Hurricanes and Electrocution

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19 December 2003

Hurricane Isabel struck eastern North America in September 2003 killing at least 53 people during and in the aftermath of the storm. One video clip showed downed power lines caught in the trees, fluttering in the breeze, sparking and crackling. Aside from the potential dangers of electrocution and fire, the devastating effects of broken utility lines were shown through the three utility workers who were fatally electrocuted while undertaking repairs.

Similarly, in Puerto Rico in 1989, four of the nine fatalities attributed to Hurricane Hugo were occupational electrocutions during the repair of downed power lines. Three other electrocutions occurred, two of which resulted from contacting live power lines. One of those was work-related.

Would it be feasible for the authorities to shut down the power grid as a hurricane approaches and refuse to turn it on until the grid is ready? If the grid is not designed to be flicked on and off--perhaps a few times a year--why not?

Hospitals, emergency operations centres, and emergency services have their own power supplies, or should. If they know that protocols for a hurricane include shutting down the main grid, they should prepare for it. People routinely board up windows and evacuate for hurricanes, so if it were standard procedure, they could just as routinely prepare for no power.

In fact, the hope is that they would be better educated on issues such as not using generators in confined spaces, which caused at least seven Isabel-related fatalities, and monitoring for candle fires, which caused at least one Isabel-related fatality. This increased preparation should occur because power being shut down for hurricanes would happen more frequently and because people would know that power would definitely be out rather than being vaguely prepared on the off-chance that power might be cut.

For example, according to the BBC, for Hurricane Michelle in Cuba in 2001: "Electricity in the capital has been cut off to avoid accidents with falling power cables" (http://news.bbc.co.uk/2/hi/americas/1637584.stm). See also Ben Wisner's essay "Lessons from Cuba?" on Radix http://online.northumbria.ac.uk/geography_research/radix/cuba.html Cuba's energy supply system, though, presumably has differences from the USA's.

An immediate technical issue to consider is whether or not adequate testing of the repaired system could occur with the power off. Surely that must occur frequently and it could not be particularly difficult to work something out. Certainly worth a few lives.

Considering the megaprojects which currently supply most developed world energy, such as nuclear power plants and fossil fuel fired plants, shutting them down and starting them up takes time. Yet shutting them down quickly could not cause that much of a problem. Witness what happened during the August 2003 blackout in eastern North America and the systems which Japan uses to automatically shut down plants when a major earthquake is detected. Regarding start up, if it takes a day or two to get them operating at full capacity, then we should wait. Or improve their design to start up more rapidly.

In theory, a simple procedure exists: 12 or 24 hours before landfall, which can be predicted reasonably well, turn the power off. Then, take 24-72 hours after the hurricane has passed to repair damage before turning the power back on. People, many of whom would have been evacuated anyway, would be without power for 3-5 days. This situation is hardly uncomfortable once you get used to it and if you have prepared adequately.

In practice, however, the theory does not stand up to scrutiny. After a hurricane, the damage is often so extensive that power companies must reconstruct the power grid, not just repair a few damaged portions. Weeks, if not months, might be required. The widespread destruction occurs mainly because trees falling over not only pull overhead power lines down but also pull up buried utilities. Taking better care of trees would not eliminate this problem because a hurricane's wind is so strong that large numbers of trees will go down irrespective. In fact, it is part of the natural ecological cycle. Planting all trees away from all power lines would present landscaping challenges.

Cutting the power 12 to 24 hours prior to the storm also raises concerns. With storm prediction still not an exact science and with all the preparations that must be completed, shutting down power over a wide area before the storm hits could increase the impact on the community and might inhibit their safety. The public still has a tendency to wait too long to make preparations and changing such behaviour is challenging, although not impossible. Many jurisdictions thus decide to leave the power on until the storm knocks it out so that people can continue to prepare in the way they are used to.

Other communities are beginning to shut off power as the storm begins to strike. Compare with the standard operating procedures that emergency services use during hurricanes. They stop responding to emergency calls once the winds have reached a speed that threatens the responders. Determining a wind speed threshold for shutting power off would be possible.

Another concern relates to the generators that people purchase to provide power for themselves after the storm. Some generators cause feedback which charges a portion of the power lines. Two of the utility workers who died in Puerto Rico following Hurricane Hugo were electrocuted when they touched power lines which were charged in this fashion. Utility companies try to inform house occupants in order to protect their workers, but making certain everyone knows--and behaves appropriately--is challenging.

In other places, most generators used are small, portable ones that are good for running a few lights and the TV. The appliances are usually hooked directly into them. Using a generator to power a whole house is difficult and expensive, requiring a much larger and more expensive generator along with some modification to the house wiring. When done correctly, it isolates the house from the power grid, but it is not always done correctly. The different generators that people use and the different extents to which they go to make them safe yields differences in the dangers which utility workers face.

For Isabel, vulnerability to wind damage was also exacerbated because the hurricane struck some areas where hurricanes are not common, where the use of electricity from the main power grid is ubiquitous, and where flood damage prevention and awareness are relatively well-developed in contrast to wind damage prevention and awareness. Thus, comparing with Cuba might not be appropriate. Cuba has a well-developed emergency plan revolving around early warning which activates centrally-planned and co-ordinated action including evacuation. The authoritarianism of Cuba's government gives it the power to do what it wants for disaster prevention.

Furthermore, leaving the electricity on might even be safer. Then, everyone would be expecting the cables to be live and dangerous and would hopefully be extra careful in keeping their hands off. If standard procedure were to turn power off and leave it off, but something goes wrong, the results could be a pile of bodies. Safety is the main concern in re-starting power. In the August 2003

London, UK blackout, power could have been restored to the Underground railway (the Tube) within twenty minutes, but it did not happen for over three hours because passengers left the trains and were walking on the rails. Absolute certainty that everyone was clear of the tracks was needed before turning the electricity back on.

Are the dangers of electrocution less than other dangers following a hurricane, even for utility workers? Post-Isabel, the electrocution deaths were less than half the toll from being hit by falling tree parts and from falling while cleaning up. If more people are forced to rely on generators longer, could the number of carbon monoxide poisoning deaths increase, rather than decrease as suggested earlier? Should we focus on electrocutions when other causes demand attention, particularly when apparently "solving" one problem could lead to other concerns and more fatalities? Rather than examining only one cause of death, efforts should ensure that the death toll overall is reduced.

Much of this discussion, though, has described the way the electricity system operates and the way in which people behave. Little addresses why the systems and people are that way and how to change them. Could we change system design and our behaviour, as well as our expectations of system design and our behaviour, in order to reduce hurricane deaths? Engineering design tends to be easier to change than human behaviour, but the latter tends to yield better long-term results than the former.

Fantastic successes have already occurred in the developed world, reducing hurricane tolls from thousands to dozens. Yet plenty vulnerability remains and should be tackled. Any approaches deemed to contribute would hopefully work not just for hurricanes, but overall for community sustainability.