UNIVERSIDAD DE CANTABRIA

GIDAI SEGURIDAD CONTRA INCENDIOS INVESTIGACIÓN Y TECNOLOGÍA

CANTABRIA CAMPUS INTERNACIONAL

Development and Full-Scale Tests of a Water Mist System inside High Speed Trains

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Objetives

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Phase 1.- Fire behavior and fire spread in high speed trains

-Provide scientific knowledge about the conditions of development and manifestations of real fire at end-use conditions High-Speed Passengers Trains.

-Determine the size of the ignition sources necessaries to cause manifestations of unsustainability for people in passenger trains.

-Provide the data needed to develop valid correlations between the results of the new tests on small scale HRR vs the results of fire behavior in end-use conditions.

-Provide data to evaluate the predictive ability of FCM in Passengers Trains.

Phase 2.- Integral fire detection and suppression system

-Development of an integral safety system based on the results of the previous phase.

-Test the system for various fire scenarios developed for this purpose.

-Provide data to evaluate the predictive ability of FCM in Passengers Trains and with the inclusion of the system.

Phase 3.- Validation of numerical model and system optimization

Objetives

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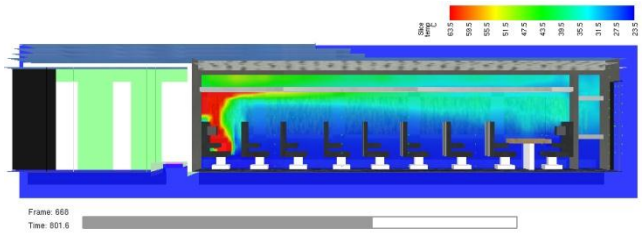
Small Scale Tests

GLOBAL PROJECT

Real-Scale Tests

Dimensional Analysis

Numerical Analysis



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Selection of the Car to Study

Serie 112: a new construction Serie of the consortium TALGO-BOMBARDIER from serie 102, with an increasing of the capacity. The tractor heads of both series are identical and also have the same numbers of cars (12 without counting the two tractor heads). The total length of the train reached 200 m, being the average length of the car about 14 m.

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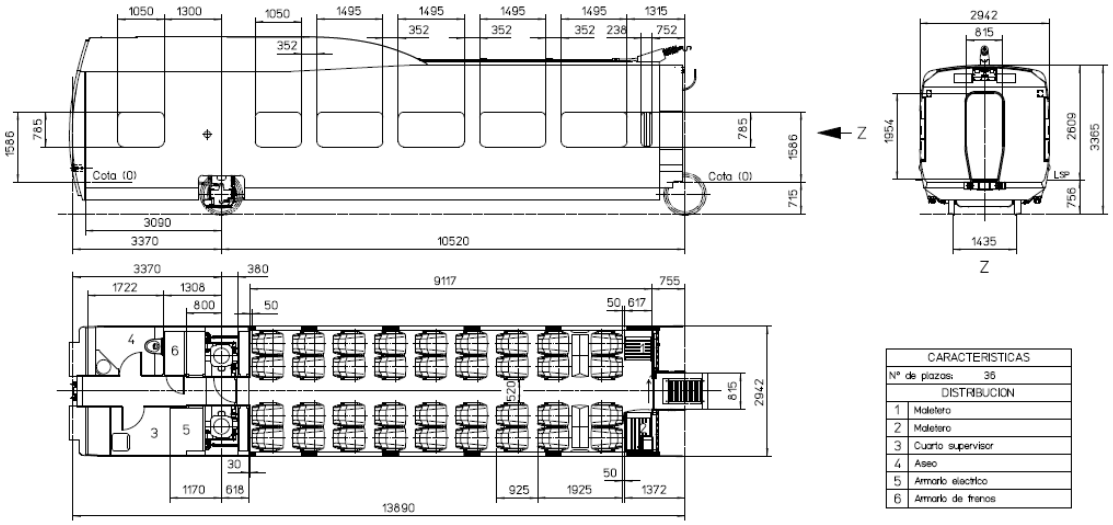
Selection of the Car to Study

End Tourist Car- Serie 112: the consequences of a fire on these cars presents more adverse conditions because of the impossibility of a direct evacuation.



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Adaptation of Test Car

The experimental program was carried out in a car donated by the General Direction of High-Speed Long Distance - RENFE Operadora.

It corresponded to an old Train BB-9201-9240, and was used as a frame and taking its structural elements.

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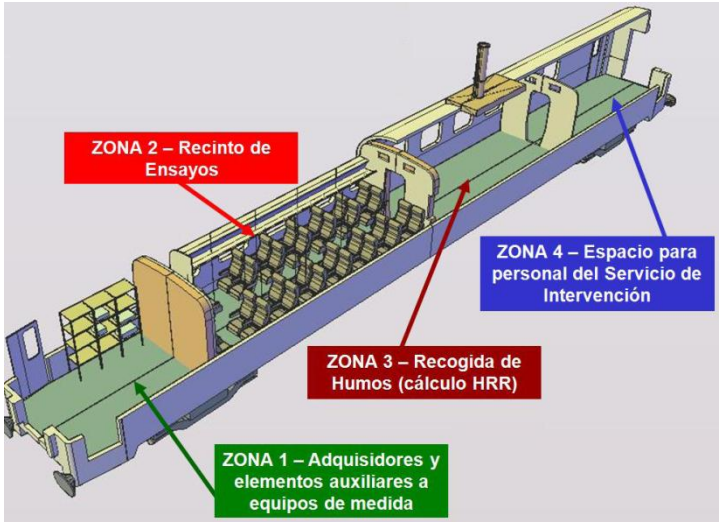
Adaptation of Test Car



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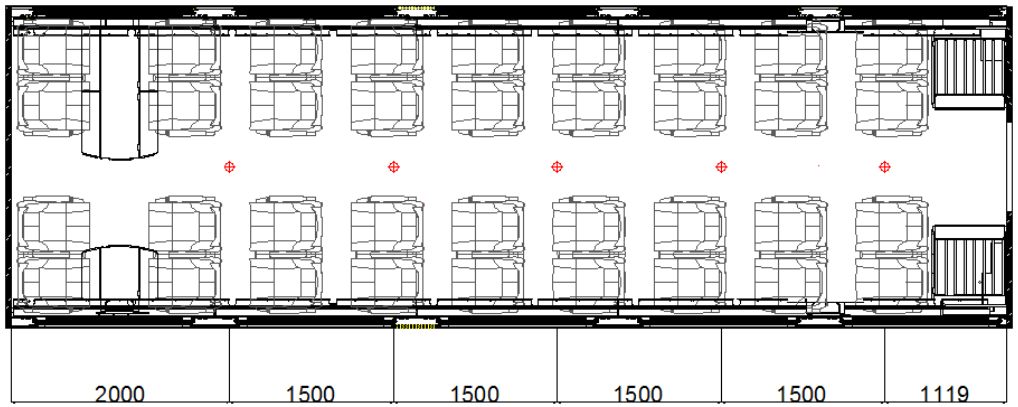
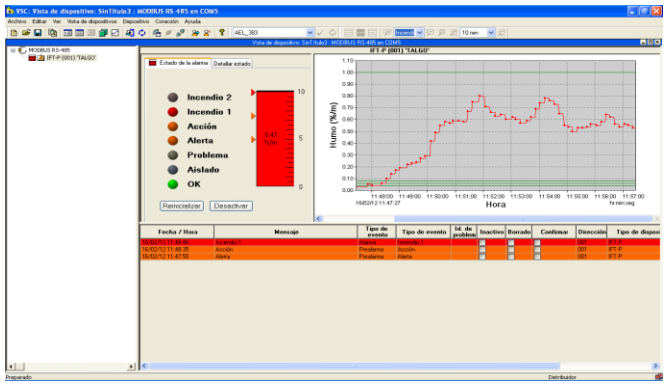
XTRALIS IFT-P:

-Five sampling aspiration points located inside of the compartment of the train.





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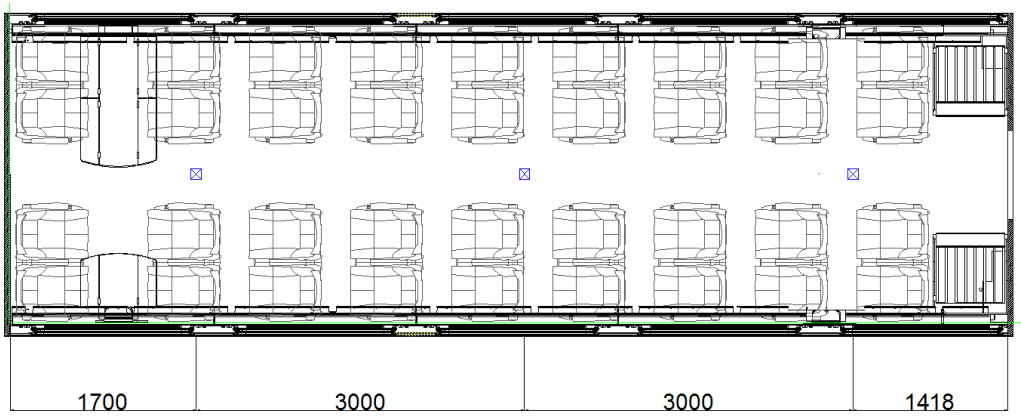
RG SYSTEMS:

-Three nozzles located inside of the compartment of the train.



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Stade of the art:

Type of analysis	nº of Tests	Parameters to be measured
Improved of measurement methods	4	Distribution of droplet sizes.
Characterization	4	Distribution of droplet sizes, water mist atomization angle and the breakup length.
Tests and Validation	4	Temperature (HRR).
	1	Temperature, concentration O_2 and outlet pressure.
	12	Temperature, extinction time, concentration O_2, CO_2.
	48	Pressure, flow velocity, temperature.
Specific Tests	4	Velocity and diameter of the droplet, temperature, HRR.
	6	HRR, temp, concentr. O_2, CO, CO_2.
	4	HRR, temp, concentr. O_2, CO, CO_2.
	15	Influence in electrical environment.
	66	Temperatures y concentrations.
Design and test of system	20	Oxygen, temperature, flow velocities and pressure.
	12	Temperature and outlet pressure.
	75	Concentration O_2, CO, CO_2, temperature, heat flux, pressure and velocity.
	13	Fire extinguishing time, temperature, pressure and species concentration.
	42	Temperatures, pressure and gas concentration.
	42	Temperatures, gas concentration, heat flux, humidity and pressure.
	13	Temperatures, gas concentration and extinction time.
	34	Temperatures, gas concentration, visibility and gas and air pressures.
	13	Temperature and gas concentration.

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Fire Scenarios

There were two cases based on different references analyzed:

- Case 1: Test in different locations where the fire was and was not shielded from direct water application.

- Case 2: Analysis of the effects of activation time of the extinguishing system.

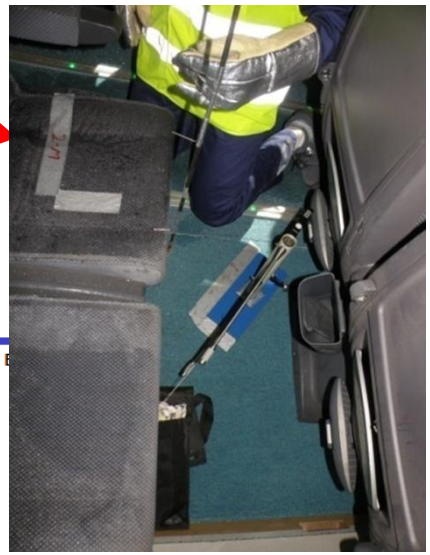
11 FIRE SCENARIOS

Fire Scenarios (Case 1):

- The ignition source was a backpack with geotextiles inside (To understand the behavior of the system against a 'real‘ fire.

- 4 different combinations of position of the ignition source (under and over the seat, under the table and over the trunk).

- Activation time 180 s.



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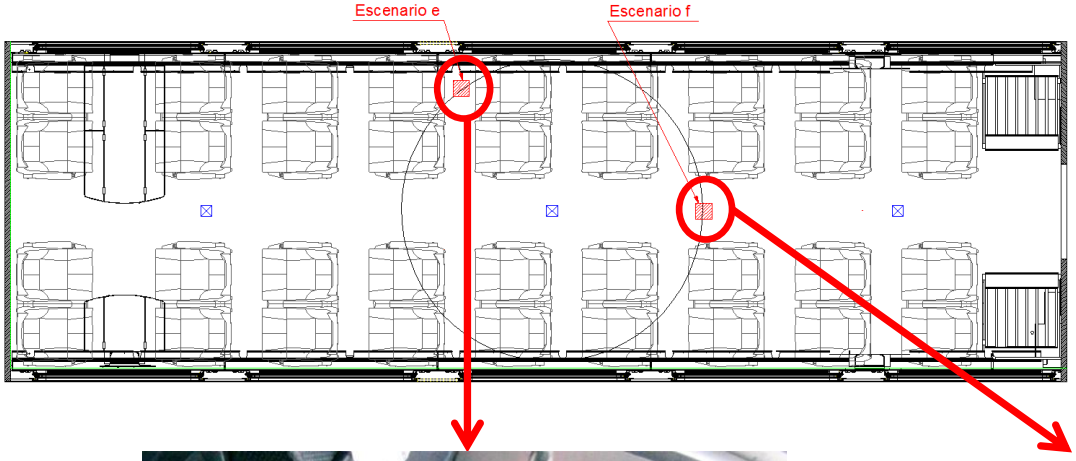
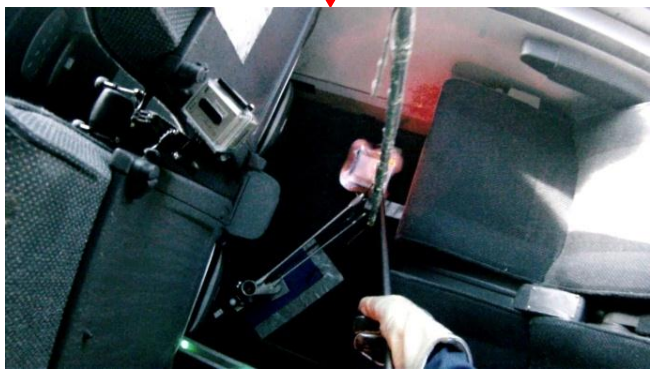
Fire Scenarios (Case 2):

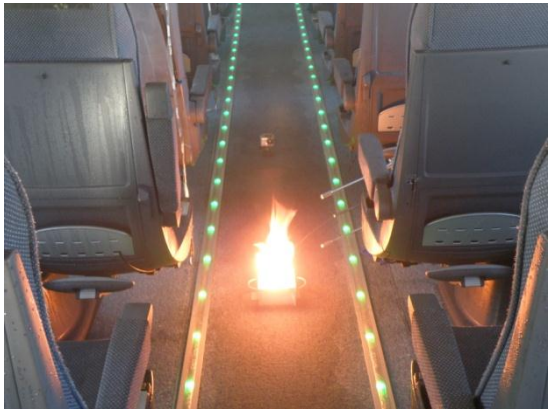
-The aim of the tests performed in this second case was testing the effects of activation time (fire HRR) in the fire extinction, considering two possibilities: fire exposed or shielded fire.



-2 locations of the ignition source with 4 different activation times (based on different points of the curve of an armchair Train Fire).

-Pool fire (design fires).





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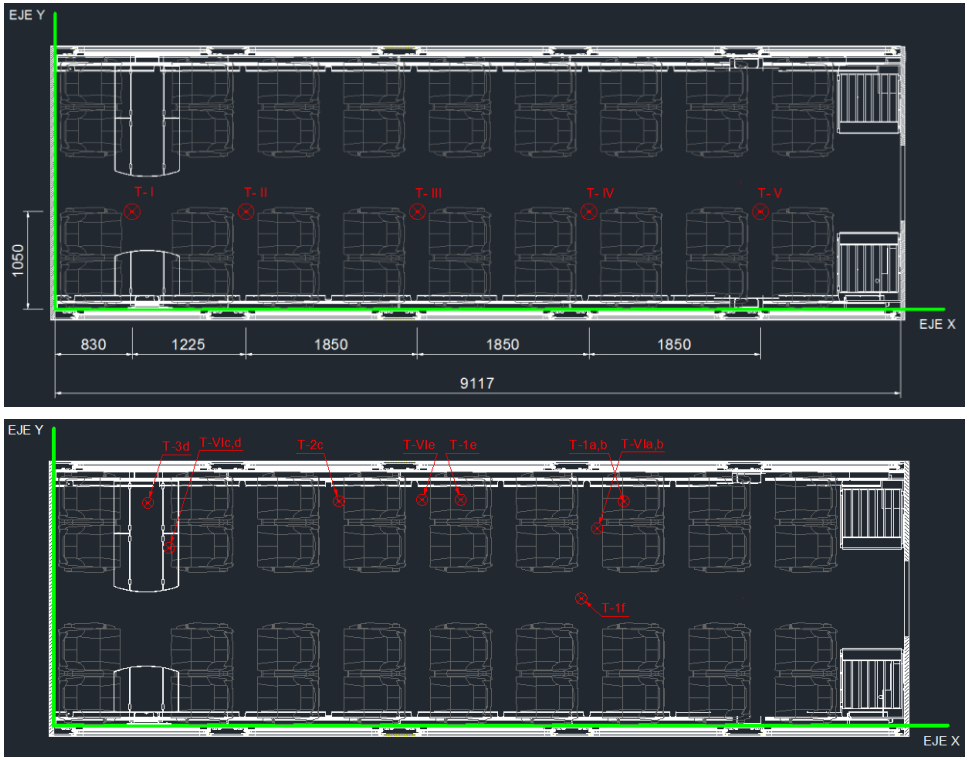
Measure Points - Temperature



-Gas phase thermocouples type K placed in 5 fixed trees and 9 thermocouples were attached to each tree at different heights.

-Gas phase thermocouples type K placed in 3 trees (close to the ignition source) and 9 thermocouples were attached to each tree at different heights.

-6 Gas phase thermocouples type K placed close to the ignition source.

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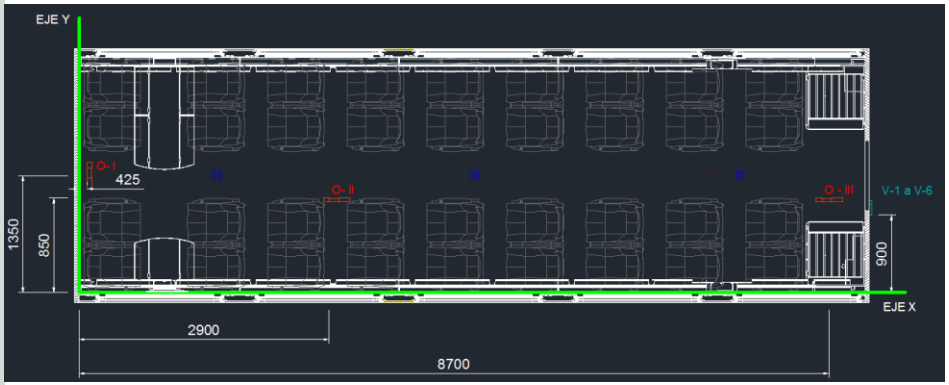
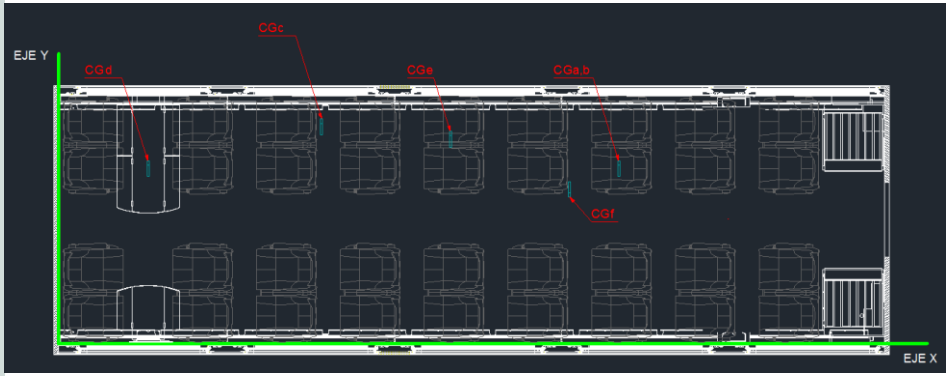
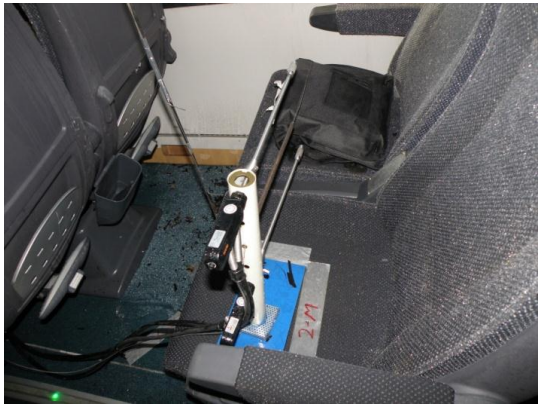
Measure Points - Others







- Laser smoke obscuration sensors.
- Gas flow velocity.
- Concentrations of different species (mainly oxygen depletion).
- Others: pressure and humidity, cameras.

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Safety and Assurance

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Case 1-B: (backpack over the seat)

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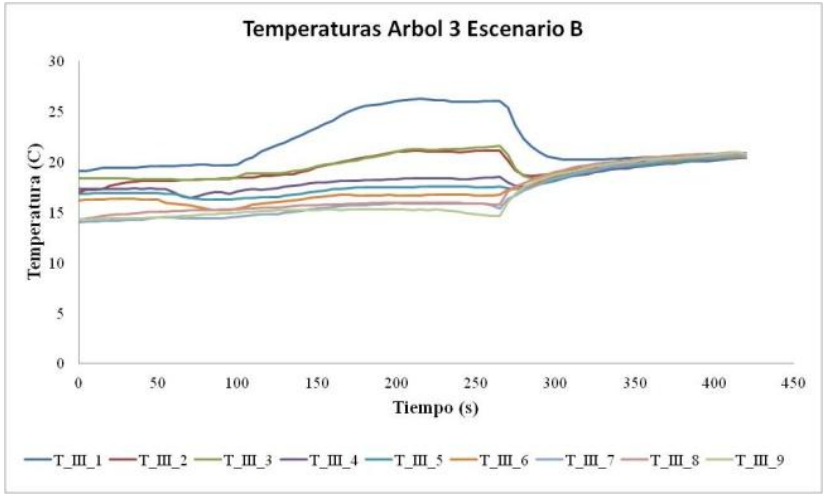
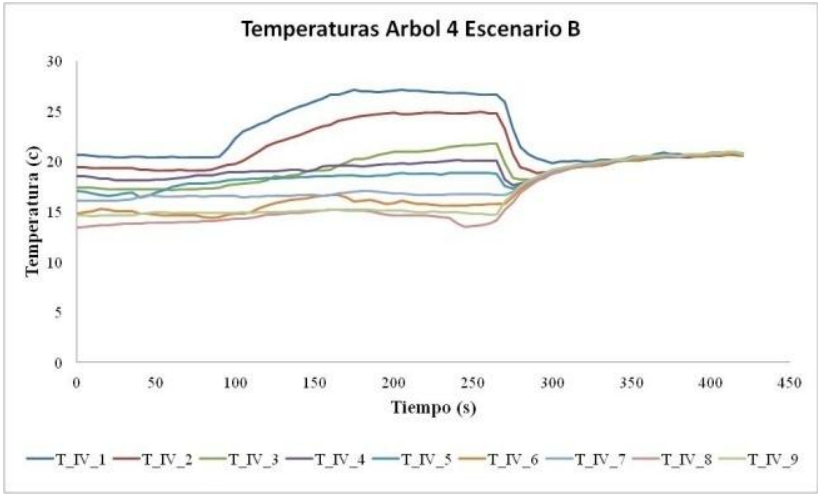
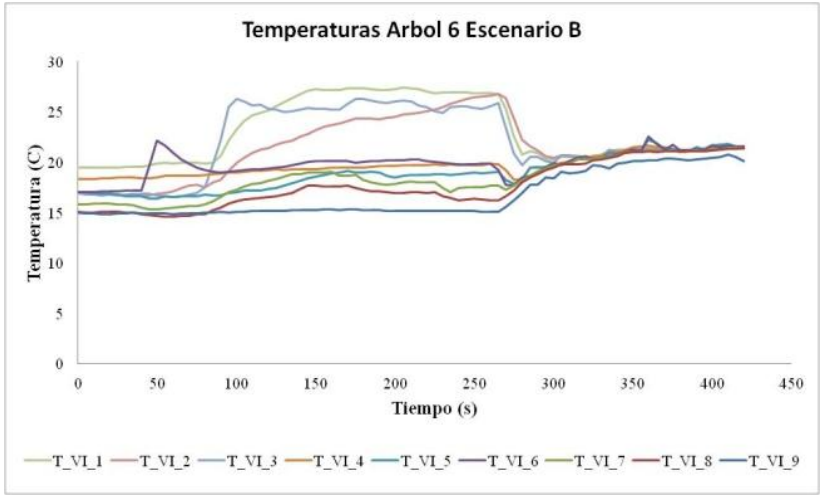
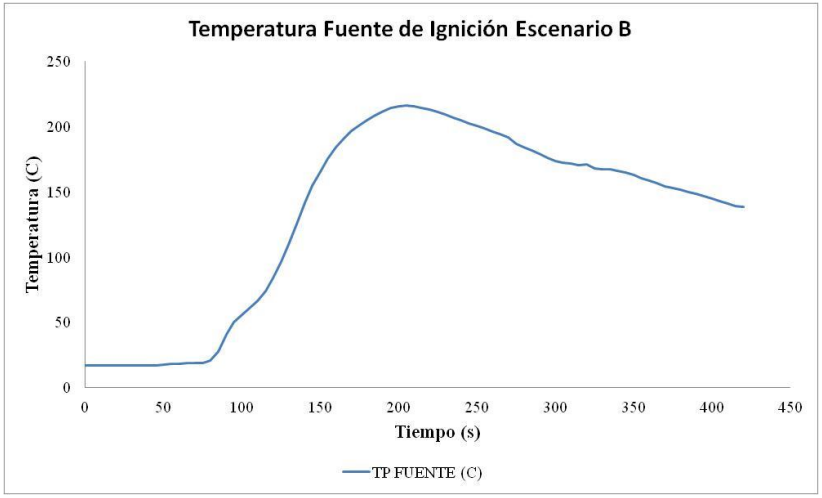
Case 1-B: Temperatures

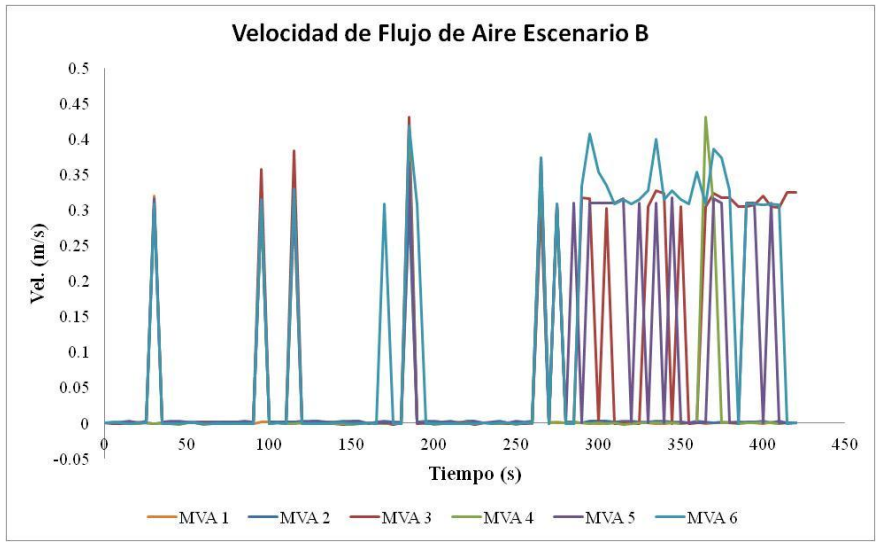


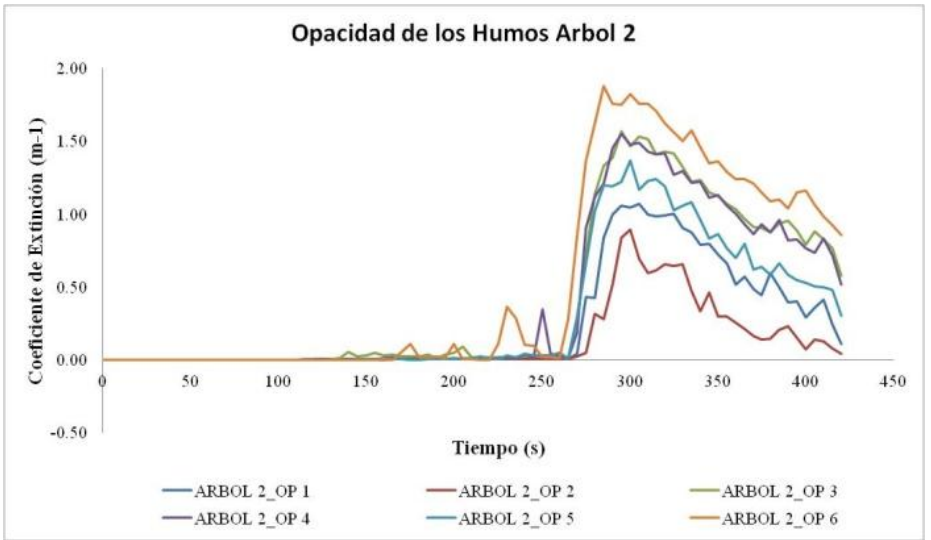


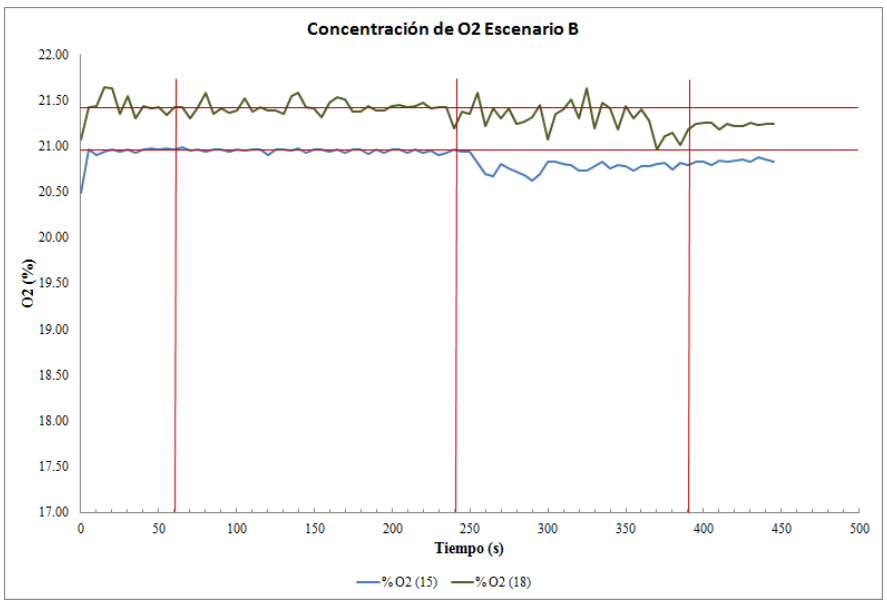




Case 1-B: Other Parameters







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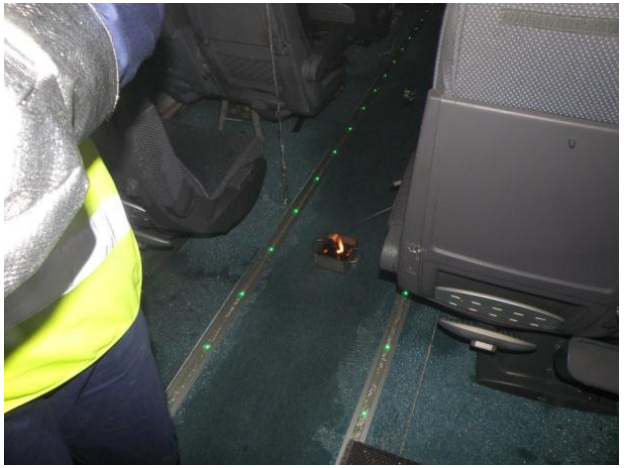
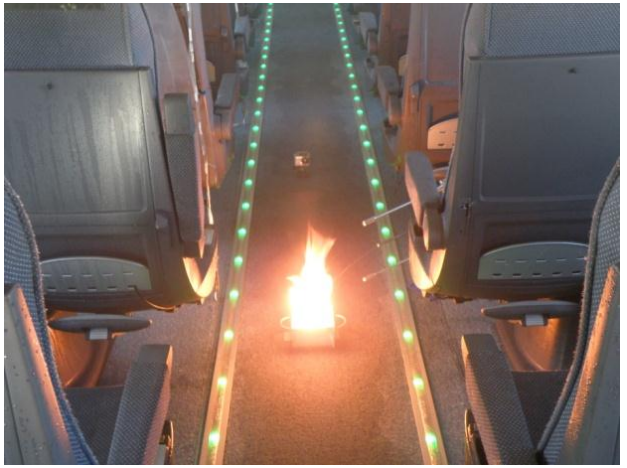
Case 2-F: (small pool fire)





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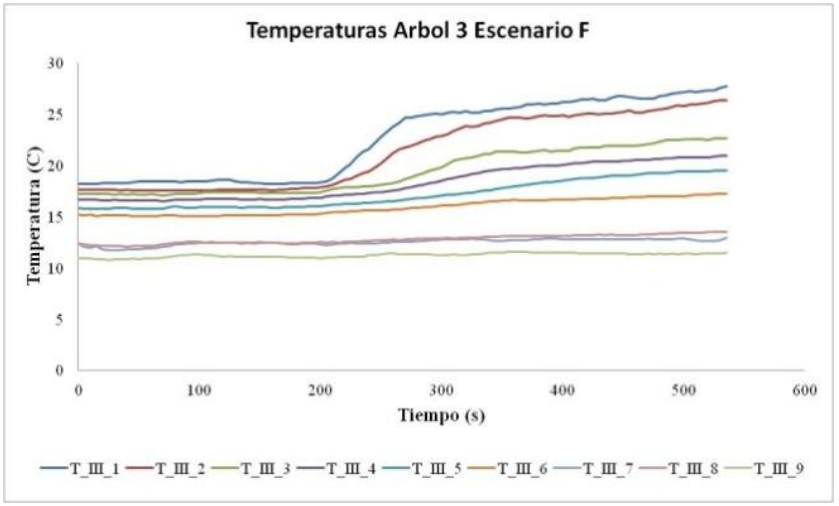
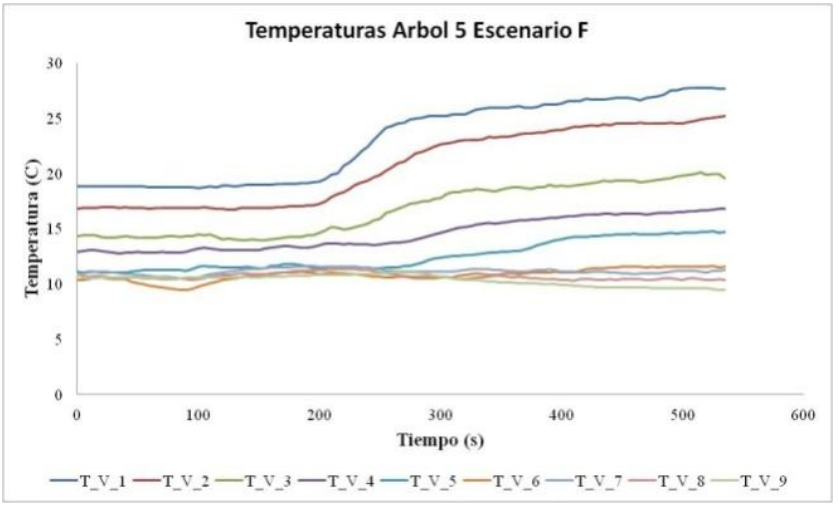
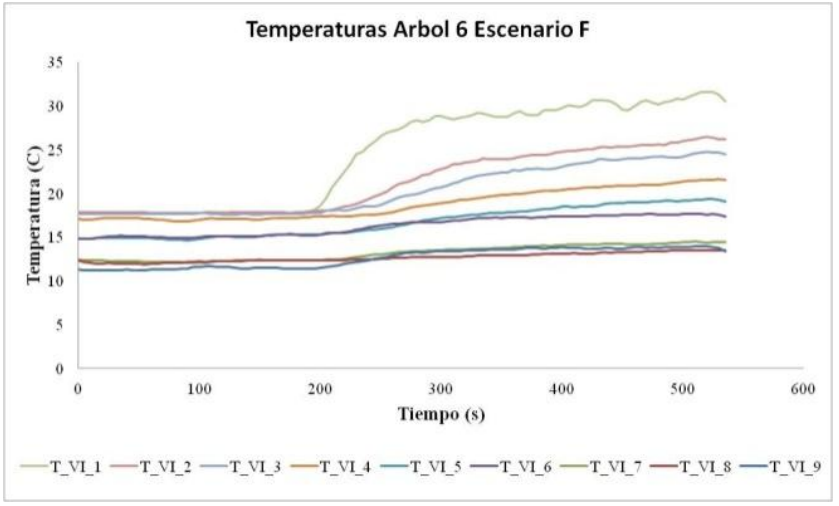
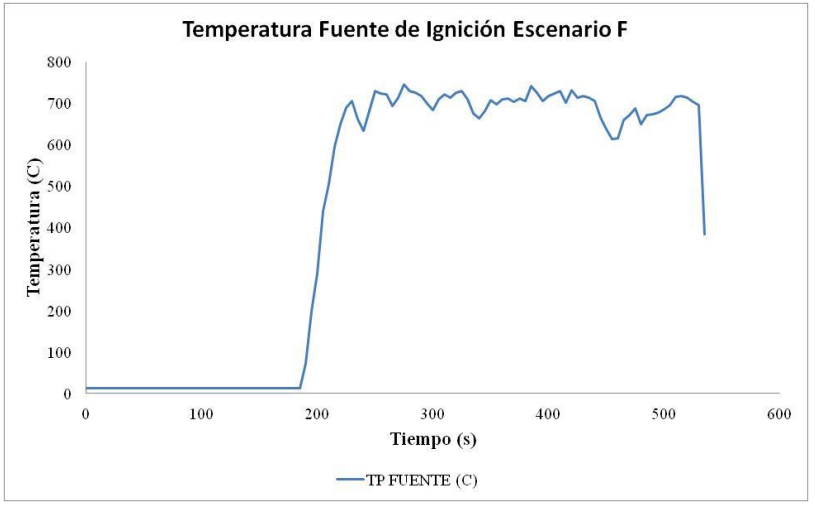
Case 2-F: Temperatures

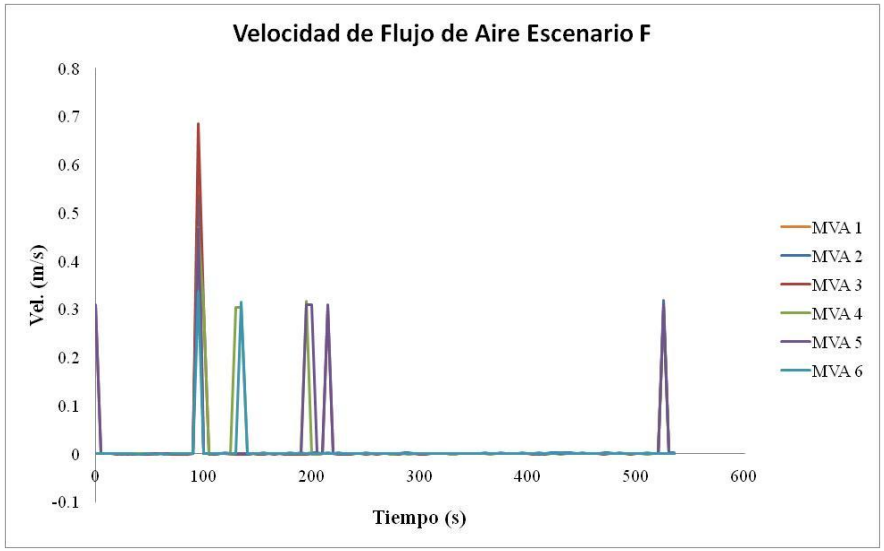


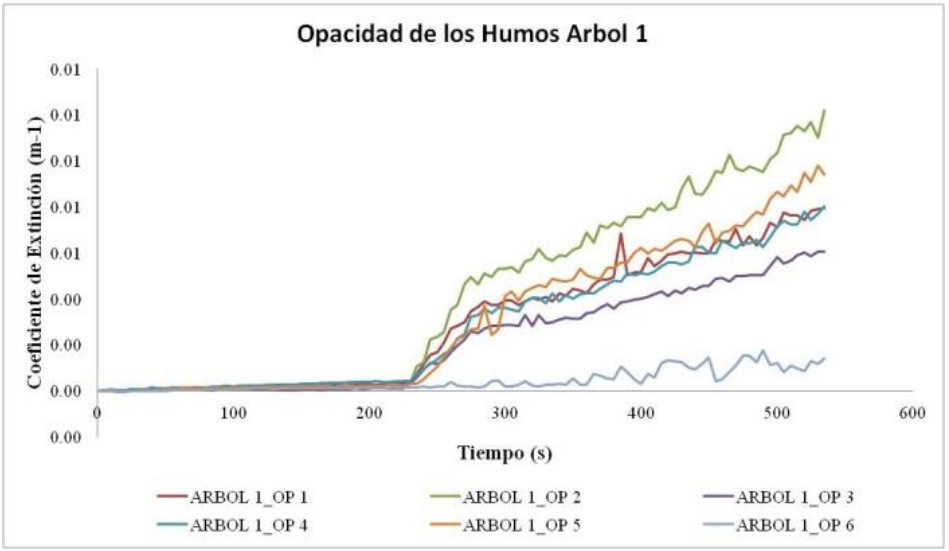


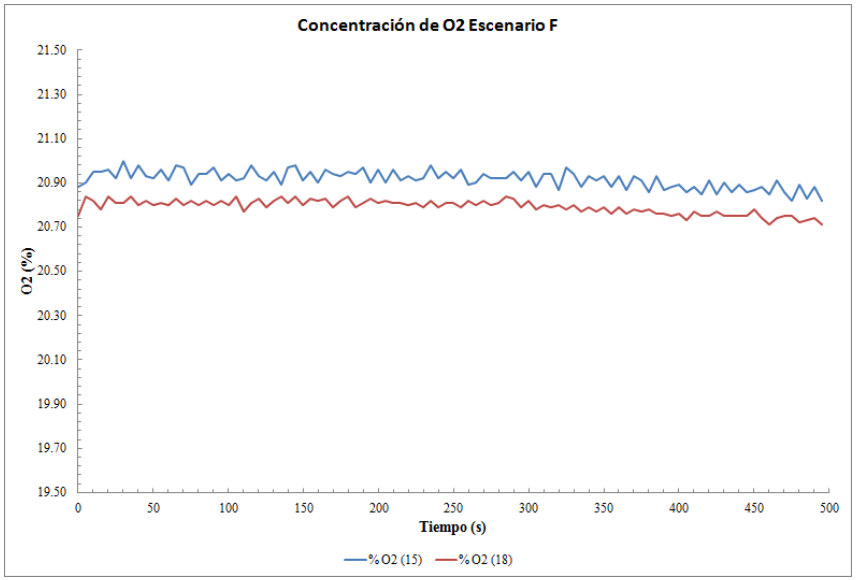




Case 2-F: Other Parameters







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Case 2-F_1: (small pool fire)

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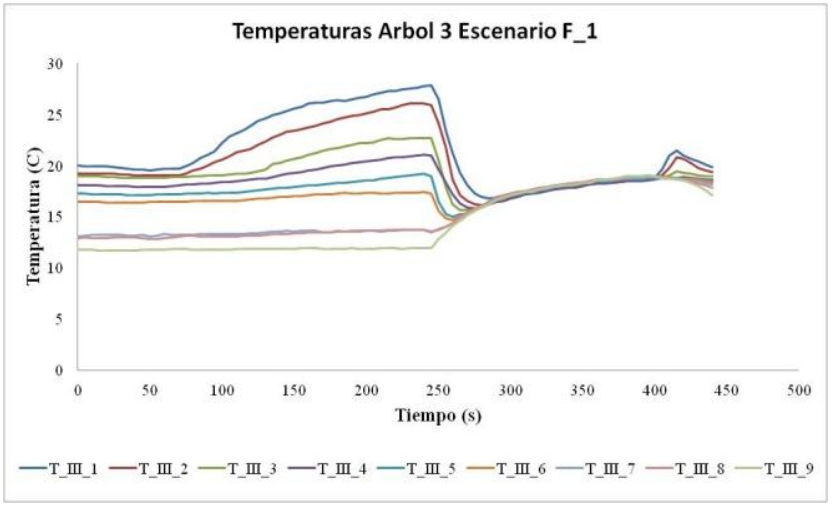
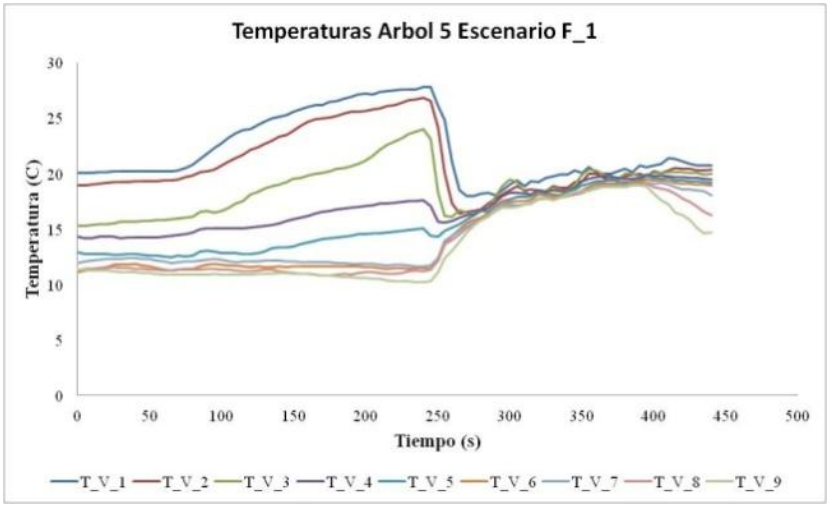
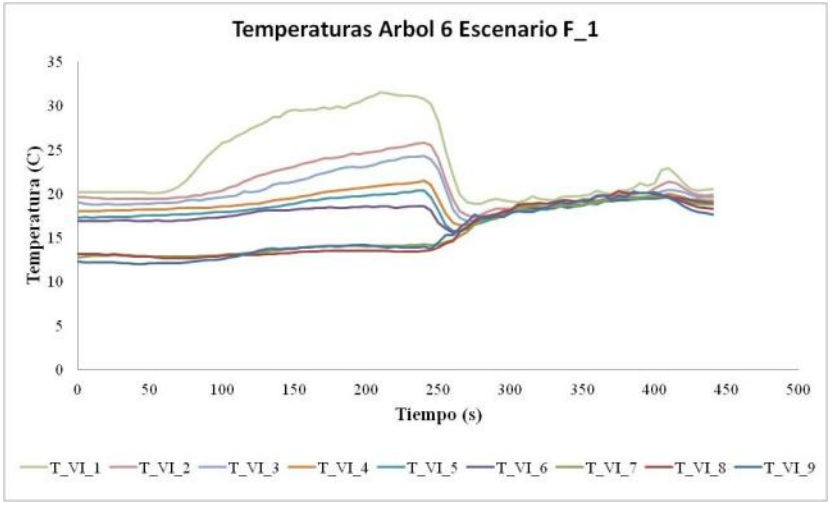
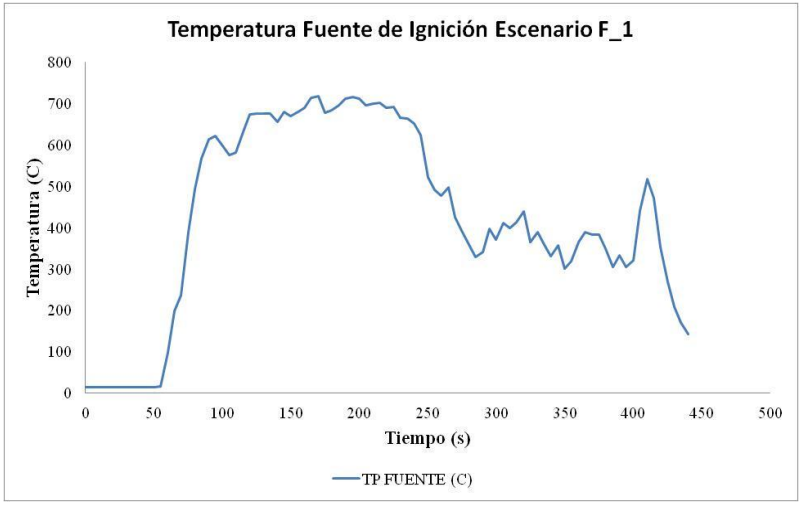
Case 2-F_1: Temperatures

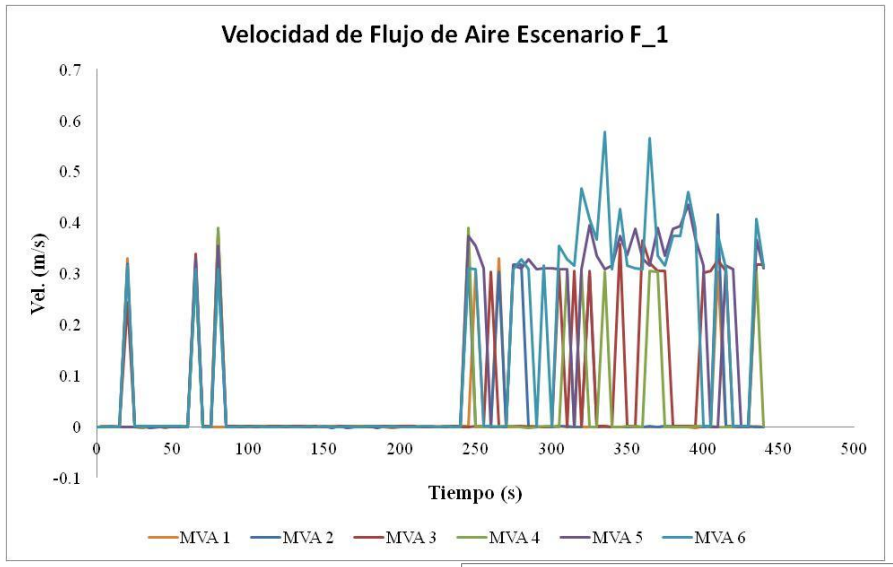


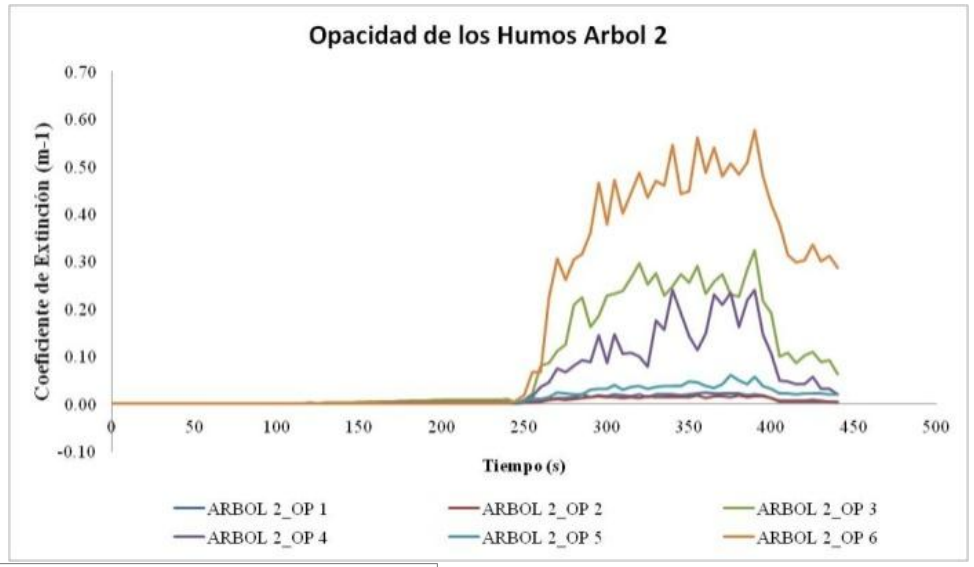


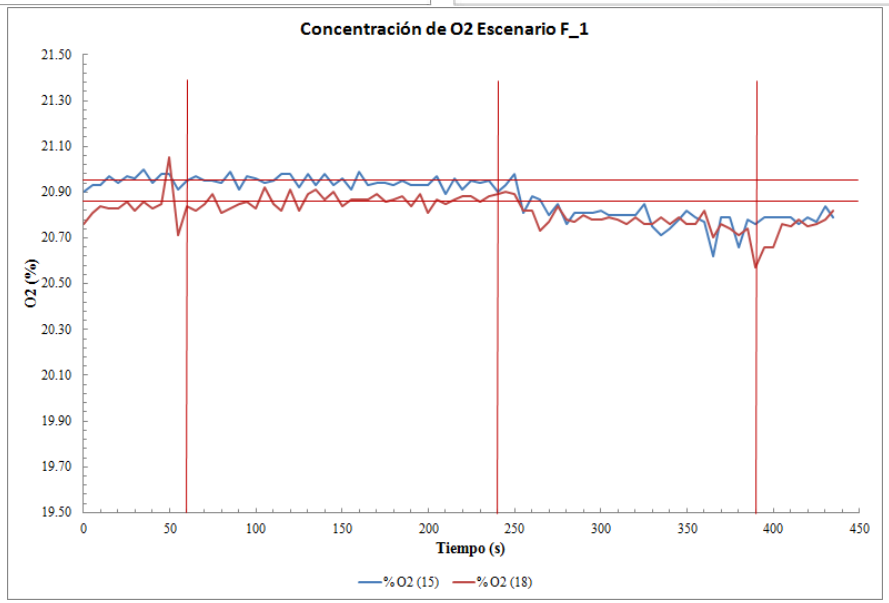




Case 2-F_1: Other Parameters







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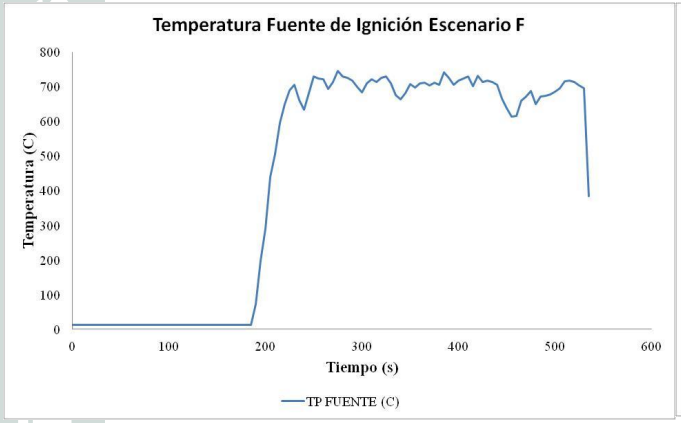
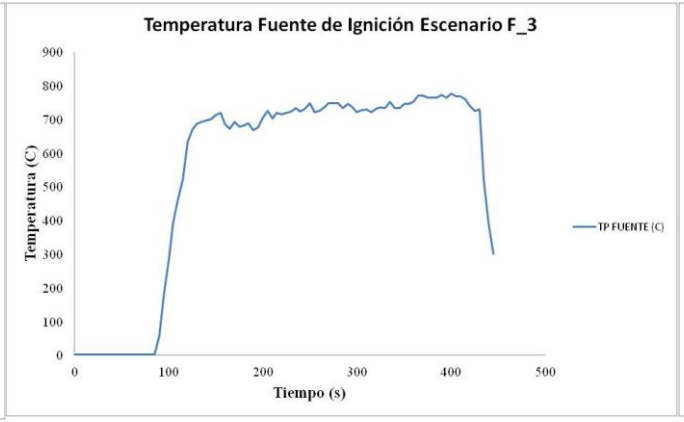
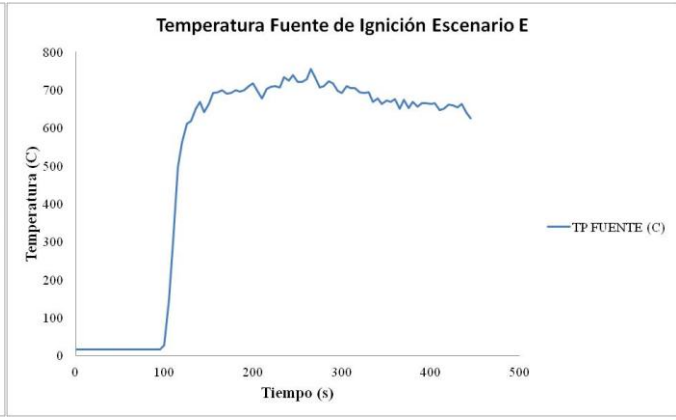
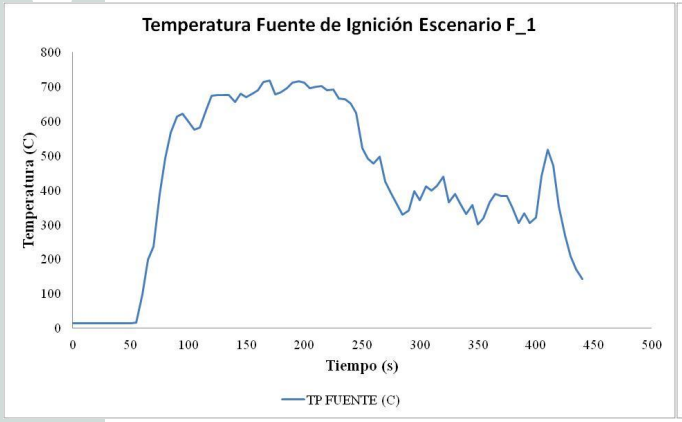
Results comparison (Case 2)

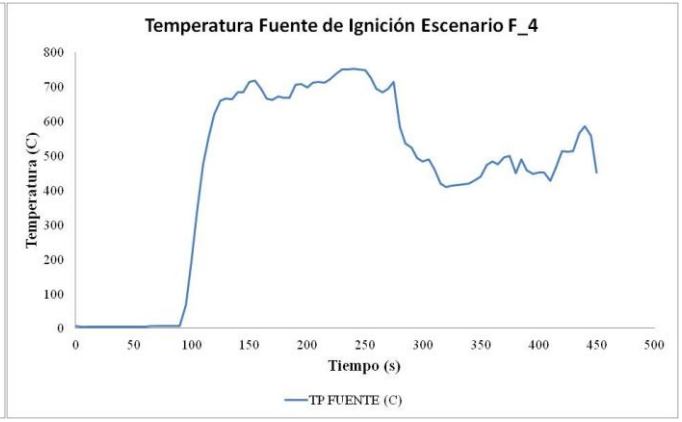
Temperatures

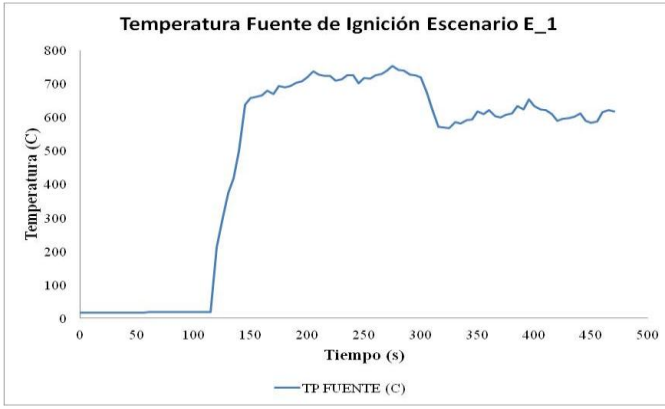












Results comparison (Case 2)

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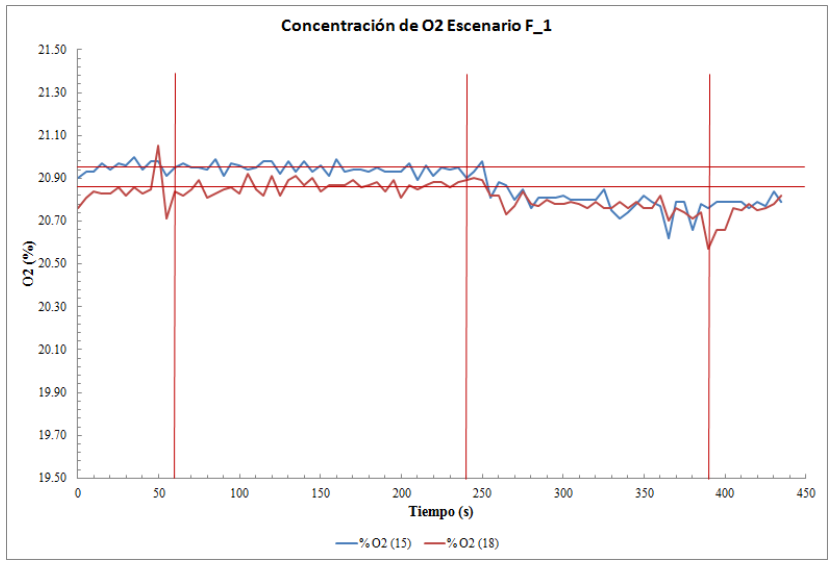
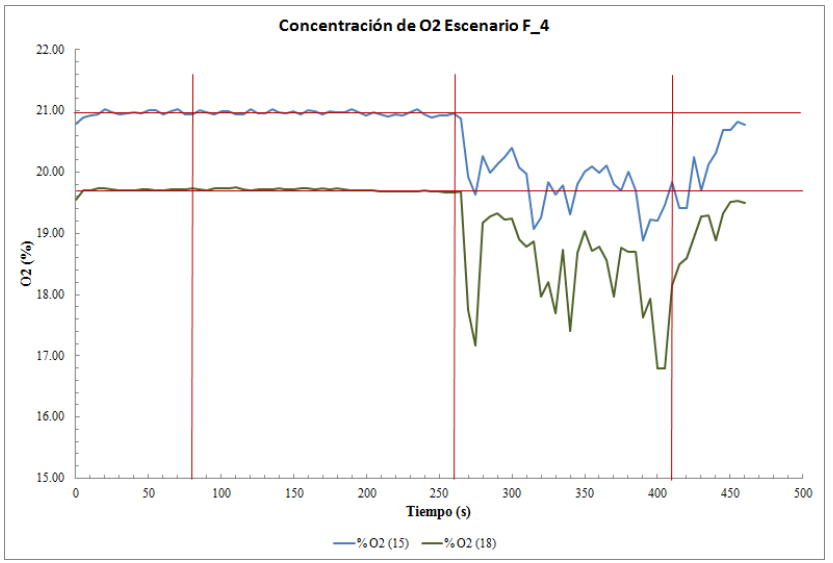
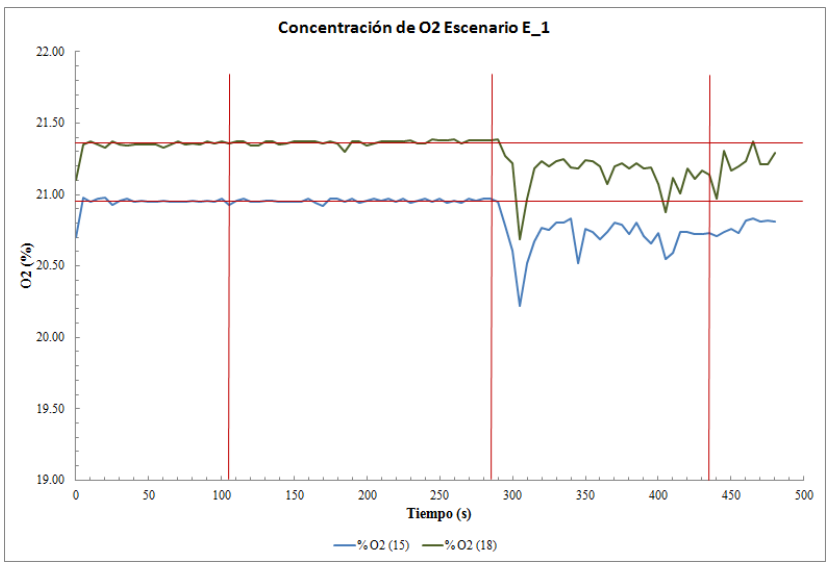
Oxigem







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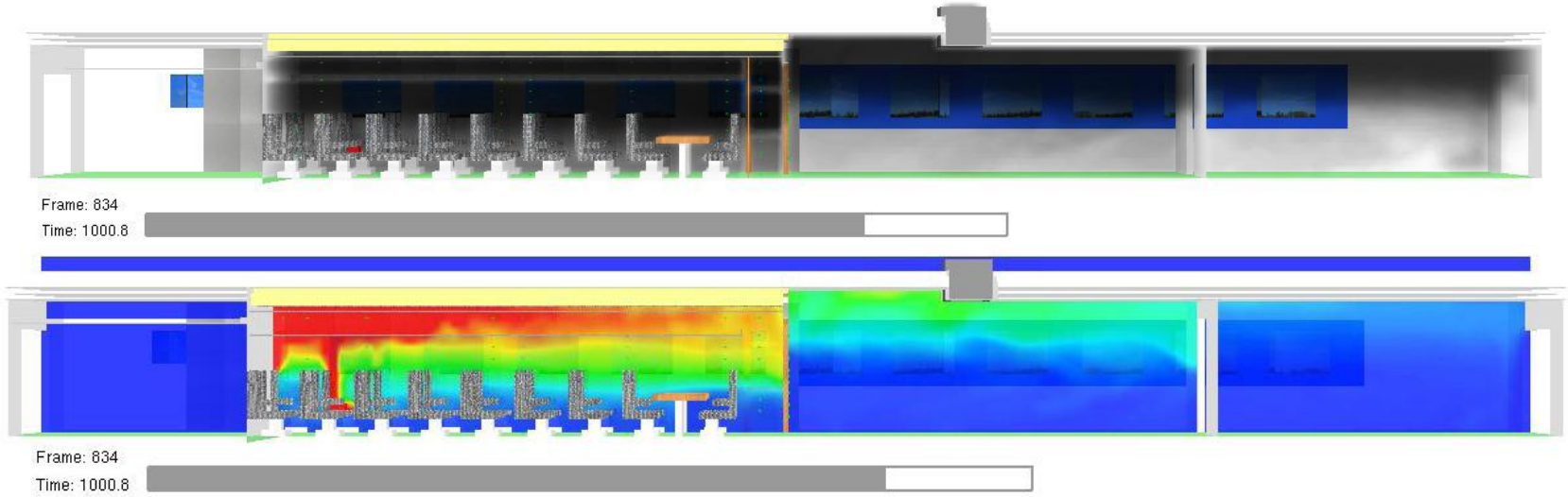
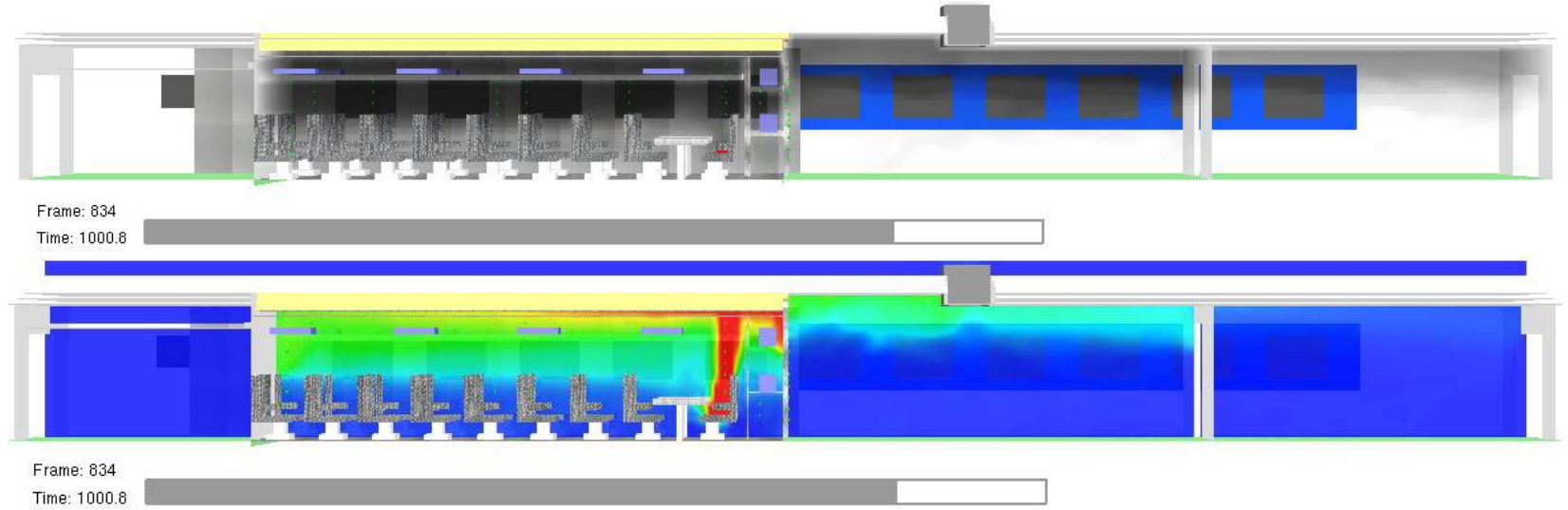


Scenario B



Scenario D

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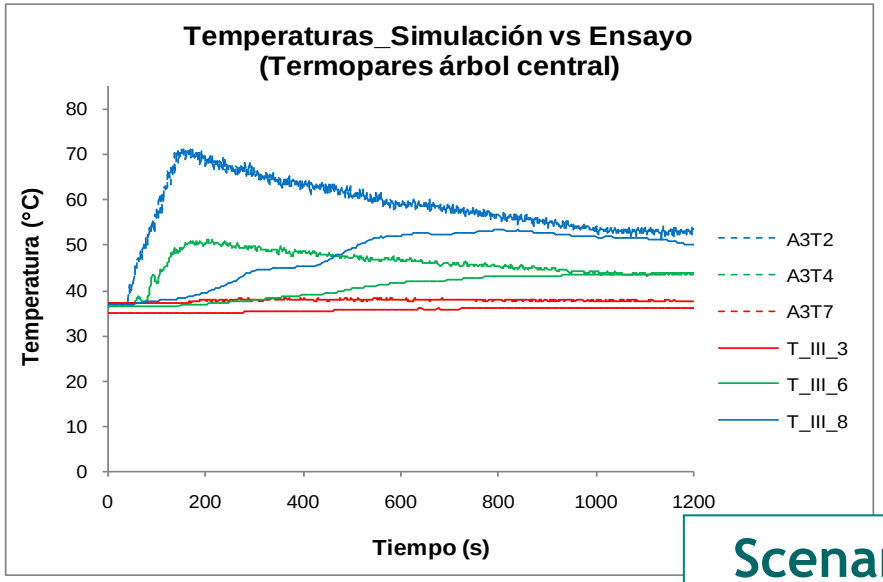
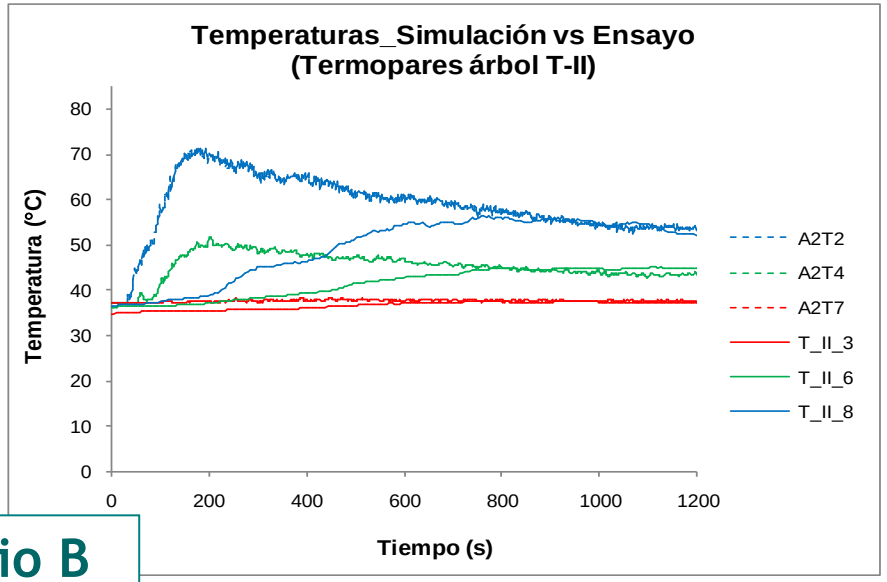
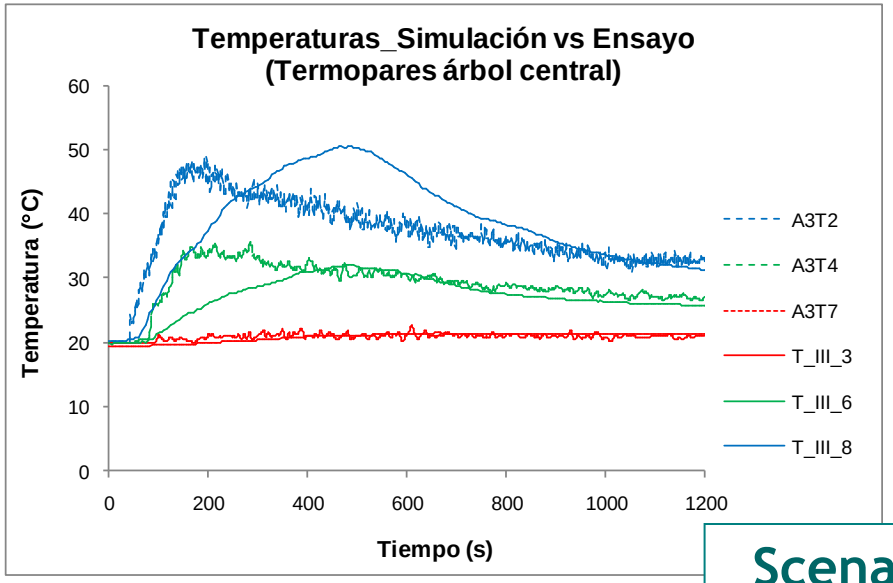
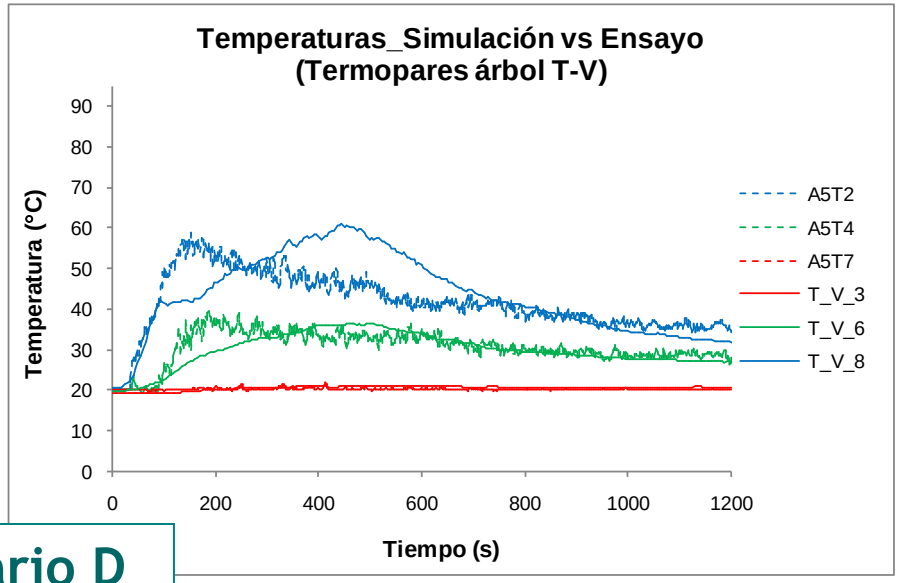




Scenario B





Scenario D

Conclusions

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-It has been sensed a high potential of these techniques for use of water mist in high speed trains.

-It has developed a methodology for the analysis of the ability of water mist against critical parameters (shielding, fuel, ...).

-The use of validated fire computer models will allow to continue with the development of the system, include improvements, and performing an optimized system.

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