The Effect Evaluation of Labor Protection Equipment Allocation in Power Supply Enterprises: A Study of Central Provinces in China

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Abstract. The allocation and correct use of labor protection equipment is an effective means to reduce occupational hazards and emergencies in special industries. Constructing allocation effect index system of labor protection equipment in the power supply enterprises, this study comprehensively evaluates personnel Labor protection equipment allocation situation, and diagnosis allocation of the whole process of the lack of links. The evaluation results show that, taking a central province as an example, the overall score of labor protection equipment in power supply enterprises is 75.76, which can meet the basic needs of operators. At the same time, some deficiencies are found including that the effectiveness of labor protection equipment allocation system is somewhat deficient, the workers’ cognition for labor protection equipment and occupational health protection needs to be improved, and the aesthetics and comfort of labor protection equipment still have room for improvement. The research results provide an effective reference for the development of electric power industry and the status assessment of other industries.

1. Introduction

Strengthening labor protection is the main methods to reduce occupational hazards of special types of work at the source and in the process of operation. When production and operation enterprises and construction workers do not comply with individual labor protection standards, it is extremely easy to cause dangerous accidents [1]. The allocation and correct use of labor protection equipment is the most significant part of labor protection management [2]. Previous researches have shown that the correct use of labor protection equipment can effectively prevent or reduce the occurrence of dangerous accidents or occupational diseases in the production process of special industries such as electricity [3]. At present, Chinese enterprises have some problems in the allocation of labor protection equipment [4]. For example, the applicability and comfort of labor protection equipment for power supply enterprises are still deficient, and the individual labor protection equipment for power industry should be crucially concerned [5]. Effective management of labor protection equipment can decrease the intensity of labor protection management, improve the efficiency of labor protection equipment, and enhance the status quo of enterprise labor protection [6]. Therefore, according to the current
situation of labor protection management in the electric power industry, workers' awareness of labor protection and feelings of using labor protection equipment should be paid more attention.

2. Establishing the evaluation index system for the equipment effectiveness of labor protection

2.1. The evaluation index system for the equipment effectiveness
The perfect degree of the power supply enterprise labor protection equipment equipment system is a comprehensive evaluation method for the scientific, practical and effective operation of the system. The selection of the technical methods for the evaluation of the equipment effectiveness should be able to evaluate the effects and benefits brought by the equipment of labor protection equipment in power supply enterprises under the framework of the equipment system. The evaluation object should fully include the subjective perception (such as operators' satisfaction with the use of labor protection equipment, effectiveness and practicability of the equipment), satisfaction of technical requirements and management cost of enterprise operation. As shown in Figure 1, we construct the evaluation index system for the equipment effectiveness of Labor protection equipment for power supply enterprises.

![Figure 1. The evaluation index system for the equipment effectiveness of Labor protection equipment for power supply enterprises.](image)

2.2. Designing questionnaire based on the index system

2.2.1. Questionnaire structure. The evaluation index system for the equipment effectiveness of Labor protection equipment for power supply enterprises mainly includes the management cost of operating enterprises, operators' satisfaction with the use of labor protection equipment, effectiveness and practicability of the equipment, and the satisfaction of technical requirements. Among them, the management and operation cost is the objective consideration of the enterprise operation, and the other four aspects are mainly the subjective feelings of the operators. In order to ensure the accuracy of the assessment, data can be obtained through questionnaire survey, and the assessment value of labor protection equipment can be obtained by option assignment. The full score of the questionnaire is 100 points. The questionnaire structure includes the basic personal information, the effectiveness and practicability of the provisioning system, the subjective feeling of the use of the equipment, and the satisfaction of the technical requirements.

2.2.2. Questionnaire design. There are three aspects in the assessment of the operators' satisfaction with the technical requirements of labor protection equipment system. On the one hand, the job protection demand satisfaction is investigated, and the enterprises are asked whether the workers are
equipped with necessary labor protection equipment. On the other hand, we measure the satisfaction of the equipment and ask whether the labor protection equipment issued by the enterprise can meet the requirements of job protection. In addition, the satisfaction with the training situation is asked whether the enterprise organizes training about labor protection equipment and benefits from the training. And the type of training preferred by the operators is also asked. The score varies from 0 to 5 points, and the total score is 20 points.

The effectiveness of labor protection equipment system is evaluated from three aspects: the cognition of labor protection equipment, the cognition of job risk and the correct wearing of labor protection equipment. The design question of cognitive assessment of labor articles is "which of the following belongs to labor protection equipment". This question is multiple and has four correct options. The cognition of job risk is assessed by two questions: one is "which of the following operations is correctly equipped with labor protection equipment". The second is to reply to the occupational hazard factors according to the situation of individual positions. The correct answers of each job position are different. The investigation of the correct wearing of labor protection equipment is to ask the interviewees whether they know the correct way of wearing. 5 points for correct answers, 3 points for incomplete answers, and 0 points for incorrect answers. The total score for this part is 20 points.

In the evaluation of the utility of the labor protection equipment system for power supply enterprises, the question of the usage situation is "Are you willing to wear labor protection equipment during the work". The custody situation has two problems. One is "How do you deal with the placement of labor protection equipment after the operation". Another is "How to manage labor protection equipment in your work group (personal or group custody)". Three questions are set in terms of the replacement situation, which are respectively "Under what circumstances do you change labor protection equipment?", "How to deal with the replaced labor protection equipment?" and "Do you think the replacement cycle of existing labor protection equipment is reasonable?". Among them, some questions have no correct answers and are only used as reference questions to understand the current situation of the use of labor protection equipment. The total score for this part is 20 points.

To investigate the subjective feelings of labor protection equipment used by front-line workers in power supply enterprises, seven categories of labor protection equipment (including summer work clothes, winter work clothes, summer work shoes, winter work shoes, gas masks, dust masks and earplugs) are selected as evaluation objects. According to the actual use situation, front-line workers make subjective evaluation on the aesthetics, convenience, comfort and protection of the labor protection equipment. The rating is "very good", "good", "general", "poor", etc., and the score is 10, 8, 6, and 2. In some low-risk operations, it is not necessary to wear gas masks, dust masks and earplugs, and the corresponding operators do not evaluate the labor protection equipment which they do not wear. The total score for the assessment of the feelings of the front-line workers on the use of labor protection equipment is 40 points.

3. Empirical analysis

3.1. Questionnaire distribution and statistics
This study evaluates the situation of labor protection equipment in power supply enterprises in central China, and the research object is the front-line employees of the power industry in this province. The labor protection equipment of the same type of work in the electric power industry in this region is completely the same and conforms to relevant laws and regulations. A total of 94 valid questionnaires were collected for the study.

3.2. Evaluation of labor protection equipment in power supply enterprises

3.2.1. Evaluation of technical requirements satisfaction. Operators' satisfaction with the technical requirements of labor protection equipment system in power supply enterprises was 15.74, which
showed a good overall situation. Labor protection training plays an effective role in enhancing the labor protection awareness of power supply enterprise employees and correctly using labor protection equipment. According to the statistics of favorite training types, on-site demonstration and operation are better choices in the following training management.

3.2.2. Evaluation of equipment system effectiveness. It scored 9.14 out of 20 on the effectiveness assessment of the protection system. In order to investigate the case of power supply enterprise front-line staff awareness of occupational risk factors, the positions of front-line personnel are divided into 6 categories according to the types of exposure risk factors, and the classification is shown in Table 1. According to the assessment results, the scores of workers on the knowledge of occupational hazards, the knowledge of labor protection equipment and the correct use of protective equipment were 1.08, 0.77 and 2.02 respectively. Workers lack a comprehensive understanding of how to use labor protection equipment, lack of occupational risk awareness.

### Table 1. Classification and sorting of risk factors for power supply enterprises' front-line jobs.

| Number | Jobs | Risk factors |
|--------|------|--------------|
| 1      | Live work, Distribution maintenance, Transmission maintenance, Substation secondary maintenance | High temperature, Ultraviolet radiation, Power frequency Electric field, Noise |
| 2      | Cable maintenance | High temperature, Power frequency Electric field, Ultraviolet radiation |
| 3      | Substation overhaul once | High temperature, Ultraviolet radiation |
| 4      | Electrical test | Dust, Chemicals, Power frequency Electric field, Noise |
| 5      | Installation of meter power, Meter reading | High temperature, Chemicals |
| 6      | Inspection and testing, Business charges, Hotline | High temperature, Ultraviolet radiation |

3.2.3. Evaluation of the utility of equipment system. The practical evaluation score of the labor protection equipment system was 17.80. There are 96.8 % of respondents said they wear labor protection equipment throughout the work, 62.8 % clearly know that labor protection equipment should be kept sealed separately, and 92.6 % believe the current cycle of replacing labor protection equipment is reasonable. The labor protection equipment system of power supply enterprises in this province is practical.

3.2.4. Evaluation of labor protection equipment usage experience. Front-line workers of power supply enterprises evaluated the subjective feelings of the performance of four categories of seven labor protection equipment, and the results are shown in Figure 2. Evaluation results show that the power supply business line workers have good feelings about the use of summer work cloths and winter work cloths, the aesthetic and comfort of the summer work shoes and winter work shoes are less satisfactory. The convenience and protection of labor protection equipment being used by power supply enterprises can meet the needs of users, and there is still room for improvement in comfort and aesthetics.

4. Conclusions
In this study, the effect of labor protection equipment in a power supply enterprise in a central province of China was comprehensively evaluated by establishing an index system for evaluating the effect of labor protection equipment. Main conclusions are as follows: (1) The evaluation results show that the power supply enterprises in the province scored 15.74, 9.14 and 17.80 points for satisfaction, effectiveness and practicability of labor protection equipment system technology. The evaluation
system has great room for improvement in the effectiveness of the equipment system. (2) The workers lack a comprehensive understanding of how to use labor protection equipment correctly and the awareness of occupational risk prevention. (3) Labor protection equipment in this province can meet the basic use needs of operators, but it is still deficient in aesthetics and comfort. The research results can provide reference for the management of labor protection equipment in power supply enterprises and the evaluation of labor protection equipment in other industries.

![Figure 2. The evaluation results of the satisfaction of the front-line workers of power supply enterprises on the use of labor protection equipment.](image)

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