and overhaul in addition to the 60 MW spinning reserve mentioned above. This large provision for capacity out of service was justified by the maintenance problem mentioned above and the condition of the Pasir Panjang A station where some units were long overdue for major overhaul. As a matter of fact, a substantial portion of the installed capacity, averaging 115 MW in 1967 and 120 MW in 1969 and 1970, has been out of service since 1966 for maintenance and repairs as shown in the following table by the difference between installed capacity and average capacity actually available.

<u>MW</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Installed Capacity	464	464	464	584	644
Average available capacity	413	349	392	463	523
Peak-demand	223	248	283	320	377
Reserve Capacity	190	101	109	143	146
Spinning Reserve	60	60	60	60	60
Net Spare Capacity	130	41	49	83	86

Moreover, the ^{actual} ~~amount of~~ reserve capacity (after deducting spinning reserve) during the most critical times in each year after 1965 ^{was as low as} reached about 15 MW in 1966-1967 and ~~more than~~ 40 MW in 1968 and again in 1970.

4.05 The large amount of capacity out of service, outgrowing the 85 MW allowance planned for it, was due to worse than average conditions; as a result of the maintenance policy followed prior to 1966, substantial capacity was taken out of service for major overhaul in P.P.A. station and for breakdowns in the P.P.B. station which contributed itself about 70% in 1967-68 and 40% in 1969-70 to the total capacity out of service. Even under these conditions, the average net spare capacity (after allowing for spinning reserve) has amounted to more than 60 MW in 1969-70. Though it is difficult to reach definitive conclusions in this matter without further investigation, it appears that there has been some over-investment since the Jurong station, not ~~directly~~ financed by the Bank (para. 2.08), was commissioned. The ongoing installation of two 120 MW units (with possible addition of a third) to be commissioned by 1973-74 in this station and a possible reduction of maintenance requirements could reinforce this preliminary conclusion, unless future demand grows at a much faster rate than the 14% p.a. average increase of the past four years.

V. Project Construction and Cost

Generation

5.01 The most important project financed by the Bank in the PUB's Electrical Department has been the Pasir Panjang B Thermal station with

a final capacity of 240 MW consisting of four generating units of 60 MW each. The first loan 337 SI (1963) covered the first phase of the plant erection, i.e., the major civil works and the installation of the first two units; the second power loan 473 SI (1968) provided for retroactive financing of the installation of the third and fourth units.

5.02 Construction for the first phase started in January 1963, and the first two units were commissioned in June and July 1965 respectively, two months behind schedule. The second phase was initiated in October 1964, more than two years before loan 473 SI was made, and the last two units went into operation in August and December 1966 respectively.

5.03 The cost of the first phase was slightly lower (6.5%) than expected (Table III) and the actual foreign exchange cost was US\$ 13.6 million, leaving US\$ 1.4 million savings from the loan, of which US\$ 0.8 million were withdrawn with the Bank's consent for purchasing spare parts, supervisory control equipment, and transformers. As work on site for the second phase was nearing completion at the time of the second loan appraisal, the estimated costs had been very close to the actual cost of US\$ 12.86 million (1% lower than forecast), with a foreign exchange cost of US\$ 9.56 million leading to US\$ 0.44 million savings from the loan. The total cost of the whole plant reached US\$ 33 million which is equal to a unit cost of US\$ 138 per kw installed, as compared to \$144 forecast in the appraisal reports. This compares favorably

with the Jurong Thermal station, financed without Bank help, which had a total cost of US\$ 36 million, corresponding to a unit cost of US\$ 150 per kw installed.

Distribution

5.04 The power part of loan 503 SI (1967) was made to cover the US\$ 15 million foreign exchange cost of the 1967-68 expansion program of the PUB's distribution network. This program was expected to consist mainly in the installation of 232 km of cables and 430 MVA transformer capacity, with a total cost of US\$ 25 million. Due, however, to the long delays in supply of equipment from the manufacturers the major part of the loan was actually used to finance the foreign exchange cost of the 1968-69 distribution investment program; this program consisted mainly in the installation of 315 km of cables and 432 MVA transformer capacity with a total cost of US\$ 19.1 million, of which US\$ 13.1 million for foreign exchange, resulting to a unit cost of US\$ 60,800/km of line (with associated substations) as against US\$ 104,700/km forecast. Both unit costs appear high, probably as a result of ample, if not excessive, dimensioning of the network.

Total 19.1
Transf 2.1
cables 17.1
= \$59/m of cable + subst
\$30-40 is normal in developing countries, for cable alone is \$60 in densely populated areas would not be too bad. At that, cable network at \$45 per km is cheap!

cable

your adjacent, not mine

Procurement and Disbursement

5.05 The PUB has traditionally purchased equipment on the basis of international competitive tendering and bidding, and specifications for equipment required for all its projects have been prepared with this in view. Procurement actions which have been taken by the PUB are in accordance with the Bank's guidelines.

5.06 Disbursements were made against presentation of the usual documents evidencing expenditures of foreign exchange. In the case of re-

troactive financing (second power loan 473 SI for the second stage of the P.P.B. station) bids on an international competitive basis had been obtained for the works and all related contracts had been awarded with Bank approval.

VI. Forecasting the Financial Aspects

6.01 The financial projections made in the first appraisal report (1963) underestimated substantially the future investments to be made by the PUB during the period 1963-66. These investments were projected to be \$43.3 million, half of it for the first stage of the Pasir Panjang B station (Table II -B); the PUB actually invested \$68.4 million, half of it in both stages of Pasir Panjang B in order to meet the faster than expected load growth. Due to higher sales revenues, the rate of return on the net fixed assets in operation was higher than expected, except in 1965 and 1966 when a temporary rise in fuel and property taxes added to the operating costs (Table II-A.1).

6.02 Financing of the investments was different from the forecast for the 1963-66 period; about 65% of total funds were expected to come from net internal cash generation and the remainder from the Bank loan. Due mainly to the poor results of 1965 and 1966, net internal cash contributed only 35% to the total requirements, while foreign borrowing contributed 32% and domestic contribution was 33% (Table II-B). Because of the delay in Bank lending due to the absence of a General Manager, the expenditures incurred on the second stage of P.P.B. in 1964 and 1965

were partly financed by long-term loans from the Singapore Government and at the expense of working capital.

6.03 Total applications of funds as forecast in the second appraisal report (1966) for the period 1966-1970 were lower by 19% than the US\$ 127 million applications actually made in the same period, of which US\$ 104 million for fixed investments; the major discrepancy came from the working capital forecasts while fixed investments forecasts were off only by 4%. While net internal cash contributed about 40% to the total requirements as expected, total foreign borrowing was three times the forecast amount because of greater contributions from the suppliers and from the Bank itself; on the other hand, the Government stopped lending to PUB after 1968, reducing the domestic contribution from an expected 36% to 11% (Table II-B). Moreover, gross and net fixed assets in service, as well as the operating costs, were overestimated in the forecasts, while the sales revenues were underestimated due to the tariff increases introduced in November 1966; as a result, the rate of return on the net fixed assets was higher than expected. Forecasts made in the third appraisal report (1967) for the Electricity Department's cash flow for the period 1967-70 were similar to the previous ones; net internal cash was expected to contribute 37% to the total requirements, Government loans 31% and foreign borrowing 31%, most of it from the Bank.

6.04 There has been a strong complementarity between Government and Bank loans to PUB. During the period 1963-66, the necessity to in-

vest more than expected and the delay in Bank lending obliged the Government to make loans which were not foreseen by the Bank. Conversely, during 1966-70, the Government withdrew its aid to PUB and the Bank took over with lending in 1966, 1967 and 1969 successively; as a result, the contribution from the Bank has been considerably higher than originally foreseen.

VII. Institutional Development

The Consultants

7.01 After the installation of unsatisfactory free piston units, Messrs. Merz and McLellan became the PUB's permanent consultants in 1963 and have since been working on the planning, design and construction supervision of the new thermal generating plants of the PUB. Management consultants, R. W. Beck and Associates of Seattle, who were selected with Bank approval, made in 1965 a comprehensive study of the PUB's organization and made a large number of recommendations, *which, for the major part were never implemented*. According to the requirements under the first Loan Agreement (1963), the PUB engaged external auditors, Messrs. Turquand, Youngs and Co., and appointed them to make recommendations for a proper system of accounts on a commercial basis; the PUB was also assisted by its auditors in carrying out the necessary reorganization. Under the covenants of the third power Loan Agreement (1967), the PUB engaged Electro-watt of Switzerland to review the tariff structure and to determine a rate suitable for domestic service which would eliminate the Singaporean two-meter system; Electro-watt submitted its *draft* report and recommendations in *and the final report in June 1971* April 1968. In 1968 the PUB engaged the Montreal Engineering Company Ltd. of Canada to undertake the study of the basic distribution development pro-

gram suggested by the Bank and to submit recommendations for long-term system network development; the consultants' report was delivered in February 1969.

7.02 The PUB's experience with these consultants has taken various forms. The general technical consultants, Merz and McLellan of London, ^{been required to} have not fulfilled any educational or expertise-building function within the PUB (except for some training of operating staff), and they have worked out their generation planning and design without close collaboration with PUB's staff; ^(mainly due to lack of counterpart staff) their terms of reference did not mention training. The quality of their planning and studies, relying on conservative methods based on a pragmatic approach, has not appeared, in the PUB's opinion, very satisfactory, because of the lack of long-range perspective and modern methodology. Ongoing discussions between the PUB and these consultants would allow the PUB to obtain adequate training and planning services in the future as well as lower fees than in the past. The management study made in 1965 did not bring very positive improvements in the PUB's situation, ^{the organisational recommendations were only partly implemented and} insofar as the formal management problem is still unsolved. Though the PUB agrees that outside views are in general helpful, its opinion on this matter is that recommendations of the consultants should have been adjusted to the local administrative and political conditions and environment, particularly with respect to the phasing in implementing these recommendations.

In 1971 the PUB has engaged Montreal Engineering Company for the design of its new Senoko power station which will be located near the causeway linking Singapore with Malaysia.

The y shifted to Montreal Eng for the new power station

7.03 On the other hand, the reorganization of the PUB's accounting system yielded positive results, although the recommendations of the internal auditors were implemented slowly. Since 1966, accounts have been presented on a commercial basis and progressively refined; management reporting, which virtually did not exist before 1967, was geared to the new commercial system and has greatly improved, resulting in a meaningful budget control and a further improvement in the PUB's management. The PUB has been keeping separate accounts for the water, gas, electricity, and service departments. Water, gas and electricity meters are read once per month, and the bill prepared on the computer (introduced in 1964) is sent out for the three services; non-payment of a bill results in prompt cut-off of one or more of the services. This procedure works well and there is no problem concerning uncollected accounts.

7.04 Electro-watt's recommendations on electricity tariff structure were agreed upon by the PUB which is implementing them gradually and expects to complete their implementation by April 1972 as required by the last Loan Agreement (1969). Experience with the Montreal Engineering Company has been very fruitful, in the PUB's opinion. Long-range planning was introduced for the first time in the study of the ~~generation and~~ distribution development programs; though their terms of reference did not mention it, these consultants have fulfilled successfully the educational and expertise-building function, involving staff from PUB's different departments in their studies and having them work together on new

methods and approaches, thus resulting in improved staff relations and coordination between the different departments.

Operations Efficiency

7.05 *Over time the PUB's has increased* The PUB has succeeded in increasing over time its average profit/kwh sold while *reduced substantially* reducing substantially its average price/kwh sold; this was made possible by reducing more substantially its average cost/kwh sold, as shown in the following table:

PUB: Average unit cost (US¢ per kwh sold)

	<u>1960</u>	<u>1962</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Depreciation	0.55	0.51	0.45	0.47	0.57	0.48	0.44	0.37
Administration	0.14	0.16	0.17	0.16	0.13	0.09	0.11	0.09
Fuel	0.59	0.48	0.66 ^{a/}	0.56	0.40	0.39	0.39	0.32
Other Operating Costs	<u>0.40</u>	<u>0.41</u>	<u>0.46</u>	<u>0.40</u>	<u>0.36</u>	<u>0.30</u>	<u>0.27</u>	<u>0.26</u>
Total	<u>1.68</u>	<u>1.56</u>	<u>1.74</u>	<u>1.59</u>	<u>1.46</u>	<u>1.26</u>	<u>1.21</u>	<u>1.04</u>

Decrease over the previous year of:

Fuel cost/kwh, %	(35) ^{a/}	15	29	3	-	18
due to: Fuel cost/ton, %	(30) ^{a/}	13	26	(3)	-	17
Operations Efficiency ^{b/} , %	(5)	2	3	6	-	1

a/ includes 0.15¢ for fuel tax which was exceptionally high in 1965.

b/ as reflected by the number of Fuel tons/Gwh generated and by distribution losses.

PUB's depreciation costs per unit have declined sharply, presumably mainly as a result of the larger generating units added since 1965, with lower

This implies they did the reductions but it was the rapid increase in sales that did it - the higher efficiency of new thermal plants, i.e. this is the normal effect of increase in scale and of newer units as to that performance as ever said.

reduced substantially also decreased considerably

cost/kw installed. Fuel cost/kwh has also fallen sharply, at an average rate of some 16% p.a. over 1965-1970, of which 13% is due to decrease in fuel prices and 3% to increasing operational efficiency in thermal plants and to decreasing distribution losses.

Observance of Loan Agreements Covenants

7.06 The Bank's ordinary covenants on rate of return and long-term debt incurrence were easily observed by the PUB through the period 1963-1970 (except in 1965). These covenants actually have been less restrictive than the PUB's own Ordinance regulations drafted by the Government in 1963 with the Bank's assistance and revised after 1968. Other covenants were generally respected. Those covenants specifically designed to build up the internal management were implemented with delays, in particular the reorganization of the accounting system (337-SI) and the recruitment of specialized engineers (595-SI), ~~but were~~ *the latter covenant was* eventually fulfilled (paragraphs 7.03 and 3.06), *by promoting available staff after a training period of about one year in France and the U.K.*

VIII. Conclusion

8.01 The PUB's past performance has been reasonably satisfactory. After 1966, this was due, in the Bank's opinion, to the ability of the Board's Chairman rather than to the inherent strength of the PUB's management which suffered from the Chairman's apparent inability to delegate and to build up a responsible senior staff. However, the records suggest that performance was as good before 1966 as after (Table I), *with the qualification that it probably would have been even better if the*

8.02 On the technical side, distribution losses, averaging 7% over 1963-70, have been improving and are acceptable; the major concern has

institutional objects of the Bank had been implemented more fully and more expeditiously.

been the maintenance operations which were insufficient before 1967 and led afterwards to substantial amounts of capacity out of service (paragraph 4.04), although without causing failure to meet the demand. The financial rate of return of the whole PUB on its average net fixed assets in operation has been steadily over 9%, except in 1965 and 1966 (4.9% and 7.4%, respectively) when fuel and maintenance taxes were temporarily increased. The financial rate of return of the Electricity Department has been higher, growing from 11.8% in 1962 to 14.5% in 1970, with a drastic fall in 1965 and 1966 when it reached 6.1% and 7.2%, respectively; it recovered, however, in 1967, reaching 9.3% that year and growing afterwards. The average cost per kwh sold decreased steadily, except in 1965 (see para. 7.05); part of the benefits of these economies was given to ^{mainly} ~~industrial and commercial~~ the customers. Average revenue per kwh sold decreased from US\$ 2.42 in 1961 to US\$ 2.19 in 1970, less percentagewise than the unit cost because of tariff increases in 1966. The productivity of labor in the Electricity Department, defined very globally, has shown an average increase of 5.9% p.a. over the period 1960-1970, growing from 236 Mwh/per employee to 418 Mwh. ^{During the same period the number of consumers per employee increased} The debt service coverage on an annual basis has always been higher than 2.0 (except in 1965: 1.8) with a maximum of 2.9 in 1963, and the debt/equity ratio reached a maximum of 57/43 in 1966.

8.03 The PUB's Electricity Department has been growing impressively during the last decade and operating satisfactorily on the whole. It has been gaining an increasing importance within Singapore's economy; its fixed investments have represented a significant part -- between

T from 35 to 57 which, however, is still rather low.

6% and 11% -- of the country's gross fixed capital formation, and the proportion of households supplied with electricity has grown from 32% in 1960 to 70% in 1970. The quality of its services has been satisfactory and no prolonged outage was recorded during this period; new connections are made presently without unreasonable delays (two weeks to one month) except in the small rural areas where important efforts are being made for rural electrification. Its internal management of financial and technical operations has been built up with considerable help and guidance from the Bank and some consultants, and in recent years the PUB has been studying and planning continuously its future operations: network development, design for civil works, feasibility studies for its future stations. It envisages the erection of a nuclear plant by about 1980 (the feasibility study is being financed by the UNDP) and feels able in future years to act itself as consultant to other utilities. The PUB expects to finance from its own resources half of its future investment, and, on the basis of its creditworthiness, to borrow the other half from the Asian Development Bank, equipment suppliers, the Bank, and the Government, if necessary. Suppliers credits would be used mainly for heavy equipment; the Bank, being cheaper than suppliers for financing of smaller equipment, would be asked to finance earmarked projects of the distribution type.