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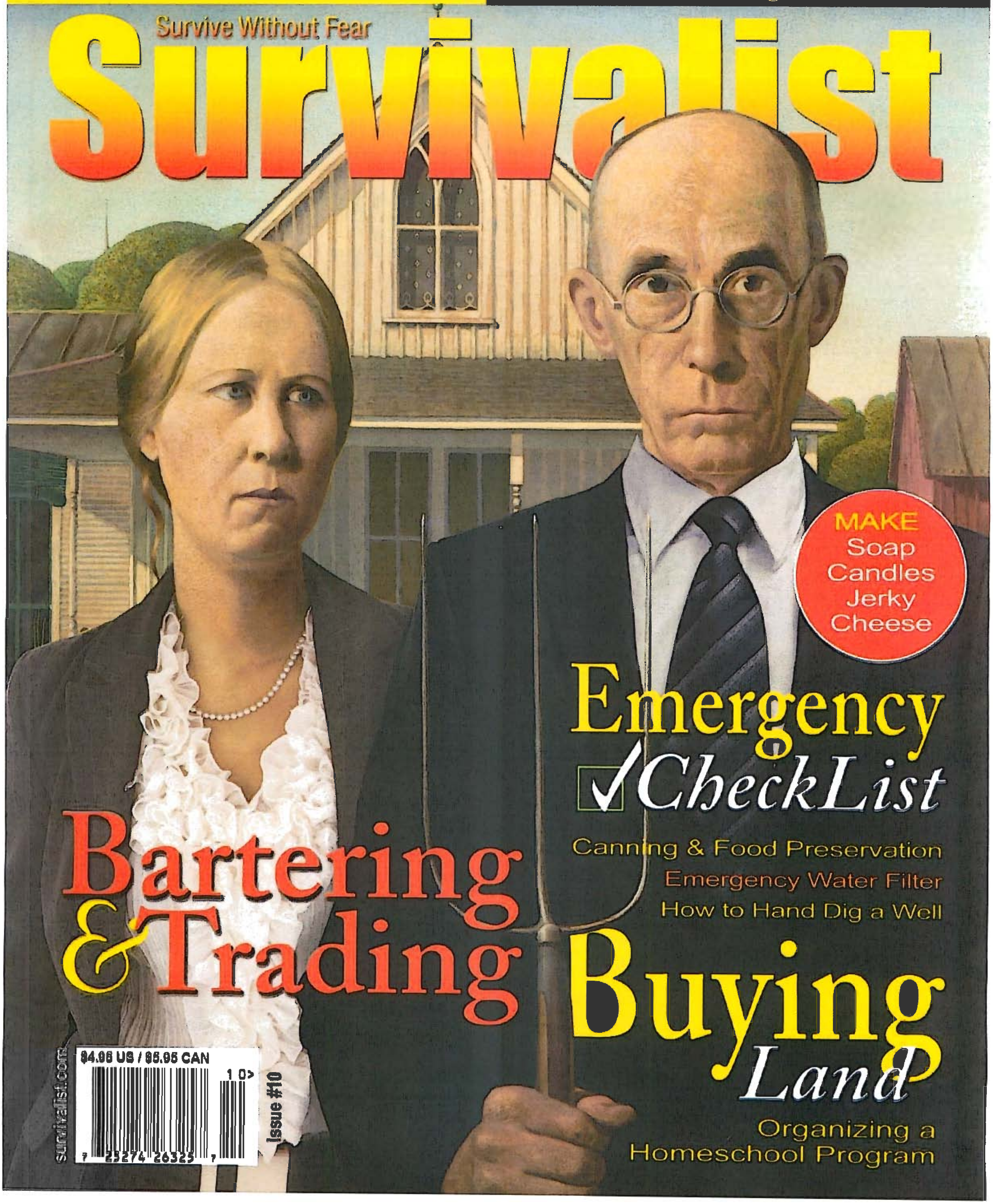

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Protecting CRITICAL Emergency Fuel Supplies

By Ralph E. Lewis

The story never changes. A massive hurricane strikes. Power fails. Emergency diesel generators kick on at major medical facilities. But then, after just a few minutes, the hospitals go dark again, forcing evacuations of hundreds of patients under the worst of conditions. Some of the most critically ill die.

In at least half the cases of these failures (think Sandy, Ike and Katrina), investigators discover that these engines had sputtered to an abrupt halt operating on an emergency fuel supply that had simply deteriorated like soured, curdled milk, choking fuel systems and over-heating engines into a slow death.

Recriminations and fault-finding are loudly exchanged between self-important local officials. But quickly, people forget and the finger-pointing stops. Little is ever done.

Few Americans realize the extent to which emergency generators command the first line of defense in the event of a power grid failure, and fewer still are aware that most of these critical systems stand in sad neglect. Today, tens of thousands of diesel generators sit idle at hospitals, high rise office buildings, IP service providers, cell phone sites, airport control towers, fire and police stations, and perhaps most critically of all, nuclear power plants – silent sentinels all, and typically ignored by their caretakers.

THE WEAKEST LINK

As fuel deteriorates in storage, the residue from degradation begins to plug fuel filters. The photo of the filter above was taken from a diesel powered pumping station designed to ward off flooding in a low lying area. With a failure in the system, hundreds of homes are put at risk.

The weakest link is almost always fuel, for when an emergency fuel supply is stored unused month after month, year after year, it deteriorates. Degraded fuel becomes gummy, fouling and plugging fuel filters. Poor ignition quality results in increased ignition delay, each piston fighting against the other. Excessive carbon soon fouls fuel injection systems – eventually pinching off the fuel supply to the cylinders.

Perhaps the worst case of generator failure in modern history occurred when the fuel supplies at the Fukushima nuclear power facility in Japan were washed away when the March 11, 2011 Tsunami struck, disabling the emergency generators for reactors 1-3. In turn, no power was available for the electronic controls and back up cooling systems. Eventually, seawater was pumped into the reactors, but not soon enough to prevent a melt- down and a catastrophic threat to human health which remains with us to this day.

Closer to home, disaster was averted in January 2012 when the San Onofre Nuclear Power Generation Station, operated by Southern California Edison, went into emergency shut- down mode when radioactive leaks were discovered in two steam generation units. Fortunately for the 8.4 million Californians living within a 50-mile radius of this seaside plant, no problems were encountered with the emergency diesel generators.

Unlike so many other generators that have failed over the years, the EMD diesel units at San Onofre run on fuel treated with an industrial-grade fuel stability additive, PRI-D, a chemical that has kept the emergency fuel supply in refinery fresh condition year after year for more than a decade. In fact, the entire 60,000 gallon fuel supply is fully protected by a mere 30 gallons of PRI-D treatment.

RISKS WITH HOME SYSTEMS

Sales of small gasoline home generators have been brisk in recent years. Yet until they are needed, most sit neglected in garage corners along with pails of stored gasoline. Like their industrial counterparts, many of these perfectly good generators fail when they are most needed. Just ask any generator maker like GENERAC, Honda or Kohler. Warranty claims run rampant after a crisis hits. Again, the story is the same. The stored gasoline has gone sour, fouling and disabling the small throated carburettors of these units.

Granted, small portable generators are fine for the short term, but in the event of an extended grid failure, serious preparedness professionals understand the necessity for true, "off-the-grid" power systems. After all, portable gas, diesel and propane generators gobble fuel. They are noisy, and may attract the attention of unwanted guests. Still, they can keep things going short term before it is necessary to re-locate to a safer and more remote sanctuary.

Of course, in the event of a collapse, the nation's refining and fuel infrastructure will quickly shut down with local fuel supplies exhausted in a matter of days. This necessitates a sufficient amount of stored fuel on hand to achieve transportation to the "bug-out" location, and sufficient fuel once there to operate gasoline powered equipment.

Assuming a long-term scenario, it is smart to stock hand tools for tree cutting, log splitting, soil tilling and brush cutting. It is even smarter to have redundancy – two or more of everything in the event of a long term situation. Yet in the early going, those of us accustomed to suburban living, or those of us with certain physical disabilities, will be operating at a disadvantage. So while it is essential to stock a good supply of hand tools, it just makes good sense to also have on-hand their gasoline-engine powered counter parts – chain saws, log splitters, roto-tillers, brush cutters, even bush hogs, Bobcats, and ATVs. Again, redundancy is critical, and while having two of everything may be impractical, stocking up on spare parts and lubricating oil for these machines is not.

FUEL STABILITY ADDITIVES

The rate of gasoline deterioration depends on many factors – the refining process, and storage and handling conditions. Most gasoline will maintain freshness for three months or so, provided it is stored in a cool, dry location. But as many recreational boaters and RV enthusiasts have discovered over the years, gasoline also has a relatively short shelf life when exposed to heat and humidity. Like diesel fuel, when gasoline ages it also becomes gummy, forming varnish on fuel systems and engine components, resulting in gas engine failure and costly fuel system repairs.

The remedy is simple – application of a fuel stability additive. The good news is that there are many to choose from, and they are widely available at big box automotive and hardware stores. The bad news is that these consumer additives are typically formulated to keep fuel fresh only for about six months – and then only when the fuel is stored under ideal conditions.

A review of the chemistry one of the most popular and well- known brands reveals that the actual active ingredient that effects stability is only present in a concentration of 32 parts per million once it is dosed into the fuel. In contrast, when industrial users treat fuels for stability, they rely on a much stronger slug where the concentration of active ingredients ranges from 150 to 250 parts per million – a dose rate guaranteed to keep fuel fresh even under the harshest storage conditions. Unfortunately, "consumer grade" products simply don't pack a sufficient punch – designed only for short-term, seasonal fuel storage.

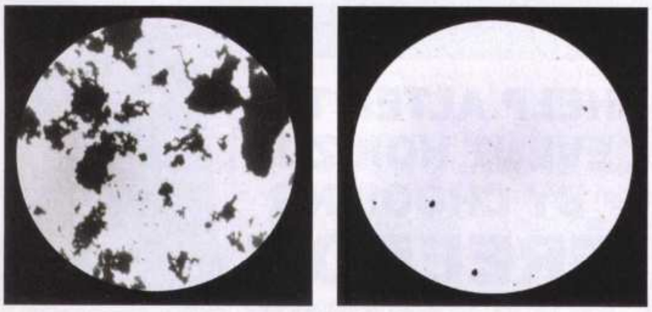
Some of the more recent versions of gasoline additives also claim they are formulated for E-10 gasoline, a moniker simply designating that the fuel contains as much as 10 percent ethanol. Yet, here's the problem. These E-10 stabilizers typically contain alcohol or glycol, which, when mixed with fuel, causes fuel to absorb even more moisture –the reason why ethanol is such a problem in the first place.

Still, there is no need to panic. Gasoline, diesel and kerosene can be preserved and stored literally for decades with the proper additive treatment and under the right storage conditions.

For gasoline storage, Power Research Inc. (PRI) manufactures PRI-G, available in 32, 16 and 8 ounce sizes. The 32 and 16 oz. contain the industrial concentrate – one ounce treating 16 gallons of fuel. The 8 ounce bottle treats 20 gallons in a more convenient concentration for smaller tanks.

PRI-G was originally formulated to preserve gasoline in bulk storage and was only available in 55-gallon drums. In the early 1990s, PRI began bottling PRI-G for recreational boaters and RV enthusiasts, packaging the same industrial chemistry used to treat large bulk storage facilities into small bottles. Consequently, consumers can now benefit from the same industrial-strength product, far stronger than conventional consumer additives.

For diesel and kerosene (yes, kerosene deteriorates too), PRI manufactures PRI-D. Few PRI consumer clients know that PRI-D, as an industrial product, is widely applied to emergency industrial fuel supplies across the USA, and is presently in use on more than 2,500 ocean going ships world-wide to treat low sulfur marine gas oil. PRI-D also contains a refinery grade, synthetic ester lubricity chemistry to protect high pressure fuel pumps against the ravages of ultra- low sulfur diesel (ULSD) fuel.



At left is a photo of unstable diesel fuel taken at 3000x magnification. The dark patches are composed of gums, resins and carbon that results from fuel instability. At right is the same fuel restored to a refinery-fresh condition with PRI-D fuel stability treatment.

Sadly, the modern standard for the lubricating value of ULSD is grossly insufficient – a standard based on an early 1990s, low pressure diesel injection pump. Today's diesel injection pumps operate at much higher pressures, a reason why diesel engine makers have lately been tearing their hair out coping with premature injection pump failures. No problem for PRI-D users.

ULSD fuels have additional problems which result in premature instability. For one, these fuels are manufactured in a process known as hydro-desulphurization. This process removes sulfur and strips out the polar components which provide natural lubricity. Worse yet, some of the lighter ends in the fuel, those responsible for ignition quality as measured by cetane number, are removed.

To compensate for this loss in cetane, refiners treat the fuel with a cetane improvement additive which can boost cetane as much as 8 points at the maximum dosage rate of 1000 ppm. This cetane improvement chemistry – 2-ethyl-hexyl-nitrate (2-EHN), is commonly used in ULSD fuels. However, when the chemistry was used in some of the first low sulfur fuels sold in California, complaints from customers – mostly those with central fuel storage facilities – began to roll in. Filters were plugging more often. Engines were smoking a lot more – all of this happening with a clean, fresh fuel.

After investigation, Chevron researchers discovered that the 2-EHN cetane improvement chemistry was actually accelerating fuel deterioration in storage. Yet today refiners do little to remedy the situation. After all, the thinking goes, most diesel fuel is turned over in less than 30 days, and very little is stored.

Interestingly, most aftermarket performance additives for diesel fuel are laced with a generous portion of 2-EHN cetane improvement chemistry. Not only does this increase the chances for more rapid fuel degradation, an additional amount of the chemistry rarely does much good in elevating cetane number. As it turns out, the maximum response rate for 2-EHN occurs at a concentration of 1000 ppm. Any 2- EHN added to fuel after the maximum dosage will not improve cetane any further, rendering an aftermarket cetane improvement additive virtually worthless. For this reason, it is always wise to steer completely clear of any so-called stability additive that also boasts cetane improvement.

Another aftermarket gimmick in recent years has been products that claim to stabilize fuel with "enzymes". A close look at these formulas show that most simply contain 99.9 percent kerosene. The "enzyme" approach sounds good at first glance – the enzymes supposedly "eating" the impurities in the fuel. Really?

For one, enzymes are nothing more than inanimate amino acids. Specifically, they are used in situations to catalyze or speed-up biological reactions – useful, for example, in promoting bacterial growth in portable toilets where bacteria is introduced to hasten decomposition. Truth be told, the chemical integrity of enzymes deteriorates quickly in a hydrocarbon environment.

What if your fuel supply has already gone bad? Proper application of PRI-G to stale gasoline will return the fuel to a state of usability, with no problems to gasoline engines. The same goes for PRI-D. But wait. Most "experts" claim that restoration of stale fuel to refinery freshness is a chemical impossibility.

So said engineers at the Tennessee Valley Authority (TVA) where stability tests established that 1.8 million gallons of diesel fuel on reserve at a gas turbine facility had degraded far beyond usability in the facility's sensitive frame turbine units. The original fuel supplier insisted no chemical could restore the fuel, but that he'd be happy to pump off the fuel for a price, and of course, replace it with fresh fuel.

The TVA engineers balked when told PRI-D could return the fuel to a refinery fresh condition. But given the expense of fuel replacement, laboratory stability tests were ordered. In test after test, the PRI-D treated fuel was restored. Shortly after, the entire 1.8 million gallons were filtered and treated with PRI-D – saving the utility hundreds of thousands of dollars in fuel disposal and replacement costs.

A PRI engineer prepares to apply PRI-D stability treatment to 1.8 million gallons of diesel fuel that had gravely deteriorated in storage at a Tennessee Valley Authority frame turbine facility. Within one day, the fuel was fit for use by the highly sensitive units.

Finally – the big question. How long will a fuel stay fresh when treated with PRI-G or PRI-D? PRI has many documented cases of fuel maintaining refinery freshness anywhere from 5-to-12 years. Retreatment after such a period will continue to extend fuel life for a similar period of time. Since storage conditions and fuel chemistries vary, PRI recommends that fuel be re-treated about every 18 months. This is the safest, surest option to maintain fuel integrity.

FUEL STORAGE RECOMMENDATIONS

First, make sure fuel is stored in conditions not to dissimilar to the optimal environment required for maximum longevity of stored foods – a relatively cool temperature – away from light, and in proper storage containers.

Preferred are five-gallon cans as opposed to 55-gallon drums. Aside from the fact that five-gallon cans are far more portable, they are safer when storing fuel for which they are specifically engineered. While state laws vary regarding portable fuel can standards, opt for containers that meet the more stringent federal OSHA standards. Pay careful attention to safe use guidelines issued by state and federal authorities. For example, it is not a good idea to fill either a plastic or metal can resting on the plastic bed liner of a pick-up truck. In sliding unsecured across a bed liner, the cans will generate static electricity, possibly causing fuel ignition.

Either plastic or metal cans are fine, provided they are properly engineered for the specific fuel. But beware. Old NATO surplus "jerry" cans used to store diesel fuel are not appropriate for gasoline storage. Problem is in the rubber seal, which gasoline will cause to deteriorate. Older military metal "surplus" cans may also be corroded in some places, contributing to accelerated fuel deterioration and potential fuel line fouling. That said, if metal cans are preferred, "jerry" cans of more recent manufacture are available for either diesel or gasoline storage.

When filled, a sufficient amount of "head space" – at least a couple of inches, will give room for expansion of the contents in hotter weather. Too much space in a partially filled can will result in too much moisture condensation.

Over time, some condensation can be expected to occur. For this reason, it is a good idea to rig a small water separation filter on a fuel line attached to the spout of the gas can. These filters are commonly available at marine supply stores.

BIODIESEL If anyone goes to the trouble of home manufacturing of biodiesel fuel, the hope is that the fuel is consumed in the first 30-days of manufacture. These fatty acid methyl ester (FAME) fuels have notoriously poor storage stability. When they chemically break down, they form carboxylate acid. Ignition quality will quickly degrade, and when burned, carboxylate acid smokes like an old coal furnace. Worse yet, deposits of carboxylate soap will foul and clog fuel injection systems, quickly disabling any diesel engine.

A few biodiesel stability additives are now manufactured. Tests of these products reveal much work needs to be done – most of these additives incapable of maintaining proper biodiesel characteristics in long-term storage. One exception is storage stability of B-20 biodiesel (20 percent biodiesel, 80 percent diesel fuel). Application of PRI-D to B-20 will keep the fuel from deteriorating over time.

Bear in mind that biodiesel can be produced either from animal fat or vegetable fat. Yet when considering the labor, resources and expense required to produce any quantity of biodiesel, the question should be asked if the effort is even worth it.

If the goal is to operate a diesel engine on biodiesel for electrical power generation – the choice may be a very poor one. Liquid fuels are notoriously inefficient for long-term power generation. Solar, wind and hydro power are better alternatives for off-the-grid power requirements.

SUMMARY The old aphorism, "for the want of a nail – the war was lost," holds true today. Emergency fuel supplies remain a dangerously weak link. It need not be so. For a few pennies per gallon, and some simple precautions, fuel can be preserved indefinitely and old fuel restored for safe and efficient use. Sadly, the message is lost on most institutional emergency power providers. Make sure it is not lost on you.