

# Kangding County Sandaoqiao Hydropower Station Installed Capacity Adjustment Optimization Report

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## Four. Economic Assessment

### 1, Preliminary Figures

#### (1) Operation Scale and Construction Timeline

The installed capacity of Sandaoqiao hydropower station is 30kW. According to the proposal of this station's construction timeline, project scale, construction conditions and the requirements that the project owner made on the total construction period, the project's construction period is three years.

The average power generation of this station over years is 157.38 million kWh. The valid electricity factor of this station is considered to be 0.8 temporarily. The yearly electricity generation of this station is shown in Table Four.

Table Four

unit: million kWh

Year	Power Generated	Valid Electricity	Power on the Grid
Year four and after	1.5738	1.25904	1.25526

Note: auxiliary electricity consumption rate is 0.30% , Power on the grid = Effective Power  $\times$  (1- auxiliary) .

#### (2) Baseline Yield

The baseline yield is 6.12%.

#### (3) Calculation Period

Based upon the construction schedule, the total construction period of the power station is three year, and the production operation period is 30 years. Thus the calculation period is 33 years in total.

## 2, Investment Plan and Fundraising

### (1) Assets Investment

Based on the further analysis and calculation of the power station's investment, by utilizing the 2005 price level, the static total investment of the construction is 162.248 million RMB. According to the National Plan Committee (1999) No. 1340 Official Document, with the consideration of the price difference, the total asset investment of this power station is 162.248 million RMB.

According to the national regulation and requirements for the debt, there must be certain amount capital in cash input during the construction of the project. The capital in cash of this project is 30% of the total investment, and the rest of the investment is from the bank

loan. The capital in cash will be used in the project at certain ratio over years. The capital cash is not required to pay back or with the interest. The profit will be distributed at an annual distribution rate of 8%, since the first set of the generation is in operation. The bank loan will be considered as the commercial bank loan, and during the same time the interest is 6.12% for the bank loan in the country with a pay period of five years or more.

## (2) Interest During the Construction Period

The interest of the bank loan is calculated as the compound interest, and after the calculation, the interest during the construction period of this power station is 7.9255 million RMB, which is included in the value of the fixed assets.

## (3) Total Investment

The total investment of Sandaoqiao hydropower station is 170.4135 million RMB (including working capital), where the fix asset investment is 162.248 million RMB, 95.21% of the total investment. The interest during the construction period is 7.9255 million RMB, which is 4.65% of the total investment. After all the generators are in operation, the power station will form the fixed assets with a value of 170.1735 million RMB, by not considering intangible and deferred assets temporarily.

## 3, Total Cost Calculation

The exporting construction does not have to be considered at this moment; therefore, the total cost of the construction is the cost for power generation.

The power generation cost of the station includes depreciation cost, repairing cost, project insurance cost, employees' wages, benefits, social insurance, health insurance, employment insurance and housing accumulation funds, material cost, interest payment, and other expenses. The operating capital is the total cost excluding the appreciation cost and the interest pay out.

depreciation cost = fixed asset value  $\times$  net depreciation rate

repairing cost = fixed asset value  $\times$  net repairing rate

insurance cost = fixed asset value  $\times$  net insurance rate

Where, the fixed asset value = fixes assets investment + interest during construction period

The net depreciation rate of the power station is 4.0%, and the repairing cost will be counted as 1.50% of the total fixed asset value:

employees' wages = number of employee  $\times$  average annual salary

Sandaoqiao power station is planned to have a fixed staff member of 33, and the average salary of these employees is 17220 RMB (including benefits, housing accumulation funds and social insurance).

According to the relevant regulations and the latest official documents, the employee's benefit cost is 40% of the salary.

The material cost is fixed as 5.0 RMB/kW.

The maintenance cost of the reservoir area and water resources cost are 0.001 RMB/kWh and 0.05 RMB/kWh, respectively.

Other cost is fixed to be 24.0 RMB/kW.

As the financial expense, the fixed asset investment debt during the production period and the interest of the working capital loan will be both included into the total cost.

#### 4, Tax

According to the regulations, the hydropower station has to pay the value added tax, additional sales tax and income tax, where the value added tax is extra price tax, and here is only used as the basis for the additional sales tax calculation. Sandaoqiao hydropower station is a small local hydropower station, and the value added tax rate is 17%.

##### (1) Additional Sales Tax

The additional sales tax includes the additional education tax and the city maintenance construction tax, where the tax rate is 3% and 5% respectively, using the value added tax as the calculation basis.

##### (2) Income Tax

The company's profit will be adjusted accordingly based upon the regulations and pay the income tax by law. According to the country's Western Development policies on hydropower station investment, the income tax is exempted for the first three years, and the income tax rate is 15% after three years.

Income tax = taxable income × income tax rate

Taxable income = power generation sales income - total cost – additional sales tax

#### 5, Power Generation Profit Calculation

##### (1) Sales Income

The grid price will be considered as 0.207 RMB/kWh (included value added tax), and will be kept the same during the calculation period (operation period)

##### (2) Profit

Power generation profit = Power generation income – total cost – additional sales tax

Profit after tax = power generation profit – income tax

The legal surplus accumulation fund and the public welfare fund will be deducted from the profit after tax as 10% and 5% of it respectively. The rest will be the distributable profit, from where the profit distributed to the investors (distributed using a 8% profit distribution rate) will be deducted, and the rest part is undistributed profit.

## 6, Payoff Ability Analysis

### (1) Debt Payment Capital

The debt payment capital includes the undistributed profit and depreciation cost. All the undistributed profit and 90% of the depreciation cost will be used to payoff the debt.

### (2) Payback of Debt's Capital and Interest Calculation

The grid price of 0.207 RMB/kWh is used in the calculation for the payback of debt's capital and interest. The results showed that the fixed asset investment debt and its interest will be paid off 12 years after all the generators in this project are in operation. The payback period of the debt is 15 years, which is shorter than the regulated less than 20-year debt payback time for normal hydropower station.

### (3) The Capital Source and Utilization

The calculation shows that the debt rate of the station during the construction period is relatively high (as high as 71.44%). However, as the generators are in operation and start to generate power, the debt rate is going to decrease quickly. After paying off the fixed capital investment debt and its interest, the capital debt rate will be very low, which is below 4.67%. This means the project has a low financial risk, with a strong ability of paying off the debt

### (4) Profitability Analysis

By calculating the financial profitability index, the total investment internal financial rate of return (IRR) is 7.88%, which is higher than the bank debt interest of 6.12%; the investment payback period is 11.33 years.

## 8, Sensitivity Analysis

Financial sensitivity analysis analyzes the sensitivity of the index and mainly to investigate the impact level from the individual changes of static investment, grid power price, operation cost and other uncertain factors on the internal financial rate of return and other financial index (range of change is +/- 20%). The financial sensitivity analysis result is shown in the Table 5 below.

Table 5

No.	Change Index	Base Value	+20%	+15%	+10%	5%	0%	-5%	-10%	-15%	-20%
1	Grid Price (RMB/kw.h)	0.207	0.248	0.238	0.228	0.217	0.207	0.197	0.186	0.176	0.166
	FIRR		10.25%	9.69%	9.12%	8.48%	7.88%	7.27%	6.58%	5.93%	5.26%
2	Static	16249	19499	18686	17874	17061	16249	15437	14624	13812	12999

3	Investment (10 <sup>4</sup> RMB)										
	FIRR		6.14%	6.53%	6.95%	7.40%	7.88%	8.40%	8.98%	9.60%	10.29%
	Operation Cost (10 <sup>4</sup> RMB)	525	630	604	578	551	525	499	473	446	420
	FIRR		7.16%	7.34%	7.52%	7.70%	7.88%	8.06%	8.23%	8.40%	8.58%

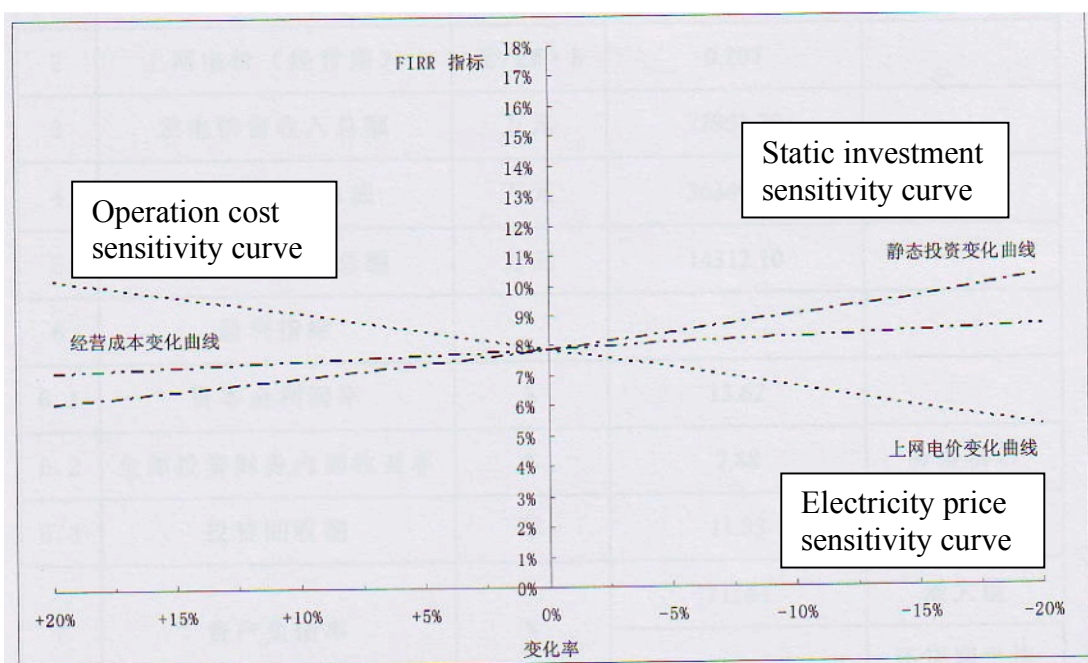


Table 5 shows that during sensitivity analysis process for the price in the operation period, static investment and capital in the operation period, their total investment internal financial rate of returns change in the range of 5.26% - 10.25%, 6.14% - 10.29%, 7.16% - 8.58% respectively. The IRR is most sensitive to the changes of the grid price in the operation period, and least sensitive to changes of the operation capital.

## 9, Financial Assessment Conclusion

The project's financial assessment index summary is shown in Table 6.

Table 6

Series No.	Item	Unit	Index (30MW)	Remarks
1	Total Investment	10 <sup>4</sup> RMB	17041.35	Including working capital
1.1	Fixed Assets Investment	10 <sup>4</sup> RMB	17017.35	
	Where: Static Total Investment	10 <sup>4</sup> RMB	16224.80	
1.2	Interest during Construction Period	10 <sup>4</sup> RMB	792.55	

1.3	Working Capital	10 <sup>4</sup> RMB	24.00	
1.4	Capital Cash	10 <sup>4</sup> RMB	4867.44	
2	Power Grid Price (during operation)	RMB/kw.h	0.207	
3	Total Sales of Power Generation	10 <sup>4</sup> RMB	77951.70	
4	Total Cost and Expenses	10 <sup>4</sup> RMB	36349.55	
5	Total Additional Sales Tax	10 <sup>4</sup> RMB	14,312.10	
6	Profit Index			
6.1	Capital Profitability Rate	%	13.62	
6.2	Total Investment Financial Internal Rate of Return	%	7.88	With income tax deducted
6.3	Investment Payback Time	Year	11.33	With income tax deducted
7	Capital Debt Rate	%	71.44	The maximum value
				The average value during payback period
8	Unit Investment Index			
8.1	Static Unit kW Investment	RMB/kW.h	5408.27	
8.2	Dynamic Unit kW Investment	RMB/kW.h	5680.45	Excluding working capital
8.3	Static Unit kW.h Investment	RMB/kW.h	1.03	
8.4	Dynamic Unit kW.h Investment	RMB/kW.h	1.08	Excluding working capital
9.5	Average Power Generation Capital during Operation	RMB/kW.h	0.1151	Including depreciation and interest

	Period			
9.6	Average Operation Cost during Operation Period	RMB/kW.h	0.0609	

A grid price of 0.207 RMB/kW.h during the operation period was used for the calculation of the financial index in this project. The total investment financial internal rate of return is 7.88%, which is higher than the bank debt interest, 6.12%. The payback time of investment is 11.33 years, and the capital profitability rate is 13.62%, with a certain amount of profit. The debt payback period is 15 years, and the bank debt with interest can be paid off within 20 years. Therefore, this project has certain payoff ability.

The sensitivity analysis shows that the project has certain risk resistant ability, however, the uncertain factors have some impacts on the station's total investment financial internal rate of return.

In summary, if the total installed capacity of this project is adjusted to 30MW, it is financially feasible.

#### Five, Conclusion

In conclusion, we think that it is economically feasible to adjust the installed capacity for this power station from 24MW to 30MW. When the design flow rate increases from  $5.84\text{m}^3/\text{s}$  to  $7.55\text{m}^3/\text{s}$ , the initial chosen hydraulic structure's flow measurement parameters will not be greatly impacted. As one the major invested items, the hydraulic tunnel's diameter will be determined by the minimum cut surface, as the construction required. After the adjustment of the capacity, the tunnel flow rate will change from  $1.86\text{m}^3/\text{s}$  to  $2.36\text{m}^3/\text{s}$ ,

No.	Items	Total	Construction period (years)			Operation period (years)							
				1	2	3	1	2	3	4	5	6	7
Basic parame ters	Installed Capacity(kW)	30000					30000	30000	30000	30000	30000	30000	30000
	Utilization hours (h)	5246					5246	5246	5246	5246	5246	5246	5246
	Power generation(10000kWh)	47214 0					15738.0 0	15738.0 0	15738.0 0	15738.0 0	15738. 00	15738. 00	15738. 00
	Sales of electricity (10000kWh)	37657 8					12552.6 0	12552.6 0	12552.6 0	12552.6 0	12552. 60	12552. 60	12552. 60
	Grid price(yuan/kWh)	0.207					0.207	0.207	0.207	0.207	0.207	0.207	0.207
1	cash inflows (CI)												
1. 1	Income of saling power	77951 .70					2598.39	2598.39	2598.39	2598.39	2598.3 9	2598.3 9	2598.3 9
1. 2	Residual value of fixed assets recovered	0.10											
1. 3	Floating Capital recovered	24.00											
	Subtotal of cash inflows	77975 .80					2598.39	2598.39	2598.39	2598.39	2598.3 9	2598.3 9	2598.3 9
2	Cash outflows(CO)												
2. 1	Investment in fixed assets(Total investment)	16224 .80		2573. 81	4751. 15	8899. 84							
2. 2	Floating Capital(Total investment)	24.00				24.00							
2. 3	Annual Operatiing Cost	15747 .30					524.91	524.91	524.91	524.91	524.91	524.91	524.91
2. 4	Sales tax and surcharges	14312 .10					477.07	477.07	477.07	477.07	477.07	477.07	477.07
2. 5	Income tax	3890.							101.51	101.51	101.51	101.51	101.51



		53										
	Subtotal of cash outflows	50198 .73	2573. 81	4751. 15	8923. 84	1001.98	1001.98	1103.49	1103.49	1103.4 9	1103.4 9	1103.4 9
3	Net cash flows before income tax	31667 .60	-2573 .81	-4751 .15	-8923 .84	1596.41	1596.41	1596.41	1596.41	1596.4 1	1596.4 1	1596.4 1
4	Accumulated net cash flows before income tax		-2573 .81	-7324 .96	-1624 8.80	-14652. 39	-13055. 98	-11459. 57	-9863.1 6	-8266. 75	-6670. 34	-5073. 93
5	Net cash flows after income tax	27777 .07	-2573 .81	-4751 .15	-8923 .84	1596.41	1596.41	1494.90	1494.90	1494.9 0	1494.9 0	1494.9 0
6	Accumulated net cash flows after income tax		-2573 .81	-7324 .96	-1624 8.80	-14652. 39	-13055. 98	-11561. 08	-10066. 18	-8571. 28	-7076. 38	-5581. 48
	Calculation indexes											
(1)	Net financial present value											
	Discount factor(Ic= )	7.80%	0.927 6	0.860 5	0.798 3	0.7405	0.6869	0.6372	0.5911	0.5483	0.5087	0.4719
	Net present value FNPV=	108.4 0	-2387 .47	-4088 .36	-7123 .90	1182.14	1096.57	952.55	883.64	819.65	760.46	705.44
(2)	Financial IRR (FIRR after tax)											
	Discount factor(i= )	7.80%	0.927 6	0.860 5	0.798 3	0.7405	0.6869	0.6372	0.5911	0.5483	0.5087	0.4719
	Net present value FNPV=	108.4 0	-2387 .47	-4088 .36	-7123 .90	1182.14	1096.57	952.55	883.64	819.65	760.46	705.44
	Discount factor(i= )	7.90%	0.926 8	0.858 9	0.796 0	0.7378	0.6837	0.6337	0.5873	0.5443	0.5044	0.4675

	Net present value	FNPV=	-25.98	-2385.41	-4080.76	-7103.38	1177.83	1091.47	947.32	877.95	813.67	754.03	698.87
(3)	Calculation parameters for static investment recovery period (years)	10											
		1494.90											
		-1096.78											
	Static investment recovery period ( including construction period)	13.73					Construction period 3 year + Operation period 10 year + $\frac{ -1096.78 }{1494.9} = 13.73$ year						
(4)	Financial IRR(FIRR)	7.88%					$7.8\% + 108.4 \div (108.4 +  -25.98 ) \times (7.9 - 7.8)\% = 7.88\%$						