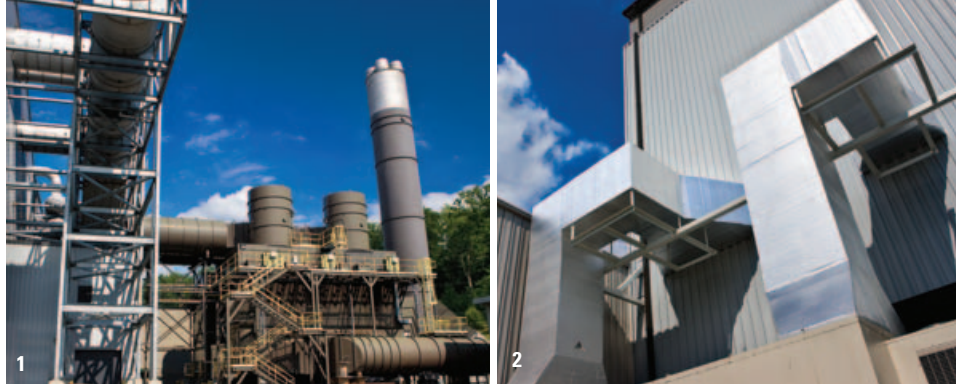




The FM Global Research Campus





> **Delivering Superior Loss Prevention Through Research and Testing** FM Global's 1,600 acre (648 ha) Research Campus is the premier center for property loss prevention scientific research and product testing. Here, FM Global helps many of the world's largest companies understand how to prevent potentially catastrophic physical threats from affecting their properties and business operations.

The Research Campus also is a leading resource for manufacturers seeking third-party certification of their industrial and commercial products. FM Approvals, a member of the FM Global Group, provides assurance that a tested product's performance meets the highest property loss prevention standards and will perform as intended. Currently, more than 50,000 products carry the FM APPROVED mark. Whether it's pure research or product certification—the work done at the Research Campus has been instrumental in preventing and reducing property loss throughout the world.

> **A Research Campus Like No Other** One of the most innovative research and testing centers in the world, the Research Campus is the largest investment in loss prevention FM Global has ever made. Here, scientists and loss prevention engineers work in four main laboratories: Fire Technology, Natural Hazards, Electrical Hazards and Hydraulics. Each is equipped with the most advanced technology and was designed with property owners, product manufacturers and continuously evolving industry trends in mind. Other prominent campus features include a remote testing area, where state-of-the-art explosion hazard research is conducted, and an explosion bunker specially designed to help visitors understand the damaging effects of a combustible dust explosion.

The Research Campus was carefully designed to give our staff of scientists and engineers the capability to address the higher ceilings of newly constructed warehouses, reduce the time it takes to set up and dismantle tests, and more realistically simulate the impact of natural hazards.

At left: The size and scope of the spacious campus allows our clients convenient access to research and testing services at a single location. Above: 1. A Wet Electrostatic Precipitator (WESP) emissions control system, which controls air pollution and helps to protect the environment by clearing the exhaust from all labs in the Fire Technology Laboratory. 2. The humidity control system conditions the climate in the large-burn laboratory to ensure proper conditions for accurate testing.





Fire Technology Laboratory

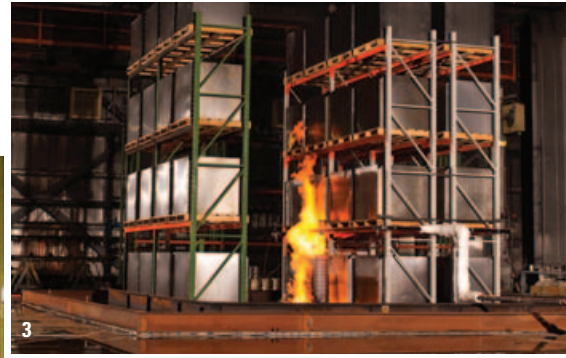
- > A 108,000-ft.² (10,000-m²) facility with a 33,600-ft.² (3,120-m²) large-burn lab
- > Two 80 x 80 ft. (24 x 24 m) movable ceilings designed to go as high as 60 ft. (18.3 m), replicating the increased warehouse heights being constructed today and allowing storage configurations ranging in height from 5 ft. (1.5 m) to 55 ft. (16.8 m).
- > A 20-megawatt, 35-ft. (11-m) diameter fire products collector (FPC), and three smaller FPCs for small- and intermediate-scale testing

Fire begins when an ignition source connects with combustible material in the presence of oxygen. The formula is easy to grasp, but the science of fire dynamics is anything but simple. At the Fire Technology Laboratory, we continue to advance the understanding of fire and its effect on different types of material, measure the heat-release rate from different configurations of material, and determine combustibility and protection requirements for different commodities produced and used by our clients.

Covering 108,000 square feet (10,000 square meters), FM Global’s Fire Technology Laboratory is the centerpiece of the Research Campus and the largest facility of its type in the world. The laboratory’s scale allows researchers to replicate a warehouse-size fire that can cause structural failure of a building without sprinkler protection in a matter of minutes. Moreover, because multiple fire tests can be conducted every day, clients don’t have to wait long for research results.

At left: A corrugated board commodity is tested under the 20-megawatt calorimeter, currently the largest calorimeter of its type in the world. Above: 1. Samples of unexpanded plastic, a standard commodity used for research and testing. 2. Cartons of the test product are prepared for a fire test. 3 and 4. A storage rack fully engulfed in flames, and being extinguished at the end of a test.





Fire Technology Laboratory [CONTINUED]

- > Humidity control system for better control of moisture content and the conditioning of products and material prior to fire tests
- > Five building material fire-test laboratories
- > Closed-loop water system for continuous cleaning and recycling; water tanks and pumps capable of replicating any facility conditions
- > State-of-the-art environmental controls. Entire facility serviced by the most environmentally friendly technology available and the most sophisticated air-handling systems

Through this full-scale testing, our researchers develop innovative and cost-effective property loss prevention solutions that protect our clients' facilities and will ultimately minimize the threats of downtime, supply chain interruption and loss of market share. The laboratory, equipped with two 80 x 80-foot (24 x 24-meter) movable ceilings designed to simulate the trend in increased warehouse heights, also features several smaller labs for intermediate- and small-scale burn testing, enabling FM Global researchers to study a much broader range of commodities and storage arrangements.

The large-burn lab's advanced humidity control system ensures test consistency, circulating up to 104,000 ft.³/min (49 m³/s) of air and removing up to one ton (900 kilograms) of water per hour. In addition, the lab's adjacent staging area provides a steady stream of pre-conditioned fire test commodities to the area beneath the movable ceilings as well as the 20-megawatt fire products collector. All of these features combine to produce the most accurate test results in the shortest amount of time. The research conducted here provides clients from the world's leading industries the chance to see their worst-case fire scenarios put to the test.

At left: Full-scale fire tests, like the one shown here, have contributed greatly to the knowledge and success of automatic sprinklers. In a recent 10-year period, the average fire loss at adequately sprinklered locations was 5.7 times smaller than at locations where sprinklers were needed, resulting in significant loss savings for FM Global clients. Above: 1. A high-clearance test is conducted in the large-burn lab to determine the effects of a fire when a commodity is stored under a high ceiling. 2 and 3. A simulated three-dimensional rack-storage test of alcohol in intermediate bulk containers (IBCs) is conducted for research purposes—to help develop protection requirements for IBC storage.





Hydraulics Laboratory

- > A 22,300-ft.² (2,070-m²) laboratory test area
- > Seven vertical turbine pumps capable of producing a combined flow of 10,000 gal. (38,000 L) per minute at 125 psi (8.6 bar), or 3,500 gal. (13,200 L) per minute at 250 psi (17.2 bar)
- > High-pressure flow capability of 750 gal. (2,840 L) per minute at 500 psi (34.5 bar)
- > 100,000-gal. (380,000-L) water supply

Fire is the leading cause of property loss worldwide, yet it's been proven that devastating fire loss is, indeed, preventable with the proper sprinkler protection. By establishing performance criteria and through rigorous testing, engineers and researchers at the Hydraulics Laboratory play a major role in FM Approvals' certification of devices used for cost-effective fire protection.

Projects undertaken at the Hydraulics Laboratory, whether conducted for a client or for a sprinkler manufacturer seeking certification from FM Approvals, are driven by the needs of industry and by our clients' desire for fire protection that is effective, affordable and flexible. Sprinkler performance capabilities are scientifically understood and empirically tested so that, in the final analysis, there is no question about a system's effectiveness.

The laboratory houses both wet- and dry-lab test areas where engineers and technicians perform various hydraulic, mechanical and environmental tests on fire protection system components and related devices, such as sprinklers, couplings and valves. Tests such as these, often conducted under conditions that replicate our clients' fire protection systems, ensure the devices will work as intended when properly installed and maintained; and the cost of testing and development is kept to a minimum in an effort to make reliable products available at an affordable price.

At left: The main floor of the wet lab of the Hydraulics Laboratory, the central artery for testing the operational features of fire systems. Above: 1. Hundreds of automatic sprinkler models, such as this one, have been tested and FM Approved. 2. A distribution test measures sprinkler water density. 3. A multiple-sprinkler test underway.





Natural Hazards Laboratory

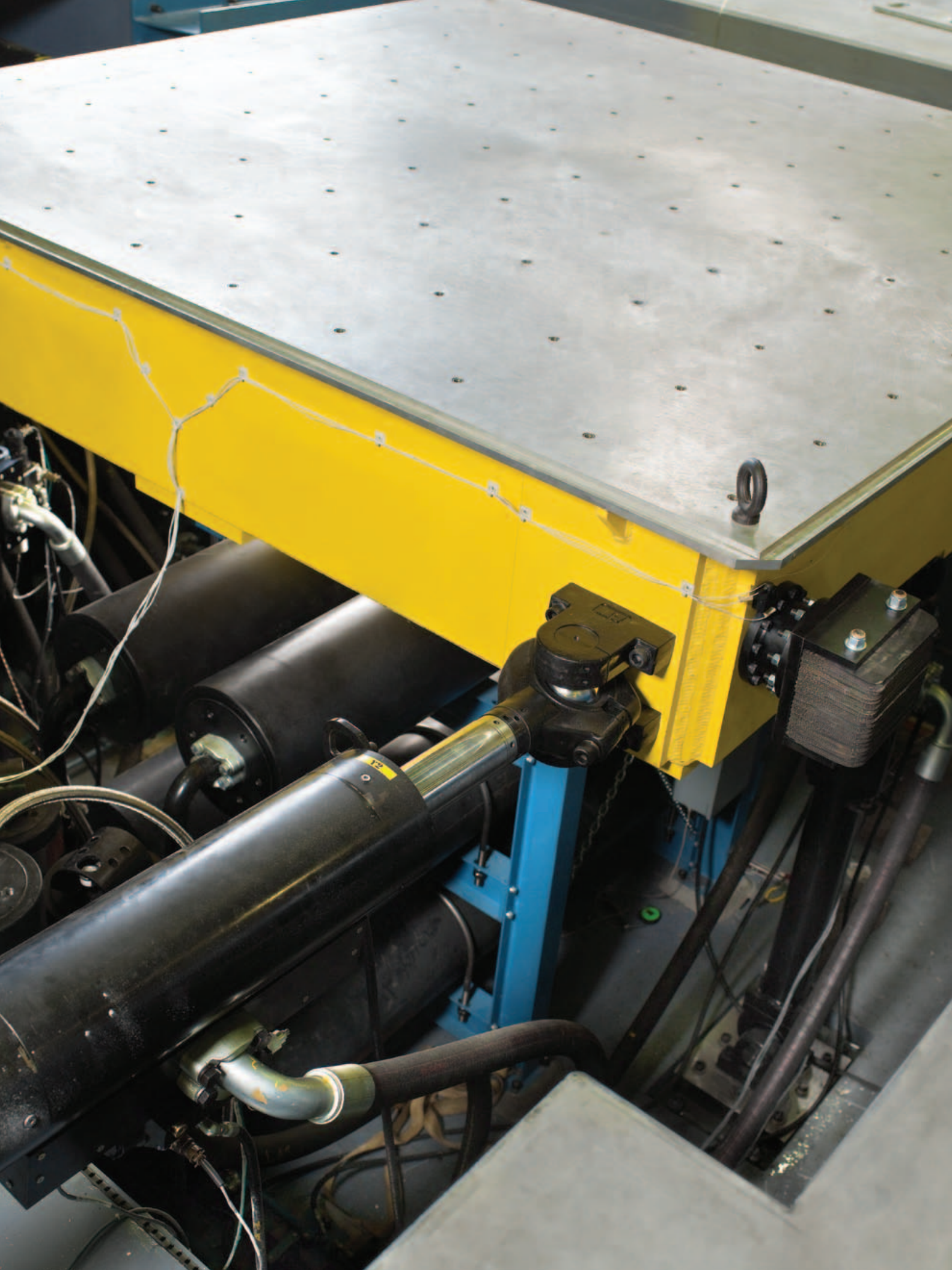
- > A 72,000-ft.² (6,700-m²) facility for testing building material
- > Ability to replicate wind force of up to 175 mph (282 km/h), a Category 5 hurricane
- > Testing services, including tests of wind uplift, wind-driven rain, hail, impact resistance, weathering, shingle uplift, fatigue and dynamic analysis

Windstorm, flood and earthquake all pose a major threat to property, but the loss potential of these natural hazards can be greatly reduced. FM Global research following Hurricane Andrew in 1992 led to recommendations that proved effective when Hurricane Katrina struck 13 years later. Statistics from Katrina showed an 80-percent reduction in loss costs when comparing exposed locations that had no outstanding risk improvement recommendations (all recommendations were completed) with those locations with open recommendations remaining. Today, the expanded Natural Hazards Laboratory continually helps researchers further understand what causes building material to fail and the best ways to design buildings to resist the effects of Mother Nature.

Researchers can now replicate even the toughest weather phenomena, and recreate hurricane-force wind of 175 mph (282 km/h). Wind this strong truly tests the strength of glass and the endurance of building material, particularly roof and exterior wall systems.

Inside the laboratory, a hail gun launches ice balls of varying sizes to simulate moderate and severe hail storms, and a debris cannon shoots simulated wind-blown wood projectiles at speeds matching those of a real hurricane to determine impact resistance of doors, windows and wall panels.

At left: Engineers at the Natural Hazards Laboratory prepare to perform a wind-uplift test on a roof membrane to determine if it meets FM Global property loss prevention standards. Above: 1. The wind-uplift test in progress. 2. The debris cannon is loaded with a stud to be fired at a target for windstorm impact-resistance testing. 3. The wind machine churns up hurricane-force wind to test the durability and strength of roofing shingles.





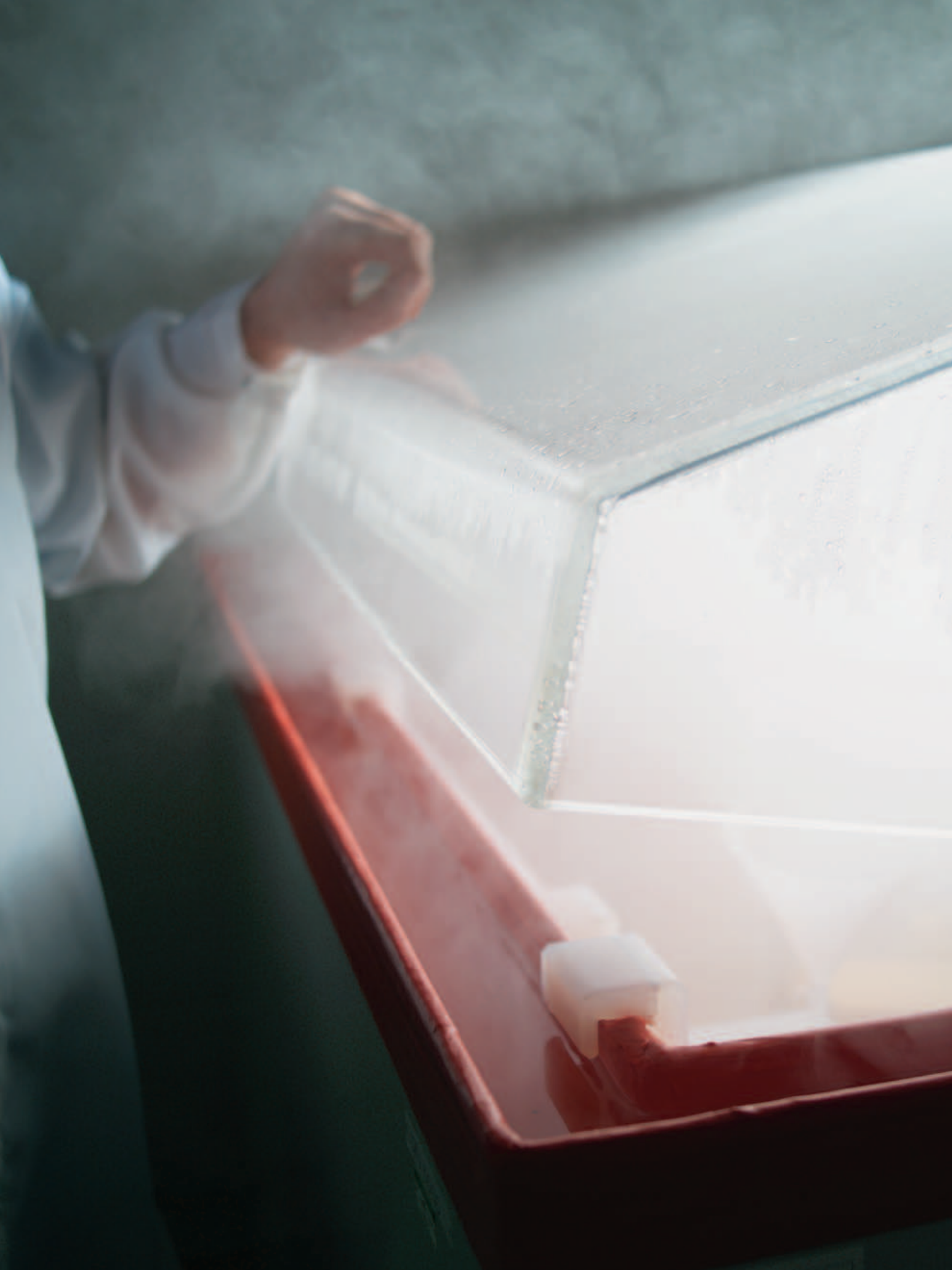
Natural Hazards Laboratory [CONTINUED]

- > 100-ft.² (9.3-m²) earthquake motion simulation table for conducting research and product testing
- > Can move 5-ton (4.5-metric ton) load with an acceleration of up to 3 g (three times the acceleration due to gravity)
- > Table sits on a 13-ft. (4-m) deep, 2 million-lb. (910,000-kg), 34-ft. x 36-ft. (10-m by 11-m) wide foundation

To address the seismic risk, a 100-ft.² (9.3-m²) earthquake shake table can move a five-ton (4.5-metric ton) payload with an acceleration of up to 3 g (three times the acceleration due to gravity). The shake table can replicate three-dimensional earthquake motions of all intensities at the ground surface and on various floors of a multi-story building, thus allowing scientists to study the effects of earthquake shaking on structures and nonstructural systems such as equipment, piping and storage racks. A thousand-ton (910,000 kg) reinforced concrete reaction mass absorbs the vibrations generated by the table.

The Natural Hazards Laboratory also is equipped with a powerful xenon arc ultraviolet (UV) accelerated weatherometer to measure the effects of the sun's UV radiation on building material that has been exposed for long periods. And, testing includes accelerating the weathering of all types of building material to determine more precisely how to design and install for long-term performance.

At left and Above: 1. The earthquake simulation table, with six degrees of freedom, can recreate ground motion from large earthquakes and/or motion on upper floors of multi-story buildings, and is the only table of its kind in the insurance industry. 2. FM Global research led to the design of unique bracing systems to protect sprinkler system piping. 3. Water flows through a cracked pipe, illustrating a potential hazard to the sprinkler system when piping systems are inadequately braced or not braced for earthquake motion.





Electrical Hazards Laboratory

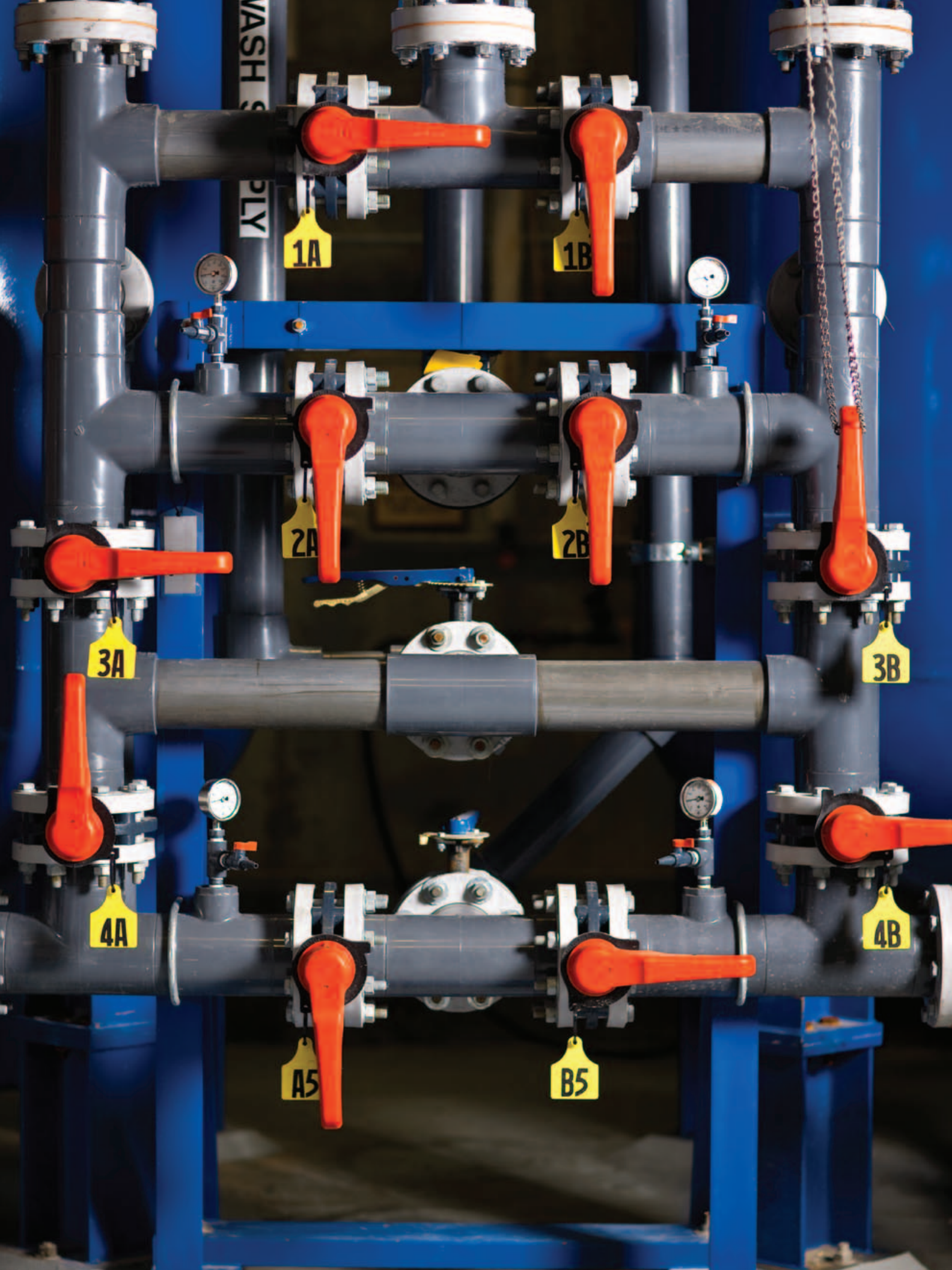
- > A 6,000-ft.² (560-m²) laboratory to test and Approve explosion-proof and flame-proof electrical equipment for use in hazardous locations
- > Associated test capabilities, such as water and dust penetration

Electrical ignition sources are consistently identified as one of the top three causes of fire and explosion in buildings containing flammable gas, flammable liquid or combustible dust. In our Electrical Hazards Laboratory, we test equipment that has to operate safely in hazardous locations under extreme conditions.

The laboratory's state-of-the-art gas-flow instruments and monitoring systems allow engineers and technicians to accurately prepare various size enclosures in explosive environments, and provide FM Approvals the capacity to run numerous tests simultaneously on electrical equipment used throughout industry worldwide. Researchers here test a range of products, including process-control instrumentation, test and measurement equipment, motors, lighting fixtures and industrial material-handling equipment.

These tests ensure that, when designed to meet FM Approvals or other recognized standards, the equipment will not ignite dust or any type of flammable gas, liquid or vapor during normal operation or under fault conditions. The explosive environment test cell area is spacious enough for testing of large enclosures and motors, including equipment for mining applications. Another test cell is dedicated to hydrostatic overpressure testing, environmental enclosure ingress protection and a salt-fog chamber that accelerates the process of metal corrosion to produce research conclusions more rapidly. Non-metallic components are similarly exposed to harsh chemicals and elevated temperatures to verify they will not degrade over time. Our clients are assured the testing conducted here will protect their properties from explosion and other catastrophic loss that can result when equipment in a hazardous environment does not operate properly, or is not adequately designed.

At left: The Electrical Hazards Laboratory's salt-spray test accelerates the process of metal corrosion to produce valid research conclusions. Above: 1. All gas-flow instruments are computer-controlled for the most accurate explosion testing and results. 2. Testing of electrical enclosure to verify explosion-proof (flame-proof) rating. 3. Many different types of gas are used in testing equipment.



WASH
PLY

1A

1B

2A

2B

3B

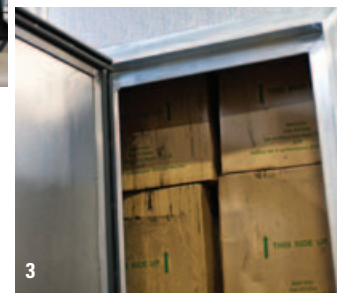
3A

4B

4A

A5

B5



Environmental Safeguards

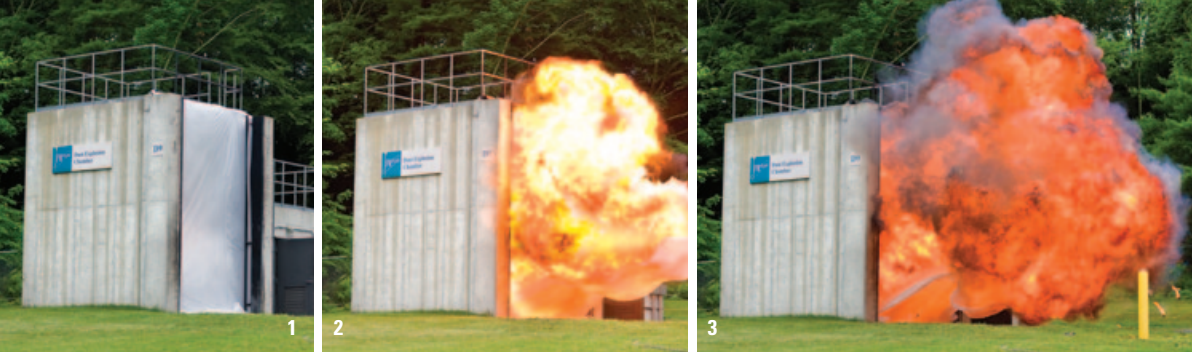
- > Closed-loop water treatment system designed to treat 200 gallons (760 L) of water per minute. Water in the system is tested regularly to ensure its quality.
- > Air emissions control system incorporates wet electrostatic precipitation technology, which efficiently removes fine particulate matter such as dust and smoke from the air stream. Purifies more than 240,000 ft.³ (6,800 m³) of air per minute (CFM) from the fire test labs.
- > New drying kiln and compactor triple the drying capacity at the campus, increasing it from 24 to 72 pallet loads at a single time.

From the initial construction of the Research Campus prior to its opening in 2003, through major renovations in 2008, FM Global has taken careful measures to protect the environment in and around the facility and minimize the environmental impact of its operations. Air quality at the Fire Technology Laboratory is maintained by a highly efficient emissions control system. Water is preserved through the facility's closed-loop water treatment system, which has been enhanced to work more efficiently while doubling throughput to meet production demands. To reduce waste, a drying kiln and compactor make it easier to store and recycle cardboard, wood and other material used in research and testing; and all waste is evaluated and segregated to ensure proper disposal.

From a broader perspective, contributions to sustainability reach far beyond the day-to-day activities of the Research Campus, and are closely tied to FM Global's business model and its mission on behalf of its mutual policyholders. Through loss prevention research, disastrous losses are prevented, properties are better protected and business continues uninterrupted—resulting in fewer reconstruction projects that require the use of natural resources. Moreover, loss prevention advice—founded on FM Global research—supports our clients' businesses in the areas of sustainable design, construction and operations. All told, the work conducted at the Research Campus has far-reaching environmental, as well as economic impact.

At left and Above: 1. The closed-loop water system for the Fire Technology Laboratory, double its original size, cleans and recycles water used to extinguish fires. In the event the water can't be recycled, it is trucked to a remote location for safe disposal. 2: One of the two trains of the Wet Electrostatic Precipitation emissions control system, which traps smoke particles and removes soot and other chemical contaminants from exhaust gas. 3: By reducing waste, the drying kiln helps to preserve natural resources and lower disposal costs. In addition, any combustible refuse is taken to a waste-to-energy facility.





Expanding Knowledge

The Visitors' Experience

- > 4,500 ft.² (420 m²)
Multimedia Center
- > Comfortably seats 130
visitors in stadium-style
theater seating.
- > High-definition theater projec-
tion system, with projection
screen larger than those found
in most cinemas, to create a
visual wrap-around effect for
viewers.

FM Global recognizes every company is unique. Yet, despite diverse concerns, our commercial and industrial clients share a common goal: preventing and controlling property loss. With more than 100 years of scientific research and product testing experience, FM Global provides assessment of hazards, innovative and cost-effective loss prevention solutions, and product performance testing certification—delivering both cost savings and improved reliability of research conclusions.

These conclusions mean a great deal to our clients because the FM Global Research Campus is all about business. Protecting the value of your business is at the heart of this facility. For that reason, we continue to expand its capabilities to use scientific research as a foundation to advise clients and industry of property hazards and solutions as they continue to evolve.

The tests conducted at the Research Campus can be riveting to watch and are always educational. Thousands from throughout the world have witnessed fire tests on Visitors Days. The campus also features a state-of-the-art Multimedia Center where the complex loss prevention concepts studied at the Research Campus are vividly illustrated. To schedule a campus tour or to learn more about FM Global's research and testing capabilities, contact a member of your FM Global client service team, or search for the FM Global office nearest you at www.fmglobal.com/contact.

At left: A group of visitors learn how a spray fire test measures the chemical heat-release rate of hydraulic fluids. Above: 1-3. The dust explosion bunker allows for impressive educational demonstrations of dust explosions resulting from a variety of combustible material, including metal, wood, grain and plastic. 4. The Multimedia Center provides a dynamic and educational experience for hundreds of visitors to the Research Campus every year.



P0208 Printed in USA (9/09)
© 2009 FM Global
All rights reserved.
www.fmglobal.com

In the United Kingdom:
FM Insurance Company Limited
1 Windsor Dials, Windsor, Berkshire, SL4 1RS
Regulated by the Financial Services Authority.



© **Mixed Sources**

Product group from well-managed forests, controlled sources and recycled wood or fiber

www.fsc.org Cert no. SCS-COC-00648
© 1996 Forest Stewardship Council

