IN THE KNOW

KEEP MAINTENANCE TOP OF MIND:
PREVENT EXPENSIVE BREAKDOWNS WITH REGULAR, PROACTIVE INSPECTIONS

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A MESSAGE FROM LLK GREENHOUSE SOLUTIONS

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A PROACTIVE APPROACH

Welcome — and thanks for your time.

Whether you have met us at an industry event or are reading this on your own time, we're glad you found us. At LLK Greenhouse Solutions, we specialize in what happens long after the design and construction of your greenhouse. From commissioning and training to maintaining and long-term renovation, our team stands ready to support your operation.

Greenhouse design is changing fast. Technology is smarter, regulatory demands are tighter, and expectations from researchers, growers, and investors have never been higher. But one thing hasn't changed: short-sighted planning still sinks good projects.

That's where we come in.

LLK is a design and infrastructure partner built for the long haul. We work with Institutions, Commercial Growers and CEA Innovators to design and build greenhouses that adapt to what's next—not just what's now. Whether it's helping a land-grant university modernize a legacy research facility or guiding a commercial grower through long-term greenhouse strategy, our goal is the same: Our Customer Success.

Our team is continuing to focus on solving critical industry questions, such as:

- How do we meet the project budget, while achieving End User Requirements?
- How do we retrofit older systems with modern equipment and technology that complements operations while providing ROI?
- How do we assess our current greenhouse operations while planning for future expansions?

How do we maintain our structures, equipment and controls to avoid long term issues?

You'll see those ideas in action in this special report, which dives into the importance of regular maintenance and scheduled equipment inspections to make sure small issues at your greenhouse facility don't fester and become big, expensive repairs.

We don't believe in one-size-fits-all design. Our experience as both designers and builders help us serve as your advocate, navigating peaks and valleys in supply and demand and negotiating the best Value Solution for your project.

How can we help you with your next greenhouse project?

- Visit us: www.llk-solutions.com
- Scan this QR Code
- Call us: 440-236-8336
- Email us: Info@llk-solutions.com

We'd love to hear where you're headed.

—The LLK Team

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OUT OF REACH, OUT OF MIND:

The Most Critical Greenhouse Components Are Often the Least Accessible

IN GREENHOUSE OPERATIONS, CRITICAL FAILURE POINTS OFTEN LURK WHERE VISIBILITY IS LIMITED. Roof panels at 25 feet up and pinion gears hidden inside ventilation mechanisms may not be top-of-mind — but when they fail, the consequences resonate throughout the facility.

Anthony Hill, LLK's National Sales Manager and Construction Lead, states an industry truth: maintaining equipment often gets pushed down the to-do list until something stops working.

And when the structure, equipment, and/or controls get left uncared for, it leads to the quiet erosion of performance over time.

The Imperceivable Threat Above

Polycarbonate panels shield greenhouses from the elements, offering excellent thermal properties, durability, light levels, and impact resistance.

With proper UV protection, panels can last up to 20 years. But photo-oxidation — triggered by prolonged UV exposure — gradually breaks polymer chains, leading to yellowing, brittleness, and reduced clarity/light levels.

From observation at ground level, panels may still appear clear, but a roof-level vantage reveals micro-cracks or deterioration that dims light penetration and weakens structure.

Maintenance teams often avoid roof inspections because they're physically demanding, risky, or simply not scheduled. Hill notes that operators rarely climb the 20 or 25 feet necessary just to check glazing until the panels visibly fail, which can impact productivity.

The Mechanics Hidden Inside

Within the greenhouse interior, mechanical systems handling ventilation, shading, or cooling may seem silent and reliable.

Yet internal parts like cotter pins, rack and pinions, or fan motor bearings quietly degrade. Hill points out that routine servicing — like greasing pinions and tightening fasteners — can prevent larger, costly failures months down the line.

The parts that fail first in a greenhouse usually aren't the ones you're watching. That's why smart operators treat greenhouse and equipment inspection as part of their standard operating practices.

When LLK advises clients, inspection planning becomes a structured cadence. Semi-annual internal reviews paired with annual maintenance vendor visits allow teams to spot wear both above and within.

Extension-based maintenance guidance reinforces this: accumulation of dust on fan blades or binding shutters can reduce ventilation efficiency by 30% to 50%, causing stagnant air zones, poor cooling performance, heavy condensation, and ultimately, higher energy and repair costs.

Without regular cleaning and lubrication, these quiet systems become sources of climate instability.

How These Issues Sneak In and Undermine Performance

Operators often place confidence in automation, but automated systems can lure teams into complacency.

Hill emphasizes that when vents open and close quietly at first, it's easy to overlook them — until they begin making noise or fail outright. That noise creeping in is often the first alert that motion systems are degrading.

Maintenance tends to slip through the cracks, and putting it off starts to become the norm.

Hill describes how LLK's team checks client status semi-annually to keep maintenance conversations alive — even when budgets stall.

Keeping those touchpoints visible ensures small issues don't become capital-intensive breakdowns.

Connecting Research & Facilities Strategy

Strong material like twin-wall or multi-wall polycarbonate may seem low-care, but without proper UV stabilizers, it can succumb to photo-aging through chain scission, yellowing, and embrittlement. That's why routine inspection — even just to document minor surface changes — can delay deterioration and extend service life.

Similarly, a well-maintained mechanical system doesn't just run — it communicates through its efficiency. When fan belts are clean, bearings are greased, and pins are seated, airflow remains high, condensation stays low, and disease pressure drops.

A More Strategic Inspection

When LLK advises clients, inspection planning becomes a structured cadence. Semi-annual internal reviews paired with annual maintenance vendor visits allow teams to spot issues both above and within.

Documentation becomes routine — observations on polycarbonate clarity, smooth movement in gearboxes, noise changes, and vent response times.

At facilities like KSU's research houses, LLK integrated roofline assessments into broader modernization plans.

Teams reported that once glazing inspections entered regular rotation, maintenance practices shifted from reactive patchwork to proactive care — smoothing out energy use and dropping maintenance callbacks significantly.

Pay Attention To What's Not Visible

The parts that fail first in a greenhouse usually aren't the ones you're watching. Polycarbonate that's weathered from years of UV exposure. Cotter pins slowly backing out of place. Vent motors working a little harder than they did last season.

These issues don't announce themselves — they creep in quietly and chip away at performance.

That's why smart operators treat access and inspection as part of the infrastructure itself. If you can't reach your roofline, you won't check it. If your shade gearboxes are out of sight, they'll be out of mind.

Build a standard operating process that makes these checks routine. Fold roof glazing reviews into your seasonal schedule. Walk the vent lines with a focus on sound, friction, and wear. Log the small stuff — rattles, tight spots, haze in the panels — before they become big problems.

In the long run, staying ahead of maintenance issues will always beat trying to react. ■

GREENHOUSE MAINTENANCE CHECKLIST & LOG

A successful growing season and harvest is the ultimate goal for growers. Proper cultivation practices are necessary, but regular greenhouse maintenance and cleaning are equally important. Without regular equipment, structural, and sanitation upkeep, the risk of lost yields and money down the drain increases exponentially.

To help ensure your operation stays profitable, efficient, and regulated, we've compiled a checklist of routine procedures to use throughout the year. *Below is a small portion of the maintenance checklist to review.*

Date _____ Contact _____

FOR THE COMPLETE CHECKLIST, SCAN THE QR CODE.

PANELING & GLAZING

TASK	DATE	PERFORMED NOTES
Clean Panels		
Repair Holes/Tears		
Repair Poly		
Seal Gaps		
Tighten Poly		
Replace Panels		
Repair Energy Screens		
Replace Glass Panes		

PREVENTATIVE MAINTENANCE ENSURES LONG-TERM SUCCESS:

An Interview with Kent State University's Melissa Davis

IN GREENHOUSE MANAGEMENT, success often hinges on one unglamorous but essential principle: preventative maintenance.

Melissa Davis, Horticultural Facilities Director at Kent State University, knows this better than anyone. Her leadership has transformed Kent State's aging greenhouse into a thriving hub of innovation and productivity, offering a blueprint for proactive management.

Revitalizing a Legacy

Kent State's greenhouse has come a long way since its 1960s origins, but by 2014, the facility was in dire need of a refresh — a challenge Davis embraced head-on.

Working with LLK Greenhouse Solutions, she and the university oversaw a sweeping renovation that upgraded everything from glazing and equipment to environmental controls.

The result? A modern greenhouse with eight specialized bays designed for precise plant growth. "When I took the directorship, it really was in disarray," Davis says. The team was still pulling chains to open and close vents, as an illustration. "We've built a facility that can truly support the work we're doing now."

Renovating the greenhouse (and later building a new 1,500-sq.-ft. research facility next door) was a major step forward.

But to keep those facilities in order… That long-term goal required ongoing preventative maintenance, something that Davis takes seriously each year.

Routine Maintenance as a Non-Negotiable

For Davis, preventative maintenance is the backbone of the greenhouse's operations. Twice a year, her team partnered with LLK to conduct comprehensive maintenance to ensure all mechanical components are in peak condition — just before the spring startup and after the growing season.

This semi-annual practice includes servicing motors, addressing rust caused by high humidity, and ensuring the facility is ready to withstand seasonal shifts.

The key is to think about the consequences of each piece of equipment — consider what goes right when it's working and what goes wrong when it's not.

Here are her pro tips:

Schedule routine maintenance.

Twice annually, before the onset of the spring growing season and again as part of winter preparations, thorough checks and maintenance are crucial. This schedule ensures that all systems are optimized to support robust plant growth and to endure dormant periods without degradation.

Inspect key systems regularly.

Key mechanical systems, such as ventilation motors and racks, require regular inspections to keep them running smoothly and to prevent the accumulation of rust and wear, especially in the high-humidity environments typical of greenhouses. Regular greasing, adjustments, and replacements of worn parts can prevent the sudden failures of these critical systems.

Keep maintenance protocols adaptable.

Given that research and cultivation needs can shift dramati-

"I would like to express my sincere appreciation to LLK for their professionalism, integrity, and highest level of performance while conducting the renovation working on the existing Kent State University Herrick Conservatory Greenhouse. The entire team (from owner to laborers) were accessible throughout the project, and the accommodations were uninterruptedly made to insure the protection of the facility's plant collections. I highly recommend LLK for all greenhouse service needs and look forward to working with them on the new greenhouse planned."

— MELISSA ANNE DAVIS, HORTICULTURAL FACILITIES DIRECTOR, KENT STATE UNIVERSITY

cally throughout the year, maintenance protocols must be flexible to adapt to new demands. This might mean altering the setup for different crops or research projects, requiring the maintenance team to understand and respond to these dynamic needs swiftly.

Act on issues early.

Documenting and addressing minor issues before they escalate into major problems is a cost-effective strategy that extends the lifespan of greenhouse infrastructure. Documenting regular maintenance checks help identify potential issues early, reducing downtime and the costs associated with significant repairs or replacements.

This proactive approach can also assist in planning, budgets for the future (Example: "x" years out for polycarbonate roof replacement).

Adopt a comprehensive maintenance plan.

An effective maintenance plan covers more than just mechanical and structural checks. It also includes ensuring that environmental controls are properly calibrated and that the physical infrastructure, such as glazing and seals, is intact and functional. This holistic approach not only preserves the physical assets but also ensures that the internal environment is always conducive to plant growth and research activities.

Leverage technology for efficiency.

Under Davis's direction, the greenhouse has embraced technology, transitioning from labor-intensive manual operations to streamlined automation.

Automated systems now handle key environmental controls, reducing workload while improving precision. This shift from manual to automated systems has been transformative, enhancing the precision of environmental controls such as temperature and humidity regulation, which are crucial for plant health and research accuracy. Broadly speaking, the university's embrace of tech and automation reduces the human labor required and also elevates the consistency and reliability of the conditions within the greenhouse.

Looking forward, Davis plans to implement automatic shading, which will further refine energy efficiency and control over light exposure, optimizing conditions for plant growth and facilitating even more sustainable operations.

Working with LLK Greenhouse Solutions, Kent State University made a sweeping renovation to its greenhouse that upgraded everything from glazing to environmental controls.

This progression toward automation in greenhouses underscores a broader trend in agricultural technology, where precision and efficiency lead to better outcomes and more sustainable practices.

Mitigate risks.

Even with a meticulous maintenance schedule, challenges arise. Extreme weather events, for instance, can test any facility's limits. To mitigate these risks, Kent State's greenhouse relies on integrated weather stations that adapt to changing conditions in real time.

Davis shares an example: "If the vents are opened, and wind speeds suddenly reach damaging levels, the system will automatically adjust. It's a safeguard that's become invaluable."

Navigating unpredictability is a crucial theme in preventative greenhouse maintenance because unexpected events can severely disrupt operations. Disruptions (such as severe weather) could damage plants, delay production cycles, and increase costs unexpectedly. By anticipating these risks and having adaptive systems in place, such as weather-responsive controls, greenhouses can maintain stable environments, safeguard crops, and ensure continuity in operations despite unforeseen challenges.

A Model for Proactive Management

Davis's emphasis on consistent maintenance, technological innovation, and risk mitigation preserves infrastructure while fostering optimal growing conditions.

Her proactive measures ensure that Kent State's greenhouse remains a leading example of how thorough care and innovation can coalesce to create an optimal environment for both academic research and plant cultivation. ■

LLK | GREENHOUSE SOLUTIONS

Delivering Solutions Nationally for

90+ Years

Design

LLK self-performs the customized design of a greenhouse environment focused on **YOUR SUCCESS**

Supply

LLK leverages our relationships to procure structure, equipment, and controls for **YOUR SOLUTION**

Construct

LLK self-performs the renovation or construction of your greenhouse to provide turn-key execution of **YOUR PROJECT**

Maintain

LLK develops, manages, and self-performs a maintenance program tailored to maximize profits of **YOUR OPERATION**

Reach out to discover how our experienced team at LLK can help with your next greenhouse project

(440) 236-8332 info@llklink.com

YOUR SUCCESS IS OUR GOAL!

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