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Environmentally Safe VpCI®/MCI® Technologies

Protecting Commercial and Institutional Facilities During Extended Shutdowns

In response to the impact of COVID-19 and the unprecedented measures to protect public safety, there have been large-scale shutdowns of hospitality, commercial, and institutional facilities across the country and around the globe. Facilities such as the following have in the past rarely need a Preservation Plan for extended shutdowns:

- Hospitality/Convention Centers
- Commercial Office Buildings
- Institutional Facilities
- School Districts
- Theme Parks
- Airport Terminals
- Universities
- Resorts

Facility managers are now faced with turning off boiler and cooling water systems without the opportunity to properly plan for a shutdown of unknown duration.

Keeping these assets corrosion-free is essential to ensuring they can be reinstated and operational as quickly and cost-effectively as possible. Corrosion is a major problem for idle equipment and assets, especially in the presence of moist, salt-laden air or fluctuating humidity. Failing to protect against corrosion can result in the following:

- Premature equipment failure
- Unnecessary and non-budgeted repair/replacement costs
- Further delays to equipment startups

Doing nothing to protect the utilities will cause even further disruption when the time comes to resume normal operations. While we all certainly hope for the best, it is important to plan for the worst.

Cortec® Corp. is working hard during this crisis to offer help and support across all industry sectors. With over 40 years of providing Asset Preservation Plans globally, Cortec® is putting its technical expertise at the disposal of its customers to assist them in the following areas:

- Boiler Layup Protection
- Cooling Water System Protection
- Closed Loop Protection
- Industrial/Institutional Odor Control
- Drain Maintenance
- Septic Treatment
- Grease Trap Management
- Concrete Repair/Mitigation

For Boiler, Cooling, and Closed Loop systems there are three methods to achieve mid-and long-term protection. Choosing any of the following types is system specific and will depend upon the varying conditions at each facility:

- **Dry**
  - Preservation product is applied after the system has been shut down and drained.
- **Wet**
  - Preservation product is added to feedwater or condensate and pumped to the boiler. The system is then shut down and maintained at high-water level.
- **Wet-Dry**
  - Preservation product is added to the system and circulated throughout. The system is shut down for 24 hours and then drained fully or partially.

With these shutdowns, many facility managers are utilizing the opportunity to do more comprehensive, detailed repairs while spaces are unoccupied. This allows them to complete the work faster as they can do a whole area at once versus smaller sections when required to keep spaces like parking garages open. Utilizing Cortec® MCI® products in conjunction with quality repair work can extend the time between required maintenance activities

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to keep more spaces open longer once the facilities are back up and running.

Following a brief description of each of the products used in preservation and repair programs, the remainder of this paper will identify application-specific options for boiler and cooling water systems.

WATER TREATMENT PRESERVATION PRODUCTS	
Boiler Lizard®	Cortec's Boiler Lizard® contains Vapor phase Corrosion Inhibitor powder in a polyvinyl alcohol (PVA) water-soluble bag. The powder formulation is free of phosphates, heavy metals, nitrites, and free amines. Designed for dry layup of boilers, the Boiler Lizard® protects metals in enclosed spaces. The VpCI® molecules vaporize and adsorb on the metal surfaces, reaching all recessed areas and interior cavities. ***Procedures:*** Take boiler out of service following normal shutdown procedures. Once drained and cooled, place Boiler Lizard® at a dosage of one for each 1,000 gallons (3.8 m³) of boiler volume inside the boiler following the application guidelines.
Boiler Egg™	Cortec's Boiler Egg™ is designed to scavenge oxygen and passivate metal during the initial filling of makeup water after seasonal or long-term dry layup of boilers. The Boiler Egg™ comes in an easy-to-handle pouch that is readily dissolved upon water contact, releasing the active ingredients as the boiler is being filled. It protects against the threat of oxygen pitting during the critical startup phase of a boiler when the makeup water is normally not pre-heated, and the operating chemical program has not yet been implemented. The Boiler Egg™ can be used in conjunction with the Boiler Lizard® as a complete preservation kit for dry layup of boilers, or it can be used on its own for applications where oxygen scavenging and metal passivation are needed during the equipment startup phase. The Boiler Egg™ provides the same protection when used in the feedwater and deaerator tank as well as the condensate return tanks. ***Procedures:*** Placed in the boiler with other components at the same time as the layup procedure, it remains dormant until startup. One Boiler Egg™ will protect up to 1,000 gallons (3.8 m³) of boiler volume and should be placed in the area of the boiler first exposed to the water when being filled.
Boiler Lizard® Plus	Cortec's Boiler Lizard® Plus is an easy-to-use, two-part complete preservation kit for dry layup of boilers. The kit combines a Boiler Lizard®, well-known for easy and effective dry layup, with the Boiler Egg™, which activates at the end of layup to protect against oxygen pitting at a critical time until the boiler reaches normal operating conditions. Boiler Lizard® Plus is designed to provide continuous vapor-phase corrosion protection throughout boiler internals after a boiler has been drained for seasonal or long-term layup. The Boiler Egg™ will lie intact and dormant until the boiler is restarted, then will dissolve and begin to scavenge oxygen and passivate metal during the initial filling of the boiler with makeup water, which is often unheated and not chemically treated. ***Procedures:*** Follow procedures provided above for the Boiler Lizard® and Boiler Egg™.

Boiler Gecko™	Cortec's Boiler Gecko™ is a convenient ready-to-use Vapor phase Corrosion Inhibitor (VpCI®) packaged in an air-powered spray can for use in the dry layup of small boilers and steam components. Boiler Gecko™ is effective for seasonal or long-term preservation of waterside and fireside components in boiler systems where the use of a Boiler Lizard® or traditional layup methods are not practical or effective. The properties of the VpCI® molecules will ensure protection throughout the boiler spaces, and direct application to a metal surface is not required. There is no need for product removal or additional flushing before the boiler is filled and returned to service. ***Procedures:*** Waterside: Take boiler out of service following normal shutdown procedures. Once drained and cooled, apply Boiler Gecko™ at a dosage of one can for each 100 gallons (380 L) of boiler volume. Fireside: Once boiler is shut down and cooled, the exhaust damper should be closed. Boiler Gecko™ should be applied to the combustion area of the boiler at a dosage of 1 fluid ounce per ft^3 (1 ml/L) of boiler combustion space.
Boiler Dragon™	Cortec's Boiler Dragon™ is a ready-to-use waterborne multi-metal Vapor phase Corrosion Inhibiting (VpCI®) fogging fluid designed for use in the dry layup of large boilers and steam components for short- and long-term preservation. The unique vapor-phase properties of the VpCI® molecules provide continued protection throughout the boiler spaces when properly applied. Direct application to every metal surface is not required. Boiler Dragon™ is a safer and/or more effective alternative to traditional boiler dry layup options such as desiccants, quicklime, or nitrogen blankets. Boiler systems preserved by the Boiler Dragon™ can be returned to service quickly by simply filling the boiler with makeup water. There is no need for product removal or flushing. ***Procedures:*** Boiler Dragon™ liquid should be applied by spraying or fogging into the equipment interior. Recommended dosage rate is 0.7-1.0 fluid ounce per ft^3 (0.7-1.0 L/m^3). One gallon of Boiler Dragon™ liquid will treat approximately 1,000 gallons (1 L/1 m^3) of boiler volume.
Boiler Iguana™	Cortec's Boiler Iguana™ is a ready-to-use waterborne corrosion inhibitor for wet layup or standby of boilers. Its combination of contact and Vapor phase Corrosion Inhibitors protect multi-metal surfaces below and above the water level. Boiler Iguana™ is easy to apply and does not require frequent monitoring—unlike traditional layup strategies that require maintenance of high pH and regular testing of oxygen scavenger levels. Boiler Iguana™ allows quick startup because it is compatible with other water treatment chemicals and there is no need to drain the boiler before bringing it back online. ***Procedures:*** Take boiler out of service following normal shutdown procedures. Once the boiler has cooled to under 250 °F (121 °C), product should be added at 0.2% concentration and circulated for 4 hours minimum prior to shutting down.

Boiler Platypus™	Cortec's Boiler Platypus™ is a ready-to-use waterborne corrosion inhibitor for wet-dry layup of both regular and high steam-purity boilers. Its combination of contact and Vapor phase Corrosion Inhibitors protects multi-metal surfaces below and above the water level. Boiler Platypus™ is easy to apply because it does not require the boiler to be drained or opened for application. It is an excellent alternative to other methods of long-term layup. ***Procedures:*** Once boiler water has cooled below 180 °F (82 °C), product should be added at a dosage of 0.3-1.0% depending upon expected period of shutdown. Water should be recirculated for 12-24 hours. Afterwards, the system should be drained.
Cooling Tower Frog®	Cortec's Cooling Tower Frog® is a Vapor phase Corrosion Inhibitor (VpCI®) powder packaged in poly vinyl alcohol (PVA) water-soluble bags. It is specially developed for dry layup of cooling tower components (tower, heat exchanger, piping, etc.) for seasonal, short, or long-term layup. Cooling Tower Frog® is effective up to 12 months. This product offers an extremely efficient method of protecting multi-metal in enclosed spaces. When the bag is cut open, the VpCIs vaporize and adsorb on all metal surfaces, reaching even recessed areas and interior cavities. The VpCI® molecules form a strong, self-replenishing, protective molecular layer on the metal. Designed for ease of application, Cooling Tower Frog® enables an easy startup. ***Procedures:*** Place bags flat into the cooling tower basin or component and slit open water-soluble bags to begin corrosion protection. Two bags treat up to 1,000 gallons (3.8 m^3) of enclosed space. After application, the internal spaces should be sealed from the outside atmosphere.
Cooling Loop Gator®	Cortec's Cooling Loop Gator® is a Vapor phase Corrosion Inhibitor (VpCI®) powder packaged in polyvinyl-alcohol (PVA) water-soluble bags. Developed for seasonal, short-, or long-term layup, Cooling Loop Gator® protects enclosed spaces for up to 12 months. Once the bag and powder dissolve, the VpCI® molecules adsorb on all metal surfaces in both the liquid and air space, reaching recessed areas and interior cavities. ***Procedures:*** One Gator treats up to 88 gallons (0.33 m^3) of water. Remove and discard outer barrier bag. Add the water-soluble bags directly into cooling water. Recirculate treated water for about 10-12 hours to obtain good protective layer before shutdown. Either drain the water out or leave treated water in cooling tower. After application, all valves should be covered, closed, and shut off.
Closed Loop Toad®	Cortec's Closed Loop Toad® is a unique combination of Vapor phase Corrosion Inhibiting (VpCI®) powders in polyvinyl-alcohol (PVA) water-soluble bags. It was developed to provide corrosion protection in recirculating and operating cooling systems. This product prevents corrosion of metals in the liquid phase, vapor phase, and at the liquid-vapor interface. The bag dissolves and the VpCI® adsorbs onto all metal surfaces, reaching even recessed areas and interior cavities. The VpCI® forms a strong protective molecular layer on the metal. Closed Loop Toad® also contains a blend of organic-based scale inhibitors to prevent scale. ***Procedures:*** Remove and discard outer barrier bag. Throw the water-soluble bags directly into cooling water. Four bags treat up to 1,000 gallons (3.8 m^3) of water. After application, all internal surfaces should be covered or closed.

INDUSTRIAL AND INSTITUTIONAL BIOLOGICAL CLEANERS AND DEGREASERS

Biological cleaners have a big advantage in use for facilities preservation. They contain beneficial microorganisms that will continue working on organic soils (meaning waste) even after initial cleaning.

ECO-CLEAN-ALL™	A powerful biological cleaner that is specifically formulated to eliminate organic soils from a wide variety of surfaces including carpet, tile flooring, fabric, and upholstery. This powerful combination digests grease, oil, protein, fat, starch, and other solid organic wastes to maintain a clean, odor-free facility. The biological activity keeps working to ensure that cleaning and odor removal occur long after the initial product application.
ECO-TRAP™ (Series)	A biological grease trap treatment containing specialty additives that loosen and liquefy heavy grease deposits, thereby speeding up their degradation. ECO-TRAP™ reduces oil and fat accumulation, prevents emergency blockages, and reduces BOD and bad odors. This product can be added to sinks, drain lines, and directly to grease traps. The bacteria will work on residual grease even when the facility is not fully operational.
ECO-DRAIN™	Formulated for the treatment of drain lines and down lines in restaurants and commercial establishments. Specially formulated so that upon 5x dilution it forms a gelatin-like substance for better contact with pipe surfaces for superior action and long-lasting effect that is important for conservation. Regular use of ECO-DRAIN™ keeps pipes clean, prevents emergency blockages, saves on line jetting, and reduces odors.
GTC 3X™	A grease trap treatment. This liquid viscous concentrate is formulated with microorganisms selected for their ability to degrade fats, oils, and greases (FOG) and reduce unpleasant odors. Can be set up to be pumped automatically into drains leading to the grease trap.
BCL5000™	A biological based cleaner/degreaser formulated for optimum cleaning and degreasing of hard surfaces such as floors, fixtures, and equipment pieces contaminated with petroleum products. BCL5000™ is especially effective on porous materials. It will degrade a wide range of hydrocarbons including gasoline, diesel, crude oil, benzene, toluene, ethyl benzene, and xylene.
PORTA-TREAT 10X	Contains a safe, non-formaldehyde formula specially designed to treat and deodorize portable toilets and mobile systems aboard vehicles.

MCI® PRODUCTS FOR CONCRETE

COMPONENT	DESCRIPTION
MCI® CorShield®	MCI® CorShield® provides excellent protection of rebar in outside storage as well as offering excellent corrosion resistance for embedded reinforcement. This product is water-based.
MCI®-2018 (Series)	MCI®-2018 is a 100% silane concrete sealer containing time-proven Migrating Corrosion Inhibitors (MCI®). MCI®-2018 penetrates deep into concrete, providing corrosion protection to reinforcing steel from existing water and chloride ions, or other contaminants. MCI®-2018 also provides water repellency by chemically reacting with the cementitious substrate under proper application, de-creasing the ingress of additional aggressive materials.
MCI®-2020 (Series)	MCI®-2020 is a surface applied, migrating corrosion inhibitor designed to penetrate through cementitious materials including concrete, mortar, and limestone. MCI®-2020 migrates in both liquid and vapor (gas) phases through the pore structure, forming a protective, molecular layer on embedded reinforcement. MCI®-2020 provides corrosion protection against carbonation, chlorides, and other contaminants. MCI®-2020 V/O is a high viscosity version of MCI®-2020 which is specifically designed for vertical and overhead applications.
MCI®-2039	MCI®-2039 is a single-component, fiber-reinforced repair mortar containing Migratory Corrosion Inhibitor™ (MCI®), fibers, and polymers. After mixing, the mortar can be applied by trowel and normal rendering tools.

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MCI®-2061	MCI®-2061 is a biological-based cleaner/degreaser formulated for cleaning concrete, asphalt, and other hard surfaces such as fixtures and equipment. MCI®-2061 is unique because it combines powerful cleaning chemistry with microorganisms capable of biodegrading hydrocarbons that stain concrete and other hard surfaces.

HOT WATER BOILER SYSTEM			
Component	**Size**	**Dry Layup**	**Wet-Dry Layup**
Boiler Waterside	<1,000 Gallon (<3.8 m^3) Boiler Volume	Boiler Gecko™	Boiler Iguana™ or Boiler Platypus™
	>1,000 Gallon (>3.8 m^3) Boiler Volume	Boiler Lizard® and Boiler Egg™	
Boiler Fireside	<1,000 Gallon (<3.8 m^3) Boiler Volume	Boiler Gecko™	N/A
	>1,000 Gallon (>3.8 m^3) Boiler Volume	Boiler Dragon™	N/A

STEAM GENERATION SYSTEM			
Component	**Size**	**Dry Layup** Drained First Preserved Afterwards	**Wet-Dry Layup** Preserved First Full/Drained/Partially Drained After
Boiler Waterside	Small	Boiler Gecko™	Boiler Iguana™
	Medium	Boiler Lizard®	Boiler Iguana™
	Large	Boiler Dragon™	Boiler Iguana™
Boiler Fireside	Small	Boiler Gecko™	N/A
	Medium	Boiler Dragon™	N/A
	Large	Boiler Dragon™	N/A
Deaerator (Feedwater Tank)	Small	Boiler Gecko™	Boiler Iguana™
	Medium	Boiler Dragon™	Boiler Iguana™
	Large	Boiler Dragon™	Boiler Iguana™
Economizer	Small	Boiler Gecko™	Boiler Iguana™
	Medium	Boiler Dragon™	Boiler Iguana™
	Large	Boiler Dragon™	Boiler Iguana™
Steam Line	Small	Boiler Gecko™	N/A
	Medium	Boiler Dragon™	N/A
	Large	Boiler Dragon™	N/A
Steam Side Heat Exchangers	Small	Boiler Gecko™	N/A
	Medium	Boiler Dragon™	N/A
	Large	Boiler Dragon™	N/A
Condensate Return	Small	Boiler Gecko™	Boiler Iguana™
	Medium	Boiler Dragon™	Boiler Iguana™
	Large	Boiler Dragon™	Boiler Iguana™

COOLING WATER SYSTEM			
Component	**Size**	**Dry Layup** Drained First Preserved Afterwards	**Wet-Dry Layup** Preserved First Drained/Partially Drained After
Full Cooling Water System	Small - Medium	Boiler Gecko™	Cooling Loop Gator®
	Large	Boiler Dragon™	VpCI®-649
Individual Chiller or Heat Exchanger	Small - Medium	Cooling Tower Frog®	N/A
	Large	Boiler Gecko™/ Boiler Dragon™	N/A
CLOSED LOOP SYSTEM			
Component	**Size**	**Dry Layup** Drained First Preserved Afterwards	**Wet-Dry Layup** Preserved First Drained/Partially Drained After
Full Cooling Water System	Small - Medium	Boiler Gecko™	Closed Loop Gator®
	Large	Boiler Dragon™	VpCI®-649
Individual Chiller or Heat Exchanger	Small - Medium	Cooling Tower Frog®	N/A
	Large	Boiler Gecko™/Boiler Dragon™	N/A

Product	Qualified MIL Spec/NSN	Standard Test Methods	Case Histories
BCL5000™		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	Bionetix® Case History 34: http://www.bionetix-international.com/wp-content/uploads/Restricted_Case_Histories/ch034.pdf
Boiler Lizard® (powder contents)	MIL-I-22110C (Commercial Equivalent)	NACE Standard TM0208-2008 (Vapor Inhibiting Ability) NACE RP0487-2000 (Selection of Rust Preventatives) OECD 306, BOD-28 (Marine Biodegradability Test) EPA/600/4-90/027F (Sea Water Toxicity Test)	Case History 146: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch146.pdf Case History 232: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch232.pdf
Closed Loop Toad® (powder contents)		NOEC/LOEC – Toxicology Testing NACE Standard TM0208-2008 (Vapor Inhibiting Ability) ASTM G-31 – Immersion Corrosion Testing	
Cooling Loop Gator® (powder contents)		EPA/600/4-90/027 F (Methods for Measuring the Acute Toxicity of Whole Effluents to Freshwater and Marine Organisms) E-17766-01 (48-hour Static Renewal Toxicity Test) NACE Standard TM0208-2008 (Vapor Inhibiting Ability)	Case History 174: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch174.pdf
Cooling Tower Frog® (powder contents)	MIL-I-22110C Vapor Inhibiting Ability Commercial Equivalent	NACE TM0208-2008 (Vapor Inhibiting Ability) NACE RP0487-2000 (Selection of Rust Preventives)	

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ECO-CLEAN-ALL™		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	
ECO-DRAIN™		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	
ECO-TRAP™ (Series)		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	Bionetix® Case History 21: http://www.bionetix-international.com/wp-content/uploads/Restricted_Case_Histories/ch021.pdf Bionetix® Case History 31: http://www.bionetix-international.com/wp-content/uploads/Restricted_Case_Histories/ch031.pdf Bionetix® Case History 32: http://www.bionetix-international.com/wp-content/uploads/Restricted_Case_Histories/ch032.pdf
GTC 3X™		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	
PORTA- TREAT™		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	
MCI® CorShield®		ASTM A944-99 Bond Strength of Steel Reinforcing Bars to Concrete	Case History 408: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch408.pdf
MCI®-2018		ASTM E-303 - Measuring Surface Frictional Properties Using the British Pendulum Tester ASTM C672 - Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals NCHRP 244 Series II Modified (Weight Gain During Saltwater Soak, Water Vapor Transmission, Chloride Ion Intrusion Characteristics) NCHRP 244 Series IV (Accelerated Weathering Test) Oklahoma DOT Test Procedure OHDL-34 and OHDL-35 (Depth of Sealer Penetration) US Bureau of Reclamation M-82 (M0820000.714) – Standard Protocol to Evaluate the Performance of Corrosion Mitigation Technologies in Concrete Repairs NSF Standard 61 – Potable Water Application	Case History 347: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch347.pdf

MCI®-2020		ASTM G-109 – Determining the Effects of Chemical Admixtures on the Corrosion of Embedded SteelReinforcement in Concrete Exposed to Chloride Environments NSF Standard 61 – Potable Water Application	Case History 653: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch653.pdf
MCI®-2039			Case History 102: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch102.pdf
MCI®-2061		EUCAST – Antimicrobial susceptibility testing – disk diffusion method, Version 6.0, January 2017 (components) OECD Method 301D (for active ingredients)	Case History 654: https://www.corteccasehistories.com/?s2member_file_download=-access-s2member-level1/ch654.pdf
VpCI®-649	6850-01-535-2531	NOEC/LOEC – Toxicology Testing NACE Standard TM0208-2008 (Vapor Inhibiting Ability) ASTM G-31 – Immersion Corrosion Testing	

Boiler Lizard +

Boiler Egg

Boiler Lizard

Boiler Dragon

Boiler Iguana

Boiler Platypus

Boiler Gecko

Closed Loop Toad

MCI®

MIGRATING CORROSION INHIBITORS
FROM GREY TO GREEN

COOLING LOOP GATORS

A Subsidiary of Cortec® Canada
Bionetix INTERNATIONAL
ISO: 9001 Certifie
Quality System Registere

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