

MAINTENANCE PROCEDURES FOR RURAL DISTRIBUTION NETWORKS - RDN'S AIMING AT THE PREVENTION OF FOREST FIRES

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Abstract Electricity itself is not a direct cause of forest fires, but poor conditions of transmission lines and/or rural distribution networks, poor sizing or operation of the protection of electrical equipment and other factors, can cause short-term circuits and electrical overloads that, in turn, can cause fires. Common causes of forest fires are associated with various human activities, such as neglect of campfires, improper use of agricultural equipment, uncontrolled burning, short circuits in transmission lines and in rural electricity distribution networks, natural phenomena, such as lightning, high temperatures and low relative humidity. The consequences of forest fires can be devastating, including loss of human and animal lives, destruction of natural habitats and biodiversity, damage to property and infrastructure, air and soil pollution, among others. In addition, forest fires can also affect the economy, especially in rural areas, where many people depend on agriculture and tourism. Brazil is one of the main eucalyptus producers in the world, with extensive plantations concentrated mainly in the states of Mato Grosso do Sul, Minas Gerais, São Paulo, Bahia and Espírito Santo. In short, electricity itself does not cause forest fires, but its incorrect use can contribute to the occurrence of fires. Therefore, it is important to follow the technical and electrical safety standards, maintain the regular maintenance of transmission lines, rural distribution networks and electrical equipment, respect the easement and security of the networks, etc. to minimize the risk of forest fires.

Keywords: Eucalyptus; electricity; forest fires; fire risk.

INTRODUCTION/OBJECTIVES

The present case study aims to explore the causes of forest fires, analyzing them in their natural context and considering multiple

perspectives, especially those arising from electricity networks.

Areas with eucalyptus plantations have a high risk of fire. In addition to the availability of wood, there is the continuous deposit of leaves and branches on the surface of the soil, from plantings and understory vegetation, which allows the formation of an organic blanket that serves as fuel material in forest fires (BORGES et al, 2011).

Eucalyptus forests are very common in Brazil, being widely used for the production of paper, cellulose, wood for construction and charcoal. Eucalyptus (*Eucalyptus*) is an exotic tree originating in Australia, which was introduced in Brazil at the end of the 19th century and adapted very well to climatic and soil conditions. Currently, it is estimated that the State of Mato Grosso do Sul alone has more than 1.3 million hectares, and by 2030 it is estimated to reach 2.0 million hectares of planted forests (MAIS FLORESTA, 2023), that is, approximately 5.6% of the Sul-Mato-Grossense (35.7 million hectares).

It is well known that climate change has affected our lives in different ways in recent years, causing prolonged droughts and excessive rainfall in certain regions of the planet. One of the serious consequences of these phenomena is the occurrence of forest fires of great proportions, which may imply unpredictable consequences in terms of lost human lives and economic losses to the economy of states and even the country (WRI BRAZIL, 2023).

Forest fires are usually caused by a combination of natural factors and human activities, in which the interaction between climatic conditions, vegetation, human activities and natural events plays an important role in their occurrence and spread of flames (SCHUMACHER MV, DICK G., 2018). The main causes of forest fires include: human negligence, uncontrolled fires for

agricultural purposes, prolonged droughts and hot weather, lightning strikes, sparks in damaged rural distribution networks or poor maintenance and conservation conditions, recreational human activities, machinery and infrastructure, industrial activities, invasions of exotic plants and others.

Despite the low frequency, electrical energy is an important cause that can contribute to fires in situations of falls of transmission/distribution lines and electrical wiring that come into contact with trees or other combustible materials. In such cases, the sparks or sparks generated by the contact between the electrical wiring and the combustible material can start a forest fire.

However, within the scope of prevention, electric power is an important cause that can contribute to the occurrence of fires and, therefore, cause for concern of this Public Services Regulatory Agency of Mato Grosso do Sul – AGEMS.

MATERIAL E METHODS

CHARACTERIZATION OF THE STUDY AREA

The study area corresponds to the private eucalyptus plantations established in the geoelectric region of the municipalities of Três Lagoas, Água Clara, Aparecida do Taboado, Inocência, Selvíria and Ribas do Rio Pardo, all located east of the state of Mato Grosso do Sul. The predominant climate is the semi-humid tropical, with two well-defined seasons - a dry winter and a very hot and rainy summer. Temperatures vary a lot: they can reach about 40 °C in the warmer months and 15 °C in the colder months (EMBRAPA, 2023).

MAIN CAUSES OF FOREST FIRES

In consultation with “ChatGPT” (2023), forest fires are usually caused by a combination of natural factors and human activities. The main causes include:

- **Human negligence:** Most forest fires are caused by human activities, such as improper disposal of lit cigarettes, poorly extinguished fires, balloons, fireworks, uncontrolled fires and welding or cutting operations that generate sparks;
- **Uncontrolled agricultural burning:** Farmers often use fires as a land management technique, but if these fires are not well controlled, they can turn into forest fires. Deforestation and clearing of land for agricultural purposes can also create fire-prone conditions;
- **Prolonged droughts and hot weather:** Prolonged periods of hot and dry weather increase the susceptibility of forests to fires, as vegetation becomes more flammable;
- **Lightning strikes:** Lightning strikes can cause forest fires when they hit areas with dry vegetation;
- **Short circuits in electrical distribution networks:** Sparks generated by damaged power lines or vegetation near distribution networks can start fires, especially during high winds;
- **Recreational human activities:** Activities such as camping, barbecues and use of recreational vehicles in forest areas can lead to fires;
- **Machinery and neglected infrastructure:** Machinery, roads and other infrastructure may cause combustion of nearby flammable materials;
- **Industrial activities:** Industrial activities involving flammable chemicals or high temperature processes can cause fires if safety measures are not strictly followed;
- **Invasions of exotic plants:** Some

species of invasive plants have greater potential for spreading fires due to their flammable characteristics and rapid spread.

HISTORICAL DATA ON FOREST FIRES

To carry out the analysis of the main causes of forest fires, information from the pulp and paper industries was requested and obtained on the occurrence of forest fires in the areas covered by this case study. All occurrences were analyzed over the periods of 2021 and 2022.

HISTORICAL DATA OF MAINTENANCE PERFORMED IN RDN'S AND INTERRUPTIONS OF ELECTRICITY SUPPLY

Regarding the supply of electricity were requested to distributors in the region of the study technical information on the conditions of rural distribution power grids - RDN's, mainly, historical occurrences by generator fact and maintenance/improvements performed in the period analyzed, are:

- Relevant maintenance performed in 2021 and 2022 in the RDN's (planned x performed);
- Relevant improvements made in 2021 and 2022 in the RDN's (planned x performed);
- Schedule the cleaning of serfdom strips of the RDN's;
- Detailed history of the actions carried out throughout the implementation of the Results Plan requested for corrections of the problems verified in the field (number of poles, km of cables, crossarms and other replaced materials); and,
- Number of long-term interruptions, by generator fact, for the years 2021 and

2022 in the RDN's.

ANALYSIS OF HISTORICAL DATA

♦ Interventions in Rural Distribution Networks - RDN's

The eletricity distributors informed that all of the planned activities, referring to the interventions in the RDN's, contained in the Results Plan were completed. Are they:

- ✓ Visual and thermographic inspections of RDN's;
- ✓ Repair maintenance of malfunctions detected during inspections;
- ✓ Cleaning of easement strips;
- ✓ Removal of disconnected power grids;
- ✓ Repair of anchor posts along rural feeders;
- ✓ Signalling of anchor posts;
- ✓ Communication actions with the agricultural team of industries and farmers;
- ✓ Review of the safety strip to take account of tree heights;
- ✓ Sectioning of transverse and parallel fences close to the network;
- ✓ Request for maintenance of the firebreaks of the easement and security strips; and,
- ✓ Maintenance of grounding, taking into account the ground resistance.

Table 1, below, presents the data regarding the actions carried out in rural feeders where the largest amounts of irregularities were found during the survey.

Representatives of Electricity Distributors reported that they have routine inspection plans in place to assess grid conditions and ensure adequate supply of electricity. Thus, all the needs identified in the inspections became part of the Maintenance Plan that seeks to

Materials	Description	Quantity
Grounding	Quantity of grounding of fences	24
Cutouts	Replacement and installation of cutouts	23
Crossarms	Replacement of crossarms	107
Clearing Trees	Kilometers of clearing of trees	59
Tree Pruning	Units of pruned trees	709
Poles	Units electric poles replaced	152
Repairs to structures	Cable splices, insulator changes and other minor repairs	887
Transformers	Replacement of transformers	37

Table 1 - Maintenance actions and improvements made in rural feeders

Generator Factor	2021	%	2022	%	Comparative
Internal Unscheduled Environment Atmospheric Discharge	473	41,7	472	39,2	-0,2%
Internal Unscheduled System Fault Mat./Equip.	199	17,5	215	17,9	8,0%
Internal Unscheduled Environment Wind	135	11,9	183	15,2	35,6%
Internal Unscheduled Environment Tree or Vegetation	89	7,8	99	8,2	11,2%
Unscheduled Internal of the Unclassified System	77	6,8	68	5,6	-11,7%
Internal Unscheduled Environment Animals	51	4,5	55	4,6	7,8%
Unscheduled Internal Features of the Unidentified System	52	4,6	42	3,5	-19,2%
Unscheduled Internal of the Desl System. Manut. Emerg.	34	3,0	29	2,4	-14,7%
Internal Scheduled Preventive Maintenance	10	0,9	23	1,9	130,0%
Internal Unscheduled Third Party Ramming	6	0,5	8	0,7	33,3%
Internal Unscheduled Third Party Interference	2	0,2	3	0,2	50,0%
Internal Scheduled Corrective Maintenance	3	0,3	2	0,2	-33,3%
Internal Unscheduled Third Party Object on the Network	1	0,1	2	0,2	100,0%
Internal Unscheduled Third Party Vandalism	1	0,1	2	0,2	100,0%
Internal Unscheduled System Own Overload		0,0	1	0,1	
Internal Unscheduled Environment Burning or Fire	1	0,1		0,0	

Tabela 2 – Principais Causas das Interrupções nos Alimentadores Rurais Levantados 2021/2022

ensure quality in the supply of electricity.

◆ Annual comparison of long-term interruptions

In response to the AGEMS request, the Electricity Distributors responsible for the respective concessions informed the data of the long-term interruptions of the RDN's for the years 2021 and 2022. Table 2, below, presents the annual comparison of these interruptions by generator fact.

Analyzing Table 2, it is observed that in 2022 the predominant generating events of the interruptions were Unplanned Interns, with emphasis on: Environment Atmospheric Discharge, Own System Material or Equipment Failure, Environment Wind, Tree or Vegetation, Specific to the Unclassified and Unidentified System, with a considerable increase in interruptions due to the Wind, Tree or Vegetation Environment.

It is important to emphasize that the increase in interruptions does not necessarily represent a deterioration in the services provided, given that other factors may have contributed to the values presented, especially adverse atmospheric conditions in the period analyzed. It will be necessary to monitor for a longer period and wait for the results of the improvements already implemented, as well as, if necessary, to intensify the measures adopted to solve the problems identified.

Also, during the analyzed period, referring to the items Generating Facts "Internal Unscheduled Own of the Unclassified System" and "Internal Unscheduled Own of the Unidentified System", there is a small improvement in the values presented. Thus, the Electricity Distributors were advised to maintain efforts for the correct classification and identification of the causes of interruptions.

In general, it is observed, with the data obtained, that the actions performed have not yet represented a reduction in

the number of long-term interruptions. But certainly the implementation of new planned improvements, such as corrective maintenances in feeders, action in vegetation close to the distribution network and cleaning of the easement strips, as well as actions of owners of eucalyptus plantations, in order to respect the easement strips, will imply the reduction of much of the problems that affect the continuity of energy supply of consumers served in the region and, consequently, contribution in reducing occurrences of forest fires.

RESULTS/DISCUSSION

FIELD INSPECTION

With the participation and mediation of AGEMS, meetings were held between representatives of Electricity Distributors and pulp and paper industries, taking advantage of the synergy between the field processes, and it was agreed to create a special channel between the parties involved, with the aim of periodically carrying out training of those responsible for the agricultural area of industries and rural producers for the risks of electricity, care for electrical structures, communication of the main problems that may occur in electrical networks, maintenance of firebreaks around forests and forests, distancing eucalyptus plantations from electricity networks, among other relevant issues.

It was verified in the field, by sampling, that all the points complained or with some kind of problem were corrected, mainly, maintenance of the structures of the electrical networks, removal of deactivated networks and cleaning of easement strips.

According to the information provided by Electricity Distributors, until the date of the last field follow-up inspection, all the actions foreseen in the schedule of the Results Plans presented to AGEMS were carried out.

Concerning the failure to observe the

network security strip in relation to planted trees, that is, in several regions tree plantations enter the safety belt, Electricity Distributors were directed to continuously maintain dealings with industries and landowners. It is essential that the plantation keep a safe distance from the power grid (height of the adult tree) to avoid interruptions in the supply of electricity and forest fires.

In addition, the following recommendations were related to the parties involved, which must be implemented, maintained and monitored permanently:

✓ Responsibility of Electricity Distributors

- Networks disengaged within the Electricity Distributors concession areas, if there is no short-term energization forecast, the possibility of deactivation (removed from all structures) should be analyzed on a case-by-case basis;
- In accordance with the criteria for inspections and preventive maintenance, with the necessary prioritisation, periodic maintenance schedules should be drawn up in order to reduce supply interruptions;
- Repair of all anchors broken along the main rural distribution networks raised, as well as proper signaling of the anchors of Electric poles in those points that require greater concern for the safety of people, electrical network structures and agricultural machinery;
- Taking advantage of the synergy between the field processes of Electricity Distributors and the pulp and paper industries, periodically carry out the training of those responsible for the agricultural area of industries and rural producers for the risks of electricity, care with Electrical Structures,

communication of problems in electrical networks and other matters;

- Make technical and institutional management with the pulp and paper industries, as well as with the other agents involved in pulp production, so that due to the new economic scenario of the region, a new standardization of the distances to the easement and safety strips of the power grids to be maintained for eucalyptus plantations, which can reach more than thirty (30) meters in height, is adopted;
- Electrically sectioning and grounding all transverse and parallel fences near rural power grids in accordance with current Electricity Distributors standards;
- Formally request from the pulp and paper industries the adoption and maintenance of firebreaks, distancing the easement and security of the electricity networks of their eucalyptus plantations. Firebreaks are strips of vegetation around plantations or farms with the aim of preventing the spread of fires;
- Periodically clean the easement strips in order to minimize problems affecting the continuity of electricity supply; and,
- Maintain in perfect condition the electrical groundings designed and executed for the proper functioning of the electrical system, especially with regard to its reliability and safety. To this end, it is vital that the ground resistance values are as low as possible in order to make protective equipment more sensitive and ground leakage currents rapidly isolated; maintain the potential differences produced by the passage of the fault stream within the safety limits, avoiding harm to humans and animals; allow safe and effective runoff of lightning currents;

and finally eliminate the static loads generated on the equipment carcasses.

✓ **Responsibility of the pulp and paper industries**

Adoption of efficient ways of preventing and fighting forest fires (e.g. preparation of fire prevention and fighting plans, emergency action plans and contingency plans, monitoring and surveillance, mapping and establishing risk zones, implementation of education and environmental awareness programmes, provision of adequate infrastructure for firefighting; climate monitoring; preparation of guidelines and warning signs, among many others);

Awareness of the risks of electricity, taking care of Electrical Structures, communication of problems in electricity networks and other matters among those responsible in the agricultural areas of industries and farmers;

Adoption of a new standardization of the distances to the easement and security strips of the electrical networks to be maintained in relation to eucalyptus plantations, which can reach more than thirty (30) meters in height;

Adoption and maintenance of firebreaks, distancing the easement and security of the electricity networks of their eucalyptus plantations; and, Periodically clean the security strips of electrical networks in order to minimize problems that affect the integrity of electrical power networks.

It is important to emphasize that prevention is essential to reduce the occurrence of forest fires. Proactive actions such as public education, infrastructure maintenance and proper regulations can be as vital as the combat measures themselves.

CONCLUSION

The study region, due to its local climatic conditions, presents a great risk of fire most of the year. The prevention and first firefighting

system developed and adopted by the pulp and paper industries has great efficiency, because over the time studied, the occurrence of fires showed significant reductions.

Despite the distributors, the quantities of long-term interruptions for the years 2021 and 2022 were analyzed. Considering that the distributors did not relate any occurrences in 2022 regarding the generator event “Internal Unscheduled Environment Burning or Fire”, it is concluded that the implemented actions had the desired effects. It is expected that with preventive maintenance and action on trees or vegetation close to the distribution network, complainants will be resolved at least part of their complaints. Certainly, other problems will arise over time, so it is imperative that joint actions are maintained.

With the implementation of the improvement and maintenance actions in the period 2021 and 2022, the Electricity Distributors remedied all the problems raised in the RDN's and showed concern about the reduction in the amounts of interruptions recorded, which will certainly happen in the medium or long term.

In view of the above, it was recommended the continuity of improvement and maintenance actions in the RDN's inserted in the entire region of eucalyptus and surrounding forests, through the monitoring of long-term interruptions, in order to verify the effectiveness of the measures adopted and, consequently, correct any deviations in the expected results.

Finally, public regulations play an essential role in preventing and fighting forest fires, since they establish rules and guidelines that aim to minimize the risks of occurrence of these events and respond effectively when they occur. Thus, it is of paramount importance to adopt regulations and implement measures to prevent and fight forest fires in regions of national interest.

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