To Shorten the Overhaul Cycle of the Unit and Eliminate the Major Safety Hazards, as Well Create a Huge Safety and Economic Benefits

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Abstract: According to the major hidden safety hazards such as heavy sediment, high-head mixed-flow hydro-generator units and serious resonance in the factory area during the flood season of the Jinkang Power Station, and the problems found during overhaul, through analysis and discussion, to address the major hidden safety hazards existing in the unit and the plant area, The idea of shortening the overhaul period of such units to two flood periods as one overhaul period was proposed to eliminate and completely solve the major safety hazards of severe vibration in the entire plant area during the flood period. At the same time, it can increase the power generation and create huge economic benefits. Provide reference and reference.

1. Introduction

Jinkang Power Station is located in a mud-sandy area, and it is also a mixed-head unit with water head. According to the People's Republic of China Electric Power Industry Standard "Guidelines for Equipment Maintenance of Power Generation Enterprises DL / T 838-2003", the hydro-generator set A of the mud-sand hydropower station The interval of overhaul (overhaul) is 4-6 years (see Table 1). Jinkang Public Power Station refers to the experience of the same type and adjacent power stations, and arranges overhaul according to 3-4 years.

However, in actual operation, it was found that starting from 2008, once the unit was installed or overhauled and experienced the second flood season and above, it was found that when the two units were running at the same time during the flood season, the unit and plant were severely vibrated and shaken; experienced the third It was even more severe during the flood season, and dormitories and canteens as far away as 150 meters were also severely vibrated and shaken, and there were major safety risks.

Overhaul was arranged for 2 units after 3 flood seasons. The over-flow parts were severely damaged when disassembled. The top cover and bottom ring were damaged. 23 places (consistent with the number of guide vanes) were seen to a depth of 50MM, which can only be organized immediately. It was sent to the manufacturer for emergency repair, and the guide vane was also very damaged, so it can only be replaced. Lenovo thinks that the unit, factory building and the entire plant area have severe jitter and vibration since the 2008 flood season. The 2009 flood season is more severe, indicating the unit's safety and reliability. Being seriously threatened, the entire plant area has serious security risks.
Table 1 Unit A level maintenance interval and maintenance level combination

<table>
<thead>
<tr>
<th>Type of Unite</th>
<th>Class A inspection interval</th>
<th>Combination of Maintenance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported steam turbine generator set</td>
<td>6~8 Year</td>
<td>Combination principle: Between the two A-level inspections, arrange a unit B-level inspection; except for A and B-level inspection years, arrange the unit C-level inspections once a year, and if necessary, increase the D-level inspections once a year. For example, when the A-level maintenance interval is 6 years, the combination of the maintenance levels is A-C (D) -C (D) -B-C (D) -C (D) -A 1 time, in the second year, C-level inspections can be arranged, and D-level inspections can be added once, and so on.</td>
</tr>
<tr>
<td>Domestic steam turbine generator set</td>
<td>4~6 Year</td>
<td></td>
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<tr>
<td>Hydro-generator set of Duosha Hydropower Station</td>
<td>4~6 Year</td>
<td></td>
</tr>
<tr>
<td>Hydro-generator set of non-sandy hydropower station</td>
<td>8~10 Year</td>
<td></td>
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<tr>
<td>Main transformer</td>
<td>Determined according to operating conditions and test results is generally 10 years</td>
<td>Class C maintenance: arranged once a year</td>
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2. Overview and Phenomenon of Jinkang Power Station

Jinkang Power Station is located in Kangding County, Ganzi Tibetan Autonomous Prefecture, Sichuan Province. It is the last stage of the five-level development plan of the Jintanghe First Reservoir. The first tributary of the left bank of the Dadu River in the Jintang River is 79.8km long, with a natural drop of 3372m, an average ratio drop of 4.23%. The basin area is 1135 square kilometers, and the average sediment content for many years is 100 g / m3 (there is no sediment in the dry season, All are concentrated in the flood season), Jintang River has an average flow of 36.6 cubic meters per second for many years. It is a low-gate diversion development. The total length of the pressure tunnel is 16302.511m, and the design reference flow of the power station is 37.4 cubic meters per second. The normal water storage level of the reservoir is 1974.00m, the dead water level is 1969.00m, and the adjustable storage capacity is 314,100 cubic meters (currently about 150,000 cubic meters due to severe sedimentation). The inlet gate is located on the left bank, and the pressure regulating chamber is a ladle air cushion Type pressure regulating room, with two installed power stations, a total installed capacity of 150MW, a rated water head of 458 meters, and a single unit reference flow of 18.5 cubic meters per second. The designed annual utilization hours of the power station are 5230h, the average guaranteed output during the dry season is 30MW, and the designed average power generation for many years is 784.6 million kW·h.

According to the People’s Republic of China’s power industry standard “Guidelines for Equipment Maintenance for Power Generation Enterprises DL / T 838-2003”, the interval for Class A maintenance (overhaul) of hydro-generator units of Duosita Hydropower Station is 4-6 years (see Table 1). Jinkang Public Power Station refers to the experience of the same type and adjacent Huaneng Lengzhuguan power station, fully considers the impact of heavy sediment on the overcurrent components of high-head units, and prepares a spare runner and a set of overcurrent components (a set of guide vanes, One top cover and one bottom ring). Overhaul was arranged according to 3-4 years. Two units were put into production in August and September 2006 respectively. The overhaul of the units was scheduled to be overhauled at the end of 2009 and early 2010 respectively. The over-flow parts are severely damaged. The top cover and the bottom ring
can be damaged to the naked eye. The depth of the guide vane can be seen at 23 places. The damage to the guide vane is also very serious. It can only be immediately sent to the manufacturer for emergency repair. The guide vane can only be reprocessed. The factory building and the entire plant area (including dormitories and canteens 150 meters away) had severe jitter and vibration at the beginning of the 2008 flood season, and the 2009 flood season was more severe, indicating that the unit's safety and reliability were affected. Heavy threat, there is a serious security risk throughout the plant.

The unit's overhaul cycle after the three flood seasons brings the following major problems and hidden safety hazards:

A. The overcurrent components are very damaged; during the overhaul of Jinkang unit, it was found that the overcurrent components were severely damaged after 3 flood seasons.

B. The entire plant area and unit vibration and vibration are very serious; when the two plants are running at the same time in the flood season, the shake and vibration are very serious and terrifying. Even the accommodation building and cafeteria 150 meters away from the plant are severely shaken and shaken.

C. The water leakage is large, and the ball valve cannot be flattened. In 2009, 2011, and 2012, the pressure difference between the ball valve before and after the ball valve exceeded 2 MPa (the ball valve can only open when the pressure difference is less than 1 MPa). It can only increase the working oil pressure of the oil pump to open the ball valve forcibly, which is extremely dangerous.

3. Analysis and Countermeasures

3.1 Causes of Severe Damage to Overcurrent Components and Vibration

3.1.1 Investigation of Sediment Situation and Analysis of Main Reasons for Damage of Over-Current Components

The average ratio of the natural drop of the Jintang River channel dropped by about 4.23%. The mineral composition of the basin is mainly chlorite, and contains a small amount of hard minerals such as quartz, feldspar, and amphibole. The content of hard minerals with a Mohs hardness greater than 5 in the suspended matter is 5.1% to 19.9%, and the relative hardness is relatively large. The vegetation in the basin is good, with virgin forests in the upper reaches and sparse population, and human activities in the middle and lower reaches are more frequent. Because the upper reaches are remote, rich in minerals, a large number of private minerals are being extracted, and roads, forests, and slopes are planted to change the natural environment, thereby increasing the erosion of soil by surface runoff was increased, and the sand content of rivers increased significantly during the flood season. The total storage capacity of the reservoir is 697,000 m3, and the adjusted storage capacity is 314,100 m3 (actually adjusted storage capacity is about 150,000-200,000 cubic meters). It belongs to a small reservoir and has a very low sediment capacity. The average sediment content of suspended sediment in storage for many years is 100g / m3, the average annual sediment transport volume is 96,200 tons, the average annual sediment content for flood season (June to October) is 134g / m3, and the average annual sediment transport volume is 84,500 tons. It accounted for 87.8% of the annual sediment transport volume. Among them, the amount of sediment transported in July accounted for 45.4% of the annual sediment transport. The annual sediment transport volume is 39.491 thousand tons[1].

After analysis, everyone agreed that the main cause of severe damage to the flow components was due to the heavy sediment content and high hardness of the sand. The flow velocity at the flow components reached more than 58 meters per second (the distance between the 23 guide vanes is about 6 Cm, height 23 cm, single machine rated flow rate 18.5 m3 / s), driven by high-speed water flow, the erosion of over-current components caused by high-speed erosion will cause damage. Combined with the nearby Huaneng Lengzhuguan and Xiaotian hydropower stations, it is even more It was confirmed that silt was the culprit[2].

3.1.2 Guide Vane Damage Analysis
Guide vane damage is mainly ① the water front, ② the tail and the top cover or the bottom ring; ① the water front damage is obviously the impact abrasion of the sand on the guide vanes in the high-speed water flow; ② the tail and the top cover or the bottom ring damage It is: cavitation and abrasion caused by water flow disturbance after the top cover or bottom ring is damaged[3].

3.1.3 Analysis of Top Cover and Bottom Ring

The damage to the top cover and the bottom ring is mainly near the rear of the guide vane journal. In order to ensure the self-closing performance of the unit (guide vane), the guide vanes are eccentric. When passing through the second half of the protective cover, it causes the water flow to impact the top cover or bottom ring at high speed (58 meters, seconds), causing erosion of sediment, forming pits, and then causing water flow disturbances, changing design conditions, causing losses and causing efficiency Drop and vibration[4].

Through Analysis, There Are Two Main Ways to Solve the Countermeasures:

A. Shorten the overhaul period: shorten the overhaul period, repair the overcurrent components in time, keep the equipment intact, greatly eliminate the harm caused by the serious damage of the overcurrent components, greatly eliminate the major safety hazards of the power station, and Greatly improve the safety and reliability of the unit and lay a good foundation for the safe operation of the power station.

B. Spraying of over-current components: Through the research on abrasion of over-current components, adopt new technologies, new processes, new formulas, etc. to spray over-current components of the unit, increase the ability of anti-sand erosion, and keep the equipment intact, thereby eliminating Hazards caused by severe damage to flow components, eliminating major safety hazards in power stations, and improving unit safety and reliability[5].

As the second method requires an investigation and research process, we use two methods in parallel, and immediately reduce the overhaul period. The unit overhaul will be immediately overhauled after two flood seasons to resolve the current major safety crisis, and at the same time carry out anti-current component Abrasive investigation and research.

Conclusion

Based on the above analysis, for hydro-generator units with high sediment content and severe damage to the overcurrent components of the unit, the maintenance procedures cannot be copied blindly, and overhauls should be arranged according to the 4-6 year cycle. Policies must be formulated according to local conditions and combined with the actual situation of the power station. Shorten the overhaul period. The Jinkang power station is currently set to 2 years. From the perspective of practical application effects, it is very significant. Not only greatly improves the safety and reliability of the equipment, but also solves the severe vibration and vibration phenomena of the unit and the plant. A series of major safety hazards, at the same time increase power generation, increase power station income, and create significant safety and economic benefits; therefore, a reasonable shortening of the overhaul period can eliminate major safety hazards and create huge safety and economic benefits.

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