Risk Factor: Refrigeration Obsolescence

Context for Plant Growth Chambers

Plant growth chambers and rooms provide a controlled environment that regulates temperature, light, humidity, and other critical variables for plant science and other life science studies. The refrigeration system for each chamber regulates thermal energy to maintain air temperature within specified limits. There are two main types of refrigeration systems used by plant growth chamber and room manufacturers: direct glycol systems and direct expansion (DX) systems with either water-cooled or air-cooled condensers. DX systems employ refrigerants to provide a cooling effect in the chamber: the refrigerant absorbs heat when used in conjunction with other components such as compressors and evaporators.

Current Situation

Certain refrigerants in DX systems are **harmful to the environment** if they are released to the atmosphere and are therefore being phased out by regulatory bans in favor of those with a lower global warming potential (GWP).

In Canada, for example, original equipment manufacturers are facing regulatory bans on both R-404A and R-134A refrigerants starting January 21, 2020. Other jurisdictions such as the US and the EU are following suit, and in some locations, such as California, have already banned R-404A in new, retrofitted and stand-alone remote condensing units from January 1, 2019.

Regulatory References:

"USA Environmental Protection Agency implements ban on refrigerants"
https://www.epa.gov/sites/production/files/2015-07/documents/phasing_out_hcfc_refrigerants_to_protect_the_ozone_layer.pdf

"California Prohibits HFCs"
https://ww2.arb.ca.gov/resources/fact-sheets/hydrofluorocarbon-hfc-prohibitions-california

"Canada accelerates phase-out of HFCs"
https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/proposed-revisions-ozone-substances-regulations/chapter-3.html

Fleet Implications

As your partner Conviron wants to keep you up to date on all changes that may impact your fleet of chambers. With many refrigerants going obsolete, we want to explain what will happen to your chamber going forward into the future. If there are no failures in your refrigeration system it can run as is without any need for repairs or retrofits. If there is a failure, depending on the severity there are a few things that may need to happen:

- At a low level of failure or malfunction, the components of your refrigeration can simply be swapped out and replaced with off the shelf parts. Your refrigerant will likely need to be replaced once service work is done to the chamber, but can be filled with alternative, eco-friendly refrigerants that are a direct replacement.
- At a higher level of failure or malfunction a simple repair may not be possible. Retrofitting your refrigeration system is possible and a consultation with your Account Manager is recommended
- At the highest level of failure a retrofit or replacement of the refrigeration system may not be possible.

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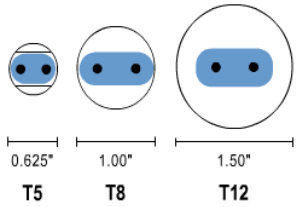
Risk Factor: T12 Fluorescent Lighting Obsolescence

Context for Plant Growth Chambers

Fluorescent lighting has long provided a versatile spectrum and a relatively efficient source of light for plant growth experiments in controlled environments used by researchers around the world. Over time, fluorescent lighting has evolved from T12 to T8 to T5 lamps. T12 generates light through electromagnetic induction, which is considered a less efficient method of creating light compared to that of newer electronic based circuits. T5 and T8 tube creates light through advanced electronic circuits; however, T5 lamps are 40% smaller than T8 fixtures, but are capable of providing the same or more light in a smaller area.

In all fluorescent lighting systems, ballasts are required to regulate the current to the lamps and provide enough voltage to start the lamps. Without a ballast to limit its current, a fluorescent lamp connected directly to a high voltage power source would rapidly and uncontrollably increase its current draw.



Current Situation

Regulatory References:
ENERGY POLICY AND CONSERVATION ACT
https://legcounsel.house.gov/Comps/Energy%20Policy%20And%20Conservation%20Act.pdf

In 1992 the Energy Policy and Conservation Act was amended to require the Department of Energy to carefully review energy standards on an ongoing basis and publish new standards as more energy efficient technologies made their way to market. In 2009, the department announced the eventual phase out of T12 lights, with production ending after July 14, 2012. Big name manufacturers (i.e. Phillips & Sylvania) were granted two-year extensions (July 2016) on the deadline, but production declined significantly over the period.

Fleet Implications

Lamp & Ballast References:
T12/T8 (p 176):
https://archive.epa.gov/epawaste/hazard/web/pdf/merc-rpt.pdf
T5:
https://archive.epa.gov/epawaste/hazard/web/pdf/merc-rpt.pdf
Ballasts:
(https://archive.epa.gov/epawaste/hazard/web/pdf/merc-rpt.pdf)

The replacement of lighting fixtures and ballasts has non-threatening implications to your chamber. Finding T12 lighting ballasts is becoming a more challenging and costly method of maintaining a chamber. However a direct replacement of your components is still a very viable option to keep your chambers running as efficiently as they are now. The replacement of the lighting does not present large roadblocks or challenges. Smaller T5 fluorescent fixtures and their ballasts are still on the market and retrofitting your chamber with T5 lighting is a great, low cost solution to continue running your chamber. Retrofitting your chamber with LED lighting may be possible and your site Account Manager would be able to verify the possibility of this retrofit.

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Risk Factor: Control System Component Obsolescence

Context for Plant Growth Chambers

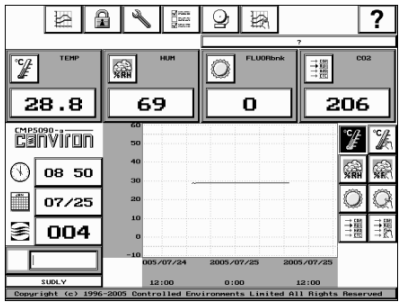
Every plant growth chamber uses a control system to regulate the mechanical, electrical, lighting and monitoring systems required to create and maintain environments for plant science experiments. Controls technology ranges from proprietary computer-based systems to specialized PLCs depending on the needs of the chamber. Conviron's line of CMP controllers was first introduced in 1982 with CMP3000. Since then, Conviron has kept pace with the rapid changes in controls technology and user requirements and currently supplies chambers with CMP6060.

Current Situation

In 1995, the CMP3000 series was replaced with the CMP4000 series system, with many additional features. In October 2005, Conviron introduced the CMP5000 series, which was replaced by the CMP6000 series in 2008. Critical components for the CMP 3000, 4000, 5000 and CMP6050 controllers are either obsolete or are no long available by the manufacturers.

Fleet Implications

In the event that your older controls do happen to fail there would be a need to retrofit your control system to Conviron's latest controller, the CMP6060. Essential parts for the Conviron CMP3000, 4000 and 5000 and 6010 series controllers have become obsolete or are no longer available. Controller retrofits are available and your Account Manager will be able to provide quotes for your fleet.



CMP4000/5000 series

CMP6010

CMP6060

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