OED SPECIAL STUDIES

85035--003

Power - Follow up

-1973
(June - July)

file
Power Follow-up

July 27, 1973

Mr. Keith Shaw
Administrative Director
Overseas Consultancy Service
30 Millbank
London SW 1P 4PD
England

Dear Mr. Shaw,

Research Project
Standards of Urban
Electricity Distribution

I refer to our telephone conversation of July 24, 1973. I trust that you have by now received the Contract for the Review Paper and the subsequent trip to Washington, etc.

I look forward to receiving the first draft of the paper early in August. I would confirm my agreement with you that it is important to keep the team working as continuously as possible, and that it is necessary to await Mr. Boley's return from Russia before we have our meetings in Washington. I am, therefore, working to the following time-table, which we briefly discussed over the telephone.

Following the receipt of the first draft of the Review Paper early in August I will circulate a copy to my colleagues in Washington, giving you comments by the middle of August. I am reserving at least two days of my stay in London during September for discussions with the team and helping them work-up the Terms of Reference for the State-of-the-Art Paper. Would Wednesday, September 5 be a convenient day for the first discussions?

With respect to the discussions in Washington I am working to the schedule of Messrs. Boley and Prior visiting Washington for discussions which would commence on October 8; visiting a local utility; finalizing Terms-of-Reference for the State-of-the-Art Paper; visiting two of our Latin American Borrowers in the period October 14 through 18; and returning to England about October 18.

Trusting that this program is satisfactory to you,

Sincerely yours,

T. W. Berrie
Power Economic Advisor
Public Utilities Department

cc: Messrs: Ray, Dunkerley, Willoughby, Sheehan,
Rovani, Howell, Friedmann, Bateman, Berrie Files
TWBerrie:jr

FORM No. 75
(2-6)

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE CORPORATION

INTERNATIONAL DEVELOPMENT ASSOCIATION

ROUTING SLIP	Date July 23, 1973

NAME	ROOM NO.
Mr. Willoughby	

	To Handle		Note and File
	Appropriate Disposition		Note and Return
	Approval		Prepare Reply
	Comment		Per Our Conversation
	Full Report		Recommendation
X	Information		Signature
	Initial		Send On

REMARKS

file Power
follow-up.

From Efrain Friedmann Ext. 5369 Room D708

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Public Utilities Division Chiefs DATE: June 13, 1973

FROM: Y. Rovani

SUBJECT: Project Monitoring System

1. Please find attached a self-explanatory draft Central Projects Memorandum (CPM) on the above subject. Before issuing it in its final format I would appreciate receiving your comments both on the proposed text of the memorandum as well as on the Indicators suggested in its 2 Annexes. With regard to the latter I am fully aware that they may be improved substantially after their review by selected members of your staff (to facilitate this I am including 5 copies of the draft CPM). As background information on this subject I would like to draw your attention to the attached memo of January 19, 1973 of Mr. Urquhart and to Mr. Willoughby's paper on Project Monitoring dated January 17, 1973.

2. In addition to this draft CPM we intend to prepare others dealing with Internal Economic Return; Checklist for Telecoms. Procurement; Checklist for Power Procurement; Checklist for P.U. Project Appraisal and Outline for Appraisal Reports. These will also be sent to you in draft form for comment.

3. With regard to the attached CPM on Project Monitoring I would appreciate if you could send all your staff comments and suggestions as soon as possible. If, in addition, you would like to hold a special meeting of P.J. Division Chiefs to discuss the subject, please let me know and I will be glad to make the necessary arrangements.

Attachments

cc (with draft CPM only) to: Messrs: van der Tak, J.A. King, Armstrong
cc " " " to: P.U. Advisory Staff
Files

EFriedmann:jr
IBRD

DRAFT

Central Projects Memorandum No. ...

Project Monitoring Indicators
Public Utilities

1. This memorandum attempts to set up in a flexible manner the beginning of a P.U. Project Monitoring System which is expected to develop and improve with experience. The basic elements of the proposed system as described below are a natural development of past Bank experience on appraisal, supervision and more recently operations evaluation work.

2. Appraisal reports usually contain i) a number of key assumptions, or forecasts, regarding future developments (demand growth, revenues, rates of return, disbursements, costs, etc.), and ii) a number of goals, or targets, to be achieved (labor productivity increases, connections, reduction of losses and outstanding bills, etc.). In order to follow-up in a more efficient manner both the accuracy of forecasting and the progress towards achievement of specified targets it has generally been agreed in the Bank that a Project Monitoring system should be developed in all sectors. The proposal is to select a few key indicators of performance in the course of the appraisal, identify them in the appraisal report, discuss them in loan negotiations, and follow up and report regularly on performance. This CPM deals with such a system as it should begin to be applied in Public Utilities projects.

Monitoring System

3. Eight or ten key indicators will be selected in the course of appraisal to represent important or critical features of the sector/project development including construction, operation, management, organization, training and other areas. Some will be used to measure the achievement of

agreed performance targets, others to check the development of significant forecasts. Both types should be present in every project. The indicators will be listed and clearly defined in a separate Annex of the appraisal report entitled "Monitoring Indicators" which should also indicate if these are to be measured quarterly, half-yearly, or annually. The selected indicators will be discussed during appraisal and negotiations and incorporated in the loan documents. The borrower will agree to report periodically on these in addition to regular progress reports. The manner of recording these agreements might vary depending on the characteristics of the selected indicators. They might be a part of the Loan Documents, a Side Letter or other suitable legal document. At the appropriate time intervals the Regional staff in charge of Project Supervision should report and comment specifically on the evolution of the indicators. It is expected that eventually this would become part of the Supervision Summary reporting system applying to all projects in all sectors.

Indicators

4. In order to facilitate the appraisal teams' work we are attaching three Annexes containing indicators which might be chosen in Power, Water and Telecoms. projects. The list does not attempt to be complete and is only indicative. The staff concerned may easily modify the suggested indicators or include new ones which would apply more readily to their specific needs.

5. As experience in the application of the Monitoring System grows, this memo and its attachments will be updated.

6. As a final point, it should be emphasized again that this system is only intended to highlight key elements already being considered in the

appraisal and supervision process, thus i) it does not entail significant extra work, ii) it is additional to and does not replace regular reporting on the projects under supervision; and iii) it does not substitute for the particular covenants on rates, debt limitations, etc. already provided for. Also the key indicators are not meant to be used for comparisons between utilities.

Attachments (2 Annexes)

EFriedmann
June 13, 1973

D R A F T

POWER SECTOR INDICATORS

NOTE: Technical and financial indicators normally shown in appraisal reports are not listed below, but they should be considered when selecting the indicators to be monitored.

Although the main purpose of these indicators is to monitor the performance of a particular enterprise, they can also be used to compare with selected characteristics of other enterprises. This should always be done with caution, but to reduce the possibility of misinterpretations, the definitions provided should be used as far as possible in all cases.

Staffing

1. Number of employees (show separately: total, generation, transmission, distribution, others)
   - 1.1 Number of professional engineers
   - 1.2 Number of qualified accountants
2. Number of employee per 1,000 connections (exclude construction labor)
3. Number of employees (per MW installed) in:
   - 3.1 Hydro generating plants
   - 3.2 Thermal generating plants
4. Number of employees in transmission per Km of line
5. Number of employees in distribution per GWh sold at distribution level

6. Participants in agreed training programs: actual vs. programmed

System Operating Characteristics

7. kWh sales (by category)
8. Number of connections (by category)
9. Connections per 100 population in service area (urban/rural)

   9.1 kWh sold per connection

10. MWA of distribution transformer capacity ÷ total generating installed capacity
11. Generating plants availability by plant (hours or % per year - separate planned and accidential outages)
12. Generation, transmission, and distribution losses
13. Peak demand (usually 30 minute)
14. Load factor
15. Thermal plant utilization by plant (energy generated ÷ total energy capacity minus planned outages)
16. System reserve margin [(installed capacity - peak demand) ÷ peak demand]
17. Transmission line faults in number per year per 100 km at different voltage levels or transmission line outage time in circuit kms (per voltage) per year.
18. Distribution faults per year and per 100 km of distribution line
19. Average BTU's per kWh generated

Financial Characteristics

20. Net plant investment - total, generation, transmission, distribution-per MW of generating capacity (plant revalued as necessary, exclude work in progress)

21. Average net plant investment per GWH sold - total, generation, transmission, distribution-per GWH sold
(plant revalued as necessary, exclude work in progress)

22. Average depreciation rate (annual depreciation charge ÷ average gross plant excluding work in progress)

23. Weighted average repayment period of debt outstanding at year end

24. Weighted average interest rate on debt outstanding at year end

25. Operating revenue per unit of value of gross plant (total operating revenue ÷ gross plant excluding work in progress)

26. Operating revenue per connection

27. Average revenue per kWh sold (total and by consumer class)

28. Cash operating expense per unit of value of gross plant (exclude depreciation)

29. Total operating expense per kWh sold

30. Total employment cost per employee (salaries, wages, benefits)

31. Fuel cost per million BTU (US¢ and local currency)

32. Number of average days bills outstanding (bills outstanding x 365 ÷ total billing for year)

33. Revenue effectiveness index

$$\left(\frac{\text{Revenue Collected} \div \text{gross kWh generated}}{\text{Average Revenue Billed per kWh}}\right)$$

34. Internal cash ratio

(net operating income plus depreciation less debt service, less changes in non-cash working capital, less dividends, taxes, etc. ÷ gross plant investment, including work in progress.

JHJennings/EFriedmann:jr
June 14, 1973

WATER SECTOR INDICATORS

NOTE: Technical and financial indicators normally shown in appraisal reports are not listed below, but they should be considered when selecting the indicators to be monitored.

Although the main purpose of these indicators is to monitor the performance of a particular enterprise, they can also be used to compare with selected characteristics of other enterprises. This should always be done with caution, but to reduce the possibility of misinterpretations, the definitions provided should be used as far as possible in all cases.

Staffing

1. Number of employees (show separately: total, production/ treatment, transmission/distribution, meter reading/ billing and collecting, others)

   1.1 Number of professional engineers

   1.2 Number of qualified accountants

2. Employees per 1,000 connections (excluding construction labor)

3. Number of employees (per average mgd produced)

4. Number of vacancies at professional/technical level

5. Number of customer complaints

6. Participants in agreed training programs: actual vs. programmed

System Operating Characteristics

7. Mg (or m^3) produced

   7.1 Mg (or m^3) consumed

   7.2 Unaccounted for water (% of production)

8. Number of connections (by category, i.e., by size of connection or by residential, industrial, etc. In either case, show number of public taps.)

   8.1 Number of metered connections (by category, i.e., by size of connection or by residential, industrial, etc. In either case, show number metered of public taps.)

9. Connections per 100 population in service area (urban/rural)

   9.1 Consumption per capita in service area

   9.2 Consumption per connection

10. Total production as a % of supply capacity

11. Peak day demand

    11.1 Peak day demand as % of production capacity

    11.2 Storage capacity as % of average daily demand

12. Number and length of periods of no pressure or reduced pressure (separate for system as a whole, and specific parts)

    12.1 Average daily hours of service, if intermittent

    12.2 Pressure range on system

    12.3 Number of system leaks repaired

    12.4 Number of meters replaced

    12.5 Number of disconnections for non-payment of bills

13. Water source data

    13.1 Streams - stream gauging data

    13.2 Lakes and impoundments - water level, discharge and yield data

    13.3 Groundwater - static level and drawdown data

14. Laboratory analysis data

15. Average filter rates

Financial Characteristics

16. Net plant investment - total, production/treatment, transmission, distribution per average mgd produced (plant revalued as necessary, exclude work in progress)

17. Average depreciation rate (annual depreciation charge ÷ average gross plant excluding work in progress)

18. Weighted average repayment period of debt outstanding at year end

19. Weighted average interest rate of debt outstanding at year end

20. Operating revenue per unit of value of gross plant (total operating revenue ÷ gross plant excluding work in progress)

21. Operating revenue per connection

22. Average revenue per 1,000 gal. or m^3 sold (total and by consumer class)

23. Cash operating expense per unit of value of gross plant (exclude depreciation)

24. Total operating expense per 1,000 or m^3 sold

25. Total employment cost per employee (salaries, wages, benefits)

26. Chemical cost per 1,000 gals. or m^3

27. Number of average days bills outstanding (bills outstanding x 365 ÷ total billing for year)

28. Revenue effectiveness index

$$\frac{\text{Revenue Collected} \div \text{gross } m^3 \text{ (or 1,000 gal) produced}}{\text{Average Revenue Billed per } m^3 \text{ (or 1,000 gal)}}$$

29. Internal cash ratio

(Net operating income plus depreciation plus any non-operating net revenues, less debt service, less changes in non-cash working capital, less dividends, taxes, etc. ÷ gross plant investment, including work in progress)

HShipman/JHennings:cdd
June 18, 1973

mr. Willoughby

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

file
Power Follow-Up.

OFFICE MEMORANDUM

TO: Public Utilities Staff (Power and Water Supply) DATE: July 5, 1973

FROM: Y. Rovani YR

SUBJECT: Public Utility Note No. 5
Pricing in Power and Water Supply

I am attaching herewith Public Utility Note No. 5 dealing with Pricing in Power and Water Supply. This Note is intended as only the first step in a program of exchange of information and discussion between public utilities staff in the Regions and Public Utilities Department on the subject of pricing. Other steps in the program are expected to be seminars, discussion groups, write-ups from operational work, papers on methodology and data collection, and further Notes.

This is the fifth of a series of "Notes" which are neither policy statements nor working instructions. They have been designed as a simple and flexible vehicle of communication, primarily with public utilities staff, amongst other things to frame and comment on issues of general interest in the public utilities sectors.

The practice has been established to have these Notes reviewed by ad hoc panels including representatives of the utilities divisions as well as other staff. Their contribution is hereby acknowledged.

Your comments and specially any suggestions for subjects to be covered in further Notes would be extremely helpful and welcome.

Attachment

TWBerrie:pfa

PUBLIC UTILITIES DEPARTMENT

P.U. Note No. 5

PRICING IN POWER AND WATER SUPPLY
(State of Bank Work Program)

July 5, 1973

PRICING IN POWER AND WATER SUPPLY

(State of Bank Work Program)

Introduction

1. Public utility pricing has always received careful consideration in project appraisal. Until recently, however, the only systematic concern has been with ensuring that the level of tariffs would be sufficient to provide the revenues needed for financing operating costs and an adequate portion of the needs of the utility toward future expansion. Some attention has always been given to attempting to spot and remedy glaring inconsistencies in the structure of tariffs, e.g., customers with obviously small costs of supply subsidizing customers with obviously large costs of supply. Occasionally certain fiscal and/or income distribution objectives have been taken into consideration.

2. In the last five years attempts have been made in the Bank to examine the subject more deeply. Desk as well as field studies have been done. The most suitable approach in future is likely to be to learn more from practice, by case studies and operational work through sector missions and the various stages of the project cycle.

3. This Note brings the reader up-to-date with respect to this Bank work, indicating what lessons have been learned, what information is now available for operational use and what further work is being done. It further suggests that economic, social and fiscal aspects of utility pricing be more systematically considered in all phases of operational work. At present only a few specific guidelines can be laid down for these aspects in that further investigatory work is required both by Central Projects and Regional Public Utilities staff.

PRICING IN POWER AND WATER SUPPLY

(State of Bank Work Program)

I. Main Aspects of Public Utility Pricing

1. There are four main aspects of public utility pricing: financial, fiscal, economic and social.

2. Financial. The Bank has always attached considerable importance to the financial reliability of its public utility borrowers, to ensure not only their solvency but also their ability to generate cash internally and raise in the form of debt and equity capital, the resources necessary for their continuing development. The policies of the Bank in this regard, the criteria used to determine the appropriate level of tariffs charged to customers, together with the covenants and other arrangements designed to ensure that this level is maintained despite inflation are described in OPM 2.63 "Public Utilities", and are not further discussed here.

3. Fiscal. The fiscal impact of Bank public utility projects requires more systematic attention, as has been demonstrated in a number of instances. In this connection the Operations Evaluation Unit in its report on electric power recommended that a paragraph on the subject be included in appraisal reports. This recommendation, which is being followed in other sectors, should be accepted.

4. Economic. In order to obtain the optimum use of resources, prices must be broadly in line with incremental (marginal) costs of supply. Recently much work has been carried out with respect to marginal cost pricing, and this work is the main subject of this Note. Marginal cost pricing has an impact on both the level and the structure of public utility tariffs. It is a very important dimension in tariff making, and basically consists of reflecting in the tariffs the incremental economic cost of supplying one extra unit of service (kWh or gallon of water) at any period in time. A compromise is always needed between the theoretical and the practical.

5. Social. Increasing attention is being paid to social aspects which can be part of tariff making, e.g., the degree that redistribution of income or social priorities can be built into tariff structures. The Operations Evaluation Unit in its report on electric power recommended that a paragraph on this subject be included in appraisal reports, especially with respect to providing water and electricity to the poorer parts of urban and rural communities when the annual financial return, at least in the early years of supply, may well be low.

II. Components of Public Utility Tariffs

6. A fundamental feature of all public utilities is that they provide each of their customers with two kinds of service:

(a) Peak Availability (capacity component). Ability to supply any quantity of the service demanded at any particular point in time (e.g., capacity to provide the maximum amount of power or water demanded over the peak hour, kW of electricity capacity, and millions of gallons per hour of water capacity).

(b) Cumulative Volume (consumption component). The actual amount of the service which they consume (e.g., kWh of electricity or gallons of water).

7. One form of tariff structure, therefore, is to have a component which represents the cost of being able to supply the amount of services demanded over the peak hours (a maximum demand or capacity component) and another component which represents the cost of the actual cumulative volume of services supplied (a consumption component). For some customers, availability of supply at the peak hours may cost more than the volume of services supplied and vice versa. Such two-part tariff structures are not peculiar to the public utility sectors; they occur in many other sectors, e.g., the cost of the ability to provide transportation services at the peak hour and the cost of the services themselves.

8. The maximum demand or capacity component of a two-part tariff (e.g. in $ per kW demanded) can be transformed for convenience into a pseudo consumption component (e.g. into $ per cumulative kWh consumed) by dividing the capacity component by the number of hours in the year which can be classed as "peak hours". This pseudo consumption component can then be averaged out with the true consumption component to give a composite consumption figure. It may be necessary to use such a mechanism if the metering of the capacity component does not warrant the expense or is technically difficult, e.g., in most residential and small commercial installations.

9. Two further important points in connection with the form of public utility tariffs are:

(a) Connection (customer component). A third component is often added to represent costs allocable to the one particular customer only (e.g., the cost of connection of the service to the common main or the cost of the meter).

(b) Both the capacity component and (more commonly) the consumption component are sometimes divided into two or more slices either to represent more truly the cost of supply with quantity of service used or for "promotional" reasons.

10. With respect to calculating the values to be used in the tariff structure, all basic information is obtained from the accountancy systems. Examples of typical conventional tariff structures used in practice are

shown in "Electricity Costs and Tariffs: A General Study", a United Nations Report[1/] which lists 25 countries. A later paragraph indicates how accountancy costs may need to be modified for use in dealing with the main subject of this Note, namely, marginal cost pricing.

III. What Has Been Done Already in the Bank in Marginal Cost Pricing.

11. The additional cost incurred in supplying an extra unit of service (a kWh of electricity or a gallon of water) at any particular moment, present or future, disregarding all actual previous investment costs, is known as the marginal cost of supplying that service and the corresponding tariff, the marginal cost tariff. By the logic of paragraph 6, any marginal cost tariff structure should have two components, a capacity component and a consumption component. To reflect adequately the interplay of economic forces from within and without the economy, marginal costs of supply must adjust financial accountancy or "book" costs in order to reflect the "true" value of foreign exchange, labor, cost of capital, etc. This type of "shadow pricing" is required in any case for determining, from a social point of view, least-cost solutions for public utility investment programs.

12. Several desk studies made in the Bank during 1967-1968 confirmed some important points, most of which had already been published in the literature:

(a) The strict application of marginal cost pricing (i) gives the optimum use of existing and future resources, and (ii) leads to optimum investment decision making.

(b) However, such strict application is impossible and likely to remain so because of problems of measurement (e.g., of each unit of service supplied for each hour of each day of each year), and lack of data from the normal financial accountancy system with respect to the marginal cost of supplying an extra unit of service.

(c) Thus, compromises must be made both in the application of marginal cost pricing and in the process of changing from present tariff structures to any structure based upon marginal cost pricing. This, in effect, is what gives emphasis to developing by case studies practical means of implementing marginal cost based tariffs, so as to achieve better rather than optimum use and allocation of resources.

13. With allowance made for some adjustment with respect to differing costs and practicalities of providing storage (which tends to add important constraints in the power and water sectors), similar findings apply to both the water supply and the electric power sectors. However, experience suggests that, in defining operational tariffs for the two sectors, primary emphasis in the case of water supply should be on the level of tariffs

1/ Available in Public Utilities Department, CPS.

(this is because rising unit construction cost is intrinsically a feature of the sector), whereas in power the structure of tariffs is a much more important consideration. In the latter case, increasing unit costs of supply are not as clearly a characteristic of the sector; there is, however, greater scope for ensuring that different types of consumption are charged at different rates, and greater opportunity of applying time of day and seasonal tariffs, normally requiring that the peak/off-peak differential be increased.

Boggis-Westfield Report

14. In 1968 a first case study was mounted to investigate directly the economic, financial, technical and institutional problems involved in (i) determining a practical marginal cost pricing structure, and (ii) carrying out the process of changing from the existing tariff system to one based upon marginal cost pricing. Another important objective was to determine the most efficient means, whether through pricing or physical control methods, of cutting down demand at peak hours. The country chosen was Pakistan, and the sector power, because of the large amount of data expected to be available from a previous power system planning study made there for the Bank, and the willingness of the Government to have such a study carried out.

15. The Boggis-Westfield Report[1/], addressed itself to the fact that when electricity is in short supply it should be made to be more expensive. It concluded that how much more expensive it should be is a most difficult question to answer since it involves all sorts of important judgments about the correctness of prices in other sectors, income distribution, capital outlays and public acceptability. What is important, however, is that prices should signal relative scarcities. (This was regarded as the "bare bones" of a practical marginal cost pricing system.) The report was not at all enthusiastic about physical rationing of electricity. Although various methods of non-price rationing were described, marginal cost pricing is at the heart of the recommendations. The first recommendation was that tariffs based upon the marginal cost of supplying the demand during peak hours should be introduced for all industrial consumers. The second recommendation was that an experiment be undertaken to explore the practical possibilities of introducing a time-of-day tariff for electrical energy consumed by private operators of agricultural tubewells.

The Turvey Report

16. The Turvey Report[2/] assumed that the financial viability requirements of a utility are predetermined; it studies the public utility pricing problems from the viewpoints of economic efficiency and social fairness.

1/ Power Load Control Study, Report No. C-57a, March 31, 1972 available from the Public Utilities Department, CPS.

2/ "Public Utility Pricing Problems" by R. Turvey (SCICON), December 1971, available from the Public Utilities Department, CPS.

The report argued that the structure of marginal costs should first be investigated and then the pros and cons of setting prices higher or lower than marginal costs studied. If, for any reason, there is a need to provide revenue over and above that collected by marginal cost pricing, the report recommended concentrating the excess of actual price charged over marginal costs on those components of demand least sensitive to price. However, it may well be government policy to subsidize some (or all) consumers by setting prices below marginal costs either (i) to encourage consumers to consume more of the utility's service or (ii) to leave consumers with more money to spend on other things.

17. The report made the following recommendations with respect to studying public utility pricing:

(a) Consider the effects of pricing on resource allocation, i.e., the incentives which pricing gives customers to consume more (or less) at different times and under different circumstances; also incentives, in relation to the structure of costs, of providing the higher (or lower) quantity of service.

(b) Look for alternative courses of action and weigh their advantages and disadvantages as systematically as possible.

(c) Avoid both "conventional wisdom" and the assumption that the best practices in developed countries are also the best in developing countries.

(d) Be explicit about any political and social judgments involved, whoever makes them.

Sector Working Papers[1/]

18. The Electric Power Sector Working Paper[2/] pointed out that, when forecasting electricity demand, the assumption normally made was that demand is price inelastic. While this was often true, peak demand could be reduced and off-peak demand increased by some form of marginal cost pricing, although the precise amount of the reduction was difficult to predict. The scope in developing countries for changing the shape of the demand curve through the pricing mechanism needed further investigation; this was also a recommendation made by the Bank's Operations Evaluation Unit[3/], after examining the electric power sector in a cross-section of countries.

1/ Electric Power Sector Working Paper and Water Supply and Sewerage Working Paper, World Bank, December 1971, available from the Bank's Publication Office.

2/ The "Research" section of the Water Supply and Sewerage Working Paper refers to the importance of forecasting demand, pricing, etc.

3/ Operations Evaluation Report: Electric Power, Operations Evaluation Division, 1972, available from the Director, Programming and Budgeting Department.

The Tunisian Case Study

19. In order to fit into the pattern of objectives emerging from the various reports described, further Bank work on public utility pricing has three main objectives:

(a) Resolution of major theoretical problems.

(b) Commissioning of further case studies to identify practical difficulties.

(c) Production of guidelines for use by operating staff (and borrowers) to examine existing tariff structures and terms of reference for carrying out reviews of tariff structures.

20. One of the case studies has been carried out. The country chosen was Tunisia because a review of the tariff structure of the main power utility (STEG) has recently been made by consultants. A first draft of the report[1/] has been produced.

21. The estimation of marginal costs had already been undertaken within STEG during periodic working sessions and discussions with the consultants, Electricite de France (EdF); the approach was similar to that used by EdF in computing the French marginal cost system, the "tarif vert". STEG's attempt to estimate the structure of marginal costs has been handicapped by certain deficiencies in the information available:

(a) The future investment costs per kW for the distribution part of the network are unknown; the extent in which they vary with kW, kWh, number of consumers, etc., can only be guessed.

(b) The cost of reinforcing distribution to meet a growing demand from existing consumers cannot be distinguished from the costs of extending distribution to supply new consumers.

(c) The information on losses is very approximate.

(d) Little is known about the low voltage network, its capacity or the diversity of demands of its consumers; indeed, consultants are being paid to map it.

(e) The daily and hourly consumptions of STEG's consumers are unkown; this is particularly important when new tariffs are to be introduced.

1/ Electricity Tariffs in Tunisia, October 19, 1972, available from the Public Utilities Department, CPS.

22. On the STEG system, only additional kWh which are demanded at time of system peak demand require installation of extra capability (kW) to be able to supply them. It is, therefore, only the marginal costs at time of system peak demand which include a "capacity" component. Marginal costs at "day" and "night" periods require only a "consumption" (kWh) component.

23. Despite the deficiencies in data, STEG was able to make very reasonable, if approximate, estimates of marginal costs which could be used as a basis for a marginal cost pricing structure:

MARGINAL COST STRUCTURE

	Medium Voltage Consumers	Low Voltage Consumers
Capacity (kW) + Consumption (kWh) Basis		
Marginal Capacity Costs, Dinars kW/Year	38½	70
Marginal Energy Costs, Millimes/kWh:		
- Peak	9	9½
- Day	4	4
- Night	3½	3½
Consumption (kWh) Only Basis		
Marginal Costs, Millimes/kWh:		
- Peak	40	68
- Day	4	4
- Night	3½	3½

24. The above presented a dilemma typical in any attempt to adopt a marginal cost pricing structure in that it is not politically or practically feasible for STEG to make such a vast change 1/ in the cost structure as the above implied. Indeed, it could be argued that it was unjust to inundate consumers with new, radically different tariffs when they may have bought appliances on the basis of the existing tariffs. A slow transition to any new tariff structure would always be necessary.

IV. Examination of Tariff Structures in Bank Lending Operations

25. Several studies have been carried out with respect to tariffs and tariff structures in direct connection with the Bank's lending operations, examples of which are given below.

1/ Involving, in some cases, more than a five-fold increase compared to present-day tariffs.

Power Sector

26. In the appraisal of the Fourth Power Loan to Argentina[1], the existing tariff structure (which was thought at the time to have several anomalies) was examined from three separate angles:

(a) How well the average revenues per kWh collected from each consumer class met the cost of supply.

(b) How close the existing tariff structure was to marginal cost pricing.

(c) From the point of view of equity of asset use between consumer classes, by allocating all costs borne by the utility to the different consumer classes in accordance with their average physical utilization of the assets.

27. A similar type of study was carried out for the Third Power Loan to Mexico[2]. Both sets of studies indicated the same approximate value for the ratio of marginal cost of supplying electricity on-peak compared with off-peak as given for the Tunisian study above. A "practical" value to be placed on the ratio was suggested in each report (obviously considerably lower than the "ideal") and this altered the levels to be aimed at for both the average and the off-peak tariffs. These practical values together with the financial tests (average revenue per kWh versus average cost of production) and the commercial tests of 26 (c) (allocation of costs to consumer classes according to utilization of the assets), enabled an overall judgment to be made on the amount of distortion in the present tariff structures (considerably less was indicated to be present in the Argentine tariff structure than was previously believed to be the case).

Water Supply Sector

28. The water supply appraisal mission[3] to Tunisia in 1972 attempted, after some analysis, to persuade the borrower to implement a pricing policy that would reflect sharply rising long-run marginal costs (a situation which tends to be common in the water supply sector); the mission also recommended that summer peak demand should bear the preponderant share of incremental costs in that new capacity (ability to supply a given quantity of water over any one hour) is basically installed to meet new peak demand. The result of the Bank's intervention has caused the borrower to seriously reconsider his attitude for the future, even though comparatively little can be done for the present.

1/ Appraisal Report No. PU-19 a) on SEGBA IV Power loan dated Sept. 19, 1969, (Argentina), available from the Reports Desk.

2/ Appraisal Report No. PU-27 a) on Mexico III Power loan dated Feb. 6, 1970, available from the Reports Desk.

3/ Appraisal Report No. PT-5 a), Annex 4, on Tunisia Tourism Infrastructure Project loan dated May 30, 1972, available from the Reports Desk.

29. The Bank's advice was sought by the Pakistan Government to examine the case for introducing domestic water metering into the city of Lahore (the question of whether or not to meter is usually an important one in the water supply sector). A study[1/] carried out by the Bank indicated that, in view of the low cost of water supply in Lahore, the cost of metering would probably exceed the benefits. These findings have since been accepted by the borrower.

30. Approval by the Bank of the Libreville (Gabon) Water Supply Project[2/] laid stress on implementation of a tariff structure that would reflect increasing unit costs. It also recommended that the tariff structure take into account in a positive way the inability of low-income groups to pay the price charged. Both suggestions were accepted by the borrowers.

31. The case of Mexico City water supply demonstrates dramatically increasing unit costs of supply. This is due mainly to the terrain, the changing level of groundwater and several other physical factors. The case for a marginal cost pricing system is thus very strong, a point the Bank mission made during appraisal.[3/] This would mean an increase in tariffs that proved unacceptable to the borrower, even after many ways (e.g., by a sliding scale of charges) of making such a policy more palatable were examined.

32. A comparison of known costs and revenues of the Bombay Water Supply project[4/] initially yielded a negative rate of return. The reflection in the calculation of tariff increases firmly projected to be necessary for financial purposes (the mission found that there was a definite need to increase the average level of tariffs) made the rate of return only slightly positive. There was every indication, therefore, that (i) marginal system costs were not known, and (ii) willingness to pay was certainly not used as an indicator, or even a benchmark, for the justification of the project. A tariff study incorporating an analysis of incremental system costs and its consequence for pricing policy (including metering practices) will stem from this exercise of calculating the rate of return on the project.

33. It is important to realize, particularly in connection with the two latter cases, that the economic analysis in the reports led to Bank recommendations for gradual increases in price levels over and above what would have been regarded as adequate to ensure the financial viability of the entities concerned. This logically reflects the increasing scarcity, and therefore the increasing cost, of water over the long term.

1/ Full Report from Mr. J.J. Warford to Mr. H.R. Shipman dated April 19, 1971, available from Central Files.

2/ Appraisal Report No. 89 a)-GA on Gabon, Libreville Water Supply loan dated April 10, 1973, available from the Reports Desk.

3/ Appraisal Report No. 99-ME, on Mexico City Water Supply loan dated May 24, 1973, available from the Reports Desk.

4/ Appraisal Report No. 88-IN on Bombay Water Supply and Sewerage loan dated dated March 2, 1973, available from the Reports Desk.

V. What Public Utilities Department and Regional Divisions Should Do Now

34. The Public Utilities Department plans to complete in FY74 the methodological desk studies in connection with marginal cost pricing (see paragraph 19). These involve:

(a) Methods of calculating marginal costs of production for power systems with an appreciable proportion of hydroelectric generating plant.

(b) Methods of calculating marginal costs of production for power systems taking into account uncertainty, reserve capacities of generation and transmission plant, etc.

35. Two more case studies will be completed in the power sector and written up in FY74, following which a summary of the main points learned from the power sector case studies will be issued, possibly together with a revised version of the Turvey Report dealing with marginal cost pricing in the power sector. A case study in the water supply sector is planned for FY74.

36. Guidelines and seminars for Regional Operating Staff are in the course of preparation. Meanwhile, in order to start a more systematic approach to the whole subject of the examination of tariff structures it is recommended that, as part of the preappraisal and appraisal data collection exercise, the missions should:

(a) Get as much information as possible on the tariff structures of borrowers.

(b) Ask the Regional public utilities economists to analyze these tariffs (whether or not they are part of the mission team) in light of the marginal costs of supply for the utility in question. Assistance will be available from the Public Utilities Department and its consultants as to how to calculate the marginal costs in the field and how to analyze the tariffs for any particular case.

(c) Check with the country economist on the relevance of shadow pricing, fiscal policies, regional/rural development policies and income distribution factors, and obtain his views about the extent to which the utility's pricing policies should reflect a need for increasing government revenues, taking into account any likely distortionary and economic effects of increasing tariffs for this purpose.

(d) Consider the financial aspects of the present tariff level and structure with respect to (i) average revenues per kWh, collected in total and from each type of customer, reflecting the average cost of providing the service; and (ii) average tariffs for each type of customer reflecting their approximate utilization of assets and share of operating costs.

(e) Prepare suggestions regarding a plan of action during the mission, e.g., new tariff structure, study of present tariff structure by specialist consultants, request for specialist economic assistance on future missions, etc., in cases where this seems worth tackling.

mr wellenstein
file Power Followups

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Public Utilities Staff (Power) DATE: June 28, 1973

FROM: Y. Rovani T.W.B. for Y.R.

SUBJECT: Public Utility Note No. 4
Standards of Urban Electricity Distribution

I am attaching herewith Public Utility Note No. 4 dealing with Standards of Urban Electricity Distribution. This Note was originally written as an Issues Paper to guide consultants being hired by the Bank to write a "State-of-the-Art" paper concerning what has been done, in theory and in practice, in developed and developing countries, concerning the determination of desirable standards of urban electricity distribution. It was felt, however, that the paper could form the basis of a very topical Public Utility Note, and it has been suitably expanded on this basis. It is topical in that it deals with some of the newer emphasis in the Bank's operational work, e.g., emphasizing that part of the service nearest to the consumer (distribution) as distinct from the more "traditional" wholesale parts of the service (generation and distribution); and also with that aspect of access to service which considers trade-offs between the standard of existing service and the expansion of access to service. You will recall that the latter topic was mentioned in the reports of the Operations Evaluation Unit.

This is the fourth of a series of "Notes" which, as I have explained previously, will be issued from time to time on a variety of subjects of interest to Public Utilities staff. These Notes are neither policy statements nor working instructions. They have been designed as a simple flexible vehicle for communication, primarily with Public Utilities staff, amongst other things to frame and comment on issues, not by any means resolved, but of important general interest in the sector.

The practice has been established to have these Notes reviewed by ad hoc panels including representatives of the public utilities divisions as well as other staff. Their contribution is hereby acknowledged.

Your comments and specially any suggestions for subjects to be covered in further Notes would be extremely helpful and welcome.

Attachment

TWBerrie:pfa

PUBLIC UTILITIES DEPARTMENT

P.U. Note No. 4

STANDARDS OF URBAN ELECTRICITY DISTRIBUTION

June 28, 1973

STANDARDS OF URBAN ELECTRICITY DISTRIBUTION

Introduction

1. Distribution represents anywhere from 30% to 50% of total investment in the electric power sector; hence considerable benefits might come from an explicit consideration of a cost versus quality-of-service analysis in the design and construction of distribution systems. This is a field little explored either within the Bank or outside but one of considerable interest, as future Bank lending for electric power is likely to become increasingly "socially sensitive," i.e. tending to deal with that part of the power system nearest the consumer (distribution), as distinct from the more remote parts (generation and transmission).

2. Although lending for distribution always has been a part of Bank lending, until recently the emphasis has been on the generation and transmission of electricity. An increasing proportion of loans now contains a distribution element and the proportion of that element is likewise increasing. Some loans are only for distribution systems and this trend is expected to grow. In these circumstances, it becomes necessary in the appraisal of projects to "look into the heart" of the distribution problem more closely than in the past. There is need, for example, to study more carefully the distribution design and engineering practices of borrowers and their consultants and, in particular, to form a judgment about the standards of service toward which they are planning. Each standard of service has its own cost of supply and benefits. In simple terms, a reduction in the quality of supply gives rise to a lower unit cost, 1/ which means that more consumers can be supplied and the net benefits that the additional consumers obtain (benefits less costs) at this lower level of supply have to be set against the reduction in net benefits to all other consumers. Conversely, the net benefits from an improvement in service to all other consumers have to be set against the net benefits that might otherwise have been provided to additional consumers. A third case is where lower unit costs can mean increased investment in another sector. This is a familiar problem in other sectors, e.g. transportation, where the net losses to one class of road user due to lower standards are offset by the gains to other users. Similar techniques for solving such problems can be applied here.

3. The best approach to planning for the long term lies in establishing, over time, a pricing policy that reflects both the marginal cost of service at the chosen standard of supply and any income distribution, fiscal, etc., policies that are intended. Until, however, more reliable measurements can be made of the socio-economic benefits derived from changes in the quality of service, heavy reliance must be placed on looking into the variations in costs. A research project has been started recently by the Public Utilities Department to establish the whole "state of the art" with respect to what has been done throughout the world on Standards of Urban Electricity Distribution. What the project hopes ultimately to develop is a method to establish what are the costs for a minimum standard of service, below which threshold both judgment and cost-benefit analysis indicate that is unwise to go in a particular situation.

1/ Up to the point where captive generating plant is installed.

STANDARDS OF URBAN ELECTRICITY DISTRIUBTION

I. The Problem

1. Anyone who has ever attempted to introduce the concept of quality of electric power service into economic calculations is well aware of the difficulties of quantifying in monetary terms the comparative benefits experienced by different types of consumer. For example, it is well known that designing a distribution system to produce voltages so low at certain times as to impair the operations of some classes of consumer may have no effect at all on other consumers.

2. The following questions must therefore be asked: Should a study be made of the quality of service relating to the average consumer; or should an analysis be made of the quality of service by categories of consumer? If the latter, which categories?

3. Answers to these questions will vary widely between countries. In a first attempt to deal with this subject it probably would be wise to limit the scope by considering only the overall quality of service to the three main consumer classes -- industrial, commercial and residential -- excluding specialized types within each class; but perhaps singling out, because of his social importance, the consumer in low-income residential areas (who traditionally gets a low standard of service) and, because of his political importance, the government office consumer (who traditionally gets a high standard of service).

II. Quality of Service

4. Many elements can be included within the definition of "quality of service." The basic ones are:

(a) Continuity of Service (number and length of interruptions to supply)

(b) Stability of "Frequency" (change in a technical characteristic of the whole system)

(c) Voltage "Flicker" (very rapid changes in voltage)

(d) Voltage "Wander" (slow changes in voltage)

(e) Voltage "Gaps" (short intervals with zero voltage)

(f) Voltage "Unbalance" (distortion of voltage)

5. Item 4(b) can be eliminated as a distribution matter on the grounds that it is entirely dependent on generation, and remedy must be sought elsewhere. 1/ Items 4(c) and 4(f) can be eliminated on the grounds that they are

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1/ The technical literature contains an abundance of references.

produced by specialized consumers who should not be considered here, for reasons given in paragraph 3. Item 4(e) can be eliminated on the grounds that it is caused mainly by apparatus protecting the main and sub-transmission systems; moreover, any consumers likely to find it important are among the specialized types mentioned in paragraph 3.

6. Two basic elements must, however, be included in the subject of quality of service, namely, items 4(a) and 4(d). These elements -- Continuity of Service and Slow Changes in Voltage -- are discussed below.

III. Continuity of Service

7. Interruptions to electricity supply are of two main types:

(a) Random, caused by the breakdown of equipment, dry years in hydro-electric systems, years of sudden high demand, etc.

(b) Planned, caused usually by a planned program for maintaining equipment and extending services.

Planned interruptions need not be dealt with since, in practice, the value attached by the consumer to this type of interruption (when he receives a warning, which he usually does) is probably at least one order of magnitude different from that attached to a random, and therefore sudden, interruption. There is an obvious correlation between the level of planned interruption for maintenance purposes, the level of equipment breakdown and thus the level of random interruption. The effect of this can be assessed only by judgment. Above a threshold of level of maintenance this becomes a second-order effect.

8. It is necessary to decide on some yardsticks with respect to measuring the level and intensity of random interruptions. Examples of these yardsticks are:

(a) Number of interruptions per unit of time, say, per year.

(b) Number of consumers affected by each interruption.

The level and intensity of interruptions as measured by both of the above yardsticks will depend very much on the structure of the distribution network, its size and complexity, and its basic parameters, e.g. whether 33,000, 11,000 or 3,000 volt distribution systems are being used. Some interesting work has been done in Britain (see Annex 1) on the percentages of total random interruptions taking place and the average time of interruption on each part of the distribution system, characterized by voltage levels. Similar information for developing countries needs to be collected.

9. Based on criteria similar to those described in 8(a) and 8(b), comparative studies of different types of network[1]/ (differing in equipment,

1/ See "Principles for Planning of Electricity Distribution Systems in Urban Areas", by Lindea and Liveus; also "Comparision of Design and Operational Criteria of the M.V. Network", by a Group of Experts; also "Integrated System and Installation Planning" by W. Kaufman; all available in Research Files under UNIPEDE Distribution Conference October 1972.

structure, or both) can be made with respect to the level and intensity of interruptions to service. As a check on the results of these studies, an alternative criterion often used in the case of well-established networks is the ratio of kWh not previously supplied to the kWh now being supplied after improvement.

IV. Slow Changes in Voltage

10. Slow variations in voltage in this sense mean in developing countries moving, over a period of hours, from a low average level toward a lower level of voltage. It is more difficult to define basic yardsticks for measurement in this case than in the case of the level and intensity of random interruptions. Some yardsticks, however, could be:

(a) Average voltage level at a particular hour.

(b) Standard deviation of the variations from a prescribed voltage level.

(c) Number of times a particular low voltage level occurs per day.

V. Means of Changing the Quality of Distribution Service

11. Changing the quality of the distribution service has a basic effect on both the cost of the service and the benefits obtained from it. The cost side is more easily dealt with.

12. The following means can be used to change the quality of service:

(a) Change the basic structure of the distribution networks.

(b) Change the reliability level of the equipment.

(c) Change the level of protection against faulty equipment.

(d) Use or not use automatic equipment to restore service after interruptions.

(e) Change the methods and equipment for system operation.

(f) Change the methods and equipment for regulating the voltage (system on customer).

(g) Provide special mobile apparatus for emergencies.

(h) Stretch the thermal capacity of the system in emergencies.

13. To change the basic structure of the distribution networks (12(a)) is a system planning problem. For example, there is a fundamental difference between the "radial" system and the "mesh" system. In the radial system each customer has but one supply link, whereas in the mesh system he has more than one. There are, of course, "half-way" stages between radial and mesh designs, e.g. when each customer normally has only one supply link but in an emergency

can be connected to another (possibly inferior) link. Mesh systems are usually the most capital intensive and radial systems the least capital intensive. Another large difference lies between basically "overhead" and basically "underground" systems. Underground systems usually take over in practice for load densities of 10 MW to 25 MW per square Km.

14. To change the reliability level of the equipment (12(b)) is a matter for the specifiers of electrical equipment (usually the utilities) and the equipment manufacturers. With the advances in technology and the efficiency of manufacturing processes, it seems that all arguments now center on the cost of improving the rate of equipment availability from, say, 99.5% to 99.8%. Perhaps the developing countries' economies cannot afford availability levels above 90%.

15. To change the level of protection against faulty equipment (12(c)) is partly a system planning and partly an equipment manufacturer's problem. Protection of the system against damage by one of its elements being faulty is the function of special protective apparatus, which comes into service automatically with a degree of success and amount of system disturbance that basically are inversely proportional to the investment cost.

16. The use of automatic equipment to restore service after an interruption (12(d)) is becoming increasingly popular with respect to distribution systems; for example, this type of equipment helps to improve the standard of service of radial systems. It seems likely that the cost of such equipment (at present it tends to be high) will decrease with the advances in technology over the years. However, cost of manual restoration is not always high.

17. To change the methods and equipment for system operation (12(e)) is a matter for the utilities. This is the complement to 12(a), changes in the basic structure of the distribution networks, in that it means obtaining a particular standard of security out of an existing network, as distinct from designing a particular standard into a future network. Obtaining a particular standard out of an existing network often involves improving the efficiency of operation.

18. To change the methods and equipment for regulating the voltage (12(f)) is a regular means of improving the standard of supply by using specialized apparatus on the distribution system. 1/ The sole purpose of this apparatus is to help maintain a given standard of supply with respect to voltage level. Despite its cost, this type of apparatus might achieve net system savings in that a lower cost design of the distribution system might be made possible for a given standard of supply. Items 12(b), 12(c), 12(d), 12(e) and 12(g) act only on the level and intensity of interruptions, while item 12(f) acts only with respect to slow changes in voltage. Item 12(a) acts with respect

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1/ At a certain threshold of low average levels of voltage certain consumers begin installing costly voltage regulating equipment.

to both. In any case, however, some credible attempt usually can be made to cost the effects of the above changes and relate the costs of the changes to the quality of service. (Item 12(h) has been left out of the discussion in that a good deal of further investigation is required in the climate of developing countries.)

VI. Consumer Density

19. The quality of service which derives "naturally" from a particular type of network depends on the network's physical nature (e.g. as indicated in paragraph 12) and the consumer density. For a given type of network at a given design voltage, the greater the density of consumers the shorter the length of the distribution circuits, the lower the level of interruptions and the less the voltage variations for an average consumer. Similarly, the less the density of consumers the greater the level of interruptions and the greater the voltage variations. In general, consumers who cost the most to supply per unit of consumption generally get the worst quality of service and tend to be asked to pay the highest tariff (or consumer contribution). This may well not be the optimum manner of proceeding with respect to the economy as a whole and thus needs further examination. Typical data on the relative costs for different types of network -- e.g. radial or mesh type, overhead or underground design, etc. -- are given in Annex 2.

VII. Marginal Costs and Improvement in Quality of Service

20. Studies have been made in various countries (mostly in France - see Annex 3) involving different types of distribution systems to determine both the marginal cost per kWh not supplied (defined as the total additional cost required to prevent interrupting the supply of that kWh) and the cost increments per additional kWh sold. A general rule seems to be that the marginal costs for a "benefit" from a given quality of service represent a higher percentage of average costs in the case of medium-voltage distribution than in the case of low-voltage distribution. It remains to be seen whether this is because the in-built standby facilities are just not satisfactory (or needed) on a low-voltage distribution system, or whether there is a more fundamental reason.

VIII. Benefits

21. **Until more reliable measurements can be made of the socio-economic benefits derived from changes in quality of electricity service,** heavy reliance must be placed, using judgment, on looking into variations in changes in costs in relation to changes in the standard obtained. It may be possible in some cases to obtain, and use as a yardstick, a reliable estimate of what a customer is willing to pay for a given increase in the standard of supply, e.g. in the case of certain industrial and commercial customers. Until we gain more knowledge of the socio-economic benefits, however, the best approach to planning is to endeavor to establish a pricing policy that reflects as closely as possible the long-run marginal costs of

supplying service at a particular standard of supply and any income distribution, fiscal, etc., effects which are intended (see Public Utility Note No. 3 on Generating Plant Reserve Margins and Public Utility Note No. 5 on Public Utility Pricing).

22. The Public Utilities Department has started a research project to establish the whole "state of the art" with respect to what has been done throughout the world on Standards of Urban Electricity Distribution.

The Economics of Reliability of Supply - Distribution (Great Britain)[1/]

Percentage of Total Interruptions by Voltage of Distribution System

Voltage of Distribution System	Number of Consumers Affected (at most)				
	10	100	1000	10,000	100,000
	Percentage of Total Interruptions				
132,000 and above	5	8	14	50	100
33,000	15	18	28	40	0
11,000	5	26	46	10	0
200-600	35	48	12	0	0
Others	40	0	0	0	0
Total	100	100	100	100	100

Percentage of Faults Restored by Time Quoted by Voltage and Type of Distribution System

Voltage of Distribution System		Outage Time in Hours			
		1	10	100	1000
		Percentage of Faults Restored by Time Quoted			
33,000	Underground Cables	2	6	52	95
	Overhead Lines	43	83	100	100
	Others	20-60	60-80	85-95	100
	All	40	72	90	100
11,000	Underground Cables	5	23	90	100
	Overhead Lines	20	90	100	100
	Others	10-50	65-90	100	100
	All	20	80	100	100

1/ See paper of the same name by H.J. Sheppard, IEE, London, Conference Publication No. 34, Part 1, October 1967.

Guidelines to Distribution System Capital Costs in US$ (1968) [1/]

Overhead Distribution Systems	
13,800 Volt Primary Circuits, 3 phase	**Cost in US$ (1968)**
Wood pole construction, per Km	2,000 - 5,500
Concrete pole construction, per Km	3,000 - 6,500
13,800 Volt Primary Circuits, 1 phase	
Wood pole construction, per Km	1,500 - 4,000
Concrete pole construction, per Km	2,000 - 4,500
100 - 250 Volt Secondary Circuits on Wood Poles	
3 phase, per pole	110 - 220
1 phase, per pole	90 - 140
Transformers, Primary to Secondary Circuits	
3 phase, per KVA	5 - 16
1 phase, per KVA	7 - 13
Transformers, Pole Mounted	
3 phase, per KVA	15 - 50
1 phase, per KVA	20 - 45
Underground Distribution Systems	
Total System, excluding substation, per KVA	105 - 220

1/ Taken from a recent scan of the published technical literature.

Comparison of Marginal Costs for Improving Standard of Service 1/

Continuity of Service

Studies involving overhead and underground distribution networks have determined both the marginal costs per kWh not supplied (the additional expense on the distribution network to prevent non-supply of a kWh) and the incremental cost per kWh sold. For a radial system for which the number of kWh not supplied per year would be about 8, the meshing together of the system extends that radial network from 4 Km to about 6.5 Km for the same standard of supply; this would be worth doing if the value attributed to each kWh not supplied is 5 francs.

Furthermore, at 5 francs attributed to each kWh not supplied, for a "standard" French distribution network, the mesh network was shown to be a better investment than a radial network.

Variation in Voltage Level

Maximum voltage changes before the average consumer was materially affected were calculated and shown to be 3% of normal declared voltage for underground networks and 10% for overhead networks.

1/ Taken from "Report by the Mixed Group of Experts on the Quality of Distribution Service" UNIPEDE Report V/VI, 1970.

FORM NO. 75
(2-60)

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE CORPORATION

INTERNATIONAL DEVELOPMENT ASSOCIATION

ROUTING SLIP	Date June 27, 73

NAME	ROOM NO.
Mr C. Willoughby	G1050
File Power - Follow-up.	

	To Handle		Note and File
	Appropriate Disposition		Note and Return
	Approval		Prepare Reply
	Comment		Per Our Conversation
	Full Report		Recommendation
XX	Information		Signature
	Initial		Send On

REMARKS

You may be interested in the attached

From T.W. Barrie

Messrs. Kirmani, Knox, Thalwitz, Napenhans, and Weiner

June 25, 1973

Y. Rovani

Economic Analysis of Public Utility Projects

As you know the economic analysis and justification of Public Utility projects have been the subject of much discussion and disagreement in recent years. Management and the Board continue to raise questions which often arise, in part, from the different treatment given and terminology used in various Appraisal and President's Reports. In the near future, we hope to circulate a draft paper setting forth the rationale for the economic analysis which has evolved from the discussion and issue guidelines on the exposition to be given in Appraisal and President's Reports. Your helpful comments on an earlier draft are gratefully acknowledged. The final version of the paper is expected to be sent to Management and the Board.

In the meantime, it appears desirable to use more standard terminology especially in the Annex to the President's Report. I suggest that, for this purpose, we summarize the analysis along the following lines:

Benefits

"The rate of return is X% if benefits are measured by incremental revenue attributable to the project and financial costs are adjusted for taxes, internal transfers, etc." This statement should be followed by a further qualifying explanation, some examples of which are given below, to be used as appropriate to the situation.

(i) "However, the incremental revenue understates the benefits consumers receive from the project, since the level of tariffs is low and it is considered that a X% increase in tariff level, which would be necessary to cover the full costs of the incremental supply, would not reduce the projected demand significantly. (The willingness of consumers to pay more is illustrated by the fact that costly captive plant is being installed to meet electricity needs.)"

(ii) "However, this excludes the social benefits of providing an adequate supply of safe water to a large

segment of the urban poor at subsidized tariffs matched to their ability to pay."

(iii) "However, these revenues do not fully reflect the health benefits from a safe water supply (or the environmental impact resulting from better treatment of sewage)."

Cleared with and cc to: Mr. van der Tak

cc: Messrs. Baum, Baizen, Rovani, Howell, Jennings, Shipman, Warford, Anderson, Friedmann, Schkolnick, Rydell, Berrie

Files

TWBerrie:jr
IBRD

development benefits from spread of electrification – eg. increasing efficiency of small industry or aiding production and education in rural or marginal areas.

Bank undertook to disseminate results of above-mentioned research as and when available among staff and apply them.

Banks projects have not greatly increased % for

Distribution	Fy 70	Fy 71		Fy 72	Fy 73	Fy 74
		No	Amt ($)			
(1) Total Projects approved		12	2000			
(2) Total Loans approved		12	800			
(3) Distribution Part of Project.		6	500			
(4) Loan Funds for Distrib		4	50			
(5) (2) as % of (1)						
(6) (4) as % of (2)						

New connection policies need looking at in connection with all projects since part of what Bank is supplying are there, but in almost no project has this been done

Research studies done to show substantial ag & ind dev. benefits: Indian program emphasizes coordinated programs.

~~This will be~~ Looking at new connection policies will have to be done if proposed approach to IFR & IER is rigorously applied.

Bank should get into a position, with its new economic analysis of system extensions, to ~~[illegible]~~ assess, & provide advice to borrowers on, whether, from the economic point of view, their pace of new extensions sh'd be accelerated or retracted. ~~[illegible]~~

10
10
10
30
10
5
45

Self-help for Distribution expansion

6. Encourage authorities and power companies to find appropriate institutional mechanisms.

~~Necessary~~ The Bank undertook to be on the look-out for successful experience in this field with a view to including them in project or otherwise propagating them.

RE study emphasizes labor not a very important part in

Closing Report on Actions Relating to Recommendations of the Electric Power Evaluation Study

1. Purpose of Report and Basis – contact w CPs, review of research papers + guidelines and of last FY's appraisals
2. Summarize main conclusions of Report re Bank Action (2 pages)
3.

4. System Extensions : develop techniques for analyzing economic validity thereof. accelerate work on it.

Bk agreed with the need to study – to identify economic & social effects of system extensions to smaller & less dense markets, with a view to finding practical ways to improve C/B techniques and also provide a sounder basis for justifying departures from strict econ/financial pricing policies in attempting to meet social objectives.

Bank has carried out a major research study of rural electrification experience in El Salvador and produced a number of internal instructions and papers relating to the topic., However a preliminary appraisal has been made of a major R.E. project in India, giving special attention to economic justification. A number of other projects with major R.E. components are under consideration: Iran, Zaire, Peru

Further study underway in Ecuador. Appraisals of projects, even those with substantial distribution component, do not yet reflect this work at all

Studies done lead to conclusions:

1. Econ validity is relatively easy to assess for projects where much electricity will be for irrigation and industry (resultant increases in production & savings on alternative fuels), but expensive to do on an individual case basis even there, and almost impossible on individ case basis for residential. (quality improvements, savings on alternative fuels).

2. Thresholds and response (i.e. growth rate) are crucial may warrant subsidized tariffs in early years

3. Most practical way for general purposes is to establish a financial criterion, such as begin to contribute to depreciation (often covering already all other costs) after 5 years, as in India.

4. Go on using internal financial rate of return converted into internal economic return for system extension as for bulk supply projects but give more attention to relationship of tariffs to long run marginal costs of supply

Need to propagate the use of this system: practical experience. The Bank intends to have some of those who have done the research participate in project work.

Electricity generally being left out of rural dev projects (Mexico maybe be first one w. electricity) but not sure how is colour

5. New Connection Policies : assess them at both selection and appraisal stages to see if they respond satisfactorily to any opportunities that may exist for accomplishing significant

of RE, not more than 25% but since financing is a major constraint even this could be a major help to electrifying more people more quickly.

The bank is aware of several successful applications of this — Andhra Pradesh, banks of Colombia (Accion Communal),
but there is no effort any systematic effort has been made to propagate experience.

7. Generation + Transmission Reliability Standards

The Bank should develop, & require ~~it~~ its/its & consultants, ~~to~~ more systematic ~~~~ procedures for rational determination of reliability standards ——— with a view to eventual presentation in appraisal reports of explicit justifications of standards selected ———

The Bank indicated its agreement with this general proposal but emphasized the difficulties of estimating the cost to the economy of providing service at lower standards, ~~even if the cost~~ Research ~~was~~ and guidelines were intended to lead to appraisal reports explicitly stating the standard of risk of failure to supply.

The related research was cut short by staff shortages, but some useful notes were circulated. The subject continues to be reviewed by project engrs on basis of experience and judgment. But no statements of the type suggested are to be found, and no progress has been made in assembling and relating to developing countries, the information gathered in developed countries on costs of failures to supply. Nor are consultant terms of ref systematically examined for their coverage of this aspect.

Mexico - SoFelec

To get more attention to this simple guidelines

general agreement →

should be prepared, calling for ~~statement~~ treatment in feasibility studies and, to the extent possible, in appraisals of

(1) the standard of risk of failure to supply which is aimed at

(2) the costs of providing this standard as against a next lower one.

Remarks about why these extra costs are worth undertaking are likely to be generated automatically. But not a top priority: many of the more important borrowers are still suffering from shortages & have little or no adequate testing may be more important in some cases - e Brazil.

8. Distribution Reliability Standards

Distribution standards should be subjected to the same treatment as mentioned above for 6 & 7 and the Bank should encourage borrowers to carry out systematic studies to optimize distribution standards to local conditions.

The Bank expressed general agreement with these proposals and, emphasizing again some of the technical difficulties involved, referred to planned research to be undertaken.

A useful note has been prepared, on the aspects that need to be examined by appraisal and other Bank technical missions, and most of the planned research has been carried out, but it has not been possible to extend that research yet, as envisaged, to the case of a sample city in a developing country.

The work so far done suggests that there may be considerable scope for saving on costs simply to reach presently ~~desired~~ intended standards in many developing countries. And there is considerable interest in this subject, even though it is not yet in ~~practice~~ operational work receiving ~~much greater~~ attention than in the past, nor have systematic studies been urged on borrowers. However it is envisaged that the consultants who have done the research may participate in selected operational missions and that some specific studies may be undertaken by Bank staff to seek scope for reducing the cost of distribution,

Consultant preparation of ~~A project~~ project may materially in Ghana is covering this aspect

particularly a study of power development in East African countries, partly stimulated by concern about the possibility of distribution standards presently being excessive in Zaire. A useful step may be to require that (consultant) feasibility studies for distribution projects always present comparison of at least two alternative network layouts.

9. Urban Context

~~Const~~ Appraisal & sector reports could usefully consider power in its urban context and treat explicitly the question of balance between power and other services and facilities in terms of the quantity and quality of their supply. - - ---- & interrelations.

The Bank took the view that ~~these were not very serious questions and that~~ appraisal teams ~~anyway~~ had neither ~~the~~ the opportunity nor the ability to make judgments about the adequacy and ~~ability~~ quality of other services compared with power and that anyway they were not very serious questions, except possibly in very rare cases in which case they would be given special treatment. Normally these issues would be treated in the Bank's operations at the time of developing the country program and in discussions with Governments as to appropriate projects for Bank consideration.

Several cases of imbalance of urban services, with power being consistently more plentiful and better in quality than other services, have been encountered by the Op's Evaln Dept in its work on past Bank projects. It does seem that a problem has existed at least in the past. If appraisal missions are not able to treat this matter, perhaps President's Reports should reflect the clear judgment of the Bank's program officers regarding the extent to which ~~that~~ the problem ~~is not likely to~~ may recur in connection with the proposed project, perhaps with support in the form of statistics on relative availability and coverage of different utility services in the principal urban areas to be ~~supported~~ supported.

10. Tariff Structures

The Bank should increase its attention to borrowers' electricity tariff structures. Its objective should be to analyze wherever possible the extent to which ..... reasonably reflect incremental costs of supply ..... Explicit justification of deviations.

The Bank accepted this point, planning research, case studies and production of appropriate guidelines, but it stressed the shortage of qualified persons in the Bank and its borrowers to work on these problems.

The Bank has produced high-quality research, case studies (Tunisia a Sudan) & guidelines envisaged. It has increasingly raised questions about major deviations between charges to particular consumer groups and the cost to supply them, and these questions may arise more as the new proposals for econ. analysis of power project are systematically applied. The main limitation appears to have been shortage of staff trained to analyze cost structures and compare them with tariffs, but the matter is studied to a much greater extent than before in connection with project appraisals now.

specific The points raised seem now to be very generally accepted

Consultant studies of other measures to come up w. more rational tariff required at operational loan appraisal :- Algeria, Tunisia,

looked at :- Burma & Ri -

11. Strong Central Power Institutions

Encourage development of such .....

The Bank was in full agreement with this recommendation, very much in line with, ~~efforts~~ and indeed drawing on, the successful experience of the Bank in earlier years in this field.

It has continued over the past year to assist the development of several ~~more~~ new institutions of this

but not countries with many small power Cos. → Electrobras, Brazil.

type (NEPA in Nigeria, ZESCO of Zambia, PLN in Indonesia) and to encourage their emergence in other countries (CEA in India, Enel in Yugoslavia, SONEL in Cameroon, Morocco) Study also being done at Bank request in Iceland

12. Unified Control of G, T & D in urban areas

The Bank agreed that this point was relevant in certain circumstances.

~~On the whole, the~~ ~~appropriate circumstances~~

While the Bank has made very useful contributions in this direction in earlier years the ~~appropriate circumstances~~ need for this emphasis is becoming rarer now with the rationalization accomplished in many ~~towns~~ cities & regions, and with the growth of national bulk supply agencies assuring G & T.

13. Efficiency Indicators

The Bank agreed that there large potential benefits in ~~the~~ more systematic use of technical and financial performance indicators though at that time it seemed to think of them more for broad comparison between countries, to understand ~~actual~~ existing situations, rather than as bases for targetting improvement. Guidance was to be given to the Regional Offices in their application.

Instructions regarding the systematic use of indicators in appraisal reports have been issued, but

but it gave time targets with regard to completion of certain studies and steps, no values for the performance which was expected to be obtained (except overall operating ratio)

but still some variation of opinion about use and meaning

Interest in ef between countries.

they have not been followed except in a perfunctory way. An elaborate 'Plan of Action' was developed for the improvement of ~~the~~ one borrowing utility (in particular difficulties in Indonesia) and was presented in the appraisal report; in response to the Exec. Directors' request, during discussion of the project, a progress report ~~one year later~~ after one year was recently circulated to the Exec. Dr.

There appears to be unanimous agreement in principle that greater use of efficiency indicators and targets would be useful in Bank operations. More technical advice may be required to operating staff to help prepare meaningful sets of targets to reflect the problem areas in a specific utility's operations and the amount of improvement that is agreed to be feasible over the following years. Perhaps OPS should have followed up with doing an actual case, to show how it should be done (cf. argt about consultants staying to implement)

14. Planning Units' Functional Adequacy.

more attention in sector and appraisal missions

The Bank agreed, pointing out that ~~the~~ ~~adequacy~~ of ptg units needed to be examined for the adequacy of their techniques, their staff and their influence. Guidelines emphasizing these points were to be prepared.

This matter normally gets some attention from appraisal missions, but the difficulty is that problems are seldom subject to quick solution, mainly because good planners are difficult to recruit and train.

& some old borrowers are now effectively doing their own ptg: eg. EGAT in Thailand. VRA in Ghana

It would seem desirable to prepare the guideline envisaged, to underline the importance of this subject, and to seek even more thoroughly every opportunity for consultants preparing feasibility and system-planning studies, to include training in their

terms of ref. (but difficulty of absence/shortage of suitable trainees in some cases)

14. Training

Systematically consider need for trg. including the needs of the rest of the sector

The Bank fully agreed with this point.

A significant difference between current Bank-supported projects and earlier ones does seem to be that training receives much fuller & more frequent attention. Two ~~projects~~ loans approved in the last year have included particularly major PE contributions to training —

Papua & N. Guinea

Indonesia

Training in planning and accounting appear to need particularly close attention

15. Accounting System Weaknesses

More systematic diagnosis

The Bank emphasized the time required to install effectively improvements in accounting systems and financial planning techniques and ~~confirmed~~ suggested that the problem might be less in diagnosis than in follow-up on improvements proposed or agreed. To facilitate work it envisaged the preparation of Standard Financial Annex formats for appraisal reports and more supervision effort in this field.

There have been no notable developments in this field and the Standard Fin Annexes have not in fact yet been agreed. But syst. has continued to receive emphasis. More could probably

Cases where there are problems ... continue to receive special emphasis in appraisal – e.g. loan recently

be done, as is now being suggested and as the IDB has illustrated, by greater Bank work with the authorities

particularly important aspect is cash-flow planning: spec can help – or more use of a reporting requirement including revised cash flow forecasts every 6 months.

16. Specialized Consultant Firms to Check Cost Estimates

The Bank agreed with this recommendation for appropriate circumstances.

There is now wide awareness in the Bank of the advantage in some cases of having detailed revisions of cost estimates by specialized consultants. This fairly expensive technique appears to have actually been applied only to one project approved over the last year – the Kafue project in Zambia, for which at present it appears as though the original estimates ~~[illegible]~~ and ~~as well as~~ those of the specialist consultants (whose were actually lower) were about equally close to the final bids. It is not clear that greater use should have been made

a specialist individual consultant retained to study costs on part of Eldoret

17. Use of Shadow Prices

The Bank agreed that ideally shadow prices should be used in benefit-cost analysis, project selection, design, and construction and setting tariffs, although in practice at the time it use was largely confined to a few cases of project selection and to the calculations of internal economic rates of return (based on adjusted financial data).

The use of shadow prices has become ~~much~~ more widespread for ranging selection among alternative projects and

for calculations of economic returns in country situations that make them appropriate. But their use in assessment of tariffs, where they could be more important in the power sector, appears still to be the exception rather than the rule. And source and application somewhat haphazard — eg. in "economic analysis" tariffs of course excluded but shadow price sometimes still considered to be same as official price

More attention to use in connection w. tariffs, and fiscal help from country specialists: probably need to supply them in consultant terms of reference so that they can influence the basic design of ~~the~~ system

have they ever been included in basic documentation for consultants?

18. Fiscal Aspects

The Bank, ~~agreed that it would be useful~~ stressing that all flows between Government and power company as well as internal cash generation substitutes for Government capital contributions should and would quite easily be considered, planned to ~~be~~ prepare instructions on this subject.

The ~~first~~ planned instructions have not been prepared due to shortage of staff and appraisal reports for power projects have not yet included the proposed presentation. However the Bank has continued to intervene on this matter, sometimes suggesting ~~that~~ that a utility begin to pay ~~a~~ dividends to Government, as in Ethiopia, or ~~that~~ accepting or promoting as a means of improving a borrower's profitability that it should be relieved of taxation, as in Philippines. More general draft instructions, of more elaborate nature, have recently been prepared for all projects, not only those in power. And some research in connection with public utilities is being begun in collaboration with IMF.

There seems to be general agreement that this would merit more attention and be fairly easy

It is probably still true that a good starting point, not difficult, would be a simple presentation in appraisal reports of the various aggregate flows between Government and power company, perhaps with some comparative figures from other countries. This in itself would raise the most important questions.

19. ~~Institution-Building~~ Lending Delays for Institution-Building Purposes

They should be judged on an ad hoc basis but some evidence of Bank having been too restrictive in the past.

Very few delays in the past year
— Sudan: institutional problems
Turkey, Ethiopia: tariffs, staffing TEK (not lived up to commitments on earlier loan)

perhaps not enough between end of delay and what Sudan might actually get out of it. Making all "conditions" sine qua n

20. Sales of Participation in Bank Loans

The circumstances of the last year have not been very relevant to this point insofar as the Bank has not had difficulty in raising funds. It was considered in regard to Kafue project — Italians Coal become useful as means for oil-exporting countries to participate in IBRD loan.

21. World Trends in Power Financing

~~Not considered an im~~

The Bank agreed with this suggestion in principle but pointed out that staff constraints would not permit the amount of work that would be needed.

The Bank has in fact ~~done~~ found it necessary to do some ~~very~~ work on this at the global level in connection with assessing the impact of the energy crisis on its member countries. It is considering carrying the work to a more detailed level now insofar as capital requirements for electric power, which have long accounted for a remarkably large part of ~~international~~ loan financing between countries and internationally, may now become even more important.

22. Follow-up Evaluation Studies

no time, but still worth considering
Our Volta project v. worthwhile being ; doubts remain
about aspects mentioned - evalu — the buy-form low fixed price contracts
(we have been only tentatively renegotiated) with VALCO, the
resettlement problems (still unsolved) and the negative
ecological ~~effects~~ effects

Net result is a lot of research and useful guidelines, but little action yet in actual Bank operations, with some exceptions - Indo-RE

Conclusions

The Bank has done a remarkably large amount in terms of research and the preparation of policy papers and guidelines in the electric power field, especially in view of the large amount of effort that has to be diverted to dealing with energy problems. Nonetheless the effects of this research and guidelines has been slow to be reflected in actual operations. It may have suffered to some extent from faults shared with the evaluation report itself through perhaps less sensitivity at its stage — namely failure to bring the suggestions that have emerge down to the very practical level of specific instructions.

Problems:
(1) lack of economists, especially w. energy problems of Tariff / Non Conventional / Electricity
(2) Inefficient control and discipline on simple things (eg. fiscal, indicators

But a major problem in actual operational implementation of some of the suggestions of the recent documents' suggestions, as some of the evaluation report, has been the shortage of economists working in the future utility divisions units of the Bank directly responsible for operations.

visibility report

On the whole more important things of operational relevance among the suggestions made have received more attention — system extensions, distribution standards, tariff structures.

but slowness in reflecting in practice

An important way of disseminating some of the ideas developed, which is under consideration and seems useful, is an EDI course for senior power utility staff: eg. tariffs & rural electrification. Create demand from the utilities on consultants

of mention in connection w. Central Asia Study

This has covered all the principal concerns of the Bk in connection w. power, except one — namely inter-country interconnections, W. Afr., Cent. Amer., E. Afr.

Joined		73-74	72-73	71-72
1969	Anderson	research		research
July 71	Baker W. Africa (water)		water.	power (Wyatt).
1968	Berrie	out	research for power papers, guidelines advice to of depts – energy	→ ditto
1972	Bolte (EAf.)	? water	water/power feasibility appt reviews appraisal Malawi (tariffs) power	—
1971	Jennings (YP) grad. Feb 1'73	water	Minas Gerais water; Mexico water; small: Ecuador 15 village elect. survey; water/power sector briefs.	YP in CES.
1970	Montfort	power	Power: India RE a generally advised on econ justification of dev projects helped evaluate reports	Power: Indonesia Delhi? India Power transm. Brazil power & advising on econ justific
1968	Russell	power	Power: coordinate sector surveys/notes Syria pumping Iceland Sigalda appraisal Turkey Elbistan preapp.	Power: Start RE research coordinate sector reviews Pak power & review

		73-74	72-73	71-72
Now	Research	1	1, 1	1, 1
	Operations	2	2 ½	3

position vacant

Berrie

Shahan econ

2nd econ EMENA

Supplemented by:

some YPs.

some consultants.

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

OFFICE MEMORANDUM

TO: Public Utilities Projects Department Professional Staff

DATE: November 16, 1970

FROM: J. H. Jennings & T. Berrie

SUBJECT: Handbook for Appraisal

1. In view of the rapid increase in activity and expansion of staff over the past couple of years, it has become apparent that there is a need for collecting the various kinds of standing instructions (O.M's, D.M's, etc), and our working procedures that have developed from experience, into a single document. Thus, a concept called a "Handbook for Appraisal" has evolved. It will be more useful for new staff, but, based on trial runs with the first two sections, experienced staff will also find it quite helpful.

2. Attached are the first two sections:

a. Checklist for Appraisal Missions - which is designed to help plan and organize the work of appraisal missions; and,

b. Outline for Appraisal Reports - which is designed to aid preparation of appraisal reports.

3. In due course, there will be a section on "Procedures", i.e., the mechanisms of preparation and review of reports from white to grey covers; there will be a set of suggested formats for certain annexes (mainly the three basic financial annexes), and a glossary aimed at standardizing financial and economic terminology. Several brief "methodology" papers are also planned, covering subjects such as "How to Calculate an Internal Financial Rate of Return", "The Least Cost Solution", etc. The Handbook is seen as a collection of loose leaf stenciled sheets, suitable for carrying in the staff member's mission notebook. However, several other arrangements are possible.

4. In the Introduction of both the "Checklist" and "Outline" we have tried to make it clear that they are intended as aids - not as impositions. The professional competence and good judgment of the appraisal team, and the guidance of the Division Chief, continue to be the most important factors in the appraisal process; and full responsibility for the quality of our appraisal work rests with them.

5. These sections will be revised from time to time to reflect our experience in using them, and also our gradually evolving methodology. After you have used them, please tell us whether you have found them helpful, and give us any ideas for changing the form and content to make them more useful. If you find them worthless, tell us that too.

JHJennings/TBerrie:cdd

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

PUBLIC UTILITIES PROJECTS DEPARTMENT

CHECKLIST FOR APPRAISAL MISSIONS

**	See O.M. 5.02	- Project Appraisal
**	See O.M. 5.50	- Public Utilities
**	See O.M. 6.01	- Loan/Credit Preparation and Negotiation
**	See D.M. 1.1	- Preparation for Appraisal Mission

INTRODUCTION

The checklist is intended to serve as a reminder to appraisal teams of important points which need to be considered during most appraisal missions. All of the points listed are potentially vital for a given project. However, the ranking in order of importance will be different in every case, and some of the questions may not be relevant for a specific project. It is suggested that the first part of every mission (say 1/4 to 1/3) be devoted to a survey of all the major aspects - to the point where priorities for the appraisal of the particular project can be established. Then the remaining work of the mission can be planned so that the "must" things are done, along with as many of the "desirable" things as possible. If the project is a "repeater", or if there have been one or more preappraisal missions, it may be possible to do this planning before the mission.

The checklist does not reduce the appraisal team's full professional responsibility for the work of the mission. The team should consider all of the relevant aspects, whether or not they are on the list, and the extent to which each question is investigated is their decision. Thus, it should not be used mechanically, but as an aid to memory, as a means for organizing the work of the mission, and as a preliminary to preparation of the appraisal report. It is not an outline of an appraisal report. See the "Outline of Appraisal Reports", which contains suggestions for the focus and content of each section.

1.0 THE ECONOMY

Read at least the summary of the latest economic report and the sections on the sector concerned.

1.10 Consider:

a. Geography and natural resources;
b. Infrastructure;
c. Inflation;
d. Local currency availability;
e. Foreign exchange problems; and,
f. Cost of capital

1.20 Consider the overall effect of the project on the economy (including the effect of not doing the project).

1.30 How does the project fit with development plan?

1.40 How may the project be affected by decisions by the planning body - concerning either the project itself or any related project.

** See O.M. 4.02 - Country Economic Reports
** See O.M. 5.02 - Project Appraisal (paragraphs 6-8)

2.0 THE SECTOR

NOTE

Some of the detailed information listed in this section could only be obtained during a full sector study. If no sector study has been made, the mission should not attempt to make one; the scope of their investigation should be indicated in the terms of reference. However, the mission should, in all cases, attempt to obtain a broad understanding of the major questions.

If the sector is represented largely by one national entity, these questions will overlap to some extent with the Project, Borrower, and Justification sections. The mission should obviously adjust its work accordingly.

2.10 Organization (Legal and Institutional)

2.11 Review and evaluate applicable legislation.

2.12 Review the institutional structure of the sector with particular attention to the ministries and/or departments of the national government which have a direct interest or involvement in the sector. (Prepare an organization chart, if possible.)

2.13 Are the operating units public? private? or some variation or combinations of these?

2.14 Determine the means (if any) by which the national and/or local governments regulate and control the operating units of the sector, e.g., rates, capital and operating budgets, procurement, employment and personnel policies, board memberships, operating regulations, design criteria, expansion of service policies (e.g., rural electrification) appointment of management, public utility commissions, licences, etc.

2.15 What is the position of the borrower in the sector? Determine the relevant relationships with other parts of the sector.

2.20 Technical Characteristics of the Sector as a Whole

2.21
a. Present demand (national and by region);
b. Production and sales records (by category and total);
c. Losses (separating if possible - company use, "physical" losses, theft, inadequate meter reading, etc.);

d. Historic growth rates;
e. Demand patterns - national and local (kind of consumers, extent and timing of peaks, load factors, changes in areas served, effect of climate, etc.). Consider price and other policies affecting level and structure of demand;
f. Problems in quality or quantity of service, percent of population served;
g. Study and evaluate any recent market studies (national level);
h. Demand forecasts (total and by consumer class);
i. Describe any market studies needed; and,
j. To what extent has demand been affected by consumers providing their own service?

2.22 Determine existing production, transmission, distribution facilities (national and local).

Kinds, sizes, capacities, lengths, any noteworthy technical characteristics of important items.

2.23 To what extent can goods and services needed for operation and expansion of the systems be produced within the country? What are production capacities, quality, price? To what extent can or will they be competitive for the project?

2.24 To what extent does the sector have available the technical and managerial skills necessary to operate and expand the system?

a. Quantity and quality of managers, engineers and technicians;
b. Training facilities (universities, trade schools, overseas training programs, etc.); and,
c. Availability and quality of local consultants.

2.30 Sector Investment Program

2.31 What are the objectives of the sector program?

2.32 For other works included in the program (of which the project is a part):

a. Physical description;
b. Cost estimates;
c. Procurement and construction schedules; and,
d. Preparation and execution by whom?

2.33 How is the program being financed?

Major local and foreign sources (including the Bank Group).

2.34 General evaluation of the program

Is the development strategy the best of alternative possibilities?

** See O.M. 5.01 - Preinvestment Studies
** See O.M. 7.03 - Sector and Feasibility Studies

3.0 THE PROJECT

NOTE

Some of the questions considered in this section will usually be presented in the Justification section of the appraisal report.

** See O.M. 5.02 - Project Appraisal

3.10 Background of the Project

3.11 The borrower's present technical operations

a. History of physical production, bulk purchases, if any, and sales (by customer category, also geographical distribution, if relevant);
b. Losses (and analysis - see 2.21"c");
c. Historical growth rates (total and by category, if possible). Consider the effect of any very large consumers;
d. Important characteristics of production, transmission, distribution facilities. Is the system well-balanced? Is the technology appropriate?;
e. Load and plant factors (present and past trends) in principle areas concerned;
f. Service area and population served;
g. Number and kinds of customers (by same categories as sales);
h. General quality of service (evidence of shortages, if any) in principle areas;
i. Quality of maintenance and general technical operations; and,
j. What improvements, if any, are needed in technical operations (whether project related or not).

3.12 History of development of the project:

a. Studies, reports by borrower or others;
b. Quality of studies and proposals; and,
c. What is the present status of preparation of the project?

3.13 Demand forecasts:

a. On what methods and data are the demand forecasts based? (See 2.21 "e" and "h");
b. Have the forecasts been made from more than one approach, i.e., can they be cross checked in any meaningful way?

c. If more than one forecast has been made, do they form a consistent set?
d. Give an evaluation of the forecasts together with a credible range about the mean value if possible; and,
e. Should data collection and forecasting methodology be improved?

3.14 The borrower's investment strategy:

a. Is it intended to fully meet forecast demand? If not, why?;
b. Have sufficient alternative investment plans been considered? How were they selected?
c. How was the chosen plan selected? Was it a true minimum total present cost solution? Check the test discount rate and whether alternative plans would have been selected on other values of the test discount rate. How sensitive was the selection to this?
d. What is the sensitivity of the selection to uncertainties in cost and demand data, and other criteria, e.g., availability of foreign exchange, ability to obtain long-term debt, political constraints; and,
e. How does the project fit into the chosen sector development plan with respect to timing and alternatives? How sensitive is the project's selection to choice of sector development program?

3.15 Internal financial rate of return:

a. Calculate the return on the project alone, if possible. If not, can the rate be calculated for an increment to the system as a whole?
b. Can a meaningful range be placed on the return? What are the main parameters to which it is sensitive? Can the results usefully be expressed in the form of probabilities?
c. Can any meaningful benefits be included besides the financial revenues, e.g., social benefits, secondary benefits? What is the resulting increase in the return? Are there any other costs which need to be considered?

** See O.M. 5.03 - Economic Tests of Project Acceptability

3.16 Consider relationships between the borrower's program, the sector program, and any other related project.

3.17 If the borrower has had a previous loan or credit from the Bank Group or other development agency, evaluate the performance in executing the project. Reports from US-AID, IDB, and other agency projects may be relevant.

3.20 Description of the Project

3.21 What are the components of the project?

3.22 Which components are proposed for Bank financing?

3.23 Is the project self-contained? Or, are there outside elements vital to its success (e.g. sewerage connections over long-term).

** See D.M. 2.5 - Definition of Capital and Current Expenditure

3.30 Cost of the Project

3.31 Detailed cost estimate

** See D.M 2.3 - Presentation of Cost Estimates
** See D.M.2.4 - Calculation of a Project's Foreign Exchange Costs

a. Breakdown by component or contract;
b. Foreign - local;
c. Contingencies (physical and price level changes) by foreign and local exchange;
d. Engineering, training, management and consultants, etc; and,
e. Interest during construction shown separately.

3.32 What is the basis for the estimates? Degree of uncertainty? Risk of important changes in local and foreign inflation rates?

3.33 Comparative unit costs, if appropriate

** See D.M. 9.1 - Cost Ranges

3.40 Execution of the Project

3.41 Procurement (see Procurement Guidelines)

** See O.M. 5.08 - Procurement
** See D.M. 1.2 - Relations with Executive Directors
** See D.M. 2.6 - Statement Concerning Procurement
** See D.M. 7.1 - Origin of Goods
** See P.U.P.M 7 - Expenditures under Contract

Administration of procurement - what is role of consultants and borrower in preparation of documents, advertising, opening, analysis of bids, prequalification, etc.

** See O.M. 5.07 - Consultants
** See D.M. 8.1 - Selection of Consultants
** See P.U.P.M. 16 - Selection of Consultants
** See "Uses of Consultants by World Bank and its Borrowers"
** See O.M. 5.09 - Financing Engineering

Which contracts will be on full international competition? - limited competition? - local competition only?

What will be the position of local bidders?

** See O.M. 2.05 - Preference for Domestic Suppliers

Is standardization a problem?

Details of mechanism for comparison of bids (specific attention to local preference)

** See D.M. 7.2 - Comparison of Bids

a. Details of import procedures and any potential problem - e.g. import license, duties, taxes, fees, regulations, procedures, or customs that may affect project; and,
b. Joint or parallel financing (procurement aspects).

3.42 Supervision of construction

Role of consultants and borrower?

** See O.M. 5.07 - Consultants, etc.
** See D.M. 8.1 - Selection of Consultants by Borrowers

Field supervision, inspection, quality control.

Financial control (procedures to be worked out with accounting department), certification of payment requests.

Periodic reports, contract numbering system, etc.

** See D.M. 5.2 - Procurement Data

Schedules:
a. Procurement;
b. Construction; and,
c. CPM/PERT (if any)

3.43 Disbursement

a. Describe disbursement mechanism proposed for Bank loan;
b. Explain Bank requirements to borrower; and,
c. Prepare a quarterly disbursement schedule

** See O.M. 6.05 - Disbursement
** See Controller's Department Memo on Forms and Procedures

Details of disbursement or drawdown mechanism(s) for all other sources of funds.

3.44 To what extent does technical staff of borrower need strengthening for the construction period? operating period? - Should this be done with consulting firm, individual consultants, secondment from within the country, expatriates as individuals or under bilateral aid, overseas training, addition of permanent staff, etc.

3.45 Consider the construction phase from the point of view of the Bank's project supervision activities:

a. Are there any foreseeable problems?
b. How frequent supervision mission?; and,
c. Discuss reporting requirements (technical aspects).

** See O.M. 6.06 - Supervision

3.46 Miscellaneous

a. Identify any effects on the natural environment which the project may have (e.g. loss of agricultural land or fishing grounds; pollution of air and water; chemical pollutants harmful to man or wildlife; disturbing or destroying a valued natural habitat or reserve). Discuss the significance and possibilities of increasing, avoiding or minimizing these effects - and the costs involved. Should any related costs/benefits be taken into account in the estimate of the economic return;

** See P.U.P.M. 19

b. Resettlement;
c. Land acquisition problems; and,
d. Water rights

** See O.M. 5.05 - Projects on International Waters.

4.0 THE BORROWER

4.10 General Organization

** See O.M. 5.04 - Organization and Management of Project Entities

4.11 Is the present organization appropriate for planning, execution and operation of the project, or is some other kind of entity or a different structure needed? (This question needs particular attention when the project is large in relation to present operations.)

** See O.M. 3.02 - Choice of Borrower, etc.

4.12 What is the legal basis of the organization and any noteworthy features of the legislation or decree or charter, etc. If the necessary information is available, before departure the mission should discuss this question with the Legal Department.

4.13 What are the important provisions of any regulations or controls which affect the borrower (see 2.14)? Any problems of borrowing power or obtaining guarantee?

To what degree is (or should be) the borrower autonomous?

What constraints affect the ability of management to set rates?

4.14 Are there any unusual features of operating regulations, rules and by-laws?

4.15 Does the borrower have any activities other than electricity (water, telecom) service? How do they inter-relate?

4.16 What are the functions of the policy-making body (the Board of Directors or equivalent) and management and the relationships (formal and informal) between them? Are any changes indicated? How and under what conditions are Board members appointed?

4.17 Are there any close relationships with any other company(s) or department(s)?

4.18 Obtain or prepare an organization chart for the borrower.

Consider:
a. Lines of authority;
b. Span of control;
c. Division of operational responsibility;
d. Overlapping functions;
e. Departmental structure;
f. Informal structure; and,
g. Geographical structure

Any changes indicated?

4.20 Management and Staff

4.21 Investigate and evaluate the individuals in the top two or three levels of management for qualifications, experience, competence. How well do they carry out their technical, financial and general management functions - individually and as a team? Does management need to be strengthened? Should the Bank have a voice in selection of key managers? If the Board of Directors take an active role in management, their abilities should also be taken into account.

4.22 Would the organization be seriously damaged by the loss of one or two key men?

4.23 Adequacy in numbers and quality of staff below management level:

a. Engineers and technicians;
b. Accountants; and,
c. Administrators

Is there much turnover?

What are the important gaps (if any) at all levels, and/or describe any problems of overstaffing.

4.24 What is the total number of employees (by categories if possible)?

Is the total high/low? e.g. in relation to number of customers?

4.25 What effect will project have on company employment during both construction and operating periods? Are there any constraints on management right to hire and fire?

4.26 Are any special training programs indicated?

4.27 Are personnel policies satisfactory?

Consider:
a. Recruitment;
b. Salaries and fringe benefit levels;
c. Promotion; and,
d. Working conditions

4.28 Do all employees belong to a union? How strong is it? Have union-management relations been satisfactory?

4.30 Management Systems

4.31 Investigate and evaluate the accounting system, with particular attention to its design, how well it functions, and the quality and timeliness of its output. How effective are cost control methods, and the internal audit?

If the accounting system is not an effective management tool, what changes in the system itself and/or its operation are needed?

4.32 If the borrower has more than one activity, are separate accounts needed?

Is there need to protect against diversion of funds?

4.33 Audit

Are the arrangements for independent audit of annual accounts satisfactory?

Do the borrower and the auditor fully understand the Bank's requirements and standards for the audit?

** See O.M. 5.10 - Audit of Borrower's Accounts

4.35 Investigate and evaluate:

a. Technical and financial planning (long-term);
b. Budget system - capital and operating (annual);
c. Internal information flow (financial and operating information);
d. Meter reading, billing and collecting;
e. Purchasing;
f. Inventory control;
g. Public relations and customer service; and,
h. Insurance program

4.36 If changes in the management systems are indicated, to what extent is the borrower capable of making the changes itself? Is outside help needed? If so, how much, in what areas, and in what form?

** See D.M. 8.1 - Selection of Consultants by Borrowers.

5.0 FINANCES

5.10 Past Record

5.11 Analyse income statements for the past three to five years with particular attention to:

a. Average rate and rate structure (calculate "index rate"[1] for each year);
b. What has been the objective of rate policies;
c. Total revenues (by category). Note effect of past tariff changes;
d. Operating expenses (excluding depreciation): are they high or low in relation to sales, number of employees, physical plant characteristics, rate base, number of customers, fuel costs, etc? Do they reflect adequate maintenance? Do they reflect important price level changes? What are policies regarding capitalization of overheads?;
e. Depreciation (policy and rates);
f. Dividend policy (if any);
g. Is the borrower subject to income taxes? If so, how is the tax calculated? What other kinds of taxes are levied?
h. Calculate operating ratio and rate of return.

Keep in mind that trends over several years are more revealing than one year's accounts.

5.12 Analyse balance sheets for the past three to five years with particular attention to:

a. Plant account - basis of valuation? If revaluation needed, what is the best mechanism?;
b. Receivables - detailed analysis by customer category and age. If receivables are too high, what actions are needed? What is write-off policy, if any?;
c. Inventories - level, valuation;
d. Cash and equivalent - What is the normal level of working cash? Are overdrafts used routinely? Does level reflect needs for project or program? Does borrower have complete or limited control over its funds? How effective is management of cash?;

1/ The "index rate" is the average rate (expressed in US¢/kwh, US¢/1,000 US gal., etc.) necessary, with all other factors remaining unchanged, to produce a 10% rate of return.

e. Long-term debt - lenders, currencies, amounts (original and outstanding), terms, conditions, amortization schedules, mortgage and other indenture provisions, exchange risks, etc.;
f. Paid-in equity, retained earnings, customer contributions, identity of shareholder(s);
g. Accounts payable - by category and age. Are trade, contractor, supplier relationships satisfactory?
h. Short-term debt - lenders, purpose, terms, etc;
i. Contingent liabilities and commitments;
j. Material litigation; and,
k. Calculate debt:equity ratio and current ratio.

5.13 Analysis of cash flows for past three to five years with particular attention to:

a. Capital expenditures;
b. Sources of debt and equity;
c. Amount of self-financing;
d. Debt service coverage; and,
e. Effect of any change in exchange rates.

5.14 If the basic statements are consolidated, call attention to any important effects of the consolidation.

5.15 Obtain and analyse as necessary the statements of parent, subsidiary, or related companies.

5.20 Financing Plan

** See O.M. 5.02, pages 4-5

5.21 For the project and other works during the project period:

Requirements:
a. Capital expenditures by time period;
b. Debt service; and,
c. Working capital, dividends and other requirements

Source:
a. Bank loan - basis for amount and terms of loan proposed. Does the borrower need the loan? Is any retroactive financing involved? For consultant services - for supply or construction contracts? Is any local currency financing involved? If IDA, what relending terms and legal arrangements are proposed?

** See O.M. 2.01 - Payment Terms of Loans and Credits
** See O.M. 2.03 - Foreign Exchange Loans for Local Expenditure
** See P.U.P.M. 18 - Local Currency Financing
** See O.M. 2.06 - Interest During Construction
** See O.M. 3.04 - Security Arrangements

b. Other borrowing - local bond market, government, suppliers, etc. - amounts, terms, conditions;
c. Joint financing (if any);

** See O.M. 3.03 - Joint Financing

d. Other sources of funds - government equity or grants, sales of shares, customer contributions, internal cash generation; and,
e. Present status of all arrangements in (b), (c) and (d).

5.22 Are there well-defined and detailed disbursement or drawdown arrangements for all sources of funds?

5.23 What measures are proposed to cover any cost overruns?

5.24 Is there need for the Bank to establish any kind of control over the level of capital expenditure for the program and the project? After the project?

5.30 Financial Forecasts

** See O.M. 5.02, pages 4-5

5.31 General instructions:

a. Projected income statements, cash flows, balance sheets should begin with at least one year's actual figures (preferably two or three) and extend at least two full years beyond the year of the closing date. See _____ for the standard form of the statements and standard terminology; and,
b. The projections (especially the income statements and cash flows) should be completed (or at least roughed out) in the field so that the assumptions, the figures themselves, and their implications (e.g. for rates) can be discussed with the borrower.

5.32 Projected income statements

a. Physical sales - related to technical forecasts, any change in sales mix, losses? Any change in consumption expected to result from rate changes? To what extent are long-term sales contracts important?;
b. Rates and rate structure (what kind of covenant will be proposed);
Calculate average rate and index rate (see 5.11, (a)) by years;
c. Revenues - from sales, other fees and charges, interest, non-operating revenues. Take into account a reasonable amount for uncollectable accounts;
d. Operating expenses - detailed projection by category (see standard statements) and, if possible, separately by function (production, transmission, distribution, administration, etc.). Important assumptions in notes. Give specific attention to the effect of the project on the present level of operating costs;
e. Interest (see standard annex for debt service projections);
f. Dividends; and,
g. Analysis (standard ratios plus other noteworthy features)

** See D.M. 2.7 - Sensitivity Analysis

5.33 Projected balance sheets

a. Forecast of receivables;
b. Forecast of payables (special attention to processing of project payments);
c. Inventory changes;
d. Short-term investments, investments in subsidiaries, etc;
e. Plant account - work in progress and timing of entry of facilities into rate base, make clear the basis of valuation; and,
f. Forecast of debt - is there any need for Bank control of long- or short-term debt?

5.34 Analysis of balance sheets (see ____ for standard ratios).

5.35 Projected cash flow statements.

5.36 Analysis of cash flow statements (see ____ for standard ratios.

6.0 MISCELLANEOUS CONSIDERATIONS

a. Keep in mind the need for protective covenants and other kinds of assurances from the government and the borrower;

** See D.M 6.1 - Loan Documents
** See D.M. 6.2 - Contractual Documents

b. A timetable for specific actions or events pre-requisite to negotiations, signing, effectiveness of the loan should be discussed and agreed with the borrower;
c. The general provisions of reporting requirements should be discussed; and,
d. A specific channel of communication (including copies to other parties) should be agreed with the borrower.

JHJennings/TBerrie:cdd
November 12, 1970

FORM NO. 75
(2-60)

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE CORPORATION

INTERNATIONAL DEVELOPMENT ASSOCIATION

ROUTING SLIP

Date JUN 20 1973

NAME	ROOM NO.
Mr. C. Willoughby	

	To Handle		Note and File
	Appropriate Disposition		Note and Return
	Approval		Prepare Reply
	Comment		Per Our Conversation
	Full Report		Recommendation
XX	Information		Signature
	Initial		Send On

REMARKS

Public Utility Note No. 3

I attach one copy for your information.

Thank you for your helpful comments on the earlier drafts.

From Thomas W. Berrie Ext. 5368 Room D705

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

Folder Power Follow ups

TO: Public Utilities Staff (Power)

DATE: June 20, 1973

FROM: Y. Rovani YR-7471

SUBJECT: Public Utility Note No. 3
Generating Plant Reserve Margins

I am attaching herewith Public Utility Note No. 3 dealing with Generating Plant Reserve Margins, a topic of importance with respect to power system planning, operation, standards of supply, etc. This is the third of a series of "Notes" which, as I have explained previously, will be issued from time to time on a variety of subjects of interest to Public Utilities staff. These Notes are neither policy statements nor working instructions. They have been designed as a simple and flexible vehicle for communication, primarily with Public Utilities staff, regarding important developments, such as Public Utility Note No. 1 dealing with the Petroleum situation; to keep staff posted on specific Bank lending problems, such as Public Utility Note No. 2 on estimating the costs of Large Tunnels; to report on progress regarding longer term research projects such as Village Electrification; and finally, like this Note, to frame and comment on issues, not necessarily resolved, but of general interest in the sector.

The practice has been established to have these Notes reviewed by ad hoc panels including representatives of the utilities divisions as well as other staff. Their contribution is hereby acknowledged.

Your comments and specially any suggestions for subjects to be covered in further Notes would be extremely helpful and welcome.

Attachment

TWBerrie:jr

PUBLIC UTILITIES DEPARTMENT

P.U. Note No. 3

GENERATING PLANT RESERVE MARGINS

June 20, 1973

GENERATING PLANT RESERVE MARGINS

Introduction

1. This note describes some practical approaches to determining the amount of spare generating plant capacity that should be planned for in order to achieve an optimum standard of security for a particular electrical supply system. The more generating plant provided, the higher the standard of security obtained but the higher the amount of capital required; conversely, the less generating plant provided, the lower the standard of security obtained (and the less amount of capital required) but the greater the likelihood of loss to the economy from interruptions of supply.

2. Until the last few years, little attempt has been made to quantify the loss to the economy in planning for a particular standard of security, decisions on generating plant reserve margins having been taken on a purely subjective basis. Recently, however, it has been shown that in many cases it should be possible to carry out a simple arithmetic calculation to determine, at least within a range of values, what the reserve margin should be.

3. Since expenditures for generating plant require large amounts of capital resources, this question of what would be the optimum reserve margin is an important one, especially for the developing countries. Therefore, all appraisals of electricity supply systems should include an examination of the various elements involved in assessing the optimum reserve margin for the particular system under appraisal.

4. This note assumes that the estimated system demand (kW and kWh) must be met, dealing with how to come to grips with determining the standard of risk at which it should be met. It does not deal with the arguments either for or against making system extensions or raising or lowering the estimated system demand; both of these topics are dealt with in other Public Utility Notes.

GENERATING PLANT RESERVE MARGINS

I. The Problem

1. It is not possible to provide infinite security for electricity supplies as this would require infinite resources; hence the practical problem is to decide what standard of security should be planned for in a particular case. The plant shortage which causes the maximum loss to the economy is that of the generating plant, as distinct from the transmission and distribution plant. This is because a shortage of generating plant affects the system as a whole, while a shortage of transmission or distribution plant affects only a part (often a very small part) of the system. Capital expenditure for electricity can amount to 30% of the public expenditure, and expenditure for generating plant amounts to about 20 - 40% of this. This is of great importance to all economies, but particularly to the economies of the developing countries, where capital resources are difficult to obtain.

2. Practical methods of determining the amount of generating plant which is appropriate to planning a particular system vary from the "rule-of-thumb" to the sophisticated mathematical type, depending on what is warranted in the circumstances. At "risk" are both the capacity of the generating plant to meet the instantaneous demand (kW) made on the electricity supply system at "critical" periods (e.g. at the time of maximum system demand) and the amount of electrical energy (kWh) required over a given period of time, the latter being important mainly for systems with a large proportion of hydroelectric capacity. The amount of "spare" generating capacity to cover this risk is described as the "generating plant reserve margin" and is usually expressed as the excess of installed capacity over the maximum system demand divided by the latter.

II. Two Approaches

3. There are two approaches in determining generating plant reserve margins. The first one is not appropriate to the Bank's work; it is to consider mainly the financial consequences of different security standards on the supply utility only. This is the approach a profit-maximizing enterprise with no direct social responsibilities would use. Such an enterprise would either offer the lowest tolerable standard of generating plant security or merely raise prices to provide for any margin of spare capacity it considered desirable to maintain the "goodwill" of its customers, also bearing in mind their political influence. This is because:

(a) security of supply is expensive to provide;

(b) the number of interruptions of supply due to transmission or distribution failure greatly exceed those due to a shortage of generating plant, even though their total effect on the economy may be less; and

(c) within reasonable limits of standards of security, it cannot be proved that security significantly affects the rate of long-term load growth.

4. The second possible approach is to consider, in addition to the financial effect on the supply utility, the effects of electricity supply interruptions on the community, i.e. on industrial production, trade and business, social and leisure activities, etc., in all of which the loss of benefits to the community as a whole resulting from a supply interruption can greatly exceed the cost of the electricity itself. This approach of including the benefits to the community as a whole in the assessment of an acceptable standard of security is the one which is appropriate in the Bank's work.

III. Rules for Deciding on the Standard

5. The electricity supply industry should not spend less on security than the value of the loss, damage or inconvenience suffered by the community collectively from an interruption of supply, nor should it spend more. This criterion can be expressed as:

> The optimum standard of security is that at which the expected cost at the margin to consumers of kWh not supplied equals the expected cost of supplying those kWh.

Rule.

6. If it were possible to reflect in retail tariffs the costs of security for every hour of every day throughout the year, the decision as to what standard of security is appropriate could be left to the consumers. In some cases it is possible to give an approximation of this "message" to them by making special charges at critical periods, so far as the supply position is concerned. However, in most present tariffs the costs of security are spread over all kWh supplied throughout the year or a large part of it and the consumers are not given enough information to make a fully informed decision for themselves. Therefore, the main method of deciding on the standard of security is to estimate the marginal benefits and costs of security, so as to lead to approximately the same standard as the consumers would select if they could be given the full information. This requires a consideration on the following:

(a) The benefits of a particular standard of security

  (i) to consumers, in terms of how they might value kWh not supplied (included are community benefits, e.g. those of a "law and order" nature) assuming a given pricing structure;

  (ii) to the supply industry, in terms of the indirect loss through the effect of security standards on public confidence and goodwill and through the restriction on the natural growth and demand due to loss of confidence.

(b) The cost of security.

Each of these items will be taken up in turn.

IV. Benefits of Security to Consumers

7. It seems reasonable to suppose that the benefits of security to the consumers vary according to the time of day or year of the potential load reduction, its duration and the type or consumer affected. The duration of the load reduction can be particularly important in aluminum works and similar continuous-process industries where a lengthy disconnection might cause considerable damage. Unless such industries dominate, in order to simplify the problem it usually is possible to assume that either the duration of a disconnection will not be long enough to cause this sort of damage or that security for this type of supply is provided for separately from the rest of the system.

8. A difficult problem in trying to estimate the benefits of security for the separate classes of consumer is to distinguish between voltage/frequency reductions and total disconnections. Apart from those consumers using equipment sensitive to voltage or frequency changes (e.g. computers, control equipment or television), voltage and frequency reductions may be scarcely noticed or may become a normal part of daily life. This can be decided only in practice, however, as failure to supply kWh may cause high-value use to be denied (where the marginal value is greater than the price charged) and, alternatively, even marginal use may be less valuable than a marginal reduction in costs. Also, industrial, commercial and the wealthier residential consumers often adjust to voltage and frequency reductions by the extensive use of costly voltage regulators (as in Argentina).

Industrial Consumers

9. An estimate of the value of kWh not supplied must have regard to the possible pattern of production of goods and the capability and cost of being able to supply the producers. The maximum value of the benefits foregone by an additional consumer of a kWh not supplied is at least equal to the cost per kW of any captive plant he is prepared to put in (if any) divided by the number of hours during which he is catering for public power shortages. A lower value of the benefits foregone is represented by the change in value added (averaged out over the year) due to the non-supply of a kWh, remembering that some costs normally counted as variable (e.g. labor) may be fixed costs in the short run. The ability to determine these values with any accuracy will vary from case to case. A minimum value is the average revenue per kWh not supplied at current tariffs.

Commercial Consumers

10. An approach similar to the above can be made for commercial consumers. Here it is often more difficult to determine the change in value added (or the profits foregone) due to the non-supply of a kWh than in the case of industrial consumers. Again, the ability to determine the values with any accuracy will vary from case to case. A minimum value is the average revenue per kWh not supplied at current tariffs.

Domestic Consumers

11. Estimates of the value placed by domestic consumers on a kWh not supplied will vary according to the activity being performed and in some activities a short interruption of supply simply leads to postponement of the activity. The main items affected will be domestic work and leisure; time spent on either activity will vary with the life style, standard of living and wage level. In the case of a large domestic consumer, the maximum value of the benefits foregone due to the non-supply of a kWh is again represented by at least the cost per kW of any captive plant he is prepared to put in (if any) divided by the number of hours during which he is catering for public power shortages. A lower value of the benefits, however, and the value of the benefits foregone by average and small domestic consumers are much more difficult to estimate. Some estimates can be made from the total amount spent in a year on alternative apparatus for supplying heat/light (e.g. kerosene stoves/lamps and candles) divided by the number of kWh not expected to be supplied. A minimum value for this is the average revenue per kWh not supplied at current tariffs.

Community Services

12. With respect to the value of electricity in community services, e.g. street lighting, traffic lights, law enforcement and hospitals, which intrinsically have high socio-political values demanding individual high standards of security, it is more economic to provide them by means of emergency on-site generation or batteries than by raising the standards for all consumers.

V. Putting a Value on kWh Not Supplied

13. The above empirical analysis will lead to a set of values that consumers might place on kWh not supplied, as follows:

Industrial consumers:	**a¢ to b¢**
Commercial consumers:	**c¢ to d¢**
Domestic consumers:	**e¢ to f¢**

An average for each consumer class, weighted by the number of consumers - kwhs in the large, medium and small categories can be made. An average for all consumer classes, weighted for the proportion of total consumers-kwhs in each class, also can be made.

14. Comprehensive estimates were made in the period 1967/68 by a Swedish Committee on Supply/Interruption Costs, which carried out a survey among consumers of the real detectable cost of a supply interruption (i.e. excluding costs of a psychological nature -- anger, discomfort, etc.). A summary of the estimated value to consumers in Sweden of kWh not supplied, as determined by the simple system of weighting described in paragraph 13, is as follows:

Industrial consumers: 30¢ per kWh
(lower figures apply to consumers disconnectable at peak)

Domestic consumers: 78¢ per kWh
Commercial consumers: 96¢ per kWh

This Swedish work is worthy of study. The English version is "Costs of Interruptions in Electricity Supply" (September, 1969). 1/

15. The U. S. Federal Power Commission in its report on the Northeast Power Failure in November, 1965, suggests that the total economic loss attributable to the failure was in the neighborhood of $100 million. At a recent UNIPEDE Congress in Madrid, Lalander of Sweden suggested that this was consistent with the Swedish estimate that the average cost to consumers of a supply interruption is 20¢ per kW plus 40¢ per kWh. Another example of the value of electricity not supplied, which was applied by a power company in Japan in the 1960s, is:

kW value: $2.8 to $6.6 per year (depending on the magnitude of the interruption)

kWh value: 20¢ per kWh

16. The effects of an interruption of supply depend not only on the kWhs not supplied but also on its gross magnitude; for instance, the effect of a loss of 100 MW demand for five minutes might not be equal to a loss of 5 MW for 100 minutes. Thus, in calculating the benefits of electricity supply, both the kW-value and the kWh-value should be taken into account if this is practicable. All of these figures can be regarded as only the crudest of guides. They have been determined for large, interconnected electricity networks in developed countries. The values for developing countries may well be different, especially for those with small electricity networks. For reference there is a report prepared by Ebasco Services for Taiwan Power Company on system reserve capacity requirement under the system planning study of the Bank's second power loan to Taipower. 2/ The report tries to find the optimum standard of security by balancing the investment cost and the losses to the economy due to power curtailment on a macro basis. Although the result was not perfect due to insufficient basic information, the approach is correct.

VI. Benefits of Security to the Utility and the Economy

17. The direct benefits to the economy as a whole are any sales taxes received from the sale of kWh that would not otherwise be produced.

1/ Available from the Public Utilities Department, CPS.

2/ Available from the Public Utilities Division, Asia Projects Department.

18. The indirect benefits of security to the utility are the goodwill associated with a high standard of supply. This is partly reflected in the attitude of consumers toward installing privately owned plant, as already discussed, and partly in the consumers' attitude toward paying their bills on time, etc. It also affects the long-term growth rate of the power sector. 1/ All indirect benefits are intangible and can be decided on only by judgement.

19. A higher standard of security eases the tasks of management from the operational and some public relations points of view (it may increase the tasks from the financial and other public relations points of view). The question has to be asked, however, how much consumers' money should be spent to safeguard the industry's reputation or to ease the tasks of its managers. Before proceeding to the cost aspect of security, some linking items will be dealt with, i.e. when and how to provide for security.

VII. When to Provide for Security

20. Any part of the electricity supply system can fail at any time. With respect to generating plant, sufficient plant must be operating, or available at any time, at less than full output to take over quickly a reasonable proportion of the loss of output caused by the failure of other generating plant in the system.

21. In power systems with a large proportion of thermal generating plant the period of system peak demand, 2/ when nearly all generating capacity is in operation, needs to be especially catered for. For planning purposes some spare generating capacity (kW) must be built into the system.

22. In power systems with a significant proportion of hydroelectric plant, besides the period of system peak demand a further period of importance is the critical period when there is danger of not being able to supply both the maximum demand (kW) and/or electrical energy (kWh) requirements due to lack of water in the reservoirs. For planning purposes some spare hydro storage or steam plant (kWh) must be built into the system.

VIII. How to Provide for Security

23. Whether maximum demand (kW) or electrical energy (kWh) is the predominant factor, the basic method for providing security is to install a margin of spare generating plant over and above the capacity required to meet the mean expected peak demand and usually expressed as a percentage of the latter. Some of the countries with significant proportions of hydro plant take for their hydro capacity the maximum output that could be depended upon in the driest year, and in other such countries the average year is used in the estimates.

Reliable one? That's security judgement.

1/ There is some dispute over this, see paragraph 3.

2/ In such systems this is usually the only "critical" period.

24. Methods of determining what degree of security will be provided by a particular size of generating plant reserve margin 1/ are based on "probability" and/or "experience." "Probability" in this connotation means that the probability of meeting demand (kW or kWh) is calculated from empirically found distribution functions of the deviations of generating plant availability and demand at any particular time from the mean expected values. The distribution functions are based on a statistical analysis of past years. The use of "experience" is similarly based on an analysis of past years; but generally only average quantities are calculated and judgment is used to fix the appropriate allowance for departures from the average.

25. The method of quoting the degree of security is very often in the numbers of years in ten in which a supply failure can be expected, due to a shortage of generating plant (kW of kWh). Four components 2/ of "allowance" are usually catered for in the above process:

(a) Allowance for uncertainties of load (kW of kWh).

(b) Allowance for generation output being below the maximum expected (late commissioning, lack of availability of existing plant or unexpected hydrological conditions).

(c) Reliance on interconnection between generating plants.

(d) Allowance for load reduction by reduction of voltage or frequency or by disconnection by mutual arrangement with consumers.

The degree of security warranted in any situation can be determined either by judgement from past experience or by finding the implied plant margin whose costs equate the benefits to consumers and the economy, as calculated in paragraphs 7 through 13, or a mixture of both.

26. Additional security implies an additional plant margin and therefore additional capital cost for the generating plant and associated transmission equipment to connect the plant to the electric power system. These costs are usually calculated on a $/kW/annum basis, the capital cost per kW being converted into an annuity over the plant's economic life at an interest rate equal to the opportunity cost of capital.

1/ As the margin increases, the degree of security must also increase.

2/ See "Security of Supply in Planning and Operation of European Power Systems" by Peter Cash and Edward Scott, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-88, No. 1, January 1969 (Available in the Joint Library).

27. Some further points to be taken into consideration are:

(i) The addition of new, (usually) highly efficient generating plant to the system can, in the first few years of its life, effect large savings in total operating costs in that some of the existing plant need not generate so many kWh. This effect must be costed, the costs given a present value, these present values totaled, then annuitized over the life of the additional generating plant at an interest rate equal to the opportunity cost of capital and the annuity subtracted from the annuitized capital cost. 1/

(ii) In systems where the degree of interconnection is small, a small amount of judgment is better than a great deal of calculation.

(iii) It is usually possible to make up for shortages of supply in the medium term by adding either diesel or gas-turbine plant, but this may well not be the most economic in the long-term.

IX. Calculating the Warranted Plant Margin and the Degree of Security

28. Thus the arithmetic of calculating the warranted generating plant margin and the degree of security becomes 2/ a matter of determining that margin at which

? what is the unknown? I_C?

$100\ I_C$ = H times I_B where,

I_C = Net cost in \$/kW/annum of an incremental increase in plant margin.

H = Number of hours per annum considered to be at risk at the degree of security. given

I_B = Incremental benefits in ¢/kWh/annum.

29. The relationship between the plant margin and the degree of security for a particular system and how these can be calculated are described in paragraphs 23 through 26 and in more detail in the article cited in the footnote in paragraph 27. The heart of the calculation is the daily load curve of electricity demand against time for "typical" days of the year.

30. In many situations it may be judged that there is insufficient data to calculate I_B. In such cases a rough check on judgment can be made by dividing I_C by H (both can be determined with some accuracy for any system) and judging whether the community would be willing to pay the quotient times

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1/ See "The Economics of System Planning in Bulk Electricity Supply" by T.W. Berrie, in "Public Enterprise", Penguin Economics, 1968, available in the Joint Library.

2/ The worthiness of separating out a warranted margin to cover the most critical period (kw), as distinct from that to cover an average of all periods at risk (kWh), is not great, except in the case of the most complex of electricity systems.

100 for I_B. If I_B looks about ten times too high (or low) then one can expect that something is wrong with the generating plant reserve margin being used for planning purposes. Some perspective must be borne in mind when making such a judgment with respect to the "lumpiness" of plant installation. When large elements of generating plant capacity are being installed as a regular part of a plant extension program, then I_B should be applied to the average conditions over (say) a five year perod.

31. In the few cases where the judgment referred to in the above paragraph cannot be used, it is still possible to examine alternative degrees of security with their implied plant margins and net costs in order to "seek" a set of appropriate values. In Annex 1 are typical criteria for determining "ad hoc" generating plant margins, and in Annex 2 are some typical values.

32. Annex 3 gives a list of questions which appraisal missions can use to collect information on this subject and make an assessment of the standard of security which is appropriate for the particular system being appraised.

ANNEX 1

Typical Criteria for Determining "Ad Hoc"

Generating Plant Margins at Critical Periods

Which ones are recommended for Lde's?

Predominantly Thermal Systems

Largest generator out of service.
Largest and second largest generator out of service.
Largest generator and largest transmission link out of service.
Judged percentage of system peak demand from past experience.
Typical figures from other systems (see Annex 2).

Predominantly Hydro Systems

Water availability during a "dry" year.
Water availability during an "average" year (5 out of 10).
"Effective" generation capacity.
Typical figures from other systems (see Annex 2).

ANNEX 2

Degree of Security of European Systems /1

Country	Predominant Problem	Basic Method	Gross Plant Margin (% Peak Demand)	Degree of Security (years of Failure/10 year period)
Austria	kW and kWh	Experience	9 (of Ultra-Dependable Hydro)	No Estimate
Belgium	kW	Probability	15	0.1
Denmark	kW	Probability	16-20	2-2-1/2
France	kW and kWh	Probability	17	0.7
Germany (F.R.)	kW	Experience	17	No Estimate
Great Britain	kW	Probability	17	0.3
Hungary	kW	Experience	9	No Estimate
Italy	kW and kWh	Probability	16	No Estimate
Netherlands	kW	Probability	27-30	0.03
Norway	kWh	Experience	16 2/	0.1
Poland	kW	Experience	14-1/2	No Estimate
Portugal	kWh	Probability	20-25	0.5
Spain	kWh	Experience	20	0.5
Sweden	kW and kWh	Probability	19	0.3
Switzerland	kWh	Experience	10-15	No Estimate

/1 For much more detailed information see "Security of Supply in Planning and Operation of European Power Systems" by Cash and Scott, IEEE Transactions on Power Apparatus and Systems", January 1969, available in Joint Library.

/2 Gross Plant Margin calculated on a somewhat different basis using "firm" capacity instead of installed capacity. Norway is an all-hydro system and always carries out calculations on the basis of "firm" capacity of generating plant, i.e. that capacity which can be depended on (calculated from the water available) at the critical time.

Checklist for Appraisal Missions

The following items are listed as a reminder to consider the important elements in assessing the required margin of spare generating plant in any development program:

1. What is the "critical" period for the system (time of year, duration etc.)?

2. What is the implicit or explicit standard of risk adopted?

3. Is the value assumed for the percentage of total generating capacity available at times of system peak demand reasonable? How was it determined? Could a figure greatly improved in accuracy easily be produced by better data or method of analysis? What is the adequacy of records of duration, size and periodicity of historical outages of generating plant?

4. Have errors in forecasting the maximum demand and/or total system energy requirements been allowed for adequately?

5. Has any allowance been made for "interruptable" demands?

6. What percentage of demand can be removed by reducing voltage and frequency?

7. For systems with a significant amount of hyrdo plant, what class of rainfall year has been planned to (average or low)? Is this assumption reasonable?

8. Has the feasibility of obtaining electricity from other systems been examined?

9. Has any thought been given to determining the change in costs to the economy of planning to a higher or lower risk standard? If not, could some figures be easily calculated, however crude?

10. Is the level of generating plant margin consistent with normal planning practice on similar systems?

Predominately Thermal Systems	10% to 25% 1/
Mixed Hydro-Thermal Systems	15% to 30% 1/
Predominantly Hydraulic Systems	20% to 40% 1/ 2/

1/ The above figures are defined as the excess of installed capacity (kW) over the estimated maximum demand divided by the latter, and assume a reasonable degree of transmission interconnection between generating stations.

2/ See also note 2/ of Annex 2 in respect to using firm capacity instead of installed capacity.

FORM NO. 75
(7–73)

WORLD BANK GROUP

A1

ROUTING SLIP	DATE 2/6/74

NAME	ROOM NO.
Mr. Willoughby	

	APPROPRIATE DISPOSITION		NOTE AND RETURN
	APPROVAL		NOTE AND SEND ON
	COMMENT		PER OUR CONVERSATION
	FOR ACTION		PER YOUR REQUEST
	INFORMATION		PREPARE REPLY
	INITIAL		RECOMMENDATION
	NOTE AND FILE		SIGNATURE

REMARKS

FROM	ROOM NO.	EXTENSION
J. L. Howell		

M. Willoughby

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

1818 H Street, N.W., Washington, D. C. 20433, U.S.A.

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June 1, 1973

Mr. K. Shaw
Administrative Director
Overseas Consultancy Services
The Electricity Council
30, Millbank
London, SW1P 4RD
England, U.K.

Dear Mr. Shaw,

Standards of Urban Electricity Division
Research Project

No doubt you will have seen a copy of the letter to myself from Mr. P.M. Prior, Deputy Chief Engineer, South Wales Electricity Board. I briefly acknowledged the letter on May 16, 1973 and must apologize for not sending you a copy.

I would acknowledge that it is Stage I(a), involving the writing of the "State of the Art" paper only, which is the subject of seeking from you a proposal at this stage. The Terms of Reference for the work remain as those attached to my letter to you of March 29, except that I would like to add to the "Background" the perspective of the difference between dealing with large as compared with small towns.

Bearing in mind the approximate time expected to be devoted by your two-man team, as given in the attachment to my letter of March 29, 1973, could you please send to me a formal proposal for taking on this work including:

1. A total cost, plus an approximate breakdown for each item numbers 2 through 6 of the Terms of Reference.

2. When your team will be able to start work.

3. Whether your team will be able to carry out the items in the Terms of Reference without breaks in between; if not, when you would expect to complete the work.

I have no special comments on the letter from Mr. Prior to myself of May 16, 1973. We are basically dealing with those parts of the system at (say) 11 KV and below. The effects of devices and designs of those parts of the system above these voltages would be treated as exogenous inputs into the study. I have a general comment, which is to point out the importance of gathering together everything possible on the benefits side,

i.e. the economic cost of kWh not supplied by adopting various standards of supply. It did occur to me that the use of one of the economists at the Council (Mr. Boley?) for a very short period would be extremely beneficial.

To save time I am copying this letter to Mr. Prior and look forward to your replying at an early date. My target is to commence the study sometime in mid-July, 1973.

Sincerely yours,

T. W. Berrie
Power Economics Advisor
Public Utilities Department

cc to Mr. P.M. Prior
Deputy Chief Engineer
South Wales Electricity Board
St. Mellons
Cardiff CF3 9XW
Wales

cc: Messrs. Stern, Ray, Dunkerley, van Gent, Willoughby, Rovani
Howell, Friedmann, Berrie

Files

TWBerrie:jr

OFFICE MEMORANDUM

TO: See Circulation Below

DATE: June 1, 1973

FROM: Y. Rovani

SUBJECT: Central Projects Memorandum: Public Utilities Series
The "Return on the Investment" in Public Utility Project Appraisals

Since it was introduced a few years ago in the appraisal of public utility projects, the calculation of an internal economic rate of return on a project has been the subject of continuous controversy. This matter is already dealt with to some extent in OPM2.63 "Public Utilities". The above Central Projects Memorandum is meant to be read alongside OPM 2.63 and to be an extension to it on the matter of the return, giving clarification in the light of recent experience.

Before the Memorandum is issued in final form, and bearing in mind its importance, I would like to receive comments from you on the attached draft by Wednesday, June 13, 1973.

Attachment

Circulation: Messrs. Kirmani, Knox, Thalwitz, Wapenhans, Weiner, Arnold, Krombach, Morse, Sheehan, Wyatt, Churchill, J. King, Haq, Stevenson, van der Tak, Willoughby, Barry, Eccles, Gillette, Street, Zinman

DRAFT: May 23, 1973

CENTRAL ~~POLICY~~ PROJECTS MEMORANDUM

PUBLIC UTILITIES SERIES

The "Return on the Investment" in Public Utility Project Appraisals

1. Since it was first introduced a few years ago in the appraisal of public utility projects, the calculation of an "internal economic rate of return" on the project has been a subject of continuous controversy amongst public utility staff in general and economists in particular. The return in this memorandum is defined as the discount rate which equates the economic costs and benefits attributable to the project over the economic life of the latter; the economic benefits normally being approximated by attributable revenues.

2. The controversy stems from the serious doubts expressed by many over the role played by the return in the project justification process in that:

(i) consideration of going without the project in the public utility sectors is "known" not to be a practical alternative (because of the serious loss caused by electricity shortage to the economy), and a return calculation is not needed to prove this;

(ii) the method used often gives questionable and unreliable answers due to the difficult assumptions that one needs to make in the public utility sectors, in order to allocate the incremental revenues experienced by a whole "system" between the project and the other elements of the system; and

(iii) the justification of the project continues to be based on (a) an evaluation of the market forecast over the life of the project and (b) the least-cost solution, at the opportunity cost

of capital, of the alternative programs of projects to meet the market forecast.

3. At the same time, the calculation of the return has increasingly been shown to be useful for quite a different purpose:

(i) it has caused people to ask themselves questions which would otherwise not have been asked. For example, in the Mexico City water supply sector the borrower's financial position for the near future was seen to be adequate; however, the low return on the new investment pointed to a position in which the average price of water was lower than the rising incremental cost of supply, reflecting increasing scarcity of water resources (Report No ... Annex 13, para...). Also, the Bombay municipal water supply tariffs were estimated to be adequate to achieve the utility's financial immediate objectives. However, the low return on investment showed that willingness to pay was not used for decision-making, nor had the tariff structure been used in any conscious way to achieving the objectives of serving poorer elements of society with water (Report No... para ...). In the recent Jordan power project (Report No... para...), the low return on the investment of that portion of the project being installed to meet growth in peak demand indicated an urgent need to examine the present level of tariffs at time of peak demand.

(ii) a paper is in draft, which develops a new methodology for calculating the return on electric power projects. The methodology is directed towards using the calculation for indicating necessary reforms in present pricing policy, rather than justifying projects. Low returns would normally not lead to rejection of projects but to gradual and selective price increases; high returns may lead to selective price reductions. This paper is to be finalized shortly.

4. This memorandum explicitly recognizes that the purpose of calculating the return on investments is no longer to deal with the justification of projects but rather to improve the quality of the economic analysis of the projects and to make policy recommendations in public utility pricing.

5. Therefore, this memorandum, to be read in conjunction with OPM 2.63, recommends that:

(a) the calculation of the return should continue to be attempted in every one of our appraisals, and in the process, due regard should be given to applying shadow pricing, external benefits and income distribution factors whenever relevant;

(b) when this calculation is not meaningful, i.e. when no reasonably reliable assumption can be made as to allocation of system benefits, the report should not specify any return and say why it does not;

(c) in all other instances, the value of the return should be shown, along with reasonably standard language of definition along the lines of paragraph 1; in the very many cases, where the return can be regarded as "normal", i.e. approximates to the opportunity cost of capital, any further statement suggesting the existence of consumer surplus or otherwise should be avoided, since in these cases, OPM 2.63 provides an entirely adequate background;

(d) on the other hand, any particularly important feature should be commented on; such include:

(i) description of important assumptions such as shadow pricing;

(ii) comments on sensitivity to changes in important parameters; and,

(iii) interpretation of "abnormal" results, either low (say less than 8% to 10%) or high (say more than 15%), especially with respect to pricing; give conclusions and recommendations;

(e) the return should be known by the "neutral" term "return on the investment" since:

(i) although financial data may be all that is available, the return defined in paragraph 1 is plainly economic in nature and the name "internal financial rate of return" on the project is too easily confused with the annual financial return on the utility;

(ii) yet the name "economic return" is inappropriate, since the benefits are normally approximated by consumers' revenues attributable to the project, which are more a reflection of pricing policies in a regulated industry than an approximation of benefits.

(f) the chapter in appraisal reports presently called "Justification of the Project" should not include the return on the investment since:

(i) its inclusion tends to imply that the return on the investment is one of the project choice decision-making elements; and

(ii) discussion of pricing policies and tariff structures is the most important reason why the return is calculated, as it is aimed at changes in pricing policy which will help improve decision-making for subsequent projects.

(g) the return on the investment should be included with the rest of the discussion on the tariff structure in appraisal reports.

6. In the long term, as the whole process of public utility pricing undergoes adjustment by the Bank's borrowers in the direction of becoming aligned with incremental costs, then the return on investment will gradually become meaningful as a guide to investment decisions, prices will more nearly

approach incremental costs, and conditions will approach much nearer those in other sectors of the economy, where there is a world market price by which to measure benefits. This indeed is the main impetus for working towards marginal cost pricing.