INSTRUCTION MANUAL

for the

BIRNS CORONA

Model 5220

and

BIRNS Wet/Dry Ballast

Model 3802

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INTRODUCTION

Scope

This Manual provides basic information and requirements for operation and maintenance of the BIRNS CORONA HPSV (High Pressure Sodium Vapor) Lighting System. It also incorporates instructions for the Wet/Dry Ballast, as a sub-set of the overall Corona system.

Applicability

This Manual is applicable to the following Models:

Model 5220 BIRNS Corona 1,000-watt HPSV Lighthead

Model 3802 Wet/Dry Ballast for the BIRNS Corona

SAFETY PRECAUTIONS

- Do not look directly into the light or shine it into another person's eyes. Serious eye injury could result.
- The lamp in the BIRNS Corona is a vacuum jacketed lamp and may implode if broken. Do not scratch the lamp glass or subject glass to undue pressure; either may cause breakage or shattering.
- If the outer bulb of the lamp is broken, shut off power immediately.
- Wait until the entire fixture is cool to the touch before performing any maintenance on it. **The HPSV lamp normally operates at very high temperatures! Burn risk and fire hazard exists from hot lamps! Wait until unit is completely cool before removing or handling the lamp!**
- Ensure that the power source is properly grounded (earthed).
- Operate the system only on a power circuit with ground-fault circuit interrupter (GFCI or GFI) or earth leakage circuit breaker (ELCB) protection.
- Always de-energize the power and disconnect the power cable when opening the unit or performing any maintenance on it. **Do not perform any maintenance on the Corona when the power is "ON".**
- Read and understand all instructions prior to performing any operation or maintenance work on the unit.

GENERAL INFORMATION

General

The BIRNS Corona is the world's most advanced nuclear-grade high-intensity light. It is a long-term wet/dry high pressure sodium vapor area light, and can be operated for indefinite periods in air and immersed in cold water without damage. The BIRNS Corona is based on proven BIRNS nuclear lighting technology, in concert with the immense illuminance of HID high pressure sodium vapor lamps.

Purpose

The purpose of the BIRNS Corona HPSV System is:

- To provide long-term illumination of new and spent fuel pools, and fuel transfer canals
- To provide brilliant short-term illumination of reactor cavities during fuel handling, and of turbines during inspection
- To provide general-purpose high-intensity illumination in any applications where extreme low levels of maintenance and high luminous efficacies are required.

Features/Benefits

The BIRNS Corona provides:

¬ Brilliant illumination (140,000 initial lumens, 132,000 mean lumens!)
¬ Lowest operating costs of *any* lighting system
¬ Lamp life rated at 24,000+ hours[1]
¬ 60-second tool-free relamping
¬ Commercially-available lamps (price: less than $100 each!)
¬ Rugged, Type 304 stainless-steel indexed connectors
¬ Redundant o-ring seals, in stainless-steel grooves, based on proven technology
¬ Safe, reliable operation on GFCI's (Ground Fault Circuit Interrupters)

[1]The lamp manufacturers rate this lamp at 24,000"+" hours because the lamp loses efficiency, but typically does not fail at this point. The actual number of hours at which 50% of a large number of lamps are expected to have failed is approximately 28,000 hours. However, please note that this rating is determined by the lamp manufacturer under laboratory conditions. Your own field results may vary.

- Sturdy, rugged construction
- Lamp operating in dry, one-atmosphere chamber

Theory of Operation

General

High pressure sodium vapor lamps are a subset of high-intensity discharge (HID) lamps, which are based on a wall-stabilized arc discharge contained within a refractory envelope (arc tube) within the bulb. In order to achieve better color rendition, high pressure sodium lamps are doped with additives. A special ceramic, polycrystalline aluminum oxide, is used for the arc tube. This material is extremely resistant to attack by sodium vapor and can withstand the very high operating temperatures required for maximum efficiency, yet has excellent transmission characteristics (typically over 90%) for visible light.

Light in sodium lamps is produced by passing electric current through the sodium vapor under pressure at high temperature. The gas fill is vaporized when the gas attains operating temperature. Although the primary radiating element in the arc is sodium, mercury is included as a buffer gas for color and voltage control, and small amounts of xenon (or, sometimes, argon plus neon) are used as a “starting gas”. Because long and narrow arc tube geometry is required for maximum efficiency and since starting probes are not used, extremely high voltages are necessary for lamp ignition.

The starting function is accomplished by an electronic starter circuit working in conjunction with the magnetic component of the ballast. The starter supplies a high-voltage, high-frequency pulse on each cycle or half cycle of the supply voltage to ionize the starting gas and initiate the starting sequence of the lamp. Once started, the lamp warms up to full light output, during which time the color output changes. Initially, there is a very dim, bluish-white glow produced by ionized xenon which is quickly replaced by a typical blue, brighter mercury light. With an increase in brightness, there is an abrupt change to monochromatic yellow which is characteristic of sodium at low pressure. Them, as the pressure in the arc tube increases, the lamp comes to full brightness with a golden white light.[2] The warm-up time is usually 3-4 minutes, while the restrike time (after momentary interruption of power) is usually less than one minute.

[2]The older low pressure sodium lamps produce a yellow light with visible energy radiated at two closely spaced wavelengths of 589.0 and 589.6 nm in the yellow region of the spectrum. However, at the high temperature in the arc stream of the HPSV lamp, the normal sodium radiation is altered and becomes a continuous spectral energy distribution, which to the eye appears to be golden white in color.

Operating Position

High pressure sodium vapor lamps have small arc tube diameters and thus have only a slight arc bow; therefore they exhibit very little change in efficacy or electrical characteristics when operated in a horizontal (rather than vertical) position. They can consequently be operated in any position, with no significant effect on light output.

End of Life/Cycling

The HPSV lamp is made with an excess of sodium which is in the form of an amalgam with mercury. Over time, sodium is lost to the arc stream. As the ratio of sodium to mercury pressure changes, the arc voltage rises. Eventually the lamp operating voltage will rise to a level beyond the ballast's ability to sustain. When this happens, the lamp will start, warm up to full brightness and then extinguish. This sequence (called "cycling") is repeated and is the normal end of life failure mode of HPSV lamps.[3]

Lamp Efficacy

The most important feature of the BIRNS Corona is its high efficacy. The lamp in the BIRNS Corona provides 140 lumens per watt, i.e. 140,000 initial[4] lumens. This is better than twice that of an equivalent wattage mercury lamp, and is in fact the most efficacious of *any* polychromatic general lighting source.

Light output gradually declines throughout life, as shown in the table below:

Burning time (hours)	0	6,000	12,000	18,000	24,000
% of Initial Lumens	100%	96%	90%	82%	71%

The mean lumens during life are approximately equal to 90 percent of the initial values.

[3]According to IES Testing Procedure LM-47, the average rated lamp life is defined as that time after which 50% of a large group of lamps are still in operation. The procedure prescribes burning cycles of 11 hours on, 1 hour off, when doing HID lamp life testing. However, as your own cycle times may be different from this, so may your lamp life results.

[4]HID lamps are usually rated for "initial" lumens after 100 hours of burning.

PRODUCT DESCRIPTION

Introduction

The complete BIRNS CORONA System includes everything necessary to provide general-purpose high-intensity illumination inside nuclear containment. It includes the CORONA Lighthead; a hermetically sealed Wet/Dry Ballast which operates in air and/or in water; support poles, and interconnecting cables with rugged metal-shell connectors.

The CORONA Lighthead

The CORONA Lighthead (including connectors) is constructed entirely of heavy-gauge electropolished Type 304 Stainless steel. Four 3/8-inch (10 mm) solid stainless steel bars are welded across the front of the Corona, which increases rigidity and protects against mechanical impact. A captivated heavy-gauge stainless-steel mesh screen provides further mechanical protection for the Corona. Its secure captivation notwithstanding, however, it can be removed for cleaning, without tools, in 60 seconds.

The body of the CORONA Lighthead is the parabolic reflector. To the back of the reflector is welded a solid yoke support block, situated in the center of gravity of the unit. One end of the CORONA Lighthead secures the quartz dome and connector rear nut assembly; the other end provides additional dome support and is removable for easy decontamination access.

The BIRNS Corona provides a separate quartz envelope to enclose the lamp in a dry, one-atmosphere chamber, so that no water ever comes into contact with the lamp itself; the lamp is not subjected to the pressure, thermal shock, corrosive effect etc. of the underwater environment.

The BIRNS Corona uses heavy-duty stainless-steel connectors throughout. These connectors are indexed (i.e. they have a stainless steel keyway system that prevents mismating) and provide complete mechanical protection for the electrical pins. These connectors seal with captivated dual redundant o-rings in stainless steel o-ring grooves, one radial o-ring inside the connector and one “face” seal on the end of the connector.

The BIRNS Corona features redundant seals throughout; all high-stress sealing points have a back-up seal. The BIRNS Corona will operate safely and reliably on all commercial ground fault circuit interrupters (GFCI’s), because its sealing methodology is reliable and precludes electrical “leakage”. Finally, the CORONA Lighthead has a positive case ground.

Wet/Dry Ballast

The Wet/Dry Ballast (Model 3802) is constructed entirely of heavy-gauge electropolished Type 304 Stainless steel. All necessary electronics are permanently and hermetically enclosed inside the housing, which is welded shut.

The Ballast is rectangular, approximately 9" x 6_" x 4_" (23 x 16 x 12 mm). Because the Ballast sinks heat directly through its housing, the housing wall is etched “CAUTION : HOT SURFACES” in the center of the heat-producing region.

Two metal-shell connector receptacles are permanently welded to the top of the Ballast; one connector has three internal pins and one has four (to obviate incorrect connection). These are marked “To Power” and “To Light”, respectively. These connectors seal with captivated dual redundant o-rings in stainless steel o-ring grooves, one radial o-ring inside the connector and one “face” seal on the end of the connector. The latter is captivated inside a half-dovetail groove.[5]

Between the two connectors on the top of the housing is welded a stainless steel tube, coaxial with the long axis of the Ballast housing; a similar tube is welded to the housing bottom. These secure the Ballast to the support poles and to the Corona Lighthead, respectively.

Mounting Poles

The BIRNS CORONA system is available with a variety of standard, custom and/or semi-custom support poles. These are all made entirely of heavy-gauge electropolished Type 304 Stainless steel, and offer your choice of support options, including: T-bar, Lift-Bail, Hook, or any combination of these. Various lengths to suit your application are also available, as are extension poles.

All poles secure to their mating parts by means of 18-8 stainless steel quick-release pins, captivated on a 18-8 stainless-steel wire rope lanyard wich is permanently affixed to the relevant part.

A typical arrangement is a support pole with a Lift-Bail and T-bar, say, supporting the Wet/Dry Ballast which in turn supports the Corona lighthead. (Please see BIRNS Drawing 5220-TA.)

[5]These same o-ring designs seal BIRNS deep-submergence lights without difficulty in the marine environment to depths of thousands of meters, under extremes of thermal stress, mechanical abuse, and seawater corrosion.

Interconnecting Cables

The Interconnecting Cables provide electrical continuity between the power source and the Ballast, and between the Ballast and the Corona Lighthead. These cable assemblies are terminated in indexed GRE connectors with permanently embedded power sockets, protected by a rugged hexagonal electropolished 304 stainless steel engaging nut; this also serves as a coupling ring to mate and unmate the connector halves.

The cable itself is made either of BIRNS Super-Vutron or BIRNS Polyurethane cable.

BIRNS Super-Vutron cable (color-coded yellow) is jacketed with smooth chlorinated polyethylene (CPE) and insulated with ethylene propylene diene monomer (EPDM). This cable is often used in the nuclear industry, as its insulation is radiation-tolerant, its jacket is easy to decontaminate, and it meets the requirements of IEEE-383. It experiences "mild to moderate" radiation damage at 8×10^5 R (8×10^3 Gy), and "moderate to severe" damage at 4×10^6 R (4×10^4 Gy).[6]

BIRNS Polyurethane cable (color-coded blue) is jacketed with polyurethane and insulated with cross-linked polyethylene (XLPE). This cable is excellent for use in the nuclear environment, as it is extremely radiation-tolerant and "clean", and its slick surface is very easy to decontaminate. It experiences "mild to moderate" radiation damage at 8×10^6 R (8×10^4 Gy), and "moderate to severe" damage at 4×10^7 R (4×10^5 Gy).[7]

The GRE connectors at the end of the Interconnecting Cable assemblies are back-potted with epoxy resin, and overmolded with polyurethane molding compound.

[6] CERN does not recommend use of the materials in Super-Vutron jacket above 10^8 R (10^6 Gy).

[7] CERN does not recommend use of the materials in Polyurethane cable above 10^9 R (10^7 Gy).

UNPACKING YOUR SYSTEM

Step 1 - Unpack

1. Open the BIRNS Corona cardboard carton and remove the 1"-thick polystyrene flat cover. Remove the Corona from the polystyrene insert and polyethylene bag.

    a. Note the Instruction Manual situated in the slot. Remove the Manual; read and understand it thoroughly prior to putting the Corona into service.

    b. Note the red plastic connector cover; remove and discard this prior to putting the Corona into service.

    c. Note the “Bubble-pack” wrapping around the Corona yoke (on the back of the Reflector Weldment); remove and discard this prior to putting the Corona into service.

    d. Note the “Bubble-pack” wrapping around the Corona dome (inside the Screen); remove and discard this prior to putting the Corona into service. To remove this wrapping, open the Cover (see “Removing/Replacing the Cover” for detailed Instructions), slide the wrapping off of the Dome, and replace the Cover.

    e. Note that the HPSV lamp is packed separately within that same carton; this must be installed prior to putting the Corona into service. (For detailed instructions, see “Corrective Maintenance — Replacing the Lamp”.)

2. Open the BIRNS Wet/Dry Ballast cardboard carton and remove the polystyrene flat cover. Remove the Ballast from the polystyrene insert and polyethylene bag.

    a. Note the two red plastic connector covers; remove and discard these prior to putting the Ballast into service.

3. Open the carton containing the Interconnecting Cables. Remove the Cables from the carton and polyethylene bag(s).

4. Open the packaging containing the Mounting Poles. Remove the Poles from the packaging.

Step 2 - Verify Receipt

Your CORONA System includes the following components. Please verify that you have received all items listed below:

1. BIRNS CORONA Lighthead, Model 5220
2. BIRNS Wet/Dry Ballast, Model 3802
3. Mounting Poles per your order
4. Power Cables per your order

Step 3 - Inspect for Damage

Carefully inspect all items for damage. Obvious damage to shipping or packing materials may signal potential damage to the goods themselves.

Signs of actual or potential damage include:

- Items broken, bent, chipped or cut
- Items scraped or burnt
- Loose parts, clinking or rattling sounds

Should any of these signs be evident, save all packing materials and immediately file a claim with the carrier. Notify your distributor and/or BIRNS directly, in writing, describing the damage.

How to contact BIRNS

Voice

You can contact BIRNS by telephone on:

- +1-805-487-5393 (International)
- 1-888-BIRNS-88 (Nationwide toll-free)

We have customer service personnel available to take calls Monday through Friday, 08:00-16:30 PST. In addition, we have 24-hour voice mail to take calls at other times.

Data

You can contact BIRNS in writing by:

Mail: BIRNS, Inc.
P.O. Box 909
Oxnard CA 93032-0909 USA

24-hour Fax: 1-805-487-0427

Email: service@birns.com (or through our Internet address: www.birns.com)

Physical

You can ship goods to our receiving department at:

BIRNS, Inc.
Attention: (Name of your BIRNS customer service representative)
1720 Fiske Place
Oxnard CA 93033-1863 USA

Note: please always contact us prior to shipping items to us, and label the goods as for the attention of your customer service representative.

BASIC SET-UP AND OPERATION

The BIRNS CORONA System is designed to be “plug and play”. After unpacking the system and inspecting for damage, follow these steps:

1. Install the lamp into the Corona Lighthead.

Note: For maximum protection purposes, the HPSV lamp is packed separately. (For detailed instructions, see “Corrective Maintenance — Replacing the Lamp”.)

2. Affix the Corona Lighthead to the Wet/Dry Ballast. (For detailed instructions, see “Affixing the Support Poles”.)

3. Affix the Wet/Dry Ballast to the Support Poles. (For detailed instructions, see “Affixing the Support Poles”.)

4. Plug in the Interconnecting Cables. (For detailed instructions, see “Mating and Unmating the Metal-Shell Connectors”.)

a. Mate one end of the Ballast-to-Light Cable Assembly 17F-028 to the Corona Lighthead. Mate the other end to the Wet/Dry Ballast’s 4-pin connector marked “To Light”.

Note: the two ends of the Ballast-to-Light Cable Assembly 17F-028 are interchangeable, i.e. it doesn’t matter which end you use.

b. Mate one end of the Power-to-Ballast cable 17F-048 to the Wet/Dry Ballast’s 3-pin connector marked “To Power”.

c. Plug the other end of the Power-to-Ballast cable 17F-048 into a mains power outlet with ground-fault circuit interrupter (GFCI or GFI) or earth leakage circuit breaker (ELCB) protection, and energize the circuit.

5. Your BIRNS CORONA System is ready for use!

Note: Sometimes a very light hum may be heard, and/or a very delicate vibration may be felt in the unit when the circuit is energized. This is normal as long as it is very minor. However, should the hum get loud or the vibration become more intense, discontinue use and contact your distributor and/or BIRNS.

Note: The HPSV lamp inside the Corona Lighthead requires approximately two to five minutes to reach full intensity. However, sufficient light output to verify operation should be available immediately on application of power.

GENERAL INSTRUCTIONS

Mating and Unmating the Metal-Shell Connectors

The “plug” is the connector with a captivated stainless steel hexagonal engaging nut (coupling ring). It has sockets, and is a permanent part of the cable assemblies.

The “receptacle” is the connector with a stainless steel body. It has pins recessed inside its body. The receptacles are permanent parts of the Corona Lighthead and Wet/Dry Ballast.

Note: The underwater metal-shell connectors on the Power-to-Ballast Cable (17F-048) and the Ballast-to-Light Cable (17F-048) have three and four sockets, respectively. This is meant to preclude accidental connection to the incorrect receptacle. Therefore, prior to mating the connectors, ensure that the receptacle has the same number of pins as the plug has sockets!

Note: These connectors are true underwater connectors and, when properly mated, will seal to depths of 20,000 FSW (6,000M). However, they are not underwater mateable! Do not attempt to mate or unmate these connectors underwater!

Note: Mate and unmate these connectors only while the circuit is de-energized. This is a much safer practice, and will avoid unnecessary wear and tear on the connectors.

To mate the metal-shell connectors, follow these steps:

1. Verify that the plug and the receptacle have the same number of sockets and pins. Ensure that both connectors are clean and dry.

2. Insert the plug into the receptacle. The plug has a “key” (a longitudinal raised bump, hemispherical in cross-section) which fits into a “keyway” in the receptacle, and indexes the connectors such that they can only be mated in one orientation.

3. Turn the engaging nut (coupling ring) clockwise such that it engages the threads of the receptacle.

4. Continue turning the engaging nut until the connectors are fully mated.

   Note: These connectors will fully seal when “hand-tight”. There is no need to use a tool to engage them; higher torque applied will not improve the seal, but might damage the connectors. If a tool is needed, something is wrong! Do not force the connectors together!

5. To unmate the connectors, simply turn the engaging nut counter-clockwise until the connectors are disengaged. Separate the connectors.

Affixing the Support Poles

All portions of the interconnecting poles mate the same way: the end of one pole fits into the end of the other, and a quick-disconnect pin secures the connection.

To affix the Support Pole to the Ballast:

1 Align the end of the Pole with the top of the Ballast.

2 Insert the end of the Pole into the mounting tube on the top of the Ballast, such that the holes in the Pole and those in the mounting tube are aligned.

3 Insert the spring-loaded quick-disconnect pin (attached to the Pole near the end) through the aligned holes in the mounting tube and the Pole. Verify that the pin is fully inserted — it should protrude out the other side of the mounting tube.

To affix the Ballast to the Corona Lighthead:

1 Align the bottom of the Ballast with the Yoke on the back of the Corona Lighthead.

2 Insert the mounting tube on the bottom of the Ballast into the Yoke, such that the holes in the mounting tube and those in the Yoke are aligned.

3 Insert the spring-loaded quick-disconnect pin (attached to the Yoke) through the aligned holes in the mounting tube and the Yoke. Verify that the pin is fully inserted — it should protrude out the other side of the Yoke.

Removing/Replacing the Cover

To remove the Cover:

1 Remove the Cover 14A-012 by turning the two retaining tabs 90 degrees counter-clockwise.

2 Remove the Cover and put it to one side. (Note: a lanyard prevents the Cover from accidentally falling off.)

To replace the Cover:

1 Replace the Cover 14A-012 by putting it into position.

2 Engage the two retaining tabs into their respective sockets, and turn them 90 degrees clockwise until they are firmly engaged and are oriented perpendicular to the curved “back” of the Reflector Weldment.

Adjusting the Yoke

Note: The Yoke may be adjusted such that the Corona Lighthead can be tilted in various angles, and locked into position.

To adjust the Yoke:

1 Use a 3/8" hex wrench to loosen the 3/8" yoke hex nut (23F-001).

2 Adjust the Corona Lighthead until its angle meets your needs.

3 Use a 3/8" hex wrench to tighten the 3/8" yoke hex nut (23F-001) to lock the Corona Lighthead in position.

PREVENTATIVE MAINTENANCE

The BIRNS Corona requires very little preventative maintenance. The only preventative maintenance required is limited to periodic inspection and/or replacement of the elastomeric items, specifically the Interconnecting Cables, Dome Cushion Support Ring, and the sealing O-rings.

Introduction

The sealing O-rings and the cable jackets (and primary cable insulation) used in the BIRNS Corona Interconnecting Cables, like all elastomers, are affected by prolonged exposure to ionizing radiation. The effects of radiation on elastomeric materials are to change the properties of the elastomer; ultimately, those property changes are detrimental to the performance of the sealing O-rings and the Interconnecting Cables. (For further information on this subject, please request a copy of our technical paper, “General Effects of Radiation on Elastomeric Materials”.)

Briefly stated, the effect of radiation on these elastomeric materials is primarily scission of their intermolecular bonds which will make them abnormally soft and/or “gooey” or “sticky”. However, sometimes a secondary effect is present — the abnormal cross-linking of intermolecular bonds — which causes embrittlement and makes the materials “hard”, “dry”, or “brittle”. (This is also the effect often caused by prolonged exposure to elevated temperatures or IR radiation.) Unfortunately, it is nearly impossible to accurately predict the expected lifetime of elastomeric materials in the field, and it is not feasible to determine the extent of radiation damage by electrical or other “remote” tests. Therefore, we rely on periodic visual and/or tactile inspection to determine if materials require replacement.

Checking Cables for Radiation Damage

The Interconnecting Cables' jackets should be periodically inspected for radiation damage. The length of time between inspections depends on the expected level of radiation in the application (that is, the cables should be inspected more frequently when used in high-radiation fields), but does not need to be done as a separate function — while doing other work on the lights, while changing lamps for example, the cables can be inspected; in this way, it's possible to minimize labor costs and radiation exposure time. However, no more than five (5) years should pass between cable inspections, and we recommend that the cables be replaced not less than once every 10 years of use.

To inspect the cables, simply run them through your (gloved) hands while visually inspecting them, and:

- Look for signs of being "sticky" or "gooey" or abnormally soft, especially if those symptoms are present in only a small portion of the cable. These are classic symptoms of severe radiation damage, and require immediate cable replacement.

- Look for signs of the cable being "brittle", cracked or split, or the cable jacket being abnormally hard, especially if present in only a small portion of the cable. This is a sign that the cable has suffered elevated temperature (or, possibly, radiation) damage, and requires immediate cable replacement.

- Look for signs of mechanical damage: abrasion, cuts, kinks, etc. Damage such is this does not always require cable replacement, but cable replacement is always required fi the damage is severe. (We define "severe" mechanical damage as damage which causes a decrease in the functionality of the cable.) For example, if the cable had showed reduced electrical resistance between conductors after sustaining the damage, we would strongly recommend that it be immediately replaced.

O-Ring Replacement — General

Different opinions exist regarding the preventative replacement of o-rings. O-rings do have a limited life, but that lifetime is so affected by the unique conditions of your environment and usage that it is impossible to predict, and therefore impractical to recommend a precise time frame for preventative o-ring replacement.

Furthermore, the very act of replacing o-rings involves some risk. For example, the new o-ring could become damaged in the process, or may be incorrectly installed, or some particle or hair might fall into the o-ring groove, any of which may cause the new o-ring to leak — ironically, even when the old o-ring still sealed.

Finally, not all o-ring failures cause the same degree of problems. For example, failure of O-ring P/N 59A-088 in the outside of the connector receptacles will cause minimal problems, because it has a redundant back-up sealing O-ring (P/N 59A-176), and even in the case of failures of *both* O-rings, the only probable consequence is tripping of the GFCI. Conversely, failure of the Dome O-ring P/N 59A-151 may lead to immediate lamp failure.

Therefore, in general theory, the easier and/or less risky it is to change a particular O-ring, and/or the greater the potential problems in case of O-ring failure, the more frequently that O-ring should be changed.

In practice, we recommend that O-rings be replaced once every five (5) years of use, and in no case less than once every eight (8) years. If your application or environment is particularly severe, or if you experience repeated O-ring related problems, you may consider decreasing this period to once every three (3) years of use, or in extreme cases even less.

Prior to O-ring installation, we strongly recommend that the O-rings be lightly lubricated with food-grade pure Silicone spray. A thin film of lubricant is sufficient, evenly applied over the entire O-ring surface. Although Silicone grease also works well, it is crucial to note that grease is incompressible and, if over-applied, will interfere with the seal. Spray, on the other hand, cannot be over-applied because excess will simply drip off.

Dome Cushion Support Ring Replacement — General

The Dome Cushion Support Ring (56D-014) is also an elastomeric item, but its function is not critical. Nonetheless, we recommend that it be replaced at the same time as replacement of the Dome O-ring; hence, instructions for its replacement are included under that section.

O-Ring Replacement — Instructions

To replace the Rear-Nut Assembly O-Rings:

1 Remove the Rear Nut Assembly (for detailed instructions up to this point, see “Replacing the Lamp”).

2 Remove the Lamp (32G-003) from the Rear Nut Assembly by turning it counter clockwise. Set it aside.

3 Remove the radial O-ring (59A-152) and “face” O-ring (59A-154) from their respective grooves in the Rear Nut Assembly (56F-048), and discard.

Note: We recommend the use of O-ring extraction tools for this procedure. If such tools are not available, any small probe will work, as long as its tip is smaller than about half the width of the O-ring. The probe should be made of materials softer than 304 stainless steel (E.g. plastic or brass); if not, then take great care not to damage the O-ring groove.

Note: The “face” O-ring (59A-154) is held in a half-dovetail O-ring groove for captivation purposes. The bottom of the O-ring groove is wider than the top (open part); the outer wall is slanted inward.

4 Lightly lubricate new replacement O-rings with Silicone O-ring spray or grease.

a If you use spray, simply spray the entire surface of the O-ring until it is thoroughly wet and shiny. Allow the excess to drip off before O-ring installation.

b If you use grease, apply a small amount of grease onto the (gloved) tip of your index finger. Then, holding the O-ring between that index finger and your thumb, pull the O-ring with your other hand such that it revolves through the grease on your fingertip and the grease is “smeared” along the entire surface area of the O-ring. Do not allow grease to accumulate on the O-ring; the resulting grease film should not be thicker than about 0.010 inches (0.3 mm thick).

Note: A thin film of lubricant is sufficient. Grease is incompressible and, if over-applied, will interfere with the seal!

5 Gently install new O-rings into those grooves. Press the O-rings into their grooves, and slide your (gloved) finger over their entire surface to “smooth” the O-ring into the groove, and to ensure that the lubricant is evenly distributed.

6 Carefully replace the Lamp (32G-003), and install the Rear Nut Assembly (56F-048) straight into the Corona Lighthead. (For detailed instructions after this point, see “Replacing the Lamp”). Connect the cables, and put the Corona into service.

To replace the Dome O-Rings:

1 Remove the Rear Nut Assembly (for detailed instructions up to this point, see “Replacing the Lamp”).

2 Remove the Dome (for detailed instructions up to this point, see “Removing/Replacing the Dome”).

3 Remove the face O-ring (59A-151) that seals against the open end of the Dome from its groove in the Reflector Weldment, and discard.

4 Remove the radial O-ring (59A-152) that is secured under the threads in the inside of the Reflector Weldment, and discard.

Note: This O-ring serves not as a seal but as an anti-rotation brake. That’s why it doesn’t sit in an actual groove — it’s actually in the thread relief. Although it doesn’t serve as a primary seal, it helps preserve the integrity of a primary seal, so we consider that it also fulfills some sealing function and therefore requirements replacement.

5 Lightly lubricate new replacement O-rings with Silicone O-ring spray or grease.

a If you use spray, simply spray the entire surface of the O-ring until it is thoroughly wet and shiny. Allow the excess to drip off before O-ring installation.

b If you use grease, apply a small amount of grease onto the (gloved) tip of your index finger. Then, holding the O-ring between that index finger and your thumb, pull the O-ring with your other hand such that it revolves through the grease on your fingertip and the grease is “smeared” along the entire surface area of the O-ring. Do not allow grease to accumulate on the O-ring; the resulting grease film should not be thicker than about 0.010 inches (0.3 mm thick).

Note: A thin film of lubricant is sufficient. Grease is incompressible and, if over-applied, will interfere with the seal!

6 Gently install new O-rings into those grooves. Press the O-rings into their grooves, and slide your (gloved) finger over their entire surface to “smooth” the O-ring into the groove, and to ensure that the lubricant is evenly distributed.

7 Replace the Dome (for detailed instructions after this point, see “Removing/Replacing the Dome”).

8 Replace the Rear Nut Assembly (for detailed instructions after this point, see “Replacing the Lamp”). Connect the cables, and put the Corona into service.

To replace the Dome Cushion Support Ring:

1 Remove the Rear Nut Assembly (for detailed instructions up to this point, see “Replacing the Lamp”).

2 Remove the Retaining Ring and Dome together from the Reflector Weldment (for detailed instructions up to this point, see “Removing/Replacing the Dome”).

3 Slide the Dome straight out of the Retaining Ring. Discard the Dome Cushion Support Ring 56D-014.

4 Lubricate a new black polyurethane Dome Cushion Support Ring 56D-014 by applying a small quantity of pure food-grade silicone grease to its internal diameter.

Note: Do not over-apply this grease; a thin film is usually sufficient. This grease does not make any kind of seal. Its sole purpose is to facilitate the installation of the new Dome by lubricating the Dome Cushion Support Ring.

5 Insert a new Dome (closed end first) through the Dome Cushion Support Ring and into the Retaining Ring. Insert the new Dome and Retaining Ring together into the Reflector Weldment.

6 Place the open end of the Dome onto the o-ring on the inside of the Reflector Weldment. Slide the Retaining Ring down the Dome until it is on the mating threads.

7 Engage the Retaining Ring onto the mating threads inside the Reflector Weldment, and turn it clockwise until it is threaded snugly.

8 Replace the Screen 62B-005 and the Cover 14A-012.

9 Replace the Rear Nut Assembly (for detailed instructions after this point, see “Replacing the Lamp”). Connect the cables, and put the Corona into service.

CORRECTIVE MAINTENANCE

Replacing the Lamp

Note: For maximum system performance, replace the lamp at or before the end of its published rated life.

Note: Should "cycling" (the lamp will start, warm up to full brightness and then self-extinguish) occur, it is important to replace the lamp immediately. Although cycling presents no hazard to personnel, it will create substantial wear on the ballast, leading to possible ballast degradation and/or premature failure.

To replace the lamp:

1. De-energize the circuit. Remove the Corona from service, and decontaminate as necessary.

   Caution: **Do not perform any maintenance on the Corona when the power is "ON".**

2. Wait for the unit to cool down, until it is cool to the touch.

   Caution: **The HPSV lamp normally operates at very high temperatures! Burn risk and fire hazard exists from hot lamps! Wait until unit is completely cool before removing or handling the lamp!**

3. Disconnect the Ballast-to-Light Cable (17F-028) from the Corona Lighthead.

4. Disengage the anti-rotation lanyard from the Rear Nut Assembly (56F-048).

   Note: The anti-vibration lanyard is secured using the "button-in-buttonhole" concept. The end of the lanyard has a loop which fits over the welded "T" in the Rear Nut Assembly only one way, such that the long axis of the loop is aligned with the axis of the "T" cross bar.

   a Align the long axis of the loop with the axis of the "T" cross bar.

   b Firmly grasp the lanyard above the stainless steel crimp.

   c Pull the lanyard upward until the loop disengages from the "T" cross bar.

5. Remove the Rear Nut Assembly (56F-048) by turning its coupling ring counter clockwise. After the threads completely disengage, carefully pull the Assembly *straight* out from the Corona Reflector.

   Caution: **The lamp can easily be cracked or broken by careless handling! Do not impact the lamp on the inner surface of the reflector housing!**

6. Remove the Lamp (32G-003) from the Rear Nut Assembly by turning it counter clockwise. Set aside.

7. Remove a new Lamp from its packaging. Inspect it for damage before use.

   Note: Do not touch the lamp with your bare fingers. Always use a tissue or a clean cloth.

   Caution: **Do not use a lamp if the outer glass bulb has been scratched, cracked or damaged in any way!**

8. Gently install a new Lamp (32G-003) into the Rear Nut Assembly by inserting it, base first, into the ceramic Lampholder and turning it clockwise. Screw lamp firmly but not forcibly into the socket.

   Caution: **Excessive installation force may break the outer glass bulb!**

9. Carefully insert the Lamp (32G-003) and the Rear Nut Assembly (56F-048) straight into the Corona Lighthead. Take care not to bump the lamp on the way in!

   Caution: **The lamp can easily be cracked or broken by careless handling! Do not impact the lamp on the inner surface of the reflector housing!**

10 Install the Rear Nut Assembly (56F-048) by turning its coupling ring clockwise, 'hand-tight', until it seats all the way. Align the central portion of the Assembly such that the "T" cross bar is aligned with the yoke on the back of the Reflector Weldment.

   Note: Do not use a wrench or tool to tighten the Rear Nut Assembly or the connector's engaging nut. This will not improve the seal, but may damage the units.

   Note: While a hand-tight closure of the Rear Nut Assembly is sufficient, the Rear Nut Assembly nonetheless **must** be completely installed, to prevent possible unit leakage and potential failure of the lamp.

11 Secure the anti-rotation lanyard onto the Rear Nut Assembly (56F-048).

   a Align the long axis of the loop with the axis of the "T" cross bar.

   b Hook the top of the loop over one end of the "T" cross bar.

   c Push the lanyard downward until the bottom of the loop engages the "T" bar.

10. Connect the Ballast-to-Light Cable (17F-028).

11. Put the Corona Lighthead into service, and energize the circuit.

Removing/Replacing the Screen

Note: Under normal circumstances the Screen 62B-005 would rarely be removed or replaced; its removal is not necessary for relamping. However, removing the screen is necessary to replace certain o-rings, and makes replacing the Dome (as well as general decontamination) much easier.

To remove the Screen:

1. De-energize the circuit. Remove the Corona from service, and decontaminate as necessary.

   Caution: **Do not perform any maintenance on the Corona when the power is "ON".**

2. Wait for the unit to cool down, until it is cool to the touch.

   Caution: **The HPSV lamp normally operates at very high temperatures! Burn risk and fire hazard exists from hot lamps! Wait until unit is completely cool before removing or handling the lamp!**

3. Remove the Cover 14A-012 by turning the two retaining tabs 90 degrees counter-clockwise. Put the Cover to one side.

4. Remove the stainless steel mesh Screen 62B-005 by sliding it to one side until it is free of the Reflector Weldment.

To replace the Screen:

1 Install the stainless steel mesh Screen 62B-005 by sliding it into the "track" in the Reflector Weldment. Slide it all the way in until it cannot go any farther and one end of the Screen is against one wall of the Reflector Weldment. Verify that the "open" end of the Screen is aligned with the open end of the Reflector Weldment.

2 Replace the Cover 14A-012 into position. Engage the two retaining tabs into their respective sockets, and turn them 90 degrees clockwise until they are firmly engaged and are positioned perpendicular to the curved "back" of the Reflector Weldment.

3 Connect the Ballast-to-Light Cable (17F-028).

4 Put the Corona Lighthead into service, and energize the circuit.

Removing/Replacing the Dome

Note: Under normal circumstances the Dome 35B-030 would not be removed or replaced; its removal is not necessary for relamping.

To replace the Dome:

1. De-energize the circuit. Remove the Corona from service, and decontaminate as necessary.

   Caution: **Do not perform any maintenance on the Corona when the power is "ON".**

2. Wait for the unit to cool down, until it is cool to the touch.

   Caution: **The HPSV lamp normally operates at very high temperatures! Burn risk and fire hazard exists from hot lamps! Wait until unit is completely cool before removing or handling the lamp!**

3. Disconnect the Ballast-to-Light Cable (17F-028) from the Corona Lighthead.

4. Disengage the anti-rotation lanyard from the Rear Nut Assembly (56F-048).

   Note: The anti-vibration lanyard is secured using the "button-in-buttonhole" concept. The end of the lanyard has a loop which fits over the welded "T" in the Rear Nut Assembly only one way, such that the long axis of the loop is aligned with the axis of the "T" cross bar.

   a Align the long axis of the loop with the axis of the "T" cross bar.

   b Firmly grasp the lanyard above the stainless steel crimp.

   c Pull the lanyard upward until the loop disengages from the "T" cross bar.

5. Remove the Rear Nut Assembly (56F-048) by turning its coupling ring counter clockwise. After the threads completely disengage, carefully pull the Assembly *straight* out from the Corona Reflector.

   Caution: **The lamp can easily be cracked or broken by careless handling! Do not impact the lamp on the inner surface of the reflector housing!**

6 Remove the Cover 14A-012 by turning the retaining tabs 90 degrees. Put the Cover to one side.

7 Remove the stainless steel mesh Screen 62B-005 by sliding it to one side until it is free of the Reflector Weldment. Set it aside.

8 Firmly grasp the Retaining Ring 56F-048 and turn it counter-clockwise until it is free of the Reflector Weldment.

Note: We recommend the use of our Retaining Ring Removal Tool 70A-035.

9 Remove the Retaining Ring and Dome together from the Reflector Weldment.

10 Slide the Dome straight out of the Retaining Ring.

11 Inspect the black polyurethane Dome Cushion Support Ring 56D-014 for damage. Replace it if necessary.

12 Apply a small quantity of pure food-grade silicone grease to the internal diameter of the black polyurethane Dome Cushion Support Ring 56D-014.

Note: Do not over-apply this grease; a thin film is usually sufficient. This grease does not make any kind of seal. Its sole purpose is to facilitate the installation of the new Dome by lubricating the Dome Cushion Support Ring.

13 Insert a new Dome (closed end first) through the Dome Cushion Support Ring and into the Retaining Ring. Insert the new Dome and Retaining Ring together into the Reflector Weldment.

14 Place the open end of the Dome onto the o-ring on the inside of the Reflector Weldment. Slide the Retaining Ring down the Dome until it is on the mating threads.

15 Engage the Retaining Ring onto the mating threads inside the Reflector Weldment, and turn it clockwise until it is threaded snugly.

16 Install the stainless steel mesh Screen 62B-005 by sliding it into the “track” in the Reflector Weldment. Slide it all the way in until it cannot go any farther and one end of the Screen is against one wall of the Reflector Weldment.

17 Replace the Cover 14A-012 into position. Engage the two retaining tabs into their respective sockets, and turn them 90 degrees clockwise until they are firmly engaged and are positioned perpendicular to the curved “back” of the Reflector Weldment.

18 Replace the Rear Nut Assembly into the Reflector Weldment.

19 Connect the Ballast-to-Light Cable (17F-028).

20 Put the Corona Lighthead into service, and energize the circuit.

TROUBLE-SHOOTING

Problem	Probable Cause	Corrective Action
Lamp goes out, then starts again	1. Momentary power failure	1. No action needed (unless it's "cycling")
Lamp starts, warms up to full brightness, then self-extinguishes	1. "Cycling" due to normal end of life failure. Normal if reasonable lifetime. 2. Possible ballast problem.	1. Replace lamp. 2. Check ballast, and/or contact BIRNS.
Lamp burns out	1. Normal if reasonable life time. 2. Possible over-voltage.	1. Replace lamp. 2. Check input voltage, and/or contact BIRNS.
Intermittent light output	1. Loose or bad contact in connector or plug.	1. Check wiring and/or contact BIRNS.
Extremely difficult to mate connectors	1. Possible mismating of connectors. 2. Insufficient connector lubrication.	1. Ensure connectors are properly aligned. 2. Lightly lubricate connectors.
Cable becomes brittle or hard	1. Too much heat.	1. Replace cable.
Cable becomes soft or sticky	1. Too much radiation.	1. Replace cable.
Leakage	1. O-ring(s) damaged. 2. Parts not tightened properly. 3. Dome cracked/damaged.	1. Replace o-ring(s). 2. Tighten parts as necessary. 3. Replace Dome.

TECHNICAL SPECIFICATIONS

Materials : Corona Lighthead 5220

All Housing Parts:	Stainless steel type 304, electropolished
Rear Nut Assembly:	Stainless steel type 304, electropolished
All hardware:	Stainless steel type 18-8
Dome:	Fused silica or Quartz
Dome Cushion Support Ring:	Polyurethane
O-rings:	Ethylene Propylene Diene Monomer (EPDM)
Connector shells:	Stainless steel type 316, passivated per QQ-P-35
Connector inserts:	Glass-reinforced epoxy (GRE)
Connector pins:	Brass 360 per ASTM B16, gold-plated per MIL-G-45204

Materials : Wet/Dry Ballast 3802

All Housing Parts:	Stainless steel type 304, electropolished
Connector shells:	Stainless steel type 316, passivated per QQ-P-35
Connector O-rings:	Ethylene Propylene Diene Monomer (EPDM)
Connector inserts:	Glass-reinforced epoxy (GRE)
Connector pins:	Brass 360 per ASTM B16, gold-plated per MIL-G-45204

Materials : Mounting Poles

All Support Pole Parts:	Stainless steel type 304, electropolished
All Hardware:	Stainless steel type 18-8

Materials : Interconnecting Cables

Connector engaging nut:	Stainless steel type 304, electropolished
Connector body:	Glass-reinforced epoxy (GRE)
Connector overmolding:	Polyurethane
Connector sockets:	Beryllium copper, gold-plated per MIL-G-45204
Cable:	

Super-Vutron: Chlorinated Polyethylene (CPE) jacket; Ethylene Propylene Diene Monomer (EPDM) insulation

Polyurethane: Polyurethane jacket; Cross-linked Polyethylene (XLPE) insulation

Physical : Corona Lighthead 5220

Length:	23 inches (58 cm)
Width:	17 inches (43 cm)
Height (with yoke):	9 inches (23 cm)
Weight in air:	20 pounds (9.1 Kg)

Physical : Wet/Dry Ballast 3802

Length (overall):	13.0 inches (33.0 cm), including end tubes
Width:	7.0 inches (17.8 cm), including cable clip
Depth:	4.5 inches (11.4 cm)
Weight —	
in air:	40.0 pounds (18.2 Kg)
In fresh water:	31.3 pounds (14.2 Kg)

Electrical

Input voltage:	115 +/- 15 VAC (standard)
Supply frequency:	60 Hz
Cable size:	16 AWG type SO, 3 conductor (standard)
Cable current rating:	12 amperes maximum
Cable voltage rating:	600 volts maximum

Lamp

Nominal Lamp Wattage:	1000 watts
Nominal Lamp Voltage:	250 (RMS)

Lighting/Photometric

HPSV Lamp type:	High-Pressure Sodium Vapor, mogul screw base
Bulb Designation:	E-25, 79.4 mm (3.125") nominal diameter
ANSI Code:	S52
Max. Overall Length:	382.6 mm (15.06")
Arc Length:	206.4 mm (8.125")
Start time:	3-5 minutes to 90% of peak output
Restart time:	60 seconds to 90% of peak on immediate power re-application after momentary interruption
Operating Position:	Universal (i.e. any position)
Rated Average[8] Lifetime:	24,000+ hours[9]

Light Output

Initial lumens:	140,000 initial lumens
Mean lumens:	90% of initial on 10 hour duty cycle
Correlated Color Temp.:	2100 K
CIE Chromaticity Coord.:	X — .512
	Y — .420

Environmental

Protection level:	IP68
Depth rating:	100 FSW (30 M) plus 50% safety margin

Expected Radiation Tolerance

Cable:	
Super-Vutron:	4×10^6 R (4×10^4 Gy)[10]
Polyurethane:	4×10^7 R (4×10^5 Gy)[11]
O-Rings:	3×10^9 R (3×10^7 Gy)
Dome Support Ring:	1×10^9 R (1×10^7 Gy)

[8]The time after which 50% of test lamps were no longer operating.

[9]These ratings are determined by the lamp manufacturer based on laboratory tests under controlled conditions. Your own field results may vary.

[10] CERN does not recommend use of the materials in Super-Vutron cable above 10^8 R (10^6 Gy).

[11]CERN does not recommend use of the materials in Polyurethane cable above 10^9 R (10^7 Gy).

APPENDICES

Appendix A — Applicable Drawings

Drawing	Title	Description
5220-TA	Corona System 1000W, Wet/Dry HPSV	Provides top-level overview
522000112	Corona Lamp Head Assy, Model 5220	2-sheet detailed assembly drawing
56F-048	Rear Nut Assy, Corona	Detailed assembly drawing of the Rear Nut sub-assembly
NLS 2	Nuclear Lighting Systems	Diagrammatic overview of major components

Appendix B — Reference Documents

Document	Title	Description
TDS-5220-002	BIRNS CORONA 1,000-Watt HPSV Lamp Construction	Provides detailed lamp construction and contents information