LIFE NANO HEALTH

Casos reales de cuantificación, impacto y riesgos asociados a nanopartículas en ambientes laborales. Proyecto Life NanoHealth.

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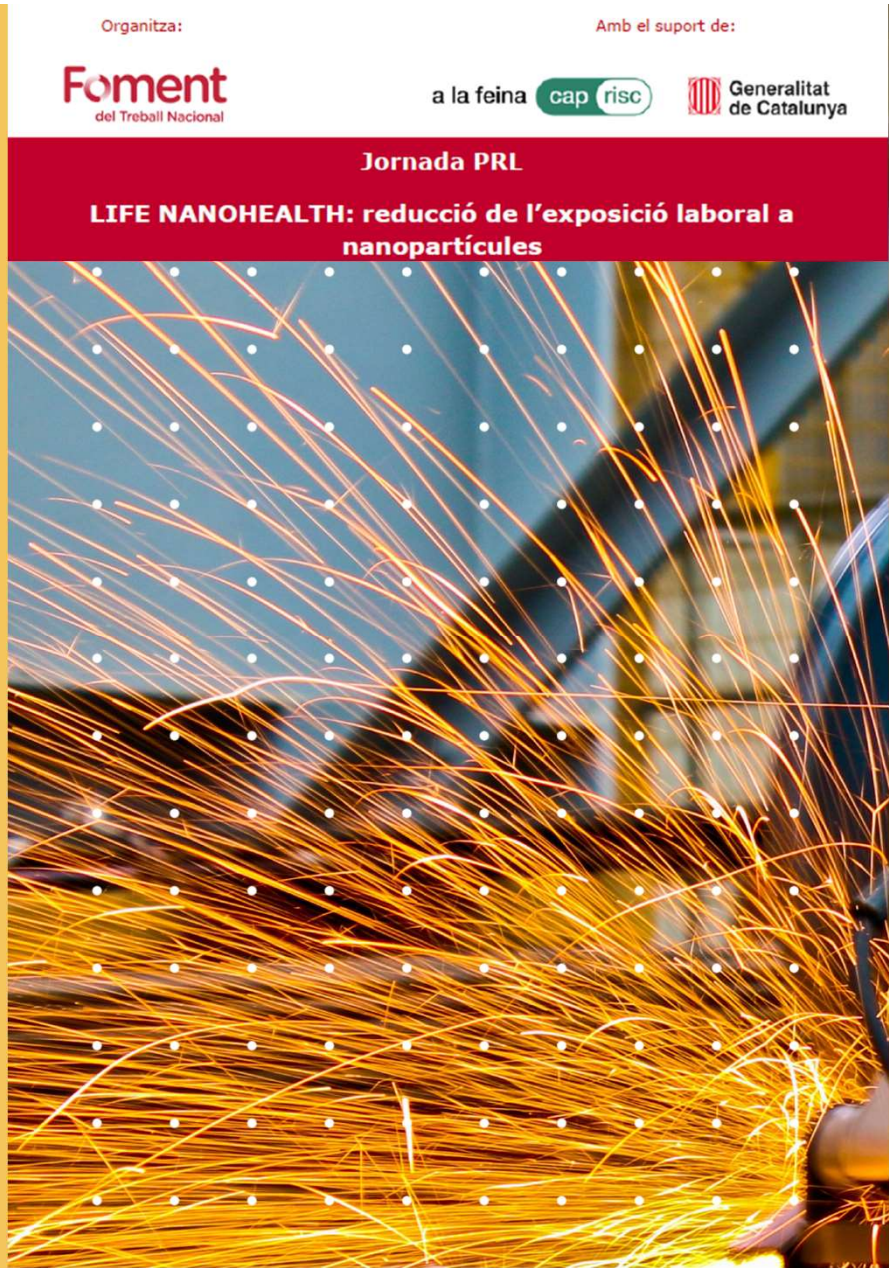

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The LIFE NANOHEALTH project aims to reduce occupational exposure to progress generated nanoparticles (PGNP) from critical permanently releasing industrial processes by optimizing the performance or Risk Management Measures (RMM) in indoor exposure scenarios.

Project coordinator: AICE jtc Universitat Jaume I

Beneficiaries:

idaea CSIC Consejo Superior de Investigaciones Científicas

UPC Universitat Politècnica de Catalunya BARCELONATECH

asp asepsia

Unimat prevención

TMCOMAS Growing Technology

SALONI

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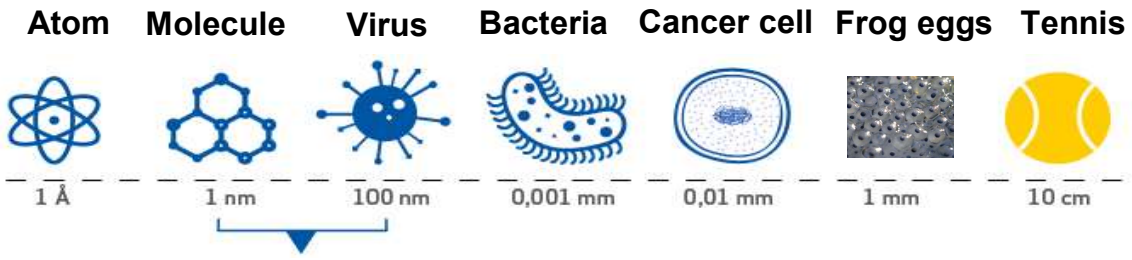
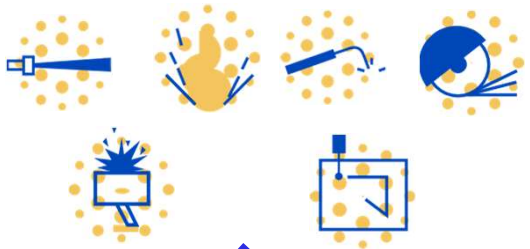
Environmental problem targeted





Occupational exposure to airborne nanoparticles (NPs) is increasing

Incidental nanoparticles (INPs)

NPs generated during processes and operating and machining of materials and surfaces

Need for field measurements to support health risk assessments

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Sampling points

Near Field – Emission source

Worker area

Far Field – Background

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Instrumentation

CPC particle counter

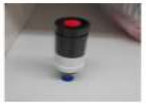
Portable particle counter

NanoScan particle sizer

ELPI+ impactor

Grimm aerosol spectrometer

Biosampler



TEM microscopy

4 - 1500 nm Number concentration Size	**10 - 700 nm** Number concentration Size	**10 - 420 nm** Number concentration Size distribution	**6 - 10000 nm** Number concentration Mass Concentration Size distribution	**250 - 32000 nm** Mass Concentration Inhalable, Thoracic, Respirable fractions	**< 2000 nm** Mass Concentration	**< 10000 nm** Mass Concentration Inhalable, Thoracic, Respirable fractions

Experimental determinations under real-world operating conditions

- Particle mass concentration (GRIMM)
- Particle number concentration and size (CPC-DiscMini)
- Particle size distribution (NS)
- Size-resolved aerosol chemical composition (ELPI+)
- Particle morphology (TEM)
- Particle toxicity (Biosampler)

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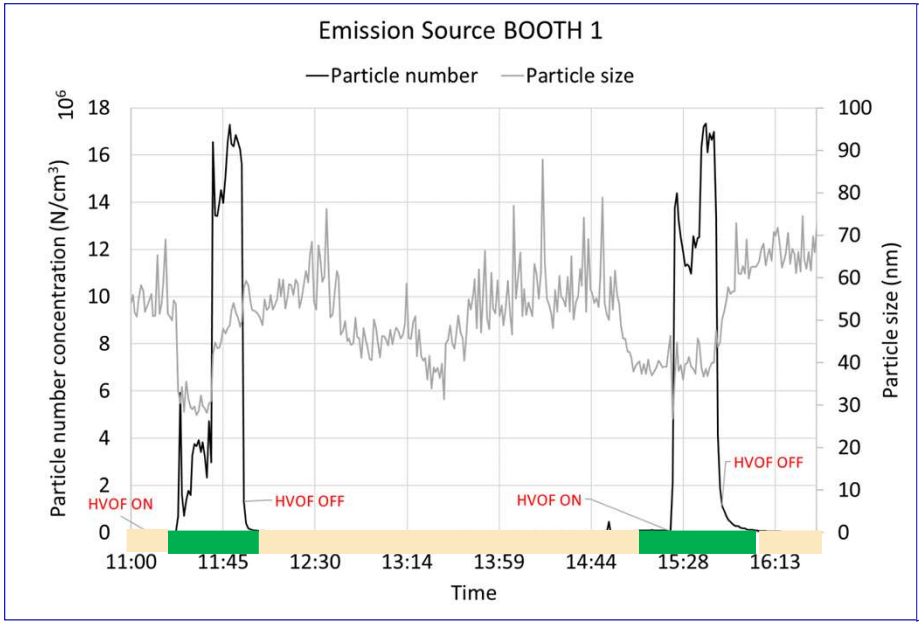
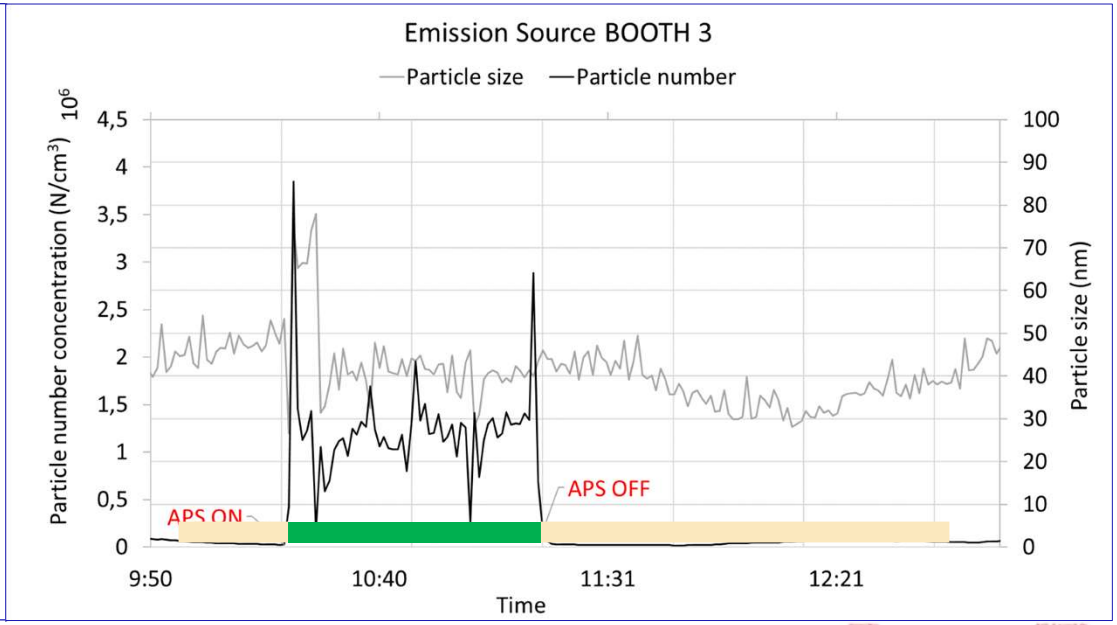
Case study A: Thermal spraying of ceramic coatings

Particle number concentration and size distribution

Near Field – Emission source





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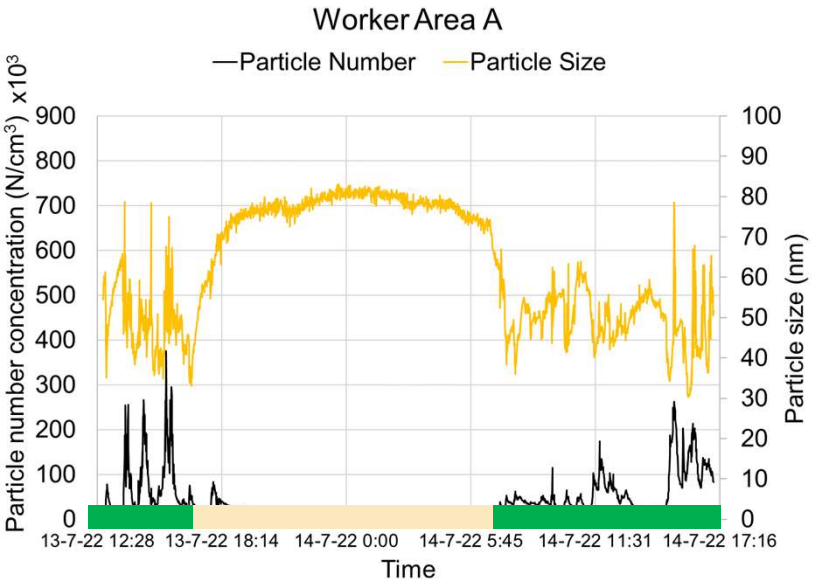
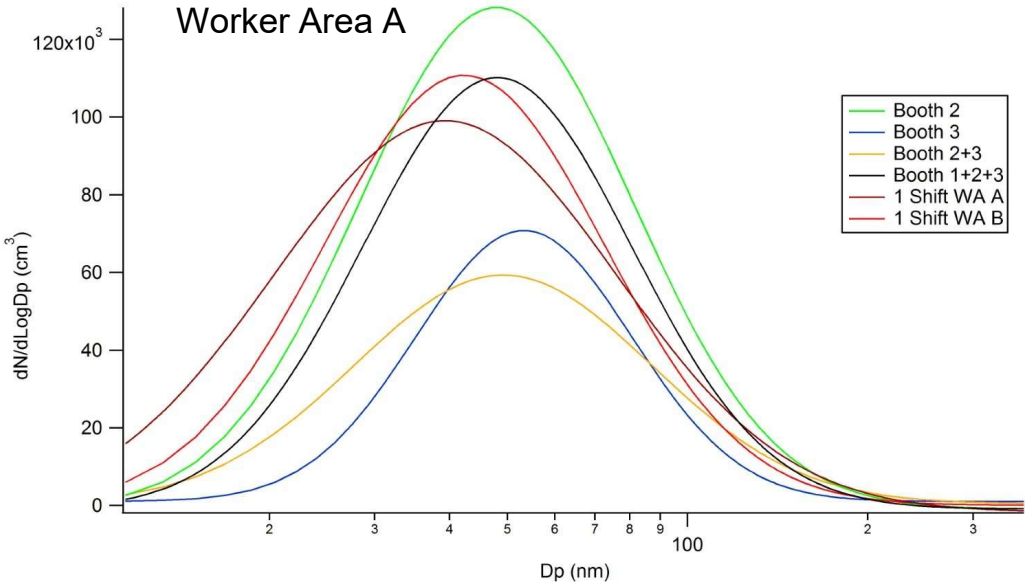
Case study A: Thermal spraying of ceramic coatings

Particle number concentration and size distribution

Worker Area





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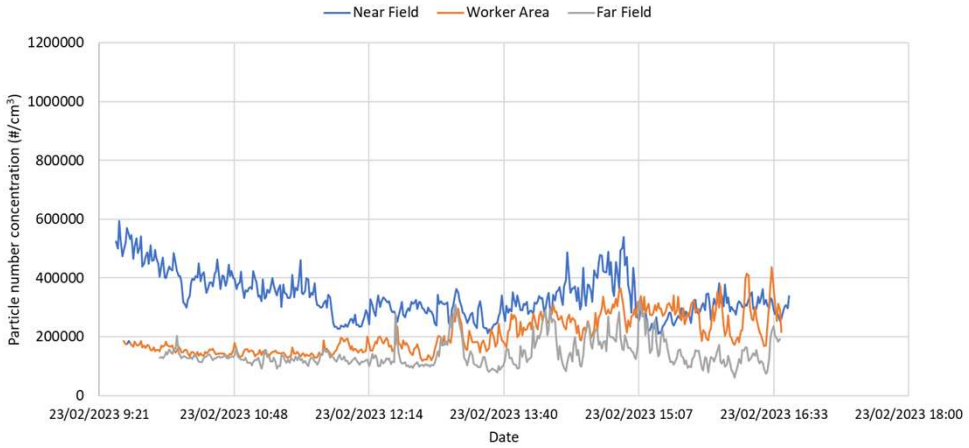
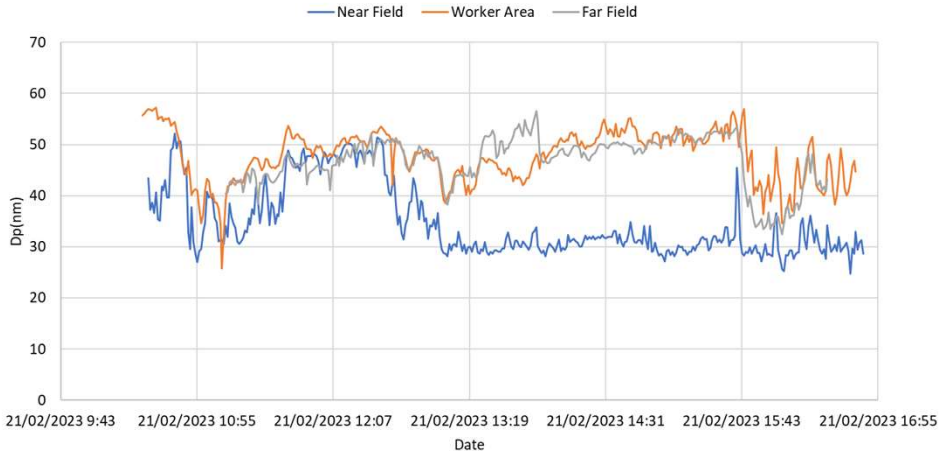
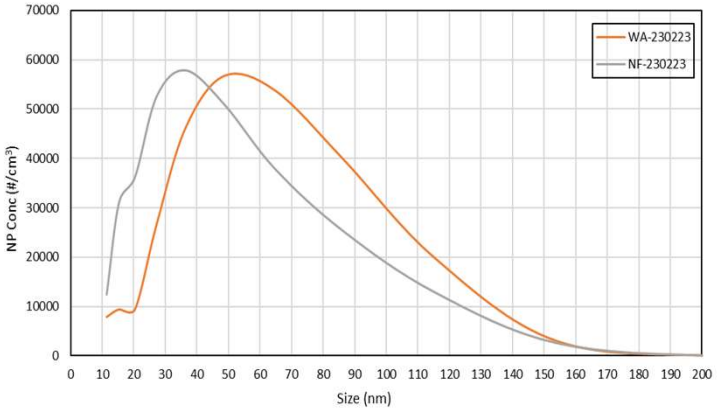
Case study B: Ceramic tile firing

Particle number concentration and size







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Summary of number/mass particle characterisation (Worker's area)

Nanometric Fractions		
Number concentration /Size	Thermal spraying of ceramic coatings	Ceramic tile firing
Percentile 90 (♯/cm³)	**115 089**	**335 122**
Average Number (♯/cm³) (Background)	**53 691**	**251 436 (≈120 000)**
Average Size (nm)	**56**	**57**

Micrometric Fractions		
Mass concentration	Thermal spraying of ceramic coatings	Ceramic tile firing
PM10 (µg/m³)	**113**	**134**
Respirable (PM4) (µg/m³)	**57**	**67**
PM2.5 (µg/m³)	**39**	**46**
PM1 (µg/m³)	**26**	**30**

- ✓ INPs were generated in the emission source but were released to the workers' area due to the presence of openings and leaks.
- ✓ The implementation of highly effective corrective measures, in the evaluated thermal spraying processes, has allowed to reduce the INPs in the workers' area ($5*10^4$ ♯/cm³), being this level slightly higher than the proposed NRV ($4*10^4$ ♯/cm³).
- ✓ The environmental impact of INPs from ceramic tile firing is significant in the workers' area with a mean N ($25*10^4$ ♯/cm³) much higher than the NRV.

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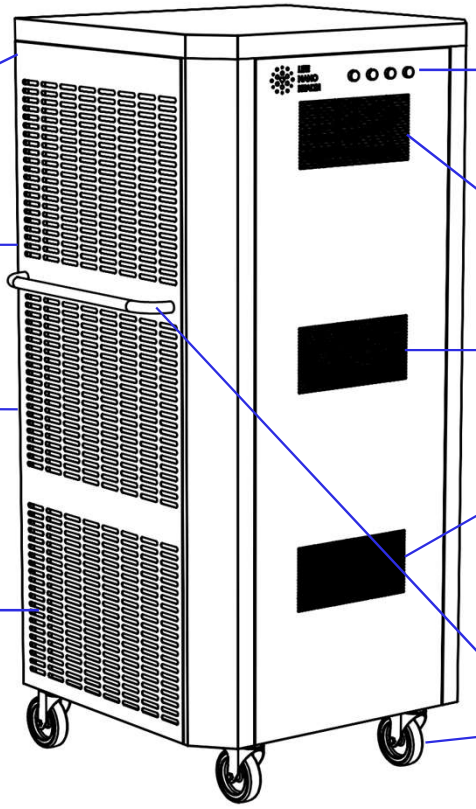
NHP: technical characteristics

Height ~ 2m



- Six air filter boxes to clean the air
- Maximum air flow rate is 12000 m^3/h, to reach a high number of air changes per hour (ACH)
- Three flow rates powers

Versatile control system: on-board, remote and web

- The purified air is distributed through three modules, one at the breathing height of the workers
- Particle sensor for ambient levels monitoring

Sidebars and wheels for improved mobility

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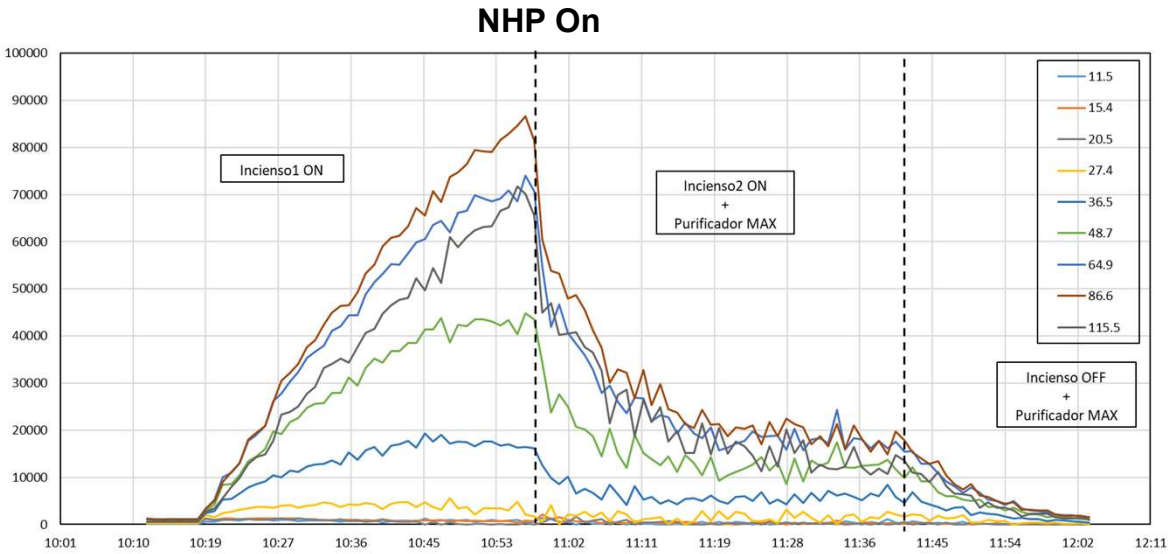
NHP: Filter box evaluation at lab scale



- **Experimental measurements carried out in an isolated chamber**
- **NPs generation: burning incense sticks**
- **Significant decrease in C_{NP} in all particle size tested: positive results were observed in a controlled scenario**
- **Next step: evaluate the NHP at industrial scale**

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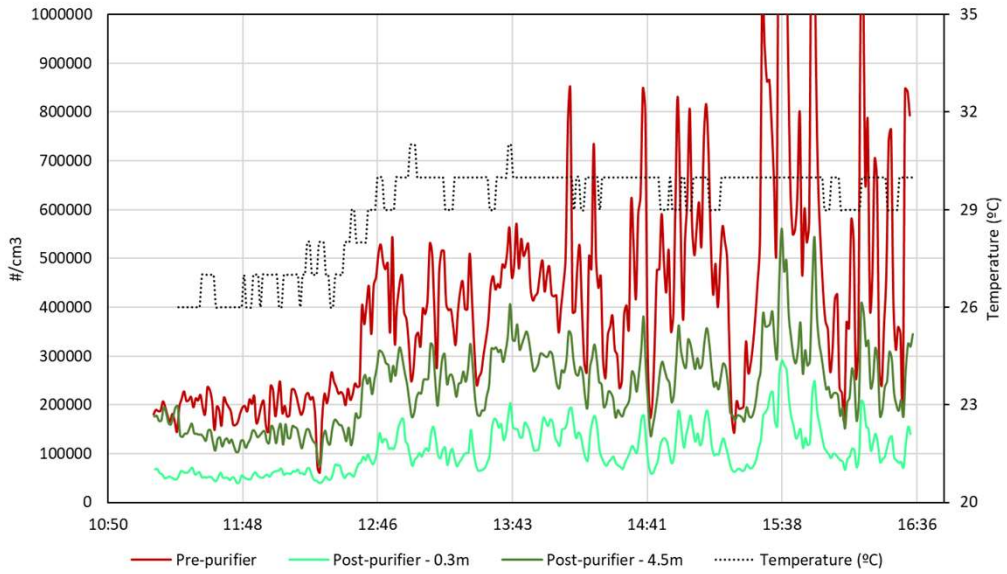
NHP efficiency. Case Study B: worker area (more shielded area)



Purifier location	$C_{10\text{-}700}$ (#/cm^3)	Efficiency
Pre-Purifier	411 989	-
0.3 m	**104 404**	**75 %**

New filter box layout increase efficiency

$C_{INP\ 0,3m}$ > NRV

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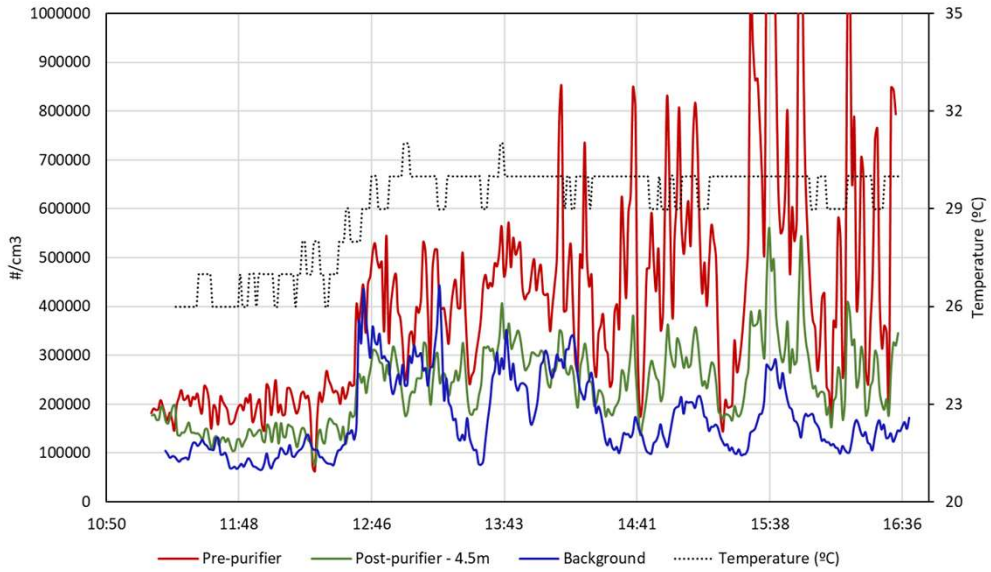
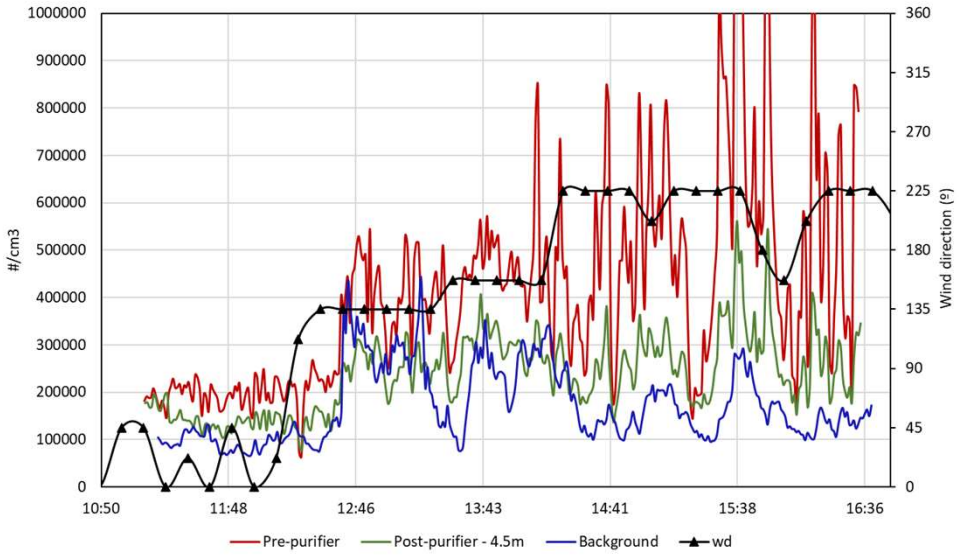
NHP efficiency. Case Study B: WA, influence of outdoor meteorological conditions



C_{INP} was influenced by the T_{room} of the industrial plant



C_{INP} was influenced by the outdoor wind direction

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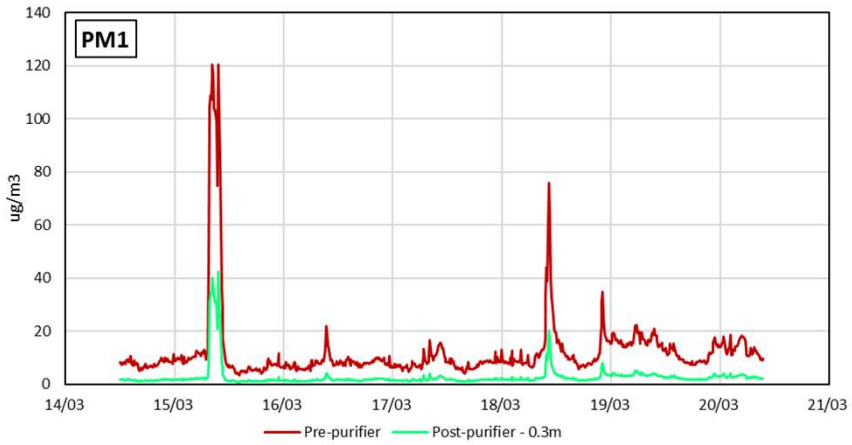
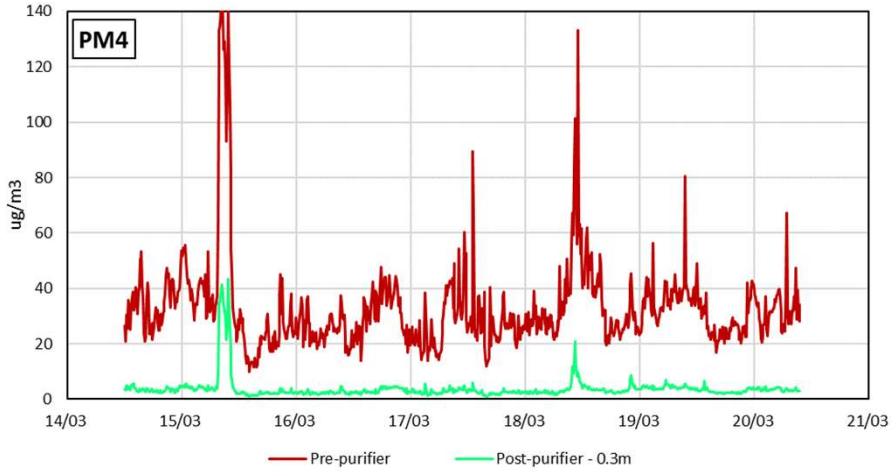
NHP efficiency: PM1 and PM4





Purifier location	C_{PM1} ($\mu g/m^3$)	Efficiency
Pre-Purifier	12.0	-
0.3 m	**2.6**	**78 %**

Purifier location	C_{PM4} ($\mu g/m^3$)	Efficiency
Pre-Purifier	32.9	-
0.3 m	**3.8**	**89 %**

OEL(Spain)= 3000 R $\mu g/m^3$
OEL(Spain)= 50 RCS $\mu g/m^3$

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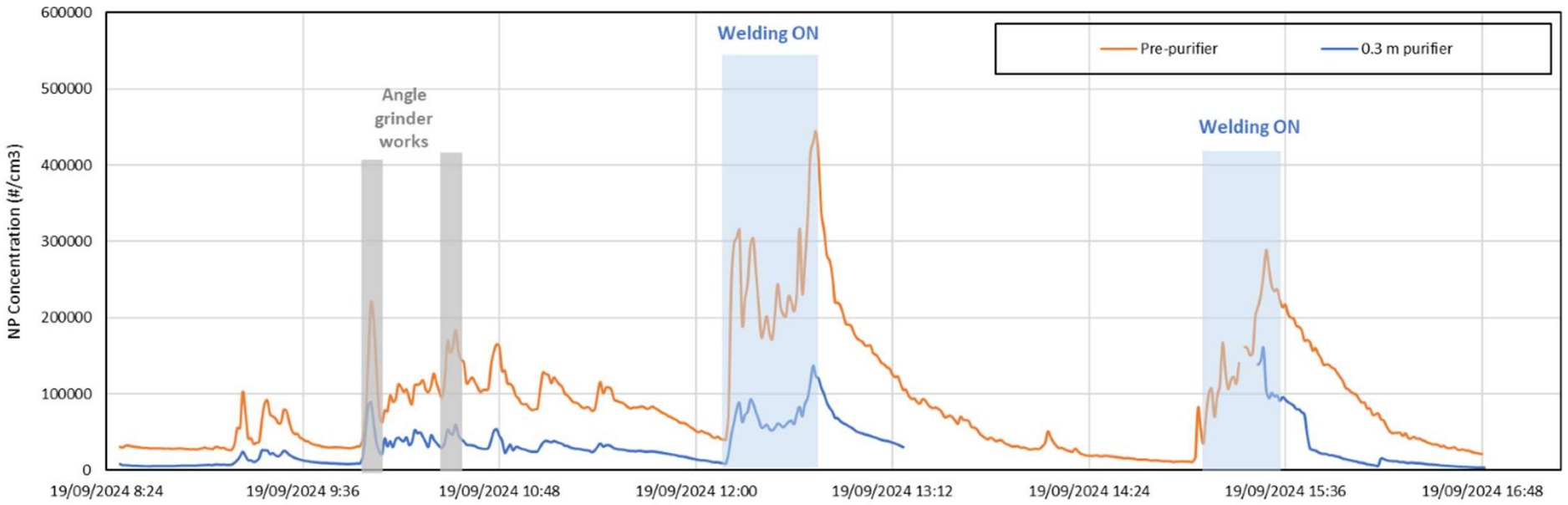
NHP efficiency: thermal spraying worker area (19/09/2024)



Purifier location	$C_{10\text{-}700}$ (#/cm^3)	Efficiency
Pre-Purifier	**106 245**	
Post-Purifier	**31 868**	**70%**

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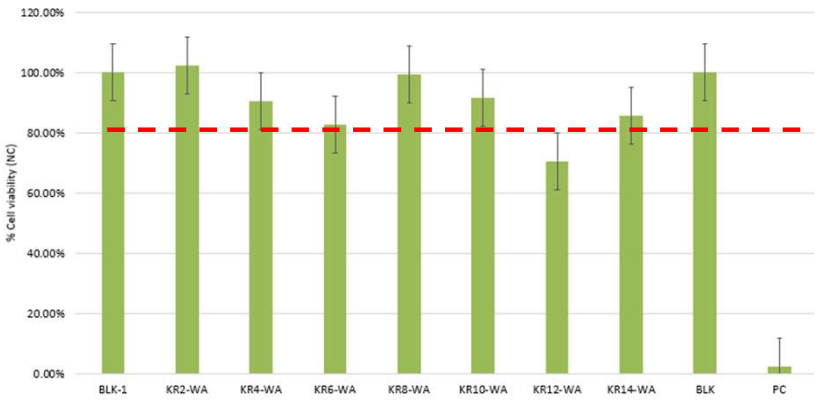
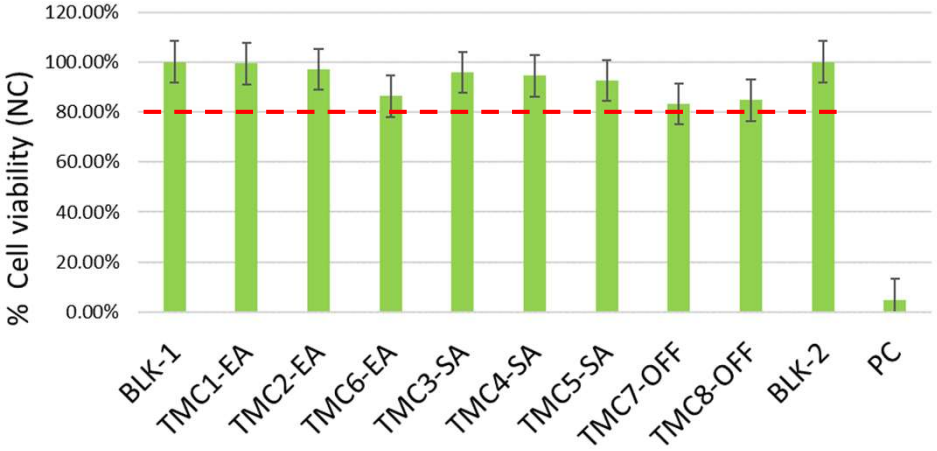
Toxicological characterisation, WA

Firing scenario



Thermal spraying scenario



Cell viability after exposure to PM2 aerosols

Preliminary toxicological tests: the sampled NP showed a reduced toxicity in terms of cell viability in both scenarios

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Thanks for your attention

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