YANGTZE THREE GORGES DAM THE MODERN GREAT WALL OF CHINA

Professor Constantine Yapijakis
Albert Nerken School of Engineering
The Cooper Union
USA

The Chinese proudly call the construction of the Yangtze Three Gorges Project "An Epic Undertaking," designed to supply electrical power - nearly 10% of the total need when completed - for the development of China "today and tomorrow," as well as to control local flood conditions killing Chinese over the centuries, improve navigation and develop aquaculture. When the National People's Congress passed "The Resolution for the Construction of the Three Gorges Project" in April 1992, it was 75 years since Dr. Sun Yat-sen, the only President of the short-lived Chinese Republic, first proposed to launch the Three Gorges Project (TGP). In those decades, extensive scientific research and international co-operation by numerous scientists, scholars and engineering experts, contributed to the solution of the complex engineering and planning problems posed by the construction of the TGP, and sought to mitigate the resulting environmental and socio-economic impacts.

From its source on the Tibetan Plateau to its estuary in the East China Sea near Shanghai, the Yangtze River - the third longest in the World - meanders over 6,300 km. Its annual runoff is nearly 1 trillion cubic meters, and its total drop is more than 5,800 m, with a hydroelectric power potential of up to 270 million kW. However, only less than 6% of this vast potential had been developed by 1993. From Fengjie to Yichang - a 200 km stretch - the Yangtze rushes through the majestic Qutang, Wuxia and Xiling gorges, otherwise known as the Three Gorges. The dam site is at Sandouping, Yichang, in the middle section of the Xiling gorge, about 38 km upstream of the existing, tiny in comparison, Gezhouba Dam. The selected dam site for the Three Gorges Project is at a rather wide valley, with sound and intact granite bedrock, an annual runoff of about 500 billion cubic meters and a vast drainage basin of more than one million square km.

The immensity of the construction site - two bridges, several highway tunnels, miles and miles of modern highway, and modern communities for the personnel - the engineering undertaking, and the management complexity of the TGP can not be adequately described, but they may be grasped, somewhat, by considering certain of the main statistics of the project.

The concrete gravity dam - the largest in the world when completed - will be 3,035 m long on the top, with the crest at an elevation of 185 m, and will allow for a pool with a total storage capacity of 39.3 billion cubic meters, of which over half is for flood control. The discharging capacity of the spillway in the mid-section of the dam is 110,000 cubic meters per second, and the two powerhouses - largest in the world - have 26 generators on both sides, with a total capacity of 18.2 million kW.

The major work quantities of the Three Gorges Project will include 100 million cubic meters excavation, 30 million cubic meters fill, 27 million cubic meters concrete, and 281,000 tons of metal and mechanical installations. The work proceeds relentlessly 24-hours a day, 7-days a week, utilising an army of workers and professionals, but also the most advanced technology and heavy construction machinery.

The TGP will be constructed in three phases, the first of which - closing the main river course - was completed in November 1997, and the final one is expected in about twelve years, if current construction rhythms are maintained and the finances are available. By the end of the construction, nearly 1,2 million people are expected to be resettled and about 30,000 ha. of farmland inundated. The estimated investment for the TGP is US$ 25 billion, of which US$ 7,5 billion is for resettlement and US$ 4,2 billion for the power transmission and transformer stations.

Obviously, a project of such magnitude has significant environmental and socio-economic impacts, and has created controversy both in China and abroad. The Environmental Impact Statement - 8 volumes - of the Yangtze TGP was prepared jointly by the EIS Department of the Chinese Academy of Sciences and the Research Institute for the Protection of Yangtze Water Resources, and describes the potential environmental impacts and the plans for mitigation of the adverse effects. But, foreign and domestic opponents of the dam challenge virtually every aspect of the government's plans, which aim to bring prosperity through maritime commerce and availability of electricity to China's interior.

Critics say that the region would be better served by a series of smaller dams located on Yangtze tributaries; that sedimentation - this is one of the most sediment-filled rivers in the world - will eventually make Chongqing's deep-draft harbour unusable and impede generation of electricity; that an annual flow of nearly one billion cubic meters of untreated sewage, together with toxic substances flushed from submerged factories, will poison aquatic species and turn the reservoir into an open sewer; that incalculable relics in unexplored archaeological sites - in what was the centre of much of China's history - will be forever lost; that real project costs could run as high as 4-5 times the government's estimate.

Many international lending institutions have refused to help finance the project, largely due to potential environmental problems as well as the dam's risky financial viability. Nevertheless, the Three Gorges dam will be completed, and it will contribute to the most populous nation's

entrance into the modern developed world. The various impacts will be determined, studied, suffered and debated later, much as it was done for the Aswan dam on the Nile. For now, economic development and modernisation is the top priority in China and the results of development in the last ten years have been astounding.

Professor **Constantine Yapijakis** teaches Environmental Engineer-ing and is Director of Environmental Research at the Cooper Union for the Advancement of Science and Art, in Manhattan, New York. He has over 20 years of international experience, both academic and industrial, in all aspects of environmental engineering. He has taught in several universities in the New York metropolitan area, and has been involved in all the major projects for New York City. These include drinking water treatment and regional resources, quality management, solid waste management, industrial waste pre-treatment, and toxic waste minimisation programs. In 1997, from early May to mid-June, he was invited to visit the Universities of Beijing, Xian and Heifei, and Tongchi University in Shanghai, where he gave seminars to top management from industries on pollution prevention, waste minimisation and the ISO 14000 certification. He was also invited to visit the gigantic construction site of the Three Gorges Dam on the Yangtze River - fenced and guarded by the Army - where he discussed the environmental and socio-economic impacts of this unprecedented water resources project.