Risk information – Property

High Intensity Discharge (HID) lights

Introduction

If you operate a warehouse or distribution facility, or have any other area with high or lofty roofing requiring high levels of light over large areas, chances are you utilise some form of High Intensity Discharge (HID) light. Such lights are present to some extent in many types of industrial and commercial facilities.

Advantages of HID lights are well documented. These include their long life (life cycle cost), high lumen output per watt (efficiency) and relatively small size. Compared with fluorescent and incandescent lights, HID lights produce a large amount of light in a small package.

The common types of HID lighting include; metal halide, mercury vapour and high pressure sodium. A less common type are the xenon short-arc lamps. Life expectancies vary depending on the type, brand, model and operating conditions.

Potential hazards of HID lights however are less documented.

The hazard

Almost all HID lights reach their end of life in a benign manner, however as these types of lights operate at high pressures and temperatures* there is potential for the arc tube to rupture (fail violently). Being enclosed in only a glass outer bulb, this bulb can be breached by particles from the arc tube rupture.

Manufacturers have generally provided explicit instructions on proper use, and warning information to reinforce the need to follow these instructions. It has been recognised by several manufacturers that failure to do so can increase the likelihood of arc tube failure.

A failure has the potential to eject hot particles into the fixture and if not completely enclosed or contained this can result in hot particles landing on combustible materials in the vicinity, with the associated potential for fire.

Such failure is evidenced through actual loss incidents and this has been acknowledged by several of the bulb manufacturers. Depending on what is stored below and possibly ignited there is potential for major fire.

To date it appears that most incidents have been with metal halide type lighting.

This fact sheet is intended to promote a basic understanding of the types of lighting involved, how they work and provide an understanding of the types of measures that can be taken to help reduce this potential hazard at your facility.

*Per NEMA (National Electrical Manufacturers Association) – Mercury vapour arc tubes operate typically at temperatures of 600-800°C and under contained pressures of 3-5 atmospheres. Metal halide arc tubes operate typically at temperatures of 900-1100°C and under contained atmospheric pressures of 5-30 atmospheres.

Typical HID light

Lighting in industry

Industries in which HID lighting is commonly used include:

- Storage, warehousing and retail
- Manufacturing plants
- Sporting facilities
- Offices
- Horticulture.

The potential for major loss varies, but is very much dependent on the combustibility or flammability of the occupancy or presence of combustible construction in the vicinity.

Further information can be obtained from Vero Risk Engineering regarding your particular industry.

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Types of HID lights

Mercury vapour

The arc is contained in an inner bulb called the arc tube. The arc tube is filled with high purity mercury and argon gas. The arc tube is enclosed within an outer bulb, which is filled with nitrogen.

Metal halide

These lamps are similar to mercury vapour lamps but use metal halide additives inside the arc tube along with the mercury and argon. Higher efficacy, shorter life.

High Pressure Sodium (HPS)

HPS lamps differ from mercury and metal-halide lamps in that they do not contain starting electrodes; the ballast circuit includes a high-voltage electronic starter. The arc tube is made of a ceramic material which can withstand temperatures up to about 1,300°C. It is filled with xenon to help start the arc, as well as a sodium-mercury gas mixture.

How HID lighting works

In all HID lighting, light is produced as a result of an electrical current passing through a mix of metallic vapour, halides and inert gases.

This process occurs within a fused quartz, silica or ceramic (polycrystalline alumina ceramic) arc tube that is under vacuum when de-energised (ambient temperature). There are typically two or three electrodes sealed in the ends. The arc tube itself is typically mounted to a metal frame and contained to exclude air, typically within a glass bulb.

HID lights require a ballast (current limiting device) to start and maintain their operation. Ballasts serve three main functions; firstly to provide the proper starting voltage to establish the arc, secondly to supply the proper voltage to operate the lamp, and lastly to limit the lamp current to the level prescribed by the lamp manufacturer for the particular lamp.

Ballasts must always be matched to the particular lamp type, wattage and line voltage being used.

When turned on the lights typically take several minutes to warm up and when switched off generally take a couple of minutes to cool sufficiently to allow re-ignition.

Failure modes

Failure of HID lights, whilst relatively rare, can occur in many ways. This includes scratches on bulbs, direct contact with water, excessive pressure, incorrect burning position or system failure etc.

It is believed that the most likely cause of failure of a quartz arc tube is through cracking caused by progressive devitrification (crystallisation) of the quartz, resulting in different rates of thermal expansion (creating stresses) within the one arc tube.

Normally the argon (inert gases) will leak out of the arc tube or the surrounding nitrogen will leak into the arc tube. The lamp will normally fail to reignite. The likelihood of violent failure increases significantly towards the end of the life of the light.

Over the life of the lights the lumens output decline (typically to a minimum of about 80 percent of initial levels) and the failure rate of the bulbs increases.

Exploded light fittings

What you can do to reduce the likelihood of an event

1. Always follow manufacturers recommendations, guidelines and warnings (for all parts of the fixture) regarding safety, installation, maintenance, replacement and reducing risk.

   This includes with respect to how the lamp can be mounted (vertical or horizontal), rated life and group relamping etc.

2. Use the correct lights.

   HID lights are classified by the manufacturer with regard to the manner in which they are recommended to be used.

   O-Type (shrouded) – Bulbs of this type have a quartz, alumina silicate or steel mesh shroud and have passed a consensus NEMA industry developed test for use in open fixtures.

   Testing has shown that these types of bulbs are expected to contain the arc tube fragments in the event of rupture.

   S-Type – (unshrouded) – May be used in open fixtures, provided certain precautions are followed. These include installation in a vertical position, at least weekly cycling (switched off for minimum 15 minutes) and group relamping prior to the end of their rated life in accordance with manufacturers recommendations.

   E-Type – (unshrouded) – Are to be used only in suitably rated enclosed fixtures.

3. Follow the lamp manufacturers instructions regarding cycling of lights. Lights in continuous operation should be turned off at least once a week for a minimum of 15 minutes. Typically lights will fail to reignite at the end of their life.

4. As part of your preventative maintenance routine, establish a program for replacement of lights based on the rated life in accordance with the manufacturers specifications.

Group relamping is recommended. Some experts indicate that group relamping of metal halide lamps should occur at 50 to 70 percent of rated life. Group relamping tends to eliminate problems with lamp explosions.

5. Operate lights on the correct ballasts that are designed to provide the appropriate wattage for the lamp.

   Lamps should be checked to be sure that the proper lamp type is being used according to the information on the label of the installed ballast. Many lamps currently offered such as high pressure sodium lamps and metal halide lamps are physically interchangeable, but not electrically.

6. Covers when provided should preferably meet UL- 1598 standards and be of tempered or borosilicate glass or third party listed/ approved plastic.

   The manufacturer should be consulted when providing covers. Poorly designed covers can increase heat build up (increasing the risk of failure) or be ineffective in containing hot particles.

   Damaged or degraded light covers or lenses should be replaced.

7. Additional care should be taken when installing HID lighting in areas with special hazards (e.g. over flammable liquids, readily ignited combustibles or oxidising materials).

8. Lighting should be located over clear aisle spaces in warehouses.

9. If dimming is required, the lamp manufacturer should be consulted. Excessive dimming may increase the risk of rupture for some metal halide lamps.

10. Be on the look out for lights cycling on and off, dim lamps, slow starting lamps, inoperative lamps and dust and dirt build up.

11. Some manufacturers are also manufacturing Teflon coated lamps designed to prevent the lamp from shattering in the event of end of life explosion.

Alternatives to HID lighting

The risk of HID light failure can be eliminated through replacement with an alternative lighting solution. Some examples of successful alternatives include fluorescent, induction and LED lighting. The improved efficiency of these alternatives when compared to HID can also provide significant cost savings in the long run.

Conclusion

Many industries use HID lighting. Whilst such lighting has many well recognised advantages, they have been identified as a potential ignition source and occasional cause of fire.

Awareness and understanding of this potential hazard, and means to minimise the likelihood or impact of such an event, are critical to ensuring an acceptable level of risk for a facility.

Following manufacturers recommendations, guidelines and warnings regarding selection, safety, installation, maintenance, replacement and reducing risk will usually minimise the hazard.

Use of correct fixtures (ballasts, shrouded bulbs, covers etc.), recommended light orientation, cycling of lights, group relamping prior to the end of the rated life and consultation with the manufacturer when making changes all assist to further reduce the risk and protect your facility.

Further guidance and assistance can be obtained from your Vero Insurance Risk Consultant.

Additional Information:

NEMA LSD25 – Best Practises for Metal Halide Lighting Systems, plus Questions and Answers about Lamp Ruptures in Metal Halide Lighting Systems, NEMA.

Definitions

Ballast: A device used to operate fluorescent and HID lamps. The ballast provides the necessary starting voltage, while limiting and regulating the lamp current during operation.

Cycling: Turning off lamps at least once a week for a minimum of 15 minutes when they are in continuous operation.

Fixture (or Luminaire): A lighting unit consisting of a lamp, lamp sockets, ballasts, reflective material, lenses, refractors or louvres, and housing.

HID: Abbreviation for high intensity discharge. Generic term describing mercury vapour, metal halide, high pressure sodium, and (informally) low pressure sodium light sources and fixtures.