Interview with Cyril Charles, electrical fire prevention specialist

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Cyril Charles, inventor of the technology able to prevent from almost electrical fires

Hello, Cyril Charles. Please introduce yourself and tell us something about your expertise in electrical fire prevention.

Hello. I've been working on this issue for 25 years, in fact, since the 1990's. I ran a company that designed and installed prewired electrical systems and electronic fire detection systems. This company often worked in public buildings such as retirement homes. I began to research how we could prevent the unpredictable fire risk present in all electrical installations, even if they are new and to code.

I ended up discovering technology able to prevent almost all electrical fires. I worked with **Michel Guignard**, who is an electrician of the prestigious Compagnons du Tour de France and he was also director of the Chamber of Trade of the Charente in France.

Then, in 2001, we were joined by **Jean Pierre Denonain**, one of the best French experts in the field.

Mr. Denonain was an engineer and director of the Inspections and Monitoring department of APAVES (1250 engineers and inspectors), a technical consultant for several insurance companies, a lightning specialist, and he was also involved in research. He was an internationally recognized expert. He had just retired and we worked with several other engineers and specialists in France as well as North America.

In 2002 we produced a 200-page technical report about the differences between European and North American electrical installations and their specific fire risk factors.

This technical report, as well as all of our research, was approved by engineer specialists and we also worked on the topic of prevention of electrical fires in Canada and the USA with chartered engineers of NEC (National Electrical Code) and other specialists.

And all this can be seen in the video report :

"The Electrical French Connection or the Real Truth about AFCIs?"

Exactly…

Michel Guignard, electrician, Compagnon of the Tour de France.

On aaim.tv. (1)?

Yes…

How does a technology that detects glowing connections allow us to prevent almost all electrical fires?

Simply because glowing connections are the cause of approximately 80% of electrical fires.

Yet we often hear of "short circuits" in Europe or "arcs" in North America as the main causes of fires…

Any conscientious professional knows that's not the case. Because overcurrents and short circuits generate an increase in the temperature of the whole circuit according to the Joule effect. We've known how to control this since we started using fuses. **And today we use** (in France since the 1980's) **thermal magnetic circuit-breakers (bimetal + coil) which are sensitive and perfectly reliable.**

However, detecting hot spots in circuits is very tricky:

Those generated by insulation faults with a leakage of electric current to ground are very much under control because they will trigger the ground fault protection if it's present at the head of the circuits.

Here in France, we've been using ground fault protection devices in the main breaker since the 60's (0.5 Amp.). In the 90's, the widespread use of 30 mAmp ground fault protection increased safety considerably. These ground faults are detected as soon as they reach 7 Watts, in 220V (and 3 or 4 Watts in North America With GFCI 30mAmp 115 Volts).

But for hot spots generated by insulation failures between phase and neutral conductors, such as short circuits that develop gradually, it's not that easy. Here the fault will have to reach the value of the overcurrent protection device which protects the circuit, for example 1750 Watts for 15Amperes! (115 Volts).

When we know that just a few Watts are enough to start a fire…

That's practically a toaster! Those are very alarming figures. Where can these faults occur?

Everywhere, but much more often in small transformers, electronic boards, and energy-saving lights. To limit these faults, these devices sometimes have small fuses in them. But even a 1 Ampere fuse, for example, will limit the fault to 115 Watts (in 115 Volts) which is still too much. So we see that these hot spots are only partially under control.

So if I understand this correctly, we can't really detect an abnormal temperature that could develop at a certain point in a circuit?

No, and that's the first part of the electrical fire problem. If we use a soldering iron, the temperature of it's highly-resistant tip will reach 660ºF - 750ºF according to the Joule effect, and of course that won't trigger any protection.

This is why in the industry we carry out inspections using infrared thermography to detect these glowing connections in electrical systems, **which is proof that no automatic protection exists.**

The connections are the second part of the problem, because they have a tendency to produce undetectable and dangerous hot spots. This association is what causes practically all electrical fires, because there is still a hazard that is out of our control.

Can you be more specific?

Connections connect wires together or wires to electrical equipment. There are connections everywhere, in switches, outlets, distribution boxes, heating appliances, hot water tanks, lighting fixtures, protections in the electrical panel, circuit breakers, electric meters, extension cords and power strips, etc... There are also connectors in all the electrical appliances.

In the average home, there are approximately 200-250 connectors (only for phase – neutral) and they are spread over all the nooks and crannies of the house. It is particularly insidious when a temperature rise somewhere in the innermost recesses of the house could start a fire.

Why do these connections have a tendency to create these types of undetectable hot spots?

Because **over time,** the electrical current running through the contacts tends **INEVITABLY to pose a problem of resistance** and to induce **a Joule effect.**

Indeed a connection opposes a resistance **(RG)** to current flow which can be expressed as the sum of several sub-resistances, for example:

RG=ra resistance of the materials used for the connection*
+ rb resistance due to contraction of the current flow
+ rc resistance associated with the formation of oxides
+ rd resistance dependent upon the mechanical quality of the contact

** At 20°C because the electrical resistance of materials increases with temperature.*

But the increase in **only one** of these **sub-resistances** will start a chain reaction causing all the others to increase **because they are interdependent**. Many factors continually solicit these contacts: rare short circuits, electromagnetic efforts, vibrations, high frequencies, power surges, and the natural oxidation of copper.

The accidental increase of one of these sub-resistances, **rc**, for example, which is related to oxidation (copper naturally oxidizes when exposed to air, which only occurs at the connections; and the formation of copper oxides considerably increases the resistance) will cause an increase in global resistance **RG** and generate a hot spot. The heat modifies the electrical resistivity (dependent upon temperature) which will cause **RG** to increase again, and thus producing higher temperatures and more copper oxide.

The heat contributes significantly to the formation of copper oxides, and **rc** will increase again, and with it the temperature and the resistivity. **Everybody understands what comes next:** the overheating increases exponentially and in the end, you have a sharp and dangerous temperature increase.

Can you give us some numbers?

1400°F according to research by Forensic Studies **(2)** and during our trials, without looking to beat the record, we very easily reached over 1110°F several times.

Isn't PVC insulation supposed to resist hot spots?

Yes, for a few seconds. But faulty connections produce overheating that can take months to develop. And as soon as it heats up, insulation material is altered and loses its invaluable characteristics. PVC insulation undergoes chemical cracking at around 212°F, and this heat provokes a modification of the chemical composition of the polymer; it loses it's characteristics, it carbonizes and becomes flammable.

The energy from the increased overheating is also transferred to nearby dust and insulating materials, creating a fire hazard.

And here, there is no hope of a ground fault or a short circuit: the hot spot is present in only one wire.

This creates the favorable and necessary elements to ignite the fire, and nothing can detect and stop the increase in temperature.

A C.Joule Effect. Inc, test: joule effect, glowing connection. No arc, temperature to over 1148°F.

It will lead to the probable fire according to the fire tetrahedron:

Under the effect of activation energy (especially heat), the combustibles break down (pyrolysis); the product of this decomposition is a gas which reacts with the combustive (in general, the oxygen in the air).

In this way, heat alone or just one arc resulting from the thermal expansion could spark a fire. And it doesn't take high wattage. For example, a few years ago in France, a 9 year-old boy was burned in a fire which started at the outlet where his clock-radio was plugged in, and two little girls perished in their bedroom because of a nightlight.

How tragic!

So we can't physically detect hot spots remotely from the panel, but some hot spots can be indirectly detected because they are the consequences of faults that are recognizable by the protections; either perfectly as with faulty line-to-ground insulation, or in a more random way as with neutral phase insulation faults?

Exactly.

But in the wiring, nothing is capable of automatically detecting these hot spots?

Nothing. Electricians are powerless.

And the connections tend to create these hot spots, and to let them develop in the exact way that creates a fire hazard, and to actually spark a fire?

Exactly. That, and the absence of protection, have always been the cause of nearly all electrical fires. It isn't short circuits or arcs.

Why are arcs designated as a major cause of electrical fires in North America, and more recently in France, according to certain publications?

In North America they don't have the same definitions for faults. For example, parallel arc can designate either a short circuit or an insulation fault. There are also opinion makers who have worked to impose a costly product called AFCI (Arc Fault Circuit Interrupter) which is supposed to detect, serial arcs (such as arcs produced by a break in the same wire), among other things.

But according to our experience, these products produce the same effects as 30mA differential thermo magnetic circuit breakers.

How is that possible?

Quite simply because in North America (in the 1990-2000's) they didn't really know about the usefulness of differential devices at the top of circuits, because they didn't have them, and they also did not have circuit breakers with coils (sensitive breakers).

What is the use of detecting "abnormal" or "dangerous" arcs?

Good question. For us, with differential devices and sensitive breakers, it's useless. And in addition, it seems very difficult to detect and reliably differentiate "abnormal" or "dangerous" arcs from the normal arcs that occur regularly within the circuits of an electrical installation.

Moreover, several senior engineers on forums in the US have said that AFCIs don't detect series arcs, such as **Bob Huddleston** in his publication **AFCI why I have a problem with it** (**3**) and that they don't detect glowing connections (glowing connections are the main cause of electrical fires). For examples, see (**4** & **5**).

Finally, Dr. Joe Engel published a paper saying that the detection of series arcs doesn't work in homes and he explains why (page 7 Copper – Copper > Paschen's Law) **in his paper: *Combination AFCIs: What they will and will not do*.** (**6**)

He presented this paper in 2012 to the NEC (National Electrical Code) during a meeting to modify the code. It is very interesting reading.

In 2012 Bob Huddleston posted an incredible video showing that the AFCIs series arcs detection function still does not work. (**7**)

But oddly, the costly AFCIs were nevertheless made mandatory in the USA from 2000, state by state, even though it was obvious that there was a problem.

And it seems that a similar product will be arriving in France (which will cost a small fortune), just as two states in the USA have made them non-mandatory because they are not proven to be efficient. Other states appear to be studying the question.

It's an incredible story…

Many professionals in the US and Canada talk about this case as a gigantic scam.

Who is Dr. Engel?

He is head of R&D of the first company to develop and bring to market AFCIs in the USA in 2000. Nobody knows more about this than he does.

And if the detection of series arcs actually functioned, would that change anything?

No, we don't think so. The important thing is to detect the abnormal heat in the connections. Because generally, when arcs occur in connections, they are caused by thermal expansion (extreme temperatures) and the fire hazard is already present. And only overheating can ignite it. I've seen expert's reports where there were fires without any arcs at all. **When the elements are present which are favorable to the ignition of a fire, it only takes one arc to start a fire. So it's too late.**

This seems very serious, especially when you have the technology to detect glowing connections. Who knows that these glowing connections are the cause for nearly all electrical fires?

The manufacturers, the experts; everybody has known this for a long time!

This has often been said by specialists during debates on the adoption of AFCIs in the US. For an example, see (**8**). Dr. Joe Engel also says this in his 2012 paper which shows photos of electrical outlets on fire. **There is even a study dating from 1977 on the subject.** (**9**)

And you patented your technology which effectively neutralizes glowing connections in 2000?

Yes, and I didn't understand why nobody before me had ever seen this solution, which is the only possible one. At the end of 1999 I registered the patent, which was written up by an expert in Paris, and in 2000 I got a very strong patent, according to the experts. I then expanded it to cover much of Europe, China, the USA, and Canada.

And how does this technology work?

It actively protects the connections. It's tiny, and must be inserted with the connections when the electrical equipment is manufactured. It continuously monitors their temperatures and any dangerous heating of terminals triggers a fault signal that causes the interruption of the power supply of the circuit.

Are there any electronic components to this protection, or electromagnetic waves?

No, nothing electronic, and just an electrical signal which is only emitted if there is an abnormal temperature.

Which brings me to the "Linky" smart meters. What is your opinion on them?

Besides the potential problems in the contract with liability, etc., this meter seems to pose four major problems, in my opinion:

The power supply in not necessarily linear. There is interference from high frequency overloads caused by network operations, and lightning strikes on the ground or between clouds. Our old analog meters have shown that they are robust and reliable against these phenomena.

The new Linky smart meters have electronic components, and it's inevitable that these electronic components will be more sensitive to these phenomena than the analog systems. And even more so for the significant number of meters which are installed outdoors, where they are exposed to moisture and temperature variations.

These factors can speed the aging of these electronic components, even if they have been designed to be installed outdoors.

All this brings us back to the hot spots (which are very difficult to detect) we discussed earlier. Aging or a power surge can provoke an insulation failure in the components and lead to fire, which was very rare with the old meters. And I think that's inevitable with the number of these new meters being installed. And there is a film by **Brian Thiesen**, *Smart Meter Fires:* ***Burning Meters, Burning Questions, Shocking Answers*** (**10**) that shows that there are problems with these meters in the United States and in Canada.

The second problem involves the transfer of data. There are more and more nonlinear loads used in electrical systems (energy-saving lights, ballasts, televisions, computers, printers, etc.) which generate distortions, and the data transfer will add to the pollution in the power supply. This pollution can engender premature aging of certain receivers/appliances and possibly the appearance of hot spots (again, which are very difficult to detect).

The third problem is the remote disconnect. In fact, cutting the power under load generates arcs between the contacts during this operation. If there is a malfunction of the device, an incomplete or too-slow separating of the contacts, there is a risk of fire. It is my opinion that an operator should systematically be present any time that power is shut off to a home.

There is also the ever-present possibility of hacking.

The fourth problem involves the homeowner's privacy. It's possible that one of the unspoken goals of these new Linky meters is to collect as much data as possible which, in the long run, probably won't be limited to electrical usage. The sales figures for electric companies are relatively fixed, and the tendency is toward lower energy consumption. The sale of data could be a veritable godsend for them! It's already possible to detect appliances in a home (through recognition of the electromagnetic signature). Why would an electric company not collect and sell this data if it has the means to do so? And won't Linky be the first necessary interface? It's just a question. Obviously in this case, the frequency of transfers will become much higher than what they are saying now, and the problems will increase.

And I'm not even talking about the transfer of information via GSM.

Getting back to your invention: could it prevent a Linky meter from catching fire?

Not at this time, because since the meter is necessarily situated upstream of the panel protections, it can't be protected. It remains susceptible to all the risks I just described.

Is it complicated to install your invention in homes?

The equipment containing this technology **is the same size and is installed in the same way as the ordinary equipment, without any additional wiring or labor.** There is no special protection on the panel, and **it requires no maintenance. So it's just the opposite of something complicated.**

How much it would cost for the average home, for example?

For the user, it would only cost **US $230 to 280** (CAD $290 to 350) per dwelling.

Would the problem be a lack of profitability?

No, all the industrial studies showed good profitability...

I'm trying to understand ... Is it in competition with other protections?

No, this function does not exist, it will complete and improve all existing systems.

Then why isn't it available in Europe and North America?

That's what's incredible about this whole thing. Along with Michel Guignard and others in the profession, we decided to launch this new invention and bring it to the general public in 2000. We were joined by Jean Pierre Denonain, one of the best electrical engineers in all of France, as well as other industry specialists and engineers. **But a French industry leader explained to us** that contrary to popular belief, **there actually isn't competition between companies in the world**. **He explained also that there was a secret agreement between French industry leaders in favor of an American technology and that we would be blocked.** We couldn't believe it, yet that is exactly what happened.

At a complete standstill in France, I decided to try doing this in the US, and it was very difficult. When we developed our technology there, and applied to the **NEC (National Electrical Code)** so that our products might be made mandatory, **we were subjected to an incredible amount of opposition from the subsidiaries of French companies.** I was even threatened.

You can see all of this in the video report on aaim.tv *The Electrical French Connection or the Real Truth about AFCIs* (**1**) (Part III).

This so-called American technology - you mean the AFCIs that you mentioned previously and for which Joe Engel shows that the arc detection doesn't function?

Yes.

And there's a product which seems similar to it that is now appearing in France with a different name?

It bears a strong resemblance to it, yes.

That's incredible. So it's possible, if not probable, that to cover that up, your invention, which could have added essential security, was blocked?

In North America, one who understands our technology and its context instantly understands the state of knowledge in Europe; instantly understands that the detection of arcs, had it worked, would not be of much use.

According to you, are EDF (Electricité de France) and UTE (Union Technique de l'Electricité) partly responsible?

The "Accélérateur" department of EDF approved this technology in 2001, before these extraordinary complications blocked our efforts. And they don't follow up on it, they know what's going on.

And UTE…They were the first to block us. You will see what I mean if you watch the video report (**1**) (Part I).

In the USA, did you meet with the CPSC (Consumer Product Safety Commission)?

The CPSC, yes, **we had a meeting at the highest level in 2012.** It was incredible, no proper technical objections could be made. **Then we heard some philosophical oppositions! What does "philosophy" have to do with this?**

According to you, is the CPSC (Consumer Product Safety Commission) partly responsible?

They know the case, so…

It seems incredible….

You will see what I mean if you watch the video report (**1**) (Part III).

And yet these are organizations that are responsible for public security. Who can we trust? Your invention neutralizes glowing connections. If it were to be put to use, what is your estimate of the resulting decrease in electrical fires?

All of the experts that our team has met with estimate that this invention would reduce electrical fires by **80 – 85%.**

A reduction of that magnitude is a real public safety concern!

Of course!

And can your invention still be approved by technical standards committees?

Yes … In 2001 we received a quote for a series of tests from LCIE (the French Central Laboratory for Electrical Industries). **There were no standard that could prevent the approval of our technology, and it's still the case.**

And what's more, **the technology uses a phenomenon that is one of the bases of the principles of electricity and the standards!** You simply can't credibly oppose this technology and they know this very well.

That's why it's so amazing!

That's also why at the UTE, the secretary-general recognized **it as promoting the public interest**. At least at first. But later on, it became obvious that some strange things were going on...

And is that also why in 2012 the CPSC could not issue justified technical objections?

Exactly…

Do you still have your patents?

Yes, partially, and I filed improvement patents in 2012 for USA and Canada.

What would you need to finally make your invention available?

We have a competent staff, and nobody has ever been able to deny the necessity of this protection for public safety, or to find fault with the viability or the profitability of the industrial project.

We hear so much about unemployment, and yet we are ready to create jobs, and there are so many lives to save as well, but all this is at a standstill. Why? **We need sponsoring, that our story be told, we need support from consumer associations, victims associations, etc.** Any help is welcome! We need support, and we need a petition.

How can we contact you?

I can be contacted though the GCI Technology© website

Thank you, Mr. Charles.

Thank you.

Links:

(1)
http://www.aaim.tv/elecrical-french-connexion-real-truth-afcis-anglais/

(2)
https://www.mcc.co.mercer.pa.us/renovation/condition.htm

(3)
https://www.mikeholt.com/mojonewsarchive/AFCI-HTML/HTML/AFCI_-_Why_I_Have_a_Problem_With_It~20020801.htm

(4)
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(9)
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https://takebackyourpower.net/smart-meter-fires-2016-video