

A New Era of Opportunities and Challenges for Electrical Engineers



The Hong Kong Institution of Engineers – Electrical Division
The Twentieth Annual Symposium
22nd October 2002



**THE HONG KONG
INSTITUTION OF ENGINEERS
ELECTRICAL DIVISION**

The Twentieth Annual Symposium

Tuesday

22nd October 2002

***A NEW ERA OF OPPORTUNITIES AND CHALLENGES
FOR ELECTRICAL ENGINEERS***

at

Ballroom
Sheraton Hotel
Nathan Road
Kowloon
Hong Kong

SYMPOSIUM PROGRAMME

08.30 Registration and Coffee

09.00 Welcome Address

- Ir T.P. Uy
Chairman, Electrical Division, The HKIE

09.05 Opening Address

- Ir Dr Alex Chan
Vice President, The HKIE

09.10 Keynote Speech

- Ir Roger S.H. Lai, JP
Director
Electrical & Mechanical Services Department
The Government of the HKSAR

1. Standards and Codes

09.40 Standardization Development and Changes After China's Accession to WTO

- Mr Raymond W.Y. Wong
Regional Vice President
Intertek Testing Services Hong Kong Ltd.

10.00 The Revision of the Code of Practice for the Electricity (Wiring) Regulations

- Ir George K.H. Ling, Chief E&M Engineer
- Ir Y.M. Chan, Senior E&M Engineer
Electrical & Mechanical Services Department
The Government of the HKSAR

10.20 Discussion

10.40 Coffee Break

2. Energy Market

11.10 China Energy Market Update and Related WTO Impact

- Ir Richard K.W. Yeung
Regional Vice President, T&D Sector
Alstom China Ltd., PRC

11.30 The Liberalization of the Singapore Electricity Market

- Mr John S.Y. Lim
Economics Officer (Market Licensing & Control)
Energy Market Authority, Singapore

11.50 Discussion

12.20 Lunch

3. Industrial Opportunities and Experience

14.00 Development of the Overseas Market by Xian Electric, China

- Mr T.X. Pu
President
Xian Electric Manufacturing Corporation, PRC

14.20 The New 22kV Distribution System for the Hongkong Electric Co. Ltd. - Design Considerations and Operational Aspects

- Ir T.C. Yee, Chief Electrical Engineer,
Project Division
- Mr K.T. Yeung, Engineering Coordination Engineer,
T&D Division
The Hongkong Electric Co. Ltd.

14.40 Project Management Success of the MTR Tseung Kwan O Extension Project

- Ir Henry H.C. Lam
Project Manager (TKE/QBR)
MTR Corporation Limited, Hong Kong

15.00 Discussion

15.20 Coffee Break

4. Design and Construction Experience in China

15.50 Opportunities and Challenges to Hong Kong After China's Accession to WTO

- Prof. G.G. Wang
Professor of Chinese and Comparative Law
School of Law
City University of Hong Kong

16.10 Design and Construction Opportunities in China

- Ir Joseph C.M. Leung
Director
J. Roger Preston Ltd., Hong Kong
- Ir Rocky L.K. Poon
Director
Young's Engineering Co. Ltd., Hong Kong

16.30 Discussion

17.00 Summing Up

- Ir Dr F.C. Chan
Symposium Chairman
Electrical Division, The HKIE

Closing Address

- Mr Stewart Saunders
Chief Operating Officer
CLP Power Hong Kong Ltd.

Acknowledgement

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Speakers / Authors

Ir Roger S.H. Lai, JP	Mr T.X. Pu
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Mr Raymond W.Y. Wong	Ir Henry H.C. Lam
Ir George K.H. Ling	Prof. G.G. Wang
Ir Y.M. Chan	Ir Joseph C.M. Leung
Ir Richard K.W. Yeung	Ir Rocky L.K. Poon
Mr John S.Y. Lim	

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Paper No. 1

**STANDARDIZATION DEVELOPMENT AND
CHANGES AFTER CHINA'S ACCESSION TO WTO**

**Speaker : Mr Raymond W.Y. Wong
Regional Vice President
Intertek Testing Services Hong Kong Ltd.**

STANDARDIZATION DEVELOPMENT AND CHANGES AFTER CHINA'S ACCESSION TO WTO

Mr Raymond W.Y. Wong
Regional Vice President
Intertek Testing Services Hong Kong Ltd.

ABSTRACT

Standardization is an important process in manufacturing and trading. It is much more developed in industrialized countries and in the developing countries; it varied a lot according to different development phase.

We used to hear a lot about the terms of "international standard" but in reality, this only applied in a few areas. In most cases, national standard is much more important than international standard. This is especially true in international trade. The importing countries will require products (including domestic made and imported) to be in compliance with their own national requirements. However, harmonization of standards, on a regional and even global basis, is occurring because consumers' behavior and requirements are getting closer.

Standardization is one thing and ways and means of enforcing standardization is another important element in international trade. Some countries, due to political needs, such as protection of national manufacturing, do appeared creating some technical barriers through stringent product standards and/or enforcement process.

After China's opening in the late seventies, there were lots of changes in standardization and infrastructure for international trade. During the process of preparation and after signatory of accession into the WTO, China has quickened development in all aspects. There are lots of changes in the government sector as well as the commercial sector. The State Council has already restructured the authorities responsible for standardization and its implementation. The former CSBTS (primarily responsible for standardization and domestic trade) and SACI (primarily responsible for standardization of international trade) had been merged at the head office level. China Compulsory Certification marks

has also been created and being enforced. Further changes in central and municipal governments are expected in the coming years.

Hong Kong manufacturers and traders, armed with international know-how, are still having competitive advantages during these changes. Standardization covers a wide range of areas. Apart from product standards, there are also manufacturing, trading and consumer behavior international practices. Anti-dumping, intellectual properties, environment protection (green movement) and social accountabilities issues are all becoming internationalized and standardized. Hong Kong's role will change from the previous "window of China trade" to become the catalyst inside China.

1. STANDARD & STANDARDIZATION

"Standard" is an agreement established for a physical object, performance, capacity, arrangement, method procedure, responsibility, duty, authority, etc. for the purpose of unification and simplification so that profit or convenience may be obtained with fairness among the persons concerned.

The International Organization for Standard (ISO) defined that "Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose". International standards thus contribute to making life simpler, and to increasing the reliability and effectiveness of the goods and services we use.

“Standardization” is the systematic activity of establishing and utilizing standards. There are four levels of standardization that are commonly known in the industries, namely, Company Standardization, National Standardization, Regional Standardization and International Standardization.



System of Industrial Standardization

Most company or manufacturers design unique company standard in meeting with client's specification, legal requirement, quality requirement for competition in the market.

National standard such as British Standard (BS), China National Standard (GB) etc. are developed in country basis. These standards are widely adopted by local authority as a reference specification for development and/or enforcement of regulations related to safe, environment, health, etc.

Regional standard such as European Standard (EN) developed by European Committee for Electrotechnical Standardization (CENELEC) is published for the purpose to support the achievement of the free market for goods and services inside Europe.

International Standards such as those issued from IEC (International Electrotechnical Commission) and ISO (International Organization for Standard) aimed at facilitate world trade by removing technical barriers to trade which leads to the development of new markets and economic growth.

2. OBJECTIVE OF STANDARDIZATION

The objectives of Standardization in a company are :-

- Standardization as a means of communicating information
- Accumulation of Technique
- Standards of Control
- Establishment of Interchangeability
- Stability and Improvement on Quality
- Cost Reduction and Simplification
- Increase in Efficiency and Unification in Business

3. IMPORTANCE OF INTERNATIONAL STANDARDIZATION

“Technical Barriers to Trade” is deviated from the non-harmonized standards for same technology in different countries or regions. The export-orientated countries (or industries) need a world agreed standard to help rationalize the international trading process. This was the origin of establishment of ISO and IEC.

International Standardization will become more importance for all sectors of industrial activity in the coming future for the following reasons :-

- Globalization in Trade
- Interpenetration of Industrial Sectors
- Global Standards for Emerging Technologies
- Infrastructure for Developing Countries
- Within a particular industrial sector, industry-wide standardization exists when large majority of products or services are in conformance to same standards. The result of industry-wide standardization came from consensus agreements reached

between all economic player in that industrial sector consists of suppliers, users, and governments. All of them agree on specification and criteria to be applied consistently in the choice and classification of materials, the manufacture of products and the provision of services.

The common goal is to facilitate trade, exchange and technology transfer through :

- enhanced product quality and reliability at a reasonable price;
- improved health, safety and environmental protection, and reduction of waste;
- greater compatibility and interoperability of goods and services;
- simplification for improved usability;
- reduction in the number of models, and thus reduction in costs;
- increased distribution efficiency and ease of maintenance.

Through the industry-wide standardization, users will have more confidence in products and services that conform to International Standards. Assurance of conformity can be provided by manufacturers' declaration (e.g. Declaration of Conformity in EU) or by audits carried out by independent bodies (e.g. ISO 9000 certification).

4. STANDARD FOR ENTERPRISE

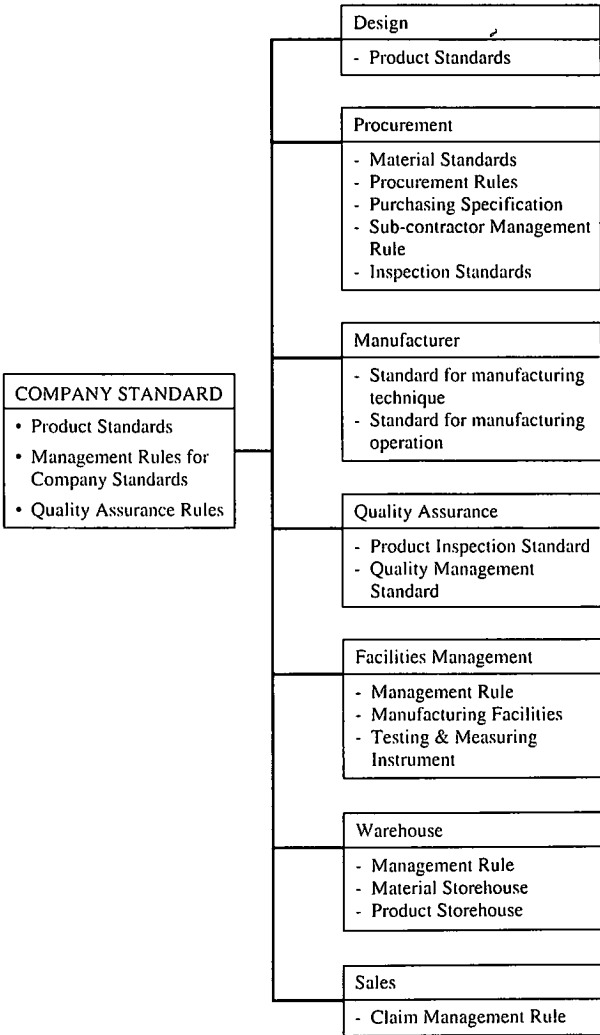
Most enterprise publish an unique Company Standard for the achievement of company goal and mission, profitability, level of productivity, quality, customer satisfaction, etc. Also, the Company Standards form a base for controlling operation and enterprise activities.

- *Company Standards as Bases for Controlling*

PLAN - To establish company standards on the qualities, cost, time limit of delivery, services and safety.

- DO - To enforce in accordance with company standards
- CHECK - To check whether it is enforced in accordance with company standards or not.
- ACTION - If it is not enforced in accordance with company standards, educate and train to enforce in accordance with company standards. If it is not enforced in accordance with company standards due to inappropriate company standards, improve the company standards.

- *Company Standards As Bases For Enterprise Activities*



5. STANDARDIZATION & PRODUCT CERTIFICATION DEVELOPMENT AFTER CHINA'S WTO ACCESSION

As a WTO member, China will be integrated with world economy featured by globalized production, trading and distribution. Standardization in line with the world is one of the important element to be taken into account. There is indication that China's intention to fulfill its commitment as a member of WTO in both the government and commercial sector.

The State Council has already restructured the authorities responsible for standardization and its implementation. The former CSBTS (China State Bureau for Quality and Technical Supervision) and CIQSA (State Administration for Entry-Exit Inspection and Quarantine) had been merged at the head office level and formed AQSIQ (General Administration for Quality Supervision, Inspection and Quarantine of PRC), CNCA (Certification and Accreditation Administration of PRC) and SAC (Standardization Administration of China). China Compulsory Certification (CCC) mark has also been introduced and being enforced. The governing body for the newly enforced CCC certification is CNCA.

Both of the former compulsory certification system i.e. Compulsory Supervision System for Product Safety Certification (Great Wall/CSBTS) and Safety License System for Import Commodities (CCIB/CIQ) have been replaced by the CCC certification system from 1 May 2002. There is one year transition period for both "CCIB & Great Wall" and "CCC" marks. Externally, the new system fulfills China's WTO entry commitments to combine the previous two systems (Great Wall mark and CCIB mark) into a single system. Internally, it improves and provides perfect internal management on the China's Compulsory Product Certification System.

The principles for the establishment of the new system are to follow the international practice for certification and the WTO/TBT Agreement. To eliminate any trade barrier arise from technical regulation, standards and

conformity assessment procedures, establishment and operation of certification is following ISO/IEC Guides and Standards, such as ISO/IEC Guides 23, 28, 65 and ISO/IEC 17020, 17025 etc.

With the set up of Certification and Accreditation Administration of PRC and the adjustment to the compulsory product certification system, process for harmonization system with the world has been started. Such process included unified products catalogue, unified technical regulation, standards and conformity assessment procedures, unified certification mark.

• *Framework of the CCC System*

The administration and implementation bodies are AQSIQ and CNCA. AQSIQ is responsible for formulating regulations for compulsory certification and approving product catalogue. CNCA is authorized by the State Council to be responsible for the establishment, management and organizing implementation of compulsory product certification.

The certification is performed based on the certificate rule includes :-

- Applicable Scope
- Model of Product
- Testing Standard
- Testing Items
- Technical Documents & Samples Required
- Critical Components Required
- Initial Factory Inspection Requirement
- Follow-Up Inspection Requirement
- Certificate Maintenance
- Special Requirement for use of Certification Mark

Applicant is requested to apply the CCC Mark through the Designed Certification Body (DCB). Currently, there are 9 certification bodies (DCB) designed by CNCA to implement compulsory certification in defined product scope.

Almost all of the testing standards are referred

to China national standards - GB. However, such GB standards are either identical or equivalent to IEC or ITU standards.

The CB test certificates issued by the member bodies of IECEE-CB system within the scope recognized by China National Committee of the IEC are recognized.

- *Adoption of International Standard*

By the end of 2001, there were 19,744 sets of national standards in PRC. SAC disclosed that 8,261 sets are in line with international and recognized overseas standards. 6,364 sets of national standards are derived from ISO and IEC standard of total 17,910 sets. This means that 32.2% of the national standards came from the international level.

For the purpose of the CCC, most of the GB standards apply to electrical engineering products are equivalent to IEC standard. For example, the PVC insulated cable evaluated under GB5013 which is equivalent to IEC60245. Even there is any national deviation from the IEC Standard, the change is very minimal. Such modification is merely for the device to be tested under local environment condition. Typical example is GB4706 and IEC60335 for the electrical household appliance.

Paper No. 2

**THE REVISION OF THE CODE OF PRACTICE FOR THE
ELECTRICITY (WIRING) REGULATIONS**

**Speakers : Ir George K.H. Ling, Chief E&M Engineer
Ir Y.M. Chan, Senior E&M Engineer
Electrical and Mechanical Services Department
The Government of the Hong Kong SAR**

THE REVISION OF THE CODE OF PRACTICE FOR THE ELECTRICITY (WIRING) REGULATIONS

Ir George K.H. Ling, Chief E&M Engineer
Ir Y.M. Chan, Senior E&M Engineer
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ABSTRACT

The Electricity (Wiring) Regulations [E(W)R] stipulate the statutory safety requirements for fixed electrical installations. In order to provide technical guidelines to the trade on how the legal requirements of the E(W)R can be met, the Electrical and Mechanical Services Department [EMSD] published the first edition of the Code of Practice for the Electricity (Wiring) Regulations [CoP] in 1992. This paper outlines the history of the development of the CoP and the latest revision exercise.

1. INTRODUCTION

Before the enactment of the Electricity Ordinance (Cap. 406) in 1990, electrical installations in Hong Kong were required to comply with the Institution of Electrical Engineers [IEE] Wiring Regulations of UK and the Supply Rules of the power companies in Hong Kong. The enactment of the Electricity Ordinance signified the establishment of a more embracing and systematic regulatory framework for the local electrical industry, and enabled EMSD to publish the CoP to facilitate better understanding of the Regulations by the trade.

The first edition of the CoP was issued in 1992. It has provided comprehensive technical guidelines and standardized practices for professionals as well as Registered Electrical Contractors / Workers (REC /REW) to understand and satisfy the requirements of the E(W)R. Compliance with the CoP would be deemed as satisfying the relevant provisions of the E(W)R.

2. REVISION OF THE CODE

It is EMSD's policy to review Codes of Practice on a regular basis so as to keep pace with the changes in international electrical safety standards and the technological advancement in the electrical trade and industry. In 1997, EMSD revised the CoP, adding testing & safety standards for high voltage installations, a list of Recognized Certification Bodies for electrical equipment and other relevant technical details and guidelines. In recent years, EMSD has received many good suggestions from the industry and the trade regarding reviewing the CoP, including the need for inclusion into the CoP additional items and new practices arising from the rapid development of the electrical industry. As a result, EMSD started to review the CoP in early 2002.

Consultation was conducted to invite comments from relevant organizations in the trade and industry on the revision of the CoP. Since then, EMSD has received very good response and valuable feedback from the electrical trade and a working group has subsequently been established to discuss details of the revision.

The members of the working group come from different sectors of the electrical trade and industry. The following organisations are represented in this working group :

- Architectural Services Department
- Fire Services Department
- Housing Department
- Water Supplies Department

- CLP Power Co. Ltd.
- H.K. & Kowloon Electrical Engineering & Appliances Trade Workers Union
- Hong Kong Electrical Contractors' Association
- Hong Kong Institute of Vocational Education
- Hong Kong Polytechnic University
- The Association of Consulting Engineers of Hong Kong
- The Association of Electrical Contractors
- The Chartered Institution of Building Services Engineers (Hong Kong Branch)
- The Hongkong Electric Co., Ltd.
- The Hong Kong Institution of Engineers
- The Institution of Electrical Engineers

Two working group meetings have been held in April & July this year. The revision of the CoP is expected to be completed by early 2003.

3. SCOPE OF REVISION

The scope of the CoP revision mainly includes the following:

Reference to International Standards

This revision will make reference to the latest international standards and address changes arising from newly developed technology in the electrical industry. Historically, the British Standards (BS) have been commonly used in the past and were therefore the most dominant standards found in technical specifications as well as the CoP. However, in recent years EMSD, the trade and the industry have progressively adopted the more widely used international standards promulgated by the International Electrotechnical Commission (IEC). The revision of the CoP will aim at making reference to relevant IEC standards as

far as practicable and with a list of IEC standards included in the CoP for reference. In addition, in view of the increasing importation of electrical products manufactured from Mainland China, the inclusion of the Chinese National Standards (Guo Biao) as recognized standards has been reviewed. In fact, the Mainland has been aligning the requirements in Guo Biao with that of the corresponding IEC standards. At present if a Guo Biao is equivalent to a corresponding IEC Standard, it would be recognized as an acceptable standard under the CoP.

Updating the List of Recognized Bodies

According to Regulation 4(1) of the E(W)R, good workmanship and suitable materials shall be employed for fixed electrical installation. This requirement has been further elaborated in details in Code 4 of the CoP. In general, electrical equipment shall be designed and manufactured to recognized standards, and shall also be tested by a laboratory / organization which is either accredited by the Hong Kong Accreditation Service (HKAS) or accredited by a body having mutual recognition agreement with the HKAS. This revision of CoP will update the list of recognized bodies including the incorporation of relevant mutually recognized organization in Mainland China.

Extraneous Conductive Parts and Equipotential Bonding

The term “extraneous conductive part” is defined in the E(W)R as a conductive part liable to introduce a potential, generally earth potential, that does not form part of an electrical installation. However, the determination of extraneous conductive part such as metallic bathroom accessories, window frame and wall mounted metal plate, has been a controversial subject especially for front-line electrical workers. To illustrate the determination method and equipotential bonding requirements for extraneous conductive parts, EMSD co-organized with HKIE a technical seminar on “Equipotential Bonding for Conductive Parts” in December 2000. The seminar was well received by more than 250 members of the HKIE. The new

revision of the CoP would include practical examples to elaborate the determination method and equipotential bonding requirements for extraneous conductive parts. Basically, if the insulation resistance of the conductive parts to main earthing terminal of the installation can always be maintained above 21,000 ohm at 220V supply system even under worst conditions (e.g. high moisture condition), the conductive parts may be regarded as non-extraneous conductive parts. In addition, new codes would be provided to specify the installation method of concealed equipotential bonding conductors.

Review on Socket Outlet in Bathroom

EMSD has reviewed the requirements for electrical installations in bathroom. The installation requirements for socket outlets has been revised to follow the IEC Standard (IEC 60364-7-701) such that a socket outlet protected by a residual current device (RCD) with residual operating current not exceeding 30mA could be installed in Zone 3 location (i.e. 0.6m away from shower basin or bath tub). This requirement was effective on 1 April 2002 and would be incorporated in the new edition. In addition, the classification of zones as specified in IEC 60364-7-701 will be added. The review will also incorporate the relevant latest requirements specified in the IEC 60364-7-701 and Section 601 of BS 7671.

The Use of Cable Lubricant

The use of cable lubricant has been reviewed by the working group. It has been agreed that cable lubricant could be used during cable installation provided that the lubricant would not affect the cable insulation property and decrease the fire resistant rating of the cable.

Revision of Checklists

The checklists in Appendix 10 of the existing CoP provide a convenient and quick reference for REC/ REW on inspection and testing of new and existing installations. To keep pace with the technological advancement, the checklists would be revised to include a new set of test sequence for LV installations. Also a new checklist for lightning protection

installation will be provided.

Other Revisions

Other revisions include reviewing the number of recommended socket outlets for various household applications, adding harmonic current limits to address the increasingly common problems of overheating electrical distribution system by harmonic currents, adding a table of IP rating, providing new testing method for earthing electrode, and adding an index section at the back of the CoP for easy reference.

4. THE WAY FORWARD

EMSD will continue to keep abreast of the latest development in international safety standards and electrical technology. Suggestions and feedback concerning the practical application of the CoP are always welcome by EMSD. Where necessary, the CoP will be reviewed and revised in close consultation with the trade and industry.

5. CONCLUSION

The guidelines on technical and safety requirements of the CoP have been used as an accepted local standard by the trade and the industry on electrical installations. We trust that the new revision of the CoP will also serve to provide the driving force in enhancing electrical safety in Hong Kong through standardization of design and practices in the trade.

Paper No. 3

**CHINA ENERGY MARKET UPDATE AND
RELATED WTO IMPACT**

**Speaker : Ir Richard K.W. Yeung
Regional Vice President, T&D Sector
Alstom China Ltd., PRC**

CHINA ENERGY MARKET UPDATE AND RELATED WTO IMPACT

Ir Richard K.W. Yeung
Regional Vice President, T&D Sector
Alstom China Ltd., PRC

ABSTRACT

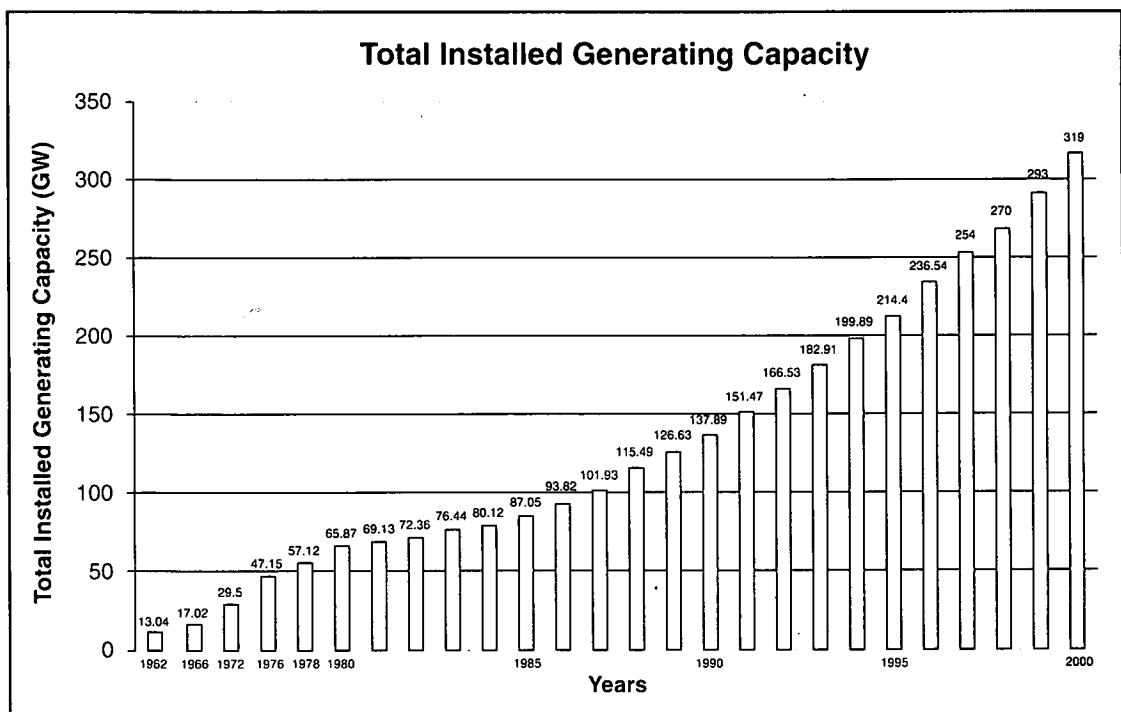
The electric power generation industries in China have made great achievements in the past 20 years. By the end of the last 5-Year-Plan (1996-2000), total installed power generation capacity has reached 319GW, almost five times the figure in 1980. In parallel with this impressive growth, the local manufacturing industries related to the field of power generation, transmission and distribution have also improved greatly their facilities and capacity with modern manufacturing technology acquired from foreign companies. Irrespective of this great success, the

installed capacity per capita in China is still 7-8% of the US and 12-13% of the French and the British.

The electric power industries will continue to grow for many years before China reaches 50% of the per-capita-installed-capacity level of the West.

This presentation gives an update of the electric power related manufacturing industries in China, and the possible threats and opportunities to both local and foreign players as a result of China's accession to WTO.

1. HIGHLIGHTS OF THE ELECTRICAL POWER INDUSTRY IN CHINA SINCE 1980



Reflecting the alleviation of tension between power supply and demand is a rapid growth of power industry since reforms and opening up in the past two decades in China. Serious power

shortage has been relieved because of achievement in the exponential increase in total installed generating capacity since 1980. By the end of 1980, the total installed generating

capacity was 65.87 GW while by the end of 2000 this figure skyrocketed to 319 GW.

Throughout this period, the actual capacity increase has always exceeded the planned increase for each of the five-year plans. The planned capacity increase for the 8th five-year plan (91-95) was 45-50 GW while the actual increase was 75.89 GW. The planned increase in installed capacity for the 9th five-year plan (86-90) was 70-80 GW, the actual achievement was 95.38GW!

Planned increase in power generation installed capacity in the current five year plan (2001-2005) is 60-65GW. It is interesting to see what will be the actual growth figure by end 2005.

Five-Year-Plan Review

	6 FYP (81-85)	7 FYP (86-90)	8 FYP (91-95)	9 FYP (96-00)	10 FYP (01-05)
Power Generation Installed Capacity (GW) at Beginning of FYP	65.87	87.05	137.89	214.40	319
Planned Capacity Increase	14.25	37	45/50	70/80	60/65
Actual Capacity Increase	21.18	48.45	75.89	95.38	?

Source: SDPC

National growth of MVA transformer capacity in the past several years, at voltage level 35 kV and above, was in the range of 9-10%. Total installed transformer capacity, 35KV and above, in 2000 has reached a figure of 996,120 MVA.

Let us have a closer look at the 220 kV level, the nation's total in 1997 was 227,910 MVA, followed by a growth of 12%. In 1998, this growth dipped to 10%, but retained its 12% value in 1999. By the turn of the century, the growth was 7%, bringing the nation's total 220 kV installed transformer capacity reaching a figure of 300,640 MVA. The 500 kV transformer capacity level saw a more fluctuating growth period starting in 1997 with 56,660 MVA accompanied by a growth of

10%. The growth of each succeeding year was 21%, 16% and 25% respectively, reaching a national total figure of 99,860 MVA capacity by the year 2000.

Growth of 500KV Transformer Capacity 1997-2000

Regions and Provinces	Transformer Capacity (MVA)			
	1997	1998	1999	2000
North China	8630	9680	11550	14550
Northeast China	11770	12580	12840	
East China	11660	14390	16640	18190
Central China	8530	8530	10030	
Shandong	2670	3000	3920	2170
Fujian		900	900	1650
Guangdong	7500	8250	10500	14250
Guangxi	1250	1250	1250	2000
Guizhou	500	500	500	
Yunnan	1750	1750	1750	
Sichuan		1500	2250	
Hainan				
Trans-Regional		6990	7740	8690
Nation's Total	56660	68820	80120	99860
Growth %	10%	21%	16%	25%

Source: SPC

In 1997 the nation's 220 kV transmission lines totaled 108,577 km, with a growth of 6%. The growth in the next three years were 7%, 10% and 5%, resulting in a total length of 128,114km 220kV transmission lines in 2000. At the 500 kV level, there were only 13,635km transmission lines in 1996. The figure grew to 26,837km by the year 2000. In between, the growth rates for each sequential year were 11%,32%, 15% and 17%.

Growth of 500KV Transmission Line (KM) 1997-2000

Regions/Provinces	1997	1998	1999	2000
North China	2109	2748	2831	3395
Northeast China	2740	2977	3550	4536
East China	2941	3761	4493	7347
Central China	2592	2850	2850	3328
Northwest China	6440*	7220*	7878*	
Shandong	739	739	874	874
Fujian		88	474	473
Guangdong	1367	1367	1742	1789
Guangxi	407	408	408	558
Guizhou			125	125
Yunnan	440	440	440	440
Sichuan/Chongqing		1200	1737	2304
Hainan				
Xingjiang				
Nation's Total	15081	19980	22927	26837
Growth %	11%	32%	15%	17%

* 330KV

Source: SPC

With the on-going projects on west-to-east power transmissions and planned HVAC interconnections among regional grids, it is expected that the growth in 500KV-transmission level will remain at a high rate.

2. RESTRUCTURING OF CHINA STATE POWER CORPORATION

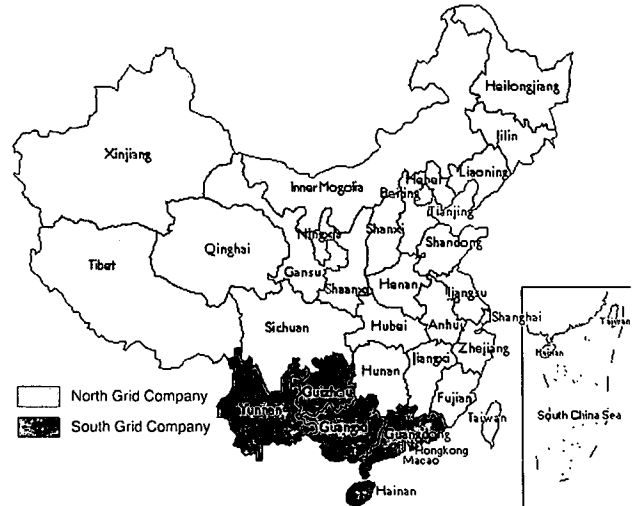
There has been a lot of talk in the market on re-structuring of State Power Corporation. According to different sources of information, the general guidelines for the reform include learning from foreign countries in their experiences in the creation of competition in the electrical supply industries, but keeping in line with the realities in the current situation of electrical supply industries in China. Furthermore, the reform should follow the current industrial development rules and should encourage optimization use of industrial resources by the market. Also, it shall promote the growth of corporate power generation enterprises, enhance the operation efficiency of these power generation enterprises and ultimately establish a market driven sector, which is suitable for industrial development, safety of electricity supply, environmental protection and economic growth.

The main goal of the re-structure is to break monopoly, and to provide a mechanism for competition. Other objectives are efficiency improvement, costs reduction, tariff pricing system reform, and optimization of resources allocation.

According to the proposed re-structuring scheme, there will be 2 power grid companies and 5 power generation corporations.

The 2 power grid companies will control the transmission and distribution assets in China. They are the South Grid Company and the North Grid Company. The South Grid Company will have a market area covering Guangdong, Guangxi, Hainan, Yunnan, Guizhou. The North Grid Company will cover the remaining part of China.

Generation assets will be allocated to 5 different power generation corporations. The allocation will follow the principle that none of these five power generation corporations will control more than 25% of power generation assets in any single province.



3. WTO IMPACT ON ELECTRIC POWER RELATED MANUFACTURING INDUSTRIES

3.1 COAL FIRED STEAM BOILER

Major local coal fired steam boiler manufacturers in China are located in Harbin, Sichuan, Shanghai and Beijing. Harbin has a 300/600 MW license from CE (Combustion Engineering now merged with ALSTOM). They are the only local manufacturers with references in 600 MW units. Sichuan has a 300 MW license from CE and cooperates with Hitachi on 600 MW units. Shanghai has a 300 MW license from CE and is looking for a technology partner in 600 MW units. Shanghai is also a manufacturing center of steam generators for self developed 300 MW nuclear power plants. Foster Wheeler has a joint venture in Beijing for boilers up to 300 MW. There are several medium sized local boiler manufacturers up to 200 MW. Some of them can also manufacture CFB (Circulating Fluidized Bed) boilers up to 50 MW. China State Council has banned the import of coal fired boilers up to 600 MW. Hence, there is little room left for foreign players in this sector except for boilers over 600 MW and CFB above 200 MW. China will continue to build quite a number of coal fired power plants in the years to come. Big local players will survive with possibly some M&A (merger & acquisition) activities among themselves in the future. They will certainly compete with

foreign players in the export market when opportunity knocks.

3.2 STEAM TURBINES AND GENERATORS

Major local steam turbine and generator manufacturing in China are also located in Harbin, Sichuan, Shanghai and Beijing. Harbin has a 300/600 MW license from WE (Westinghouse Electric, of which the power generation division was acquired by Siemens years ago). Sichuan Dongfang has a 300 MW license from WE and cooperates with Hitachi on 600 MW units. Their factory is equipped with the most modern manufacturing facilities. Shanghai has a 300 MW license from WE. They formed 3 joint ventures with WE a few years ago with majority share holding. After acquisition of WE Power Generation Division by Siemens, Siemens now owns the minority share holding in these 3 joint ventures. Shanghai has decided to stick to the WE technology to develop their own 600 MW turbine and generator unit. They will not switch to Siemens technology for these products. Beijing Heavy is the smallest player with own design in 125/200 MW units. It cooperated with ALSTOM on 330 MW units in the past and had delivered over 10 units on co-manufacture basis. Recently, it has decided to develop its own 300 MW units for the local market.

China State Council has also banned the import of steam turbines and generators up to 600 MW. There is little room for foreign players in this sector except supercritical units above 600 MW. With the strong power generation construction program in China, local players will survive with possibly some M&A activities among themselves. They will certainly compete with foreign players in export markets when opportunity knocks.

3.3 HYDRO TURBINES AND GENERATORS

Major local hydro turbine and generator manufacturers in China are located in Harbin and Sichuan. Harbin has a license from ALSTOM on 700 MW hydro turbine and generator units through the execution of the Three Gorges Hydro Power Plant Project. In

this project, ALSTOM obtained an order to deliver 8 sets of 700MW hydro turbine and generator units. Sichuan Dongfang has a license from Siemens and Voith on 700 MW hydro turbine and generator units through the same project, in which Siemens and Voith was awarded 6 units. With this technology transfer, both Harbin and Sichuan Dongfang are able to manufacture conventional hydro units up to 700MW by themselves. There is little room left for foreign players in this sector except for bulb turbine generators above 20 MW, pumped storage power plants above 150 MW, and control equipment for large hydro units. Through their licensees in China, foreign players may still have an advising role in the next few years on larger hydro power plant projects with units rated 600/700 MW. Shanghai has a joint venture with Voith on full range of hydro units. Alstom has a joint venture in Tianjin on full range of hydro units. However, both joint ventures are restricted to compete with the big local players in large units by qualifications and references.

3.4 GAS TURBINE

There is not yet a major local gas turbine manufacturer in China. Harbin is not yet in this business, but they are talking to GE and ALSTOM for technical cooperation in future projects. Sichuan is not yet in this business either, but they have reached an agreement with Mitsubishi for co-operation in future projects. Shanghai has a joint venture with Siemens on full range of gas turbines, but until today, they have not yet delivered any locally assembled gas turbine. Nanjing has a license from GE on Frame 6 since more than 10 years ago. They have a non-exclusive cooperation agreement on bigger machines.

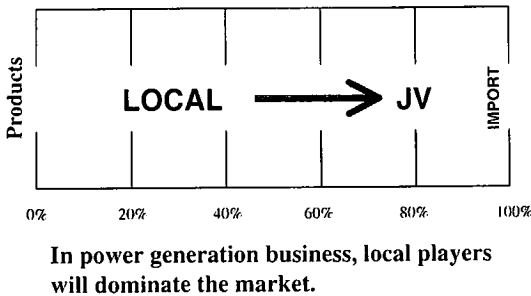
According to the current five-year plan, there are 10 large gas turbine projects included in the plan. These projects will be bundled together for tendering. Interested parties must bid all 10 projects with a local manufacturing partner and with a specific scope in technology transfer. This is the only chance in which foreign players have a possibility to take up substantial a substantial order on gas turbine power

generation projects. To win, foreign players must act in line with the requirements on technology transfer and localization.

3.5 NUCLEAR POWER PLANT EQUIPMENT

China has its “own design” of 300 MW and 600 MW nuclear power plant units which were based on the WE 300 MW loop concept. The first prototype units were installed in Zhejiang Qinshan Nuclear Power Plants. Nuclear power plant design, engineering and manufacturing activities for these units are spread across the country, with some degree of concentration in Shanghai area.

Both Daya Bay and LingAo nuclear power plants were 100% imported. There is not yet any major nuclear technology transfer to China. Two 300 MW nuclear power plant units have been exported to Pakistan. The current nuclear power plant program is being delayed by the “west power to east” project. It is not yet decided whether the next nuclear power plant project will use local made 300/600 MW units or to import 1000/1400 MW units from the West. There is a high possibility that China will enhance domestic capabilities by building more nuclear power plants with local units and will look for export opportunities for these units. China will also import a few 1000/1400 MW large units with strict requirements on technology transfer to fulfil the self-reliance policy in nuclear technology.



3.6 POWER TRANSFORMERS

Major transformer manufacturers in China are located in Shenyang, Xian and Baoding. All of them can manufacture power transformers up to 500KV 750 MVA with their own technology. In addition, Shenyang is in

cooperation with Siemens on 500KV converter transformers for HVDC projects. Shenyang is in joint venture discussion with Siemens on local manufacture of 500KV products. Xian is in cooperation with ABB on 500KV converter transformers form HVDC projects. Baoding focuses on power transformer manufacturing and is in contact with Mitsubishi for possibility of co-operation.

ABB set up power transformer join ventures in Hefei, Chongqing and Zhongshan. Siemens has a joint venture in Jinan; ALSTOM has a joint venture in Shanghai; Toshiba has a joint venture in Changzhou and Elin has a joint venture in Guangdong. Foreign players have a total manufacturing capacity about 70,000 MVA per year. They are well positioned to win 220KV and 500KV power transformer orders. Big local players will be the losers while smaller players on power transformers up to 110KV will survive because of competition, efficiency, internal structures and social burden.

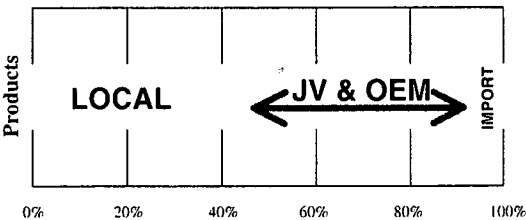
3.7 HIGH VOLTAGE SWITCHGEAR

Major local HV switchgear manufacturers are located in Shenyang, Xian and Pingdingshan. Shenyang has an old gas insulated switchgear (GIS) license from Hitachi and is in cooperation with ABB on 500 kV GIS for the Three Gorges Project. They are looking for a joint venture partner. Xian has a joint venture with Mitsubishi on air-insulated switchgear (AIS) and GIS. At the same time, it maintains the manufacture of its own products in the workshops not included in the joint venture. Pingdingshan has a GIS joint venture with Toshiba. Similar to Xian, Pindingshan maintains the manufacture of its own GIS and AIS products. ABB has an AIS joint venture in Beijing and a GIS joint venture in Xiamen. Siemens has an AIS joint venture in Hangzhou and a GIS joint venture in Shanghai while ALSTOM works through partners in local assembling activities. Local players will lose out without a foreign partner because of old circuit breaker technology and social burden; sino-foreign joint ventures will take up more market share.

3.8 LOW VOLTAGE AND MEDIUM VOLTAGE SWITCHGEAR

There are many local manufacturers in these product ranges. Most of them are small ones with annual revenue less than 10M RMB. They use mostly local made components and focus on the low end market. There are over 25 bigger local manufacturers with annual revenue over 100M RMB. They have a product mix with components from pure local, joint venture, and import. The most successful one has achieved a revenue over 700 RMB in 2001 with profit before tax over 110M RMB.

ABB has joint ventures in Guangdong, Fujian and Beijing. Siemens has joint ventures in Shanghai, Jiangsu and Shandong. Schneider has joint ventures in Tianjin, Beijing, Jiangsu and Shanghai. Alstom has a joint venture in Jiangsu. Over 50% of the small local players will not survive in the next few years because the market will become more transparent and joint ventures will take up more market shares. Big local players will become even bigger and ultimately compete with foreign players in export markets because of their strength in R&D, marketing and product renovation.



In T&D business, joint ventures and foreign players will take up more market shares from local players.

ACKNOWLEDGEMENT

I hereby extend my thanks to both Han Yeung and James Yeung spent the whole weekend on Aug 17 & 18 in helping me to prepare this paper.

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Paper No. 4

**THE LIBERALIZATION OF THE
SINGAPORE ELECTRICITY MARKET**

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THE LIBERALIZATION OF THE SINGAPORE ELECTRICITY MARKET

Mr John S.Y. Lim
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ABSTRACT

Historically, electricity companies of many countries are not only public ownership but also vertically integrated. In 1995, Singapore has taken the step to open an exciting and challenging new phase in the history of the Singapore electricity industry, with the restructuring of the electricity market. In 2000, Singapore further restructured the electricity market with the separation at the ownership level of the contestable and non-contestable parts of the electricity industry. The Energy Market Authority (EMA) was formed in 2001 to ensure a safe and reliable but most of all, a competitive environment in the new electricity market.

In this paper, a brief overview of the current Singapore electricity market is provided. The overview would focus on the market structure as well as how the existing electricity industry operates.

The next part of this paper then provides an overview of the new electricity market in Singapore. The focus would be on the wholesale part of the electricity market - vesting contract, which is of tremendous interest to the market participants.

This paper then concludes with brief highlights on other liberalised electricity markets from other countries, notably UK, and the goals that Singapore would like to achieve in the liberalization of the electricity market.

1. INTRODUCTION

On 1 Oct 1995, the Government of Singapore reformed the vertically integrated electricity industry to facilitate competition in electricity

generation and retail. The Public Utilities Board (PUB) were corporatised and vested in seven successor companies, namely three generation companies (gencos), one transmission and distribution company, one Electricity retail company, one gas supply company and one holding company. The Public Utilities Board was reconstituted to take on the new role of regulating the electricity and piped gas industries. The intention of corporatisation was to gradually introduce competition so that Singapore would have a competitive electricity market that allowed market forces rather than central planning to make investment, production and pricing decisions.

On 1 April 1998, a wholesale electricity market viz the Singapore Electricity Pool (SEP) came into operation. The SEP was implemented to introduce competition in the wholesale electricity market. A Pool Administrator operated the Pool to facilitate the trading of electricity between generation companies and the retail company in a competitive environment.

Liberalization in the Singapore electricity market was taken to a further step when key restructuring initiatives to be implemented included separation at the ownership level of the contestable and non-contestable parts of the electricity industry, the establishment of an independent system operator and the liberalization of the retail market. In addition, EMA was formed to replace PUB in April 2001 to regulate the electricity and gas markets. This step is taken to obtain the full benefits of competition.

2. OVERVIEW OF THE NEW ELECTRICITY MARKET

In the new Singapore electricity market, a main feature of the electricity liberalization is a clear separation at the ownership level of contestable/competitive businesses from natural monopolies. Therefore the generating companies and retailers or suppliers are separated from the grid company. The electricity system operator and market operator functions are now separated from the Grid company as well. It is a necessary criterion that vertically integrated functions must be separated so as to create a neutral market place for competitive functions. If not separated, there is a threat of cross subsidisation between the gencos and the grid company and will diminish the competitiveness of the industry (see Joskow 1998).

The new wholesale electricity market consists of the market operator, the generating companies (gencos), the system operator and the retailers who buy from the gencos. The Market Support Service Licensee (MSSL) is to facilitate access to the wholesale market. The retail market consists of course the retailers and consumers. The market operator oversees the whole operation in the wholesale market (please see diagram below). It dispatches bids from the generating companies and does wholesale settlements. Prices in the wholesale electricity market are determined by Market Clearing Engine (MCE). They produce what is called the Nodal Prices. The ex ante nodal spot prices are determined at each location in Singapore. It varies because of losses or transmission constraints. Registered generators are paid at their local nodal spot price. Consumers and unregistered generators are settled at the Uniform Singapore Energy Price (USEP) - this is the volume weighted average of the prices at load nodes.

Note that, however, the success of pool based system is strongly dependent on the structure of the bidding procedure (this is defined in our Market Rules), the determination of demand when market price is calculated and on the

number of active players.

Generators and (interruptible) loads provide the reserve. Energy dispatch is "co-optimised" with the allocation of reserve and regulation. Cost of reserve is shared amongst generators larger than 10 MW. Cost of regulation is shared amongst load and first 10MW capacity of each genset. There must be adequate reserves in the power system to backup operating generating sets. For this purpose, generation companies are required to hold a portion of their generation output capacity in reserve. This reserve will kick in to ensure system security when a generating set trips out. The spinning reserves market is a spot market for reserves established to enable generation companies to bid to sell spinning reserves.

On the retail side, this is liberalised in phases. There are now currently about 220 consumers who are "contestable". By contestable, this means that the consumers may choose² to buy electricity from a retailer or supplier of their choice. These 220 consumers represent about 40% of annual electricity sale in Singapore. The next phase would open competition for non-domestic consumers with annual consumption of 240MWh. This is followed by liberalising non-domestic consumers with annual consumption of 120 MWh. Full retail contestability will be the final phase whereby the remaining consumers (this is approximately one million of them) can choose the retailers of their choice.

3. VESTING CONTRACT

Market concentration is high in the wholesale market in Singapore. Almost 90% of capacity are concentrated in the three large gencos. With market power, gencos could withhold capacity to create artificial shortage and drive up prices (this is possible because short-term demand is inelastic). Alternatively, they could engage in predatory pricing to kill competition. For this reason, Vesting Contracts are imposed to curb market power.

Contracts will be between the Gencos and the Market Support Services Licensee. It commits the Gencos to sell specified quantities of energy at specified prices. The initial average coverage is 65% of the overall electricity demand. There is higher coverage during peak periods and smaller proportion for off-peak periods. The average contract quantity will reduce over time, as new capacity is built to dilute market power of incumbent gencos. With 65% of demand vested, the remaining 35% of the market will be without market power. Ability of companies to get dispatched in the 35% market depends on cost-competitiveness. Pool price is an outcome of the market. Allocation by installed capacity distributes the value fairly and proportionately to the gencos. The capacity for mothballed gensets and fast start plants will not be considered for allocation of vesting contracts.

The vesting contract will be set at the long-run marginal cost (LRMC) of new entrant. The LRMC would take account of all factors including land, fuel, construction, cost of capital and other relevant factors. The LRMC would be set at the most economic new entrant, which is the Combined Cycle Gas Turbine (CCGT) given the current technology.

The first estimate of LRMC will apply for the period from the start of the new market (given that the software is installed) till end of year 2004. Beginning from 2005 and every 2 years thereafter, EMA will reset the LRMC base price and review the extent of market power to determine the level of roll-back that will apply. For the first 5 years till 2007, the LRMC will be set based on the CCGT technology. After 2007, EMA will revalue the LRMC parameters if there is introduction of new technology that has landed in Singapore and has contributed to more than 25% of total demand. All existing generation licensees are offered vesting contracts. It is mandatory for all large generation companies to accept their allocation. The non-contestable consumers will be fully hedged by vesting contracts. The remaining contract cover will be allocated to the contestable consumers, on a proportionate

basis. LRMC covers the fixed and variable costs and provide a reasonable return to investors. It acts as signal for new plantings and encourages gencos to maximise operating and capital efficiency while minimizes cost of electricity to consumers. Vesting contracts have value as they hedge the gencos against volatile pool prices.

4. CONCLUSION

Academic studies had tried to determine the main factors that will make deregulation process a success. The main factors given are the number of active players in the wholesale market, the rules of bidding procedure, and the neutrality of the transmission grid, among others.

UK's electricity market began liberalization in 1990 and the final phase was in September 1998. Their retail electricity market is now quite competitive. The market concentration in the supply side shows that the top three largest suppliers take up 51% in 2001. The churn rate has also been very high, meaning that consumers can switch to other suppliers easily.

The Finnish electricity industry began competition in phases, starting from Nov 1995 and since September 1998, households can also choose their suppliers. For a more detailed analysis of the historical development of the Finnish electricity industry, see Myllyntaus, 1991. There is indication of falling wholesale price of electricity, and strong trend towards switching of suppliers, since the completion of the deregulation process of the Finnish electricity industry.

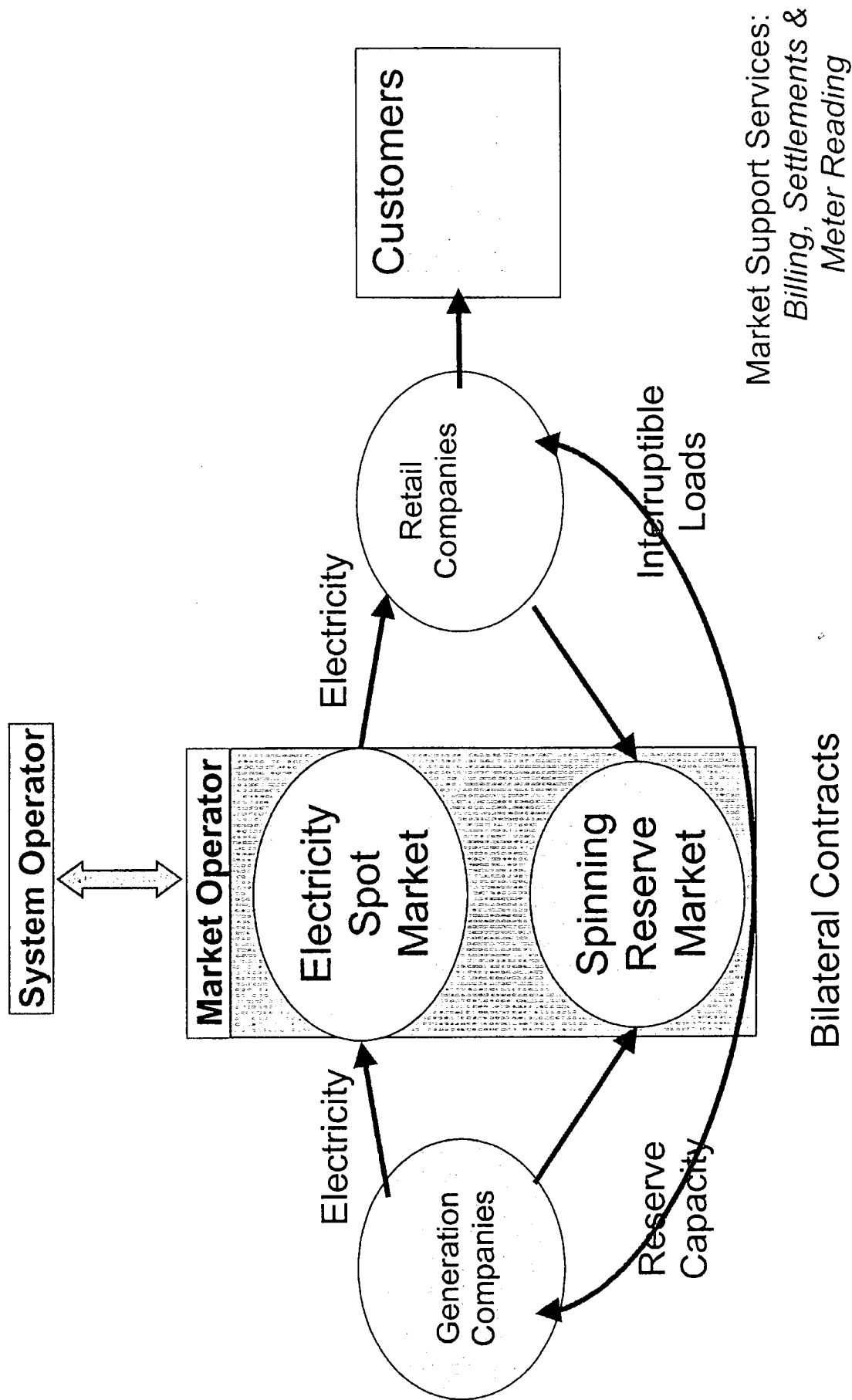
Singapore, as a country with limited resources, needs a competitive price and a price that gives the optimal signal to investors so as to provide the best incentives to allocate resources efficiently. The ultimate aim is to ensure a competitive environment in the Singapore electricity industry, so that it acts as a downward pressure on electricity price, as well as encouraging efficiency within the

competitors. This efficiency is then hopefully passed on to consumers and generate lower electricity prices.

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Figure 1 New Wholesale Electricity Market



Paper No. 5

**DEVELOPMENT OF THE OVERSEAS MARKET BY
XIAN ELECTRIC, CHINA**

**Speaker : Mr T.X. Pu
President
Xian Electric Manufacturing Corporation, PRC**

DEVELOPMENT OF THE OVERSEAS MARKET BY XIAN ELECTRIC, CHINA

Mr T.X. Pu

President

Xian Electric Manufacturing Corporation, PRC

ABSTRACT

Xian Electric Manufacturing Corporation, one of the 181 State-owned enterprises under the direct administration by the Chinese State Council, is a leading manufacturer of high voltage and extra high voltage transmission (AC and DC) equipment up to 500kV.

This paper presents the background, experience and key contributing factors that enable Xian Electric Manufacturing Corporation to successfully enter the international market.

Mitsubishi Electric, etc. All the XD factories are now ISO9000 accredited, complying with IEC standards. XD is also a corporate member of the International Electricity Commission.

From the 1980s, XD decided to enter the international market. Over the past 20 years, XD has successfully developed its competitive advantages and reputation to compete in the international market on transmission plant equipment.

1. INTRODUCTION

Xian Electric Manufacturing Corporation (XD), established in 1953, is a State-owned enterprise in China with Rmb 667 million asset and 14,700 employees. XD is one of the largest manufacturers with R & D centres of high voltage and extra high voltage transmission equipment in China.

Currently, XD has 9 large manufacturing factories, 5 research institutes, 3 trade-specific companies, 6 foreign-invested joint venture companies and more than 40 domestic sales branches serving various industries in China (such as electric power, transportation, metallurgical, chemical, coal mining, machinery building, telecommunication, electronic and military defense industries). It serves customers over 80 overseas regions/countries.

Over the years, XD has established numerous technology transfers with leading power equipment manufacturers in the world including ABB, Siemens, GE, Hitachi Electric,

2. CHALLENGES AND BENEFITS

2.1 GOING OVERSEAS

Chinese Economic Reform in the early 1980s brought excellent development opportunity for XD. With the Chinese Government's support, XD strengthened its manufacturing capability through technology exchange with the global power industry leaders, including the establishment of the modern imported manufacturing facilities. These advantages have enabled XD acquiring dominant share in the domestic market. Nevertheless, XD realized the potentially severe competition in the domestic market and decided to enhance its competencies to meet the emerging challenges in both the domestic as well as the overseas markets.

2.2 SERVING AND LEARNING FROM CUSTOMERS

The Chinese domestic market in 1980s was dominated by planned economy. Customer needs and customer services were usually ignored. XD stepped out from such circumstances by actively participating in the

international market. As a new comer to the overseas market, XD encountered bitter experiences in the initial stage. Unacquainted with the international practices and with full understanding of client's needs, XD was unable to produce technical documents that were readily accepted by their customer, thus resulting in rejection by clients. On the other hand, the project team could not prepare up-to-standard project schedule and management report. Overall speaking, the project implementation was relatively poor. With XD's project teams' determination and effort, XD learned from mistakes, enhanced product quality, adopted better project management practices and strengthened competencies of the project teams to meet both local and overseas customer requirements.

Learned from the global competition in the transmission plant equipment market, XD was able to overcome their initial handicaps in international business practices and low customer orientation, to become a reputable company using its competitive advantages to compete in both domestic and overseas markets.

2.3 IMPROVING MANAGEMENT TO SURVIVE

In a market-based economy system, customers' demand drives the market. Manufacturers must understand customers' needs, especially in both the quality and reliability. In the international power equipment market, quality deficiency is fatal to manufacturer. In the 1980's, Chinese state-owned enterprises normally were equipped with high-technology facilities but with poor management of production. They were usually criticized as "Chinese worker is capable to fabricate first-class sample but not the product". Furthermore, after sales services were also jeopardized by inadequate service staffs and spare parts overseas.

To survive in the international market, quality assurance is absolutely critical. Thus, all the XD factories and trade entities have established Quality Assurance System conforming to the ISO9000 Standards. In addition, customer's stringent requirements in design,

manufacturing, testing and inspection did drive XD's continuous improvement of its management system. Nowadays, the management system adopted in the XD's factories is well accepted by overseas clients. Such system also boosts XD's competitiveness in domestic market.

2.4 TECHNOLOGY UP-KEEPING

When XD entered the international market in the early stage, the low product cost was the key advantage to compensate its relative weakness in product quality and technology. As many international competitors started to build their own factories in China and other developing countries, XD lost its 'low cost' advantage. To maintain its competitiveness, XD had to upgrade its technologies and production facilities to lower the production cost and improve product reliability.

Since 1985, XD introduced the production management system from Japan and established joint-production of High-Voltage SF₆ Switchgear with Mitsubishi Electric of Japan. At the same time, XD introduced a large number of advanced and high precision equipment enhancing their product quality. Now, XD is capable of supplying 69kV~550kV Gas Insulated Substation (GIS) and Gas Insulated Breaker (GCB). Through continuous technology exchanges with Alstom, ABB, Hitachi, Haffly, etc., XD also produces high quality 110~550kV power transformer, rectifier transformer, special transformer and reactors.

Recently, XD collaborated with ABB and Siemens to produce 500kV converter transformer, smoothing reactor and thyristor valve for the HVDC projects in China. XD is assigned as "Chinese Manufacturing Base for HVDC Equipment" by the Chinese Government.

3. MILESTONES OF SUCCESS

In China, the manufacturers of power transmission equipment normally produce

isolated products and hence operate separately. State Power Corporation is a monopoly controlling all the power construction projects, including system analysis and design in China. As several leading power equipment factories and research institutes in China are consolidated in XD, XD is therefore capable of supplying total solution/complete system on turnkey basis to customers. XD's trading entity, Xian Electric Import and Export Company Limited, was approved by the Ministry of Foreign Trade and Economic Cooperation of China in 1987 as a supplier and contractor for the overseas projects. Thus, all the XD factories can work together with Xian Electric Import and Export Company Limited to fully utilize the potential sources of technology, products and engineering in the overseas projects.

Initially, XD started the international business in the developing countries. During 1982 to 1986, XD worked together with China National Trade House (government import and export companies) as a supplier of discrete product. In March 1988, XD directly obtained contracts of four 132kV substations, one 66kV substation and seventeen 33kV substations associated with transmission lines on a turnkey basis in Nepal through Xian Electric Import and Export Company Limited. Many XD project managers and project engineers in XD were therefore exposed to international business and hence learned and developed from the project.

In 1992, XD focused on markets of Malaysia, Thailand, Philippines and Columbia, because these developing countries had better business environment and affordable to XD's new and upgraded products. XD secured more than US\$200 million contracts in these regions, including 500kV transmission line project in Philippines and 275kV GIS substations in Malaysia. Many significant improvements on equipments and project engineering were achieved through these projects.

In 1995, XD established joint venture factories in Malaysia, Philippines and Thailand to localize the products and services and hence better serving customers. Tenaga Switchgear Sdn. Bhd. is the joint venture with Tenaga

Nasional Berhad of Malaysia to produce 132kV/275kV GIS and GCB in Malaysia. XD became the pioneer among Chinese manufacturers in localizing the foreign technology and exporting it overseas.

From 1999 and onwards, XD successfully performed several power transmission and distribution contracts in the sophisticated markets of Hong Kong and Singapore. In 2001, XD was granted a contract for electrical solutions of eight 132kV substations and other loose equipment packages by CLP Power Hong Kong Limited. These projects marked a new milestone for XD's achievement with an enhanced product quality and project management to meet customer's requirement.

4. CONCLUSION

This paper has highlighted the development of the XD from its decision to enter into the international transmission equipment market from developing countries to developed countries. The key contributing factors are understanding of customer requirements, maintaining high product quality and reliability, up-keeping technology application and adopting world class management system. Over the past 20 years, XD has successfully developed the international transmission equipment market. To maintain this established status and reputation, XD must strive for continuous improvement, producing value for money products for their customers.

Paper No. 6

**THE NEW 22KV DISTRIBUTION SYSTEM FOR
THE HONGKONG ELECTRIC CO. LTD. - DESIGN
CONSIDERATIONS AND OPERATIONAL ASPECTS**

**Speakers: Ir T.C. Yee, Chief Electrical Engineer, Project Division
Mr K.T. Yeung, Engineering Coordination Engineer, T &D Division
The Hongkong Electric Co. Ltd.**

THE NEW 22KV DISTRIBUTION SYSTEM FOR THE HONGKONG ELECTRIC CO. LTD. - DESIGN CONSIDERATIONS AND OPERATIONAL ASPECTS

Ir T.C. Yee, Chief Electrical Engineer, Project Division
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ABSTRACT

The Hongkong Electric Co Ltd upgraded its distribution voltage from 6.6kV to 11kV 40 years ago in 1961. To cope with the much increased load density in Hong Kong and to further upgrade the quality of supply to its customers, the Company will commission in 2002 a new 22kV distribution system in selected areas of Hong Kong Island. The Paper will describe the various design considerations for this new 22kV distribution system and the related operational aspects.

distribution reliability rating above 99.998%, power interruption to the customers is inevitable during single contingency because of its open ring configuration. To cope with the continual development of Hong Kong and to facilitate further load density growth, the Company, after careful consideration, has decided to introduce 22kV as the new distribution voltage which will be commissioned by end 2002.

This paper gives the various design considerations for this new 22kV distribution system and the related operational aspects that will coexist with existing 11kV system.

Paper
No. 6

1. INTRODUCTION

The Hongkong Electric Co Ltd upgraded its distribution voltage from 6.6kV to 11kV 40 years ago in 1961 when the system peak demand was just 114MW. The demand of electricity has been increased many folds over the past few decades. In 2001, system peak demand soared to 2516MW with very high load density required by many tall buildings on Hong Kong Island. The load density in Central Business District and the supply capacity for a tall building can be as high as 250MVA/km² and 90MVA respectively.

The basic network topology for 11kV system is open ring. While the open ring system offers simplicity in design and operation, reasonable utilization factor and reliability, there are several limitations when applying to densely populated city. To supply electricity to those very high load density areas, the number of 11kV cables required is numerous. The problems of finding underground space for cable laying and mutual heating among cables become a significant issue. Although the 11kV system is fully automated and has achieved a

2. CHOICE OF 22KV/33KV OPEN/CLOSED RING

To alleviate cable mutual overheating problem, a higher distribution voltage should be used. 22kV or 33kV were considered in the study and 22kV system was found more suitable than 33kV because of the following reasons: -

- a. The 33kV system is generally considered as a sub-transmission voltage. There is little operational experience of using 33kV as a distribution system. On the other hand, the technology of using 22kV as distribution voltage is more mature in terms of equipment design. Cities like Taipei, Tokyo, Singapore and Paris have been using 22kV distribution system successfully. Besides, 22kV equipment is generally less costly than those of 33kV and the design is very similar to that of 11kV. Therefore the skill and techniques required for the production, erection and

maintenance of 22kV system are quite similar to that of 11kV.

- b. The size and weight of 22kV distribution equipment are similar to those of existing 11kV which allows similar substation design and easier conversion of existing 11kV substations to 22kV if deemed required.

By using 22kV distribution voltage, the number of cable required for the same capacity will be reduced by half and the heat generated for same amount of power delivered will be reduced by 75%, which will greatly alleviate the underground space and mutual heating problems. Taking all the above factors into consideration, the overall cost of establishing the 22kV system is found to be of the same order as that of an equivalent 11kV system of the same capacity.

Since the 22kV system will be a completely new system without any compatibility issue with the existing 11kV system, there are more flexibility in system design in terms of system fault level, network topology and protection system to achieve a system with higher reliability and power quality. Two important design parameters are kept in mind when designing the 22kV system viz. 1) No customer should lose supply under single contingency and 2) in case of single phase to earth fault, the voltage dip experienced in the same busbar should not exceed 10%.

3. SYSTEM DESIGN

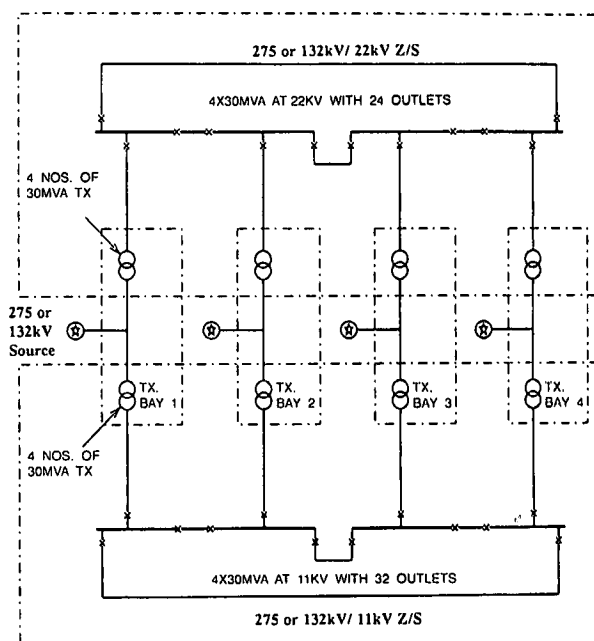
3.1 ZONE SUBSTATION ARRANGEMENT

The 22kV distribution system is by no means a replacement to the existing 11kV distribution system. Instead, it is used to supplement the existing system because 22kV will offer a more cost effective distribution alternative and better utilization of underground space.

Therefore in those well-developed areas, it is decided to construct a zone substation with half of the capacity in 22kV to cater for new development and half in 11kV to cater for the

load growth of the existing customers who are already supplied at 11kV. For virgin lands with known development, such as the Cyberport, the zone substation will be fully 22kV. Figure 1 shows a typical half-half zone substation arrangement.

Figure 1 Typical Z/S Arrangement



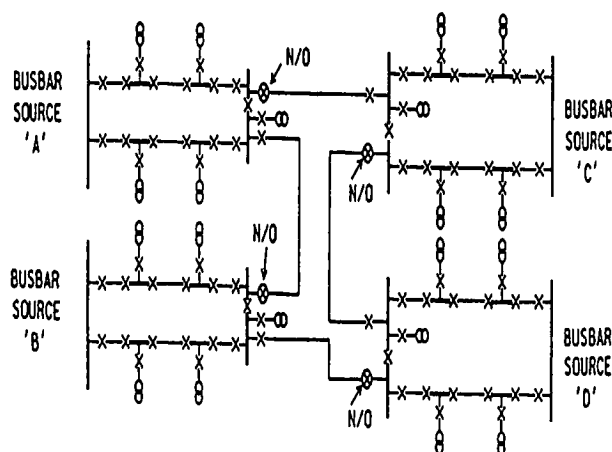
In the 11kV system, only 2 zone transformers are allowed to operate in parallel. This is due to the limitation of system fault level and voltage dip experienced by other circuits under the worst single phase to earth fault situation. That latter will sometimes be greater than 10%. Under single transformer outage, another transformer will remain in service. To improve the power quality and supply reliability of the 22kV system, the busbar configuration, system fault level, zone transformer impedance, earthing resistance are chosen such that voltage dip caused by a single phase to earth fault will be less than 10% and at most 3 zone transformers could be operated in parallel in case of single transformer outage.

3.2 22KV NETWORK TOPOLOGY

To achieve uninterrupted supply during single contingency, a simple close ring configuration as shown in figure 2 was adopted for the 22kV system. Each ring will be fed by two outgoing feeders from the same busbar of a zone

substation. Each ring will be connected with 2 other simple rings by a radial feeder with normal open point. A maximum of 4 simple rings can be interconnected to form a group. This configuration is simple, cost effective and highly reliable. It ensures no power interruption in case of a single fault. It can also cater for a busbar fault or double faults since the loads of a simple ring is designed to be fully backed-up by the interconnectors. At most two interconnectors will be arranged for backup purpose in view of possible lopsiding effect. Load transfer between zone substations is also feasible because the rings within a group can be fed by busbars of different zone substations.

Figure 2 Typical 22kV Network



Same as the existing 11kV system, the 22kV networks are fully automated with RTU installed for control and monitoring via the DMS.

4. EQUIPMENT CONSIDERATION

The general electrical parameters of the 22kV equipment basically follow those specified in IEC standard to ensure compatibility among products from different manufacturers and to ensure widest availability of equipment. The 22kV system fault level is designed to be 25kA which is the fault level as specified in IEC standard and is widely adopted by cities like Tokyo, Osaka and Singapore.

In addition to standardization, the equipment to be procured shall be long life and shall require minimal maintenance. Much attention has

been paid in achieving low maintenance and long service life when preparing the equipment specification.

Since all our zone substations and distribution substations are located either in the close proximity of or inside business/ residential buildings, all our equipment shall be oil-free as far as technically and practically feasible in order to reduce fire risk.

4.1 TRANSFORMERS

Similar to the existing 11kV zone transformers and distribution transformers, SF₆ gas insulated transformers are opted in the new 22kV system. SF₆ gas insulated transformers offers the advantages of non-flammability and completely sealed from the installation environment which make it particularly suitable for densely populated city where fire risk, humidity and pollution are of concerns. Besides, SF₆ zone transformers use vacuum switch diverter which is more reliable and requires less maintenance than its oil counterpart.

Apart from no fire risk, high reliability and low maintenance, the SF₆ gas transformers are designed to have low operating noise. The use of GFAN cooling system and sound proof jacket in zone transformers and GNAN design in distribution transformers make SF₆ transformers one of the lowest noise transformers in the world with sound pressure level less than 55dBA in accordance with IEC60551. All these features make SF₆ transformers a suitable candidate for 22kV system where simple substation design, high equipment reliability and low maintenance effort are required.

Another important feature of 22kV transformers is the complete elimination of air insulated parts, which are prone to discharge caused by air pollutants, by adopting screened cable termination and gas filled cable box. Such arrangement has greatly enhanced the reliability of the transformers in the long run.

It was found that the working stress and gas pressure of both zone transformers and distribution transformers for 22kV system are

almost same as those for 11kV. Hence there is not much difference in weight and physical dimensions. Previous designs for transformer room are basically unchanged.

4.2 ZONE TRANSFORMER LV SIDE NEUTRAL EARTHING RESISTOR

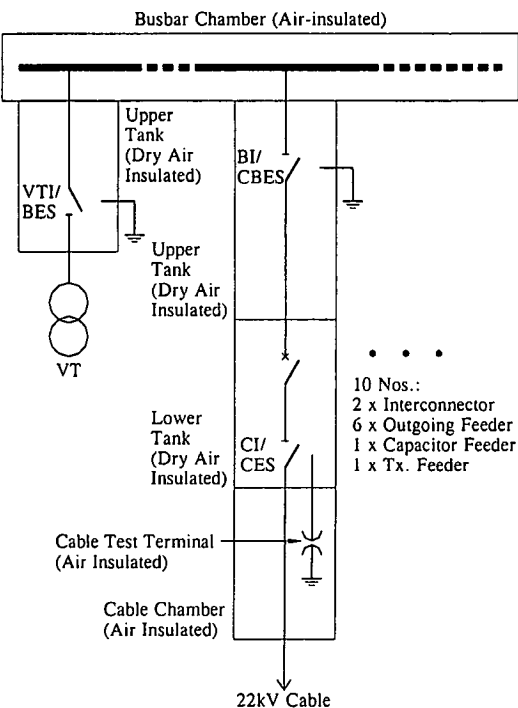
To limit the level of earth fault current, and hence the voltage dip, of the distribution system, resistance earth has long been adopted in our 11kV system. 4 transformers share a single liquid resistor. This design is simple and cost effective but is operationally more complicated and susceptible to single component failure. Furthermore, a liquid resistor requires more maintenance effort in keeping the electrolyte level.

To eliminate possible common mode failure in the 22kV system, each zone transformer will have its own neutral earthing resistor. Solid type stainless steel resistor is adopted in view of its high stability and low maintenance requirement.

4.3 22KV SWITCHGEAR FOR ZONE SUBSTATION

The typical layout of the switchgears are shown in figure 3.

Figure 3 Switchgear Layout in Z/S



Each zone substation busbar has 10 switchgear panels plus an additional panel housing VT and busbar earthing switch (BES). The size of the switchgear is only 600 (w) x 1600 (d) x 2400 (h). It has been arc-fault proven to IEC60298.

The switchgear is modular designed and is divided into 4 compartments, namely busbar chamber, upper tank, lower tank and the cable chamber.

Similar to the transformer design, air insulated HV conductors are completely eliminated in the switchgear design. Screened solid insulated busbar is used and housed in the busbar chamber. It is easier to be installed and replaced on site as compared to the gas insulated busbar because of no gas work required. Another advantage of solid insulated screen busbar is that failure of one section will not contaminate other sections in the same busbar. With this characteristic, specially made bypass busbar section could be fabricated to bypass a panel in case of contingency. This arrangement will allow restoration of the busbar in the shortest possible time in case if a switchgear panel is taken out of services. Since the busbar is screened which means the surface potential is zero, it makes the busbar more safe to be worked on and less susceptible to dust and moisture contamination. Besides, no special compartmentation is required during the emergency bypass.

The upper and lower tanks are dry air insulated at 0.07MPa (G). 5% of Helium gas is added for ease of tracing air leak. The upper tank contains a busbar isolator (BI) and a circuit breaker earthing switch (CBES). The BI can be used to isolate the lower tank and cable chamber in case of faults which occur there. The lower tank comprises a vacuum circuit breaker (VCB), a cable isolator (CI) and a cable earthing switch (CES). The VCB is automatic motorized spring charged which allows multiple operations while all other isolators and earthing switches are manually operated. Based on the experience on 11kV system, VCB is considered very reliable which have not had any problems in the 11kV system since the early 80's.

Screened outercone termination is adopted in

the 22kV switchgear panel. The outercone termination has been in the market for long time with good track record. While cable testing could be made on the outer-cone termination by removing the end plug, such practice may not be too suitable for distribution system where cable testing works are carried out frequently as a result of network change/reinforcement. In addition, the risk of contaminated end plug or incomplete restoration could never be eliminated. To minimize the chance of mis-installing the end plug and inadvertent removal of plug while the circuit is energized, a separate test terminal is provided in the switchgear cable chamber. The access of the cable chamber is interlocked with the CES to ensure access could only be made when the circuit is de-energized. The test terminal is designed just to withstand the necessary DC proof test voltage, which is DC15kV for 15 minutes in the Company. For higher voltage test such as cable fault location, which is less frequent, the normal testing by removing the end plug shall be applied.

Among the various components in the switchgear, busbar VT is considered the most vulnerable equipment due to its high working stress and low immunity to switching surge. To improve reliability, single pole cast resin type VT is adopted. The VT is housed in a separate panel in zone substation and VT isolator (VTI) with integral busbar earthing switch is provided to facilitate fast isolation of VT in case of fault or busbar testing.

4.4 22KV SWITCHGEAR FOR DISTRIBUTION SUBSTATION

The 22kV switchgear for distribution substations uses the same design and construction as those of zone substation except that BI/CBES was not provided. This is because the need to isolate the busbar to the rest of the switchgear is considered not as important as that in zone substation. The maximum number of panel per busbar in a distribution substation will be 5.

One important consideration in distribution substations is the reliability of protection supply. The reliability of the protection and

control system relies heavily on the reliability of the DC supply system. Unlike zone substations where the DC is provided by centralized duplicated DC systems, distribution substations will only be equipped with a standalone DC system because duplicated system is considered too costly in terms of initial setup and subsequent maintenance.

Having studied the technical advantages and cost benefit of different DC voltage level, 48V is chosen as the control and protection voltage of distribution system. Sealed type lead acid battery is used for high reliability, low maintenance and simple substation design. The battery capacity allows the distribution substation to operate properly for at least 4 hours without charger supply. Temperature compensated output and dual AC supply is adopted as standard features of the charger to ensure high reliability and availability of the DC system. Furthermore, the charger is equipped with automatic test function to monitor the battery periodically so that advanced warning could be given on the residual life of the battery.

Even the above are adopted, there are still chances that the DC system will fail unexpectedly. To ensure the protection function will still perform properly even when the DC is lost, a second trip supply from the 22kV busbar VT with a condenser trip device to store adequate energy for backup tripping function, is provided to the line protection and transformer protection circuit. With the second trip supply, only control function will be lost if the substation DC fails completely.

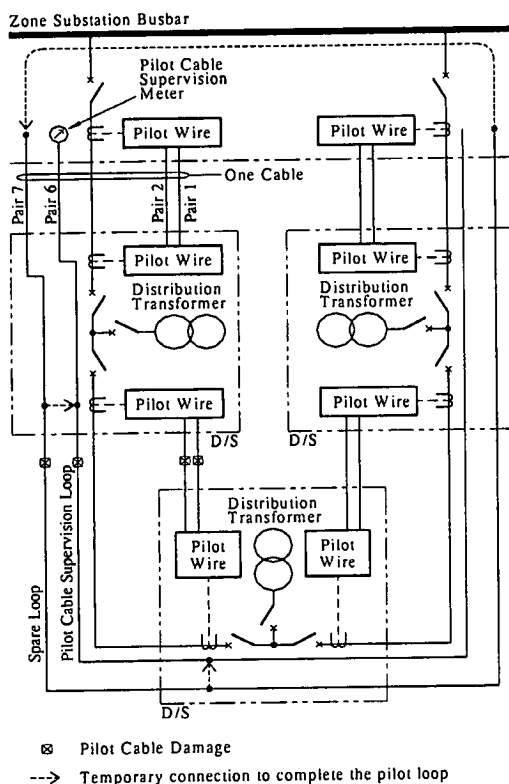
5. PROTECTION CONSIDERATION

For 22kV closed ring system, well-proven and self-powered conventional pilot-wire protection is used as the main protection. Nevertheless, provision had been incorporated in the switchgear for easily switching to other numerical combined protection and control system if found required in future. The fault clearance is about 120ms. It is much shorter

than 500ms in existing 11kV open ring system, which uses inverse time over-current and earth fault protection. The improvement in fault clearance time will shorten the voltage dip duration and consequently enhance the power quality. Furthermore, shorter fault clearance time will reduce the stress on the equipment in the system and the chance for development of induced fault will be much reduced.

Duplicated pilot pairs are provided for each pilot wire protection. Although duplicate pilot pairs are used, only one pilot cable is laid between substations. The pilot wire protection will lose if the pilot cable is damaged and the ring will become unstable. To allow prompt restoration of the pilot wire protection when a section of pilot cable is taken out of service, one additional pair of pilot is wired along the whole ring. By connecting jumper wires in a zone substation and other distribution substations, the pilot wire protection could be restored before the damaged cable is repaired. Figure 4 illustrates the back up pilot pair. This arrangement allows a simple, reliable and cost effective way to provide pilot pairs to the pilot wire relays without actual duplicating the pilot cable.

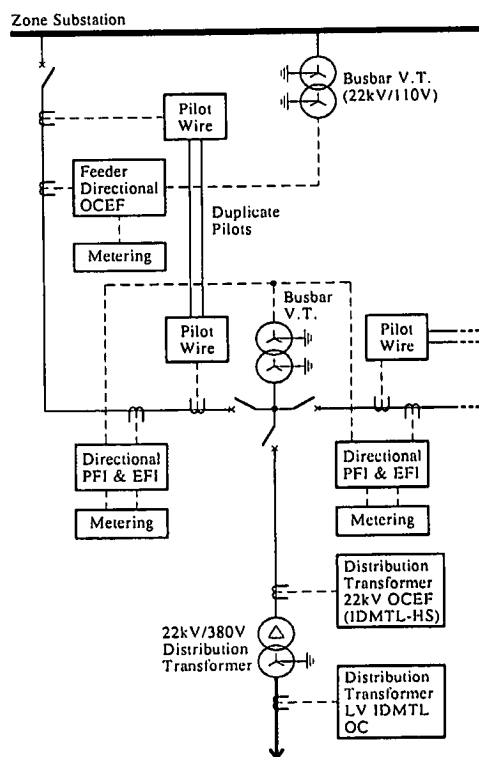
Figure 4 Pilot Scheme



Even with backup pilot pair, supervision on the pilot cable is still required. One overall indirect supervision scheme is adopted for each ring. The supervision scheme works on the DC injection principle to detect both open circuit and short circuit fault. Special selector is equipped in the zone substation switchgear such that testing of the supervision scheme after pilot cable work is much simplified.

In zone substations, the pilot wire protection is backed up by the directional inverse time over-current and earth fault protection. In distribution substations, backup protection is not provided. Instead directional phase fault and earth fault indicators are provided to indicate the fault direction. Such information is particularly useful to System Control Engineers to locate the fault position in case the pilot wire protection fails to operate. The directional fault indicator could also serve as switchgear fault indicator. Hence no switchgear protection is provided in distribution substations as the chance of having switchgear fault is considered rare. Even if switchgear fault happens, the substation could be easily identified and isolated remotely based on the information provided by the directional fault indicator.

Figure 5 22kV Protection Scheme



For distribution transformers, both HV and LV sides are equipped with inverse time over-current and earth fault protection relays. The relay at LV side is self-powered. Together with the VT trip supply, this arrangement will provide an uninterrupted protection to the transformer even when the substation DC is lost.

6. CONCLUSION

To cope with the continual development of Hong Kong and to facilitate further load density growth and promote the power supply quality as a financial centre for China, a new 22kV distribution voltage will be commissioned by end 2002. Technical considerations about the system design and main equipment have been described. We are expecting that the new 22kV distribution voltage will alleviate the current mutual heating problem faced by the 11kV open ring systems as well as providing a more reliable and better quality supply to our customers.

Paper
No. 6

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The authors would like to express their sincere thanks to the Management of The Hongkong Electric Co. Ltd. for the permission to publish this paper.

Paper No. 7

**PROJECT MANAGEMENT SUCCESS OF THE
MTR TSEUNG KWAN O EXTENSION PROJECT**

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MTR Corporation Limited, Hong Kong**

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ABSTRACT

The MTR Tseung Kwan O Extension, TKE, was successfully commissioned on 18 August 2002 as the Corporation's sixth operational line. Its completion surpassed that of the previous lines in terms of budget and programme control. Behind the achievements of the four and a half month early completion and the 40% cost saving, the MTRC strategically injected a range of improvement initiatives over its usual hands-on project management style in the project cycle. To name just a few - integrated design team, "no-change" design policy, procurement of building services works as direct contracts, partnering and incentivization scheme.

The success of the Project has attracted widespread commendations from the local construction industry and set a higher yet realistic standard of project management for the stakeholders to follow.

In an attempt to further promote its unique prescription of project management, the MTRC has launched the project management consultancy services on railway development in many overseas countries and the Greater China. With China's accession to WTO, the Corporation is optimistic that a notable success can be achieved through a wider application of their proven management experience in the many fast-developing cities where increased efficiency is demanded. Among them, Shanghai is the first destination to see their footprints.

1. INTRODUCTION

Tseung Kwan O Line, TKL, entered into full passenger service as the sixth operational line of the MTR system a few hours after C H Tung, the Chief Executive of the HKSAR officiated at the grand opening ceremony in the morning

of 18 August 2002.

Looking on a MTR route map, commuters will find TKL a single continuous magenta line starting from North Point across the Victoria Harbour northeasterly to Tseung Kwan O new town on eastern Kowloon peninsula. However, from the project management point of view, TKL is formed by two multi-billion projects - the Quarry Bay Congestion Relief Works, QBR and the Tseung Kwan O Extension, TKE. Completed in September 2001, QBR transformed North Point Station into a new cross-platform interchange by constructing two bored tunnels and the associated platforms and connecting underground adits. The modification was well-received by the travellers as it significantly relieved congestion in Quarry Bay during peak hours and reduced the walking distance and changing time for those switching between lines.

2. BACKGROUND OF TKE

Comprising all the five stations of TKL on Kowloon side, the TKE was formulated in the first Railway Development Strategy commissioned by the Government in 1994 to cope with the growing traffic demand in the expanding Tseung Kwan O new town. Project agreement was signed between the Corporation and the Government in 1998 and the commencement of major construction works followed immediately. Before the opening of TKL, road based traffic was the dominant mode of transportation for the travelling public. The successful completion of TKE not only improves the travelling convenience to the general public, but also bears profound implications to the construction industry.

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3. SOCIAL BENEFITS OF TKE

The need of an efficient mass transportation system to serve Tseung Kwan O new town stemmed from its growing population. Current population in the new town stands at 270,000. According to the demographic forecast, it will be growing gradually to reach the capacity of 520,000 by 2011. A heavy rail system is clearly the most efficient solution to meet the anticipated transportation need.

The TKE extends the existing MTR coverage at the eastern Kowloon peninsula eastward to the Tseung Kwan O new town by adding five new stations, namely Yau Tong, Tiu Keng Leng, Tseung Kwan O, Hang Hau and Po Lam. The first two stations provide cross-platform interchanges with the existing Kwun Tong Line.

Being constructed concurrently with the five stations was a 13-hectare rolling stock maintenance and stabling depot which is located off the main line at the Tseung Kwan O south area. It is expandable to accommodate future growth in the train fleet size under the same roof.

Immediately next to the depot is a site earmarked for the sixth station on the extension, which will be constructed when the population in the catchment area builds up.

The benefits of the new underground rail line to the community are threefold. Firstly it improves the accessibility to the Tseung Kwan O new town from Kowloon and Hong Kong urban area. Secondly it enhances people's mobility within local community. Thirdly it relieves the longstanding road traffic congestion and alleviates the associated deteriorating environmental problems in the fast developing Tseung Kwan O area. In a nutshell, the construction of the TKE vividly realizes the Government's aspiration of using railway as the backbone of the Hong Kong's transport system.

4. ENGINEERING SIGNIFICANCE OF TKE SUCCESS

The major construction of the 12.5-km TKE commenced in November 1998 following a few years of planning and design period. The whole project was procured with 13 major civil and 21 E&M contracts which together with the design fee, land cost and the Corporation management cost amounted to the outturn capital cost estimate of HKD 30.5 billion at 1997 price. The budget was however progressively revised downward over the period to the final account of less than HKD 18 billion. The Project was completed 4.5 months ahead of the original programme. To understand the thrust behind the remarkable results, it is necessary to look into MTR's traditional project management style and its improvement initiatives in a greater detail.

5. CHALLENGES ON TKE

Like many other major railway projects, the major challenges on the TKE were seen at the construction stage.

The first challenge was to manage a large number of contracts at the same time. Given the scale and complexity of the TKE, the whole project was divided into individual contract of manageable size and ended up with 34 major contracts running in parallel for most of the construction period.

The second was the management difficulty of the numerous contract interfaces coming along with the multi-contract nature. From the project management point of view, the more the number of contract interfaces, the more exposed the contract to claims, disputes and coordination problems.

Moreover, apart from local contractors, the project involved contractors from France,

Germany, Australia, Britain, Austria, Korea, Japan and the Mainland China. This mixture of multi-national contractors of different ways of working and cultural background required extra effort from the project managers in handling the coordination problems.

The interface management for the TKE was further complicated because of the heavy coordination with the various government departments on road works and site formation works that were carried out right next to the work sites along a substantial length of the extension. Heavy interfacing works were also required with the existing operating lines particularly at the interface areas during the commissioning stage.

Another project management challenge the Corporation faced was the low tender prices for most of the TKE contracts, which resulted in reducing the overall initial project budget. However at the same time, it rendered the Corporation and the contractors to find ways to improve productivity, quality and time management so as to maintain a reasonable profit margin and to keep the project budget.

6. MTR PROJECT MANAGEMENT STYLE

MTR's project management style is very proactive and hands on. Many of its employees, from executive managers to the frontline technical personnel, possess the wealth of rich experience of working on the previous MTR projects.

The delegation of responsibility to each party is very clear. The Corporation staff is responsible for project managing, coordinating and supervising a project. Unlike the mainstream construction industry practice, the MTR's consultants design only but not supervise the construction works. The contractors however construct and sometimes design and construct when and where appropriate.

The Corporation holds a strong belief that, for any project, success is a shared result of the efforts by the Corporation and its consultants and contractors. No party should be left out in this formula of success. This has helped the Corporation establish a longer-term business relationship with the consultants and in particular the contractors.

However, the performance of the Corporation's last mega project - Airport Railway regrettably revealed that the traditional ways of working were not adequate. Consensus was then reached among the executive managers that innovative changes were required to achieve optimum project management efficiency.

7. IMPROVEMENT MEASURES ON TKE

Learning from the past and exploring on the new initiatives, the Corporation formulated a number of improvement measures to be applied from the beginning of the Project to its completion.

8. ENHANCED MANAGEMENT STRUCTURE

Recognizing the conventional matrix reporting structure could unnecessarily lengthen the communication process and blur the responsibility of each party, the Corporation deliberately trimmed the organization structure to a simple one using short and solid line reporting mechanism. All the staff including construction safety and surveying personnel was held accountable directly to the project managers.

9. INTEGRATED TEAM

On TKE, the consultants employed by the

Corporation were arranged to work with the Corporation's design team in the same office. They shared the common office space, the meeting rooms, the same telephone system and all the office equipment. Though the initiatives were straightforward and simple, they substantially expedited the communication and document exchanges between the Corporation and the consultants. They also reduced paper consumption and the amount of administrative works.

10. INTERROGATING CLIENT'S SHOPPING LIST/ELIMINATING NICE-TO-HAVE'S

To achieve an efficient design on the new extension, it was the Corporation's determination at the commencement of the Project to avoid the incorporation of "nice-to-have" components and unnecessary design features. During the design stage, the project team spent a lot of effort and time to study every single design detail with the use of value engineering technique. As a result, only the necessary design features and essential requirements were carried forward into the detailed design.

11. EARLY SIGNED-OFF OF PROJECT DEFINITION DOCUMENTS / NO CHANGE POLICY

Once the functional and service requirements had been confirmed, the project definition documents were signed off and followed by all parties including the Chairman till the end of the Project. Unless a change was safety critical or statutorily required, it would not be incorporated for construction.

12. IMPROVED PROCUREMENT STRATEGY

To shorten the construction period, advance

works contract was used as far as practicable to remove obstacles and interfaces, e.g. site formation and foundation works. The use of advance works contract proved to be useful in keeping the contracts within manageable size and reducing contract interfaces.

On TKE, the Corporation used two major types of contract. Remeasurement contract was used for all station civil works where quantity of works was measurable and more definitive during the design stage. For tunnels and E&M works, lump sum contract was used because of the uncertainty on the amount of works required during design stage. It also saved the work on remeasuring and agreeing the quantity of work done.

Another improvement was the better control over E&M works by the Corporation through employing station and depot building services contractors under direct contract. With this arrangement, the building services contractors were held responsible to their works directly to the Corporation but not to the civil main contractor. Communication could then be proceeded and instructions given in the most efficient manner.

13. ALLOCATION OF RISKS TO THE APPROPRIATE PARTY

The Corporation is convicted of a fair risk allocation mechanism. On TKE, it assigned the risks to the most appropriate party after careful study of each risk element. For example, in contrary to the industry practice, the Corporation allocated the risk of unforeseen ground condition to its own risk.

14. PARTNERING INITIATIVE

Partnering is a project management approach used by two or more organizations to achieve specific business objectives by maximizing the effectiveness of each participant's resources. The approach is based on mutual business objectives, an agreed problem resolution

mechanism and an active search for continuous measurable improvements.

The benefits of exercising partnering include overall cost saving through increased productivity and reduced waste, programme certainty, improved quality, higher consumer satisfaction, better communication and less disputes. The degree of success in each project depends heavily on the nature of the project and the partnering management efficiency.

In Hong Kong, the MTR is one of the pioneers in partnering application. The MTR's successful demonstrations of the power of partnering has caught the attention of the Honorable Henry Tang who in his Construction Industry Review Committee Report - "Construct for Excellence" strongly recommends a wider adoption of it in the local construction industry to raise the overall performance.

15. IMPLEMENTATION OF PARTNERING ON TKE

By the time the MTR decided to introduce partnering, design of the TKE was well advanced and construction was still in its early stage with the first major construction contract just awarded. Partnering in the design consultancy would conceivably generate little benefit. It was then concluded that it should start with the civil construction contracts as a post-contract and non-binding arrangement and the E&M contracts to follow. It was also agreed unanimously to make an evolutionary start first on the soft issues like working relationship on site and then on the financial matters.

Internal workshops were held between the Project Director and the senior managers to map out the strategic direction of the partnering application. After the direction was clear and certain, contractor workshops were held regularly throughout the construction period to align both parties' interests and to build up the mutual relationship between the contractors' and the Corporation's site teams. The

agreements coming up from the workshop were then embodied into a partnering charter that governs the direction of the project would go under the partnering banner.

16. TKE RESULTS OF PARTNERING

It was of interest to note that the results of partnering application ranged from excellent to mediocre. Vast majority of the participating contractors comes back with very positive responses. It was worth-noting that the success of partnering implementation was observed in a diverse type of contracts - civil and E&M contracts, local and overseas contracts, contracts run by independent contractor and joint venture consortium. The Corporation and the contractors were able to achieve a "win-win" situation by sharing the results of overall cost saving, improved claim activities, early conclusion of final account, programme certainty and knowledge sharing.

17. OVERALL COST SAVING

As mentioned before, the project budget for the TKE was progressively adjusted downward from the original estimate of HKD 30.5 billion at commitment in 1997 to the final figure of below HKD 18 billion.

Of the HKD 12.5 billion reduction, the 1997 Asian economic downturn had a very significant impact on tender prices. Nevertheless, significant savings in project management costs were achieved with substantial contribution from the introduction of partnering under which the better working relationships, innovative working methods, improved communication and reduced paper works were attained.

18. IMPROVED CLAIM ACTIVITIES

The first notable improvement in claim activities was the small number of claims

submitted by contractors. Compared to the Airport Railway Project which recorded some five thousands claims, TKE registered around five hundred claims from contractors prior to its opening.

The improvement in claim resolution efficiency was also noted. Of the five thousand claims for the Airport Railway, only 24% were resolved at the time while 89% of the TKE claims were resolved.

19. EARLY CONCLUSION OF FINAL ACCOUNT

For many other projects, final account may take a year or so after the project completion to get settled. But for one of the TKE foundation contracts and few other civil and E&M contracts, the final account was concluded as soon as the site works were complete. It was made possible because with the openness, mutual trust and respect under the partnering spirit, the Corporation and the contractor were fully aware of the progress and the quality of works throughout the whole contract period.

20. PROGRAMME CERTAINTY

With partnering, the interfacing contractors were more willing to communicate more openly with one another. There were many occasions that the main contractor allows the follow-on contractors to access the site ahead of the programmed date without incurring any additional cost.

As a result of improved communication and cooperation between the Corporation, the contractors and the subcontractors, the progress of individual contract was more certain and better controlled. The overall completion of the TKE was consequently brought forward by 4.5 months.

21. KNOWLEDGE SHARING

The partnering initiative gave the contractors a

thrust to share their experience in every aspect related to the Project. The Corporation in this aspect organized various experience sharing sessions to pull the contractors and the Corporation staff working of a similar job nature together. They were station construction forum, E&M contractor forum, tunnel construction forum, waste reduction forum and safety liaison group.

22. INCENTIVIZATION

Incentivization was the logical progression of partnering. It contractually formalized the commercial incentives to reinforce the objectives set out in partnering to save time and money by reaching a supplemental agreement between employer and the contractor.

Under the agreement, the Corporation and the contractor agreed a lump sum for the final measure off the issued working drawings as a Contractor Risk. An agreed target cost sum for the risk costs of coordination with follow-on systemwide contractors and miscellaneous statutory inspection requirements was established as a Shared Risk to attract a gain share/pain share incentive. Any major variations remained as Client Risk.

For the TKE, the Corporation also offered contractors 50% of cost savings in rent and rates for back-up works areas vacated early and in staff costs during the defects liability period.

23. APPLICATIONS OF PROJECT MANAGEMENT EXPERTISE ON THE MOTHERLAND

The economy of the Greater China has been booming in the past decade. With its accession to WTO, the China is set to further open up its market to foreign investors. No doubt, the construction industry will be one of the fast-expanding sectors on the motherland, because of its importance in sustaining economic and social growth.

Taking the railway development in Shanghai city as an illustrative example. The municipal government has a very ambitious plan to construct and operate 200 kilometre of railway in 5 years. This requires not only the government's determination, abundant financial support, but also the expertise in project managing the huge scope of projects to materialize the plan. Among them, project management expertise is perhaps the most sought-after element in the whole master plan.

Hong Kong has taken the advantage of the relatively early knowledge on project management. We could capitalize on this advantage to position ourselves as a forerunner in the China market. The Corporation has already tapped in the fertile China railway market. We have recently formed a joint venture company with a Shanghai partner to project manage the construction of a 35km, 14-station rail line. There are yet many other invitations showing interests in our project management expertise to flow in from other parts of China including Shenzhen, Chengdu and Qingdao.

Partnering was the most widely reported initiative among them. It is a strategic management tool that emphasizes concerted efforts by all parties and alignment of everybody's goal. Whilst not being suggested as a cure-all to all problems with the construction industry, partnering is effective in improving the relationship between employer and contractor, and hence the overall performance. It involves running cost of about 0.1 - 1 % of the project cost but the potential savings will be 2 - 10 % of the project value which means a rate of return of 100 to 10000 times.

To the MTR, it was tested on the TKE with very encouraging results. Shortened construction period and reduced project cost were the two remarkable achievements for the Project. The Corporation strongly believes it will soon become the norm of the construction industry. With its proven benefits, it has been gaining increasing attentions from the local industry stakeholders as well as from overseas.

24. CONCLUSION

Railway construction, and likewise any large-scale infrastructure project, involves many contracts, numerous contract interfaces, large number of workers working at the same time and huge sum of financial investment. It requires excellent project management skill to manage the work efficiently and cost-effectively. The past experience in the construction industry tells the truth that the traditional project management approach is inadequate.

The MTR Corporation formulated a number of improvement measures for TKE to improve the project management efficiency. Some of them were revolutionary changes such as allocation of risk to the appropriate party. However, some of them dealt with people issues like integrated team arrangement and simplified organization structure.

Paper No. 8

**OPPORTUNITIES AND CHALLENGES TO
HONG KONG AFTER CHINA'S ACCESSION TO WTO**

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ABSTRACT

Hong Kong is no doubt in terrible economic difficulties. The most serious problem is that no solution or even a remotely possible solution has been offered by anyone. After China joined the World Trade Organization ("WTO"), the Chinese market has become more open everyday. Transnational corporations are now rushing into China by setting up subsidiaries, joint ventures and other types of business, Chinese concerns have also gained latitude in doing foreign trade and investment. Facing the competition from overseas enterprises in the Chinese market and Chinese businesses in foreign markets including that of Hong Kong, it was first suggested to set up a free trade area among China, Hong Kong and Macao, which was deemed a possible means in helping Hong Kong resolve its economic difficulties. Subsequently the free trade area proposal was changed into closer ties between China and Hong Kong. Recently, neither free trade area nor closer ties suggestion is heard any more. Nor substantiation of the closer ties or its implementation has been revealed. The aforesaid problems facing Hong Kong, however, remain unchanged. The question is still "What should Hong Kong do?" It is against this background that this paper is to examine the impact of China's WTO membership on Hong Kong and possible steps Hong Kong could take. In doing so, it is important to understand the traditional role played by Hong Kong before China became a WTO member.

1. THE TRADITIONAL ROLE OF HONG KONG

The accession of China to the WTO is a foregone conclusion of China's reform and opening up policy. It is in line with the general world trend. Undoubtedly, the implementation

of the reform and opening up policy of the Mainland of China played a decisive role in stimulating the economic growth of Hong Kong. It could be argued that there would not have been the high-speed economic growth of Hong Kong in the 80s and 90s of the 20th century had there been no reform and opening up of the Mainland of China.

A look back at the Hong Kong's economic history over the last two decades will reveal the reason why Hong Kong has benefited so much from the reform and opening up policy of the Mainland of China. On the one hand, the Mainland government, enterprises and individuals at that time did not understand or fully appreciate the international situation, in particular, the business methods, principles, rules and customs of the market economies. On the other hand, businesses from North America and Europe had a barely blank mind about the Mainland of China. Under the circumstances, Hong Kong, situated at the south portal of China had unique advantages compared with both businesses in the Mainland and overseas. While foreign businesses were speculating on or unaware of the reform and opening up policy of the Mainland, Hong Kong businesses had realized the dramatic changes taking place there at that time, and grasped the opportunities to serve as an intermediary between foreign traders and the Mainland enterprises.

The history over the last two decades proved that Hong Kong's intermediary role was triggered by the reform and opening up of the Mainland and underpinned by the geographical, cultural and social relations between Hong Kong and the Mainland of China. The fact that China was isolated from the rest of the world in early years, its economy

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was much underdeveloped, and its lack of a comprehensive legal system and laws, and foreign businesses' lack of understanding of the Mainland made the Hong Kong miracle a possibility. In order to explore the mysterious Mainland market, many foreign businesses came to Hong Kong for help as it had a relatively mature and free market and a good legal system. In the meantime, the Chinese enterprises that were interested in obtaining overseas finance and technology or in doing businesses with foreign businesses found it natural to rely on the help of Hong Kong. It is beyond doubt that from a historical point of view, as far as the intermediary role was concerned, no other regions could replace Hong Kong.

Of course, the Hong Kong's role was not limited to sheer intermediation. Hong Kong has also been a principal overseas investor in the Mainland, especially in the Pearl Delta River Region. The Central Government also accentuated Hong Kong's dual role of an intermediary and investor, and granted Hong Kong favourable treatments both in law and policy. Generally, the treatment Hong Kong enjoyed was above the MFN treatment.

In respect of trade in goods, although there has not been any specific arrangement on tariff reductions or exemptions between Hong Kong and the Mainland of China, in addition to the tax refund for export that applies to all overseas investors, Hong Kong enterprises have frequently had import and export tariff deductions or exemptions granted mostly through the administrative acts of the Mainland governments.

In respect of investment, Hong Kong investors have in fact enjoyed the above MFN and national treatment. It is common practice that overseas investors enjoy the above national treatment in the Mainland. It is equally undisputable that Hong Kong, Macao and Taiwan investors enjoy the treatment above the MFN. For example, according to the State Council's Regulations on Encouraging Investment by Overseas Chinese and Compatriots from Hong Kong and Macao, Hong Kong and Macao investors may purchase

shares and bonds of Mainland enterprises, borrow funds from domestic financial institutions, let their relatives in the Mainland serve as their agents, and form an association of Hong Kong and Macao investors. All these treatments are not available to other overseas investors.

In the early years, the laws of the Mainland of China were to a large extent abstract and less operative; administrative authorities hence had a lot of discretion, which was convenient and advantageous to Hong Kong businesses as they are familiar with the culture and rules of the Mainland. Therefore, it is fair to say that to a large extent the favourable treatments enjoyed by Hong Kong businesses are results of administrative discretions.

2. THE IMPACT OF WTO MEMBERSHIP ON THE MAINLAND

China is now a member of the WTO. What changes will take place in its legal system and laws as a result of China's accession to the WTO? Firstly, the rules and characteristics of the WTO itself must be examined. Quite different from the former General Agreement on Tariffs and Trade ("GATT"), the WTO involves a full range of economic and legal aspects of its members, including trade in goods, trade in services, investment, intellectual property rights, administrative and judicial principles and standards, powers of judicial authorities, etc. Furthermore, under the principle of one-single undertaking, no member may make reservations to the WTO agreements. Based on the principle of MFN, national treatment, transparency and others, the specific rules and standards of the WTO have actual effect on the members. For example, the WTO requires that laws related to trade, investment and intellectual property protection of all members must conform to the WTO rules, and decisions of administrative and judicial authorities must conform to the WTO standards and principles of equality, fairness, objectivity and reasonableness. In short, should

there be no WTO rules, how should the laws of members be drafted and interpreted, and whether or not the decisions of administrative and judicial authorities are in compliance with such laws would be left to the entire decision of those countries and regions concerned. With the WTO provisions in place, the laws of all members and decisions of administrative and judicial authorities thereof must conform to the international standards. According to the WTO practice, the principle of both MFN and national treatment are applicable to treatments in law and fact. If the laws of a member conform to the MFN and national treatment requirement, but in reality such treatment is not granted to enterprises, goods and services with equal status, the member concerned will violate the WTO provisions. Meanwhile, the WTO also requires high transparency of law and execution thereof. Accordingly, the transparency requirement demands that on the one hand, the legal provisions of members must conform to the WTO rules and be transparent, and on the other hand non-compliance with law should not happen. Even the exercise of discretion by administrative authorities must conform to the prescribed standards and be transparent.

The primary role of the WTO is to help remove trade barriers among members and provision of market access. As far as trade in goods is concerned, the obligation of members with regard to reducing tariffs is quite obvious. That is to say, any act inconsistent with their obligations under the WTO is an obvious violation. Other measures related to trade in goods such as antidumping, anti-subsidies, customs valuation, determination of origin of goods, product inspection standards and import and export licensing, etc. are of certain elasticity, which often constitute non-tariff barriers to international trade and naturally causing disputes. The general trend at present is to gradually reduce and finally eliminate all the non-tariff barriers, although it may take a long time.

As far as trade in services is concerned, the WTO is also devoted to the opening of market.

Trade in services differs from trade in goods. Firstly, so far, there is no well-defined term for services, that is the range of activities that may fall into the category of service trade is far from clear. Secondly, service trade is often directly related to trade in goods, which makes the WTO rules on both subjects applicable. Thirdly, trade in services is closely related to investment. Sometimes, even the party concerned is unclear whether its act is to provide service or make an investment. Due to the circumstances in services, many WTO members including China regard trade in services as part of investment issues, and try to bring their investment laws in line with the General Agreement on Trade in Services ("GATS"). From this standpoint, the principles of MFN, national treatment and transparency related to services also have direct effects on the investment sector.

The WTO requirements, the nature of such requirements and their application to members all have direct effects on the Mainland of China. Specifically, from an economic perspective, with the help of WTO membership, the formation of a market economy in the Chinese Mainland will gain speed and its relations with other countries and regions will definitely be closer. Changes to the economic structure and continuous enhancements of the market will inevitably require the rule of law. As discussed earlier, with regard to the laws of members, the WTO does not have only requirements on formality, but also substantive provisions. Changes of the Chinese law in the past few months clearly demonstrate that the laws of the Mainland will become more operative on the one hand, and become much more transparent on the other.

The direct result of law becoming more operative and transparent is restriction on the powers of the law enforcement bodies. It is certain that with law being more operative and transparent, the discretions enjoyed by the administrative authorities of the Mainland of China in charge of foreign trade, foreign investment and other administrative measures will be lesser and lesser and the decision-

making and law enforcement will be changed from power-dominated to rule-oriented, i.e., rule of law.

3. OPPORTUNITIES AND CHALLENGES TO HONG KONG

The WTO accession of China is generally viewed as bringing both opportunities and challenges to Hong Kong. The conclusion is obviously correct. The co-existence of opportunities and challenges does not, however, mean they both stand on the either side of a scale. Concrete analysis is required in order to ascertain what opportunities and challenges exist. Generally, the direct effect of China's accession to the WTO is the opening of market, which may bring new business opportunities to Hong Kong. Nevertheless, such business opportunities are generally available to all members of the WTO. In this instance, if China's WTO accession may bring Hong Kong new business opportunities, it will bring bigger and more business opportunities to other WTO members. In fact, according to the MFN principle, Hong Kong will lose some of the treatments it has enjoyed in the Mainland as a result of China's WTO membership. As the discretions exercised by the Mainland administrative authorities continues to reduce with the adoption of more operative and detailed laws, the treatments that Hong Kong has been able to negotiate from the Chinese administrative bodies will eventually disappear. As a result, Hong Kong soon will have to compete with multinationals from Europe, America, Japan and other countries on the same footing in the Mainland of China.

The result of China's WTO accession is the opening of market. With the opening of the Mainland market and continuous improvement of transparency of law, foreign businesses will be able to enter the Mainland without the help of Hong Kong, which gradually diminishes the springboard role of Hong Kong. Meanwhile, with the increased contact between the Mainland and foreign businesses, Mainland enterprises will be able to do business directly

with foreign enterprises, which will gradually reduce Hong Kong's role as the window of the Mainland. Losing the intermediary role will be an issue Hong Kong must address. With the fading of intermediary role, Hong Kong must compete for the Mainland market with investors and traders from North America, Europe, Japan, Australia, Korea and other developed countries under the same conditions, which at least is a tremendous challenge to Hong Kong. At the same time, Hong Kong has to compete with Mainland enterprises for markets in North America, Europe Union, Japan, Australia, Korea, Southeast Asia, etc.

As the Mainland's market economy progresses, means available to the Central Government for helping Hong Kong will be less and less, and the Central Government will be in a dilemma to do so in the end.

4. HONG KONG' CHOICES

Due to the Asian financial crisis and other reasons, Hong Kong's economy is still undergoing unprecedented structural adjustment. China's WTO accession has made Hong Kong face competition from both foreign countries and the Mainland. Then what can and should Hong Kong do? It is of course impossible for this short piece to make a detailed analysis of such complicated issues. In short, Hong Kong must complete its economic structural adjustment as soon as possible and enhance its own competitiveness.

Is formation of a free-trade area with the Mainland a solution for Hong Kong? It is submitted that the formation of a free-trade area will not violate the principles and rules of the WTO. But the parties concerned should first make it clear whether such a free-trade area is for trade in goods only or includes trade in services too. According to paragraph 8(b) of Article XXIV of GATT, "A free-trade area shall be understood to mean a group of two or more customs territories in which the duties and other restrictive regulations of commerce ... are eliminated on substantially all the trade

between the constituent territories in products originating in such territories.” If any member of the WTO decides to form such a free-trade area, an interim agreement on the elimination of restrictive measures should be first reached, which shall include a plan and schedule for the formation of such a free-trade area. Any member deciding to enter into a free-trade area shall promptly make available to the Council for Trade in Goods the interim agreement and other relevant information so as to enable the members to make an assessment. If, after having been notified and taking due account of the relevant information, other members find that such an agreement is not likely to result in the formation of a free-trade area within the period contemplated or that such period is not a reasonable one, they may make recommendations to the parties to the agreement. If such recommendations are not accepted, the said free-trade area cannot be formed. According to the rules aforesaid, if the Mainland of China forms a free-trade area with Hong Kong or with Macao as well, other members of the WTO will have no legal basis against the formation of the free-trade area. They may, however, interfere by claiming the schedule for the formation of the free-trade area is too tight, unreasonable, unrealistic, etc. As discussed above, the WTO members have the right to make recommendations to the parties concerned to change the schedule. Theoretically, other members of the WTO have no reason to object to such proposals, because, after all, the formation of free-trade areas is in line with the general goal of the WTO. The parties concerned however must run political risks. This is particularly true for the Mainland of China. The establishment of a closer tie is novel to the WTO. If it is close enough to be a free-trade area, then there will be no difference with a formal free-trade area. If it is quite away from a free-trade area of any kind but nonetheless giving the parties concerned substantial preferential treatment (mutual or unilateral), the very basis for such an arrangement will be subject to challenge. That could be the reason why both governments have stopped talking about it.

Suppose a free-trade area is formed by the

Mainland and Hong Kong which covers trade in goods only, it will be relatively easy to obtain the authorization of the WTO. To Hong Kong, a free-trade area limited to trade in goods will bring some benefits without many disadvantages. As discussed earlier, the main objective of every free-trade area is the elimination of tariff and non-tariff barriers among the members. The implementation of zero tariffs between the Mainland and Hong Kong will help maintain the intermediary role of Hong Kong in trade in goods. This however does not mean that only companies formed by Hong Kong people or existing companies may benefit from it. According to the principle of non-discrimination, any enterprise of other WTO members may come to Hong Kong and form an establishment to carry out businesses with China and enjoy the preferential treatments of the free-trade area.

Following the example of the North America Free-Trade Area and European Union, a free-trade area confined to trade in goods is considered a free-trade area of primitive stage. A full-fledged free-trade area should cover services, movement of personnel and capital as well. The GATS does not prohibit WTO members from concluding agreements on economic and labour market integration either. In case the Mainland and Hong Kong reach an agreement on the integration of the service market, the preferential treatments that the parties could provide to each other should be quite broad. Therefore, through forming a full-fledged free-trade area which includes the integration of service trade, the Mainland should be able to grant complete national treatment to Hong Kong enterprises, including free movement of personnel and capital. However, taking into consideration the gap between the Mainland and Hong Kong in economic development and education, the result of such integration is more likely to be detrimental rather than beneficial to Hong Kong.

In order to lower production costs and with the introduction of free movement of capital and personnel, Hong Kong businesses will be likely to move their factories and operation to the

Mainland. The ordinary workers in Hong Kong, especially the non-skilled workers, however, cannot move to the Mainland along with Hong Kong enterprises. Meanwhile well-educated Mainland elites will be able to come to Hong Kong for better paid positions. The outflow of capital coupled with the inflow of Mainland elites will lead to increased unemployment in Hong Kong. This will in turn adversely affect the economic structural adjustment in the territory. Logically a more feasible scheme is to form a free-trade area limited to goods. Such free-trade area, however, can hardly help resolve the serious problems Hong Kong facing.

It is submitted that facing the challenge of globalization, Hong Kong must adjust itself to the changed circumstance of the international community. It must broaden its vision, have a relatively detailed development plan for the next few decades and setting up institutional mechanisms commensurate to such plans. Immediately as the Mainland of China is negotiating with the ASEAN countries for the establishment of a free-trade area, could Hong Kong serve as the pioneer of China by opening its market to the ASEAN countries in return for the same treatment in the latter. The experience gained through such arrangement will be beneficial to the formation of a free-trade area among China and ASEAN countries.

Paper No. 9

DESIGN AND CONSTRUCTION OPPORTUNITIES IN CHINA

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DESIGN AND CONSTRUCTION OPPORTUNITIES IN CHINA

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ABSTRACT

This paper is in two parts, with Part A on design opportunities, and Part B on contracting works, both in China. Part A is not intended to lay down every step for setting up consultancy practice in China, but aim to describe the design opportunity and some of the key design management issues for projects undertaken in China that most designers would have encountered in the past two decades. There will be further opportunities for engineers from Hong Kong to actively participate in the fast growing construction activities in the Mainland China coupled with his accession to WTO.

Part B is aimed to describe the challenges and opportunities that Hong Kong based M&E contractors would usually face with for projects undertaken In Mainland China in the past two decades. It also highlights some of the key areas of concern, construction management issues, and future contracting opportunities for installation contracts executed in China in the coming years after China's entry to WTO.

PART A

A1. INTRODUCTION

Both Hong Kong and the Mainland China have gone through great changes in Engineering environment in the last two decades, and significant enough to draw world's attention. Hong Kong was governed under the British system for over a century and her sovereignty was returned to China in 1997. This marked

and drew the curtain towards more opportunities of further economic, industrial and financial integration of their past success and breakthroughs accomplished in world's arena level, witnessed by many Asian countries as well as the western world. The recent accession of Mainland China to WTO gave another big push to the economic engine and reform that China has bravely engaged with great success in the last decades.

With Engineering, it actually ran all the way back to early 1980s when China employed the "Open Door Policy" for foreign consultants, investors and contractors registering interest in participating projects and economic development. Most significant was in some specially administered "economic zones" and "industrial zone" such as Wangpu in Guangdong, Tianjin, Wuhan, Shekou, etc. for better management and central Bureau administration. It was evidenced with great success in particular the area of technology transfer and open acceptance of other international engineering standards adopted in building and construction industries. At the same time providing Hong Kong entrepreneur tremendous opportunities in large scale investments in factories, infrastructures etc. capitalizing great return even with the British backdrop. Hong Kong has certainly positioned well in the past with unparalleled success.

The paper is not intended to lay down every steps or procedures in how to establish design practices in our mainland but merely wish to share some experience that many design engineers have walked through, learnt and experienced through undertakings of design commission in China.

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A2. DESIGN OPPORTUNITIES

20 years ago, Hong Kong Engineers started to be given direct commission as lead designer role in many high cities in China for many international developers and Asia investors including many Hong Kong entrepreneur who still have significant ownership in many cities now. The main sector of services that they mostly interested to develop in China includes,

- Industrial and processing manufacturing plant (built for export as well as for domestic market consumptions).
 - Infrastructure, roads, highways, ports for economic zones and coastal cities.
 - Hotels, service apartments, office buildings.
 - Other effort including Airports, container terminals, hospitals and civic / cultural institutions.
- Understanding of long term maintenance objectives and operating efficiency
 - Knowledge of product application and system applications with global scale vendors
 - Well developed knowledge base for technology, product and commercial availability
 - Skill in resourcing system components and plants from worldwide via proven networking and quality
 - Perform professional testing and commissioning activities to client's satisfaction
 - Quality mindset on cost and programme supervision and control

A3. HONG KONG ENGINEERS' ROLE

Why Engineers from Hong Kong was employed to perform design and construction contracts in the mainland for many large-scale projects? There are many unspoken reasons and underlying recognition from many overseas investors about the Hong Kong Engineers' attributes that help to pin us high up on their selection board with more comfort and assurance. To name a few,

- Act as the cultural bridge, language go-between
- Interpreter of the Client's design brief
- Understanding of international Codes and Standards
- Quality perception of the final product matching client's expectation
- Fast Track, large and complex project experience
- More resilient to changes and long term flexibility in design approach
- Better design management skill across all disciplines including architectural and structural

A4. KEY DESIGN IMPLEMENTATION PROCESS FOR PROJECTS IN CHINA

It is not the intention here to over-emphasize any form of difficulties engaged in the design process for projects in China, but merely wish to highlight some of the twilight zones which we need to sail through in a cautious manner by the engineers of Hong Kong. In broad terms, the design process and procedures are the same everywhere in the world, but taking a snap shot of both time and cost exposure for projects in China, such as relating to authority submission, approval and permitting issues, there are some rules of thumb that you might not want to overlook or undermine.

A4.1 APPLICABLE CODES AND REGULATIONS FOR THE PROJECT

The first research is to determine the set of rules that carry jurisdiction to the design approach to be adopted for your project site, whether they are under local, municipal, provincial or Central Bureau rulings. Some examples could illustrate the differences :-

- A residential development in Dongguan is most likely subject to local rules
- A local elderly homes and health care

facility in Zhaoqing might be subject to both local and provincial design codes

- An airport or a hospital to be built in Nanjing would be subject to both Local and Central bureau rulings and approvals due to country-wide implications on operation and safety standard harmonization
- A high rise commercial building in Shanghai would easily link approvals to local and provincial level

A4.2 DESIGN APPROVALS (PRELIMINARY AND EXTENDED DESIGN)

Once guiding rules and codes are established as baselines, the next step is to develop the design intent based on the Client's brief in parallel with the Local Design Institutes (LDI) and every effort shall be made to seek common grounds before taking off on detail design. Examples are:

Fire services design

There are always the opportunities in pursuing design satisfying an overseas client's brief but not the PRC Codes. Or, you are satisfying PRC codes but not Client's requirement hence creating a certain dilemma in future "Contents and Fire" insurance valuation (e.g. FM, IRI in the case of a manufacturing facility etc). This is not only a design issue but also a long term cost exposure issue. The common grounds are therefore to design for each individual Fire Services and electrical systems such that each of them (flow rates, pressure, area coverage) are complying the higher standard of either of the two pre-requisites.

Electrical supply system

Power bureau must be consulted on all cost leading to power grid connection charges, increase capacity charges due to your loading up their grid by the new facility, cable costs connecting from nearest substation to site (could be tenths of miles and km), utility charges on operation in light of your facility (i.e. Factory industrial rate is different from charge rates applied to residential). All these

costs could add up, if not careful, to a great sum much larger than the same facility being built elsewhere in the world.

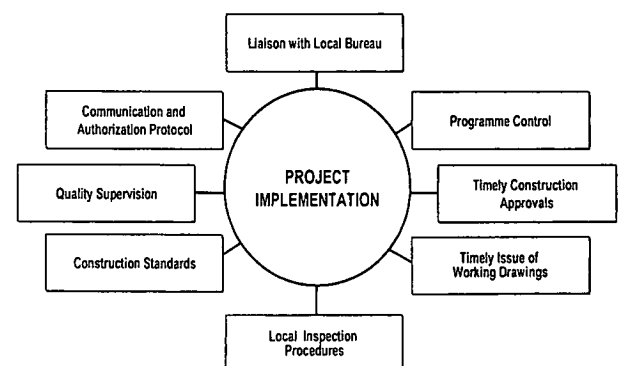
Waste discharge

Many facilities could generate industrial (or trade) waste as well as the domestic waste. The site locality might not yet have central treatment plant. The design shall include provision of a site base waste treatment plant meeting the Environmental Bureau's requirements on discharge quality (BOD, COD, toxicity etc). Failing which would entail penalty and face severe charges. Early consultation with the local Environmental Bureau or even engage their consulting arm to perform environmental assessment, EPD submission and their contracting allies to build the waste treatment plant based on your design. This approach would sometimes be viewed as a wise alternative in handling risk and minimize programme implication by utilizing their local skill and knowledge of the relevant environmental restrictions endemic to the project site vicinity.

Procurement of import equipment

Construct and establish, in conjunction with the client's team, the import equipment lists for some specialized process plants or the like. This would allow early liaison with the tax bureau in ironing out range of charge rates or waiver, if they were not commonly available in the mainland market. There might be intermittent changes to tax rulings in light of recent entry to WTO, the golden rule is therefore to consult the tax authority prior to any design, sourcing and procurement activities being implemented.

Figure A1 Successful Project Implementation



A5. COLLABORATION WITH LOCAL DESIGN INSTITUTE (LDI) / AUTHORITY SUBMISSION ON DESIGN MATTERS

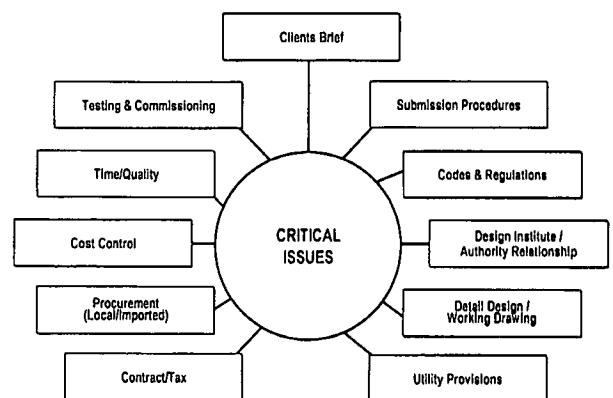
It is until recent years that foreign registered consulting and design Engineers are becoming more and more popular in China. But it is not without hindrance like every country in the world. Foreign design Engineers / design engineering firms cannot make direct Authority submissions on their own. They can either form a Joint Venture (JV) company with a qualified LDI and establish a new design company under a new PRC entity. Or, a new company is created as a foreign wholly owned firm and start off from ground zero and go through the “quality certification” process to establish pre-requisite submission standard of her own recognition. This will usually take 2 to 3 years or more to gain some form of recognition in light of projects completed which are significant enough of her own standing, on par with other grade-A LDI to achieve the same recognition by Authority / Bureau. Recently, it is noticed that some selected locations of China cities (e.g. Wuhan) would allow direct registration of foreign engineering firm as local consultants (but with quota) attached with some usually expected form of restrictions / constraints. Nevertheless, this is already a giant step forward making the administration and recognition system more open to the world.

However for expediency, the usual way for any particular project is to employ a qualified LDI for the project (by the design firm or the client direct) who could perform the following technical duties in conjunction with the design engineers from Hong Kong:

- Assist the project team in the initial conceptual and feasibility stage
- Perform environmental impact assessment and liaison with Utility companies
- Assist client in the “project registration” process

- Review of the “preliminary design” and submit for bureau approvals
- Review of detail design against the applicable PRC Codes and regulations (GB) for the project, recommend / suggest amendments to the project team prior to submission.
- Preparation of construction shop drawings to PRC construction protocol
- Stamp drawings and submit on behalf of project team to construction, planning and other related Bureaus to obtain the necessary “Construction Permitting and Licensing” at various stages
- Advise on local tendering procedures and costing guidelines
- Local sourcing of materials and products
- Pre-completion testing and commissioning to PRC standards

Figure A2 Critical Issues of PRC Projects



A6. WHAT HONG KONG ENGINEERS CAN CONTRIBUTE?

Disregard the form of business collaboration you would take on with the LDI on a certain project, design engineers from Hong Kong can offer various levels of expertise to accomplish the defined project performance objectives in particular for the following areas:

- Strong knowledge base asset of various category of projects – industrial, hospital,

hotel, grade A offices, airport, terminals etc.

- Well established knowledge systems and networking with world organization through many years of contact between Hong Kong and overseas
- Depth of conceptual and feasibility study to client's expectation
- Develop robust infrastructure design with long term flexibility in planning and expansion capability, in particular for projects which embark on mega scale phasing development scheme
- Sound knowledge in various finance models, business return, economic advantages, marketing needs, human resources planning and legal and contractual implications.
- Maximum use of international design standards developed through experience; greater use of information technology to minimize labour intensive design production
- Drawing production capability, sophistication in design co-ordination across all design disciplines
- Knowledge of contract procurement methods and works demarcation amongst many construction disciplines
- Quality control and works supervision during construction phase for fast track and large scale projects
- Design specializations such as Clean room design, super high-rise buildings elevating concept, pressure regime for critical laboratory, hospital services, industrial MEP design etc.

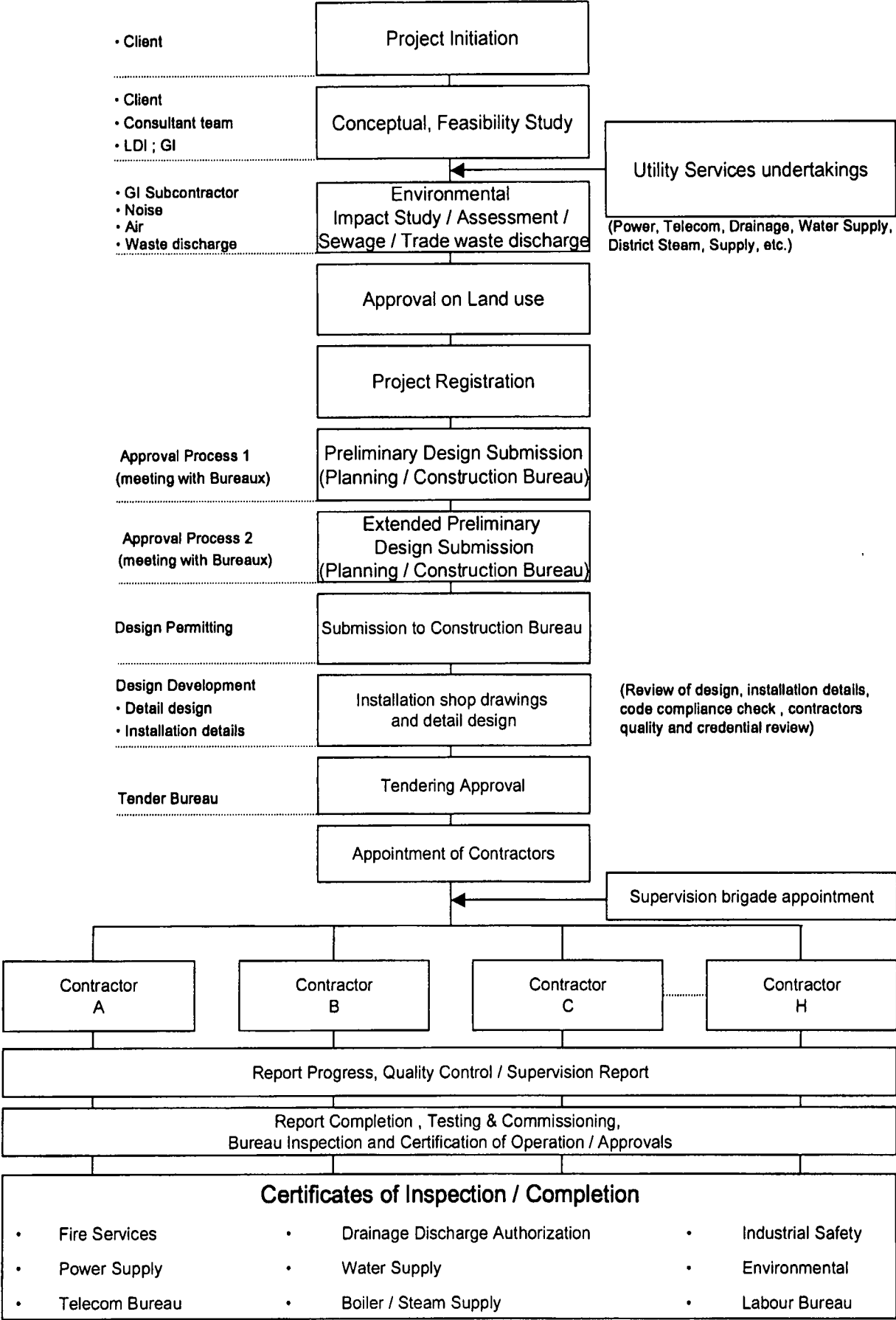
A7. FURTHER OPPORTUNITY AFTER THE ACCESSION OF CHINA TO WTO

During the next fifteen to twenty years,

Mainland China will likely become a thoroughly new type of political and economic entity judging from the movement of the last decade in trade policies and economic advancement in world's arena. The entry to WTO is a long 15 years process. Its admission is largely symbolic in many people's view, more pertinently, is the establishment of more open systems, government commitment to clean environment, build roads, telecommunication infrastructures, sewage systems, power plants, modern port facilities, high-tech industrial parks, universities and medical institutions. The China government also actively encourage more foreign investments backed up by Government's economic stability policies (including the currency -RMB) and other constructive restructuring in the management and administration hierarchy. Another example is the increasing acceptance and use of the International design consultancy contract form "FIDIC – a French acronym for the International Federation of Consulting Engineers" with membership more than 60 countries. All of the above will add more and better opportunity to Engineering professions of Hong Kong in the time to come.

No doubt, China will present the world with unprecedented challenges. Professional Engineers from Hong Kong are best placed to capitalize on the great economic growth lying ahead in the mainland; perhaps it might be one of the greatest potential market opportunities in the history of commerce and Engineering. The distinct advantages of our compatibility and capability in linguistic, cultural, ethnic, and the many Hong Kong-Mainland business ties established over the years represent a golden opportunity for us to contribute more of our resourcefulness, knowledge, dedication and technical excellence to our motherland through one way or the other.

Figure A3 An Over-Simplified Illustration of the General Design / Construction Process



PART B

1. INTRODUCTION

Many contractors in Hong Kong who have undertaken contracts for E&M projects in China in the last two decades would have gone through the learning curve and the challenges following the reform and opening up of market in China in recent years. The construction industry has undergone many exciting changes in tandem with the reform of China in many aspects and have never been so breath-taking. With great determination, contractors would need to try hard to pursue advancement while the market evolves, giving rise to new challenges and new construction requirements. Over the past two decades, we have the opportunity to witness the positive enhancement of national rules which have gradually become more substantial and complete, and the relevant legislation has been orderly enacted step by step. We trust that the construction standard and quality in China will become better and better in the years to come.

By means of a workflow diagram, which is structured to briefly illustrate the necessary procedures and steps for a Hong Kong E&M installation company needed to fulfill an installation contract from tendering through to completion of defect liability period in China, it is hoped that readers could have a better understanding of the manpower and resources required in the entire process, noting the new development that is taking place everyday.

B2. GOVERNMENT DEPARTMENTS CONCERNED IN ALL STAGES

This is illustrated in Appendix B1.

B3. IMPLEMENTATION MANAGEMENT WORKFLOW FOR E&M PROJECT CONTRACTS IN CHINA

The workflow is as shown in Appendix B2.

B4. A COMPARISON OF HONG KONG AND MAINLAND CONTRACTORS

Since the revolution and opening up of market, Hong Kong contractors have been eyeing for opportunities in the huge market of Mainland China. There have been incessant changes in the market conditions over the past 30 years. The legal framework, business operation, taxation system, monitoring mechanism and the market are becoming more and more established. The successful accession to WTO and organization of Olympics 2008 will also bring about business opportunities and competition. In response to the rapid growth of the local contractors in the Mainland, Hong Kong contractors have to trim management and operations cost effectively in order to enhance efficiency. It is also necessary to apply good management practices of the Hong Kong companies to the projects in the Mainland, including project management, cost control, computerized drawing, system commissioning, financial audit, system maintenance, etc. and expedite localization of manpower to lower the cost. New ideas have to be used in business expansion, and outdated practices must be abandoned. Under the current circumstances in China, Hong Kong contractors can retain their competitive edge only by complementing their deficiency, speeding up localization, managing imperatives along the thoughts and ways of the local people.

An integrated analysis of the situations faced by the Hong Kong contractors and the Mainland contractors are given in Appendix B3, according to our experience over the past 30 years.

In the wake of the intense competition with the Mainland contractors induced by their fast growth and advancement in technology, contractors from Hong Kong still enjoy some advantages in several areas. We will look at the comparison between Hong Kong contractor and local PRC contractor at each stage from tendering, implementation, through to completion. This is shown in Appendix B4.

B5.0 CONCLUSION

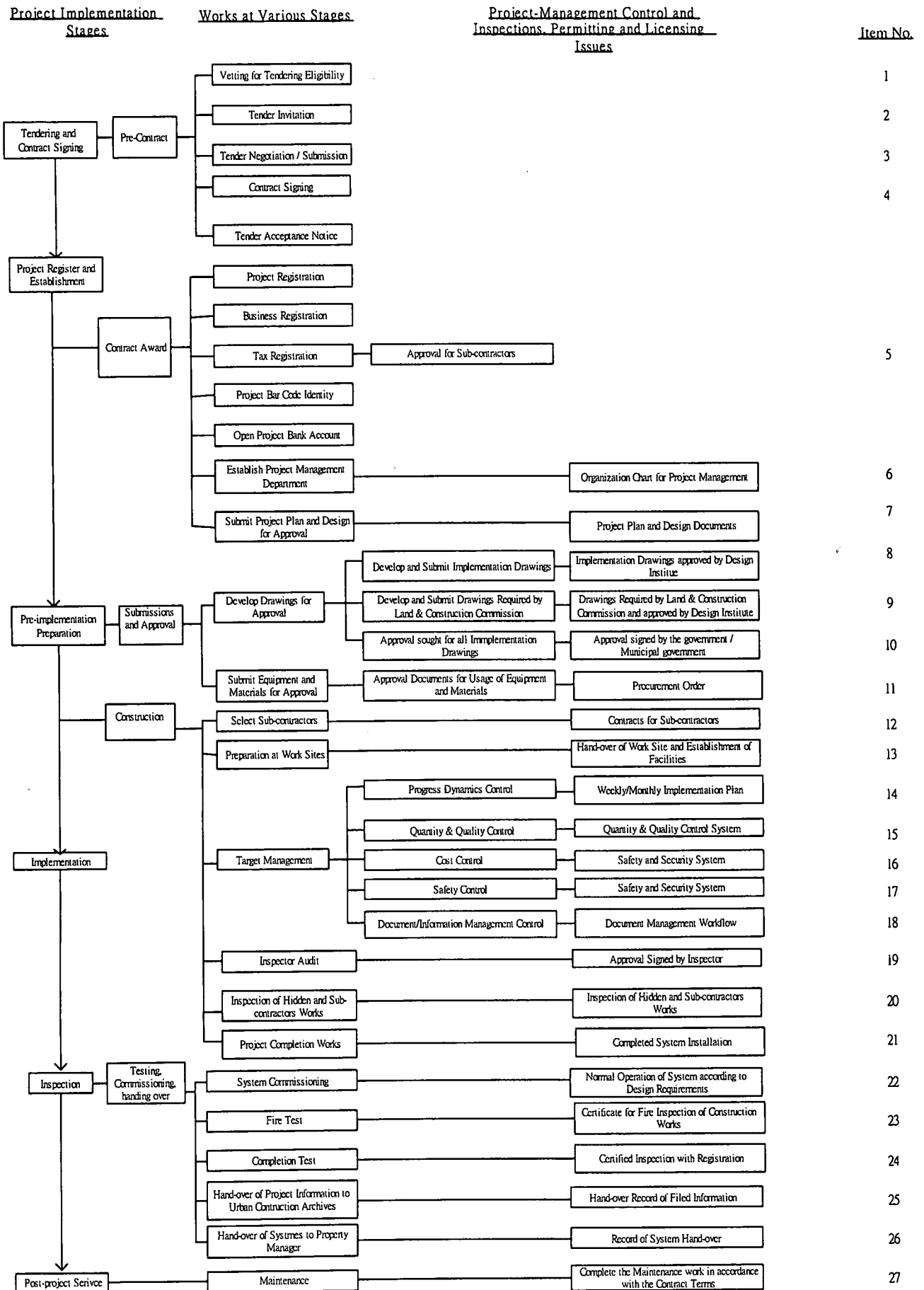
In view of the current situations in China, Mainland E&M contractors are becoming more established and their Engineering Staff are better trained, thus the competitive edge of the contractors from Hong Kong are diminishing. In other words, the advantages now enjoyed by the Mainland contractors offset the used-to-be advantageous position enjoyed by the contractors from Hong Kong. We have to fill up the gap so as to accomplish a more balanced competition. Contractors from Hong Kong must expedite localization in staffing, registration, cost, price and rethink strategy, etc. To survive in the market after accession to the WTO, all staff from Hong

Kong must obtain various levels of professional qualification in the Mainland in order to turn the companies from Hong Kong based into local qualified registered companies. The policy-making management must also be very determinant and establish head office in key cities of China to develop a better vision of the market place. It is also absolutely essential for the management to commit resources, training of engineering professionals in both in Hong Kong and in local PRC for managing the fast evolving contracting environment and maintain strong competitiveness. The old days in which managing Mainland business from a remote place have gone and is no longer effective from both the business and contracting point of view.

Appendix B1 – Government departments concerned in all stages

Stages	Government Departments involved	
	Beijing	Shanghai
Tender Acceptance Notice	Beijing Construction Project Tendering Management Office	Shanghai Construction Project Tendering Management Office
Certificate of Eligibility	N/A	Shanghai Building Trade Management Office
Project Registration	Building Trade Administration Department, Beijing Construction Committee	Shanghai Building Enterprises Management Office
Business Registration	State Administration Bureau of Industry and Commerce, Beijing Municipal Government	Shanghai Administration of Industry and Commerce
Tax Registration	Beijing Municipal Office, State Administration Taxation of China / Beijing Local Taxation Bureau	Four departments of the seven Taxation Bureaux of Shanghai Municipal Government
Project Bar Code Identity	Beijing Bureau of Quality & Technical Supervision	Shanghai Bureau of Quality & Technical Supervision
Approval for Sub-contractors	Department of External Affairs Administration, Construction Committee of Beijing Municipal Government	External Economic Technology Cooperation Company of Shanghai Municipal Government
Inspection upon Completion		
Electrical System	Beijing Electricity Co	Shanghai Electricity Bureau
Steam System	Special Equipment Testing Centre, Labour Bureau of Beijing Municipal Government	Shanghai Labour Bureau
Gas System	Beijing Natural Gas Co.	Shanghai Natural Gas Co.
Security System	Safety & Security Department, Construction Committee of Beijing Municipal Government	Shanghai Public Security Bureau
Fire System	Beijing Fire Services Department	Shanghai Fire Services Department
Water Supply System	Beijing Waterworks Group Co., Ltd.	Shanghai Water Co. and Health Preventive Check Office
Water Discharge System	Municipal Administration Department	Shanghai Urban Water Discharge Office
Environment	Beijing Environmental Protection Bureau	Shanghai Environmental Protection Bureau
Overall	Beijing Construction Quality Inspection General Station	Shanghai Construction Quality Inspection General Station
Completion Record	Beijing Urban Construction Archives	Shanghai Urban Construction Archives

Appendix B2 – Management Workflow Diagram



Appendix B2 – Management Workflow Details

Sequence no.	Remarks	Item (1) – (27)
1.	Fill in the "Pre-approval notice for Tender Eligibility" and "Pre-approval form for Tender Eligibility" as required.	
2.	Prepare Tender Submission to the department concerned upon receipt of "Tender Invitation" and Tender Document.	
3.	On receiving the client department inquiries and modification request, review and reply.	
4.	On receiving the Tender Acceptance Notice, start preparation for implementation immediately and organize contract signing.	
5.	During the application period, it is necessary to submit a number of documents to the Land & Construction Commission, including Tender Acceptance Notice, Organization Chart, Quality Certification, Company Profile, List of Workers, etc. Also, it is necessary to have business and tax registrations and apply for business operation permit.	
6.	The project management department is responsible for all organization, coordination and implementation of the project. Upon completion of project inspection, defect liability period and hand-over, the project management department shall be dismantled. Upon commencement of works, project manager and site manager shall carefully take care of the management of all document and information, including the indexing, filing, storage and security.	
7.	With an aim to realize the highest targets in project duration (short), quality (high) and cost (low), the document sets out various plans throughout the project implementation systematically and rationally with respect to the manpower, resources, and space, including manpower and resources, main and supplementary, supply and consumption, production and storage, professional and cooperation, usage and maintenance, and space arrangement and time arrangement. The document contains project brief, implementation characteristics, implementation proposal, timeframe for preparation for implementation, timeframe for implementation, requirements of manpower, materials and equipment, quality, safety, environmental issues, and implementation assurance techniques for the rainy climate in winter, major technological and economic indices, proposal for transportation and routing of large equipment. Some main contractors in the Mainland have used networking technology in compiling implementation plan, but most of the E&M contractors are still using the image progress method.	
8.	By means of on-site professional coordination, to develop professional implementation plan, to draft E&M integration plan, and to submit to design institute for approval.	
9.	Drawings required by Land & Construction Commission include integrated E&M layout plan, basic requirements for equipment.	
10.	Construction Commission and Planning Commission in Beijing allow the following organizations to approve implementation plans: Beijing Construction Design Institute and Construction Design Institute of Construction Commission. Fees are charged basing on the "Standard daily charges of project consultants". Drawings or proposals pertaining to fire system, security system, electricity, telecommunication, fuel gas, heat, stove, environment protection, water supply and drainage are still subject to approval by the relevant department of the government/municipal government, such as the fire services department, security office, electricity department, telecommunication department, gas companies, heat supply companies, labour department, environmental protection department, water saving office, etc	
11.	All equipment and materials must not be in contravention of requirements adopted in the Mainland (national standard, regional standard, industry standard, etc). They must be approved by the design institute and the landlord before usage. But quite many criteria set by overseas investors and design institutes impose concurrent compliance with other country's standards, such as Europe and US. The supply of materials must fit with the timeframe for implementation plan. It is recommended to arrange early shipping for imported items. Urgent airfreight are often held up at customs and resulted in large sum of storage fee. Clear and accurate delivery document can help minimize tax problems at customs. Quantity and quality inspections are required for most imported items after passing the customs; the inspection charges are paid by the landlords as required by the investors.	
12.	Select the suitable sub-contractors as early as possible. All sub-contractors must have the relevant installation experience and follow the labour and safety rules of the area. If the sub-contractors employ overseas workers, they should finish the required registration for the overseas workers as early as possible.	
13.	Ensure proper conditions on-site to facilitate civilized work implementation.	
14.	Adjust the monthly/weekly progress plan according to the real site conditions. Deploy manpower and resources promptly by means of active and efficient measures in order to ensure satisfactory completion of work.	
15.	Establish perfect quality assurance system, in line with the directions "Safety First", "Quality First", and "Prevention". Adopt three-tier management measures including pre-project prevention, project control, and post-project review to ensure realization of quality targets. As accountability system for project managers has been in place in the Mainland, it is necessary to take the quality matters seriously.	
16.	Establish cost control system, save cost, record work attendance properly, and handle work attendance/roster timely.	
17.	Must have security and protection staff in post to prevent burglary and carry out stringent security rules. This is to ensure safe and efficient work implementation. It takes much trouble to handle accidents involving overseas workers in the Mainland China.	
18.	Set up standard management system for information filing to manage daily documents, and store meeting records during work implementation properly.	
19.	Landlords of all large projects in the Mainland are required to employ qualified inspectors to monitor and carry out quality inspection during the work implementation period. The implementation company is required to submit information for inspector's approval, including implementation proposal, timeframe for implementation, implementation meeting, etc.	
20.	The inspection of concealed and sub-contractors works are to be inspected with the participation of the inspector. All inspection records are to be endorsed by the inspector. The main contractor, the construction institute and design institute shall be invited to participate in the inspections of major items.	
21.	System commissioning is required upon completion of system installation and defect rectification.	
22.	Commissioning proposal shall be approved by consultant and the commissioning process shall have the involvement of the inspector. Commissioning report shall be signed by the inspector and consultant. Please be aware that some property managers of the landlords may refuse to sign thus creating problems in hand-over and accounting.	
23.	Self-test is recommended upon completion of the fire services system, before the inspector carries out inspection required. When the system has passed the test, the landlord shall arrange the fire services department to conduct the final testing.	
24.	Prepare technical documents, completion drawings, and compile the operations and maintenance handbooks for joint inspections by landlord, design institute, inspector, implementation company, and government departments including quantity and quality inspectors, environmental protection department, fire services department and electricity supply department who shall sign the inspection record.	
25.	Prepare necessary project information for filing at the Urban Construction Archives.	
26.	Provide training for operators of the landlords before hand-over to ensure that they can operate the system independently. Pass the work completion information to the relevant parties including the landlord, archive, main contractor, etc. Sign to confirm completion of the handover procedure.	
27.	To ensure normal operations of the system by carrying out system maintenance pro-actively according to the contract terms. Listen to the opinions of the users and consolidate the experience for continual improvement. From this year onwards, the defect liability period stipulated in the new tender document in Beijing has generally been extended to 2 years.	

Appendix B3 – Market conditions in China

Year	Market conditions in China	Competition	Risk/Profit
70's	E&M contractors from Hong Kong seldom had their business in China. Just a few projects mainly in the Guangdong province.	Very Low	Medium, Low / High
80's	Contractors from Hong Kong participated in projects in some major cities and coastal provinces. Some technicians were deployed from Hong Kong at the early stage while the contractors also started to train up local working teams.	Relatively Low	Medium / High, Medium
90's (Mid / Early)	Contractors from Hong Kong started to involve in joint ventures and endeavoured to train the local workers and working teams. In early days, contractors from Hong Kong reaped ample profit because the Southern Visit boosted the construction industry in the southern region. However, the Macro Economy Manipulation presented in mid 90's caused many contractors to suffer loss.	Strong competition among contractors from Hong Kong. Local contractors were becoming mature	Medium / Medium, Low
90's (Late)	After the return of sovereignty of Hong Kong to China, the number of projects in the Mainland has gone up. However, in the economic turmoil, suspension of projects in the southeast Asia resulted in great impact on some of the Hong Kong contractors.	Competition became more intense	Medium high / Medium low
21 st century	Following the accession to WTO and re-organization of national enterprises, the local economy has been flourishing and the business opportunities for contractors from Hong Kong have greatly increased. In the light of the enhancement of the local contractors, contractors from Hong Kong must alter the structure, thinking, market strategy and lower the cost to maintain the competitiveness. Some contractors have even invested in some quality national enterprises as their flagship in China.	Very intense competition	Medium high / Low

Appendix B4 – Comparison between E&M contractors between Hong Kong and the Mainland

Stage	Area	E&M contractors from Hong Kong	E&M contractors in the Mainland
Market expansion	Project planning	Tighter budget and more stringent vetting	More ample budget and easier vetting
	Overseas visits	Easier arrangement for landlord to have overseas trips	More difficult for national enterprises to arrange overseas trips for landlord
	National intelligence	Less familiar than companies in China	More familiar with national intelligence and departmental operation than outside contractors
	One-stop services	Able to provide flexible one-stop services similar to those outside China, such as design implementation, design modification proposal, energy saving proposal, price limitation, etc	Relatively passive in this area, but some Mainland contractors have partnered with design companies concerned to obtain the advantages
	Design Institute	Difficult to spark close ties due to project by project engagement basis.	Have closer relations
Negotiate / Submit tender	Cost	The cost is relatively high because of the involvement of management staff from Hong Kong and tax matters.	The cost is relatively low because all staff are local and there is no need to pay tax for individual project.
	Price	The price is normally higher because off-shore companies usually make profit from equipment procurement that leads to higher cost.	Contractors in the Mainland usually procure equipment on their own, with no profit-making from equipment procurement. With all costs being low, the price will also be relatively low.
	Quality	The quality certification issued by the State Construction Commission may not necessary be applicable at all provinces.	In general, local companies have obtained the quality certification of different levels.

	Tax	Must have tax registration with the local taxation department. The tax amount, equal to a certain percentage of the contract sum, will be collected by the taxation department according to the local rule. Thus the cost on tax is relatively high.	Local companies and other national companies usually have good relations with the taxation department, thus the tax matters would be handled flexibly. For example, paying tax at the original place of registration, or using invoices to offset the amount, etc. In addition, national companies can use year-end financial audit to calculate the tax amount, so the cost on tax is relatively low.
	Risk responsibilities	More prudent in handling financial arrangement, contract terms, technical requirements and rules & regulations, hence more serious in taking risk responsibilities.	Mainland contractors are generally willing to undertake these risks. They have different interpretation of the terms and conditions.
	Spirit of Contract	Contractors from Hong Kong and Macau take the spirit of contract more seriously and normally undertake the compensation in accordance with the terms stipulated in the contract.	Mainland contractors are usually able to meet the requirements of the landlord in tender negotiation, but they often have inconsistent interpretation of the contract.
Contract signing	Project register	Contractors from Hong Kong need to register at the local Construction Committee for individual project.	Qualified Mainland contractors only need to register at the local Construction Committee.
	Business Registration	Upon obtaining approval from the Construction Committee, need to apply for business registration for individual project at the Management Board of Commerce and Industry.	Mainland contractors are normally run by local companies or subsidiaries of local registered companies.
	Tax Registration	Upon receipt of approval documents from Construction Committee and Management Board of Commerce and Industry, need to have tax registration with the local taxation department according to the contract terms.	Mainland contractors only need to pay tax according to the year-end financial audit.
Project Implementation	Project management / Contract management	Contractors from Hong Kong are used to project management practices in their respective regions; they are more privileged in handling overseas investors. More inclined to reducing staff from Hong Kong in the project management establishment in order to reduce cost and intend to train up local project management staff. They need to be more familiar with the management practices of the landlord in China.	Mainland contractors have gained some experience in the overseas investment projects and are very adaptive to these management practices. They are more familiar with the management practices of local investors.
	Procurement	Generally follow the standard practices applied in Hong Kong. Follow proper procedures according to the contracts. More advantageous in handling procurement of imported equipment.	More flexible procurement practices and more aggressive in technical requirements, price and payment methods. For procurement of imported equipment, they need to rely on Mainland suppliers, thus become more passive.
	Sub-contractors	In the past, most sub-contractors are companies in Hong Kong, but now intend to look for quality sub-contractors in the Mainland to save cost.	Mainland contractors gradually turn to using sub-contractors instead of subsidiaries. Their cooperation is more flexible but the quality of work varies greatly.
	Main contractor	During the implementation period, contractors from Hong Kong have to keep good relations with the main contractor in China. In general, proper arrangement of coordination fee and deduction of project sum for the main contractor is important.	Main contractors in the Mainland usually have their own E&M installation companies, so they are more advantageous in the competition.
	Production of implementation drawings	Contractors from Hong Kong are used to develop the tender drawings into implementation drawings before submitting to design institute for approval.	For Mainland contractors, the implementation drawings are developed by design institute, thus they are more passive in this regard and are used to follow implementation drawings.

	Production of E&M drawings	Contractors from Hong Kong are used to and have experience in drafting E&M drawings, thus they are more competitive than their counterparts in China in this area.	Due to the lack of experience and practices, Mainland contractors are still in the learning stage.
	Design modification	Contractors from Hong Kong are used to develop or modify the relevant system design to fit with the change of on-site environment or requirements. This can avoid delay of works.	Mainland contractors are used to follow drawings developed or modified by the design companies concerned. Their adaptability has yet to be improved.
Inspection	System commissioning	More serious and systematic in carrying out commissioning. They can meet the standard in commissioning method, forms, reports and design requirements. The staff members are well-trained, thus overseas investors are confident with the ability of Hong Kong contractors in system commissioning.	They begin to adapt to the practices of Hong Kong contractors only in recent years. Their staff training is not as complete as that of Hong Kong contractors, but the difference is quickly closing up.
	Maintenance and DLP	Contractors from Hong Kong are familiar with their responsibilities in the Defect Liability Period. They will send professional staff to regularly inspect and maintain the system according to the contract.	Mainland contractors are more passive in following the relevant terms of the contracts. But many sizeable national enterprises begin to set up their own maintenance department and train up the staff concerned.
	Inspection	Though the contractors from Hong Kong have maintained good relations with the government departments concerned to facilitate smoother inspection process, but they still need to catch up on the inspection criteria.	Mainland contractors are more familiar with the inspection criteria of the government departments concerned and have better networking within the government, thus they are more privileged in this regard.