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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

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NORWEGIAN WATERCOURSES AND ELECTRICITY BOARD

TOKKE EXPANSION PROJECT

NORWAY

November 23, 1960

Department of Technical Operations

CURRENCY EQUIVALENTS

7.143 Norwegian Kroner	=	US \$1.00
1.00 Norwegian Kroner	=	US cents 14
1.00 Norwegian Kroner	=	100 Norwegian Øre
1 Norwegian Øre	=	1.4 US mills

NORWAY

NORWEGIAN WATERCOURSES AND ELECTRICITY BOARD

TOKKE II and III HYDROELECTRIC PROJECT

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NORWAY

NORWEGIAN WATERCOURSES AND ELECTRICITY BOARD

TOKKE II AND III HYDROELECTRIC PROJECT

SUMMARY

This report covers the appraisal of a proposed power project consisting of the Tokke II and III hydroelectric power stations, with an aggregate capacity of 410 MW, together with transmission lines interconnecting the power system of southern Norway with western Norway and Sweden. The total capital cost of the project will be the equivalent of US\$58 million (\$41 million for the power stations and \$17 million for the transmission facilities). The project has been submitted to the Bank for consideration as the basis of a \$25 million Bank loan.

ii. The Borrower would be the Kingdom of Norway and the loan would be expended largely in Norway by the Norwegian Watercourses and Electricity Board (NVE) to build the project as an extension of the Tokke I hydroelectric project now under construction. The Bank has made two previous power loans to Norway, one of US\$25 million in 1956 and the other of \$20 million in 1959. Both projects are under construction and will commence operation in 1961 and 1963 respectively.

iii. NVE will have full direct responsibility for planning, designing, building and operating the project. NVE's organization management are sound and it is well within their ability properly to discharge these responsibilities.

iv. Planning and design of the facilities in the project are well advanced. The project is justified both technically and economically. Construction work on the power stations is scheduled to begin in 1960 and to be completed in 1964. Construction of the transmission facilities will be phased to meet the power station completion program. These schedules are realistic and feasible.

v. Power rates charged by NVE for domestic and export deliveries are expected to result in a gradual increase in average unit revenues from the present 2.3 mills/kwh to about 3.1 mills/kwh in 1967.

vi. This increase in average unit revenues would raise the return on NVE's investment in power facilities from the present level of about 5% to about 7% in 1967. The return would be higher if proceeds of the electrification tax were taken into account.

vii. The project is considered suitable for a Bank loan of US\$25 million equivalent to be amortized over 25 years, including a grace period of 4 years.

## I. INTRODUCTION

1. The Kingdom of Norway has requested a \$25 million Bank loan to assist in financing the construction of two hydroelectric power stations and additional transmission facilities. This report contains an appraisal of the proposed project. It is based on information submitted to the Bank by the Norwegian Government and on the findings of a mission which visited Norway in August 1960.
2. The project would consist of: (i) the construction of the Tokke II and Tokke III generating stations with a combined capacity of 410 MW and (ii) the construction of 326 km of high voltage transmission lines.
3. The total estimated cost of these works is the equivalent of about US\$58 million. NVE (the Norwegian Watercourses and Electricity Board) is to have full responsibility for the construction and subsequent operation of these facilities.
4. In the past the Bank has made two loans to Norway to assist in financing power projects. Loan 138-NO, for \$25 million, was made in May 1956 for the Tokke I project; and Loan 231-NO, for \$20 million, was made in July 1959, for the Tunnsjø-Tunnsjødal project. The Tokke I project included a 400 MW hydroelectric power station and 508 km of high voltage transmission lines. The Tunnsjø-Tunnsjødal project included two hydroelectric stations with a combined capacity of 168 MW and 555 km of high voltage transmission lines. Progress of construction on both projects has been very good and the Tokke I project should be placed in operation in June 1961, or about six months ahead of the original schedule. The Tunnsjø-Tunnsjødal project is scheduled for completion about mid 1963. As of November 1, 1960 disbursements under Loan 138-NO amounted to the equivalent of \$21.8 million and under Loan 231-NO to \$3.1 million.
5. The Kingdom of Norway would be the borrower and NVE would be the direct beneficiary of the proposed loan, as was the case in the previous loans. The pattern of the previous two loans would also be repeated as regards utilization of funds, which would be disbursed to cover largely the cost of locally procured equipment and services. There may be some minor expenditures of foreign exchange which, however, cannot be determined at this time.

## II. BACKGROUND

6. The development of electric power in Norway has been based on the utilization of very low cost hydroelectric sites. This has favored the establishment and growth of power intensive industries as well as high utilization of electricity by all classes of consumers, including residential. As a result Norway has the highest per capita consumption of electricity in the world (8,300 kwh in 1959).

7. Historically, the pattern of power development in Norway has been based on the utilization of small or medium-size hydroelectric sites by municipal and private undertakings to satisfy local energy requirements. This resulted in the gradual formation of isolated local grids which covered the centers of population and industrial activity in the country. Within these grids, load dispatching and power interchange among various plant owners have been and are handled very efficiently by private load dispatching organizations which are also active as advisers on expansion and interconnection programs.

8. A national grid has been under development in Norway during the last few years, which is providing interconnection among the local power systems and with the grids of neighboring countries. The justification for building a national grid rests on the following major factors:

- a) The need to achieve full utilization of the capability of existing generating facilities by interconnecting regional systems to compensate for the complementary nature of hydrology in different regions.
- b) The fact that, while there remains in Norway a large undeveloped hydroelectric potential from which electricity can be provided at a cost of 2 to 3 mills/kwh, few sites remain which are suitable for local requirements. Provision of low cost power is increasingly dependent on the exploitation of large resources in more remote locations.
- c) The existence of economically attractive opportunities for exporting surplus power, which are dependent on the existence of a nationwide grid.

9. These and other factors place the current and future development of basic power facilities beyond the scope of municipal and private undertakings. As a result, the role of NVE has become increasingly important in developing new sites to serve the Norwegian power market and to handle power exports.

### III. NORWEGIAN WATERCOURSES AND ELECTRICITY BOARD

10. NVE was created by Act of Parliament in 1920 and is administered by a Board of five members elected by Parliament for a period of three years. The Chairman of the Board is the General Manager appointed by Royal decree for a period of 6 years.

11. Among NVE's main responsibilities are the collection of hydrological data in the entire country; the formulation of recommendations concerning the administration of all concessions for the use of water for either power generation or water supply; the control of waterways for flood prevention, shore protection and reclamation purposes; the authority to recommend and supervise concessions for the establishment and operation of power generating facilities; and finally, the construction and direct operation of power generating facilities and transmission lines. Power generated in NVE's facilities is sold wholesale, NVE has no distribution systems.

12. In the past, the staff of NVE has been primarily concerned with the construction of power stations and transmission lines as the remaining

responsibilities were discharged in cooperation with other Government departments. After July 1960 the major functions assigned to NVE are being consolidated under the direct control of the General Manager. This reorganization will give NVE a much greater degree of autonomy in the operation of its general administrative affairs.

13. The total generating capacity of NVE's plants in operation amounts to 1,260 MW, or 21% of the total for Norway. Plants under construction represent an aggregate capacity of 461 MW. Annex 1 shows for all of Norway and for NVE the capacity installed in power stations and the energy produced by these stations during the period 1939-1959 with estimates through 1965.

14. Including 61 engineers and draftsmen employed in the design departments, in June 1960, a total of 300 staff were employed in the head office of NVE. An additional 377 were employed in the operation and maintenance of power stations and transmission lines, 264 employed on site supervision of civil engineering, power plant and transmission line construction, and a field labor force of 2,154. The general construction policy of NVE is to maintain a staff of the minimum size consistent with maximum working efficiency, based on a continuous program of development. Consulting engineers and contractors are employed for special problems or where a temporary increase of work cannot be carried by the permanent staff.

15. The present staff of NVE is very efficient and fully competent to carry out the proposed project and its other responsibilities.

#### IV. POWER MARKET

16. The establishment of a nationwide grid and the implementation of plans for increasing exports of power make it necessary to consider the whole of Norway when examining the market for power.

17. The average annual compound growth in capacity and energy generation during the last ten years has been between 7 and 8%. Installed capacity in Norway at the end of 1959 was 5,900 MW, owned as follows:

State (including NVE)	1,850 MW	32%
Municipalities	2,425 MW	41%
Privately owned (mainly industrial concerns)	1,625 MW	27%
Total:	5,900 MW	100%

18. Annual generation during fiscal year 1958/59 reached 28,635 million kwh, approximately in the same proportion by source as capacity. Consumption during the same year attained 25,200 million kwh, with the following breakdown by categories of consumers:



	<u>Kwh in millions</u>	<u>%</u>
Electrochemical and electrometallurgical industries	11,440	45.3
Paper and pulp industry	1,700	6.7
Mining	240	1.0
Other industries and handicrafts	2,805	11.1
Sub-total for industry	<u>16,185</u>	<u>64.1</u>
Traction	315	1.2
Lighting, residential, commercial and farm	<u>8,700</u>	<u>34.7</u>
Grand total	25,200	100.0%

Comparison of the above consumption with the consumption of 23,500 million kwh in 1957/58, shows an increase of 7%.

19. Throughout the postwar period Norway has experienced a continued shortage of power from which it has not yet fully recovered. While capability is at present approximately in balance with demand, seasonable deviations from mean hydrological conditions still result in periodic shortages which require temporary restrictions to be imposed on power sales.

20. General planning for the expansion of power facilities is coordinated by the Power Transmission Committee, which maintains a continuous review of the country's power requirements and recommends which new generating and transmission facilities should be built. The Committee represents all parties with a significant interest in the power industry.

21. Planning is based on estimating firm additional requirements by industry, recognizing that other important power users are close to saturation and represent a relatively small percentage of the load. These additional requirements are then matched by a combination of new power generating facilities, after taking into account the increase in utilization of existing facilities made possible by the extension of the grid interconnecting the regional systems. Current plans are based on estimates that industry will require the generation of an additional 10,000 million kwh by 1965, equivalent to an average compound growth of approximately 6% per annum. To meet this requirement plans have been prepared for commissioning 437 MW in 1960, 570 MW in 1961, 500 MW in 1962, 310 MW in 1963, and 300 MW in 1964, of new generating capacity. The planning, of which the project is a part, is conservative in approach and economically sound.

22. The major part of the transmission facilities included in the project is required to interconnect the new Tokke II and III power stations with the NVE grid system and to enable the output of the three Tokke power stations to be distributed to the consuming areas of NVE. The remainder will provide connections to the grid system of Western Norway and to the Norwegian border to connect with Southern Sweden and the general Swedish grid system.

23. Owing to the topography of Norway, the precipitation seasons in the Western and Southern areas do not always coincide and each area suffers water shortages and consequently power shortages. The connection to Western Norway will, therefore, have the effect of firming up the power output of all hydro stations on both the NVE system and that of Western Norway by permitting seasonal interchanges of power between the systems. In addition it will permit the development of some of the most favorable sites for large power development, which are in Western Norway, by providing the necessary power outlet to the main load centers in Southern Norway.

24. The need for power imports into Sweden arises from a lack of balance between summer and winter generating conditions in that country. Sweden has a surplus of water power in the summer months and a shortage in winter. Under a contract, now in the final stages of negotiation, between NVE and the Swedish Power Board, the grid connection will enable low cost excess summer power, generated in Sweden, to be imported into Norway. The resulting reduction in generation by Norwegian power stations will enable increased storage of water in Norwegian reservoirs. The additional energy thus available to the Norwegian power stations, from the stored water, will be sold to Sweden during winter months at the higher tariff applied to winter power. A committee is now actively investigating the possibility of a direct connection, by submarine cable, between Southern Norway and Denmark. This connection would result in the rapid development of the comparatively low cost hydroelectric resources of Norway and reduce the need to develop large thermal power production in Denmark and Northern Germany.

## V. THE PROJECT

25. The project represents a further development of the Tokke I hydroelectric scheme in which a complex of lakes forming the headwaters of the Tokke and Vinje watercourses were regulated and the rivers diverted into a tunnel, to utilize a head of 390 meters, for the operation of a 400 MW underground power station. Additional lakes in the headwaters of the rivers will be controlled by small dams, and by means of diversion tunnels will supply the Tokke II underground power station of 300 MW capacity and the Tokke III underground power station of 110 MW capacity utilizing heads of 214 meters and 253 meters respectively. Annex 2 shows schematically the interrelation of the various lakes, and waterways and the power stations, and Annex 2a shows the development on a map.

### Basic Design Features of Generating Facilities

26. After consideration of the hydrological, geological and general topographic feature of the project the basic design features of the two power stations will be:

	<u>Tokke II</u>	<u>Tokke III</u>
Operating head, meters	214	253
Number of machines	3	1
Turbine output: H.P.	140,000	150,000
Electrical capacity: Each machine MW	100	110
Total installed capacity: MW	300	110
Regulated flow, cumecs: Average	58.5	20.8
Maximum:	79	30
Minimum:	39	11
Load factor, %	34	49
Annual generation (millions of kwh):		
Winter:	815	460
Summer:	105	15
Total:	920	475

27. The increased regulation and storage due to Tokke II and III, will enable excess water flow normally diverted from the Tokke I power station, to be stored in summer and utilized in providing an additional output of 150 million kwh of winter energy from this station.

28. The electrical output of the Tokke II and III power stations will be transmitted to the main switching center at Tokke I and in addition extra high voltage transmission lines consisting of 124 km to Western Norway, 118 km to Southern Norway and 41 km to the Swedish border will be constructed as part of the project. For further details of the power plants see Annex 3 and for a map showing the location of the transmission lines see Annex 4.

#### Cost Estimates

29. These have been prepared by the staff of NVE and are based on detailed plans and a comprehensive knowledge of the power station sites and transmission line routes.

#### Summary Cost Estimates

	<u>Norwegian Kroner</u> <u>x 1000</u>	<u>Equivalent in</u> <u>US Dollars</u> <u>x 1000</u>
Land and water rights	11,700	1,638
Access roads	5,200	728
Civil engineering works	118,920	16,632
Electrical and mechanical equipment	95,540	13,391
Transmission lines and cables	81,494	11,410
Substation equipment	32,293	4,534
Planning, engineering and overheads	11,000	1,549
Sub-total:	356,147	49,882
Housing and social services	17,200	2,408
Contingencies	33,253	4,702
Interest during construction	7,700	1,078
Sub-total:	414,300	58,070
Less estimated revenue from rent of quarters	300	43
Total:	414,000	58,027

30. Contingency allowances shown as lump sums in paragraph 29 are estimated by NVE for each item in the detailed cost estimates. They are based on experience with similar items of work currently being executed and vary between 10% and 20% for civil works and power station equipment, 7% for transmission lines and 9% for substation equipment. They have been reviewed in detail with NVE's construction department and are reasonable.

#### Capital Costs and Generating Costs

31. The estimated total cost of the project will be 414 million kroner (US\$58 million) of which Tokke II power station will cost kr. 202 million (\$28.3 million), Tokke III power station kr. 90 million (\$12.6 million) and the transmission facilities kr. 122 million (\$17.1 million). On the basis of these estimates, unit capital investments at Tokke II and III work out respectively at US\$95 and \$115 per kw installed. These are extremely low costs. The cost of generation is estimated by NVE at about 2.5 US mills/kwh, having regard to the increase in generation at Tokke I. This cost is based on an average interest rate of  $4\frac{1}{2}\%$ , this may be regarded as low, if a rate of 6% were used the cost per unit would rise to approximately 3.0 mills.

#### Construction Progress and Completion Dates

32. Major construction has not yet begun and only small sections of site access roads have been constructed. The first units in the two power stations are scheduled to deliver power towards the end of 1964 and the remaining units as soon as possible thereafter. The construction program is based on making maximum use of the construction equipment already owned by NVE. A substantial amount of the equipment required will be transferred to the project when it is released from Tokke I. Substantial construction activity is scheduled to begin towards the end of 1960. Considering NVE's organization and experience, the program is realistic and should be achieved.

#### Planning, Design and Construction

33. The project has been planned and designed by the technical staff of NVE whose policy is wherever possible to undertake construction of its projects directly by employing its own staff, labor force and construction equipment. Full specifications and contract documents are prepared and contracts are sometimes awarded to qualified Norwegian contractors where it can be proved cost savings will result from the use of contractors. In the case of Tokke II and III, NVE proposes to undertake construction by the transfer of construction equipment, staff and trained labor from the Tokke I project.

34. The basic design and operating characteristics of the high voltage transmission system have been evaluated on a network analyser operated by the Electrical Research Association at Trondheim and found to be satisfactory. General planning has been completed and as the commissioning date for the transmission lines is the same as for Tokke II and III, there is ample time for detailed design, route clearance and erection.

35. Bids for plant and equipment are placed on an international basis, but under Norwegian law Norwegian suppliers are granted limited preferential treatment. The preference is at the rate of 10%, but where import duties are applicable the combined preference and import duty cannot exceed 25%. Preference is granted only to the domestic cost component of the equipment obtained from Norwegian suppliers and since a large proportion of materials and parts must be imported the actual preference given to Norwegian manufacturers is usually considerably less than 10%. The value of shorter delivery periods and of efficiency differentials is also taken into account when a final comparison of tenders is made.

36. Generating plant and machinery are expected to be purchased largely in Norway. High voltage switchgear, raw materials for transformers, high voltage cables, insulators, and metering equipment, must be imported as they are not yet manufactured in Norway.

## VI. FINANCIAL ASPECTS

37. As NVE is to be the beneficiary of the proposed loan, its past and estimated future finances are examined below.

### NVE Power Rates

38. NVE sells power, in bulk, to 45 wholesale customers - six large industrial consumers, the State Railways and 38 municipal or rural utilities in Central and Southern Norway. Industrial consumers (aluminum and chemical industries) take up about half of all the energy sold by NVE.

39. Electricity supplies to the six industrial consumers are covered by 30-year contracts. Contract prices are tied to the fluctuations of the wholesale price index of the Central Statistical Bureau, either at short intervals according to pre-established formula, or at intervals of 5 to 10 years.

40. Contracts with the State Railways and the utilities which extend on the average for 20 years, do not stipulate any price. Rates are determined by NVE and can be modified during the life of the contract, on NVE's initiative, subject to the approval of Parliament.

41. Up to mid 1956, the level of rates was set so as to produce total revenues sufficient to cover all operating costs of the NVE system as a whole, including reasonable allocations to special reserves, in lieu of depreciation, and to leave a small surplus available for reinvestment in power facilities. In July 1956, the Government decided that power prices charged by NVE should be based on the cost of generation in the new power stations, rather than on the overall average cost of generation by the system. The change resulted in an increase of about 30% in the average price charged to the distributing utilities. Although existing long-term contracts with the industries could not be amended, new industrial contracts signed since July 1956 stipulate power rates at least 40% higher than the previous level.

42. The result of the 1956 rate increase was to raise NVE's overall average revenue per kwh from 1.36 øre (1.9 US mills) per kwh in 1955/56 to the present 1.62 øre (2.28 mills) per kwh. New contracts - including export contracts to Sweden - for the supply of power to be generated by plants coming into operation in the next six years are expected to raise the average gradually to a level of about 1.9 øre (2.68 mills) per kwh by 1964 and 2.2 øre (3.10 mills) in 1967.

#### The Electrification Tax

43. The Norwegian Government levies a special electrification tax of 0.2 øre per kwh sold. The tax is paid directly to the Government by all ultimate consumers, including state-owned industries and railways. It does not enter into NVE's accounts.

44. One half of the proceeds of the tax is earmarked as part of the Government contribution to the cost of NVE's expansion program. The other half is assigned to rural electrification and regional transmission lines. The total proceeds of the tax in 1959/60 amounted to nearly kr. 60 million (equivalent to \$8.45 million). Of this total, kr. 16.2 million were levied on sales of energy generated by NVE (27% of the total for Norway).

#### Financial Organization of NVE

45. NVE is a government agency, without any financial autonomy. Its revenues and expenses are presented as government accounts, and all funds for new construction are provided as budget appropriations.

46. A statement of financial condition of the power system is published as of June 30, every year. It merely records, on the asset side, the total capital expenditures, balanced, on the liabilities side, by items of government appropriations from which the investments were made. The statement also shows various reserves, the exact counterparts of which appear among the assets as funds deposited with the Treasury.

47. This presentation does not allow a clear definition of government capital as debt or equity. Although budget appropriations for construction expenditures by NVE are shown, in government accounts, as long-term loans, these loan liabilities merely represent an internal relationship between government departments. The rate of interest credited the Government on existing loans is set each year in the general budget voted by Parliament, and the amortization requirements can be modified or waived at the Government's discretion. For these reasons, NVE's financial statements show budget appropriations merely as "government capital". There is no attempt to show what part of the "government capital" is earned surplus.

#### Past Earnings and Return on the Investment

48. Operating results of NVE are recorded in an income statement which at present is charged with all operating expenses and with special provisions, in lieu of depreciation.

49. The three provisions are:

(1) a provision for renewals calculated, for the gross value of all fixed assets in operation (excluding construction work in progress), on the basis of an annual sinking-fund, earning 3-1/2 % interest, designed to accumulate the full value of the plants in 35 years;

(2) for plants commissioned since 1953, a provision for amortization of such installations, but calculated on the same sinking fund basis using 3-1/2 % and a 35-year term.

(3) a small contribution to an insurance fund.

50. Effective January 1, 1961, the first of these provisions will be discontinued, while the second will be extended to cover the gross value of all installations of NVE, including construction work in progress. The new provision for amortization will at least equal all amortization and sinking fund payments falling due during the year, both on IBRD loans and on government advances. The insurance fund contribution will remain as it is at present.

51. No expenditure for plant renewal is being charged against any of these provisions, so that they are, in effect, equivalent to a depreciation reserve. Their combination has, in the last 5 years, been equivalent to an annual depreciation of over 2.5% of the historical cost of the assets.

52. The income statement is charged with interest on the government capital, at rates which are set annually. The rate was 3-1/2 % a year until November 1959; it is now 4%.

53. Summary income statements of NVE for the last 3 years are given in Annex 5. On the basis of the accounting described above, the NVE system has shown a surplus kr. 18.4 million in 1957/58, which was an above-average hydrological year. The surpluses shown for 1958/59 and 1959/60 were much lower, at kr. 3.2 and 4.0 million respectively, mainly because of increased allocations to the 3 reserves in lieu of depreciation and higher interest charges. To a lesser extent the decrease was also due to poor hydrological conditions in Southern Norway, which could not be offset by higher generation in other parts of the country because of the lack of adequate transmission lines between the two areas.

54. Gross income before interest charges was kr. 43.9 million in 1957/58, kr. 35.3 million in 1958/59 and kr. 40.8 million in 1959/60. The return on NVE's net investment in operation varied from 5.3% in 1957/58 to 4.3% in 1958/59 and 4.9% in 1959/60. It should be noted that the return figures would be slightly higher if NVE had charged straightline depreciation, even at the conservative rate of 2.25% a year, instead of the 3 provisions previously referred to.

#### Capital Expenditures and Sources of Funds

55. Total capital expenditures of NVE over the five and a half years from July 1, 1960 to December 31, 1965 are estimated at kr. 979 million

(US\$138 million). The Tokke II and III project accounts for about 18% of total construction expenditures during the period considered.

56. All funds required to carry out the construction program including the proceeds of the proposed loan of \$25 million and the undisbursed balances of Loans No. 138-NO and 231-NO will be made available to NVE in the form of budget appropriations, as has been the practice in the past.

#### Forecasts of Earnings

57. Forecasts on income statements of NVE for the seven and a half years from July 1, 1960 to December 31, 1967, given in Annex 5, show the gross income of NVE increasing from kr. 55 million in 1961 to kr. 142 million in 1967. From 1962 on, gross income is understated to the extent that the sum of the two provisions (amortization, reserve and insurance reserve) exceeds the amount of depreciation accruals which NVE would charge if it amortized its assets on a straightline basis at the conservative rate of 2.25% a year.

58. A computation which assumes straightline depreciation at 2.25% has been prepared and is given in Annex 5, below the estimated income statements. It shows adjusted gross income increasing from kr. 55 million in 1961 to kr. 155 million in 1967. Considering that NVE's average net investment in operation would go up from kr. 1,098 million to kr. 2,166 million, the estimated gross income would amount to a return increasing from 5% in 1961 to 7.2% in 1967. The return would be higher if proceeds of the electrification tax levied on power produced by NVE were added to NVE's revenues.

#### Rate Covenants

59. At the time of Loan 138-NO (Tokke I) in 1956, the Bank considered the then current rate of return of 3.4% as insufficient, and the Norwegian Government, in a letter to the Bank, stated its intention to establish power rates sufficient for NVE to cover all its expenses including interest and adequate provisions for funds in lieu of depreciation, and to leave a reasonable surplus for reinvestment in electric power facilities.

60. When Loan 231-NO (Tunnsjø-Tunnsjødal) was signed in 1959, a similar rate covenant was included in the Loan Agreement (Section 5.09). Only the last phrase was amended to read: "and to provide a reasonable return on the investment in NVE's facilities". In a side letter addressed to the Bank, the Norwegian Government stated that it considered 5% a reasonable return. In its reply to the Government, the Bank agreed on this point, adding, however: "In coming to this conclusion, the Bank has taken into account the tax on electric power consumers, the proceeds of which are used for the benefit of the electric power industry. Any judgments made by the Bank in the future about the adequacy or otherwise of the return on the investment of NVE will similarly take into consideration the degree to which consumers contribute to the resources of the industry."



VII. CONCLUSIONS

61. The generating and transmission facilities included in the proposed project are necessary and economically justified and the arrangements proposed for their design, construction and operation are satisfactory.

62. The return on the investment in NVE facilities is at present relatively low. Taking into consideration that the return is expected to increase during the next 5 years, it may be considered satisfactory. If proceeds of the electrification tax were taken into account, the return would be more satisfactory.

63. A covenant similar to the covenant in the Tunnsjø-Tunnsjødal Loan Agreement (Section 5.09) has been negotiated for the proposed loan.

64. The proposed project is suitable for a loan of the equivalent of \$25 million. Owing to the nature of the facilities and the period of construction, a term of 25 years with a grace period on amortizations of 4 years appear appropriate.

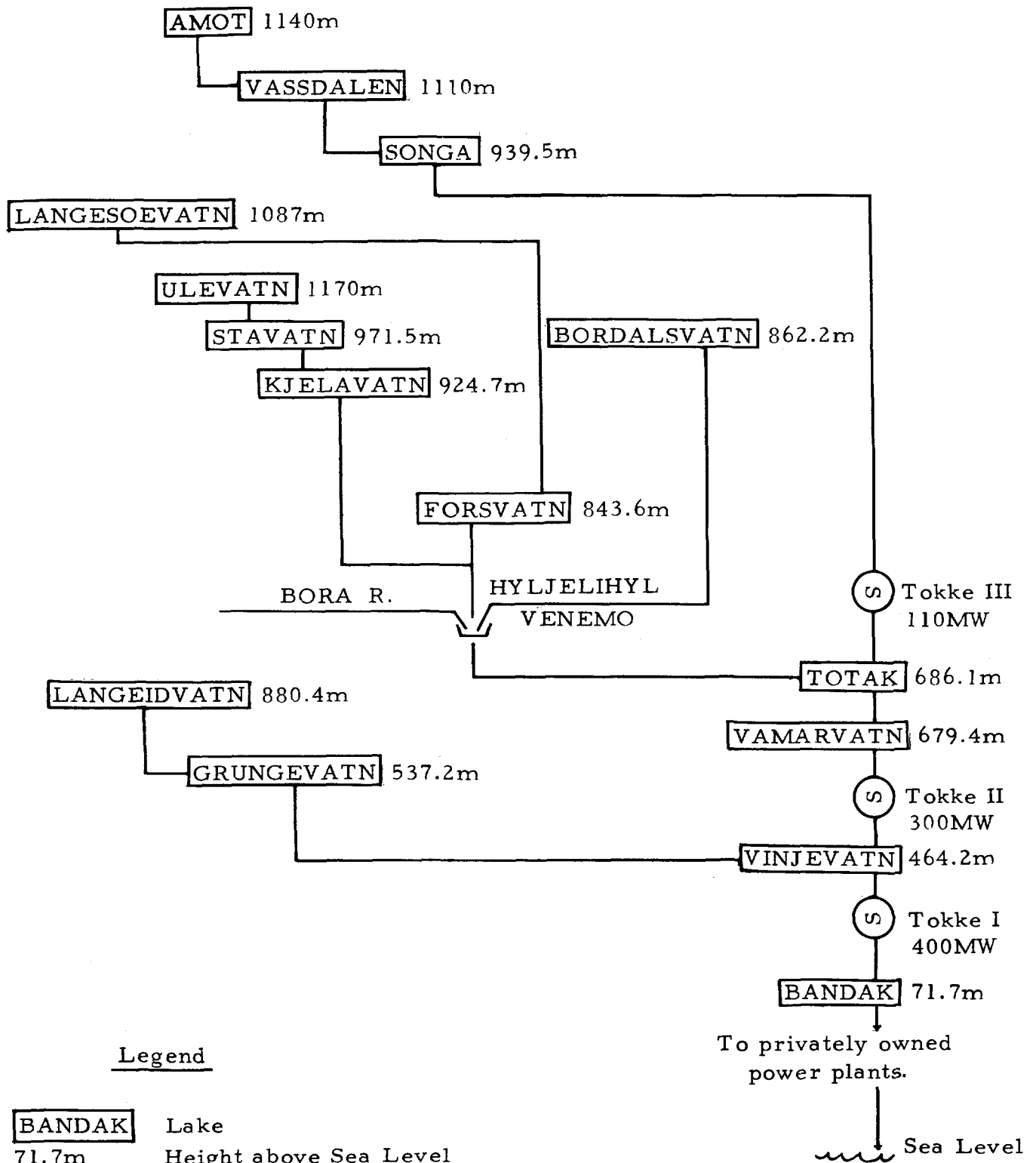
ANNEX 1

STATISTICS ON POWER DEVELOPMENT IN NORWAY

<u>Calendar Year</u>	<u>Installation in million kw by end of year</u>		<u>Yearly energy production in billions of kwh</u>	
	<u>All power stations</u>	<u>NVE's power stations</u>	<u>From all pow- er stations</u>	<u>NVE's power stations</u>
1919	1.25		ca 4.2	
1944	2.33	0.29	11.3	1.0
1949	3.03	0.55	15.5	2.1
1954	3.83	0.69	21.7	3.9
1959	5.9	1.21	28.6	6.7
<sup>1/</sup> 1960	6.13	1.26	30.2	7.1
1961	6.7	1.60	33.1	7.5
1962	7.2	1.85	35.4	8.9
1963	7.5	1.91	36.8	9.2
1964	7.8	2.07	38.3	10.7
1965	8.2	2.27	40.3	11.9

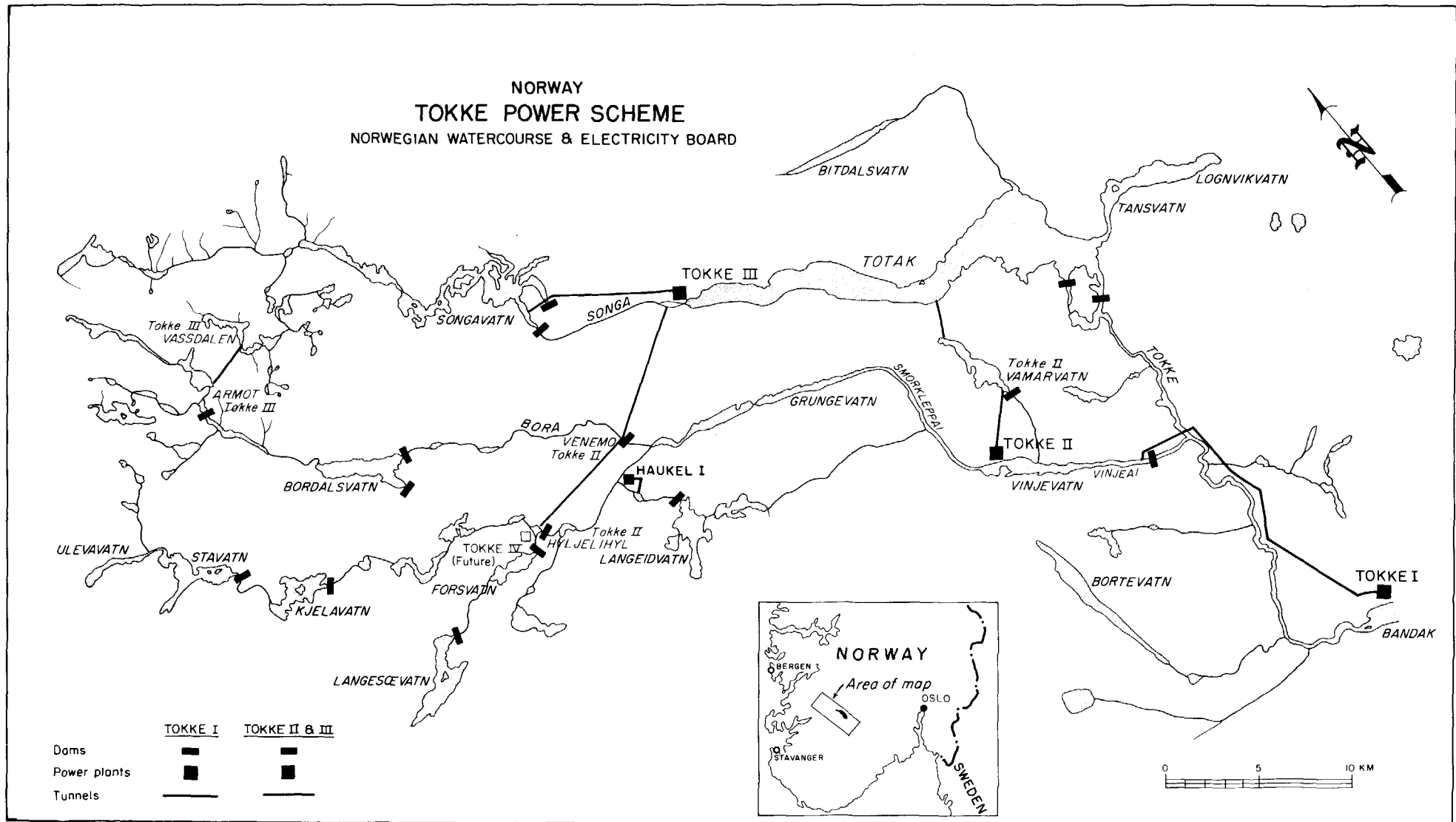
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<sup>1/</sup> Over the period 1960/65 the kwh forecast from all power stations is based on an expected station load factor of 56%.



UTILIZATION OF LAKES SUPPLYING  
THE TOKKE POWER PROJECT

NORWAY  
**TOKKE POWER SCHEME**  
 NORWEGIAN WATERCOURSE & ELECTRICITY BOARD



NORWEGIAN WATERCOURSES AND ELECTRICITY BOARD

TOKKE II AND TOKKE III PROJECT

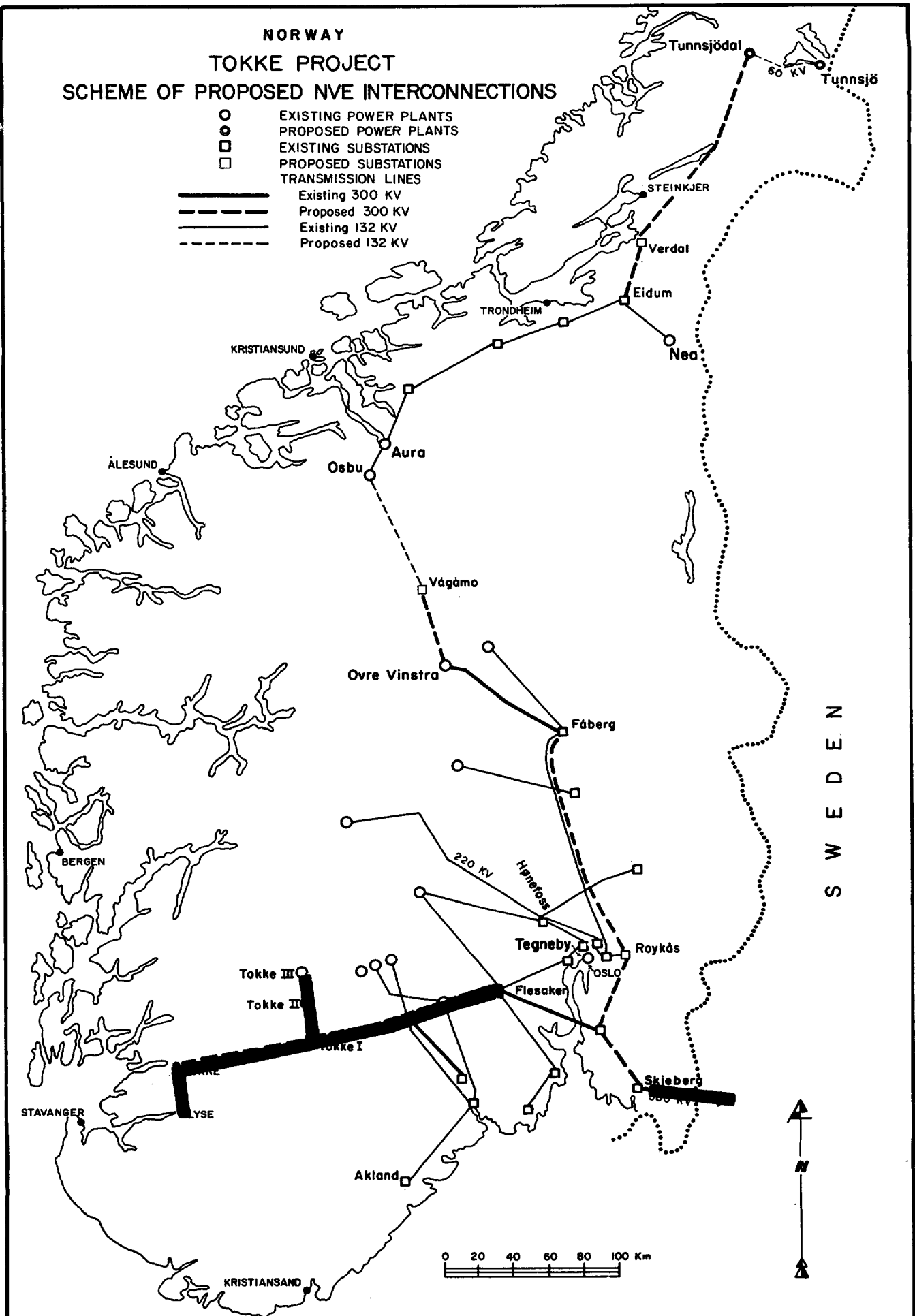
The Tokke II and III power stations will require the construction of the following works:-

I. Tokke II Power Station

- (a) a small diversion dam, at Hyljelihyl, 25 meters long and approximately 6 meters high.
- (b) a tunnel, 27 sq. meters cross section, 6 km long from Hyljelihyl to Venemo (Bora).
- (c) a rockfill diversion dam, with asphalt upstream face, at Venemo (Bora), 220 meters crest length, 52 meters high.
- (d) a tunnel, 27 sq. meters in section, 8.5km long, from Venemo to Totak Lake.
- (e) a tunnel, 70 sq. meters in area and 2.3 km long, from Totak Lake to Vamarvatn Lake.
- (f) a concrete gravity type dam at the outlet of Vamarvatn Lake.
- (g) a power station supply tunnel, 90 sq. meters in section and 2.3 km long, from Lake Vamarvatn to the three power station pressure conduits.
- (h) An underground surge chamber and three steel-lined pressure shafts each 3.4 meters in diameter inclined at an angle of  $45^{\circ}$ , to convey water from the supply tunnel to three turbines each of 140,000 HP output of 219 meters gross head.
- (i) an underground power station, 80 meters long 21 m wide, 31 meters high, with an access tunnel 50 sq. meters in section and 950 meters long.
- (j) a tailrace tunnel, 90 sq. meters in section and 1,100 meters long, from the power station to Lake Vinjevatn.
- (k) electrical equipment comprising three 100 MW alternators, unit transformers, 300 kv cables and an outdoor double busbar switching station with provision for 300 kv transmission lines to Tokke I and Tokke III and 20 kv transmission lines to the local distribution system.

II. Tokke III Power Station

- (a) a small diversion weir, 3 meters high, 25 meters crest length at the discharge of Lake Arnot.
- (b) a tunnel, 7 sq. meters cross section and 3 km long, from Lake Arnot to Vassdalen.
- (c) a tunnel, 18 sq. meters cross section and 1.7 km long, from the Songa main dam to the Songa secondary dam (these dams have been constructed as part of the Tokke I project).
- (d) a power station supply tunnel, 38 sq. meters in area 8.9 km long, from Songa secondary dam to the power station pressure shaft.
- (e) an underground surge chamber, and a steel lined pressure shaft, 3.4 meters in diameter inclined at an angle of  $45^{\circ}$ , to provide 253 meters gross head for one 150,000 HP turbine.
- (f) an underground power house, 50 meters long, 20 m wide and 30 m high, with an access tunnel 250 meters long and 45 meters cross section.
- (g) a tailrace tunnel, 38 sq. m. cross section 650 meters long, from the power station to Lake Totak.
- (h) electrical equipment comprising one 110 MW generator and auxiliary equipment, three single phase generator transformers, 300 kv generator cables and an outdoor switching station from which a 300 kv transmission line will be constructed to the Tokke II switching station.



N V E INCOME STATEMENTS

	ACTUAL			ESTIMATED							
	1957/58	1958/59	1959/60	2nd half 1960	1961	1962	1963	1964	1965	1966	1967
Sales of Kwh (in millions)	5,610	5,971	6,200	3,050	7,050	8,300	9,050	10,100	11,400	11,900	12,200
Average revenue per Kwh (øre)	1.60	1.52	1.62	1.56	1.67	1.72	1.80	1.89	2.12	2.18	2.22
	— Thousands of N. Kroner —			Thousands of N. Kroner							
Revenues from sales of power (Norway)	89,760	90,642	100,546	46,726	113,436	138,090	150,350	168,150	203,000	213,000	220,500
"    "    "    "    "    " (export)	-	-	-	800	1,850	2,450	8,250	14,050	21,800	25,800	25,800
Other revenues from power operations	-	-	-	-	2,600	2,600	4,740	8,740	16,740	21,000	25,000
Total gross operating revenues	89,760	90,642	100,546	47,526	117,886	143,140	163,340	190,940	241,540	259,800	271,300
Non-operating revenues	767	743	675	1,577	4,500	4,860	4,860	4,860	4,860	5,000	5,200
Total revenues	90,527	91,385	101,221	49,103	122,386	148,000	168,200	195,800	246,400	264,800	276,500
Operating costs, including purchased power	23,494	27,653	31,987	15,937	39,404	41,600	45,400	52,700	58,400	59,900	68,300
Net receipts from operations	67,033	63,732	69,234	33,166	82,982	106,400	122,800	143,100	188,000	204,900	208,200
Revenue deductions, in lieu of depreciation:											
Allocation to renewal reserve	14,250	14,355	16,328	9,960	-	-	-	-	-	-	-
"    "    amortization reserve	8,020	13,156	11,122	2,314	26,420	39,260	43,400	55,235	61,815	63,200	64,150
"    "    insurance reserve	803	905	905	503	1,097	1,550	1,850	1,900	2,100	2,100	2,100
Total "in lieu of depreciation"	23,073	28,416	28,355	12,777	27,517	40,810	45,250	57,135	63,915	65,300	66,250
Gross income	43,960	35,316	40,879	20,389	55,465	65,590	77,550	85,965	124,085	139,600	141,950
Interest charges	32,178	38,165	43,870	22,880	48,930	59,575	66,210	77,705	80,430	80,960	80,820
(less): Interest capitalized	6,640	6,082	6,991	3,576	8,270	8,165	10,510	7,880	1,905	-	-
Net interest charges	25,538	32,083	36,879	19,304	40,660	51,410	55,700	69,825	78,525	80,960	80,820
Surplus for the year	18,422	3,233	4,000	1,085	14,805	14,180	21,850	16,140	45,560	58,640	61,130
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<b>Pro-forma income statements *</b>											
Net receipts from operations, as above				33,166	82,982	106,400	122,800	143,100	188,000	204,900	208,200
(less): Pro-forma depreciation *				12,050	28,090	36,360	40,070	45,050	51,250	53,200	53,200
Adjusted gross income				21,116	54,892	70,040	82,770	98,050	136,750	151,700	155,000
(less): Interest, other than capitalized				19,304	40,660	51,410	55,700	69,825	78,525	80,960	80,820
Adjusted net surplus				1,812	14,232	18,630	27,070	28,225	58,225	70,740	74,180
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Average net investment in operation				878,000	1,095,000	1,378,000	1,630,000	1,860,000	2,180,000	2,218,000	2,166,000
Return on net investment in operation				4.8%	5.0%	5.1%	5.1%	5.3%	6.3%	6.8%	7.2%

\* Assuming depreciation accounting on a straightline basis, at an annual rate of 2.25%