Preliminary Study on Analysis Technology of Normal Level Adjustment for Constructed Reservoir- Taking Hangzhou City Qingshan Reservoir as an Example

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Abstract. To determine the normal water level is an essential part of new design process, only normal water level adjustment is the new things gradually in recent years. Reservoir is an important part for the development of social economy system, may affect the situation as a whole, and then normal water level adjustment analysis technology also has some particularity. Accumulation of relevant experience through the engineering case, perfect technology system, has reference value for the similar work. With the theories of hydrology and water resources, dam safety, sociology and the cost benefit theory, the Hangzhou City Qingshan reservoir normal water level adjustment analysis technology conducted a preliminary exploration, and a integrated analysis model of necessity analysis, water resources demand, runoff flow, feasibility, risk benefit and operation mode etc. of normal water level adjustment for constructed reservoir are put forward. Then normal water level adjustment analysis framework and technical route are creatively put forward, and successfully applied to Hangzhou City Qingshan reservoir normal water level analysis. After analysis, the necessity and feasibility of improving the normal water storage level of Qingshan reservoir have been met, and the increase of 2.0m to 25.16m can increase the storage capacity of 18 million 790 thousand cubic meters, which can be used as recommended program.

introduction

In the social economic development system of our country, the role of reservoir is more and more significant in the social and economic development, as it is an important infrastructure for the construction of high quality water resources and ecological civilization in the surrounding area. In recent years, the development trend of reservoir water resources demand is gradually increasing in our country, as the development process of Switzerland, the United States, Canada and other developed countries. The problem of increasing efficiency of reservoir is of general concern. Under the premise of ensuring the safety of flood control, the safety of the project and the safety of the flood, adjust the normal water level and flood water level has become the preferred solution to the above problems, due to the low cost, high efficiency, quick effect. At present, the relevant research and practice mainly focus on dynamic limited water level of reservoir[1-5], the demonstration methods and practical experience of normal water level adjustment is still not sufficient, many researches have been focused on the relationship between normal storage level of new dam, ecnomic benefits and engineering safety[6-9]. There is little research and practice about the

adjustment of water normal storage level of dam. Although the increase or decrease of normal water storage level affects only the operation of reservoir in non flood season, but the aspects involved are very complicated, including not only the problem of dam safety, and the adequacy of upstream, reservoir area, the downstream flood reliability(Whether the water level can be in a relatively short time to limit water level before the flood season) and so on. As the reservoir may have been running for several years or even decades, the demonstration of the adjustment of the normal water storage level can not simply refer to the relevant methods of the new dam. So, it is significant to increase the efficiency of the reservoir and the development of surrounding social and economic to research the analysis technology of normal level adjustment for constructed resevoir. This paper takes Qingshan reservoir in Hangzhou as an example. A preliminary exploration on analysis technology of normal level adjustment for constructed resevoir has been done in this paper in order to provide references for similar works.

technology roadmap about analysis of normal level adjustment

Qingshan reservoir is a large (2) type water conservancy project with a total capacity of 213million m^3. The functions of it are mainly in flood control, with irrigation, environmental water, electricity generation, fish and other comprehensive utilization. The design of flood control standard according to P=1%, the design flood level is 32.42m checked as P=0.01%, the maximum flood level is 35.17m; the normal water level and flood limit water level are 23.16m, the dead water level is 17.16m; the immigration criteria of reservoir area is P=5%, the immigration water level is 31.16m; the flood season is from April 15th to October 15th, it can be divided into plum flood season and typhoon flood season, the rest of time is non flood season. Qingshan resevoir is an important water conservancy project for the water Safety of Hangjiahu area and dongshaoxi watershed. It is strategically positioned as an important guarantee of Hangjiahu eastern plains and Hangzhou city flood control safety, an important source of water supply in Hangjiahu area and the main ecological barrier in the northwest region of Zhejiang Province, ecological core area of Ling'an city and Zhejiang science and Technology City. It plays an important role in sustainable development of Hangjiahu area. At present, especially the non flood season, the problem of insufficient regulation and storage capacity gradually appear, as the upstream water shortage, coupled with the water resources demand is constantly increasing. It is the basis of achieving the strategic positioning of Qingshan reservoir to further optimize the dispatching mode of Qingshan reservoir which is based on previous comprehensive management of reservoir area(indeed the right demarcation of reservoir, treat the pollution of surface source, improve the water environment, enhance the ecological civilization of the reservoir area). Project is to adjust the normal water level first, improve the reservoir characteristic water level, improve the capacity of reservoir to some degree, then considering the problem of dynamic flood control level.

To analyse the normal level adjustment for constructed resevoir, it is necessary to study the necessity, feasibility of the adjustment and the corresponding benefit and risk analysis method of adjustment scale. Considering the reservoir is important to the safety of the upstream, dam project, downstream, therefore, the analysis must be rolled out within the scope of the three types of objects. Technology roadmap about analysis of normal level adjustment for Qingshan reservoir is shown in Figure 1.

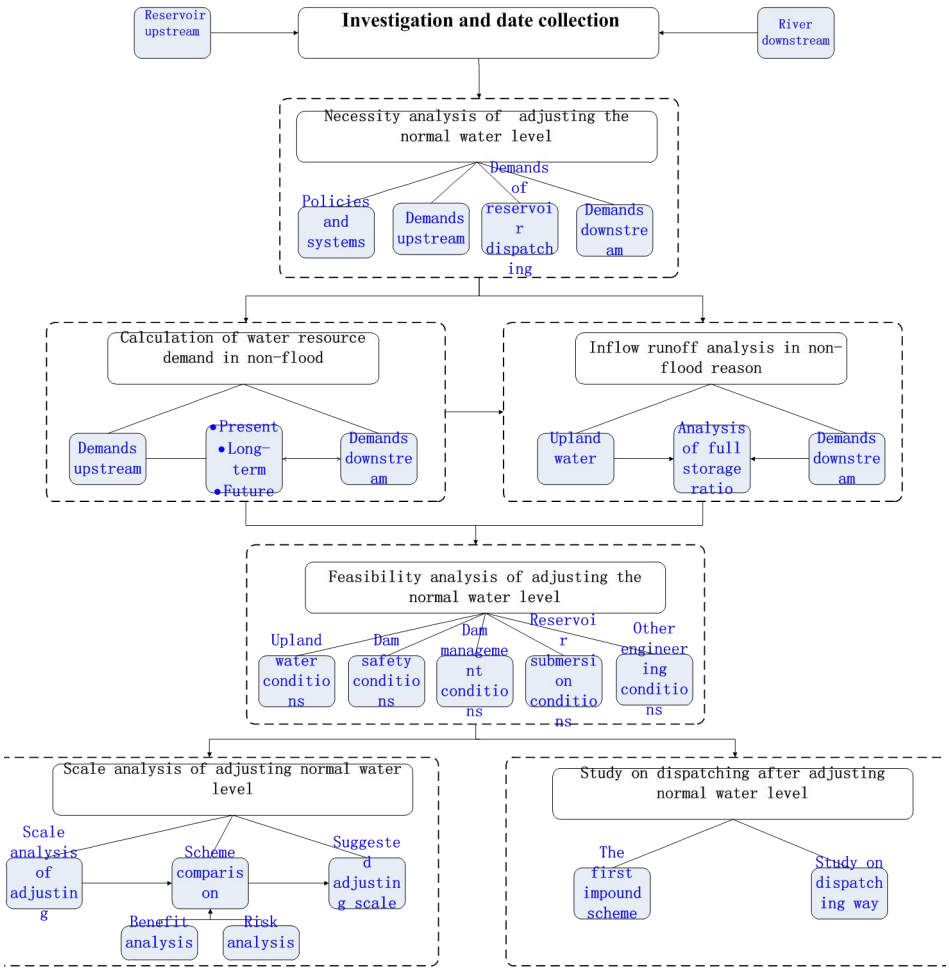

Figure 1. Argumentation technology roadmap of adjusting normal water level

necessity of normal level adjustment for Qingshan reservoir

improving the quality of water environment downstream of Tiaoxi.

In recent 10 years, there is emergency water supply to downstream for water pollution every year, especially during the period of 2006-2015 year, emergency water supply capacity of Qingshan reservoir was not less than 10 million m3. Water pollution incident shall be guaranteed as it is a matter of public safety. Alleviating the problem of water pollution downstream by increasing the discharge of Qingshan reservoir has become a fixed pattern.

improving the quality of water environment upstream of reservoir

The water environment in the upstream of the reservoir can not adapt to the needs of the development of social economy. The main water quality indicators showed a good trend with the increase of reservoir water level, such as dissolved oxygen, permanganate index, chemical oxygen demand, biochemical oxygen demand, ammonia nitrogen, fluoride, total phosphorus, total nitrogen and so on. It can improve the water enviroment capacity of reservoir and solve many problems such as the poor water self purification ability of reservoir and the explosing of bottomland to further improve normal level of reservoir basing on comprehensive protection project of Qingshan reservoir.

(3) Improve the operation capacity of the Qingshan reservoir

In recent years, because of the inadequate water-holding capacity, Qingshan reservoir operation is hard to balance flood prevention, drought resistance and environmental water supply. The reservoir

water resources scheming should be extraseasonal even throughout the year. It should prepare overall drought but also flood prevention scheduling in order to prevent the passive situation of reservoir operation. According to statistics, although the multi-year average inflow of the driest month in non-flood season between 1966-2012 (October 16th ~ January 31st, the least inflow from upstream month in a year), 57 million 170 thousand cubic meters, meet the total storage capacity of 46 million 220 thousand cubic meters calculated in accordance with the ecological environment demand flow of 5 meter per second. But nearly half year inflow is less than downstream water demand (guarantee degree of water supply less than 50%, seen Table 1). The guarantee degree of water supply of Qingshan reservoir is insufficiency and time-history distribution is hard to meet the demand of the constant water downstream and emergency water. The current storage capacity and non-flood scheduling mode of Qingshan reservoir has been difficult to meet the social economy and ecological environment water demand of surrounding areas.

Table 1 The statistical table of difference between inflow and downstream water demand between October 16th to January 31st of the next year

Year	The inflow volume (ten thousand m³)	difference between inflow and downstream water demand（ten thousand m³）	Year	The inflow volume (ten thousand m³)	difference between inflow and downstream water demand（ten thousand m³）
1966	3098	**-1524**	1990	9533	4911
1967	399	**-4223**	1991	1929	**-2693**
1968	6055	1433	1992	3311	**-1311**
1969	1030	**-3592**	1993	6941	2319
1970	4831	209	1994	7799	3177
1971	1551	**-3071**	1995	2688	**-1934**
1972	11211	6589	1996	2916	**-1707**
1973	3036	**-1586**	1997	17068	12446
1974	8496	3874	1998	2273	**-2349**
1975	14738	10116	1999	3720	**-902**
1976	5012	390	2000	9118	4496
1977	3147	**-1475**	2001	7226	2604
1978	907	**-3715**	2002	14671	10049
1979	1033	**-3589**	2003	3120	**-1502**
1980	2995	**-1627**	2004	5396	774
1981	16459	11837	2005	7783	3161
1982	6221	1599	2006	3576	**-1046**
1983	8196	3574	2007	4363	**-259**
1984	3195	**-1427**	2008	7516	2894
1985	5855	1233	2009	6556	1934
1986	4493	**-129**	2010	5873	1251
1987	4127	**-495**	2011	6462	1840
1988	2564	**-2058**	2012	7090	2468
1989	3114	**-1508**			

(4) Constructing of multiple water resources water supply configuration in Yuhang district

In the future, Hangzhou will form the multiple water resources water supply configuration of Thousand Islands Lake, Qiantang River and Dongtiaoxi. In order to construct this configuration, it’s necessary improve the water resources guarantee capability of Qiantang River and Dongtiaoxi while promoting the water diversion project of Qiandao Lake. It can further optimize the water resources allocation configuration by improving the normal water level to enhance reservoir water storage capacity.

(5) In response to public attention

In 2016, the representative of the Zhejiang Provincial People's Congress and the Hangzhou Municipal People's Congress has proposed to adjust the normal water level of Qingshan reservoir. Ling'an City[12] upstream and Yuhang district[13] downstream of the Qingshan reservoir both

requested to improve the normal water level explicitly. Therefore, improving the normal water level of the Qingshan reservoir is a response to public attention.

In summary, in the basis of the reservoir comprehensive management, the adjustment of the reservoir normal water level and improve the reservoir storage capacity is the need of adapting to the surrounding social and economic development, improving the quality of downstream water environment, improving the reservoir operation ability, construction of Yuhang area water supply configuration and the promotion of Qingshan reservoir water ecological protection system construction and water environment protection. At the same time, it response to public attention, necessary and urgent.

The demand of water resources of Qingshan reservoir during non-flood season

The supply objects of Qingshan reservoir water resources mainly include the downstream domestic water, production water, power water, irrigation water, emergency water of Yuhang district and water production and life of the Ling'an city upstream. And emergency water includes drought emergency water supply and environmental emergency water supply etc. The normal water level is characteristic water level during the non-flood season. In the non-flood season, Qingshan reservoir is mainly aimed at the ecological water and environmental emergency water, and also take the production and living water of Yuhang district into account. The randomness of time and scale of environmental emergency water is high, which is inconvenient to take into account quantitatively in the analysis of water resources demand. Also, there are overlaps between the ecological baseflow water and the surrounding production and living water. Therefore, it is mainly based on the downstream ecological baseflow to determine the demand for Qingshan reservoir water resources of the surrounding social economy, with the production and living water upstream and downstream as a secondary concern. According to the the relevant opinions of "ecological index system and application guidance of water project planning and design", the river ecological flow base in the south of China should not be less than the bigger of average flow rate of lowest month with assurance rate of 90% and 10% of annual average natural runoff. It can also be 20%~30% or above of annual average natural runoff by Tennant law. The average annual natural runoff of Qingshan reservoir is 484 million 910 thousand cubic meters and 10% of the average annual natural runoff is 1.5 meter per second. And calculated with 30% of average annual natural runoff, the ecological baseflow upstream Qingshan reservoir is 4.5 cubic meter per second. According to the annual volume statistical analysis of Nantiaoxi and Dongtiaoxi where the Qingshan reservoir located, 50% of the volume in Dongtiaoxi from Nantiaoxi. Based on the water demand of present (2015), recently (2020) and long-term (2030) upstream and downstream, it can be deduced that the production and living water upstream and downstream should be provided by Qingshan reservoir, with the present 4.5 cubic meter per second, the recent 5.5 cubic meter per second and long term 6.5 cubic meter per second (seen Table 1). Based on the roughly equivalence of water demand between ecological base flow and production and living water upstream and downstream, the water demand of the reservoir can be 5 cubic meter per second.

Table 2. The calculation result table of water demand upstream and downstream provided by Qingshan reservoir

Level years	Daily water demand of Yuhan district			Daily water demand of Linan（ten thousand m^3）	Total daily water demand	
	Daily water demand of Dongtiaoxi（ten thousand m^3）	the ratio of reservoir water-supply	Daily water demand of reservoir（ten thousand m^3）		（ten thousand m^3）	（m^3/s）
2015（present）	77.0	0.5	38.5	0	38.5	4.5
2020（rencent）	75.0	0.5	37.5	10.0	47.5	5.5
2030（long term）	82.0	0.5	41.0	15.0	56.0	6.5

The inflow runoff analysis of Qingshan reservoir

(1) Stationary annual inflow runoff

According to the statistic analysis of data of daily inflow runoff series, there are some fluctuations in inflow runoff between different ages (seen Figure 3), but there is no obvious tendency to increase or decrease. But during the period of 2003-2007, the annual runoff of Qingshan reservoir appeared a 5-year low flow period. This 5-year average annual inflow runoff is 313 million 870 thousand cubic meter, less than 35.3% of the average annual runoff of 484 million 910 thousand cubic meter.

(2) Distribution characteristics of annual inflow

The runoff annual distribution characteristics showed that the driest months of average monthly inflow runoff are January, October, November and December. The inflow runoff of this four months only accounted for 14.6% of the average annual runoff. The most abundant month of average monthly inflow runoff are May to August. The inflow runoff of this four months accounted for 51.1% of the average annual runoff. The calculation results of the inflow runoff frequency in the non-flood season show that inflow runoff in wet year with the frequency of 25% is 211 million 900 thousand cubic meter, inflow runoff in normal year with the frequency of 50% is 154 million 400 thousand cubic meter, inflow runoff in dry year with the frequency of 95% is 60 million 300 thousand cubic meter.

(3) The inflow in non-flood season of some year is less

The statistics of daily runoff from 1966 to 2013 of Qingshan reservoir shows that the inflow runoff of the non-flood season (October 16th - April 14th) (the inflow runoff from October 16th 1966 to April 14th 1967 calculated as the inflow runoff in non-flood season of 1967). The statistical results shown in figure 4. The average annual runoff is 166 million 960 thousand cubic meter and the maximum value is 384 million 290 thousand cubic meter in 1998 while the minimum value is 28 million 270 thousand cubic meter in 1968. The maximum value is 13.6 times as much as the minimum. During 1967 to 2013, the inflow runoff in the non-flood season of Qingshan reservoir was in a state of fluctuation and there was no obvious tendency to increase or decrease. From a long series of 47 years, there existed some continuous dry periods, such as 1970-1972, 1977-1981, 2004-2008 and 1999-2001. The average runoff of these continuous time were 117 million 830 thousand cubic meter, 107 million cubic meter, 133 million 60 thousand cubic meter and 116 million 870 thousand cubic meter, compared with the average non-flood season less respectively 29.4%, 35.9%, 20.3% and 30%.

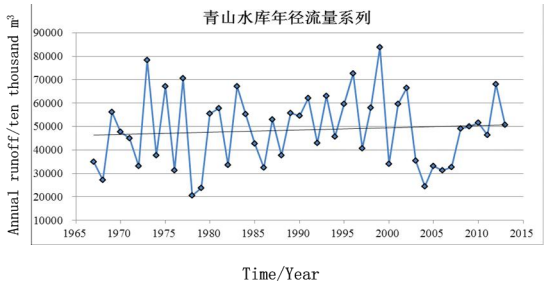

Figure 2. The hydrograph of annual runoff of Qingshan reservoir

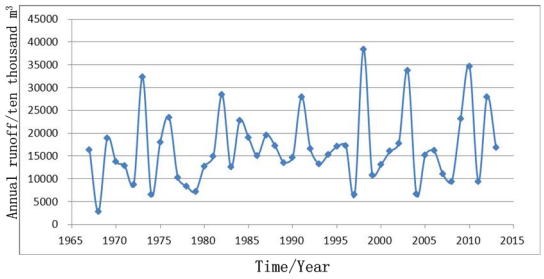

Figure 3. The hydrograph of annual runoff of Qingshan reservoir in non-flood season

(4) The characteristics of reservoir water supply guarantee rate and saturated storage rate

Reservoir water supply guarantee rate is the ratio of the years of which water demand of the object in the long series of calculation period the total number of years can be met to the total length of the entire series. The saturated storage rate is different from the reservoir water supply guarantee rate. The saturated storage rate characterize that the reservoir can storage to the normal water lever under the condition of satisfaction about water demand of object. It is an increment index of degree of assurance of water supply. Because the special water supply mode of Qingshan reservoir, it has no clear requirement of reservoir water supply. In this calculation of saturated storage rate, it is premised on satisfy the water demand of the object (the water supply rate is 100%), which means that saturated storage rate can represent the adjustable capacity of normal water level and saturated storage rate is 100%. Through the analysis and calculation of the adjustable capacity of normal water level, under the condition of meeting the basic demand of ecological environment flow downstream which is 5.0 cubic meter per second (about 432 thousand cubic meter per day), the normal water level in non-flood season increased to 25.00m or 26.00m and the reservoir filled year can reach 38 or 36 years and saturated storage rate can reach 80.9% or 79.6%. That is to say, under the conditions of 100% guarantee rate of water storage downstream, the saturated storage rate can reach about 80% by improving the normal water level. improve the normal water level of non-flood season need the guarantee of water resources.

(5) The problem of flood control operation in the non-flood season

Taking the flood process in March 2010 of the non-flood season and a once-in-a-hundred-years design flood process as an example, using controlled discharge flow of 200 cubic meter per second to analyze flood routing in non-flood season, the results showed that even with 26.16m as a limitation level of the non-flood season, the highest water level in March 2010 and the a once-in-a-hundred-years design flood were 28.74m and 28.22m, which were lower than immigration water level of 31.16m and 29.84m of land submerge compensation water level. This shows that after increasing the normal water level in non-flood season, the reservoir will not have the flood if come into the flood of March 2010 or the once-in-a-hundred-years design flood.

(6) Improving water resources benefit of normal water level

If the normal water level increased to 25.00m, it can increase the water storage of 17 million 150 thousand cubic meter; if the increase to 26.00m, it can increase the water storage of 27 million 980 thousand cubic meter. The water storage of two groups is equivalent to the size of a medium-sized reservoir.

Feasibility analysis of normal water level regulation

After improving normal water level of Qingshan reservoir, it may effect flood protection of river basin, dam safety, reservoir submersion safety, dam safety operation management and emergency

management and so on. The feasibility analysis of improve improving normal water level is as follows:

(1) High regulated capacity of reservoir

The annual average runoff of Qingshan reservoir is 475 million cubic meter, with the total capacity of 213 million cubic meter, and the utilizable capacity is only 31 million cubic meter. Because of unreasonable storage allocation, low regulation and storage capacity, abandoning most of the upper reaches, failed to effectively play the function of the reservoir water supply efficiency, there is still a large improvement space in storage allocation.

(2) Do not affect the flood protection of region

Since the runoff from October to December is less in the whole non-flood season, there's no problem of flood protection(seen as Figure 4). During the non-flood season before the flood, discharge flow of the Dongtiaoxi river downstream which is between 200-300 cubic meter per second could not cause flood protection problems. Calculated with discharge flow of 200 cubic meter per second (when discharge control flow exceeds the discharge capacity of reservoir, fore-discharge according to the discharge capacity), it takes 2-3 days to let the reservoir water level from 25.00m or 26.00m decrease to the flood control level. If calculated with discharge flow of 300 cubic meter per second, the time of fore-discharge is shorter. Thus, it can transit the normal water level to the flood control level in a short period of time before flood while ensuring the dam safety and downstream safety. The adjustment of the normal water storage level of Qingshan reservoir does not affect the flood control.

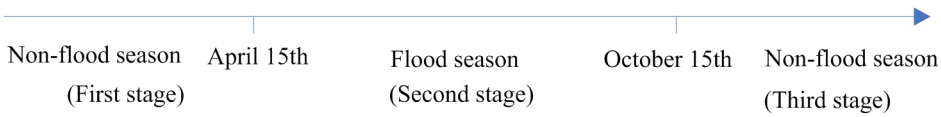

Figure 4. Three-stage sketch map of the operation period about Qingshan reservoir

(3) Sufficient water inflows condition upstream

The inflow of Qingshan reservoir is generally stable. The annual average inflow runoff in the non-flood season (October 16th - April 14th the next year) is 166 million 960 thousand cubic meter, accounting for 34.6% of the annual average inflow runoff of 482 million 380 thousand cubic meter. Under the current water supply conditions and ensuring the water supply guarantee rate downstream of 100%, the Qingshan reservoir can full to 24.16m, 25.00m, 25.16m, 26.00m and 26.16m of the rate at least 78.7% (seen as Table 2) in non-flood season. In short-term and long-term water supply conditions, reservoir can full to 24.16m, 25.00m, 25.16m, 26.00m and 26.16m of the rate at least 68.1%. Improving the normal water level of Qingshan reservoir in non-flood season has a water security.

Table 2. The results of full storage rate under different normal water level of Qingshan reservoir

The normal water level（m）	current water supply 385 thousand m^3/d		short-term water supply 475 thousand m^3/d		long-term water supply 560 thousand m^3/d	
	Years of full storage（year）	full storage rate（%）	Years of full storage（year）	full storage rate（%）	Years of full storage（year）	full storage rate（%）
24.16	42	89.4	39	83.0	36	76.6
25.00	41	87.2	38	80.9	36	76.6
25.16	40	85.1	37	78.7	36	76.6
26.00	36	79.6	36	76.6	34	72.3
26.16	37	78.7	35	74.5	32	68.1

(4) Guaranteed dam safety

After maintenance and reinforcement from December 2014 to May 2015, the dam safety state is one class[14] . It's feasible that the normal water level increased 1.0m, 1.84m, 2.0m, 2.84m and 3.0m. In addition, because of completion of Li Fan Reservoir expansion project and Ling'an Jincheng backwater embankment reinforcement project, the flood control standard is obviously improved to effectively reduces the influence of the tail area and reservoir area for flood control. Siling, Shuitaozhuang reservoir which upstream and downstream of the Qingshan reservoir were built one after another and strengthening and treatment along the Dongtiaoxi has been completed. The flood control system of Tiaoxi river basin changed greatly and flood control pressure of Qingshan reservoir relieved obviously. It provide very favorable conditions for normal water level elevation.

(5) Dam safety operation management and emergency management capacity meet the demand

Qingshan reservoir safety management system improvement, good hardware and software conditions, high quality of management personnel, guaranteed safety monitoring and inspection and guaranteed capability of pre-disharge and over-discharge can adapt to the actual demand of safety management and emergency management after the normal water improving.

(6) Acceptable inundation risk of reservoir

At present, there is no migration resettlement, production resettlement and compensation issues below 28m of the reservoir. Transportation facilities can have alternative solutions in reservoir area. There's no impact in the range of 2m increase of flood control facility around the reservoir Overall, the submerged conditions are ready.

In summary, the adjustment of Qingshan reservoir normal water level does not affect the flood control task, the project safety and the scheduling management. And the upstream water inflows condition is good and feasible.

The scale of adjustment and benefit analysis of the normal water level

Through the comparative analysis of 5 cases' risk and benefit which increase the normal water level of 1.0m, 1.84m, 2.0m, 2.84m and 3.0m, it shows that it is acceptable and beneficial to increase the normal water level from 1.0m and 1.84m to 24.16m and 25.00m. And it has no obvious effect to the reservoir flood control, reservoir inundation, engineering safety and reservoir management. It can increase water storage of 8 million 820 thousand cubic meter and 17 million 150 thousand cubic meter and save alternative project investment of 1 billion 200 million yuan and 2 billion 300 million yuan. The water quality can be improved by 21% and can experience a long history of water level test. The normal water level increased from 2.0m to 25.16m and the effect is obvious, the risk is acceptable. And it has no obvious effect to the reservoir flood control, reservoir inundation, engineering safety and reservoir management. It can increase water storage of 18 million 790 thousand cubic meter and save alternative project investment of 2 billion 600 million yuan. The water quality can be improved by 23% and can experience a long history of water level test. The normal water level were increased by 2.84m and 3.0m and increase the water storage of 27 million 980 thousand cubic meter, 29 million 780 thousand cubic meter, saving alternative project investment 3 billion 800 million yuan and 4 billion 600 million yuan. The water quality can be improved by 30%. But it may flow backward to affect the normal flood discharge of Jinxi upstream without a long history of water level test.

After comprehensive analysis, it is necessary and feasible to increase the normal water level of Qingshan reservoir. In the 5 cases of increasing the normal water level of 1.0m, 1.84m, 2.0m, improved 2.84m and 3.0m, the case of increasing 2.0m to 25.16m is recommended and it can increase thewater storage of 18 million 790 thousand cubic meter.

Study on reservoir operation regulation

(1) Reservoir operation in flood season. After increasing of the normal water level, flood control level remained 23.16m unchangeably. It does not affect the flood protection and flood control operation can maintain the existing way in flood season.
(2) Reservoir operation in the non-flood season after flood. The normal water level elevation scheme don't need impounding in the flood recession. Optimal operation can maintain the existing way in the non-flood season after flood.
(3) Reservoir operation in the non-flood season before flood. In the non-flood season before flood, it must ensure that the water level decrease to flood control level before April 15th. Calculated with discharge flow of 200 cubic meter per second (when discharge control flow exceeds the discharge capacity of reservoir, fore-discharge according to the discharge capacity), it will take 3 days to let the reservoir water level from 25.16m decrease to the flood control level of 23.16m. In the actual operation, it can make ensure that the water level will drop to flood control level before April 15th according to the weather situation and rainfall forecast information, by a comprehensive analysis to determine reasonable reservoir pre-discharge time.

Conclusion and suggestion

Using hydrology and water resources, dam safety, sociology and the cost benefit theory, this paper do tentative exploration normal water level adjustment demonstration technology about the Hangzhou Qingshan reservoir and conduct an analysis model of normal water level adjustment demonstration about a technical route, necessity, the water resources demand, runoff flow, feasibility, risk and benefit and operation mode etc. And it put forward demonstration analysis framework and technical route of adjusting normal water level creatively and successfully applied to the normal water level demonstration of Hangzhou Qingshan reservoir. Through analysis, the necessity and feasibility of increasing the normal water storage level of Qingshan reservoir have been met, and the increasing 2.0m to 25.16m can increase the water storage of 18 million 790 thousand cubic meter, which can be used as the a recommended program.
It's suggested to further study flood characteristics in Qingshan reservoir flood season especially Meiyu period. Put forward dynamic flood control mechanism in Meiyu period and typhoon season, strengthen the research of integrated dispatching mode, develop detailed, comprehensive, strongly operational reservoir operation rules.

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