

## USING MODERN FIRE SCIENCE... TO PUT UNDESERVING PERSONS IN PRISON

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I have been practicing in fire safety science for forty years now, so I have seen the evolution of this specialty essentially from its very start. Other countries have had different histories, but in the U.S., fire safety science dates back only to about 1970. Prior to that time, fire technology existed, but not what would today be understood as fire science. In other words, codes, standards, and procedures existed for many decades for designing sprinkler systems, testing fire walls, and similar endeavors which required technical procedures but not much physics or chemistry. Since about 1970, fire safety science has gotten established and has become an accepted academic discipline. This is even more evident in fire investigation. Up through the 1980s, fire investigation was almost a wholly empirical specialty. Books were written giving advice which was subsequently shown to be 'myths.' Today, NFPA 921 is the standard of care for fire investigation, and it is a highly-detailed, science-based document. But the first edition was only issued in 1992, when the NFPA Committee tasked with developing this document successfully implemented their charge that a science foundation for fire investigation be established. Thus, myths such as spalled concrete means a flammable liquid has been poured, crazed window glass indicates the fire origin was close by, or burn-through of a localized area on a wood floor indicates the fire had an incendiary origin, were successfully demolished. The standard evolved over several editions, and today's document (2011) has an even stronger science basis, with fire investigators being instructed in clear terms how science must be used in fire investigations.

While fire safety science is properly considered an academic discipline, its effects can be very practical and down to earth. In recent years, a number of persons convicted of arson have had their cases reviewed by fire scientists who ended up exposing highly inadequate (to put it mildly) fire investigation work, done by fire investigators or fire marshals grossly lacking in training and education. This might suggest that such 'bad old days' are now over, and that such miscarriages of justice would be unlikely to happen in today's world. Unfortunately, this may not necessarily be true.



Recently I had the experience of serving as a fire science expert on the behalf of an individual who was accused of an arson/murder of his wife. But who I saw on the other side were some highly trained, competent fire safety science professionals working for ATF. The prosecution never put it quite clearly, presumably since they were afraid the jury would snicker, but basically the man was accused of setting out to murder his wife by pouring gasoline around his own feet, then lighting it. There was no motive uncovered, apart from the fact that (as with most Americans), there was a life insurance policy for his wife. On the contrary, the telephone records seized from the accused showed loving and tender messages being sent to his wife. The ATF built their case on fire science. The area of fire origin was determined, all potential ignition sources in the area carefully evaluated, and everything except a deliberate ignition was ruled out. The ATF laboratory was then used for large-scale tests and, the prosecution claimed, these results clearly showed an accidental fire could not happen the way the accused man had described things. Simple? When I and a fire science colleague reviewed the case, we did not feel that this was sound and correct. It was uncontested that the accused was using gasoline to refuel a weedeater. But he ended up spilling gasoline, and then, in his excited condition ended up spilling more.

Our investigation revealed a number of things. First, it was undeniable that this was a vapor flash fire. NFPA 921 cautions investigators that determining the area of origin for vapor fires is different from the procedures to be used for solid-fuel ignitions. Vapors can spread rapidly over appreciable distances, and ignition may occur at a locale not close to where heavy burning took place (which an investigator otherwise might surmise denotes the area of origin). In this case, the prosecution used a combination of the accused's interview statements plus burn patterns to establish a very small area of origin. They did not explain why they could rely on some of the accused's statements, while on the hand disbelieving him so thoroughly that they were endeavoring to have him imprisoned. Within this small area of origin, the ATF's staff testified that

they examined all potential ignition sources, conducted extensive large-scale tests in their laboratory and were able to rule out everything except a deliberate ignition.

My fire science colleague, Dr. David Icove, examined carefully the photographs of the fire scene and found that there was a small refrigerator with its door wide open right behind where the accused said he was standing. But ATF considered this outside the area of origin and did not even consider it. Upon learning of this from the defense, they realized that the refrigerator had been discarded and not even its brand was known. Undaunted, they bought various refrigerators and attempted to show that a non-defective refrigerator could not ignite a gasoline vapor cloud. During the trial, it was brought out that not only was the door open, but it clearly showed a ‘burn horizon’ on the inside of the door, corresponding to the level of other burn damage in the room. Two of the scene investigators then testified that the door had been closed when they arrived, and that they opened the door. When asked about the burn horizon, they explained that this was due to thermal radiation. Thermal radiation is indeed an important concept in physics, but it was necessary to point out to the jury that it behaves the same way as visible light—it does not go around corners, nor penetrate opaque objects.

The jury took one hour to find the accused Not Guilty. It was a relief that an innocent man was not sent to prison, however, the context of all this is very disturbing. The accused was able to hire a good private lawyer to defend him. But I do not feel sanguine that he would have been acquitted on a public defender’s budget. And it is precisely the mismatch of scientific ‘firepower’ that is so alarming. The defense was able to hire two fire science experts, but certainly would not have been able to finance the kind of very expensive, large-scale testing that the prosecution had at their disposal. The ATF laboratory is an outstandingly good laboratory, better than any laboratory in the civilian sector where a defense team could have mounted tests, had they been needed and had there been a budget to afford them.

To us working on the defense, the fire science aspects were clear, so one must ask why did the prosecution experts not appreciate the full picture. I believe that the answer is in the organizational structure of ATF’s fire laboratory. For each prosecution case that they undertake, the work is divided up by three individuals: the Special Agent (who is a fire investigator, but not an engineer), and two engineers at the lab, the test engineer and the analyst engineer. In this scheme, it is not in anyone’s job description to appreciate the full picture. Essentially, the Special Agent determines what he thinks are the circumstances of the alleged crime, then goes to the



lab and asks the engineers to prove this. Since the Special Agent is not an engineer, he does not have the science background of an engineer. On the other hand, the laboratory engineers are well versed in science, but take as a starting point the determination of the Special Agent.

Interestingly, it was described at the trial that the lab’s work undergoes rigorous peer review. But it emerged that this involves simply a number of in-house engineers sitting down and agreeing on a test plan. In science, however, a peer review explicitly means that the review is by persons who have no connection to the activity being reviewed. One has to ask, would

the system not be more reliable if the review or planning involved inviting defense experts? After all, if the scientific work is claimed to be reliable, it should be able to withstand detailed scrutiny.

The case described here was eye-opening to me, since it so graphically indicated that a high level of fire science competence is no assurance that justice is being done. While I feel that justice prevailed in this instance, I am troubled by the process. If the accused is unfairly convicted due to clearly incompetent individuals testifying against him, it can be fairly easy for competent scientists to help overturn such a conviction. But what about innocent persons who might have unjustly gotten convicted with the assistance of highly competent, technically qualified engineers or scientists? A successful defense can still be mounted, but it is evident the odds are poor. To a large extent, this is a matter of resources. If the defense has to fund an effort comparable to what a government laboratory such as ATF spends on a prosecution case in using fire science for testing or modeling, then only the truly wealthy can properly defend themselves. That is a social policy issue which I invite bright minds in that area to contemplate.

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## ABOUT THE AUTHOR

Vyto Babrauskas was the first-ever person to obtain a Ph.D. degree in Fire Protection Engineering. He now focusses on Fire Safety Science solely on focusing on science R&D and consulting. Known for his inventions (Cone Calorimeter, large-scale oxygen consumption calorimeter) or publications, such as the Ignition Handbook, which has become an essential resource for fire investigators, forensic scientists.

After an extensive career at NIST. He became a consultant, started his own company in 1993, and has been working for manufacturers, government agencies, insurance companies, and attorneys.

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