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Fault Statistics and Analysis of 220-kV and Above Transmission Lines in a Southern Coastal Provincial Power Grid of China

BINGHUANG CHEN

School of Information Science and Engineering, Fujian University of Technology, Fuzhou 350118, China
e-mail: chenbh@fjut.edu.cn

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ABSTRACT Because the causes of transmission line faults are not known clearly at present, this paper proposes fault classification for transmission lines, and analyses the characteristics of different faults. Using the transmission line faults data of southern coastal provincial power grid from 2007 to 2018, this paper analyses the influence and distribution of transmission line faults affected by lightning, typhoon, wildfire, foreign object and external damage. These five faults are the main factors affecting the safe and stable operation of transmission lines in this region. According to the different fault classification and statistical rules, the design standards for important transmission lines should be improved. Considering the factors of micro-topography, micro-meteorology and engineering cost, the inspection and maintenance of existing lines should be strengthened. The statistics and analysis will be helpful to the research, development and application of new theories, new technologies and new equipment in disaster prevention and reduction from the aspects of disaster prediction and monitoring.

INDEX TERMS Transmission lines, trip out, lightning, typhoon, wildfire, foreign object, external damage.

I. INTRODUCTION

IN MODERN society, the basic engineering facilities that maintain the function of modern city and regional economy are defined as lifeline engineering system. It includes: power system, traffic system, communication system, urban water supply, heat supply, gas supply system. As an important part of lifeline engineering system, the safe operation of power system is related to national security and our normal life order. With the rapid growth of national economy, 220-kV and above transmission lines are regarded as the backbone of provincial power grid, and the faults of transmission lines will impact the power grid inevitably, threaten the safe and stable operation of the power grid, which affect the power reliability of users [1]. However, the total length of 220-kV and above overhead transmission lines of the provincial power grid reach tens of thousands of kilometres, traverse through the wild and severe environment areas. These transmission lines often trip out due to disasters, man-made damage and other reasons.

Through the statistics and analysis of transmission line faults, it is of great significance to find out the main causes of transmission line trip-out and the spatial and temporal distribution rules of inducing factors, so as to carry out tripping prevention and control work for transmission lines. Jiazheng *et al.* [2] analysed the faults of 220-kV and above transmission lines in a province from 2005 to 2014 statistically, proposed a fault classification method, and elaborated the characteristics and influencing factors of different fault classification. Some Suggestions are put forward for design, operation, maintenance and scheduling personnel. Liang *et al.* [3] took ultra high voltage direct current(UHVDC), high voltage DC and back to back HVDC system as the research object, conducted statistical analysis of forced outage, and illustrated the security situation faced by the HVDC system of state grid corporation of China combined with typical failure cases, analysed the weak links of existing systems and put forward relevant suggestions. He *et al.* [4] focused on serious lightning activity in several regions of China, present the lightning performance of power grid by statistics obtained from long-term monitoring data, and intended to indicate some general characteristics.

However, they did not further explore the internal relationship between the influencing factors of tripping and transmission line tripping. At the same time, due to the differences of geographical elements, meteorological conditions and cultural environment in various provinces and cities, the causes and distribution of transmission line faults are also different that make it difficult to guide the design, operation and maintenance of power grids in a targeted way [5].

Based on the 2007-2018 southern coast 220-kV and above provincial power grid transmission line faults data, this paper analyses the reasons such as lightning, wind, fire, and foreign body, external damage which affect the safe and stable operation of transmission lines. Moreover, this paper puts forward some suggestions for the predictable and unpredictable transmission line faults respectively.

This region studied in this paper is located in the southeast coast of China, the island across a strait in the southeast, with a total land area of 121,400 square kilometres, as shown in Fig.1. The whole terrain is by the mountain and by the sea situation and the terrain is high in the north-west, low in the south-east, the mountains and hills account for about 90% of the province's total area. The total length of the land coastline is 3,051 km which is located in the northern side of the tropic of cancer, at low latitude, close to the Pacific Ocean and is belong to the southern and subtropical regions with a humid monsoon climate. It is long summer short winter, higher temperature and less frost in this region. But the coast is often affected by typhoons and monsoons. The region is developed economically and has 13,370 km of 220-kV transmission lines, 5,348 km of 500-kV transmission lines and 342 km of 1000-kV transmission lines.

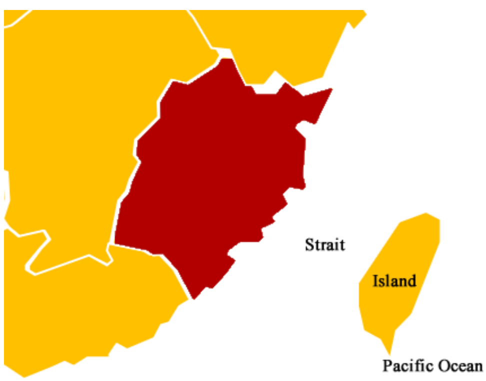

FIGURE 1. **The geographical location of the region.**

II. TRANSMISSION LINE FAULT CLASSIFICATION

According to whether the transmission line fault can be predictable, it can be divided into two classes: predictable transmission line fault and unpredictable transmission line fault. Predictable transmission line faults include wind disaster, lightning, ice damage, wild fire and pollution flashover fault, while unpredictable transmission line faults including foreign object, external damage, earthquake, equipment failure, line failure, human error operation and unknown fault. From the above fault classification, the annual trip-out times of predictable transmission line faults and unpredictable transmission line faults are counted, as shown in Fig.2.

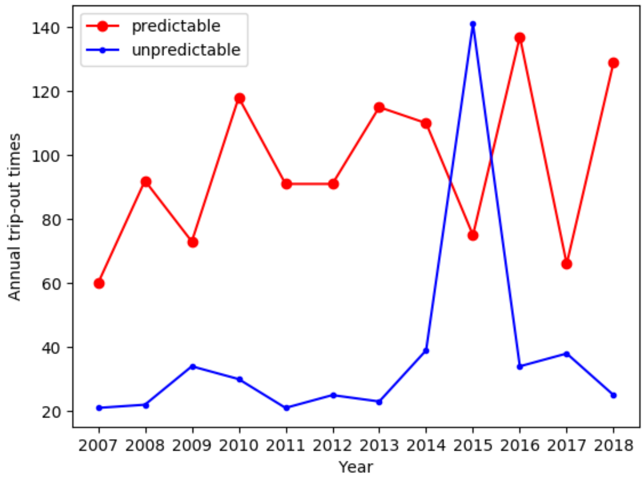

FIGURE 2. **Trend chart of annual trip-out times of power transmission line.**

TABLE 1. **Fault statistics of 220-kV and above power transmission line from 2007 to 2018.**

Type of Trip-out	Reason	Times	Ratio	Reclosing success rate
Predictable	Lightning	837	51.99%	87.81%
	Wind damage	176	10.93%	62.50%
	Wild fire	97	6.02%	45.36%
	Pollution flashover	42	2.61%	85.71%
	Ice damage	5	0.31%	0.00%
	Subtotal	1157	71.86%	79.95%
Unpredictable	Unknown Fault	154	9.57%	88.31%
	Foreign object	132	8.20%	64.39%
	External damage	124	7.70%	43.55%
	Equipment failure	37	2.30%	32.43%
	Line fault	5	0.31%	20.00%
	Maloperation	1	0.06%	0.00%
	Subtotal	453	28.14%	63.58%

The fault characteristics are shown in Fig.2 and Table 1. In Fig. 2, the average number of predictable faults is far more than that of unpredictable faults. From Table 1, predictable transmission line faults in this region account for 71.86% of the total number of transmission line faults, and the power grid suffers from predictable disasters seriously.

Although the proportion of fault lightning tripping is the highest in this region, the reclosing success rate of lightning tripping reaches 87.81%, and it is dispersed in a short period of time relatively, but its influence on the stability of power grid and power supply for users is not obvious.

Wind disaster is the second major cause of transmission line trip-out after lightning strike, and its reclosing success rate is 62.50%. Because this coastal region is located on the west coast of the Pacific Ocean, which is affected by typhoons every year and mainly in June-September. It is concentrated and destructive in a short period of time.

Fire disaster causes transmission line to trip less than 100 times, but the reclosing success rate is less than 50%, only 45.36%. Meanwhile, the distribution of mountain fires is affected by industrial and agricultural production and life greatly. Most transmission line faults are concentrated in Spring Festival, Qingming Festival, spring ploughing and burning, autumn harvest and drought periods.

Because overhead transmission lines are always set up in the wild field, it is difficult to find the cause of tripping accurately when arriving at the scene after the tripping accident. Therefore, the cause of tripping of some transmission lines is not clear(Unknown fault), accounting for 9.57% and the success rate of reclosing is 88.31%. But the success rate of reclosing of foreign object and external damage are low, are 64.39% and 43.55% respectively.

III. STATISTICS AND ANALYSIS OF PREDICTABLE TRANSMISSION LINE FAULT

A. LIGHTNING

Grid accidents caused by lightning and unplanned outage and other faults have brought huge hidden dangers to the power grid. Existing studies seek for effective lightning activity rules [6]. It plays a direct guiding role in the selection of transmission line path and the effective lightning protection for operating units [7].

From 2007 to 2018, there are 837 lightning trips on the main power grid in this region, including 702 trips in 220-kV lines, 133 trips in 500-kV lines and 2 trips in 1000-kV lines. Lightning trip-out times in each year are shown in Fig.3. The annual average trip-out times is 58.5 and 11 for 220-kV and 500-kV lines, respectively. From Fig.3, specially in 2010, there are 148 trips in this region, including 97 lightning trips, accounting for 65.54% of the total number of trips. The proportion of lightning tripping in this year is much higher than that of other years. Furthermore lightning tripping times in this year is nearly 40 percent higher than the annual average, reaching the highest value in 12 years. As can be seen from Fig.3, the tripping times of 220-kV lines in 2008, 2010, 2012 to 2014 and 2018 are higher than the annual average, and the tripping times of 500-kV lines in 2008, 2010, 2012 to 2014 are higher than the annual average. In 2010, the tripping times of 220-kV line reach the peak(81), while in 2012, the tripping frequency of 500-kV line reach the peak(19). At the same time, in 2018, tripping accidents occur in the ultra-high voltage 1000-kV lines, and the success rate of reclosing was 50%.

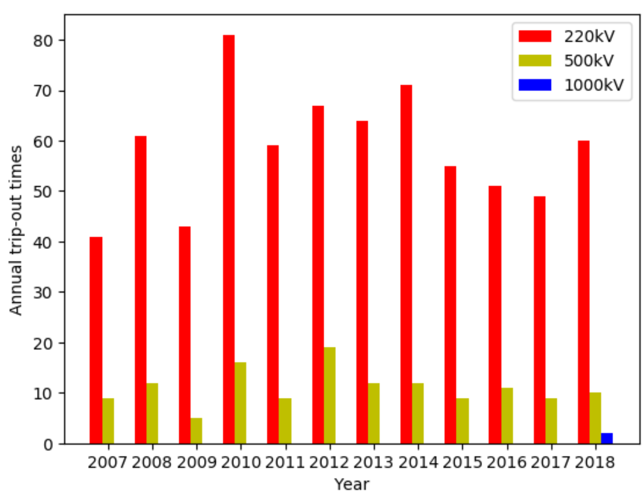

FIGURE 3. **Lightning trip-out times of transmission line of different voltage levels from 2007 to 2018.**

The monthly distribution of the transmission lines tripping times due to lightning in this region from 2007 to 2018 is shown in Fig.4. No lightning tripping occurs in January and December. But from May to September, transmission lines are affected by lightning activities seriously, accounting for 83.63% of the total number of lightning tripping. Specially in August there are 189 trips, accounting for 57.80% of all trips.

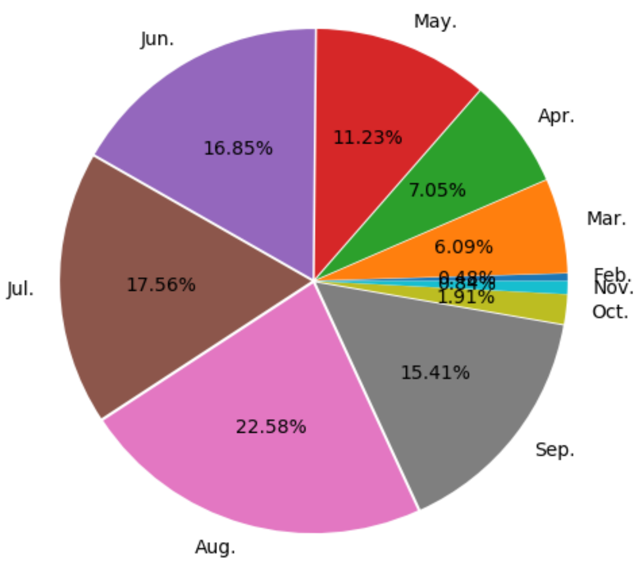

FIGURE 4. **Distribution of the average trip-out times caused by lightning of every month.**

Lightning of overhead transmission lines is affected by lightning parameters, terrain parameters, line parameters and lightning protection devices [8]. When lightning activity is stronger, the possibility of lightning trip-out is greater. Fig.5 shows the ratio of lightning trip-out times and ground flashover times in each year from 2007 to 2018. As can be seen from Fig.5, the total number of lightning tripping and the total number of lightning ground flashover per 10,000 times have a certain correlation. Basically, when the total number of lightning ground flashover per 10,000 is high, the total number of lightning tripping will also increase. And in 2010, the number of line lightning tripping is the highest from 2007 to 2018, reaching 97 times. However, the ratio of lightning tripping and ground flashover (the ratio

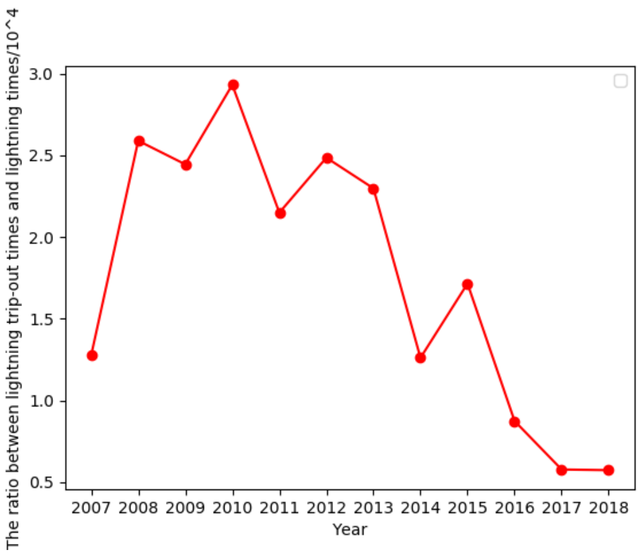

FIGURE 5. The ratio relationship between the number of lightning trips and lightning flashes in each year from 2007 to 2018.

of lightning tripping times and lightning ground flashover per 10,000 times) is decreasing year by year, which is also related to the enhancement and improvement of lightning protection measures for power transmission lines in this region in recent years. Although the lightning protection work in this region has some effect, it still can't prevent the occurrence of lightning tripping effectively. At the same time, we should pay attention to the lightning fault caused by the current extreme weather.

B. WIND DISASTER

China has one of the world's worst wind disaster on its power grid. The region is located in the south-east coast, the west coast of the Pacific Ocean, affected by its geographical location, the main wind disaster is the typhoon disaster [9]. From 2007 to 2018 the number of transmission line tripping caused by wind deflection is 4 times, while the number of typhoon affected tripping reached 172 times, accounting for 97.73% of the number of transmission line wind tripping. However, the reclosing success rate of wind deflection tripping is low, only 25.00%, which has a great impact on transmission lines.

The region is a major landfall region for typhoons. Statistics show that from 2007 to 2018, a total of 26 typhoons made landfall in the region, ranking the second in the country. Second-hand typhoons are the main form because there is a similar area island at south-east of the region. This island likes a natural barrier that has helped hold off many typhoons for this region. Statistics also show that of the 26 landfall typhoons, 11 landed in the region directly, accounting for 42.31%. Another 15 landed island first and then landed in the region. In addition to landfall typhoons, there are also 47 influential typhoons from 2007 to 2018. From the perspective of time distribution, there are more typhoons from July to September, accounting for 81.11% of the total number, and typhoons have the greatest impact on overhead transmission lines. The statistics of trip times of transmission lines affected by typhoons in this region in the past 12 years are shown in Table 2. Among them, the influence of typhoon on the transmission lines in this region is not significant, only one trip occurred in 12 years, accounting for a very small proportion. Among the landfall typhoons, the number of trips caused by typhoons directly landing on the transmission lines is more, reaching 148 times, accounting for 86.04%, and the success rate of reclosing is only 60.13%. It shows that direct landfall typhoons are destructive to power transmission lines.

TABLE 2. Effects of different typhoon types on transmission line trip-out.

Type of Typhoon	Times 220-kV	Times 500-kV	Ratio	Reclosing success rate
Direct landfall	118	30	86.04%	60.13%
Second landfall	22	1	13.37%	86.96%
External influence	1	0	0.58%	0.00%

The main effects of typhoon on transmission lines in this region are power tower damage, collapse and other mechanical overload accidents, as well as line deflecting tripping. The wind speed during the typhoon landfall also has a great impact on the transmission lines [10]. The typhoon wind speed in China ranges from 10 to 15, as shown in Fig.6. Fig.6 shows that the greater the typhoon level is, the more destructive it is, and the greater the impact on the transmission line will be. When the wind scale is 10-11, the number of trips of 220-kV transmission line is 5, and there is no trip of 500-kV transmission line. But when the wind scale is 15, the maximum number of trips of 220-kV transmission line is 59, and the number of trips of 500-kV transmission line is 11, and the success rate of reclosing is only 50.00%. Because under the action of wind scale 15, power tower collapse occurred in 220-kV and 500-kV transmission lines.

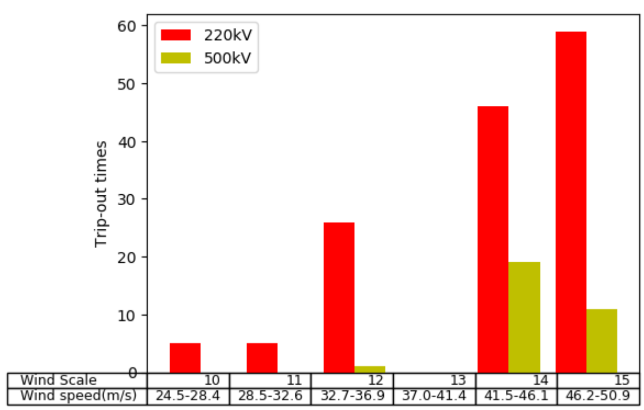

FIGURE 6. Influence of typhoon wind scale on transmission line trip-out.

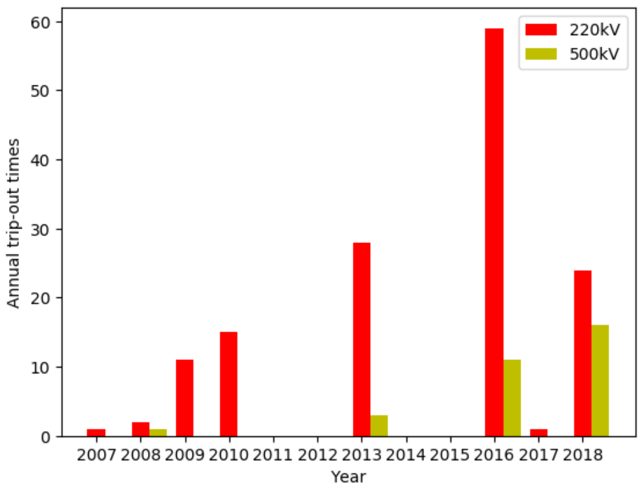

FIGURE 7. Trend chart of trip-out times of transmission lines affected by typhoons from 2007 to 2018.

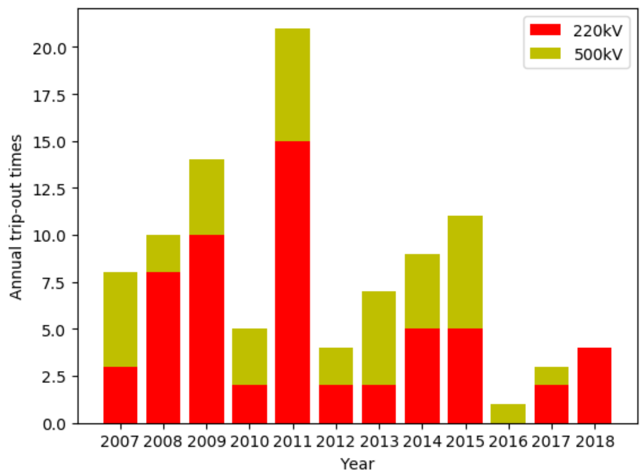

FIGURE 8. Trend chart of trip-out times of transmission lines affected by wildfires from 2007 to 2018.

Fig.7 shows that the number of trips in 2016 is very prominent. This is because on September 15, 2016, the world's most powerful typhoon "Meranti", numbered 1614, made landfall in Xiang'an, Xiamen, with a wind scale of 15 (52m/s) at the time of landfall [11]. Typhoon "Meranti" affected the region severely, causing the collapse of three towers for 220-kV transmission line and four towers for 500-kV transmission lines, affecting 1.407 million people and causing a direct economic loss of 7.49 billion yuan($107 million). The 220-kV damaged towers were almost designed in the 1980s or 1990s with a wind speed of 35m/s and a recurrence period of 15 years standard. The design standard of the damaged transmission lines is lower than the current design standard, so its wind resistance is weak. These lines can increase their resistance to wind loads by about 1.2 to 1.3 times as long as they comply with current standards. Although the design wind speed of 500-kV line is 35m/s, with a recurrence period of 30 years, the damaged towers are concentrated on the windward slope relatively. This position is the highest point of the surrounding mountains and has the characteristics of microtopography. The measured average maximum wind speed is 42.9m/s for 10min, and the instantaneous maximum wind speed is 63.1m/s. The main reason for the collapse of the towers is that the stress of tower angle steel member is far exceeds its carrying capacity due to the strong wind.

C. WILDFIRE DISASTER

Transmission line wildfires pose a serious threat to the power grid [12]. Wildfires is determined by two factors: fire source and meteorological conditions [13]. Fire source in China is affected by industrial and agricultural production and life. Especially the Qingming Festival, Spring Festival and spring ploughing and burning period are high incidence stages of wildfires. The precipitation in meteorological factors determines whether the wildfires occur and spread.

The forest area of this region is 8,012,700 hectares, with a forest coverage rate of 65.95%, ranking first in mainland China.Wildfires pose a major threat to overhead transmission lines because the vast majority of them go through the forest. In Fig.7, the wildfire trip-out times of transmission lines reach a peak of 21 in 2011, and the trend is downward in the following years. At present, 220-kV and above transmission lines are still weak in responding to wildfires. The discharge of transmission line affected by wildfire will cause poly-phase fault, while the success rate of poly-phase fault reclosing is low [14]. In these 12 years, there are 97 times of wildfire tripping, and the success rate of reclosing is only 45.36%. Under the severe environment of burning wildfire and dense smoke, the recovery condition of discharge channel is poor. There are many consecutive trips in a short period of time, which bring many shocks to the power grid.

Monthly transmission line fire tripping times from 2007 to 2018 are shown in Fig.9. The peak trip-out times are from February to April and October, accounting for 13.40%, 13.30%, 26.80% and 12.37% of the total trip-out times respectively. There are two reasons for the high incidence of wildfires in these months. One is the low moisture content of winter vegetation in this region, and the frozen vegetation in winter is easy to ignite and spread after being dried in spring. On the other hand, the Chinese Spring Festival, Qingming Festival and other customs, as well as the spring ploughing and burning waste, and the autumn harvest burning straw lead to increase fire sources.

Fig.9 shows that the region has been carrying out studies on wildfire prevention in the power grid actively in the past three years. A series of outstanding achievements have been achieved in the aspects of wildfire prediction on transmission lines, satellite wide-area monitoring, distributed monitoring and wildfire disposal technology in the power grid [15]. Due to accurate prediction, reliable monitoring and efficient wildfire suppression, the number of wildfire trip-out times is

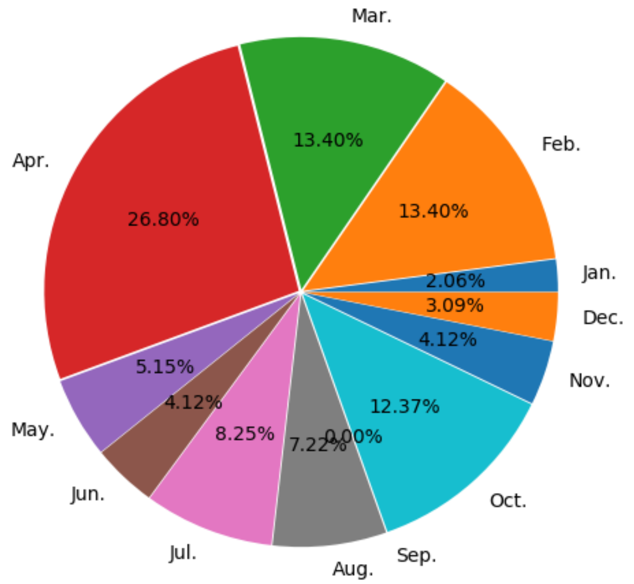

FIGURE 9. **Monthly transmission lines wildfire trip-out times from 2007 to 2018.**

decreasing, which marks a breakthrough in wildfire prevention technology and guarantees the safe and stable operation effectively.

IV. STATISTICS AND ANALYSIS OF UNPREDICTABLE TRANSMISSION LINES FAULT

Unpredictable transmission line faults are caused by foreign objects, external damage, device faults, line faults, unknown faults and other reasons. In addition to unknown faults, the main causes are foreign objects and external damage.

A. FOREIGN OBJECT

The main foreign objects on the transmission lines in this region are balloons, bird droppings, bird nests, sunshade cloth, plastic film, ribbons and other floating objects. The entanglement of these foreign objects in the transmission line will shorten the ultimate discharge distance of the high voltage and pose a threat to pedestrians and vehicles passing through the transmission line.

In Fig.10, the number of foreign object trip-out increases year by year. The number of foreign object trip-out on 220-kV transmission line is 119 times with an average annual average of about 10 times. But the reclosing success rate of transmission line foreign object trip-out is 64.39%. This region is affected by strong wind weather more, the foreign objects drift easy away in the wind. Moreover, the large forest and frequent bird activities pose a great threat to the entire transmission line.

B. EXTERNAL DAMAGE

In 2007-2018, external damage accounts for 7.70% of the total number of transmission line trips in this region, which is caused by the collision of construction vehicles or the close

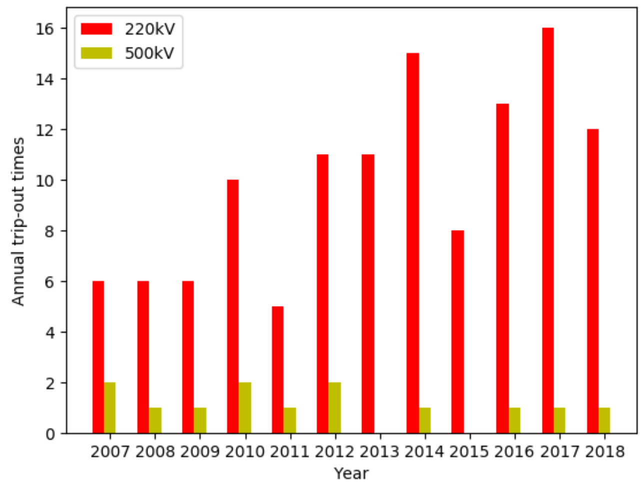

FIGURE 10. **Trend chart of transmission line foreign objects trip-out times from 2007 to 2018.**

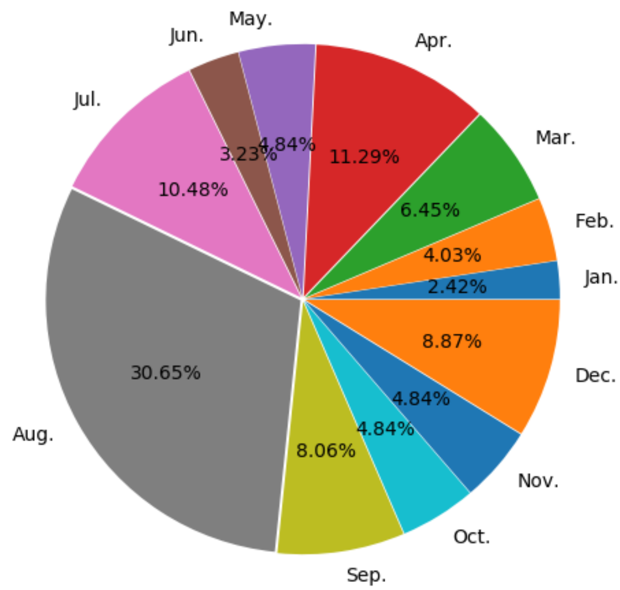

FIGURE 11. **Monthly transmission lines external damage trip-out times from 2007 to 2018.**

distance between the objects such as illegal buildings, trees and the line. The success rate of reclosing is only 43.55%, and it takes two to three hours for the outage to resume, which has a great impact on the power supply reliability. The number of external damage trip-out of 500-kV transmission lines is only 3 times, because their height are higher than 220-kV towers. External damage is seasonal, especially in summer. From Fig.11, the number of tripping in August reaches 38, accounting for 30.65% of the total number of tripping caused by external damage in 12 years.

The main cause of external damage is human factors. Some units or individuals disregard the law, regardless of the safe distance of power facilities, using cranes or cement tanker to carry out brutal construction. The minimum distances

TABLE 3. Minimum operation distances specified in the electrical safety regulations.

Voltage level	Hot-line(m)	Close(m)	Hoisting(m)
220-kV	3	4	6
500-kV	5	6	8.5

specified in the power safety regulations are shown in Table 3. Electric power branch inspects to the line for periodic undertake, which is once a month. Some operation personnel often work in holiday even at night, that brings tremendous difficulty to the inspection. Transmission lines are long and often located in the wild, so the application of on-line monitoring technology is limited.

V. MEASURES AND SUGGESTIONS TO PREVENT TRANSMISSION LINE TRIP-OUT

The design standards for regional transmission lines refer to the code for the design of 110 kV 750 kV overhead transmission lines (GB 50545-2010) and the technical regulations for the design of 110 kV 750 kV overhead transmission lines (Q/GD w179-2008). Considering the construction status and project cost factors, the power transmission lines designed with reference to the design standards can adapt to different disasters. Therefore, it is effective for the current design standards and the measures adopted in the project to improve the importance coefficient of the tower structure. For the major disasters in this area, it is suggested that the power sector should take three effective measures. First, the power department shall check the existing transmission lines one by one according to the current standards, and strengthen inspection, maintenance or reconstruction. Second, according to the analysis of historical statistical data and the actual situation of micro-topography and micro-meteorology, the structure coefficient of the tower or the design wind speed of the tower should be increased when planning and designing transmission lines. Third, it is suggested that the power department should carry out further research on the tower load and optimize the load calculation method and the value of each parameter.

The power operation and maintenance departments should master the disaster occurrence rules in the areas traversed by the transmission lines and suppress the impact of disasters on the transmission lines from the predictable disaster source. Through the transformation of transmission lines that are not able to withstand disaster risks, the operation and maintenance costs of the lines can be reduced and the adverse effects caused by the trip of the lines can also be reduced. Give full play to the role of disaster prevention and reduction technology in improving the power grid's ability to resist natural disasters, and strengthen the research and experiment, popularization and application of new theories, new technologies and new equipment of disaster prevention and reduction.

Since there are five major transmission line fault types in the region, targeted preventive measures should be taken.

In order to reduce lightning failure, it is necessary to conduct field investigation on the transmission lines and conduct comprehensive analysis based on the actual conditions such as line channel, landform and lightning density. By adopting new lightning protection devices [16], differentiated lightning protection transformation is carried out pertinently. Unbalanced insulation technology is adopted for the double circuit in the same tower to avoid the double circuit trip at the same time.

In response to typhoon disasters, the hidden dangers of transmission lines can be investigated comprehensively and treated before the typhoon comes, and effective preventive measures can be taken in advance. During the typhoon landfall, it will conduct inspections and take measures on the power transmission lines in the areas affected by the typhoon. When planning a new transmission line, the value should be calculated according to the latest wind speed zoning map, and the defense standard of wind speed should be improved for important channels or micro-terrain areas [17]. The power towers with rectangular cross section should be avoided in coastal mountainous areas.

Many measures should be taken to reduce the influence of wildfire on the transmission lines. According to the actual situation of the power grid, it is considered that stopping the line reclosing and restoring the power in time after the wildfire goes away. The power balance, power flow limit control, equipment N-1 pre-control and other relevant measures should be taken in advance in consideration of the influence on the power grid if the line cannot be restored for a long time. The power department should make annual and monthly maintenance arrangements for power transmission equipment according to the analysis of historical statistics. The combustible objects such as dry trees and grass under the corridors of transmission lines should be removed in time. And the number of trees under the corridors should be reduced. It is necessarry to strengthen the close contact with forestry and forest fire control departments, establish a fire linkage notification system, improve the isolation safety measures, do contingency measures for emergencies [18]. There are some application to prevent wildfire in transmission lines including intelligent monitoring and fire location system. Coupling of two or more technologies is the focus of research and application. For example, the coupling of visible/infrared dual-band technology, the combination of visible image monitoring technology and infrared thermal image monitoring technology, the coupling application of satellite remote sensing technology with traditional terminal monitoring technology, the coupling application of lidar monitoring technology with gas and combustion sound monitoring technology, which can improve the accuracy and real-time of wildfire location.

In order to reduce foreign object in the transmission line faults, it is necessary to strengthen line inspection. The white garbage and greenhouse film should be removed around the transmission line corridor. New devices can be set up to cope for birds, including anti-bird thorn [19], anti-bird pull wire, artificial nest and insulator umbrella skirt.

For the transmission line trip caused by external damage, the power department should strengthen the information communication with the construction department and pay close attention to the construction conditions around the power transmission channel. Take specific technical measures such as protective piles, limit facilities, laser alarm devices, warning signs or flags, warning guardrails and other new protective devices. Strengthen the patrol of key lines vulnerable, implement prevention measures and crack down on illegal and criminal ACTS of damaging power facilities severely.

VI. CONCLUSION

According to the statistics and analysis of the operation data of 220-kV and above transmission lines in the past 12 years, the main failure factors that affect the safe operation of transmission lines are lightning, wind disaster, wildfire, foreign object and external damage.

From 2007 to 2018, there are 837 lightning tripping times of transmission lines, accounting for 51.99% of all fault tripping, which is the highest proportion. Lightning failure occurs from May to September chiefly, and is the main cause of transmission line failure in the region. But the reclosing success rate reaches 87.81%. The number of power transmission line fault trips caused by wind disaster, wildfire, foreign object and external damage account for 10.93%, 6.02%, 8.20% and 7.70% of the total fault trips respectively. Typhoons from July to September have the greatest impact on the transmission lines, while wildfires mainly affect the transmission lines from February to April and October, while external damage is mainly concentrated in August.

With the global warming, severe weather such as strong thunderstorms, strong typhoons and rainstorms occurs frequently and brings serious impact on the safe operation of power transmission lines. It is suggested that the design of transmission lines should take into account the factors of micro-topography, micro-meteorology and engineering cost on the basis of national standards and specifications, and take measures to improve the safety level for important lines. Inspect existing transmission lines one by one according to current standards, and step up inspections, reinforcement or reconstruction. At the same time, disaster prediction theories and methods should be studied, new technology should be applied according to the specific operation rules and fault characteristics of transmission lines.

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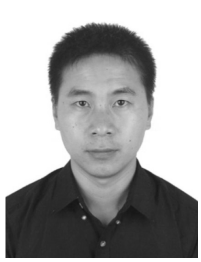

BINGHUANG CHEN received the M.S. degree from Central Southern University, Hunan, China, in 2008. He is currently pursuing the Ph.D. degree in power system and automation with Fuzhou University. He is also a Teacher with the School of Information Science and Engineering, Fujian University of Technology. His research interests focus on intelligent fault diagnosis and artificial intelligence.