WATER SECURITY PROBLEMS OF SHANGHAI EXPO 2010 AND COUNTERMEASURES

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Abstract
Water security is a key factor for the success of Shanghai Expo 2010. Generally speaking, there are two kinds of water security problem, which are flood hazard and water pollution. In this paper, the characters of the water disasters are analyzed through the collection and analysis of the materials. According to the two different types of water disasters, some proposals are pointed out as the countermeasures for the meeting.

1. INTRODUCTION
The world-famous Expo 2010 will be held on May 1st, which is the first Expo in China. Being the first World Exposition on the theme of city, Exposition 2010 will attract 200 countries and 70 million people from across the world, focusing on the theme "Better City, Better Life". Except for the display of technology and commodity, there will be wonderful performances, and more than that, the people all over the world will get together to communicate and strengthen friendship [8], shown in Photo 1. In the new era, Expo 2010 Shanghai China will contribute to human-centered development and technological innovation, cultural diversity and win-win cooperation for a better future, thus composing a melody with the key notes of highlighting innovation and interaction in the new century. While, as the Expo will last a long time, there will be lots of security problems such as terrorism, traffic jams and so on. Water security problem is one of the key problems. In this paper, the characters of the water disasters are analyzed and proposals are pointed out.
2. WATER SECURITY PROBLEMS OF EXPO 2010

Water problems refer to the problems in the environment of human society and the process of economic development, such as flood, water shortage, water pollution and so on [9]. Water problem is one of the key factors related to the success of the Expo, which should be studied carefully with the countermeasures. There are two main kinds of water problems: flood hazard and water pollution.

2.1 Flood Hazard

Shanghai is located in the catchment area of Taihu Basin. Every year from June to July, there will be a lot of rain together with the tropic cyclone. Tropic cyclone, rainstorm, spring tide, flood from the Taihu Basin are the four main causes of the flood hazard of Shanghai [6]. What’s more, the Expo will be held just during the flood season, the main problems of flood hazard are as follows:

(1) Vulnerable to Typhoon

As the special location, the area is affected by typhoon for 2 or 3 times, 6 times at most, which happen mainly in summer.

(2) Vulnerable to Paroxysmal Rainstorm

In recent years, the rainstorm of 100mm often happens in Shanghai. In August 25th 2008, the precipitation rain fall is more than 100mm, with a hundred-year return period, which causes a serious submergence situation of the road, shown in Photo 2.

(3) High Pressure of Flood Control of Huangpu River

Huangpu River is the main spillway of Taihu Basin. In 1954, 1991 and 1999, there was a severe damage in Shanghai caused by the flood [7]. What’s more, the pressure is
enhanced especially after the Taihu Lake Harnessing Projects are finished.

(4) Combined Effect of Storm Surges [1]

In recent years, the city of Shanghai is often affected by the storm surges. When Typhoon Matsa influenced Taihu Basin in 2005, the average rainfall came to 203mm; the high tide level of WuSong and HuangPu Garden were 5.03m and 4.94m, which were 0.28m and 0.37m more than the warning water level respectively; the high tide level of MiShiDu was 4.38 which is the new history record, shown in Photo 3. In 2009 when Typhoon Morakot influenced Shanghai, the water level of Taihu Lake is 4.16m, which is the highest in the 21st century, and the water level of lots of the water level stations was higher than warning water level.

![Photo 3: Inundated situation of the road](image)

(5) Affected by Flood, Typhoon, Tide Storm and Rain

As there will be more and more typhoons and the rain season lasts longer than before, there is a possibility that the city will be affected by flood, typhoon, tide storm and rain. If the flood of 1999 and typhoon Chebi come together, there will be a huge damage to the expo.

(6) Urban Lifeline Vulnerable to Flood

The system of traffic, water supply, power supply and so on is vulnerable to the flood hazard, which will cause great damage to the city.

2.2 Water Pollution

At present, about 80% of the daily routine utilization of water is supplied by the water source of HuangPu River, whose water quality is mostly lie on the Taihu Lake and Taipu River. As a result, the water quality of Taihu Lake, Taipu River and Huangpu River is significant to the water security of Expo 2010.

(1) Water Quality of Taihu Lake

The economic of Taihu Basin develops rapidly, while at the same time, the industry and domestic wastewater annual emission is 5 billion m3, which causes the serious pollution. Now, Above V kind of water occupies 75% of the water body of the main river, and the 75% water of Taihu Lake has changed from II kind to IV kind, with the eutrophic water up to 80% of the Taihu Lake area, shown in Fig. 1. The water supply is threatened in the city of Shanghai, Suzhou and so on [2].
(2) Water Quality of Taipu River
The water quality (2007) of the cross sections of Taipu Gate and Bridge Liantang is shown in Fig. 2. The month average concentration per month of CODMn is 14.67 and 15.20mg/L respectively [2]. What’s more, the highest concentration appears during the Expo, which causes great pressure.

(3) Water Quality of Huangpu River
80% of sewerage of Shanghai discharge into Huangpu River directly [3]. The water quality of all the sections of the river is V kind, and the main contamination is nitrogen and phosphorus leading to serious situation [4].

(4) Increase of Sudden Water Contamination Accident
In recent years, the possibility of sudden water contamination accident increases in Taihu Basin. For example, in August 5th, 2003, there was an oil pollution accident in Huangpu River, nearly 85 ton fuel oil discharged into the river, which caused 150,000 m2 water polluted. In Jun 2007, there was a blue alage eruption in Wuxi with the polluted area of 412km2(17% of the area of Taihu Lake), which caused the crisis of water supply in the city.
3. COUNTERMEASURES OF WATER SECURITY

Through the analysis above, there is a serious situation facing the Expo 2010. As a result, some measures should be pointed out integrated with some existing laws, policies and technologies.

3.1 Measures Against Flood Disaster

Aimed at the flood risk during the course of Expo 2010, the non-engineering measures should be pay more attention at the same time of enhancement of engineering measures.

(1) Risk Elimination and Solidification

The flood control facility should be examined carefully, and the projects such as flood walls and hydraulic gates with hidden troubles should be reinforced.

(2) Control Flood Comprehensively

In order to prevent the flood hazard effectively, speedy and comprehensively, different departments such as weather bureau, ocean bureau and fire departments should work together and cooperate well.

(3) Improve Emergency Plans

Establish and perfect the emergency response mechanism. And the ability to meet the paroxysmal rainstorm should be improved. Meanwhile, the preparation should be done to meet the challenge of storm surges.

(4) Make Flood Hazard Maps

Flood risk map is the map that shows the area that would be affected by the design flood, it graphically provides information on inundation, as well as on evacuation in an easy-to-understand format. It will also estimate the losses cause by floods, which is an important non-engineering measure and can be applied by the flood control headquarters [10], shown in Photo 4, Photo 5.

![Photo 4: Flood Hazard Map (water depth)](image1)

![Photo 5: Evacuation Routes](image2)
(5) Informatization of Flood Control

The information mediums should be applied sufficiently, which will make the work of flood control effectively, shown in Photo 6.

Photo 6: Information management system of Flood Hazard Map of Huangpu River

3.2 Measures Against Water Pollution

In recent years, with the policy of diverting water from Yangtze River to Taihu Lake carried into execution, the water quality of the basin has been greatly improved, which ensure the water supply of Shanghai. While, the paroxysmal water pollution is unpredictable, as a result, the establishment of the policy to meet the water pollution becomes significant to the Expo 2010.

Generally speaking, there are four main paroxysmal water pollutions, salt water intrusion, spilled oil pollution, chemical pollution and eutrophication and so on. As for the Expo, the most dangerous threatens are blue alage in Taihu Lake and oil eruption in Huangpu River.

(1) Measures to Blue Alage in Taihu Lake

According to analysis above, there is a serious situation of eutrophication in Taihu Lake. The concentration of nitrogen and phosphorus is a little high, which is easy to bring to a blue alage eruption. As for this serious situation, there are there main measures [2]:

(a) Water Diversion

The project of “Water Diversion from Yangtze River to Taihu Lake” should be implemented scientifically that will make the concentration of the contamination could be reduced and the fluidity of the water body can be enhanced, which will increase the self-purifying ability.

Take diverting water through Wangting hydro-junction for example. The more the flow is, the steeper the curve becomes, shown in Fig. 3, which explains that the speed of the dissipation of contamination increases. As result, increase of flux has a positive impact on the dissipation of the contamination.

(b) Qing Caosha Reservoir

During the Expo, the water shortage is estimated to be 4.7 million m³ per day. As the completion of Qing Caosha Reservoir which would be the main water source region of Shanghai in future, it would supply Shanghai with 7.19 million m³ fresh water per day and could be applied to ensure the security of water supply in the city.

(c) Refloatation

Refloatation is an effective method to relieve the situation of eutrophication, improve the water quality and protect the water source of Taihu Basin. In order to improve the effectiveness of work, it should be operated in a mechanized way, instead of artificially. A professional team should be set up, the harmless treatment and resource utilization must be paid more attention. The monitoring measures should be changed from negative
(d) Chemical Measures

Now, there are 247 kinds of algaecide. While, chemical measures should not be used if the blue alage erupt near the water intake because the second pollution maybe caused. So this measure should be applied only in the water body not employed by human beings.

(2) Measures against Oil Pollution

The security of water supply in Shanghai will be greatly threatened if oil pollution and similar accidents happen in Huangpu River [5]. According to the location where pollution happens, the measures are as follows:

(a) Downstream of Water Source

In this case, such as the oil pollution in Port Wujing of Huangpu River in 2003, the pollution source should be closed immediately, and the oil must be controlled in a limited area. Next, the observation points should be set up in the place where the water might be polluted, and dispersion condition ought to be monitored.

At the same time, the measures of water diversion water could be employed to reduce the concentration of contamination. In 2003, the Taipu River Pumping Station was used by Taihu Basin Authority with the maximum flux close to 200m$^3$/s, blocking off the polluted water 2km away from the water source. Fig. 4 shows the simulated result.

(b) Upstream of Water Source

In this situation, all the incoming water entrances upstream should be closed in case the water body got polluted. Also, the observation points should be set up in the place where
the water might be polluted. In order to prevent the water source polluted, the equipment blocking the oil should be installed. In the area already polluted, the oil could be absorbed employed cotton and saturating felt.

(c) Far away From the Water Source

In this case, expect the measures mentioned above, the chemical methods could be also applied. While the ecosystem, meteorological system and current conditions should be considered to prevent the second pollution.

4. CONCLUSIONS

In order to ensure the success of the Expo 2010, water security must be paid more attention. As for the complexity, particularity and essentiality of the problem, all kinds of departments such as government, company, university should cooperate effectively to make the expo an excellent one in history.

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