

Commissioning Schedule of the
Tseung Kwan O Substation and
the Tsz Wan Shan to Tseung Kwan O
Transmission Link

Research and Library Services Division
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Purpose of Study

The construction of a new Tseung Kwan O Substation and a transmission line linking this substation and the Tsz Wan Shan Substation is part of the Black Point 400 kV Transmission System project proposed by the China Light and Power Company, Limited (CLP) in the early 1990's. The entire project is due to complete by the year 2000; while the Tseung Kwan O link is scheduled to complete on 1.1.1996. This paper studies the justifications behind the completion schedule of the Tseung Kwan O Substation and its link with Tsz Wan Shan Substation when the project was planned in early 1990's; and examines whether they are still valid today. New information now supplied by CLP regarding the reasons to complete the link in 1996 is also given.

Background

2. The purpose of building the new Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O transmission link is to ensure the security of power supply to East Kowloon including Tseung Kwan O. This area has a population of 1.05 million, which is projected to increase to 1.08 million and 1.12 million in 1997 and 1998 respectively.

3. East Kowloon can be broadly divided into three districts. Their population for the years 1992 to 1998 are given in the table below:

	1992	1993	1994	1995	1996	1997	1998
Kwun Tong							
Population	551160	539150	534520	520790	522940	508710	508930
Change over last year	-	-2.18%	-0.86%	-2.57%	0.41%	-2.72%	0.04%
Wong Tai Sin							
Population	368530	376540	369730	384890	386200	389440	392420
Change over last year	-	2.17%	-1.81%	4.10%	0.34%	0.84%	0.77%
Tseung Kwan O *							
Population	124146	125690	144212	146705	149135	186625	220133
Change over last year	-	1.24%	14.74%	1.73%	1.66%	25.14%	17.95%
Total							
Population	1043836	1041380	1048462	1052385	1058275	1084775	1121483
Change over last year	-	-0.24%	0.68%	0.37%	0.56%	2.50%	3.38%

Source: Development Programmes, 1992 - 1994 Editions, Territory Development Department, Hong Kong Government

* Including Sai Kung

4. It can be noted that population in Kwun Tong will decrease and Wong Tai Sin will increase moderately in the coming years. Population in Tseung Kwan O will increase slightly in 1995 and 1996 but drastically at 25% and 18% a year in 1997 and 1998.

The Need for the Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O Link

5. The electricity demand of the East Kowloon area is at present served by the Tsz Wan Shan 400 kV Substation. According to projections made by CLP in 1992, the peak demand of East Kowloon would exceed the capacity of the Tsz Wan Shan Substation in the mid 1990s. CLP therefore proposed that a new 400 kV Substation at Tseung Kwan O and a link for Tsz Wan Shan to Tseung Kwan O be constructed. The proposal has been assessed by the Administration with the assistance of an international consultant and is found to be in order.

6. The new Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O link are scheduled to be commissioned in 1996. The justifications for the commissioning timing as given in the Environmental and Visual Impact Assessment compiled by CLP in 1992 are as follows:-

- (i) The peak demand of the East Kowloon area is expected to exceed Tsz Wan Shan Substation's total firm capacity of 1200 MVA in 1996; and
- (ii) Neighbouring 400 kV substations (e.g. Tai Wan) are expected to be heavily loaded, making transfer of excess load from Tsz Wan Shan Substation not practical.

An extract from the assessment report on the justifications is at Appendix I.

Present Situation

7. Peak demand figures available now show that the forecasts made in 1992 are on the high side. The latest figures for 1995 and 1996 are around 17% below those envisaged in 1992 when the new substation and the link were proposed.

Peak Demand (in MVA) in East Kowloon/Tseung Kwan O					
	1993	1994	1995	1996	1997
Demand envisaged in 1992	974	1070	1191	1272	NA
Actual demand and latest forecasts	912	948	995	1052	1148
Deviation from 1992 forecast	-6.4%	-11.4%	-16.5%	-17.3%	NA

Source: China Light & Power Company, Limited

NA: Not available

8. It was expected in 1992 that Tsz Wan Shan's neighbouring 400 kV substations, including Tai Wan and Sha Tin Substations, would be heavily loaded in 1996. However, it now turns out that the peak demand for these substations are well below their capacity. In fact, the peak demand for Tai Wan has decreased due to load transfer to the newly commissioned Yau Ma Tei 400 kV Substation. The possibility of relieving the load of the Tsz Wan Shan Substation by transferring some of its load to these neighbouring substations therefore exists.

Peak Demand (in MVA) for Tsz Wan Shan's Neighbouring Substations			
	1995	1996	1997
Tai Wan 400 kV Substation	718	679	706
Sha Tin 400 kV Substation	546	585	618

Source: China Light & Power Company, Limited

CLP's Current View

9. CLP now claims that it is necessary to limit the total load handled by Tsz Wan Shan Substation to 1000 MVA. As the peak demand in East Kowloon is 995 MVA in 1995 and is expected to reach 1052 MVA in 1996, it believes that the new Tseung Kwan O Substation is required for the transfer of the excess load from the Tsz Wan Shan Substation starting from 1996.

10. It must be noted that the above differs from the information given by CLP in 1992. The discrepancies are summarised below:-

Information given by CLP in

	<u>1992</u>	<u>1995</u>
Capacity of Tsz Wan Shan Substation	1200 MVA	1000 MVA
Basis for arriving at capacity	Six 240 MVA transformers connected and work as a group; Capacity = 5 x 240 MVA, assuming 1 transformer out of service	Six 250 MVA transformers divided into two groups - each handling 500 MVA; Capacity = 2 x 500 MVA

Details of CLP information are given at Appendices I and II.

11. Any such changes could be due to complex engineering criterion which include limitations resulting from thermal¹, stability² and fault clearing³ criteria. Without a thorough study of the technical data, it is difficult to conclude whether the present grouping of transformers, and in turn the calculation of substation capacity, is reasonable or not.

Concluding Remarks

12. The latest revised peak demand of East Kowloon including Tseung Kwan O for 1996 is some 17% lower than the forecast made in 1992, when the new Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O transmission link were planned. Following the planning principles in 1992, there does not appear to be a need to adhere strictly to the original commissioning schedule for the purpose of securing the electricity supply to East Kowloon and Tseung Kwan O in 1996.

¹ Thermal limitations are related to the nameplate rating of the power system equipment.

² Stability criterion is related to the ability of the system to continue to work as a group following disturbances.

³ Fault clearing criterion is the ability of the circuit breakers to interrupt short circuit current.

13. Diverting some load from the Tsz Wan Shan Substation to its neighbouring substations, especially the Tai Wan Substation which is handling decreased peak demand, may be considered as a fall-back if there is a need to postpone the commissioning of the Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O transmission link.

14. CLP now points out that the link is still required in 1996 for technical reasons. Without a detailed study by relevant professionals, it is difficult to conclude whether CLP's argument is acceptable or not.

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Extract from "Tseung Kwan O 400kV Substation Environmental and Visual Impact Assessment Final Report", October 1992

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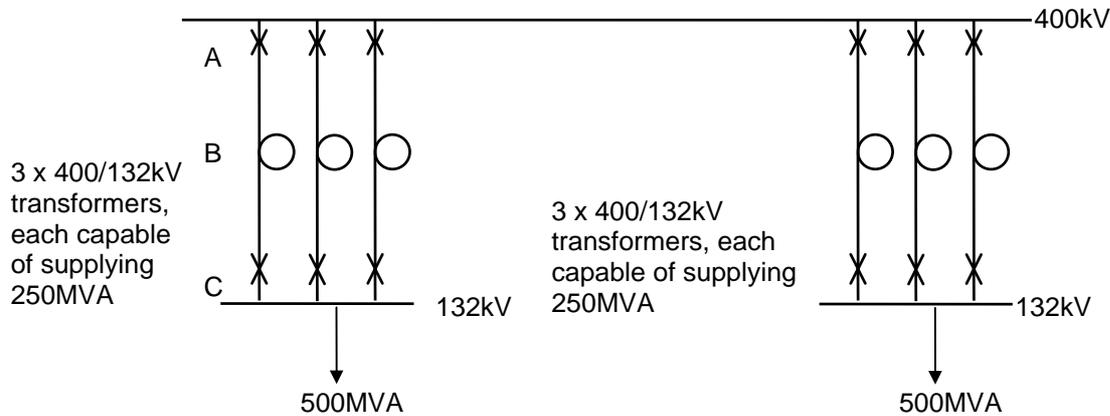
1.2 Justification for the Substation

The bulk of the electricity demand of the East Kowloon area from Kai Tak and Tsz Wan Shan to Tseung Kwan O is supplied from the 400kV substation in Tsz Wan Shan. From current load forecasts, the estimated loading of Tsz Wan Shan Substation would be approximately 1200MVA and 1300MVA in 1995 and 1996 respectively.

The planning criterion for establishing new 400kV substations is that the loadings of existing 400kV substations (each of which can accommodate up to six 240MVA transformers) should be restricted ultimately to around 1000MVA as far as practicable. This 1000MVA limit is set to avoid widespread loadshedding on a catastrophic loss of a 400kV substation (or the circuits feeding it), and to ensure that the subsequent restoration of supply would be within the capacities of neighbouring substations.

It can be seen from the forecasts that the loading at Tsz Wan Shan Substation exceeds the 1000MVA planning criterion in 1995. The loading in 1996 also exceeds the total firm capacity of 1200MVA (i.e. the capacity of the remaining five transformers at Tsz Wan Shan should one of the six 240MVA transformers be out of service). As neighbouring 400kV substations (e.g. Tai Wan) will also be heavily loaded, relieving Tsz Wan Shan by transferring part of its load to other 400kV substations via new 132kV circuits would not only be expensive but also impractical. A new substation will, therefore, be required in 1996 to relieve the heavily loaded Tsz Wan Shan Substation. CLP proposes to build this new substation in Tseung Kwan O.

Latest Information on Tsz Wan Shan 400kV Substation provided by China Light and Power Company, Limited



The total maximum load of 1000MVA handled by Tsz Wan Shan Substation is supplied via two groups of 400/132kV transformers with three transformers in each group as shown in the above diagram, each group catering for half the maximum total load, i.e. 500MVA. Separation of the transformers into two groups is necessary in order to ensure that the fault rating of the 132kV switchgear (the capability of the 132kV switchgear to isolate successfully any fault in the 132kV transmission system connected to the 132kV switchgear including cables, overhead lines and transformers) is within the switchgear manufacturer's design limit.

Should a fault occur on a component within either group shown in the diagram, such as a 400kV switch (A), a transformer (B) or a 132kV switch (C), the electrical protection system will automatically isolate the faulty component, leaving the remaining two transformers in the affected group to handle the load of 500MVA. The system will still remain stable since the two transformers can jointly supply 500MVA.

If the total load handled by Tsz Wan Shan Substation exceeds 1000MVA, each or at least one group of transformers must supply over 500MVA of load. Under the circumstances, should a fault occur on any component (400kV switch, transformer or 132kV switch) associated with the group(s) supplying over 500MVA, the automatic isolation of the faulty component by the electrical protection would leave the two remaining transformers in an overloaded situation, supplying over 500MVA of load. This in turn could result in automatic tripping of the two remaining units (with the total loss of 500MVA of load) or forced load shedding to correct the overloaded situation.