WATCHDOG ROBOTICS

Defending a Remote BESS Facility from Wildfire: A Utility Case Study in Autonomous Robotic Fire Suppression

How an Upper Midwest utility engineered a NozzleBot Defender fire protection solution for a remote battery energy storage site, designed to protect both the BESS installation and surrounding forest using single 2,000-gallon water tanks, with no permanent water infrastructure on site.

Executive Summary

An upper Midwest electric utility recently constructed a battery energy storage system (BESS) in forested service territory, with the nearest fire department 24 minutes away by road. Like most owners of outdoor lithium-ion storage, the utility adopted the accepted industry response to a battery fire: isolate the equipment and let the affected container burn down. What that plan could not address were the two exposures on either side of it: a battery fire that escapes into the surrounding forest, and a wildfire that arrives at the facility. The utility designed a solution to both gaps using an Autonomous Robotic Fire Suppression System (ARFSS): fixed NozzleBot Defender units paired with outward-facing flame detectors, engineered around a strict 2,000-gallon water storage limit, with acquisition as a capital asset under the utility's regulated rate structure. This paper describes the exposures, the design constraints, and the reasoning behind each decision.

The accepted practice: letting a BESS fire burn

Lithium-ion thermal runaway is self-sustaining. A cell in runaway generates its own heat and releases oxygen internally, so oxygen-displacing agents have limited effect and water applied to the outside of a container rarely reaches the cells that are actually burning. NFPA 855 and the International Fire Code both acknowledge this reality, and for outdoor installations in remote areas, authorities having jurisdiction routinely approve a defensive strategy: de-energize and isolate the system, allow the affected container to consume itself, and apply water only to protect neighboring containers and exposures. Fire departments increasingly train to this playbook, in part because flooding a battery enclosure produces enormous volumes of contaminated runoff with little suppression benefit.

The utility in this case study adopted burn-down as its base fire plan, coordinated with the local AHJ. It is a defensible, well-supported position for the container itself.

But burn-down answers only one question: what to do about the burning battery. It says nothing about the forest standing beyond the fence line.

Exposure one: a battery fire that becomes a forest fire

This site is surrounded by timber. A container in thermal runaway vents burning electrolyte and ejects sparks and embers, and it can do so intermittently for hours. Under a burn-down strategy, that container will be venting unattended in the middle of a fuel bed.

The nearest fire department is 24 minutes away, and that figure is drive time. Add detection, reporting, dispatch, and turnout for what may be a volunteer or paid-on-call department, and the realistic interval between first ignition in the treeline and first water on the fire is 35 to 45 minutes or longer. In cured grass and conifer litter on a dry, windy afternoon, that is not an incipient fire anymore. A wildland fire given half an hour of undisturbed growth can transition from a spot fire to an established head fire, at which point the responding engine company is no longer suppressing an ignition; it is requesting mutual aid.

For a utility, the liability dimension compounds the operational one. Utility-caused wildfire ignitions have produced some of the largest loss events in the history of the industry. An owner who has documented a credible ignition pathway from its own equipment into adjacent wildland, and left the interval between ignition and suppression unaddressed, has a difficult conversation ahead with insurers, regulators, and plaintiffs' counsel alike.

Exposure two: a wildfire that reaches the BESS

The second scenario runs in the opposite direction. During a regional wildfire event, firefighting resources are triaged toward life safety and populated areas. A remote, unmanned storage facility will not be at the top of anyone's protection list. Ember showers can arrive miles ahead of a flame front, lodging against enclosures, cable trays, transformers, and switchgear. Radiant heat alone can compromise seals and initiate thermal runaway in otherwise healthy cells, converting the facility from a wildfire victim into a second hazardous incident when few resources are available to manage it.

The recognized mitigation is perimeter defense: wetting vegetation and structures ahead of the fire and knocking down ember ignitions as they occur. The problem is that this work traditionally requires people on site, at exactly the moment when nobody can safely be there.

The engineered response: autonomous perimeter defense

Both exposures share one characteristic: the decisive interval is measured in minutes, and the site is unmanned. That is the specific problem an ARFSS exists to solve.

The utility specified fixed NozzleBot Defender units: autonomous suppression monitors aligned with FM Global Data Sheet 4-14, the April 2026 standard that formally recognizes autonomous monitor-based fire suppression as an engineered protection layer. NozzleBots can be paired with thermal monitoring, flame detection, or both. This utility selected triple-infrared (IR3) flame detectors facing outward only, a choice that follows directly from its coverage philosophy, discussed below. When a detector confirms flame in the tree line or along the perimeter, the nearest Defender trains a directed water stream on the base of the fire within seconds, 24/7/365, in any weather, with no human intervention. The Defender simultaneously notifies pre-determined personnel.

The effect on both scenarios is the same. An ember ignition in the forest is attacked while it is still a spot fire, and the 24-minute fire department response becomes the backup rather than the plan. An approaching wildfire meets pre-wetted vegetation and an active suppression capability at the fence line rather than an undefended asset.

Design constraint one: a 2,000-gallon ceiling on water

The site has no water infrastructure of any kind. No hydrants, no mains, no process water. The conventional answer is large tank storage, typically 20,000 gallons or more. Here, state environmental regulations intervened: on-site water storage vessels exceeding 2,000 gallons trigger multiple reviews, each adding months to the schedule. The design ceiling became a single 2,000-gallon tank for each NozzleBot.

That constraint eliminates any area-coverage approach outright. A conventional monitor or deluge system flowing 500 GPM exhausts 2,000 gallons in four minutes. A directed, detection-driven system changes the arithmetic entirely: water flows only when flame is confirmed, only at the point of ignition, and only for as long as flame persists. Two thousand gallons applied that way is sufficient to knock down a spot fire in the treeline, or to wet the perimeter fuel bed ahead of an advancing front — enough, in either case, to hold the line until fire department tenders arrive. What looked like a disqualifying limitation became a design input.

Design constraint two: do not spray the batteries

The utility was adamant on one point: the NozzleBots would not cover the battery containers. The reasoning was sound on both engineering and regulatory grounds. The water required to meaningfully affect a container in thermal runaway is far beyond any volume the site could store, and any water applied to the battery enclosures generates runoff.

The coverage plan therefore faces outward. Every nozzle defends the exposure paths: the treeline, the perimeter vegetation, the approach corridors, and none is aimed at the containers.

The economics: why the utility wouldn’t lease the system

As a regulated utility, the owner earns an authorized return of 7% on capital expenditures and nothing on operating expenses. That drove the procurement structure.

Mobile Defender units can be deployed seasonally, and for some organizations, renting protection for the fire season is often the rational choice. For this utility, rental payments would be pure operating expense: a cost with no return. Purchasing the system instead placed it in the rate base as a capital asset earning the authorized 7%. The utility therefore planned to purchase the system outright with contracts for decommissioning and winterization each fall, and recommissioning every spring ahead of fire season.

The lesson generalizes: ARFSS procurement is not purely a fire protection decision. The same hardware can be a rental expense or a rate-base asset, and the right answer depends on the owner's regulatory and accounting position.

What other infrastructure owners should take from this

The profile of this site (remote, unmanned, high-consequence, long fire department response, little or no water) describes a great deal of critical infrastructure: pump stations, electric substations, compressor stations, communications sites, and switchyards throughout the wildland-urban interface. The design sequence used here generalizes to all of them. Define both directions of exposure, outbound ignition and inbound wildfire. Let water availability and environmental constraints size the system rather than disqualify it. Aim detection and coverage at what needs defending, and run the buy-versus-rent analysis under your own model before assuming the answer.

Burn-down remains the right plan for the battery. Autonomous perimeter defense is what makes it a complete plan for the site.

About WatchDog Robotics

WatchDog Robotics manufactures the NozzleBot family of Autonomous Robotic Fire Suppression Systems, including the fixed-installation Defender and the mobile Expeditionary unit. NozzleBot systems pair IR3 flame detection and thermal imaging with directed water streams to detect and attack fires in seconds. To discuss protection for a BESS facility, substation, pump station, or other remote infrastructure, visit WatchDogRobotics.com.