Compact Fluorescent Lights, Mercury, and the Landfill

By Ms. Martha M. Miller

With the cost of energy today and the threat of continued cost increases, everyone is looking for ways to cut energy usage at home and in the workplace. There are many ways to do this without spending money, such as using daylight when possible and turning off lights, radios, televisions, and computers when they are not in use. Consumers can invest in Energy Star-certified products when purchasing new appliances and electronics. Another way to save energy is to replace incandescent lights with compact fluorescent lights (CFLs). CFLs and fluorescent lights are effective alternatives to incandescent bulbs for household, industrial, commercial, and military use in the United States and overseas during contingency operations. These lights have characteristics that are slightly annoying, such as not coming on immediately when their switch is hit; taking time to warm up to full brightness; and being adversely affected by cold temperatures, making them less acceptable for outdoor use. They also need to be properly disposed of at the end of their life cycle. The bulbs should not be thrown in the trash to end up in a landfill, but should be recycled. Aside from these issues, they can save money and electricity because they use approximately 75 percent less energy than equivalent incandescent bulbs. They also last up to 10 times longer and generate less heat when in use.

Risks From Mercury

The main concern is that CFLs contain mercury, which is a persistent, bioaccumulative neurotoxin harmful to the environment and to human health.

Environmental Risks. Most CFLs manufactured and sold today contain much less mercury than earlier versions. Manufacturers have tested individual lights according to the methodologies of the United States Environmental Protection Agency (USEPA) to ensure that the amount of mercury contained is low enough to be nontoxic and safe to go into a landfill. The manufacturer will even provide analytical documentation if requested. However, mercury does not break down in the environment and has a cumulative effect, building up until it reaches a toxic level.

Mercury exists in several forms:

- *Elemental or Metallic.* Elemental mercury is a shiny, silver-white metal that is liquid at room temperature. This is the form used in thermometers, fluorescent lights, old thermostats, and some electrical switches. Elemental mercury evaporates at room temperature when exposed to the air and becomes an invisible, odorless, toxic vapor. People are particularly at risk of exposure to mercury vapor when a mercury-containing product breaks or a mercury leak occurs in a poorly ventilated area.
- *Inorganic.* Inorganic mercury compounds take the form of mercury salts and are generally white powder or crystals, with the exception of mercuric sulfide (cinnabar), which is red. These compounds have been included in products such as fungicides, antiseptics, and disinfectants, as well as some cosmetics and traditional medicines.
- *Organic.* Organic mercury compounds, such as methylmercury, are formed when mercury combines with carbon. Methylmercury is the most common form of mercury found in the environment.

A recent landmark study by the United States Geological Survey has achieved the first documentation of the process by which increased mercury emissions from human sources across the globe make their way into the ocean. Mercury is released into the atmosphere through—

- Burning of coal and hazardous waste.
- Producing chlorine.
- Breaking mercury-containing products.
- Leaking or spilling mercury.
- Treating and disposing of mercury-containing products and waste improperly.

It returns to the earth in raindrops, snow, dust, or simply due to gravity and eventually ends up in the world's water ecosystems. Mercury that contaminates the soil will also contaminate the groundwater and migrate into water

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ecosystems. Once it reaches the water, it is transformed by microscopic organisms into methylmercury, which is taken up by aquatic plants and animals that are then ingested by fish. The substance accumulates in the tissues of fish, and as larger fish eat smaller ones, bioaccumulation and biomagnification concentrate the methylmercury up the food chain.

Birds and animals that eat fish are more exposed to mercury than other animals in the water ecosystems. Similarly, animals that eat fish-eating animals will also be exposed. Ecologically, wildlife exposed to high levels of methylmercury experience reduced fertility, slower growth and development, abnormal behavior that affects survival, and death.

Human Health Risks. Can mercury cause harm to human health? Ask Mr. Jeremy Piven, a well-known actor who was forced last year to give up an important acting role due to mercury poisoning. According to his doctor, it was probably caused by a diet high in fish and Chinese herbal remedies. The consumption of contaminated fish and shellfish is the main source of methlymercury poisoning in humans. Fish is an important part of a healthful diet because it is a low-fat, reduced-calorie source of protein. Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. The greatest danger is for women of childbearing age, pregnant women, nursing mothers, and young children. The exposure of unborn and young children can harm the developing nervous system; has been linked to developmental disorders, learning disabilities, and cardiac dysfunction; and has been indicated as a possible link to autism. Based on human biological monitoring conducted by the Center for Disease Control and Prevention in 1999 and 2000, most people have blood mercury levels below the 5.8 micrograms per liter of whole blood which is associated with possible health effects. It was found that increased consumption of larger predatory fish, which contain higher levels of mercury contamination, causes higher levels of methylmercury in the bloodstream.

This information was used to develop the reference dose (RfD)—0.1 microgram per kilogram of body weight per day—used to determine acceptable exposure limits for women of childbearing years and those who are pregnant or nursing. In USEPA's 1997 Mercury Study Report to Congress, it was estimated that approximately 7 percent of women of childbearing age had a blood mercury level higher than the RfD. Blood mercury analyses completed from 1999 to 2000 during the National Health and Nutrition Examination Survey for women from 16 to 49 years of age showed that approximately 8 percent of women had levels higher than 5.8 micrograms per liter. Based on this information, it was estimated that more than 300,000 newborns were at risk due to *in utero* exposure to methlymercury.

Not all fish are contaminated with dangerous levels of mercury. In 2004, USEPA and the United States Food and Drug Administration (USFDA) issued the first fish consumption advisory to help guide consumers. It stated that there are health benefits from eating fish and shellfish low in mercury, such as shrimp, canned light tuna, salmon, pollock, and catfish. It also advised avoiding fish that are known to be contaminated at higher levels, such as shark, swordfish, tilefish, and king mackerel. USEPA also hosts a web-based compilation of fish advisories issued by states, tribes, territories, and local governments. USFDA provides several resources to assist consumers, such as <*www.FoodSafety.gov*> and 1-888-SAFEFOOD.

Although CFLs contain low levels of mercury, placing them in landfills just increases the amounts already being added from other sources, such as batteries, electrical switches, thermometers, and thermostats. Industrial, commercial, and federal/military facilities within the United States are required by law to properly handle and dispose of old fluorescent lights (generally black- or silver-tipped tubes) as hazardous waste, or accumulate and recycle them under the Universal Waste Rules because they contain mercury at a highly toxic level. With the introduction of the low-mercury fluorescent lights, those facilities also are throwing fluorescent lights in the garbage. Since mercury is a persistent substance with a cumulative effect, levels increase dramatically based solely on numbers. Elemental mercury vaporizes very easily, so it may be entering the atmosphere from broken mercury-containing items in landfills. Landfills are designed to reduce waste by adding anaerobic bacteria to increase the rate of decomposition. This suggests the possibility that inorganic mercury could also be converted to methylmercury in the landfill. If the landfill is not properly constructed, the different forms of mercury could leach into the soil, contaminate the groundwater, and make their way to water ecosystems.

CFLs vs. Incandescents

So is it better to use CFLs containing mercury or continue to use incandescent lights and avoid the possibility of increasing the level of mercury contamination that already exists? A CFL contains approximately 5 milligrams of mercury, an amount that would cover the tip of a ballpoint pen. It would take about 100 CFLs to equal the amount of mercury in an old thermometer. As stated earlier, burning coal to produce electricity is one of the contributing factors to mercury contamination and one of the benefits for using CFLs is a reduction in energy use. A 60-watt-equivalent CFL uses 13 to 15 watts of energy, a 75-watt-equivalent uses 18 to 25 watts, and a 100-watt-equivalent uses 23 to 30 watts. CFLs also last much longer and generate less heat, which can mean additional savings. It is estimated that if every American switched one incandescent light to a CFL, it would save more than $600 million in annual energy costs and reduce mercury emissions from burning coal.

The fact that CFLs use about 75 percent less energy is the biggest reason to support their use in contingency operations. Generators are the main source of energy for bases where grid power is not available, and generators require a fuel source to operate—normally diesel fuel or

JP-8. Some of the benefits of reduced energy use include—

- Cost savings from reduction of fuel for generators.
- Reduction of wear and tear on equipment.
- Reduction in man-hours to tend generators.
- Reduction of fuel used to bring in necessary resources from other locations.
- Reduction of man-hours required for transportation.
- Reduction in the exposure of our Soldiers to hazardous movement through enemy territory while transporting combustible materials.

Since CFLs last longer, fewer replacement lights must be purchased and stored.

The benefits must be weighed against the problems of managing CFLs once they are expended. Many countries where the U.S. military operates do not have environmental laws to provide guidance for the handling of hazardous waste. In those circumstances, as good environmental stewards, following U.S. regulations as closely as possible in each situation is a best management practice for the health and well-being of our Soldiers and the surrounding community and will save environmental cleanup money before redeployment.

A number of commercial establishments offer free CFL collection and recycling programs. If none are available in your area, request that the local waste hauler offer the service. Local municipalities may collect CFLs or have periodic collections. Utility companies in some states sponsor collection and recycling programs, and many household hazardous waste-collection centers accept CFLs. A list of these centers can be viewed at <*www.epa.gov/bulbrecycling*>. Sylvania <*http://www.sylvania.com/Recycle/CFLandHouseholdlightBulbrecycling/*> and <*http://www.lightbulbrecycling.com*> sell recycling kits of various sizes that come with prepaid return labels so they can be returned once they are full. Users on military installations should contact the facility recycling center for assistance. If there is no CFL recycling program in place for CFLs generated in the residential areas or for military/federal civilian personnel living off post, call the Installation Management Officer and request that one be started. Army bases are required by both federal and state laws—and Army regulations—to properly manage fluorescent lights. For this reason, there should be a program already in place that could be expanded to assist military/federal civilian personnel. These entities in the United States are also required to complete due diligence investigations on the waste haulers and disposal companies they use to dispose of or recycle hazardous waste to ensure compliance with all environmental laws.

The benefits of using CFLs in contingency operations must be weighed against the issues that arise with proper handling and disposal or recycling. Studies in Iraq and Afghanistan have shown that there are many issues that must be overcome or circumvented for the proper handling and disposal of hazardous waste. The lack of environmental laws, guidance, and recycling operations is the first. The fact that many countries surrounding the area of operations do not want hazardous waste transported through their territories to reach a place of export creates problems and increases the disposal costs. It is imperative that contractors be required to comply with sound environmental practices, that these practices be explicitly enumerated, and that due diligence be built into the contracts for vendors who will be handling hazardous waste. It is also imperative that follow-up, strict enforcement, and penalties be implemented to ensure that hazardous waste is handled according to the contracts. Containers such as those provided by Sylvania can temporarily store CFLs safely and may provide a disposal option through the U.S. Postal Service even during contingency operations.

For more information about mercury, CFLs, and the Universal Waste Rules, go to <*http://www.epa.gov*>. For information about cleaning up a broken CFL or mercury spill, go to <*http://www.epa.gov/mercury/spills/index.htm*>.

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