A study on decision making for replacement on old hydroelectric facilities based on RBM

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ABSTRACT

Hydroelectric power plants are operated with various types of hydroelectric power plants. The aging of these facilities is increasing the importance of stabilizing the facilities for stable power generation, and the demand for the reliability of such facilities is continuously increasing. In this study, the evaluation items of hydropower generation facilities such as water turbines, generators, control facilities, auxiliary facilities, transformers, transmission facilities, etc. were developed and the technology for evaluating the hydroelectric power plant technology was developed and the RBM technique And to make optimal decision making of alternate hydropower facilities.

1. TECHNIQUE EVALUATION

Table 1. is the hydroelectric power plant is divided into mechanical equipment such as turbine, generator, control equipment, auxiliary equipment, electrical equipment, transformer, and transmission equipment. Hydro AMP, Hydro CAP, and HAP reports were used to select the evaluation items and discuss the expert questionnaire and the expertise of each facility. Table 2. is the condition index is derived from the obtained weight and evaluation criteria. The derived ci is divided into a, b, and divided into 10 levels and associated with the failure probability class.

Table 1. Classification of equipment parts for evaluation of hydraulic equipment aging

Group	Main facilities (Unit)
Ⅰ	Turbine
	generator
	Control equipment
	Ancillary equipment
Ⅱ	Transformers
	Transmission equipment

Table 2. Condition Index and Failure Probability Grade Relationship

Breakage probability (Likelihood)	CI ; Condition Index
Ⅴ Almost Certain	0 ~ α/3
	α/3 ~ α×2/3
Ⅳ Likely	α×2/3 ~ α
	α ~ (β-α)/4+α
Ⅲ Possible	(β-α)/4+α ~ (β-α)×2/4+α
	(β-α)×2/4+α ~ (β-α)×3/4+α
Ⅱ Unlikely	(β-α)×3/4+α ~ β
	β ~ (10-β)/3+β
Ⅰ Rare	(10-β)/3+β ~ (10-β)×2/3+β
	(10-β)×2/3+β ~ 10

2. ECONOMIC EVALUATION

Fig 2. is the economic evaluation method uses the investment cost and the operating cost to obtain the annual equivalent cost, obtains the years of use of the equipment with the minimum annual equivalent cost, and determines the economic life of the equipment. The economic life span is calculated by substituting the derived economic life in Eq. 1, as shown in Table 3.

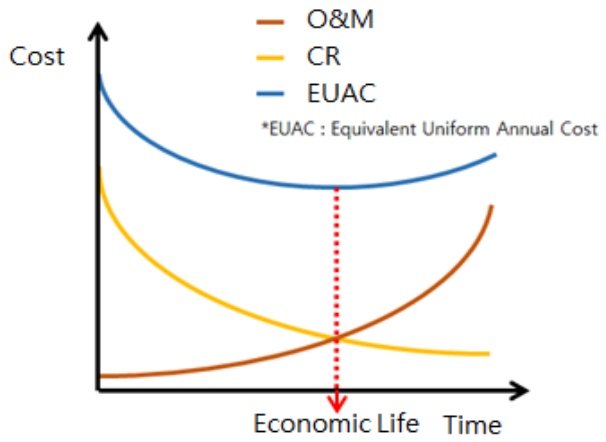

Figure 1. Concept of annual equivalent cost

$$Economic life\ utilization = \left(\frac{Year of\ use}{Economic\ life}\right) \times 100\% \quad (1)$$

Table 3. Economic rating index grade

Economic life utilization	등급
Economic life utilization > 90%	a
80% < Economic life utilization ≤ 90%	b
70% < Economic life utilization≤ 80%	c
60% < Economic life utilization ≤ 70%	d
Economic life utilization ≤ 60%	e

3. OVERALL EVALUATION OF HYDROELECTRIC POWER GENERATION FACILITIES

The RBM concept was used to determine whether to replace the dog by using the probabilistic class obtained from the technical evaluation and the economic evaluation index class obtained from the economic evaluation. The technical evaluation was judged to be more important than the economic evaluation, and the technical evaluation score was multiplied by 2 times the economic evaluation score to obtain Fig 2. Table 4. shows the classification according to the scoring range. Fig 3. is the RBM matrix of the evaluation of the decision to replace the hydraulic facilities obtained from the breakdown probability grade and the economic evaluation index according to the grade, and the measures for each grade are shown in Table 5.

Table 4. Classification according to range of points

Range of points	18~21	22~24	25~30
Rating	C	B	A

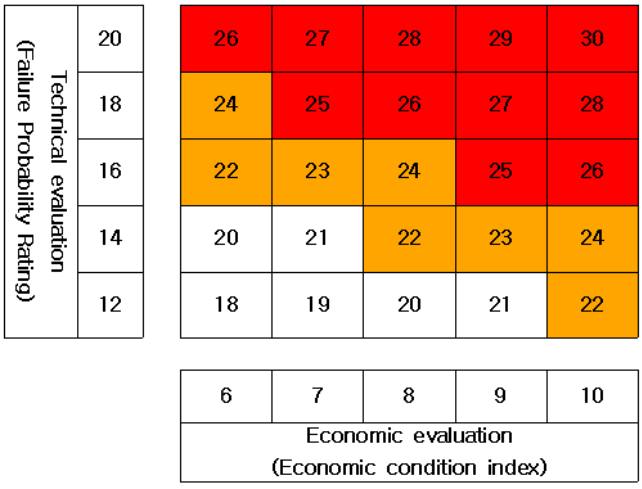

Figure 2. Breakage probability grade and economic evaluation index point

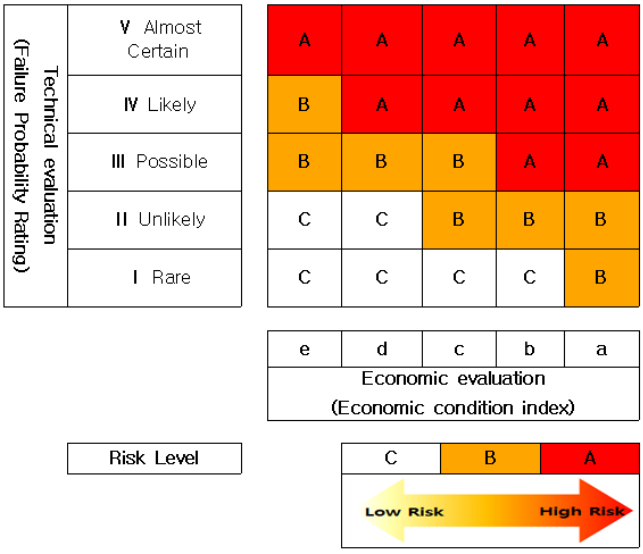

Figure 3. Hydraulic equipment expansion and replacement decision RBM

Table 2. Measures by collective judgment grade

Grade	Action plan	Meaning of grade
A	Immediate replacement	Failure mode that can cause serious consequences if the system is sufficiently degraded and continues to fail due to a fundamental failure of the system - Immediately, after replacement plans are established
B	Management of trends	Since deterioration is progressing to some extent according to aging, the deterioration tendency is continuously monitored and reevaluation will be carried out in the future.
C	Normal maintenance	Conducting normal operation and maintenance

4. CONCLUSION

We obtained the RBM Matrix for the evaluation of alternative hydraulic power facilities, which is different from that of the existing RBM, through the technical evaluation obtained from experts' questionnaires and the data obtained from experts in each field and the economical evaluation obtained through the annual equivalent method.

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