SHANGHAI MUNICIPAL ELECTRIC POWER ORIENTATION VISIT

JUNE 2-11, 2002

SPONSORED BY:
U.S. TRADE AND DEVELOPMENT AGENCY

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The U.S. Trade and Development Agency

The U.S. Trade and Development Agency (TDA) promotes American private sector participation in developing and middle-income countries, with special emphasis on economic sectors that represent significant U.S. export potential. Through the funding of feasibility studies, orientation visits, specialized training grants, business workshops, and various forms of technical assistance, we help U.S. businesses compete for infrastructure projects in emerging markets. We assist in building mutually beneficial partnerships between American companies and overseas project sponsors, which result in increased U.S. exports and jobs, and the completion of high quality, successful projects in host countries.

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Preliminary Itinerary

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<u>Day 1 – Sunday, June 2nd</u>

Daytime	Arrive in San Francisco, California
Evening	Crown Plaza Union Square, San Francisco – Introduction and review of OV activities – Subjects to be covered include tour administrative matters, general orientation to U.S. culture, power sector specific issues and the OV tour agenda.

<u>Day 2 – Monday, June 3rd</u>

8:45 am	Leave for PG&E
9.30 am – 12:00 pm	Visit to PG&E's Distribution System, Head Office. Review of the system operation and system reliability needs due to geographical constraints of San Francisco. Subjects to be addressed would include but are not limited to: Distribution SCADA, Distribution Operations Management, Distribution Outage Management and Restoration, Demand-Side Management, Substation Control and Protection, Effects of Capacitor Placement Variations, Switched Bank Capacitors, Voltage Control Considerations, Load Profile and Composition Modeling Using Programmable Logic Controller (PLC), and the Circuit Breaker Control Ladder-logic Software, etc.
11:30 am – 1:00 pm	Lunch Break
1:30 pm – 3:00 pm	Visit to Pacific Energy Center Guided tour of the Pacific Energy Center
7:00 pm	Dinner for the Delegates to be hosted by Vendors (To be confirmed)

<u>Day 3 – Tuesday, June 4th</u>

8:30 am	Leave for Palo Alto Welcome and Opening remarks by EPRI
9:30 am – 12:00 pm	EPRI – Palo Alto Welcome and Opening remarks and EPRI's collaboration in China in the power sector control equipment and technologies Presentation of EPRI activities in Power Quality Control EPRI activities in Grid Operations and Planning
12:00 pm – 2:00 pm	Lunch to Be hosted by EPRI
2:30 pm – 5:00 pm	Visit to Utilities Consultant International, Inc Presentation by UCI for their overseas services including activities in China, Philippines, Malaysia and Singapore, etc. in the areas of Power Quality Control.
7:00 pm	Dinner to be hosted by UCI

<u>Day 4 – Wednesday, June 5th</u>

8:00 am	Leave for Sacramento
9:30 am – 12:00 pm	Visit to SMUD's Distribution Control Center. The SMEPB team will be able to observe the Man-Machine Interface for: • Displaying both static and real-time information on CRT displays; • Entering data into the EMS database; • Handling of dispatcher control requests, etc.
12:00 pm – 1:00 pm	Travel to Folsom – Lunch on the run
1:00 pm – 4:00 pm	Visit to California ISO (Independent System Operator) center. California ISO is charged with managing the flow of electricity along the long-distance, high-voltage power lines that make up the bulk of California's transmission system. The mission of the California ISO is to safeguard the reliable delivery of electricity, facilitate markets and ensure equal access to a 12,500 circuit mile "electron highway".
7:00 pm	Dinner to be hosted by either SMUD or CA-ISO (To be confirmed)
Night	Radisson Hotel, Sacramento

Day 5 – Thursday, June 6th

Morning	Travel
Night	Radisson Hotel Woburn, Boston

Day 6 – Friday, June 7th

8:30 am	Leave for Boston Edison
9:30 am – 12:30 pm	Visit to Distribution Control Center – Boston Edison Meet with the Boston Edison Company for visit to their Distribution Control Center and if possible, visit Substations to observe automatic switching functions.
12:30 pm – 2:00 pm	Lunch
2:30 pm – 5:30 pm	Visit to Beacon Power Manufacturing facility for Power Quality improvement equipment. Introduction to Beacon Power Flywheel Storage Technology Power Quality Issues and Applications for Shanghai Electric Equipment Demonstrations
7:00 pm	Dinner to be hosted by Beacon Power
Night	Boston, Massachusetts (Hotel to be confirmed)

Day 7 – Saturday, June 8th

Day	Travel to Philadelphia, Pennsylvania
Night	Crown Plaza Philadelphia Center, Philadelphia, PA

Day 8 – Sunday, June 9th

All-Day	Rest/Free time for sightseeing

Day 9 – Monday, June 10th

8:30 am	Leave for PJM Interconnection Center
10:00 am – 12:30 pm	Visit to PJM Interconnection Center. PJM Interconnection LLC operates the largest wholesale electric market in the world. PJM's foremost responsibility is the safe and reliable operation of the electric transmission system to assure the reliable supply of electric energy from generation sources to wholesale customers.
12:30 pm – 2:00 pm	Lunch
2:30 pm – 5:00 pm	Vendor Presentations
7:00 pm	Dinner to be hosted by Equipment Vendors

Day 10 – Tuesday, June 11th

Daytime	Depart Philadelphia for Los Angeles – End of official visit
June 11th through 13th	No TDA Planned activity
June 14th	Delegates Depart for Shanghai

U.S. Trade and Development Agency

The U.S. Trade and Development Agency's (TDA) mission is to promote American private sector participation in developing and middle-income countries by helping U.S. companies pursue overseas business opportunities. Through the funding of feasibility studies, orientation visits, training grants, conferences, and various forms of technical assistance, TDA enables American businesses to become involved in the planning stages of infrastructure and industrial projects in middle income and developing countries. Through these programs, TDA provides American firms with market entry, exposure, and information, thus helping them establish a position in markets that are otherwise difficult to penetrate. TDA aims to assist U.S. Companies in creating jobs here at home while simultaneously promoting economic growth in developing and middle income countries. TDA works closely with government officials and industry leaders in the host countries to ensure that TDA funded projects are of a high development priority for the countries where the projects are located.

Since the U.S. Trade and Development Agency's inception in 1981, TDA has been associated with approximately $16.8 billion in exports – or nearly $40 in exports for every dollar invested in TDA activities. In Fiscal Year 2000, TDA obligated $51.7 million for U.S firms in more than 63 strategically targeted developing and middle-income countries in the following regions: Africa/Middle East; Asia/Pacific; Central and Eastern Europe; Latin America and the Caribbean; and the New Independent States (NIS). TDA is primarily involved in the following sectors: agriculture; energy; environment; health care; information technology manufacturing; mining and minerals development; telecommunications; transportation; and water resources.

TDA's success is often achieved through the cooperation and assistance of colleagues throughout the U.S. Government. TDA works closely with the Department of State, the Department of Commerce's U.S. Foreign Commercial Service, the Agency for International Development, the Department of Transportation's Federal Aviation Administration and Federal Railroad Administration, the Department of Energy and, most recently, the Federal Emergency Management Agency. TDA also works closely with the U.S. Export-Import Bank, and the Overseas Private Investment Corporation.

TDA funds project planning activities that directly influence the procurement decisions related to major industrial or infrastructure projects in developing and middle-income countries - projects that typically represent millions of dollars in U.S. export potential. From radar for airports in Asia to process controls for refineries in Latin America, hundreds of goods and services are required to implement a project. TDA works to ensure that the services and products provided by U.S. firms receive "equal access."

For more information, visit TDA's website at www.tda.gov.

Brief Resumes for Delegation from China

Official Delegation of:
SHANGHAI MUNICIPAL ELECTRIC COMPANY

Name	Affiliation	Title
Mr. Zhou Xinfu	Shanghai Municipal Electric Company	Vice Chief Engineer
Mr. Teng Letian	Shanghai Municipal Electric Company Production and Technology Department	Deputy Manager
Ms. Wang Xiaojin	Shanghai Municipal Electric Company Financial and Assets Management Department	Deputy Manger
Mr. Jiang Fengqing	Shanghai Municipal Electric Company Planning and Development Department	Section Chief
Mr. Qian Weiming	Shanghai Municipal Electric Company Human Resources Department	Director
Mr. Jiang Ren	Shanghai Municipal Electric Company Foreign Affairs Office	Interpreter
Mr. Shen Zhaoxin	Shanghai EHV Transmission and Transmission Company	Manager
Mr. Yu Yin	SEPC Design Institute	Deputy General Manager
Mr. Zhang Wei	Shanghai Urban Power Supply Company	Vice Chief Economist
Ms. Jiang Haiying	Ministry of Foreign Trade and Economic Cooperation American Division	Deputy Director
Mr. Scott Yao	Commercial Service U.S. Consulate General Shanghai	Senior Commercial Specialist

Mr. Zhou Xinfu
Vice Chief Engineer
Shanghai Municipal Electric Power Company

Work Experience:
1984-1999: Manager, Shanghai Transmission and Transformation Engineering Company
- 500kV Nanqiao AC/DC Substation Project
- 500kV Yang Gao Substation Project
- 500kV Si Jing Substation Project
- 500kV YangHang Substation Project
- 35-220kV Transmission Lines Construction

2000-2001: General Manager, Shanghai Eastern Power Supply Company

2002-Present: Vice Chief Engineer, Shanghai Municipal Electric Power Company
Taking charge of Shanghai power grids construction and management.

Mr. Teng Letian
Deputy Manager
Shanghai Municipal Electric Power Company
Production and Technology Department

Work Experience:

- Lead the preparation of the department of Dispatch Center of Shanghai Southern Power Supply Company (SSPSC)
- Lead the build up the Dispatch Automation System covering 5 districts and 1 region in SSPSC;
- Lead the build up the Transmission Automation System of SSPSC; drafted the AM/FM/GIS system scheme of SSPSC
- Developed the ‘Ninth Five-Year Technology Plan’ of SSPSC, ‘Two Network Renovation Plan’ and related technical principle.

Ms. Wang Xiaojin
Deputy Manager
Shanghai Municipal Electric Power Company
Financial and Asset Management Department

Work Experience:
Ms. Wang is the deputy manager of the Financial and Assets Management Department of SMEPC. She is in charge of the capital management including annual budget, capital operation, and capital safety management. She also is the leader of the Real Asset and Under-Construction Project group.

Mr. Jiang Fengqing
Section Chief
Shanghai Municipal Electric Power Company
Planning and Development Department

Work Experience:

- During his tenure at the Dispatch Center of Shanghai Urban Power Supply Company, Mr. Jiang took charge of the operation management and safety of the 220kV, 110kv and 35kV power grids. He has been the leader for tens of 220kV substations project and handled several troubleshooting projects. He is also in charge of the R&D work of SCADA and PAS.
- He is in charge of the Load Estimate of Electricity Market and Power Grid Planning, analyzing the power demand for power grid investment. He is also in charge of the 220kV and 500kV power grid planning work.

Mr. Qian Weiming
Director
Shanghai Municipal Electric Power Company
Human Resource Department

Work Experience:

1981 to Present: Human Resource Management on Labor Organization, Labor Performance, Statistics and Analysis, Information Management.

1984: Member of the working group on Labor Quota of Shanghai Urban Power Supply Company;

1996: Member of the development group on ‘ Personnel Information Management System’ of SMEPC

1998: Member of the working group on ‘Labour Quota Standard of Power Supply Enterprise’ of State Power;

2002: Member of the Investigation Group of ERP human resource module

Mr. Jiang Ren
Interpreter
Shanghai Municipal Electric Power Company
Foreign Affairs Office

1984: Graduated from Shanghai Electric Power Institute

1984– 1994: I&C Engineer, Boiler Operator of Shanghai Zaibei Power Plant

1994: Interpreter, Project Officer of the Foreign Affairs Office of Shanghai Municipal Electric Power Company

Mr. Shen Zhaoxin
Manager
Shanghai Extra-High Voltage Transmission and Transformation Company

Working Experience:
1983-1988: Leader of Line and Uninterrupted Work group of Shanghai Urban Power Supply Company (SUPSC).
1986-1989: Vice director of Lines Section of Shanghai Urban Power Supply Company
1989-1992: Assistant to Chief Engineer of Shanghai Urban Power Supply Company.
1992-1994: Vice Director of Transformation Section of Shanghai Urban Power Supply Company.
1994: Director of Product and Technology Section
1994-1997: Deputy Manager of SUPSC
1997-2000: Deputy General Manager of Shanghai Southern Power Supply Company.
2000-Present: General Manager of Shanghai Extra High Voltage Transmission and Transformation Company

Working Achievement:
- 220kV 2244 Line Project;
- 220kV 2206/2215 Line Steel Pillar Base Boosting Project
- 220kV 2218 Line Lightning System
- 550kV Line, Huang Du Substation Project
- P13 Monitoring System of 550kV Nan Qiao Substation Project
- 220kV Tangzheng Substation Renovation Project
- 220kV Pudong Substation, Main Transformer Core Changing work;
- 35kV Busbar Troubleshooting
- APEC power supply work

Mr. Sheng Zhaoxin worked as the Leaders of several sections and companies during his working time and published several essays in different technology literature. He is also the excellent manager of several sub-companies of SMEPC.

Mr. Yu Yin
Deputy General Manager
Shanghai Electric Power Design Institute

Work Experience:
Participant in the design of the following projects:

- Shanghai Electric Power Dispatch Center Building, primary design
- Wu Jin Power Plant Oil Silo and Oil Loading Station
- Training Center of Electric Power Bureau of Eastern China
- Training Center of Shanghai Municipal Electric Power Company
- 110kV Substation of Shanghai No.1 Metro, Shanghai Stadium Station
- 110kV Substations of Shanghai No.2 Metro, Center Park Station & Jin An Temple Station
- Shengneng Xinghuo Thermal Power Station
- 550kV Si Jing Substation
- 220kV Underground Substation of People’s Square, 2nd Phase.
- Wu Jiang Fenhu Diesel Power Station
- 220kV Substations of Ruijin, Huashan, Dongchang, Zangjiang, Airport, Xuhang
- Baoxing, Hongqiao 110kV Substations of Shanghai Overhead railway Mingzhu Line

Mr. Zhang Wei
Vice Chief Economist
Shanghai Urban Power Supply Company

1981: Graduated from Shanghai Electric Power Institute

1981– 1991: Engineer and Section Chief of Shanghai Hunan Power Supply Branch

1991– 1999: Vice director of Shanghai Hunan Power Supply Branch

1999: Vice Chief Economist and director of planning Dept. of Shanghai Urban Power Supply Company

Ms. Jiang Haiying
Deputy Director
State Economic and Trade Ministry
America Division

Jiang Haiying has been with the Department of American and Oceanian Affairs at the Ministry of Foreign Trade and Economic Cooperation (MOFTEC) since 1989. She currently holds the position of Deputy Director at the U.S. Affairs Office. Her responsibilities include the handling and day-to-day management of government affairs related to the development of bilateral economic and trade relations between China and the U.S.

Ms. Jiang has been dedicated to the promotion of Sino-US bilateral trade and economic cooperation over the past decade. She successfully organized a number of seminars sponsored by the two governments on Standards, Intellectual Property Protection and WTO-related training programs. She participated in the Market Access negotiations and textile consultations. She was frequently a member of high-ranking Chinese Government Trade Missions visiting the United States for the purchasing of US airplanes, automobiles, fertilizers and other staple commodities. She was also directly involved in the organizing of major trade events between the two countries. In the mid-90's, Ms. Jiang was Office Manager of a NZ-based trading company under MOFTEC, where she obtained substantial commercial experience from her 3-year term of appointment.

Ms. Jiang is enthusiastic in promoting business cooperation between SMEs of the two countries. She was awarded honorary citizenship of Alaska for her devotion and distinguished contribution to the business development in that region. With her coordination, many trade and investment disputes were successfully settled.

Ms. Jiang holds a Bachelors Degree in Economics from Shanghai Institute of Foreign Trade. She is fluent in Mandarin Chinese and English.

Mr. Yao Dekang (Scott)
Senior Commercial Specialist
Commercial Service
U.S. Consulate General Shanghai

Mr. Scott Yao is a Senior Commercial Specialist with the U.S. Commercial Service, U.S. Consulate General Shanghai. His portfolio covers architectural, construction and engineering services, building materials, power generation, machinery, and the steel industry. In addition, he is also the office coordinator for WTO related activities and information.

Although Scott Yao has been with the FCS Shanghai for only one year, he has experienced the entire spectrum of Commercial Service activities and events. He has worked a Presidential visit last October for the APEC meetings, organized trade missions for 50+ companies, organized second-tier outreach WTO programs, as well as handled ordinary FCS programs such as Gold Keys, IPS and authored IMIs. He also has experience working with and promoting the U.S. Trade and Development Agency (TDA). As a result of efforts, he will be traveling with a group of 10 Chinese power bureau officials to the U.S. on a TDA orientation visit grant in June 2002.

Prior to joining FCS Shanghai, as a former sales manager for Reynolds Metals Shanghai Co., Ltd. an American company in the private sector in Shanghai, he has a unique perspective on what it takes for American businesses to succeed in China’s marketplace.

A graduate of the China Europe International Business School, Mr. Yao holds a MBA degree.

China Power Sector Overview [1]

Since 1994, China's electric power industry has seen a considerable transformation. An Electric Power Law was put in force April 1996. This was a major event in China's electric power history. The new law promotes the development of the electric power industry, protects the legal rights of investors, managers and consumers, and regulates generation, distribution and consumption.

Before, electricity supply was managed by electric power bureaus of the provinces and cities by administrative agents. Now utilities have been changed into companies outside of the administration. It is expected that the municipal electric power companies will be divided into electric power generating and electric power supply companies. A policy of competition between the different generators will be implemented in the next years.

China's electric power industry continuously maintains a high growth rate. By the end of 2000, the total installed power was 315 GW, that means an increase of 16.5 GW or 5.5% compared to 1999. Hydropower amounted to 77 GW, accounting for 15 %; thermal power amounted to 235 GW, accounting for 83% and nuclear power amounted to 2GW, accounting for 1% of installed capacity. Electricity generation reached 1400 TWh, 13.5% more than in the previous year. In 1999, the construction investment of the electric power industry reached 14 billion US dollars, of which 49.3% were dedicated to thermal power, 12.5% to hydropower 6.4% to nuclear 26.1%, to transmission lines and transformers and 5.7% to other investments.

By the end of 2010, it is expected that the total installed capacity will reach 500 GW. Annual generation of electricity will exceed 2040 TWh.

Electricity Demand and Supply [1]

In 2000, the total installed capacity of electric equipment for final use was over 2 times larger than the total generating capacity. The national electricity consumption was 1400 TWh of which, 166TWh was consumed by households, accounting for 12 %, increased by 13 % compared to the previous year; 1078 TWh was consumed by industry, accounting for 77 %, increased by 22 %; 68 TWh was consumed by agriculture, accounting for 5 %, increased by 30 %; 87TWh was consumed by service industry, accounting for 6 %, decreased by 33 %.

In 2000, the main features of electric demand and supply were as follows:

- Power demand growth rates unbalanced in different regions, this led to great differences in power generation growth in different networks.
- Load factor being decreased for some networks.

[1] Zhou Jia Ping , Director of General Engineer Office Chongging Energy Conservation Technical Service Center, " The Current Situation of China's Electric Power Industry," November 2001

- Electricity quality being improved.
- Investment for upgrading rural networks increasing by a large margin and the same electric price policy of rural areas and cities being implemented.
- Conflicts between power supply and demands being serious at peak period.
- Electricity consumption per capita still being low. In 2000, the national installed capacity per person was only 0.24kW, increasing by 0.003 kW over the previous year, consumption per capita was 1069 kWh, 90 kWh more than 1999.

Development Direction of China's Electric Power Industry

1. China has prioritized the development of hydropower, especially in the southwest of China. Since the 1990's, newly added hydropower installed capacity has grown greatly. At present, there are many large sized hydropower stations under construction. At the end of 1999, 36GW of hydropower were under construction, of which the Three Gorges was 18GW. Other large sized hydropower projects amounted to 8 GW; medium and small hydropower projects amounted to 10 GW.
2. Thermal power plants will account for three-fourth of the newly added capacity in the future. Coal will still be the major fuel source for these plants. A certain amount of imported fuel oil and liquefied natural gas will fuel thermal power stations in the coastal areas with booming economic development.

   Future development goals are to construct a number of large thermal power plants near the coal mine areas.

   A number of large thermal power plants will also be constructed in the concentrated area along the coast, near the sea and/or at railway junctions. The low and medium pressure thermal power units as well as the units beyond their normal service life will be rehabilitated or substituted with large units, in order to reduce fuel consumption and to improve the environment. Research, development and demonstration of clean coal technology shall be carried out, including integrated gasification combined cycle generation, fluidized bed combustion, low NOx combustors and flue gas treatment techniques.

   Co-generation will be encouraged at places where concentrated thermal loads are located. A small number of gas turbines and gas-steam combined cycle units will be installed in the coastal areas.
3. China possesses nuclear fuel resources and nuclear technical forces. In east China, south China and the coastal area of northeast China, where serious energy shortages occur, nuclear power is considered an appropriate solution to improve the local energy supply.

There are two nuclear power stations (2.1GW) in operation and 4 nuclear power stations (6.6 GW) under construction.

Rural Electrification

The Chinese government has prioritized rural electrification. At the beginning of 1990s, the government proclaimed the principle of "the power industry should serve for agriculture, the farm and for rural economy". By the end of 1994, the former Ministry of Electric Power Industry (MOEP) made arrangements, in order to improve the reliability of peasants' domestic power supply.

By the end of 1996, the percentage of households with access of electricity amounted to 94.7%; in 11 counties, 72 million residents throughout the country remain with no electricity.
In June 1998, the Chinese government authorized the construction and upgrading of rural networks for 2,400 counties, with a total investment of 23 billion US dollars. It is expected that the project will be completed at the end of 2001. After the project is finished, 11 counties originally with no electricity will have access to electricity, and the percentage of households with access to electricity will amount to 98%.

For households with no electricity in remote regions, the government encourages farmers to exploit and use new and renewable energy technologies, such as micro hydropower, solar energy, wind energy, geothermal energy and biomass energy, giving subsidies and loans on favorable terms for the households in remote regions.

At present, there are 14 electric networks in China with the capacity over 1 GW. The largest is the East China power system, with a system capacity of 31.67 GW; the Central China, North China and Northeast China electric networks each exceed 25 GW, all have capacities of 27.60 GW, 27.15 GW, 26.53 GW respectively; the Guangdong, Shangdong, Northwest and Sichuan electric networks each exceed 10 GW, and reach 19.0 GW, 11.25 GW, 11.48 GW and 10.9 GW of capacity respectively.

The total installed capacity of the 14 above mentioned power systems is 184.12 GW, and their annual generation is 890.2 TWh, accounted 92% and 95% of the national total respectively. China's networks are not currently connected completely with each other. The State Electric Power Company has a plan to connect the networks in 2001; it will invest 72.5 billion US dollars during 2000-2005, of which 43.5 billion US dollars is networks construction and upgrading. At the end of 2005, China's networks will be integrated except for the Tibet, Hainan and Xinjiang networks.

Shanghai Municipal Electric Power Company

The Shanghai Municipal Electric Power Company (SMEPC) provides electric power to the entire city of Shanghai. In order to keep pace with Shanghai's rapid development and to support the rising standard of living, SMEPC has become the most progressive utility in China. SMEPC hopes to build its power network into a first-class urbanized power grid built to international standards. It will do this by upgrading electric supply grid reliability and voltage quality.

According to the U.S. Department of Commerce Commercial Service, SMEPC's upgrading project offers significant opportunities for U.S. suppliers in areas related to management systems (EMS) and automatic generation (AGC) and power application software (PAS). Opportunities also exist for U.S. suppliers of distribution management systems (DMS).

In 2000, SMEPC had 10 power plants possessing 9,160.2 MW of generation capacity and 479 35-500 KV substations possessing 40,174.3 MVA of transformer capacity. Annual power generation and power sales are 55,775 billion KWH and 39.569 billion KWH respectively.

Due to the construction of power plants over the past 10 years, Shanghai's balance of supply and demand changed from a power shortage to basic equilibrium, with only a small gap during peak load periods. By the year 2000, supply reliability had reached 99.91% , with a rate of qualified voltage of 99.06%. SMEPC hopes to increase the supply reliability to 99.99% by upgrading its grid.

SMEPC plans to invest US$240 to 300 million over the next five years to improve distribution, transmission and energy sales. Sixty to seventy percent of the budget will be used for the procurement of equipment, with the remainder for construction. Less than one percent will be used for training. Internal funds and bank loans will be used to finance these projects. SMEPC describes its financial condition as healthy and it reports that it easily qualifies for bank loans.

SMEPC received a US$100 million loan from the World Bank last year. Of this amount, US$20 million was used for upgrades.

For more information, please contact:
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United States Power Sector Overview

2000 In Review

Capacity

Installed generating capacity of the total electric utility industry totaled 636,200 megawatts as of December 31,2000. This was a decrease of 6.2% from 1999 capacity. This decline in capacity was due in large part to the sale of almost 48,000 megawatts of electric utility plant capacity to non-utility producers. The investor-owned electric utility industry generating capacity declined 8.2%, which was also largely attributed to the sell-off of capacity to non-utility producers. The Middle Atlantic and New England regions showed the largest declines in investor-owned electric utility capacity at 46.8% and 14.8%, respectively.

Generation

Total electric utility industry generation was 3,009,750 GWh in 2000, decreasing 5.2% from the previous year. The investor-owned utility industry generation portion decreased 2.2%, falling to 2,246,266 GWh.

Total electric utility industry generation from coal decreased 4.3% in 2000, while electricity generated from fuel oil declined by 16.5%. Electric power generated from hydro sources declined 15.8%. Nuclear power generation decreased 2.7% over 1999 generation.

The share of total electricity generated from coal increased slightly, from 55.7% in 1999 to 56.2% in 2000. The share of electricity generated from gas also increased slightly. Nuclear fuel increased to a 23.4% share, as compared to a 22.8% share in 1999.

Customers and Revenues

Total sales to ultimate customers for the total electric utility industry were 3,398,118 GWh in 2000. This was an increase of 5.0% over 1999. Sales by the investor owned segment rose by 5.2%, to 2,521,317 GWh.

The average number of ultimate customers for the total utility industry increased by 2.3% over 1999, totaling 128,116,989 for 2000. The investor-owned segment also increased by 2.3%, to 94,559,505.

Total industry revenues from sales to ultimate customers for 2000 increased by 5.1% to $226.5 dollars. The investor-owned segment showed an increase of 5.1%, to $172.0 billion.

The average revenue per kWh sold to total ultimate customers in 2000 was 6.66 cents for the total industry, and 6.82 cents for the investor-owned electric utilities.

Financial

Total assets of the investor-owned electric utilities rose from $713.9 billion in 1999 to $859.7 billion in 2000, an increase of 20.4%. Investor-owned electric utility operating revenues rose by 39%, to $440.8 billion in 2000. Total investor-owned electric utility operating expenses increased by 45.1%, to $406.9 billion.

The 2000 consumer price index for electricity was 128.5. The producer price index for electric power was 130.7.

2000 At-A-Glance

Total United States- 2000	Total Electric Utility Industry	Investor-Owned Electric Utilities
Installed Generating Capacity	636,200 MW	443,942 MW
Generation	3,009,750 GWh	2,246,266 GWh
Energy Sales to Ultimate Customers	3,398,118 GWh	2,521,317 GWh
Ultimate Customers	128,116,989	94,559,505
Revenue from Sales to Ultimate Customers	$226,482,452,000	$171,974,028,000
Average Revenue per kWh Sold	6.66 Cents	6.82 Cents
Average Annual kWh Use per Customer	26,524 kWh	26,664 kWh
Average Annual Revenue per Customer	$1,767.78	$1,818.69

KWh: Kilowatthour
MW: Megawatt = One thousand Kilowatt
GWh: Gigawatthour = One million Kilowatthour

Other Information About US Electric Industry (1999)

17 : Non-Operating Holding Companies
19 : Wholesale Generating Companies
13 : Service Companies
10 : Divisions
200 : Investor-Owned Companies
1,821: Municipal Systems
927 : Rural Electric Cooperatives
76 : Public Power Districts
9 : Irrigation Districts
37 : U.S. Government Owned Systems
70 : State Owned Systems
5 : County System
7 : Mutual System
3 : Transmission Networks

Transmission and Distribution System

United States Transmission and Distribution (T&D) systems, operational control, and network dispatching operations activities focus mainly around the tracking and management of the current conditions of the feeder network and related service problems in the associated regions. In general, in all utilities, the Dispatcher's actions and decisions center around several primary manual and automated tools such as:

- **Supervisory Control and Data Acquisition (SCADA) System**: This system provides all monitoring of substation equipment and control of distribution feeder breakers and automated field switches. It is usually based on CYBER Mainframe technology with PC based Man-Machine-Interface (MMI) capabilities supporting the dispatcher.

- **Trouble Board**: The trouble board represents a high level schematic overview of the circuit routes, devices and current conditions of the feeder network within the geographic region of the particular dispatch center. The board is manually updated to reflect the current conditions of switching devices, location of priority customer trouble calls and planned construction. It is the only accurate reflection of the actual conditions of the feeder network at any given time.

- **Dispatch Center Files**: The dispatch center files are paper information sources that include Feeder and Primary Facilities Maps. Substation Books containing substation operating diagrams, Switch Books containing switch numbers and corresponding location addresses, Underground Residential Distribution (URD) Loop Books which are manually updated to reflect current switching conditions of fused underground primary circuits, and Vault Diagrams.

- **Trouble Call Management System (TCMS)**: This system provides analysis and grouping of customer trouble calls into 'trouble tickets' which are assigned to the appropriate Dispatch Center, dispatcher and troubleman. The system is usually run on an IBM mainframe supported by the Distribution Database System (DDBS) which contains all distribution feeder facilities and their nominal connectivity with corresponding x, y coordinates within a state-wide grid coordinate system. All trouble analysis is preformed under the nominal feeder conditions.

In recent years, additional T&D system management told/activities that contribute to improved reliability of T&D systems include:

1. Computer System
2. SCADA-EMS-DMS Integration
3. AM-DMS Integration

1. Computer Systems

Hardware Overview

The hardware subsystems are arranged by the function performed. Each subsystem has some level of computational power. Major subsystems include:

- Main Computers – Usually dual cyber 180/830
- Data Acquisition – Remote terminal units (RTU), Local Data I/O, and Data Communication Units (DCU)
- Man-Machine – Dispatcher consoles, remote consoles, dial access remote CRT, loggers, programmer terminals and Man-Made Control Units (MCU)
- Process Input/Output – Local I/O unit and digital displays
- Communications – Computer data links and Communication Network Units (CNU)

Software Overview

EMS is designed with various software levels. One grouping of software is designed to support the power system application programs. The other grouping of the software is designed to interface with the system hardware and is not oriented to any specific application.

a) Data Acquisition
The Data Acquisition Subsystem periodically collects, monitors, and processes information from local processors and RTU's located throughout the power system. This information is stored in the EMS database for display to the dispatchers and for use by application software. Data

Acquisition is composed of a number of sub-functions including:

- Time Control, which initiates and sequences periodic and demand functions and tasks.
- Data Collection, which controls scanning and collects the data from local processors and RTU's.
- Scan Equipment control, which provides for both automatic and manual reconfiguration of the communication interface with RTU's.
- Data Processing and Monitoring, which converts new analog data to engineering units and checks it for reasonability; also, processes digital data and monitors it for a change of state.
- Limit Monitor, which checks analog values against high and low operating limits and notifies when a limit is exceeded.
- Limit Entry, which allows the dispatcher to change the operating limits.
- Data Dissemination, which stores analog and digital data into the database and notifies when digital data changes state.
- Special Calculations, which periodically calculates additional analog and digital values from other analog and digital data.
- Accumulator data collection and Processing, which provides features necessary to freeze, collect and process pulse accumulator data from watt-hour metering.
- Sequence of Events (SOE) Data Collection, which provides the features to collect and process SOE data.
- Communication Performance Analysis, which monitors the availability and performance of communication links to remote equipment.

The RTU's and local I/O processor are periodically polled and data is collected at the following scan rates:

- Generation/Transmission status/alarm data: two seconds.
- Analog data from generators, tie lines and frequency sources: seconds.
- Other Generation/Transmission analog data: twelve seconds
- Distribution status/alarm data: twelve seconds.
- Distribution analog data: thirty-six seconds, and

- How pulse accumulators are frozen every thirty minutes on the hour and half-hour and these data are collected every thirty minutes following the freeze.

b) Man-Machine Interface
The dispatcher interfaces with the EMS software/hardware by means of CRT display consoles. Man-Machine Interface software provides for:

- Displaying both static and real-time information on CRT displays.
- Entering data into the EMS database.
- Handling of dispatcher control requests.
- Sending displays to other CRT display consoles.
- Hardcopy printouts of CRT displays.
- Interfacing to the On-Line Display Generator, which creates and modifies CRT displays.
- Manually inhibiting or overriding conditions and providing data/requests to application programs for processing and control.

2. SCADA-EMS-DMS Integration

The Following characteristics will be highlighted during the site visits:

- Integration of the various systems with tight coupling between the SCADA-EMS-DMS and the AM/FM systems. This coupling is the result of the need to transfer displays (maps and schematics) and related database from the AM/FM system to the DMS system.
- How the distribution system is handled based on maps and schemes displayed by the SCADA-EMS-DMS and how a single user interface for all operator interaction is used.
- How Work Orders are coordinated by the operators based on on-line information prepared by the AM/FM system.
- How periodic consistency updates of maps and schemas are coordinated between the two systems.
- How trouble call messages are received in the form of messages by the operator (preprocessed or directly received)
- How reliability related data is calculated and stored by the system.

3. AM/FM-DMS Integration

The following basic characteristics of the AM/FM-DMS are normally integrated:

- Various systems with more loose coupling between the SCADA-EMS-DMS and the AM/FM systems. This coupling is the result of the need to transfer limited a number of data (mostly real-time information) form the SCADA-EMS.
- The distribution system is handled based on maps and schemas displayed by the AM/FM-DMS system. Two user interfaces (probably with different mechanisms) are used for operator interactions.
- Access to the operator to other than DMS information.
- Coordination of Work Orders by the operators based on on-line information prepared on the AM/FM–DMS system.
- Receiving trouble call messages by the operator and processing them.

Directory of U.S. Transmission and Distribution Industry

Computer Software – Microcomputing

ASPEN
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Julie Black, Dir Sls.
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Cust. Service Center
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Computer Workstations

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Howard Industries
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Scotty Sumrall, VP Mktg.
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Computers – Data Collection

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Dan Block
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Maintenance Strategies, Inc.
PO Box 112
Crum Lynne, PA 19022
Jeff Evans, Bus. Mgr.
800-676-6565

Universal Power Products
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918-622-5548

Consoles – SCADA Control Centers

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Steve Thompson, Sales
403-291-1444

Consoles – T&D Control Centers

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Consultants – Distribution Automation

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ABB Power T&D Company, Inc.
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Computers – Micro

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14502 N. Dale Mabry, #227
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Computers – Purchasing Management System

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Edison, NJ 08837
Anne Staffin, Dir. Of Mktg.
732-738-6500

NUS Information Services, Inc.
2650 McCormick Dr., Ste 300
Clearwater, FL 33759-1049
John Kelly, Dir. Sls. & Mktg.
727-669-3008

Computing Services – Data Processing

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Computing Services Programming

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Consoles – Communication

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803-892-2181\

Consoles – Custom Design

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PO Box 14444
Lenexa, KS 66285
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33-1-4746-6789

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Remote Terminal Units

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Automation System Equipment

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Training – Telecommunications

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VAr Systems – Static

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3. California Independent System Operator (Dispatch Center)
   151 Blue Ravine Road
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OV Related Technical Articles

Article 1: EPRI identifies industry "Best Practices"

Online Exclusive, May 15, 2002

EPRI (Palo Alto, California, U.S.) recently completed the first comprehensive database of electricity distribution practices across the nation because of its Power Delivery Reliability Initiative Distribution Project. Utility companies developing strategies for improved system reliability in the most cost-effective manner will use the information.

"Distribution managers are faced with the difficult challenge of maintaining an aging infrastructure at a time when their companies are under pressure to lower costs," says Rich Lordan, director of EPRI's Power Delivery and Markets Department. "The Reliablity Initiative offers an efficient means to evaluate other practices, identify gaps in achieving their own business reliability goals, and adapt the most effective strategies for their particular business."

The EPRI Reliability Initiative was launched in early 2000 to identify root causes of power reliability problems, share this information among utilities, and develop new methods for improving performance of the electric distribution system. The initiative created separate projects for transmission and distribution through the funding by its more than 40 utility members and in coordination with the North American Electric Reliability Council (NERC).

Phase One of the Distribution Project provided detailed audits and in-depth reviews of five unique distribution systems. This effort generated a report that outlined outage causes and made recommendations for design modifications and changes in operational and maintenance practices. These results were the foundation for the Distribution Program Knowledge Base, which assists utilities in performing self-assessments of key distribution system functions. Using the web-based Distribution Reliability Self Assessment Template (DRSAT), participants are able to review industry practices and assess their own practices in key areas such as asset management, planning, maintenance, operations and engineering.

In Phase Two, EPRI and EXL Consulting (Pleasanton, California, U.S.) conducted in-depth interviews to confirm the key drivers that impact a company's goals for improving reliability. More than 100 utility managers were questioned about their company's practices in areas such as asset management, vegetation management and maintenance management.

"Phase Two provided a unique opportunity for the participants to explore the key drivers of reliability in more detail," said Matthew Olearczyk of EXL Consulting. "These companies are clearly committed to improving reliability and are ready to take the challenging steps necessary to influence those drivers to yield real results."

EPRI and EXL conducted thorough assessments of utility practices to identify the most effective activities and formulate new methods of improving performance. The objective was to provide an independent view of policies and practices as they affect reliability, cost and service quality. The Phase Two assessment reports identify areas for further improvement and make recommendations.

In a series of workshops, participants in the Reliability Initiative were provided opportunities to identify common objectives and share information on industry practices in developing more effective distribution programs for their own businesses.

"The extent to which utility managers have shared their ideas for the common good of providing affordable, reliable power to the nation has been most impressive," noted Robert Donohue, senior vice president for electric operations at Consolidated Edison Company of New York, and chairman of the Reliability Initiative.

EPRI's Distribution Program Knowledge Base now contains detailed descriptions of hundreds of distribution system practices. By using the database, distribution companies learn how other utilities solve reliability problems and can adapt the appropriate practices to improve their own system performance.

Annex 1

California ISO

Annex 2

EPRI PEAC Corporation

Annex 3

Electrical World T&D Article: "Transmission at a crossroads"