

Research on Human Resource Management and Training in Electric Power Companies

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Abstract: The current situation is that the Chinese electric power industry is entering an important stage of transformation: the in-depth construction of smart grids, the acceleration of the iteration of energy structures and the full implementation of the "dual-carbon", the traditional power system will be transformed and upgraded comprehensively and profoundly into a new power system. Electric power companies, as the main body ensuring the national energy security and guaranteeing the stable operation of power grid, require new development needs such as intelligent production, digitalized operations, refined operation and maintenance and standardized safety control, which brings higher level challenges and demands on their human resource management systems and employee training mechanisms. In this paper, we systematically analysed the existing problems in human resource management and employee training in electric power companies, put forward corresponding optimization strategies which are scientific, digitalized and scenario-based to improve the talent cultivation system of electric power enterprises, matching the development of talent teams with the trends of smart grids and new energy industries, providing solid talent support for the high quality transformation and upgrading of the electric power industry and green and low-carbon development of the energy sector.

Keywords: electric power companies; human resource management; employee training; new power system; talent development

1. Introduction

This is an important time to fully build a new power system, deep promotion of the energy revolution and implement the "dual-carbon" strategy during the 15th Five-Year Plan period; we deepen the structural reform on the energy supply side and actively promote the coordinated upgrade of the electric power industry from the aspects of intelligence, digitalization and green development, which has put forth brand-new and strict requirements for the professional, interdisciplinary and innovative development of the talent team in the power industry^[1]. With the large-scale integration of new energy into the grid, the intelligentization of grid dispatching, the digitalization of operation and maintenance service and the diversification of energy services, the traditional human resource management mode and talent cultivation system of electric power companies cannot meet the development rhythm and post competency requirement of the power industry in this new stage^[2]. To actively adapt to the energy development strategy and deployment of the 15th Five-Year Plan, consolidate the core competitiveness of enterprises, electric power companies urgently need to innovate its human resource management concept, restructure a refined, digitalized and practical employee training system, improve post competency evaluation and talent incentive mechanism, establish a talent cultivation ecosystem that suits the construction of the new power system, constantly optimize the talent team structure, improve the professional quality of all staff so as to facilitate the high-quality and sustainable transformation and upgrading of the power industry, provide solid talent support for the implementation of the national energy security and green low-carbon development strategies^[3].

2. Importance of Human Resource Management and Training in Electric Power Companies

2.1 Enhancing Operational Efficiency and Enabling High-Quality Development

In addition to coordinating its core business operations (power generation, transmission, distribution, dispatching), for an efficient and stable operation of electric power companies, it is necessary to have a standardized human resource management system that has a high quality talent team^[4]. The scientific

human resource management will optimize the corporate organization structure, define the boundary of authority and responsibility at every position, allocate human resources rationally, streamline redundant management process, effectively avoid waste of human resources and comprehensively improve the internal operating efficiency of the enterprise; Meanwhile by setting up a standardized post competency model and improvement of performance appraisal and incentive mechanism, we can accurately match personnel and positions, fully activate post execution capability and organizational flexibility which support us to efficiently implement our core businesses like power production and grid dispatching.

The regular systematic employee training is the key to increasing the standardization level of post operations, employees' professional skills and vocational competencies^[5] in emerging high-tech businesses like smart grid operation and maintenance, new energy grid integration and automated dispatching so that they can quickly master new technologies, grasp new equipment and adapt to new processes which shorten their adaptation cycle for skill iteration, avoid equipment failure and process delay due to skill gap or improper operations and reduce corporate operating cost. Deep integration and coordinated effort between human resource management and employee training allows electric power companies to continuously improve their production and operational efficiencies, improving market responsiveness and overall operational economy with strict adherence to the bottom line of safety and compliance; laying a solid foundation for high quality development of the enterprise.

2.2 Consolidating the Bottom Line of Work Safety and Strengthening the Operational Foundation

The electric power industry possesses its own features: high risk, high precision, and high standards. The work safety is the core bottom line and red line of electric power enterprises; Scientific human resource management system along with an established employee training mechanism is the core support to form a long-term mechanism for work safety. In terms of human resources management, enterprises may standardize post operation behavior from institutional perspective through establishing a standardized post responsibility system, strictly implement the certification requirement for employees working with proper licenses, refine the hierarchy of safety management responsibilities to improve the job suitability of on-the-job personnel, reduce safety risks resulting from mismatches between people and posts or lack of competency at the source. Enterprises may precisely allocate personnel so that the skill level, safety awareness, and post requirements of employees in important high-risk positions (such as dispatching, operation and inspection, emergency repair), match very closely, avoid safety hazards due to human operational errors.

The training of employees is an important leverage to enhance safety control and emergency response ability. The regular dissemination of safety knowledge, standardization of operating procedures, warning education by typical accident cases can help employees accurately recognize risks and hidden dangers at different links of power system operation; completely understand the key points of safety control; comprehensively improve the abilities of predicting operational risks and responding to emergencies. Through a standardized training system, guide employees to form standardized and compliant working habits, avoid illegal operations, systematically reduce the occurrence of safety accidents including equipment damage, personal injury, and grid failure. It's obvious that the deep integration between human resource management and training systems are the core guarantee for electric power enterprises to reduce the incidence of safety accidents, improve the level of safety control and build up a solid defense line for work safety.

2.3 Optimizing the Talent Team Structure and Strengthening Talent Empowerment

Electric power enterprises are both technology intensive and labor intensive: the scientific nature and rationality of talent team structure is the core cornerstone for sustainable enterprise development. With the advance of new power system construction using extensive new energy technologies and expanding the boundary of grid business, there will be great demand for interdisciplinary, innovative and highly-skilled professional talents in the power industry as the traditional monolithic talent structure cannot meet the requirement of industrial transformation anymore. A scientific human resource management system through job classification, competency grading, function refinement and supply - demand analysis of talent accurately identify the weakness in an enterprise's talent structure, coordinate the rational distribution of technical and skilled talent, innovative interdisciplinary talent and managerial talent, which can effectively solve common industry problems like shortage of high-skilled personnel, gap in talent echelon and imbalance in structure^[6].

Standardized and tiered training system enables optimization of our talent structure and realization of

human capital value appreciation. The regular tiered training mechanism breaks through the traditional barrier in skill between posts; change employees' profile from single-skilled to multi-skilled and interdisciplinary; upgrade talent team from "quantity-scale" type to "quality-efficiency" type. Targeted training on key positions (grid dispatching, equipment operation and inspection, communication operation and maintenance, data analysis, new energy control and management), accelerate the iteration of employee's knowledge and skills, shorten the growth cycle of young talents, constantly increase the proportion of mid-level and senior technical talents, build up a talent system with clear hierarchies, established echelons, and balanced structure. The organic combination of human resource management and training can dynamically optimize the talent team structure, comprehensively improve the enterprise's ability to adapt to complex business scenarios of the new power system, provide continuous talent empowerment for strategic implementation, technological innovation, and industrial upgrading.

3. Existing Problems in Human Resource Management and Training of Electric Power Companies

3.1 Outdated Post Evaluation Standards and Insufficient Adaptability

Operating mode, operational scenario and technical requirement of the power system with wide use of new technologies like smart grids, distributed new energy and distribution automation has been disrupted. Most electric power companies adopt the evaluation system of the traditional power system to their current post evaluation standards which are too slow to update and lag behind, can not meet the post competency requirements of new businesses. Emerging posts (such as: smart dispatching, distributed generation operation and maintenance, new energy grid integration control) have different work responsibility, technical standard and operating procedure from the traditional posts at present. But the existing evaluation system didn't set up special evaluation criteria for these emerging posts, thus it is hard to determine the core competency requirements of the posts accurately.

Meanwhile, current post evaluation system is narrow focused and over-emphasizes on basic skill certification and post compliance assessment while ignoring the evaluation of comprehensive competencies needed by power industry posts in the new era such as innovation capability, cross-departmental collaboration skills, emergency response capabilities and digital operation proficiency. Lagging and one-sided evaluation standards will cause enterprises to mistakenly identify interdisciplinary talents suitable for new businesses through talent selection, job allocation and capability assessment process which leads easily to person-post mismatches and skill disconnects that limits the individual career development of employees and make it hard for enterprises to quickly adapt to the change of industrial technology and market demands, thereby decreasing enterprise's core competitiveness and market responsiveness.

3.2 Rigid Emergency Training Formats and Weak Practical Effectiveness

Power system failure/grid emergencies often involve some special scenarios such as extreme weather, cascading equipment failures, etc., which require an extremely high requirement for employees' practical ability in emergency response, on-the-spot decision-making abilities, and collaboration coordination skills. Most electric power companies have established a routine emergency training mechanism but there are still many problems with rigid training mode, monotonous content, and lack of practicability that make it hard to guarantee the overall effectiveness of training. The main form of emergency training relies on traditional modes: theoretical lecture, reciting procedure, basic simulation operation without immersive and scenario-based practical drill matching real complex working condition, reproducing complex emergency scenarios (large-scale grid blackout, line trip, new energy grid integration anomaly, system failure).

Long-term homogenized and shallow theoretical training by employees can not gain practical handling experience in complex scenarios, when there happens a sudden power accident, they will be prone to make mistakes in judgment, do non-standard operations or respond untimely, greatly increasing the safety risk of grid operation. The lack of dynamic tracking, process evaluation and closed-loop feedback in the emergency training of enterprises can't evaluate the ability of employees' emergency decisions, their practical handling capability and their on-the-spot adaptability in real-time, so it's hard to accurately find out the deficiency in training and optimize the training content, resulting that emergency training becomes a mere formality with low effectiveness, fail to effectively establish a solid emergency defense line for enterprise work safety.

3.3 Lagging Construction of Training Platforms and Uneven Resource Coverage

The digital online learning platform has been an important means of employee training in electric power enterprises. Some obvious shortcomings exist when constructing digital training platforms in most electric power companies currently: Firstly, the coverage of training resources is not even. The course resources provided by the platforms mainly focuses on core technical positions and mid-level and above management positions; however, there are few training resources for employees who work in grassroots positions (such as front-line operation and maintenance, grassroots emergency repair and distributed equipment operation). Due to their geographical location, network condition and equipment configuration, employees at remote sites and grassroots teams can't take equal parts in systematic training, which makes it hard to achieve the goal of universal training for all employees.

However, there is no intelligence or personalization for these digital training platforms. Updating speed of courses on them is slow; most courses are traditional with fixed contents without any specialized high-quality courses applicable to new businesses (smart grids, new energy, etc.) that can't meet the needs of employees' skill iteration. Platform functions are monolithic providing only a one-way course learning process, lack of interactive teaching, intelligent assessment, personalized learning recommendation and practical simulation. They can't provide exclusive learning plans customized according to the differences between employee positions, competency gaps and learning progress, thus not satisfying the tiered, refined, and personalized training needs. It greatly hinders training efficiency and quality, limiting the implementation of the enterprise's long-term talent cultivation planning.

4. Optimization Strategies for Human Resource Management and Training in Electric Power Companies

4.1 Building an Intelligent Evaluation System to Achieve Precise Personnel-Post Matching

To meet the development needs for a new power system and solve problems like outdated post evaluation and low personnel-post fit, it's necessary for electric power companies to utilize digital technology (big data or artificial intelligence) to establish an intelligent and dynamic talent evaluation system according to the post competency model so that there is a dynamic and accurate match between post requirement and capability of employees.

Firstly, enterprises need to optimize its post competency model based on the operational characteristics, technical standards, and job responsibilities of different posts (especially emerging posts: smart dispatching, new energy operation and maintenance, automated operation and inspection) through professional methods like expert interview, critical task analysis, behavioral event interviews etc., to comprehensively sort out the core competency requirements of the posts; build up a multi-dimensional competency evaluation system including professional skills, safety literacy, emergency response capability, innovative thinking, collaboration ability, digital operation capability; define the capability assessment standards for each post, and fill in the evaluation gap for emerging posts.

Secondly, enterprises need to establish an intelligent multi-dimensional assessment system: Based on a digital assessment platform by integrating various assessment modules (cognitive test, psychological evaluation, professional quality assessment, simulated practical operation assessment), using artificial intelligence algorithms comprehensively and quantitatively assess employees' capabilities and map each employee's capability profile; In high-risk positions like transmission and substation operation and inspection, fault emergency repair and dispatching command, adding immersive simulation for testing employees' ability to deal with faults and make emergency decision in complex working condition so that the assessment matches the actual operational requirement of the posts.

Lastly, enterprises should set up a dynamic talent management and control mechanism by Human Resource Information System (HRIS) to construct a dynamic talent database covering all employees with real-time updating on their core information including skills level, training record, certification qualification and post performance; combined with work plans such as grid maintenance, project construction and dispatching operation, dynamically optimizing staffing plan based on intelligent prediction model, accurately allocating talent resource, constantly improving the person-post fit and providing talent support for safe and efficient operation of the power grid.

4.2 Promoting Scenario-Based Practical Training and Strengthening Emergency Response Capabilities

To solve the problem of lack of practicality and low effectiveness in the emergency training for electric power companies, we propose that they use real grid operation scenarios and typical faults and emergency incidents as the core, establish a comprehensive immersive and closed-loop scenario-based practical training system involving all processes, and comprehensively improve their emergency response capability and collaborative operational capability.

On the contrary, enterprises need to determine standardized emergency training scenarios: with focus on their core business such as substation operation and maintenance, transmission and distribution line emergency repair, dispatching automation control and management, and new energy grid integration operation and maintenance, comprehensively identifying typical emergency scenarios (large-scale grid blackouts, line trips, equipment failure, disaster caused by extreme weather, cyber information attack) refine the emergency response procedure, operational specification, safety standard, and response time limit in every scenario, compile standardized emergency operation instruction, establish a systematic scenario-based training resource library which achieve the standardization and normalization of emergency training.

Contrarily, enterprises need to establish an intelligent practical training and drill platform: By adopting VR/AR virtual simulation technology, they shall create an immersive intelligent training base with highly recreation for high-risk and complex scenarios like high-voltage operations, extreme weather or system failures, organize employees to conduct immersive practical drills, overcome the limitation of scenario from traditional training so that employees have accumulated emergency handling experience under complex working conditions safely; Meanwhile by employing its real-time data collection and intelligent analysis function, it can precisely evaluate the standardization of employees' operation, the accuracy of their decision-making and their emergency response speed, accurately identify deficiencies in capabilities, forming a closed loop of "training-drill-assessment-rectification" mechanism.

Secondly, enterprises should enhance the cross-departmental collaborative drill mechanism: by combining resources from various departments (dispatching and control center, operation and inspection teams, emergency repair teams, and communication operation and maintenance teams), regular organization of cross-specialty and cross-departmental joint emergency drills and skills competition focusing on key points in grid safety control, collaborative fault handling, quick information transmission and emergency command and dispatching; improve the overall collaborative combat ability for all employees and the overall emergency response effectiveness, form a comprehensive and three-dimensional electric power emergency support system.

4.3 Upgrading Digital Learning Platforms, Broadening Training Coverage, and Enhancing Quality and Efficiency

To address problems such as uneven coverage on training resources, monotonous training mode and lack of personalization, it's imperative for electric power companies to apply technologies such as cloud computing, big data and artificial intelligence in upgrading and constructing a comprehensive, intelligent and inclusive digital learning platform which could widely cover training and refine and improve the efficiency of cultivating talents.

Firstly, enterprises should build an integrated course resource system. Enterprises need to combine their current learning resources (safety training, skills training, professional title education, post improvement training), together with their business needs of the new power system to create special high quality micro-courses and practical courses on such topics as: smart grid operation and maintenance, new energy control and management, energy storage system operation, digital dispatching; build a modular, standardized and dynamically updated course resource library that covers all employees, all positions, all business scenarios.

Secondly, enterprises should create a personalized intelligent learning model: By using big data analysis technology together with employees' position attributes, competency assessment results and their learning history data, accurately construct an employee's learning profile; custom exclusive learning path for employees by AI algorithm; exactly push courses matching position requirement; solve employees' skills gap systemically in order to achieve "tailored teaching and precise cultivation" meeting the personalized learning needs of employees at different positions and level.

Thirdly, enterprises should build a closed-loop training evaluation mechanism: Through digital

platform, monitoring the learning process, completion of courses, taking online test in real-time as well as offline practice assessment, comprehensively evaluate the training effects; automatically generating learning analysis reports, identifying common weakness of all employees or individual specific problem, dynamically optimizing course system and training programs. Meanwhile, integrating the data about employee's training effectiveness and capability improvement into the human resource management system, deeply linking it with performance appraisal, position promotion, and career development, fully mobilize employees' learning enthusiasm, iteratively iterating skills and steadily improve capabilities for all staff.

5. Conclusion

In light of the energy transition and intelligence upgrade in power system, talent team development has become an important cornerstone to realize the transformation, upgrading, quality improvement and efficiency enhancement of electric power enterprises. There are some serious issues with the current human resource management and training systems of electric power companies like outdated evaluation standards, ineffective emergency training and incomplete digital training systems which limits the development of talent teams and high-quality development of enterprises. Electric power enterprises should fully leverage the trend of industry development based on their own operation reality by comprehensively optimizing human resource management and talent cultivation model via establishment of intelligent post evaluation systems, promotion of scenario-based practical training and upgrading of digital learning platform to achieve accurate talent allocation, effective skills improvement and continuous team structure optimization. It's necessary for electric power companies to further deepen the deep integration between digital technology and talent cultivation, improve the mechanism of long-term talent cultivation and incentives, constantly build a high-quality, professional and interdisciplinary electric power talent team to provide solid talent support and intellectual backing for the construction of the new power system and the green, low-carbon and high-quality development of the energy industry.

References

- [1] Zhao Guotao, Qian Guoming, Wang Sheng. "Path Analysis of Low-Carbon Development of Green Power under the 'Dual-Carbon' Goal." *Huadian Technology*, 2021, 43(6): 11-20.
- [2] Wang Wenxin, Liu Jixuan. "Research on Multidimensional Challenges and Synergistic Mechanisms of Low-Carbon Transformation in the Power Industry under the 'Dual-Carbon' Goal." *Modern Industrial Economy and Informationization*, 2026, 16(3): 177-178+181.
- [3] Yang Boyu. "Research on Talent Support for High-Quality Development of Traditional Energy Industry under the 'Dual-Carbon' Background." *China Electric Power Education*, 2025(12): 15-17.
- [4] Wang Yi, Liu Chen, Zhang He, et al. "Teaching Reform of 'Power System Analysis' Driven by the 'Dual-Carbon' Goal." *China Electric Power Education*, 2025(3): 76-77.
- [5] Yuan Bing. "Cultivation and Development Plan for Specialized Talents in State-Owned Enterprises from the Perspective of Human Resources." *China Collective Economy*, 2026(12): 161-164.
- [6] Wen Xuehui. "Focusing on 'Three Havings' to Strengthen Education and Management of Young Cadres." *Communist Party Member (Hebei)*, 2022(08): 40.