

# Development of Measures for Self-Protection Against Forest Fires: Application in Highly Vulnerable Installations<sup>1</sup>

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## Abstract

The National Institute of Aerospace Technology (INTA), a public research agency founded in 1942 and reporting directly to the State Secretary of Defence, is dedicated to aerospace research and technological development in other industrial areas.

INTA carries out a wide range of research and development activities in different aeronautic disciplines, communication and navigation systems, remote sensing, etc. Development in these fields requires sophisticated and technologically advanced facilities. Should a forest fire occur, these installations would be placed at a great risk.

The threat of forest fires forms part of Civil Protection planning, and is thus contained in the Basic Civil Protection Regulation, which determines the need to prepare Special Fire Protection Plans in corresponding areas of need.

The pertinent regulation for the Community of Madrid is the Civil Protection Plan for Forest Fire Emergencies (INFOMA), which is integrated in the Community of Madrid Civil Protection Plan (PLATERCAM). The Plan lays out the organization of and the procedures for using the resources and services owned by the Autonomous Community of Madrid and any other resources and services that the National Administration or other public or private entities might assign to the Community. The purpose of the plan is to effectively respond to forest fire emergencies within the Madrid boundaries. Accordingly, Appendix 5 establishes the need for Self-Protection Plans for forest fires with measures “involving all the resources (existing human and material resources of a company, isolated centre of population, housing developments, or camp grounds, etc. located in or near a forest area), as well as the regulations for taking action for prevention, initiation of fire suppression, and protection of the population until the time external Action Groups arrive on the scene and intervene”.

This framework was used to develop INTA’s Forest Fire Protection Plan, which includes a series of preventative measures to effectively and appropriately respond to the possible event of forest fire.

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<sup>1</sup> An abbreviated version of this paper was presented at the second international symposium on fire economics, policy, and planning: a global view, 19–22 April, 2004, Córdoba, Spain.

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## Introduction

The main aim of the Plan is to equip INTA with a series of self-protection measures, with preventative aspects such as control of forest fuel and water availability, in order to guarantee protection against possible woodland fires which, given the proximity, could affect the Institute’s facilities.

The first step in turning this abstract objective into a concrete plan was to divide the area in question into zones and to prioritise the defence measures. This was done by identifying the present forest systems and their flammability, quantifying the fire risk and locating the elements that would be vulnerable in the event of a fire (figure 1).

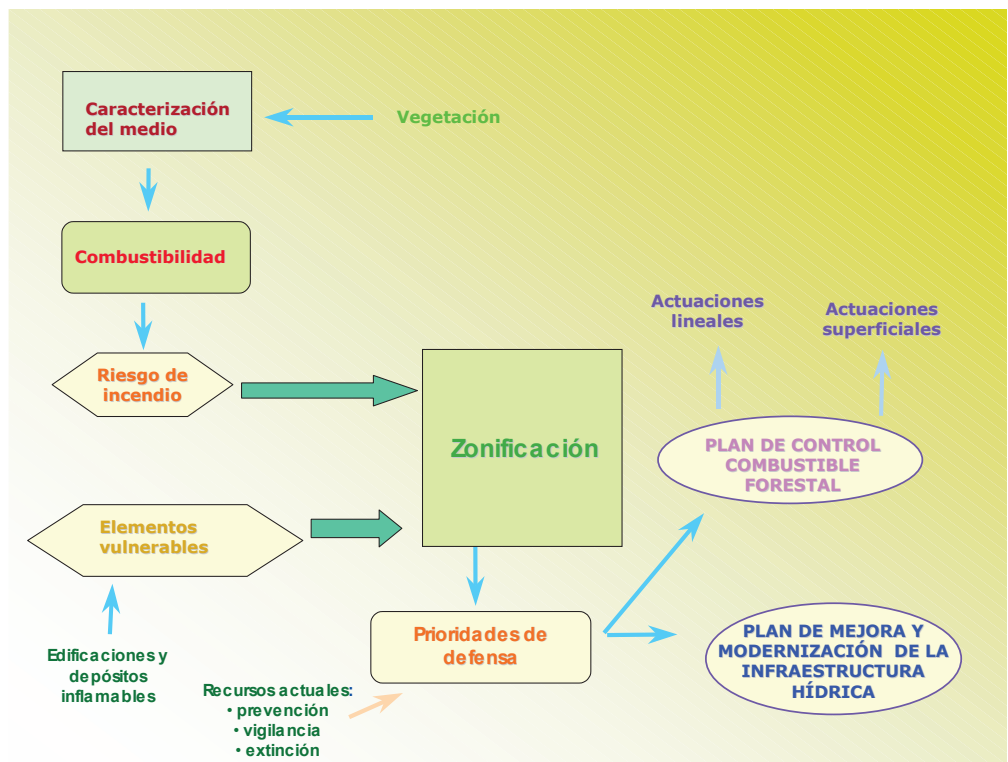


Figure 1—Organization of the Plan.

## Description of the Situation

INTA has facilities throughout Spain; however, the main facilities for which the Plan has been developed are located in the municipality of Torrejón de Ardoz and cover more than 363 ha.

The Plan corresponds to two clearly differentiated zones: an essentially woodland area with only a few facilities that covers 306 ha (84% of the total area) and a predominately developed area, where almost all of the Institute’s infrastructures and facilities are located.

The area in question was classified according to use and the forest systems were identified by using georeferenced orthophotography supplied by INTA’s Remote Sensing Laboratory and taken during a flight with an AMDC (Airborne Multispectral Digital Camera) in early 2002. The classification was also done with

the support of TRAGSATEC's Dinamap SIG software for the development of projects with three basic components: cartography, databases and images.

## Development of the Plan

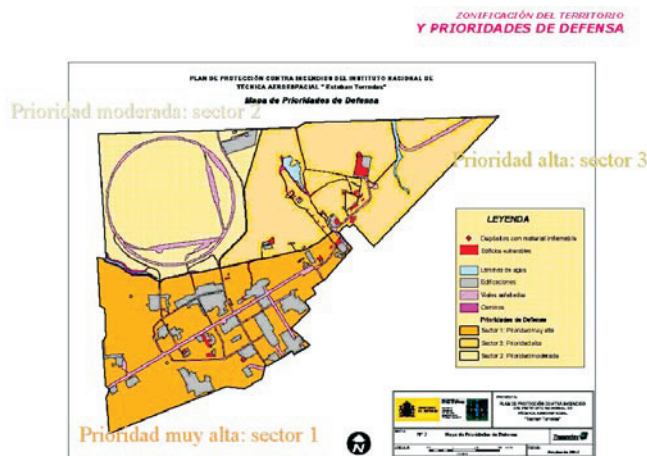
### Zoning

In the **woodland** zone, the most relevant factor is the **risk of spread**, interpreted in the Plan through flammability. The relief factor is not taken into account since the change in level in the area is less than 50 meters and therefore irrelevant when considering spread.

Within the **urban** area, practically all the buildings are occupied during the week, and thus the occupants of the buildings are at risk. Evacuation plans are therefore required.

In addition, factors such as the presence of inflammable materials or the nature of activities that could take place in certain facilities are especially important and were taken into account when prioritising the preventative measures.

Accordingly, the territory was zoned bearing in mind the aspects of risk of spread and the classification of vulnerable elements (*figure 2*).



**Figure 2**—Map of protection and defence priorities (Very high priority: Sector 1, Moderate Priority: Sector 2, High Priority: Sector 3)

From this zoning, priorities for protecting and defending the installations were established in the form of two Plans: Improvement and Modernization of the Water Infrastructure and Forest Fuel Control.

### Improvement and Modernization of the Water Infrastructure

INTA's facilities house a complex network of well-water pipes that provide water to 40 hydrants—all of which are type 100 except two type 80—through a 20 KW pump supplying between 3.5 and 4.5 kg/cm<sup>2</sup> pressure. The pump takes water from an 800m<sup>3</sup> reservoir that is refilled with water extracted from the well by an underwater

pump. In addition, the fire suppression system includes a series of hydrants serving certain buildings not connected to the mentioned well-water mains but rather to auxiliary deposits or directly to the Canal de Isabel II water network.

Overall, INTA has a total of 53 exterior hydrants, 83 valves and 15,700 m of piping, mainly high-density polyethylene and fibre cement pipes.

In order to calculate the needs of the facilities, existing regulations<sup>4</sup> were taken into account. Software<sup>5</sup> specially designed for calculating supply and irrigation mains was used for the sizing of the facilities, assigning of the materials, diameters and registered pressure of the piping, and determining the necessary pumping groups. With this software it is possible to simulate the most unfavourable supply conditions.

Once the calculations were made for the current INTA water main, it was apparent that some stretches of piping had to be substituted to satisfy the calculations made of the most unfavourable conditions. It was also necessary to incorporate another pump and another generator, so that the well-water network would have two impulse pumps and two generators, situated on parallel lines so that both pumps could function with electric supply and, in case of a power failure, with the generator.

Likewise, the Plan provides for the incorporation of 35 new type-100 hydrants, 15 of which will be placed consecutively every 200 meters along the test circuit. The remaining 20 hydrants will be placed in different points of the well-water main that surrounds the constructed area.

### ***Forest Fuel Control Plan***

The regulation of fuel, or preventative silviculture, is the ideal tool for creating horizontal and vertical fuel discontinuity. Of the methods for modifying or eliminating fuel, the main measures are mechanical clearing, application of herbicides and prescribed burning. In view of the special characteristics of the land on which INTA's installations are found, the following actions are most appropriate:

- ❖ **Lineal measures** such as creating and continually maintaining fuel break strips, as both a barrier to advancing fire and as support for fire suppression teams and resources. More than 16 km would be affected by these measures.
- ❖ **Superficial measures** that include silvicultural treatments and chemical clearing. The treatments involve thinning or felling, which contribute to the modification of the fuel models by attempting to break horizontal fuel continuity. These treatments would be effected in more than 23 ha. **Chemical clearing** is the best alternative for protecting areas that lie near buildings. The selected herbicide was glyphosate, which is a non-selective, systematic broad-spectrum herbicide. In addition, it biodegrades rapidly.

<sup>4</sup> Norma Básica de la Edificación NBE-CPI/96: Condiciones de protección contra incendios en los edificios y Reglamento de prevención de incendios de la Comunidad Autónoma de Madrid. (Basic Construction Regulation NBE-CPI/95: Conditions for Fire Protection in Buildings and Regulation of Fire Prevention in the Autonomous Community of Madrid.)

<sup>5</sup> GESTAR, diseñado conjuntamente por el Departamento de Agricultura y Medio Ambiente del Gobierno de Aragón, por la Escuela Universitaria Politécnica de Huesca perteneciente a la Universidad de Zaragoza, y por la Comisión Interministerial de Ciencia y Tecnología (GESTAR, co designed by the Department of Agriculture and the Environment of the Regional Government of Aragón, the Polytechnic University of Huesca (part of the University of Zaragoza), and the Inter-Ministerial Commission for Science and Technology)

The herbicide is to be applied to a 25 m strip around the buildings (44 ha to be treated).

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