R-CFL Technology Procurement – Phase 1

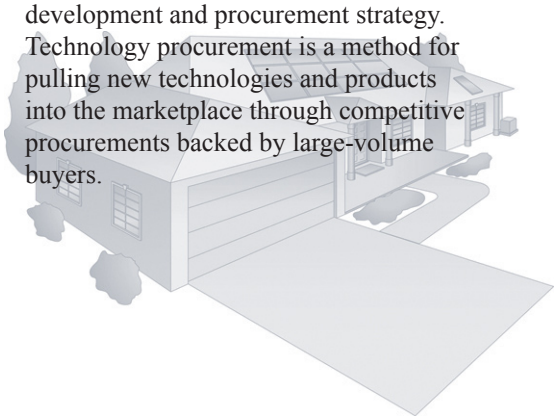
Background

Recessed "cans" downlights are among today's most popular lighting fixtures with an estimated 400 million installed in U.S. homes. The vast majority of these fixtures are fitted with incandescent reflector lamps (R-lamps) typically drawing 65 to 100 watts of power per lamp. An estimated 120 to 140 million R-lamps are sold in the United States each year. Roughly half of these are for residential use.

Many incandescent R-lamps could be replaced with reflector compact fluorescent lamps (R-CFLs) that produce similar light levels while using as little as 1/3 the energy. While CFLs are gaining in popularity, there have been concerns about the performance and longevity of R-CFLs when used in recessed downlight fixtures in insulated ceilings with airtight housings (ICAT). Operating temperatures increase dramatically, which directly impacts light output and can reduce lamp life when R-CFLs are installed in ICAT cans.

Program Overview

This effort, sponsored by the U.S. Department of Energy (DOE) and the Northwest Energy Efficiency Alliance (Alliance) and implemented by the Pacific Northwest National Laboratory, aims to improve the performance of screw-based R-CFLs and increase their availability in the Northwest and throughout the United States by means of a technology development and procurement strategy. Technology procurement is a method for pulling new technologies and products into the marketplace through competitive procurements backed by large-volume buyers.



RFP Development and Proposal Review

After several months of industry involvement and feedback on draft minimum technical specifications, DOE issued a request for proposals for R-CFLs intended for use in ICAT recessed can fixtures in 2002. Five manufacturers responded with proposals for 12 R-CFL models.

DOE evaluated each model for compliance with the minimum specifications, including maximum operating temperature, overall lamp length, beam angle, and minimum light output. DOE also conducted short-term tests (6 hours of operation in a simulated ICAT) to see if the models operated within the manufacturer's rated maximum temperature. Short-term tests verified a number of the manufacturer claims, and long-term testing was initiated on the eight models that met the minimum specifications.

Initial Research

DOE investigated reflector lamps to determine market potential and to see what limitations existed in the currently available R-CFL stock. In 2002, DOE completed market and technical research on R-lamps.

Key findings include the following:

- The potential market for R-CFLs was large.
- Existing R-CFLs were not widely available via traditional consumer distribution channels.
- R-CFLs were hard to find and expensive, as much as $15 per lamp.

Performance drawbacks of existing R-CFLs included the following:

- Lamps did not fit well in fixtures designed for R-lamps – they were too long.
- Total light output was often significantly less than their incandescent counterparts.
- Light beams were often too diffuse.
- Very few models were ENERGY STAR® compliant, and those that were had questionable performance in high-heat environments.

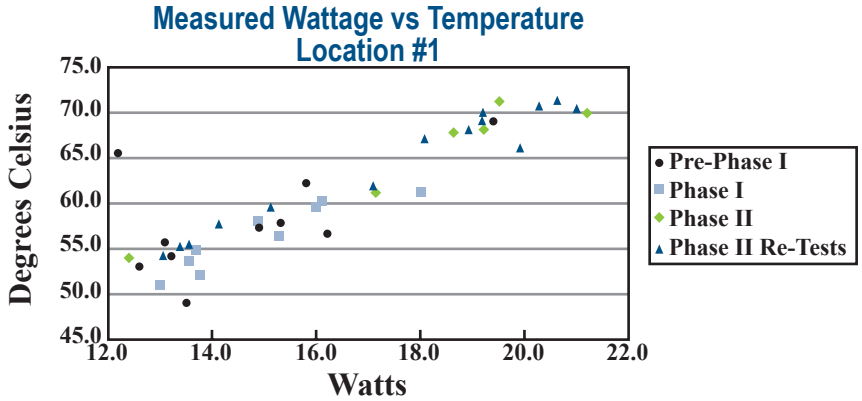


Figure 1: A sample of 10 R-CFLs tested by DOE in a simulated ICAT fixture showed that most operated above the manufacturer's maximum operating temperature of 50°C.

Elevated Temperature Life Testing

The eight R-CFLs that moved into elevated temperature life testing (ETLT) were subjected to a minimum of 6,000 hours of operation in a simulated ICAT environment (laboratory testing). 6,000 hours is a minimum requirement for both this program and ENERGY STAR. Models with rated life claims beyond 6,000 hours were required to continue testing until that claim was met.

Ten lamps of each model were tested. The testing apparatus operated the lamps in an automated cycle of 3 hours on, 20 minutes off, for the test duration. Lamps of 16 watts or less were tested at an ambient temperature of 55°C, while lamps over 16 watts were tested at 60°C (140°F). DOE measured light intensity for each lamp every 2 weeks throughout the long-term testing process to evaluate lumen depreciation over time.

Phase 1 Winners

In 2004, two of the 10 lamp models submitted to the R-CFL Technology Procurement Project (Phase 1) successfully completed over 6,000 hours of elevated temperature life testing and were deemed "winners." The SLS/ R40 20-watt and the EL/A BR30 16-watt Reflector Flood, are part of the Philips® Marathon™ line and are available through The Home Depot Supply Inc. (the commercial subsidiary of The Home Depot) and other channels. In 2005, a third lamp, Feit Model ESL15R30H, became available at Costco wholesale stores nationwide. Look for Conserv-Energy Item #BPCE15R30H/4. See **www.pnl.gov/rlamps** for more information on how to purchase these lamps.

The other six models failed before 6,000 hours (see Table 1). A failure is defined as 6 or more of the 10 lamps sampled failing before they had operated for 100% of their rated life. DOE is evaluating the causes of the lamp failures.

Key Dates

July 25, 2003:
Initial lamp selections made.
September 9, 2003:
Long-term testing initiated on eight models.
June 17, 2004:
Long-term testing (at 6,000 hours rated life) completed. Winning models announced.
July 9, 2004:
"Winning" models available at **www.pnl.gov/rlamps.**

Current Status

The winning R-CFL lamp models will continue to be promoted by DOE and its partners. Additional information on this project and the winning lamp models, as well as an order form to purchase the lamps, can be found at **www.pnl.gov/rlamps.**

DOE is conducting an evaluation into the causes of the lamp failures and will share this information (without identifying manufacturer names) with industry and program partners.

DOE intends to initiate a second phase of this project early in 2005, aimed at bringing additional compliant R-CFLs into the market.

Table 1. Elevated Temperature Life Testing Results - Phase 1

Manufacturer ID	Model ID	# Failed (of 10)	Calculated "Rated Life" (Hours)
A	4A	10	2376
A	4B	9	1075
A	5A	7	3466
B	8A	8	4520
B	9A	10	2595
B	10A	10	2793
Philips	EL/A BR30 16-W	3	10,000 [a]
Philips	SLS/R40 20-W	2	10,000 [a]
Feit	ESL 15R30H	0	8,000 [b]

[a] Testing terminated at 10,000 hours. [b] Testing terminated at 8,000 hours.

For Program Information on the Web:
http://www.eere.buildings.gov

For Program and Product Information on the Web:
www.eren.doe.gov/buildings/emergingtech

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Reflector CFL Website:
www.pnl.gov/rlamps

NORTHWEST ENERGY EFFICIENCY ALLIANCE

The Northwest Energy Efficiency Alliance is a non-profit group of electric utilities, state governments, public interest groups and industry representatives committed to bringing affordable, energy-efficient products and services to the marketplace.

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Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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