EVIDENCE

Why the AKA Payload: A Technical Brief on Precision Aerial Suppression

The Aerial Kinetic Atomizer is the part of Inari Watch's vision that is furthest from deployment and most often misunderstood. This brief is the honest version: what it is, what it is not, why the physics points toward precision rather than volume, and why it is deliberately a Phase II problem.

Honesty first

The phrase "suppression drone" invites a specific misunderstanding — a small aircraft that flies out and puts fires out. The Aerial Kinetic Atomizer (AKA) is not that, and a technical reader deserves to know exactly where it stands before reading further. Inari Watch's Phase I capability is detection and verification: the aircraft sense and confirm; they release nothing. The AKA is a Phase II concept. The company's near-term value does not depend on it in any way — a system that compresses the detection-to-decision window and coordinates a response is fundable and useful with no kinetic capability at all. What follows is an engineering brief for readers who want to understand the actuator rather than the marketing, and it will be candid about the constraints, because the constraints are the interesting part.

What the AKA is

The AKA is a precision suppressant-delivery payload: a device that atomizes a fire-suppression agent into a controlled droplet spectrum and places it accurately, rather than gravity-dumping a slug of liquid. In the architecture, it is the eventual physical actuator — the kinetic end-effector at the end of the loop, the hands that act, under human authorization, on a fire the system has already detected, characterized, and decided to engage. It is a patent-pending invention, and it is a component within the integrated system, not a standalone product. The "kinetic" in its name refers to the kinetic energy used to atomize the agent into the target droplet spectrum; the output is atomized fire suppressant, and nothing is released without explicit, contemporaneous human authorization.

The science: droplet size is the whole game

The reason an *atomizer* sits at the center of the design, rather than a bigger tank, comes down to droplet size. The standard way to characterize a spray is the Sauter Mean Diameter (SMD, or D32): the diameter of a droplet whose volume-to-surface-area ratio equals that of the entire droplet population. It matters because the two things a suppressant must do — deliver mass and remove heat — pull droplet size in opposite directions. Surface area, which drives evaporative cooling, runs against droplet size: many small droplets present far more cooling surface per unit mass than a few large ones. But small droplets evaporate quickly, drift on wind, and are carried off by a fire's own convective updraft before they reach the fuel. Large droplets penetrate and resist drift, but offer less surface area and coarser coverage. There is an optimum, and it depends entirely on the regime.

That regime distinction is where a lot of intuition goes wrong. Most published droplet-size optimization for fire suppression concerns enclosed-space water mist, where very fine droplets — tens to roughly 150 micrometers — extinguish by evaporative cooling and oxygen displacement inside a sealed compartment. Open-air delivery over a wildland canopy is a different problem. There is no room to fill with steam; a mist that works in a compartment would largely evaporate or blow away before reaching surface fuels. The open-air regime calls for a coarser, tightly controlled spectrum — droplets large enough to fall through the plume and the canopy and resist drift, small enough to maximize cooling where they land.

What governs all of this is atomization itself — the breakup of the liquid into droplets. In the aerial-firefighting literature, the breakup stage is identified as the single most important process controlling a drop's behavior, because it determines the size, velocity, and placement of the droplets, and those in turn determine the ground pattern and the overall effectiveness of the drop. Control the atomization and you control the outcome. For a small mass of suppressant, the way to make it count is to deliver the right droplet spectrum precisely — not to deliver more.

The canopy problem

The canopy is where good intentions evaporate. Fire-service guidance is blunt about it: where a fire burns in surface fuels beneath a dense tree canopy, water drops may have little effect, because the canopy intercepts the liquid before it reaches the fuel. An aerial drop penetrates and coats the canopy, and only the material not retained by leaves and branches reaches the ground. How much penetrates depends on droplet size and on momentum — the product of drop velocity and aircraft speed. Too much forward speed produces what crews call shadowing, coating one side of the fuel and leaving the other untouched; the ideal is closer to a vertical, gentle rain that penetrates evenly.

Precise delivery therefore means controlling not just droplet size but approach geometry and momentum — and this is one of the few places where a small uncrewed aircraft has a genuine advantage. A slow, low, precisely positioned airframe cued to an exact point can shape its approach for even penetration in a way a fast, high-altitude pass cannot, at least for a small and accessible target. This is not a claim that the AKA solves dense-canopy suppression; it is a claim about where a precise, low-momentum delivery can do something a conventional high-speed drop cannot.

Why precision, not volume — and why a UAV

The volume arithmetic forecloses the tanker-replacement fantasy immediately. Sustained suppression of an established fire is a mass-delivery problem measured in thousands of gallons and fleets of aircraft; a small uncrewed airframe carries a tiny fraction of a single tanker load. The AKA is not a tanker and is not meant to be one.

Its case rests on the premise that runs through this entire system: the leverage in wildfire is in the fires caught while they are still small. The aerial-firefighting literature makes the point directly — aerial intervention matters most in the early stages, before a fire escalates into a high-intensity surface or crown fire — and the cost-and-loss analysis in *Detection-to-Decision* locates nearly all of the damage in the small population of fires that escape initial attack. For an incipient fire, the binding problem is not volume. It is getting the right droplet spectrum onto a small target, precisely and early, in the minutes that matter, cued by the integrated system and released only on human authorization. That is the niche the AKA is engineered for, and it complements conventional aerial firefighting rather than competing with it.

The underlying physics is not exotic. Precision-agriculture drones already spray crop canopies with controlled droplet spectra, and a substantial literature characterizes how droplet size, flight height, and speed trade off against canopy penetration, coverage, and drift. The AKA builds on that mature foundation — while acknowledging that fire imposes requirements agriculture does not: intense heat, a convective updraft working against the droplets, and a need for enough mass to actually cool and wet the fuel.

Why it is a Phase II problem

All of which is why the AKA is deliberately a Phase II problem, not a Phase I headline. There are three reasons, and they are worth stating plainly.

First, the integration value stands entirely on its own. A company should not make its near-term case depend on its hardest long-term hardware, and Inari Watch's does not.

Second, an actuator that releases anything onto a real fire must be validated before it is fielded — its droplet spectrum characterized on the bench against a target SMD, its penetration and coverage measured, its effectiveness tested on controlled fires, and its integration proven on a purpose-built Response UAV rather than the recon airframe, which is a sensing platform and nothing more. The specific droplet targets and their validation are open objectives with a plan attached, not specifications we are claiming to have already met.

Third, the AKA sits behind the same line as everything else in the system. A Response UAV releases nothing without explicit, contemporaneous human authorization, enforced in the policy layer — the boundary described in *Mission, Principles, and the Authority Boundary*. Adding a kinetic capability does not loosen that boundary; it attaches to it.

The actuator at the end of the loop

The AKA is the long-term physical end of the integration thesis — the hands that finally act on what the system has seen and decided. It is intentionally the last thing built: behind the human authority boundary, validated before it is fielded, and matched to precision rather than volume. For a technical reader, the interesting question was never "a drone that fights fires." It is narrower and harder: what droplet spectrum, delivered by what vehicle class, with what approach geometry, under what authority, makes a small and early intervention actually count? That is a research program — and we would rather describe it as one than sell it as a finished product.

Sources

"A Review of Airtanker Drop Characteristics, Effectiveness, and Future Research Directions," *Fire* 9(4), 2026.

R. Amorim, *Numerical Modelling of the Aerial Drop of Firefighting Agents by Fixed-Wing Aircraft* (technical report).

Scottish Government, *Fire and Rescue Service Wildfire Operational Guidance* — Aerial Suppression Tactics (Section 8B9).

A. H. Lefebvre & V. G. McDonell, *Atomization and Sprays* — standard reference for spray metrics including the Sauter Mean Diameter.

Representative enclosed-space water-mist droplet-optimization studies (CFD/FDS modeling of compartment fire suppression).

Representative precision-agriculture UAV canopy-deposition studies (droplet size, flight height, and velocity effects on penetration, coverage, and drift).

Cross-references: *Detection-to-Decision: Benchmarking the Critical Window* (cost-and-loss and initial-attack evidence); *Mission, Principles, and the Authority Boundary* (the human authority boundary).

The droplet-physics and canopy-interception claims are drawn from the published literature above. The AKA's specific droplet targets are Phase II validation objectives and are not stated here as established results.

About Inari Watch

Inari Watch is a veteran-founded company building an integrated system of systems for regional wildfire defense. We unify the sensors, aerial assets, and data feeds a region already depends on into one coordinated capability — connected by AI at the edge and bounded agentic coordination, with humans in command of every consequential decision.