

# One More Case in the Big Dam Debate

**W**hat is a big dam project? Borrowing from the definition of the International Commission on Large Dams (ICOLD), a leading professional association of dam engineers, a large dam is one exceeding 15 meters in height, having more than 1 million cubic meters of storage capacity or having more than 2,000 cubic meters per second spilling capacity. In the Freeman Lecture, one speaker, Robert Goodland, further refined this definition by designating big dams as those costing more than \$100 million and/or those associated with power stations generating 100 megawatts or more of electricity. The big dam controversy has led the International Rivers Network — a group of citizen organizations from 26 countries — to adopt the "The San Francisco Declaration" in June 1988 expressing their position on big dams and water resource management projects. The controversy led ICOLD to issue a "Position Paper on Dams and Environment" in November 1995, calling for the sustainable development of water resources and providing guidelines for doing so. It has led the World Bank — once a leading funding source for big dam projects worldwide — to revamp its lending policy for big dams and to refuse to fund the Three Gorges Project on the grounds that the project does not meet its environmental and human resettlement criteria. It has led Dan Beard, former head of the U.S. Bureau of Reclamation, the leading U.S. dam-building agency, to declare in a 1994 speech that as far as America was concerned, the days of big-dam building were well and truly over. As noted in Simon Winchester's 1996 book *The River at the Center of the World: A Journey up the Yangtze, and Back in Chinese Time*, Beard stated that:

"Large dams are tremendously expensive. They always cost more than you thought and tie up huge sums of capital for many years. . . There is no more visible symbol in the world of what we are trying to move away from than the Three Gorges dam."

Such is the general controversy to which we devote this issue. But in order to make the debate more tangible, we choose Winchester's very visible symbol to zero in on a specific big dam controversy — namely, the Three Gorges Dam Project. Not only is the Three Gorges Dam the largest dam project in the world but it contains, in microcosm, many of the dilemmas and conflicts inherent in the entire debate.

John R. Freeman was no stranger to the big dam debate. During his prolific career, he was appointed in 1902 as the Chief Engineer of the Charles River Dam Commission. In that capacity he prepared an exhaustive report on the project for the conversion of the tidal estuary of the Charles River into a fresh-water basin. Opponents to the Charles River Dam project included an attorney

who was later appointed a justice of the Supreme Court of Massachusetts, two former governors of Massachusetts and a powerful coalition of Boston commercial interests and Beacon Street property owners.

In another phase of his career, Freeman visited China and served as a consulting engineer to the Chinese Government from 1917 to 1920 working on the improvement of the Grand Canal and on measures to prevent catastrophic flooding on the Yellow and Hwai rivers. Likely, he would smile on this issue of *Civil Engineering Practice*, which not only addresses the big dam controversy today, but looks at the world's largest dam project at Three Gorges — a dam which promises flood control and hydroelectric power but which will also have huge, unavoidable and long-lasting social and environmental consequences. If Freeman were alive today, one would imagine that this is exactly the kind of debate he would relish!

## "The Big Dam Debate"

Why did the Freeman Committee choose the "The Big Dam Debate" as the topic for the 1996 Freeman Lecture and for this issue of *Civil Engineering Practice*? The controversy over the construction of big dams comes from many quarters, both within and outside the engineering community. Dam engineers are proud of their profession's track record of building over 36,000 large dams, accomplishing these projects in partnership with leading international financial institutions such as the World Bank. The World Bank has been the largest provider of funds for big dams, lending over \$50 billion to help finance the construction of more than 500 large dams in 92 countries. In the immediate future, the World Bank will fund several dozen additional big dam projects. Proponents of big dams say that the hydropower, irrigation, navigation, flow regulation and financial benefits outweigh the costs. Hydropower dams replace power stations that burn unrenewable fossil fuels, which contribute to the climatic greenhouse effect. In addition, they often can provide flood protection.

The following statement from ICOLD's 1995 report, "Position Paper on Dams and Environment," lists the various potential benefits of big dams but fails to mention that, in many cases, considerable hydroelectric potential must be sacrificed to obtain multi-purpose benefits:

"We need dams and the many benefits that their reservoirs offer all over the world, by storing water in times of surplus and dispersing it in times of scarcity. Dams prevent or mitigate devastating floods and catastrophic droughts. They adjust natural runoff with its seasonal variations and climatic irregularities to meet the pattern of demand for irrigated agriculture, power generation, domestic and industrial supply and navigation. They provide recreation, attract tourism, promote aquaculture and fisheries, and can enhance environmental conditions. Thus dams and reservoirs have become an integral part of our engineered infrastructure, of our man-made basis of survival. Still more dams will be needed in the future for the adequate management of the world's limited, unevenly distributed and, in many places, acutely scarce water resources."

Critics of big dam projects say that all too frequently their social and environmental impacts have been inadequately addressed and their actual long-term costs and benefits have been improperly calculated. Since 1948, more than 10 million people have been displaced on account of big dam construction. Big dams have increased the incidence of waterborne diseases, adversely impacted downstream riverine or coastal fisheries, threatened endangered species, been subject to enormous cost overruns, and destroyed archeological and cultural sites, national parks and wildlife sanctuaries. Irrigation projects associated with large dams have contributed to salinization and waterlogging of useful agricultural land. Beneficiaries of big dam procurement contracts have often been consultants, manufacturers and contractors based in donor countries, while citizens of the borrowing countries have become burdened with debt as well as destructive environmental and social impacts. Unfortunately, it is all too common that the only beneficiaries of big

dam projects built in underdeveloped countries have been the inept and often corrupt government or government officials who promoted the project.

## The Yangtze Three Gorges Dam

What better way to illustrate the complexity of the Big Dam Debate than by a case study? And what better dam to choose for examination than the Three Gorges Dam? This gigantic project has all the necessary elements of a classic controversy: the benefits of "clean" power (to an economically growing nation dependent on fossil fuels and nuclear power) as well as flood control (in a region where tens of thousands of lives can be lost in a single flood) versus drawbacks that include the financial burden a project of this size can have on a burgeoning economy, strangulation of the Yangtze River upstream and increased danger of flood from dam failure downstream.

In many ways, this project can be viewed in the light of the "old guard" versus the "vanguard" of leadership in China as well as in the light of "old" bigger-is-better technology versus "new" local-sustainability. In an interview with Audrey Ronning Topping in the *New York Times Magazine* in January 1997, Dai Qing, one of the 1996 Freeman Lecture participants, brings to the foreground the political and sociological issues confronting this huge technological undertaking:

"Three Gorges is a metaphor of China's changing society. The politicians who support it have all the characteristics of the old society: authoritarianism, central economic control and the dictatorship of one person. They have no regard for the individual and allow no democratic discussion. . . Those opposed to the dam represent the new society. They are the majority of the intellectuals, who oppose it for scientific, financial and ecological reasons as well as human rights and the preservation of cultural relics. So one can actually study China through this case — the whole of society and contemporary Chinese affairs. . . All we are asking for is for an open debate. What is the government afraid of? We don't want to repeat the fatal mistakes the Communist Party has made in the past, like the Great Leap Forward and the Cultural Revolution."

The proposed Three Gorges Dam is located at the bottom of the upper Yangtze River at Sandouping, approximately 40 kilometers upstream of Yichang in Hubei Province, China. The concrete gravity dam is to be 1.9 kilometers long and have a maximum height 175 meters above bedrock, creating a reservoir that is 600 kilometers long, with an area of 1,084 square kilometers and a storage capacity of 40 billion cubic meters at the normal operating water storage level of 175 meters above sea level. The hydropower station will have 26 units and an installed capacity of 17,680 megawatts, making it the world's largest hydropower plant. It will generate 84.7 billion kilowatt hours of electricity annually — equivalent to the power furnished by burning 40 million tons of coal.

Dam construction began in 1994. The Chinese government expects 1997 to mark the "welcoming of double happiness" with the return of Hong Kong and the completion of the first stage of construction on the Three Gorges Dam, which is the diversion of the Yangtze River at the site. By the end of the second construction stage in 2003, the dam will be finished and will start generating electricity. The final stage will mark the completion of the entire project in 2009.

However, opponents feel that the Three Gorges Project can still be halted. When asked by Topping in that *New York Times Magazine* article mentioned above about the possibility of stopping the project, Dai Qing replied:

"I think we have two years, assuming that Deng dies [which has since happened]. Li Peng's term ends in March 1998, which is the main reason he wants to push the project beyond the point of no return. There will be two important figures in Chinese politics, namely Jiang Zemin [General Secretary of the Communist Party and President of the country] and Zhu Rongji [Vice Premier and economic czar]. Neither have uttered any

direct support of Three Gorges, so they wouldn't embarrass themselves by announcing one day that it would be terminated."

## In This Issue

This issue of *Civil Engineering Practice* takes the three presentations at the 1996 Freeman Lecture as the starting point and adds three papers on the Three Gorges Project emanating from China: an in-depth, government-authorized description of the project; an impassioned plea by a revered hydraulic engineer that the dam not be built because it would be physically disastrous, choking the Yangtze at the reservoir entrance with precipitated coarse gravel and cobble river bed-load; and an authorized reprint of an interview with a highly respected former deputy chief engineer of the Ministry of Water Resources and Electric Power minimizing the flood control benefits the project could produce.

Two participants in the 1996 Freeman Lectures, Robert Goodland and Philip Williams, address some general aspects of the big dam debate. Goodland, an ecologist at the World Bank, emphasizes the importance of integrating environmental and social impacts into the planning process and cites a wide range of big dams — especially in Asia, including the Narmada Irrigation Dam in India, Upper Kotmale Clarendon Dam in Sri Lanka, Arun Dam in Nepal and Nam Ngum Dam in Laos. Williams, a practicing hydrologist as well as founder and president of International Rivers Network, focuses not on the big dams but on the engineers who build them, arguing that making ethical considerations paramount will return the engineering profession to its one-time prestige and authority.

The case in favor of the Three Gorges Dam is presented in the Chinese government paper "Three Gorges Project: Key to Development of the Yangtze River." This comprehensive and balanced document presents the chief aspects of the Chinese government's position. It gives the history of the project, indicates the urgency and necessity of flood control, covers investment and technical feasibility, and argues that the reservoir will not induce earthquakes or cause unmanageable sedimentation problems. According to this paper, the Three Gorges Dam will confer major benefits, especially flood control and hydroelectric generation. It argues that the population resettlement program is well-conceived, that archeological sites and cultural relics are being preserved and that the dam will not diminish the scenic value of the Yangtze gorges.

The controversy surrounding this project extended even to the planning of the Freeman Lecture. Several invited speakers, including a Chinese member of the environmental assessment committee supportive of the People's Republic of China's decision to press forward with the dam, declined the invitation to speak once it became known that we were planning to invite opponents to speak as well. As a result, and given time and organizational constraints, we could only invite a Three Gorges Dam opponent, Dai Qing, to participate in the Freeman Lecture. Dai Qing, the engineer and dissident journalist who has led the movement in China opposing the construction of the Three Gorges project, enumerates the critical problems — sedimentation, human relocation, environmental impacts, and the destruction of archeological sites and cultural relics — posed by the project. She provides the latest information, including confidential Chinese government data on actual costs, numbers of people to be relocated and small dam alternatives.

Through Dai Qing, we were introduced to Professor William Wanli Huang, whose paper, "The Gigantic Yangtze Three Gorges Project Must Never Be Built," asserts that the Upper Yangtze will deposit its annual average cobble and gravel bed-load (which he estimates at 100 million tons per year) in the upper reach of the reservoir, including the major harbor at Chongqing. These deposits will block the harbor, inundate land upstream and potentially kill 10,000 people. While the project feasibility study and the engineers of the Yangtze Administration expect that bed-load problems can be successfully addressed, Huang argues that the bed-load phenomenon alone is sufficient reason to cancel the project.

In the final paper of this issue, we republish an interview with Lu Qinkan by Chen Kexiong that was included in the 1994 English-language edition of the book *Yangtze! Yangtze!* which was pub-

lished by Probe International. In that interview, Lu Qinkan attacks the claimed flood control benefits of the dam and offers other solutions to the flood-control problem.

From the overview material on big dams and the engineers who build them to the presentation of two radically different perspectives on the Three Gorges controversy we hope the reader comes away with a deeper appreciation of the complexity of the issues involved in the design, implementation and operation of large dam projects. In reading this issue, it is hoped that we all will gain a fuller understanding of what constitutes the sustainable development of large dam and reservoir projects.



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