Office of Environment, Health, Safety and Security
Operating Experience Level 3

OE-3: 2025-03 **October 2025**

Fire Hazard When Using LED Bulbs in Fluorescent Light Fixtures

PURPOSE

This Operating Experience Level 3 (OE-3) document is to alert the Department of Energy (DOE) Enterprise of the potential fire risk associated with fluorescent light fixtures equipped with incompatible light emitting diode (LED) bulbs and to recommend inspection, mitigation, and eventual risk-prioritized replacement for fixtures that show evidence of overheating. Industry and DOE operating experience provides evidence that, over time, fluorescent lighting fixtures with magnetic ballasts may have been retrofit with LED tubes that introduced a risk of generating excess heat and potential fire. Risk-informed inspection and replacement of these incompatible light fixtures is recommended to reduce the fire hazard at DOE nuclear and non-nuclear facilities.

BACKGROUND

Traditional fluorescent lighting contains an internal fluorescent ballast which is typically magnetic, although some are electronic. This ballast is designed to maintain a high potential to supply the large surge current that fluorescent light tubes require to operate without causing significant fluctuations in the overall lighting circuit. The ballasts therefore remain energized even when the light is in the "off" position enabling them to be provide a start-up current at any time. This continuous power causes the ballast to be at high temperature even when the fixture is "off", often at temperatures of 150 °F.

Although fluorescent ballasts were designed to endure these conditions, fire and electrical risks still existed due to the high operational currents, continuous voltage when de-energized, and the excessive heat they generate.

As technology advanced, safer lighting fixture options emerged, leading to the discontinuation[1] of magnetic ballasts, which are no longer allowed to be manufactured[2] in the United States.

The fluorescent lights originally paired with the magnetic ballasts had hazards and efficiency issues, leading to their replacement by LED technology. LEDs are cheaper to produce, use less energy, cost less to operate, do not contain the heavy metals found in fluorescent mediums, and provide a better range of luminosity than traditional fluorescent light tubes. Retrofitting fluorescent lighting to LED tubes often left many of the existing fluorescent ballasts intact and energized within the lighting circuit, subjecting the LED tubes to the subsequent high temperature conditions and current levels beyond their specifications. Industry operating experience has found LED tubes on average start to deform at ~125 °F. Fire can start at as low as ~140 °F while fluorescent ballast temperatures routinely exceed both of those temperatures. Using LED tubes outside of their operational specifications while exposed to high temperature ballasts presents a fire hazard.

OPERATIONAL HISTORY

A query conducted by the NNSA Office of Environment, Safety and Health (NA-ESH) of the DOE Fire Protection Reporting System Database for calendar years (CY) 2020 – 2024 noted twenty incidents of retrofitted light fixture failures due to

[1] The Energy Policy Act of 2005 led to the 2010 phase-out of magnetic ballasts used to light various fluorescent lamps. See article link HERE.

[2] In 1998 and 1992, two significant laws were passed that banned manufacture and distribution of magnetic ballasts and certain fluorescent lamps. See article link HERE.

smoking, burning, and fires from light fixtures falling into workspaces. A similar query of from CY 2020 – CY 2024 of DOE OPEXShare and Occurrence Reporting and Processing System (ORPS) both reported four light fixture failures each due to smoking and fires. A recent event was reported by Los Alamos National Laboratory (LANL) and described in the informative Lesson Learned article published in DOE OPEXShare: Fire Incident Caused by LED Lighting Fixture Failure. As a result of their investigation and extent of condition review, LANL identified over 1000 fixtures of varying complexity currently targeted for replacement. There are likely similar numbers of incompatible fluorescent ballast fixtures equipped with LED lights in operation across the DOE Enterprise, all posing fire risk to every category of DOE operations.

Within Industry, the hazards represented by an imprecise retrofit of fluorescent lighting fixtures to LED are well known. Though not specifically tracked in the data, one insurance carrier[3] noted 34 separate incidents of fire from retrofitted fluorescent light fixtures over a 4-year period with an average cost of ~$100,000 per incident. British Columbia, Canada had multiple incidents in a single week which prompted a country-wide safety alert to be issued in 2019[4].

RECOMMENDATIONS

Step 1: Inspection and Documentation
DOE facilities should inspect all lighting containing fluorescent ballasts or located near fluorescent ballasts for visible changes, unexpected sounds (e.g., ticking, vibration, buzzing), or smells (e.g., melting plastic, ozone) that indicate evidence of overheating, burning, charring, or deformation.

- For legacy fluorescent lighting fixtures, visual inspection is adequate to identify any fire hazards that need to be addressed.
- For retrofitted LEDs with fluorescent ballasts, internal inspections are also warranted.
  - LEDs start to develop internal problems and deformation at ~125 °F. Therefore, an acute temperature meter should be used to assess for non-visible damage that may require priority replacement.

Problem fixtures may exhibit the following issues:

- Overheated ballast, evidenced by smoke, odor, or discoloration
- Light output reduction
- Unstable light output, flickers or blinks
- Lamp blackening at one end of the tube

Results should be documented in a report listing the quantity, location, and signs of failure observed to facilitate the prioritized replacement of such light fixtures and to track the actions to completion.

Step 2: Place in Safe Condition
DOE facilities that identify problematic fixtures during inspection should disconnect those fixtures from live electrical power, without eliminating complete illumination of affected area, label as damaged equipment, and remove from operation.

Step 3: Risk-Prioritized Abatement
DOE facilities should implement a prioritized plan for the abatement (replacement or mitigation) of all lighting fixtures where fluorescent ballasts are present. Priority level is based on the risk associated with the location of the light as well as the amount of damage identified during inspection.

It is essential to plan for the eventual replacement of all LED lights that use incompatible ballasts, treating them as potentially damaged equipment. Damage to LEDs can be internal and non-visible. Relying solely on inspections for visible damage is inadequate for fully assessing the fire hazard risk.

A reference guide to this OE-3 is included as the Attachment*: Risk-Prioritized Abatement Options Tool* and provides pros and cons to consider when a DOE facility is developing a risk-prioritized abatement plan.

SUMMARY

All LED lights using incompatible ballasts pose a fire risk to DOE facilities, their operations, and their workers. An inspection plan should be established at each DOE site to find incompatible ballasts and design an acceptable path forward to have ballasts of unacceptable risk replaced or appropriately mitigated.

[3] Property Risk Consulting Guidelines: Fluorescent Lighting, AXA XL Risk Consulting PRC.5.11.1.

[4] *Electrical Fires Caused by Fluorescent Luminaires Retrofit with LED Tubes*, Technical Safety BC, April 3, 2019.

ONLINE INFORMATION RESOURCES

Can LED Lights Cause a Fire? Understanding the Risks and Safety Measures, Fire Risk Assessment

Fluorescent Light Ballast Hazards, Fire Engineering, September 2002.

DOE OPEXShare, *Fire Incident Caused by LED Lighting Fixture Failure*, Los Alamos National Laboratory, May 2025

VIDEO: Fluorescent Light Ballasts, Edison Tech Center, 9:05 minutes

DOE REFERENCES AND GUIDANCE

DOE O 231.1B, *Environment, Safety and Health Reporting* [Requires organizations to report fire-related incidents and data]

DOE O 420.1C, *Facility Safety*

DOE-STD-1066-2023, *Fire Protection*

DOE-HDBK-1092-2013, *Electrical Safety*

This OE-3 document requires no follow-up report or written response.

LARRY PERKINS

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FOR MORE INFORMATION

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Operating Experience Level 3 (OE-3) Documents are operating experience-based articles published by the Office of Environment, Health, Safety, and Security (EHSS) and distributed across the DOE complex through the DOE Corporate Operating Experience Program to **highlight important issues with recommendations for follow-up**. OE-3s inform senior headquarters and field management when an operational trend or event warrants attention and potential action.

OE-3: 2025-03 ATTACHMENT

RISK-PRIORITIZED ABATEMENT - OPTIONS TOOL

This reference guide to OE-3: 2025-03 provides pros and cons to consider when a DOE facility is developing a risk-prioritized abatement plan.

The guidelines below provide points to consider when choosing to **replace** or **mitigate** problematic ballasts. They do not encompass every option available but can be used to inform management planning and decision-making.

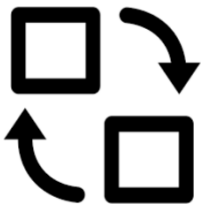
Replacement:

- LED electronic ballast with a compatible fixture:

  Pros: Simple installation utilizing existing wiring, requiring no retrofit
  Cons: more expensive, may leave additional wiring installed, which can become a hazard as it ages.

- Non-ballast, direct line LED with ballast bypass:

  Pros: eliminates the ballast, reducing maintenance and hazards, draws less current
  Cons: higher voltage in sockets, precise installation required to prevent additional hazards, increased variability in product (due to differing wiring and specifications), potential socket incompatibility; with some products, the ballast may still be present and potentially energized.



Mitigation:

- Ballast bypass – direct line tap:

  Pros: No need to remove equipment or wiring, resulting in less initial cost
  Cons: potentially electrified equipment may remain in place and continue heating the space, legacy equipment takes up future workspace and needs to be checked periodically to ensure additional hazards are not created.

- Full Removal:

  Pros: opens space for safer electrical work, easier installation
  Cons: disposal may involve heavy metals

- Fully de-energize and demolish/abandon in place:

  Pros: no need to remove equipment or wiring, less initial cost, don't have to dispose of potentially toxic materials.
  Cons: Legacy materials take up space making future electrical work more difficult in tighter areas, any toxic materials left in place should be tracked for future disposal.

- Lighting circuit adjustment - rewire to de-energize ballasts when in the "off" position and create smaller zones of operation. This will not eliminate the hazard but may increase the likelihood of worker presence when an event occurs:

  Pros: no need to replace lights, smaller initial cost, and workers are likely to notice the problem before it escalates
  Cons: this solution does not provide a permanent fix and fails to address the issue of lights being left "on"