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Scientific Analysis of a Chicken Coop Fire

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On November 30, 1989, the office received a telephone call requesting assistance by a fire investigator to investigate the cause of a fire in a chicken coop on an egg farm in eastern Connecticut. The fire involved coops that were 50 feet wide, with one being 300 feet long and the other 500 feet long.

At the first meeting the author and the fire investigator were given the particulars of the loss. A fire had occurred at an egg farm in eastern Connecticut. The farm had two coops, Coop #1 and Coop #2. An electrical contractor had installed the electrical system in the second coop on the site during its construction in 1981. Although the 1975 National Electrical Code specifically addressed agricultural buildings, this code was not in effect because Connecticut does not recognize or enforce a code until it is voted on by the State Legislature. Therefore, the second coop was constructed with an electrical system which complied with the 1972 Code which did not specifically address agricultural buildings. The second coop had been covered with a tar-impregnated, compressed paper product in place of the customary corrugated sheet metal. Although plans and manufacturer's information called for a plywood sheathing beneath the compressed paper product, photographs of the construction showed the siding being installed directly over the coop's studs and rafters.

The second coop's electrical system consisted of a 3-phase main disconnect which supplied circuit breaker panels. In 1981, an emergency generator and a transfer switch were added. At this time, wiring was re-routed to permit integration of the transfer switch into the coop's electrical system. The same electrical contractor was used to modify the coop's electrical system for the emergency generator installation.

Both coops had an extensive amount of automated machinery to feed and water the hens and to collect eggs. Each coop was approximately two and one-half stories high with the hens enclosed in cages on the second floor. The first floor (ground floor) level was designed to contain up to one year's accumulation of manure from the 60,000 chickens in one coop and approximately 40,000 chickens in the other.

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On April 11, 1988, an automatic alarm was received by a private alarm company. Because of a previous arrangement, the egg farm's owner was notified and responded to the farm. Sometime later, he made a telephone call to the local emergency dispatch center who notified the fire department. The fire chief was first to arrive on the scene. In the course of driving down the access road, he was faced with a fully-involved structural fire in Coop #2 and smoke emanating from Coop #1.

Records, photographs and videotapes documented the initial fire investigation which was conducted by private and state investigators. Their efforts included an excavation of Coop #2, visual examination of electrical devices and wiring, and a review of the fire patterns on the remaining structural members. Based upon observations and physical damage a conclusion was reached that the fire had been initiated by a catastrophic failure in Coop #2's electrical wiring. Conductors, electrical trough and panels were taken as evidence. An electrical expert and a metallurgical expert were employed to provide scientific analysis of the evidence. While the electrical expert addressed installation techniques and resulting failures, the metallurgist concentrated his efforts on the structural enclosures and the copper conductors. He documented copper having penetrated the grain boundaries of the sheet steel, thus concluding that high energy faults had occurred. These results and conclusions were used by the insurance carrier in a subrogation against the electrical contractor. The author's investigation was on behalf of the defendant.

Initially, one of our CAD technicians, working with the fire investigator, produced a plan view of the fire scene from partial plans and photographs of the scene. By doing so, it was possible to establish the relative position of the coops, machinery and other details of the site to each other.

The first viewing of the evidence was at the plaintiff's fire expert's storage facility. Three pieces of electrical trough, two electrical enclosures and various bits and pieces of conductors and damaged parts were shown and it was revealed that the two coops and all of the remaining electrical system components had been demolished shortly after the fire.

During the first 18 months of work, several requests were make to the defendant's attorney to engage the services of a metallurgist. While the fire investigator and author both felt confident to oppose the plaintiff's fire and electrical experts, respectively, neither had the training or expertise to oppose the plaintiff's metallurgical expert. In the course of reading the deposition transcripts and reports, it became apparent that a great deal of the plaintiff's case was based upon metallographic analysis. A metallurgist was hired and from that point on the investigative process gained positive inertia.

After reviewing the plaintiff's metallographic analyses, it was requested that samples from the retained evidence be taken. Areas of visible fault activity, as well as those where none was evident, were chosen for comparison purposes. Although the plaintiff's conclusion that the observed damage was the result of high-energy faults, the author was confident that the faults were the result of fire impingement. However, the hypothesis needed to be supported with hard data. The plaintiff's metallurgist was present and took samples at each location where the defendant's experts had taken theirs.

In a corner of one electrical trough, a small white object was retrieved. It was tubular in shape and was approximately one-eighth inch in diameter and approximately three-eighths of an inch in length. This object was packaged and taken to the laboratory with the metal samples for analysis.

The author was presented with over 1000 pages of deposition to review. It was interesting to note that the plaintiff's electrical expert presented an account of the wiring modifications to the coop's electrical system, during the generator installation, as if he were standing next to the electricians, not sitting in an office 300 miles away. Also, none of the wiring or electrical devices saved as evidence were from the area of modification.

Approximately three weeks after the day of gathering metal samples, the metallurgist called. All of his test results confirmed the catastrophic failure of the electrical system. He found copper particles in the grain boundaries of the steel from the electrical troughs. Again, documenting high-energy faulting as the plaintiff's expert had done previously. All data pointed to energized electrical failures at the points where the samples were taken. His most significant finding, however, was the identification of the white tubular specimen found in one of the troughs. By performing specific analyses, he was able to obtain sufficient data to refer to published reference material. What we had discovered were bone platelets from a rat's vertebrae. And by further analysis he was able to determine that the rat had been alive at the time of the fire. The electrical troughs were of sufficient size to house rats and mice, and the chicken feed provided a plentiful supply of nourishment. The plastic insulation on certain electrical wiring has been found to be attractive to mice and rats. By gnawing on the insulation, conductors are left void of insulation and short circuits can evolve. Following negotiations, an out-of-court settlement was agreed upon, that was approximately 14% of the original subrogation.

The team effort was responsible for the success of this undertaking. Each of the three disciplines assisted the other, and the overall outcome was the direct result of the interplay.

Since completing this assignment, the author has been vigilant in efforts to identify areas of particular expertise or qualifications. Many times, due to budgetary considerations and cost constraints, attorneys and insurance adjusters will make every effort to get the biggest "bang for their buck." A few assignments have been refused when it was found that a single expert was wanted to cover many disciplines. Most often the client has been willing to engage the services of the appropriate experts, thus greatly improving the probability of a successful outcome.

References:

NFPA Standard 70-1972 Edition

NFPA Standard 70-1975 Edition

McCrone's Atlas of Micro Particles

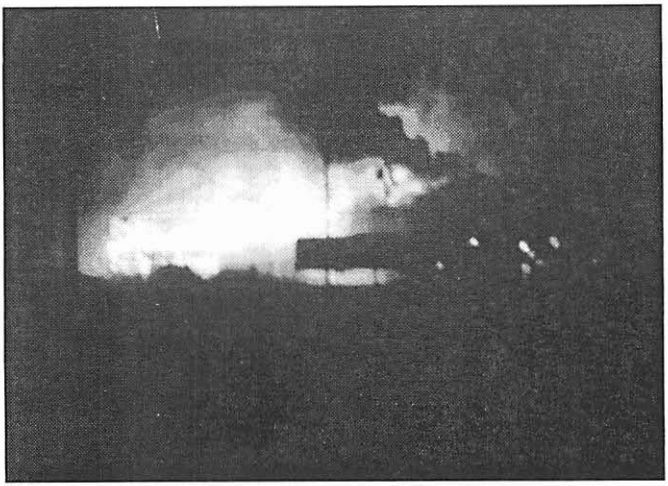

Photo 1
"What the fire chief saw upon arrival."

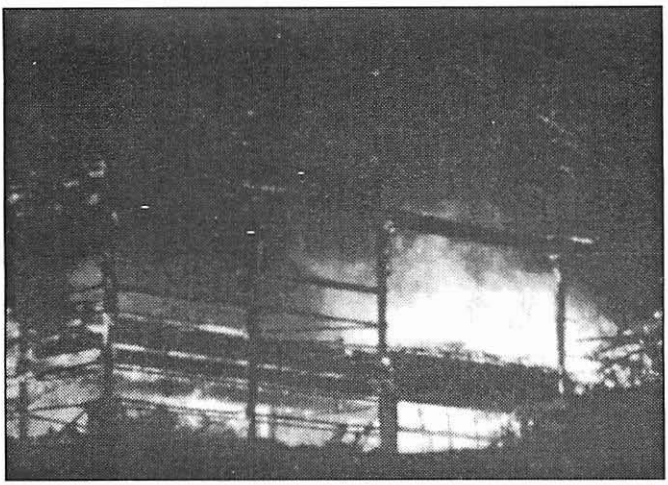

Photo 2
View of front portion of coop # 2.

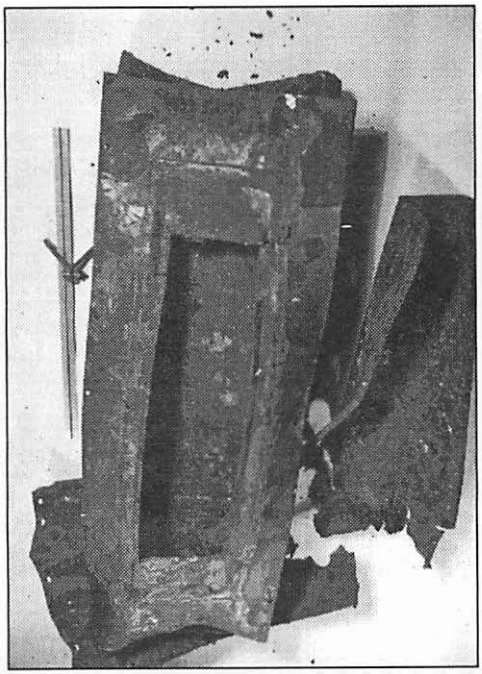

Photo 3
Electrical panel and raceway that were retained by plaintiff's expert.

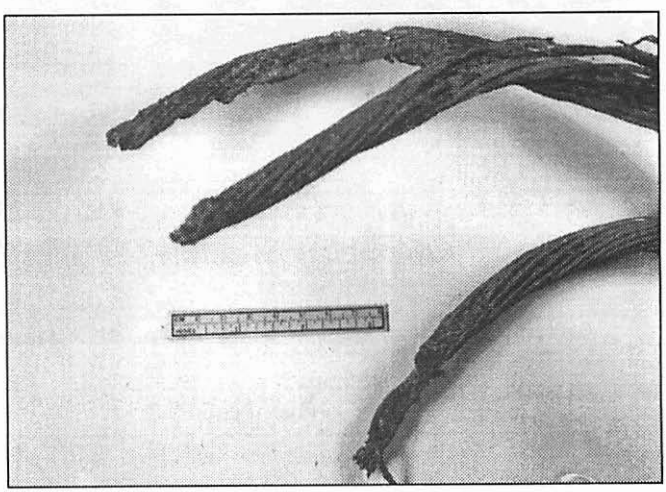

Photo 4
Damaged power conductors retained by plaintiff's expert.
This photo is intended to show the evidence that was retained.

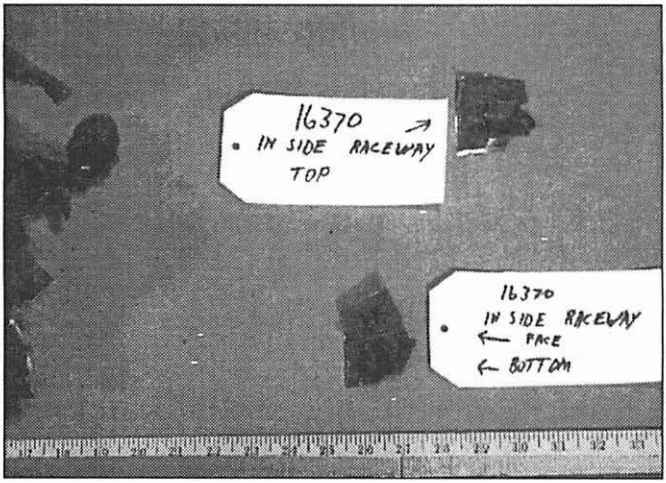

Photo 5
Samples cut for metallographic analysis by plaintiff's metallurgist.

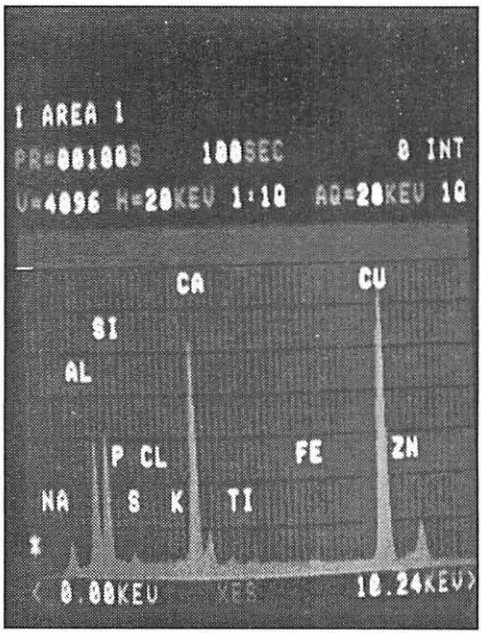

Photo 6
Typical scanning electron microscope analysis of a metal sample.