

LONG-DAY LIGHTING (LDL) IN DAIRY BARNS
Field Days, East Bristol, WI
December 4-5, 2001
(revised, Feb 7, 2002)

Gunnar Josefsson

Healthy Farmers, Healthy Profits Research Project
Biological Systems Engineering
University of Wisconsin-Madison

The field days were carried out in collaboration between the Healthy Farmers, Healthy Profits project and UW Extension in Dane, Dodge/Columbia and Jefferson counties.

Tuesday, Dec 4 was the Ag Professionals' Field Day
Wednesday, Dec 5, was the Dairy Producers' Field Day

Presenters and resource persons:

Gunnar Josefsson, Healthy Farmers, Healthy Profits project, Un. of Wisconsin-Madison
Nolan Andersen, UWEX, Dane county
Bob Kaiser, UWEX, Dodge/Columbia county
Ken Bolton, UWEX, Jefferson county
Mr. Jim Drunasky, James Electric
Al Eissens, This AJE Ag Lighting Equipment Co.
Tim Grygera, Sales manager, Ruud Lighting
Tom Miller, R&G Miller and Sons

Professional assistance and collaboration during the preceding field research at the Miller farm was provided by:

Ruud Lighting
Retrolite Corporation
Mr. Al Eissens
Mr. Jim Drunasky
Professor Geoff Dahl, University of Illinois at Urbana-Champaign

Financial assistance for arrangements during the field days was provided by
Alliant Energy

Contact information

Gunnar Josefsson, Assistant Scientist
Biological Systems Engineering
University of Wisconsin-Madison
460 Henry Mall
Madison, WI 53706
Ph: 608-262-7408
e-mail: kgjosefs@facstaff.wisc.edu

CONTENTS

Field day and contact information (inside front cover)

1. LDL RESEARCH & COST-EFFECTIVENESS of LDL (p. 1-6)

- 1.1 Previous LDL research
- 1.2 Research design – this farm
- 1.3 Research results – this farm
- 1.4 Investing in new barn lights used for long-Day Lighting.

2. LIGHT REQUIRED AND ACHIEVED (p. 7-9)

- 2.1 How much light do you have?
- 2.2 How much light do we need?
- 2.3 Lighting terms
- 2.4 Old barn lights & bids for new lights
- 2.5 New lights installed
- 2.6 Light levels do change

3. LAMPS & FIXTURES (p. 10-12)

- 3.1 Lamps for barn lighting
- 3.2 Light choices – stall barns
- 3.3 Light choices – freestall barns

4. ELECTRICAL INSTALLATION (p. 13)

- 4.1 Re-wiring?
- 4.2 Play it safe!
- 4.3 Controlling the barn lights

5. BREAKING NEWS (p. 14-15)

- 5.1 Do cows respond to LDL into their next lactation?
- 5.2 Do we have to clean the barn lights?
- 5.3 Should we have red light in the barn?

Section 1 : LDL RESEARCH & COST-EFFECTIVENESS

1.1 Previous LDL Research

- Milk production: ++ 5-15%. Estimates often assume ++ 8%
- Milk fat %: Mostly no change. Some times marginal decrease
- Feed intake (DMI): Increase, often 4-6%
- Fertility: No change
- Hair coat: Decrease in winter hair coat
- Feed conversion, growth rate, and udder gland development for replacement heifers: more research needed and expected

1.2 Research Design - This Farm

- **Old barn:**
 - + No LDL
 - + “Low” and “Mid” group cows
- 2 **Newer barn:**
 - + LDL since Nov 2, 2000
 - + “Hfrs” and “Hi” group cows
- 6. **Feeding during trial (Nov-Dec, 2000)**
 - + Forage part of TMR same, all cows
 - + No changes in ration
- **NOT a fully controlled scientific study.** Best comparison under farm conditions.
- **Weekly milk weights** (8 weeks after start of LDL)
- **Cows included in study (LDL barn):**
 - Present in barn from day 1
 - Remained in barn: LDL for entire test period (8 weeks)
 - 7 or more weekly milk weights recorded (out of 8 possible)

1.3 Research Results - This Farm

Over-all milk production response to Long-Day Lighting (LDL)

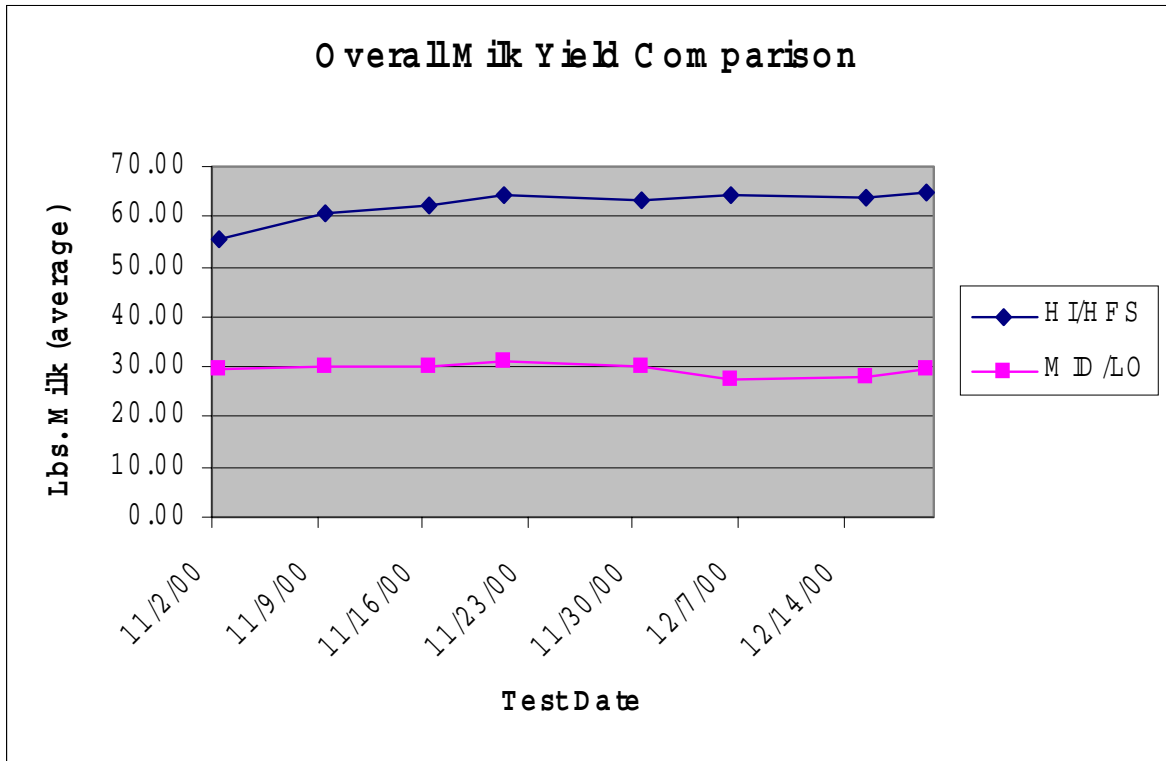
As is shown in table 1 below, there was a very clear increase in milk production among cows in the new barn during the weeks following the start of LDL. From week 1 to week 8, cows in the “LDL barn” gradually increased their production by 9 lbs./day (an increase

of 17%). During the same time, there was virtually no change in milk production among the cows in the older barn where LDL was not in use (an increase of only 1 %).

Table 1. Milk weights recorded during 8 week long trial period (lbs./cow/day)

Barn (Prod. Groups)	No of cows	Week 1 11/2/00	Week 2 11/9/00	Week 3 11/16/00	Week 4 11/23/00	Week 5 11/30/00	Week 6 12/7/00	Week 7 12/14/00	Week 8 12/19/00	Increase from week 1 to week 8
New barn with LDL (Hi&Hfs)	184	55.4	60.5	62.4	64.4	63.3	64.2	63.9	64.6	9.2
Old barn, w/o LDL (Mid&Lo)	50	29.4	30.0	29.8	31.1	29.9	27.5	28.1	29.7	0.3

When graphing these (below), we can see that the timing of the production increase in the new barn closely matches the start of the LDL management practice in that barn. Most of the increase took place during the first three weeks.



However, since cows routinely enter the “LDL barn” after freshening, the increase may be related to an increased proportion of fresh, high producing cows in the “LDL barn”. This is a valid criticism because we do not know if there was such a change. In order to study the production response more closely, we decided to analyze the response among cows at different stages in their lactation.

Lactation Stage response to LDL

We calculated for each cow her number of days in milk (DIM) on day 1 of our experiment and used this number to divide the cows into three categories:

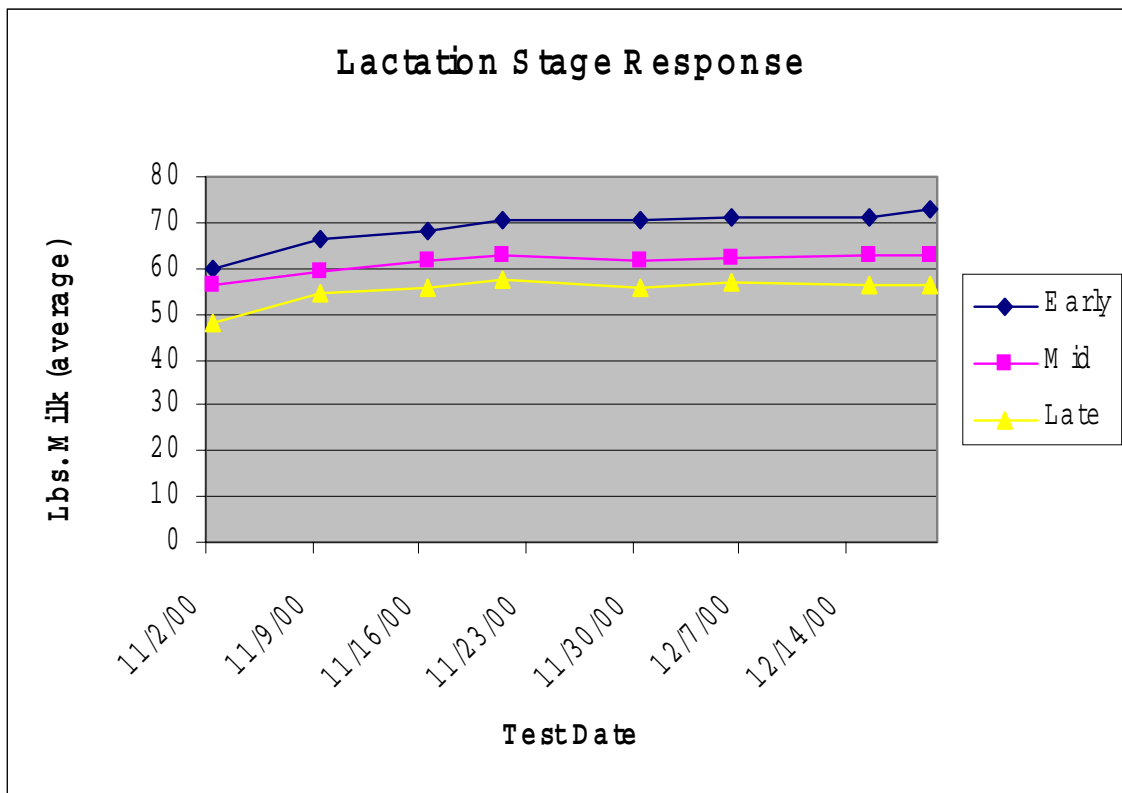
- Early lactation: 100 or fewer days in milk (DIM) on test day 1
- Mid-lactation: 101-200 days in milk (DIM) on test day 1
- Late lactation: 201 or more days in milk (DIM) on test day 1

The yield results according to this grouping are summarized below.

Table 2. Milk production response to Long-Day Lighting by lactation stage

Lactation stage and No Cows	Week 1 (Start) Lbs. Milk/day	Week 8 (End) Lbs. Milk/day	Increase from start to end of 8 week test period Lbs. Milk/cow/day (%)
Early Lactation (1-100 DIM) 65 cows	59.9	73.0	13.1 lbs. (+ 22%)
Mid Lactation (101-200 DIM) 70 cows	56.4	62.9	6.5 lbs. (+ 12%)
Late lactation (201+ DIM) 48 cows	47.9	56.2	8.3 lbs. (+ 17%)

The results, presented in the form of a graph (below) demonstrated there was a gradual milk production increase over the trial period among cows in all three lactation stages.



When analyzing these findings, we concentrate on the response among mid and late lactation cows. These cows are at or past their production peak. The considerable increase in production among these cows (12-17%) with a timing that corresponds to their being exposed to the LDL treatment is a strong indication that there is a genuine production response to the LDL treatment. Using previous research as a frame of reference, the present production response (12-17%) is among the higher responses recorded in published studies. We need to emphasize the fact that we in this trial did not use a control group, so we are unable to exclude other factors which might have contributed to the production increase. For the purpose of estimating the cost effectiveness of the investment in this new barn lighting system (on the following pages), we will assume a more modest production increase of 8%. This level reflects the average production increases achieved in previously published studies on photo period control (long-Day Lighting) with dairy cattle.

1.4 Investing in new barn lights used for Long-Day Lighting

Example for 200 milking cow herd, 60 lb/day average

In the following, alternative calculations are made for two design alternatives (option 1 and 2). The actual installation was a combination of these two, as explained under “Station 2”, below. Without experimental considerations (to demonstrate and compare two different fixtures), the farmer would have chosen option 2, due to lower investment costs, and no clear functional differences between the two options.

Milk revenue (8% increased production)

- $200 \times 60 \times 0.08 = 960$ lbs/day increase in milk production
- 960 lbs valued @ \$10 per 100 weight = **\$96** increased milk revenue per day

Operating costs - feed

- Expected increase in DMI is 6%
- Average feed cost per cow per day assumed to be \$3.00
- Additional feed cost = 200 cows x \$3.00 x 0.06 = **\$36/day**

Operating costs – electricity

Option 1: 18 metal halide 320W (two rows near feed alley) **and 20 metal halide 100W** (on side walls)

- 320W fixture: total system (include. ballast) is 368W. With 18 fixtures, the total load is $18 \times 368W = 6624W = 6.624$ kW
- 100W wallpack fixture: total system is 127W. With 20 fixtures, the total load is $20 \times 127W = 2540W = 2.54$ kW
- Grand total load for this option = $6.62 + 2.54$ kW = **9.16 kW**

Option 2: 18 metal halide 320W (two rows near feed alley) **and 22 fluorescent 2-lamp, 4’ fixtures 100W high light output lamp T8 32W** (near side walls)

- 320W fixture: total system (include. ballast) is 368W. With 18 fixtures, the total load is $18 \times 368W = 6624W = 6.624$ kW
- Fluorescent fixtures: total load is 78W per fixture. With 22 fixtures, the load = $22 \times 78W = 1716W = 1.72$ kW
- Grand total load for this option = $6.62 + 1.72$ kW = **8.34 kW**

Operating time

- Daily operation: 5:00 – 8:00 am = 3.0 hrs and 4:30-10:00 pm = 5.5 hrs. Total = 8.5 hrs/day.

Energy cost

Chastain and Hiatt (1998) use a price of \$0.10/kWh. We add 20%, assuming a price of \$0.12/kWh.

Calculating the daily electrical operation cost:

Option 1: $9.16\text{kW} \times 8.5 \text{ hr} \times \$0.12/\text{kWh} = 77.86 \text{ kWh} \times \$0.12 = \mathbf{\$9.34}$

Option 2: $8.34\text{kW} \times 8.5 \text{ hr} \times \$0.12/\text{kWh} = 70.89 \text{ kWh} \times \$0.12 = \mathbf{\$8.51}$

Net daily income over operational cost

Option 1:

$\$96.00 - (\$36 + \$9.34) = \$96.00 - \$45.34 = \mathbf{\$50.66}$

Option 2:

$\$96.00 - (\$36 + \$8.51) = \$96.00 - \$44.51 = \mathbf{\$51.49}$

Investment cost

Option 1:

$\$6,450 \text{ fixtures cost} + \$3,660 \text{ installation} = \mathbf{\$10,110}$

Option 2:

$\$4,665 \text{ fixtures cost} + \$3,660 \text{ installation} = \mathbf{\$8,325}$

Pay-Back Time

Option 1:

$\$10,110 \text{ divided by } \$50.66/\text{day net income} = 199.6 \rightarrow 200 \text{ days} = \mathbf{6.7 \text{ months}}$

Option 2:

$\$8,325 \text{ divided by } \$51.49/\text{day net income} = 161.7 \rightarrow 162 \text{ days} = \mathbf{5.4 \text{ months}}$

Longer Term Profitability

The investment is paid back in full after about 6 months. From here on, the only cash expense is lamp replacements. The expected lamp life is declared by the manufacturers to be about 24,000 hrs for the fluorescent as well as the metal halide lamps. With a daily use time of 8.5 hrs, lamps theoretically need to be replaced only about every 2,824 days = every 7-8 years.

Excluding the re-lamping cost, we can estimate the net profit after the cost of the light system is paid back. The net income over operational costs was estimated at \$50.66/day and \$51.49/day for light systems option 1 and 2 respectively. This generates a **net profit of between \$18,491 and \$18,794 per year** in a herd milking about 200 cows.

NOTES ON COST EFFECTIVENESS OF LDL

The above calculations assume cows are housed in a barn with proper LDL during their entire lactation, and housed separately (away from LDL) during their dry period. If cows are exposed to LDL continuously, the stimulation to produce more milk is likely to wear off (“refractoriness”). It is uncertain whether there will be any yield increase at all during following lactations, if the cows are not provided a “break” from the LDL treatment. Emerging research hints that the initial yield increase (when LDL starts) may decline gradually, leaving a much smaller yield advantage for the LDL treatment during the latter part of the lactation or LDL treatment period. We conclude:

1. To achieve the cost effectiveness estimated above, systematic management to break refractoriness needs to be in place (see section 5: “Breaking news”).
2. The above economic estimates may need to be adjusted downwards, if the LDL yield advantage does not last a full lactation. However, even if the LDL yield advantage were to last only 6-7 months out of a year (or lactation) – LDL remains a very cost-effective investment. You may want to revise the above calculations, using your own data, and assuming LDL works only 6-7 months per year.

Section 2: LIGHT REQUIRED & ACHIEVED

2.1 HOW MUCH LIGHT DO YOU HAVE?

- **Can you judge it?**
- **Measuring yourself?**
 - + After full dark at night
 - + Beware of shadows
 - + Measure all areas, many spots
 - + At cows' eye level
 - + Buy a light meter: \$ 50-150
- **Use a helper with a light meter?**
- **Tell your contractor, measure before you pay?**

2.2 HOW MUCH LIGHT DO WE NEED?

- **Cows: 15 FC+ average** (all cow activity zones; feed, rest, drink, loaf, being milked)
- **Workers:**
 - + 20-25 FC average, feed alley
 - + 40+ FC for detailed work (treat animals, milk in parlor)

2.3 LIGHTING TERMS?

Ballast: Provides correct electricity, drives the lamp.

- Electronic, cold start “0F” or “-20F”
- Draws energy even with a burnt-out lamp or no lamp

Color temperature: Warm, neutral, cool. Measured in Kelvin

Color rendition index (CRI): Indicates the “whiteness” of the light. Incandescent has CRI around 99

Footcandle (FC): Measure of light intensity on the surface illuminated.

- One FC = one wax candle, one square foot, one foot away

Lumen: The raw power of the lamp. You need this number to estimate how many fixtures to install in the barn. Each fixture is rated by the mfr for total lumens produced. Look for the “average lumens” (not “initial lumens”) when estimating how many fixtures are needed.

Luminaire: A complete lighting unit (fixture, lamp and all).

Lux: The “metric footcandle”. 1 lux = 10.76 FC and 1 FC = 0.0929 Lux

Reflector: The parts of the fixture designed to reflect the light downwards (surfaces above, and to the sides of the lamp).

Refractor: Bottom cover of enclosed fixture. Functions as a lens, dispersing the light.

Work plane: The height at which you use the light, when working. Usually considered to be 2-3 feet above floor.

2.4 OLD BARN LIGHTS & BIDS FOR NEW LIGHTS

Old System:

Five mercury vapor light fixtures, 175W

The light levels measured before installing the new lights were:

- Feed alley: 0.7 FC average (0.0-3.4)
- Scrape alleys: 0.2 FC average (0.0-0.4)

The farmers had requested and received 3 proposals to install new lights in their “new” barn prior to this study (as specified below). In our collaboration with the farmers, we agreed to help design a lighting system which would meet the current recommendations for Long-Day Lighting as closely as possible and to document the performance of the light fixtures as well as the cows.

Bid 1

- 12 metal halide fixtures 400 W (near center of barn)
- \$1,700
- 20+ FC in center part of barn expected

Bid 2

- 18 HPS fixtures 400W (near center of barn)
- \$2,300
- 20+ FC in center part of barn expected

Bid 3

- 18 HPS fixtures 400W (near center of barn)
- 28 HPS fixtures 150W (outside rows)
- \$6,100
- 20+ FC in center, 10+ FC over outside rows of freestalls expected

2.5 NEW LIGHTS INSTALLED (combination of option 1 and 2)

The actual installation was a combination of two options (1 and 2, below) for the purpose of demonstrating and comparing two different light fixtures to provide light by the outside walls.

Option 1:

- 18 metal halide fixtures 320W (two rows of fixtures, near side of center feed alley)
- 20 metal halide “wall packs” 100W (one row on each side wall, above outside rows of freestalls)
- Fixtures: \$6,450 (est.)
- Installation: \$3,660

Option 2:

- 18 metal halide fixtures 320W (two rows of fixtures, near side of center feed alley)
- 22 fluorescent 2-lamp, 4’ HLO fixtures (one row near each side wall, above outside rows of freestalls)
- Fixtures: \$4,665 (est.)
- Installation: \$3,660

2.6 LIGHT LEVELS DO CHANGE!!

- **Lamps become gradually duller as they age.** Mfrs. tend to declare initial lumens, which is substantially higher than the actual amount of lumens towards the end of the lamp’s useful life, years later. Use AVERAGE lumens when you estimate how many fixtures are needed!
- **Bird poop, fly poop and barn dust steal your light!**

Table 3. Effects on light output of 10 months use without cleaning the fixtures.

Outside freestalls	Near center freestalls	Feed alley
15.9 FC At start	21.9 FC At start	27.1 FC *) At start
13.1 FC After 10 months	13.4 FC After 10 months	18.5-21.9FC **) After 10 months
Lost: 2.8 FC = 18%	Lost: 7.5 FC = 34%	Lost: 5.2-8.6 FC = 19-32%

*) Initial light levels measured immediately in front of feeding line, without cows present

**) Light levels measured near feeding line, with cows present in feeding positions (18.5 FC) as well as in center of feed alley with cows present in feeding positions (21.9 FC)

Solution:

- **Clean fixtures twice a year**
- **Installing fixtures with cord and plug (not hardwiring) may make the cleaning job easier**

Section 3: LAMPS & FIXTURES

Different types of bulbs are used on farms, i.e. incandescent, fluorescent and high intensity discharge (HID) lamps. The HID lamps include three different kinds:

- Mercury Vapor
- High Pressure Sodium (HPS)
- Metal Halide (MH)

3.1 Lamps for barn lighting:

- Incandescent: avoid using them because of energy wastage and short lamp life
- Fluorescent: use new T8, 32W lamps. Very energy efficient, good color rendition. Ideal in stallbarns.
- Metal Halide (MH): use high powered lamps (300-400W) only in freestall barns with sufficient height (min. 15 feet). They are quite energy efficient and have acceptable color rendition.
- High Pressure Sodium (HPS): High powered lamps (e.g. 400W) are energy efficient. Because of poor color rendition (orange yellow light) these lamps are now seldom used in dairy barns.
- Mercury Vapor: Avoid these lamps because of poor energy efficiency and toxic waste.

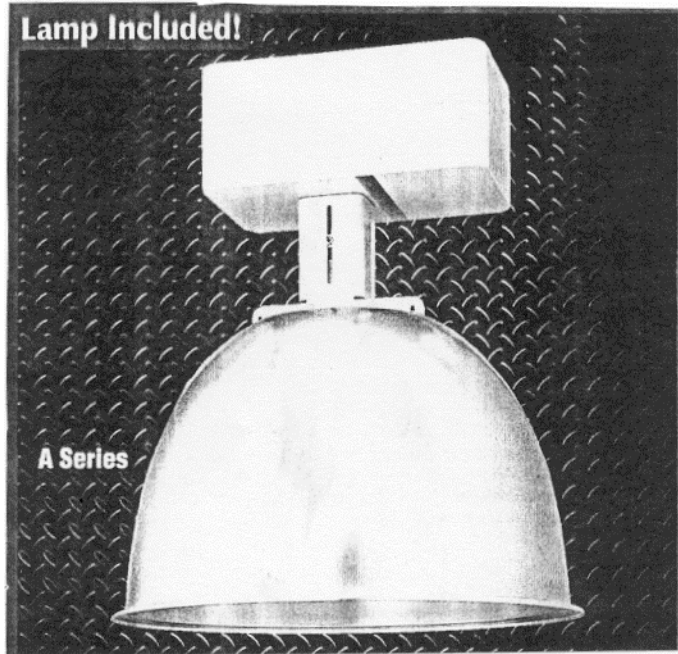
Table 4. Light fixtures installed in this barn (HPS data for comparison; not installed)

Fixture	Power draw	Lamp (lumens)	Efficiency (lumens per watt)	Lamp life, hrs	Color rendition (CRI)
Fluorescent T8, 32W, 4', 2-lamp	78W	7,200	92	24,000	80-85
Metal halide 320W, high bay, adjustable, puls start	328W	30,600	83	24,000	60-80
Metal halide, 100W, "wallpack"	127W	8,100	64	24,000 (?)	60-80
Comparison only: HPS 400W	470W	45,000	96	20,000-30,000(?)	40-60

High Bay Fixture

A typical high bay fixture is pictured below. The reflector (bell-shaped) may be acrylic/clear, or an opaque material (aluminum or steel). The ballast is very large and heavy, designed to drive powerful lamps.

High Bay



- Typically fitted with a powerful MH or HPS lamp. e.g. 400W
- Large diameter housing: 16-20"
- Need to be mounted 15+ feet high to be economic, and to give even light
- May have open or closed bottom. Open bottom preferred, to avoid build-up of dust and debris and possibly condensation.
- Reflector ("dome") may be clear acrylic or opaque aluminum or steel
- Acrylic reflector may give more even light distribution

Low Bay Fixture

- Usually has lower powered MH or HPS lamp, e.g. 150-300W
- Designed to spread light more widely. Space more closely than high bay fixtures.
- May be used on mounting heights between what is suitable for high bay fixtures and fluorescent fixtures (10-14 feet).

(Note that some manufacturers terminology is confusing – and some "low bay" fixtures are designed for mounting heights up to 25 feet).

3.2 Light Choices - Stall Barns

- Sealed or open fixtures?
- Hardwiring or install with cord, plug, chain and hooks?
- 1-lamp or 2-lamp fixtures?
- 4-foot or 8-foot fixtures?

Consider ONLY fixtures with T8, 32W fluorescent lamps! This may mean both fewer fixtures and lower energy bill because they give 40-45% more light, using about the same amount of electricity.

3.3 Light Choices - Freestall Barn

- **Can I use only powerful high bay metal halide fixtures?** MAY be possible if mounted at 16+ feet. Make sure there is enough light over the outside rows of freestalls and add fixtures to supplement the high bay fixtures as needed!

If you need to supplement with light close to the outside walls, you have several choices:

- Low bay metal halide lamp fixtures
- Fluorescent lamp fixtures
- Perimeter fixtures placed on the side walls
Your choice between these hardware options depends on your preferences and priorities:
- Low cost → Fluorescent
- Energy efficiency → Fluorescent
- Maximum stray voltage prevention → Whatever comes in 240 Volt

Section 4: ELECTRICAL INSTALLATION

4.1 Re-wiring?

You may be thinking about Long-Day Lighting as a way of improving both your dairy farming business and your working environment. Before you actually go ahead with your project, please consider this a chance to straighten out the not-so good and not-so new electrical wiring system in your barn. Please contact your power supplier and find out if they have a rebate or loan program for rewiring. If they do, chances are your Long-Day Lighting project would qualify for a grant and/or loan that could get you the money you need for removing or disabling the bad old wiring and install the new lights with a brand new, safer wiring system.

4.2 Play it safe!

- Work with a competent electrician to make sure your new barn lights do not create an electric or fire safety hazard!
- More specifically, see to it that the additional load from the new lights is distributed equally between the phases so it does not pose a risk in terms of stray voltage.
- Consider using all or most 240V components for the new lights.

4.3 Controlling the barn lights

- Buy a simple mechanical timer and use it to turn the lights on in early am and to turn them off at night time.
- Choose a lighting schedule which fits your routines. Pick any day length between 16 and 18 hrs of light. Once you decided, stick with the schedule, with the help of the timer.
- In a stallbarn, you probably need to have the lights on all day. In a curtain-sided or open-sided freestall barn you can save money by turning the lights off during the day-time hours. To achieve this, you need to install a photocell.
- Find a place on the outside, upper part of the barn wall where morning sun does not hit, and place the photocell there. Fine-tune things with the help of the electrician such that the photo cell turns the lights off when there is enough outside light to make the barn sufficiently lit. When you found the right adjustment, the photo cell will automatically turn the lights off in mid-morning and turn them back on in mid afternoon. In addition, during exceptionally gray and gloomy winter days, the photo cell allows the barn lights to remain on, as needed.

Section 5: BREAKING NEWS

Issue No 1:

Do cows continue to respond to LDL into their next lactation??

- We don't know with certainty. No research study shows the cows actually continue to respond (studies typically carried out during 6-7 months, Oct/Nov – Mar/Apr).
- Studies with other animal species indicate that the response to LDL tends to wear off (“refractoriness”).
- Cows develop refractoriness (become unresponsive to light treatment) if they are exposed to 24 hr light each day, because there is no change in day length.
- Recent research showed that if you treat dry cows with very short days and then let them have longer days again (after freshening) – cows produced about 7 lbs. More milk during the first 4 months of the following lactation, compared to cows treated with LDL during their dry period.
- Researchers at a dairy cattle research station in Canada have for years recommended farmers to use LDL but also to let the cows have a break from it every year, to let the cows re-set their “biological clocks”. They refer to one study which strongly suggested there was a gradual decline of the LDL response.

Thus, some studies do suggest that the LDL effect is likely to decrease within the current lactation. It seems very likely that much of the LDL effect may be lost after one lactation, due to “refractoriness”. To be on the safe side, the following recommendations aim to make sure cows will continue to respond to LDL on a long term basis:

1. House the dry cows separately, away from the lactating cows and their LDL treatment.
2. Increase the number of daylight hours in the LDL program for lactating cows (up to 18 hrs/day). This way, the difference in day length when cows shift from lactation/LDL to dry period/natural day length is likely to be more pronounced and give a loud and clear signal for the cow to re-set her biological clock when she is removed from the barn with LDL and experiences natural day length..
3. If dry cows can't be housed and managed away from the lactating cows and the LD program, all cows (dry and lactating) can be given a break from LDL. E.g. we can let July through September be LDL-free months. This way all cows experience the decreasing day length for three months and when we turn the LDL program back on, the cows will notice a more distinct difference and be able to respond fully again.

Issue No 2:

Do we have to clean the barn lights?

- Our experiences from this study teaches us that farmers do need to clean light fixtures in dairy barns to maintain the required light levels. With no cleaning, a farmer may lose 1/3 of the light output in less than a year – and this decline would continue as we go through the next fly and bird season.
- If we start out with light levels near the recommended minimum (15 FC) – the accumulated impact of deposits from birds and flies quickly reduces the light output to such low levels that we are uncertain if a timed lighting program (LDL) would stimulate to increased milk production.

Issue No 3:

Should we have red light in the barn?

- First, we need to be clear on one thing. We have a conflict between the needs of the cows and the needs of the workers. Both needs are very clear and need to be respected. Cows do need about 6 hours of uninterrupted darkness each night to be able to function and continue to respond to the LDL program. The herdsmen need good light to do a good job and to work safely.
- We can't pit the cows needs against the herdsmen's needs. Instead we have to work creatively to come up with some changes in working routines. If the farmer is seriously interested in LDL, it is possible to develop a system involving parlor schedule and assigning pens in the barn/s such that most of the cows can get the full benefit of LDL.
- The idea that red lights will be a magic bullet that makes it possible to meet both the cows' needs and the workers' needs, without changing herd management routines appears to be wishful thinking for the following reason. Cows can only tolerate a low level of red light without disturbing their dark resting period. Thus, red light at levels which may provide a decent working light for the herdsmen seems NOT to be an option.

In this barn, the farmers wanted to keep some night time light because they were used to have one of the old lights on all night. We compromised by installing three low powered fluorescent fixtures (38W lamp) with a red lens. The owners have been satisfied with that very low level of light, which is less than one FC measured directly under the fixture (herd milked 2x).