Forest Fires -

Measures for the Protection and Resilience of Electronic Communications Infrastructure

I. Framework

Over the last few months, Portugal has been affected by a significant number of large-scale forest fires. According to information provided by the European Forest Fire Information System (EFFIS) 356 forest fires (fires covering an area of 30 hectares or more) were recorded up to 19 October 2017; these have impacted a total area of 520,515 hectares[1] - an average area of approximately 1,462 hectares per fire. This figure is four times higher than the corresponding average area calculated for the years 2008 to 2016 (about 357 hectares per forest fire).

In general terms, and notwithstanding the result of ANACOM's ongoing assessment on the security and integrity of electronic communications networks and services, being carried out pursuant to the provisions of Law no. 5/2004 of February 10 (Lei das Comunicações Eletrónicas - Electronic Communications Law) and of Decree-Law no. 39/2015 of 16 March (ANACOM Statutes), the preliminary information held by ANACOM in terms of the overall impact on electronic communications of forest fires occurring so far in 2017, indicates the following:

- **Radiocommunications stations**
  - over two hundred radiocommunications station installation sites affected;
- **Poles, cables and aerial routes**
  - over 500 kilometres of communications cables burned (including copper and optical fibre cables);
  - over six thousand poles burned.

[1] According to information from EFFIS, the total area burned will be 650,644 hectares

The available information also indicates the following districts/municipalities of mainland Portugal as being impacted:

- **Aveiro**: Águeda, Anadia, Arouca, Castelo de Paiva, Mealhada, Oliveira do Bairro, São João da Madeira, Sever do Vouga, Vagos, Vale de Cambra;
- **Braga**: Braga, Guimarães, Póvoa de Lanhoso, Terras de Bouro, Vieira do Minho, Vizela;
- **Bragança**: Macedo de Cavaleiros;
- **Castelo Branco:** Belmonte, Castelo Branco, Covilhã, Fundão, Manteigas, Oleiros, Penamacor, Sertã;
- **Coimbra**: Arganil, Cantanhede, Condeixa-a-Nova, Coimbra, Figueira da Foz, Góis, Lousã, Mira, Mirando do Corvo, Oliveira do Hospital, Pampilhosa da Serra, Penacova, Penela, Tábua, Vila Nova de Poiares;
- **Guarda**: Almeida, Celorico da Beira, Fornos de Algodres, Gouveia, Guarda, Manteigas, Sabugal, Seia, Trancoso;
- **Leiria**: Bombarral, Castanheira de Pêra, Figueiró dos Vinhos, Marinha Grande, Pedrogão Grande, Peniche;
- **Porto**: Baião, Gondomar, Vila Nova de Gaia;
- **Santarém**: Abrantes; Mação;
- **Viana do Castelo**: Arcos de Valdevez, Melgaço, Monção, Ponte da Barca, Valença;
- **Vila Real**: Boticas, Montalegre, Vila Real;
- **Viseu**: Carregal do Sal, Castro Daire, Cinfães, Mangualde, Mortágua, Nelas, Oliveira de Frades, Penalva do Castelo, Santa Comba Dão, São Pedro do Sul, Tondela, Viseu, Vouzela.

Based on the evaluation criteria for rural fire hazard index in mainland Portugal and under the terms of article 5 of Decree-Law no. 124/2006 of 28 June, ICNF - Instituto da Conservação da Natureza e das Florestas (Institute for Nature Conservation and Forests) has classified the territory into five classes; the two classes of highest hazard are designated "High" (class IV) and "Very high" (class V). On its website[2], ICNF posts a forest fire hazard map for 2017, in which the geographical areas corresponding to each class are indicated.

According to the reports of the Intergovernmental Panel on Climate Change (IPCC) and documents produced by the International Telecommunication Union (ITU)[3], forest fires are among the most destructive natural disasters for electronic communications infrastructure,

[2] http://www.icnf.pt/portal/florestas/dfci/inc/cartografia/map-perig-incend-flor

[3] Recommendation ITU-T L.1502 (11/2015) - Adapting information and communication technology infrastructure to the effects of climate change

and as in the case of other extreme events (e.g. floods or landslides), their intensity and frequency is expected to increase as a result of climate change.

ITU-T (ITU Telecommunication Standardization Sector) has developed a set of recommendations (Series L) on the environment and on information and communication technologies (ICT), as well as on the construction, installation and protection of cables and other components of outdoor infrastructure (see annex for list of references). These recommendations are used internationally as a benchmark for the adoption of best practice. In the case of forest fires, the most vulnerable components of outdoor infrastructure are poles, especially wooden poles, and aerial communications cables.

At an international level there are several countries, Sweden[4] and the United States[5], which, in order to enhance the level of protection given to electronic communications network infrastructure, have encouraged or have established rules on the use of advanced techniques for the installation of underground communications cables (for example, use of micro or mini trenches), as well as on the clearing and thinning of undergrowth and the crowns of the surrounding trees, thereby establishing a safety perimeter around above-ground infrastructure.

II. ANACOM Action Plan

Following the fires in Pedrógão Grande, in July and within the scope of its assigned powers and responsibilities, especially as under point m) of paragraph 1 of article 8 of its Statutes - "*to provide for the maintenance of the integrity and security of public communications networks and of publicly available services, including national and international interconnections*", point c) of paragraph 1 of article 5 - "*to promote the interests of citizens, pursuant to the present law",* and point f) of paragraph 4 of article 5 - "e*nsuring that the integrity and security of public communications networks are maintained",* ANACOM began an assessment of the impact of forest fires on the infrastructure of electronic communications networks.

In this context, ANACOM has established an on-going action plan which includes:

- The performance of a site survey;

[4] http://www.pts.se/sv/Bransch/Internet/Robust-kommunikation/Atgarder/Robust-fiberanlaggning/ and http://robustfiber.se/
[5] http://www.fire.ca.gov/

- The establishment of contacts with suppliers and installers of communications cables and poles to acquire better knowledge of the offers existing in the market and of the options available to operators in terms of technical anti-fire characteristics;
- Meetings with electronic communications companies (and other companies to be identified) for the purpose of obtaining additional information;
- Meetings with entities external to the sector seen as having information or seen to be carrying out relevant actions.

As regards the site survey, which has already been concluded, it was sought to observe and characterise the existing situation in terms of the vulnerability of radiocommunication stations and poles, cables and aerial routes to forest fires where located in areas of high forest fire hazard: designated "High" (class IV) and "Very high" (class V) by ICNF. In the first phase, a visit was made to the area of Pinhal Interior corresponding to the fire area of Pedrógão Grande, and, in a second phase, the sample was extended to the Algarve and to the North.

As a result, ANACOM visited 48 radiocommunications stations and various network routes, and subsequently produced a detailed report identifying a number of situations with regard to:

- **Radiocommunications stations**
  - Some have dried leaves and branches inside the fenced enclosure, one contains dense vegetation;
  - Stations are surrounded by vegetation without a zone of separation, and sometimes the tree tops encroach over the fenced enclosure;
  - The entry of cable into the station areas does not follow a uniform pattern and sometimes the entrances are sited within the surrounding vegetation;
  - Cable transits were unprotected;
  - The stations are normally supplied at low voltage and by means of an aerial route.

- **Pole, cables and aerial routes**
  - The use of aerial cable transits is by far the most common;
  - Poles, with rare exceptions, are wooden and provide no indication of the identify of their owner or of any owner contact, sometimes with a number painted on them (one or two figures) that apparently indicates the position of the pole in the route;
  - Aerial routes, near roads or in forest areas, are sited within vegetation without protection/separation zones; poles and communications cables cross treetops, and at their base, are surrounded by undergrowth;

- When they catch fire, poles are reduced to ashes; where the undergrowth surrounding a pole catches fire, this enough to cause the base of the pole to catch fire, causing the pole to break.
- As a result of the fire, cables either melt or they are left suspended in the burned treetops or lying along the ground.

Contacts were made in order to identify companies in Portugal that sell machines used in the installation of cables in underground routes, using horizontal directed drilling techniques or micro or mini trenches, in asphalt or dirt; as a result, ANACOM confirmed that these solutions are available for use in Portugal.

ANACOM also confirmed the existence on the market of techniques for protecting wooden poles (where already installed or due to be installed) against the combustion of surrounding ground vegetation; these include the application of special paints or protective coatings.

The market also provides for communications cables with technical characteristics that make them more resistant to fire and therefore more suitable for situations of increased fire hazard.

III. Aerial versus Underground routes - Issues to consider

ANACOM sought to identify some of the issues to be considered in respect of communications cable routes using the two methods: aerial routing and underground routing.

- Comparison or Selection Requirements

In order to compare the different methodologies of construction, installation and protection of optical fibre network infrastructure in terms of costs, it is important to consider not only investment costs (CAPEX), but also costs that result from operation, maintenance and functioning (OPEX). As such, account must be taken of the duration of the useful life cycle that is to be guaranteed for the infrastructure concerned.

As far as investment costs are concerned, the least expensive options are necessarily those making use of existing suitable infrastructure, which, at the time of installation, takes advantage of circumstances where another entity intends to carry out a construction project which allows sharing and consequently a reduction in costs, or which imply the construction of above-ground infrastructure, in particular as regards aerial communications cables.

As regards operation, maintenance and functioning, it is important to consider, for the duration of the infrastructure lifecycle, costs related to improvement and protection, which in the case of forest fires include above-ground infrastructure costs related to clearing and removal of vegetation, as well as rents payable for the use of suitable infrastructure or sites belonging to other parties or costs incurred due to the supply of goods and services. Further to these costs are costs which stem from the modification of infrastructure where adaptations are necessary due to changes in infrastructure requirements or objectives not foreseen during planning, and finally recovery and repair costs resulting from damage and other losses caused, in particular, by forest fires and other extreme events.

However, the cost perspective is just one of the requirements to be taken into consideration when it comes to comparing or selecting techniques of construction and installation of outside optical fibre network infrastructure.

According to the ITU[6], for the purpose of comparison or selection of technologies to be used in support of sustainable and low-cost telecommunications infrastructure, several requirements are identified, besides cost (CAPEX and OPEX), including (i) reliability; (ii) data rate; (iii) flexibility; (iv) scalability; (v) energy efficiency and (vi) environmental impact.

In the same recommendation, the ITU considers that the reliability of the solution should be enhanced as far as possible to cope with harsh natural environments.

- Best Practices in Underground Route Construction

According to the ITU, best practices in construction and installation techniques for underground routes of optical fibre network infrastructure requires some alteration and adaptation of procedures and methodologies traditionally used in the construction and installation of cement duct networks.

Following the installation of underground piping infrastructure, optical fibre cabling is blown in[7], i.e. fibre cable is no longer pulled and stretched.

In terms of planning, a Geographic Information System (GIS) should be employed, with comprehensive information on subsoil infrastructure existing in the area of work; the SIIA -

[6] Recommendation ITU-L L.1700 (06/2016) - Requirements and framework for low-cost sustainable telecommunications infrastructure for rural communications in developing countries

[7] Recommendation ITU-T L.57 (05/2003) / L.156 (02/2016) - Air-assisted installation of optical fibre cables

Sistema de Informação de Infraestruturas Aptas (Suitable Infrastructure Information System)[8] is particularly suitable for this purpose. In addition, especially in the case of techniques that do not involve trenching, it preliminary analysis of the subsoil must be performed along the intended path, by means of soil radar penetration[9] [10].

Infrastructure construction and installation techniques are divided into two types, depending on whether a trench is necessary or, if not, a subsoil drilling or boring technology is used.

In the case of trenching techniques, the choice of the specific technique depends, among other things, on whether the intervention is made on asphalted ground, i.e. on the roadway or on earth. Intervention on the roadway depends, *inter alia*, on articulation between the entity seeking to install the fibre with the entity that regulates access to the asset of the public domain - the roadway. The SIIA is especially focused on facilitating this articulation. So-called micro trench techniques[11] or mini trench techniques[12] are particularly suited for interventions on asphalted terrain, and the ITU-T's work covers intervention in urban areas regarding the use of low-impact trenching techniques[13].

Subsoil installation techniques are often used in cases where an obstacle, such as a road or a river, is traversed by crossing underneath, although their use is not limited to these cases. The techniques used employ boring methods, in the case of guided horizontal boring, or drilling, by means of directional drilling methodology[14].

IV. Measures

Based on the activity undertaken up to this point and, in particular, the situations which result from the site survey (notwithstanding continued prosecution of the established action plan), it is possible to identify an initial set of measures aimed at improving the protection and resilience of electronic communications infrastructure.

[8] https://www.anacom.pt/render.jsp?categoryId=384522

[9] Recommendation ITU-T L.39 (05/2000)/L.257 (02/2016) - Investigation of the soil before using trenchless techniques

[10] Recommendation ITU-T L.84 (07/2010) / L.260 (02/2016) - Fast mapping of underground networks

[11] Recommendation ITU-T L.49 (03/2003) / L.154 (02/2016) - Micro-trench installation technique

[12] Recommendation ITU-T L.48 (03/2003) / L.153 (02/2016) - Mini-trench installation technique

[13] Recommendation ITU-T L.155 (11/2016) - Low impact trenching technique for FTTx networks

[14] Recommendation ITU-L.38 (09/99)/L.152 (02/2016) - Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation

ANACOM recommends that these measures be considered as described in this document and with the involvement and consultation of all stakeholders.

- **Globally**
  - Preparation, approval and establishment of a new legal and regulatory framework governing the planning, construction, reconstruction, reconversion and installation of electronic communications infrastructure and of infrastructure suitable for carrying electronic communications, which envisages the creation of technical standards and regulations, including protection against fire and other natural disasters, in accordance with best practice, in particular the ITU-T recommendations referred to above and taking into account the legal regime set out by the LCE and Decree-Law no. 123/2009 of 21 May (DL 123/2009);
  - Promotion and dissemination of Decree-Law 123/2009, in particular with regard to the use of the SIIA for the dissemination of announcements regarding work projects, for the promotion of infrastructure-sharing, as well as for the planning and control of the construction of new electronic communications infrastructure, within the scope of the infrastructure development plans to be launched at national, regional or local level.

- **Radiocommunications stations**
  - Establishment of requirements and procedures for the management of biomass and flammable vegetable waste:
    - Creation of a paved strip surrounding the station outside the enclosing fence with a suitable minimum width (e.g. 2 metres);
    - Cutting and thinning of treetops and shrubs, establishing a suitable minimum distance from the station (e.g. 5 metres);
    - Clearing the ground around the station by cutting back and removing vegetation (undergrowth and fire-propagating material), thereby establishing a band of flammable material management with a minimum adequate width (e.g. 50 metres);
    - Clearing the interior of the enclosure, by removing dry leaves and branches and other flammable material deposited there;
  - Establishment of cable entry protection requirements;
  - Establishment of requirements with the aim of creating and maintaining a fire protection band of adequate width (e.g. 5 metres) along the aerial routes of communications and power cables, in particular in relation to the municipality

concessions of low voltage energy infrastructure, in the accesses to radiocommunications stations;

- Establishment of requirements that promote the sharing of paths in aerial routes of communications cables and electric power cables, with the purpose of creating and maintaining a fire protection band with adequate width, common to both routes, in accesses to radiocommunications stations;
- Establishment of requirements to promote the replacement of aerial routes of communications cables with underground routes or, where appropriate, radio beams, in accesses to radiocommunications stations.

- **Poles, cables and aerial communications**
  - Establishment of technical requirements for the protection of electronic communications network infrastructure which, where appropriate, in areas of recurrent risk, ensure that priority is given to underground installation rather than aerial routing, taking advantage of existing suitable infrastructure (e.g.: roadway ducts) and adopting ITU-T recommendations, see annex (e.g. horizontal drilling and micro and mini trenches), in the case of:
    - Construction and installation of new networks, especially within the scope of national, regional and local infrastructure development or investment plans, and
    - Reconstruction of current networks, in particular, after the occurrence of a forest fire or other natural disaster that has affected them, as long as the recovery time of the services allows;
  - Preparation of a plan for conversion of aerial routing to underground routing of electronic communications network infrastructure, ensuring access to the electronic communications services and networks of municipality capitals and radiocommunications station sites located in geographical areas classified by the ICNF, according to the National Forest Fire Protection System[15], as "High" (Class IV) or "Very High" (Class V), taking advantage of existing suitable infrastructures (e.g. roadway ducts) and adopting ITU-T recommendations, see annex (e.g. guided horizontal drilling and micro and mini trenches, where terrain permits);
  - Plan to affix geo-referenced identifiers on each pole, with indication of the owner and their contact details, prioritising areas of "High" (class IV) and "Very high" (class V) forest fire hazard;
  - Establishment of requirements with the aim of creating and maintaining a fire protection band with adequate width (e.g. 5 metres) along aerial communications

[15] Decree-Law no. 124/2006 of 28 June

cable routes, prioritising areas of "High" (class IV) and "Very high" (class V) forest fire hazard;

- Establishment of requirements and procedures for fire protection of wooden poles (e.g. base paint), prioritising areas of "High" (class IV) and "Very high" (class V) forest fire hazard;
- Establishment of appropriate fire resistance requirements for communications cables to be used in aerial routing, prioritising areas of "High" (class IV) and "Very high" (class V) forest fire hazard.

V. Implementation

The adoption of measures for the protection and resilience of electronic communications infrastructure is more effective and the costs lower where identified and implemented sooner during their life cycle, i.e. during planning and implantation[16].

In terms of maximising social benefit resulting from the adoption of these measures, it is important to bear in mind the objective of guaranteeing continuity in the provision of electronic communications services in places where, in case of failure, the resulting negative effects would be most severe for the community, particularly where impacting decision-making and support centres and emergency network support points.

In this sense, priority should be given to electronic communications infrastructure supporting accesses to networks at seats of local government, since these locations have a concentration of a set of elements which are basic to the functioning of the community and which provide a set of essential services, namely:

- Seat of local government corresponding to the decision-making centre, where municipal services responsible for security and civil protection are based;
- Fire stations;
- Hospitals/Health Centres/Pharmacies;
- Security authority stations/posts;
- Schools/points of collection and assistance to the population; or
- Centres for the supply of food, fuel and other essential goods

[16] Recommendation ITU-T L.1502 (11/2015) - Adapting information and communication technology infrastructure to the effects of climate change

On the other hand, with analysis being made as to the adoption of measures to provide for the protection and resilience of electronic communications infrastructure to forest fire hazards, it is important to take into account the assessment made by the ICNF, within the scope of the National Forest Fire Protection System[17], as to the dangers of rural fires, giving priority to the geographical areas of most probable occurrence, i.e. areas classified as "High" (class IV) and "Very high" (class V) hazard.

The adoption of these measures, in particular those which are the subject of ITU-T recommendations, requires the development of technical knowledge, in terms of know-how and capacity to plan and acquire, the development of an appropriate legal and regulatory framework and the establishment of new interconnections between economic agents in terms of production chains resulting in new infrastructure or alteration of existing infrastructure.

The proposed measures seek to improve the security and integrity of electronic communications networks and services and the formulation, approval and establishment of a new legal and regulatory framework to govern the planning, construction, reconstruction, reconversion and installation of electronic communications infrastructure and of infrastructure suitable for carrying electronic communications. To this end, it is also important to establish technical standards and regulations for the construction and protection of infrastructure against fire and other natural disasters, in accordance with best practice and with ITU-T recommendations, taking into account the legal regime set out by the LCE and DL 123/2009.

To this end, ANACOM considers it essential to ensure the involvement and prior consultation of a number of public and private entities, such as the Assembleia da República (Assembly of the Republic), the Government, municipalities, electronic communications companies, machine manufacturers and installers.

ANACOM will proceed with the above action plan and with the promotion of actions to strengthen coordination between the public and private entities involved, the promotion of infrastructure-sharing and reduction of costs. ANACOM will also work to develop technological knowledge in relation to the construction and installation of electronic communications infrastructure, in particular through workshops and working groups, and maximizing the benefits of using geographic information systems.

[17] Decree-Law no. 124/2006 of 28 June

ANNEX

List of L-Series ITU-T Recommendations and their supplements

SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

RECOMMENDATIONS

- Rec. L.38 (09/99) / L.152 (02/2016) - Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation;
- Rec. L.39 (05/2000) / L.257 (02/2016) - Investigation of the soil before using trenchless techniques;
- Rec. L.48 (03/2003) / L.153 (02/2016) - Mini-trench installation technique;
- Rec. L.49 (03/2003) / L.154 (02/2016) - Micro-trench installation technique;
- Rec. L.57 (05/2003) / L.156 (02/2016) - Air-assisted installation of optical fibre cables;
- Rec. L.64 (10/2012) / L.361 (02/2016) - ID tag requirements for infrastructure and network elements management;
- Rec. L.69 (06/2007) / L.362 (02/2016) - Personal digital assistant requirements and relevant data structure for infrastructure and network elements management;
- Rec. L.79 (07/2008) / L.108 (02/2016) - Optical fibre cable elements for microduct blowing-installation application;
- Rec. L.84 (07/2010) / L.260 (02/2016) - Fast mapping of underground networks;
- Rec. L.92 (10/2010) - Disaster management for outside plant facilities;
- Rec. L.155 (11/2016) - Low impact trenching technique for FTTx networks;
- Rec. L.1502 (11/2015) - Adapting information and communication technology infrastructure to the effects of climate change
- Rec. L.1700 (06/2016) - Requirements and framework for low-cost sustainable telecommunications infrastructure for rural communications in developing countries

SUPPLEMENTS

- Supp. 22 (04/2016) – Low-cost sustainable telecommunication for rural communications in developing countries using fibre optic cable
- Supp. 23 (04/2016) – Low-cost sustainable telecommunications for rural communications in developing countries using microwave and millimetre radio links
- Supp. 24 (04/2016) – Overview of climate change effects and possible impacts
- Supp. 25 (04/2016) – Best practices for infrastructure adaptation to climate change
- Supp. 29 (10/2016) - Low-cost sustainable telecommunication for rural communications in developing countries using cellular radio technologies
- Supp. 30 (10/2016) – Setting up a low-cost sustainable telecommunication network for rural communications in developing countries using cellular network with capacity transfer
- Supp. 31 (10/2016) - Setting up a low-cost sustainable telecommunication network for rural communications in developing countries using satellite systems