

BP-Husky Refinery

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Legionella Hazard Assessment Policy

It is important to identify and control the amount of legionella in our cooling towers due to our aging work force, vicinity of process units, and extent at which exposure can occur. In order to address the legionella risk there is a need to routinely sample, and if needed treat the systems. Areas of concern include #3CT Cooling Tower, DHT Cooling Tower, #4 Cooling Tower, EPA Cooling Tower, and the Marley Cooling Tower. Each area will be sampled on a quarterly basis to ensure our water treatment practices are sufficient to maintain legionella below 100 CFUs. There will be a total of seven samples taken per quarter, unless there is a positive analysis at which resampling will occur after treatment has taken place. Treatment will consist of shocking the system using one of two substances: Bleach which is an oxidizing biocide or Gluteraldehyde a non-oxidizing biocide.



LEGIONELLA HAZARD ASSESSMENT

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LEGIONELLA HAZARD ASSESSMENT

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DISCLAIMER - The Nalco/Environmental Hygiene Services (Nalco/EHS) process is designed to assess control practices to reduce health-related risks associated with *Legionella* in cooling systems, domestic services, and other "at risk" water systems. No warranty as to the completeness of the information is given as this assessment is in part based upon limited information related to Nalco/EHS by the facility named herein. Assessment may also not be complete with regard to all best practices taught by various published guidelines or governing authorities. The facility named herein assumes full responsibility for the content presented. Nalco/EHS exercised due diligence, but disclaim all liability and responsibility for the direct or indirect loss or damage that may be suffered through reliance upon the completeness of the information upon which Nalco/EHS has no control. Recommendations made for *Legionella* control are intended to reduce health-related risks and to ensure the overall health and safety of employees, associates, patients, residents, guests, contractors, and visitors. No control program can eliminate all health-related risks. Regular maintenance schedules are therefore critical to the operation and the safety of the systems included in the assessment. Recommended control practices may also mitigate risk associated with other waterborne pathogens, but no claim is expressly or implicitly made since other risk factors specific to other waterborne pathogens may not be included in this assessment. In addition, recommended practices presented herein do not guarantee that water quality within the assessed systems will meet governmental or non-governmental standards. Local regulations override specific recommendations where relevant.

NOTICE – This assessment may not be applied to other facilities and systems. New systems introduced through new construction, renovations, or major system changes should be included in subsequent assessments. Other "at risk" systems discovered should also be assessed.

This assessment evaluates health-related risk factors only. It is not an assessment of any particular system as it relates to operational performance requirements. That is, recommendations made herein do not imply that practices for cooling systems, domestic services, or other "at risk" systems do not meet operational performance requirements as performed by facility personnel or through a contracted service provider. Recommendations made herein may go above and beyond standards or practices designed for optimizing operational performance goals or requirements.

LEGIONELLA HAZARD ASSESSMENT

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1. PROGRAM SUMMARY

This Legionella Hazard Assessment included the following types of engineered water systems:

- Utility Water Systems
 - East Cooling Towers (DHT, CT#3, CT#4)
 - North Marley Tower Loop (CT cells 1-9, EPA CT)

Nalco, Environmental Hygiene Services (EHS) lead and prepared the Legionella Hazard Assessment, and prepared the initial drafts Legionella Management Plans, which are included in the Legionella HACCP Program Manual. The facility management team and various site personnel provided water system details to complete the hazard assessment.

1.1 Program Goal

Development, implementation, and regular review of a Legionella HACCP Program will align key facility decision makers, will assure water safety, and will optimize operational efficiencies.

The program is based on the Hazard Analysis and Critical Control Point (HACCP) approach, which is a process for identifying risk and implementing control measures to reduce risk associated with legionellae in water systems. Benefits of following a defined program approach include:

- ✓ Prevention of waterborne disease by controlling the hazards which cause them
- ✓ Establishment of a defined defensible water safety management program
- ✓ Utilization of the following water system best practices:
 - OSHA. 1998. Occupational Safety and Health Administration. Legionnaires' disease. OSHA Technical Manual, Section III: Chapter 7.
 - ASHRAE. 2000. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. Minimizing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE Guideline 12.
 - Proposed ASHRAE Standard 188P. Prevention of Legionellosis Associated with Building Water Systems.
 - CTI. 2000. Cooling Technology Institute. Legionellosis Guideline: Best Practices for Control of Legionella.

1.2 General Approach

The hazard assessment included the following:

1. Water System Inventory – An inventory of all known engineered water systems was completed by the HACCP team or a responsible person
2. Water System Walkthrough – A walkthrough of the facility was performed by a designated responsible person to confirm the water system inventory, to confirm the system water temperatures, to confirm the system chlorine residual, or to confirm any other relevant information regarding the systems.
3. Water System Flow Process – A simple water flow process diagram was prepared to define unit process operation steps.
4. Hazard Analysis – Each process unit operation was evaluated to determine significance of a hazard and determine critical control points (CCP). Critical Control Points are points at which control can be applied and is essential to prevent or eliminate a safety hazard or reduce it to an acceptable level to prevent it from harming people.
5. Monitoring, Verification, & Validation Planning – An initial plan was defined with recommended control strategies, control limits, monitoring frequency, and corrective action.

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1.3 Management Team

Site Team Members

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1.4 Program Validation Schedule

Activity	Goal	Frequency	Accountable Person	Reviewer
HACCP Program Development	Perform initial hazard assessment and plan outline	Initial performed January 2013	Program Lead	Program Lead External HACCP Manager
Management Plan Verification	Review plan documentation to verify control strategies are within control limits, corrective action is taken, and documentation is completed.	Quarterly	Program Lead	Program Lead
Management Plan Validation	Review the plan to validate it is being followed and is effective for controlling the intended hazard.	Annually	Program Lead	Program Lead
Full HACCP Program Reassessment	Perform a full hazard assessment to account for system changes or adjustments.	Every 3-5 years or upon new construction	Program Lead	Program Lead External HACCP Manager

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2. COOLING SYSTEMS

The primary utility water system that presents a legionellae risk is the cooling water system. The purpose of a cooling tower is to provide a heat sink for heat exchange refining processes. Cooling towers by design use water by breaking it up into tiny droplets of water to maximize heat transfer. Release of water droplets or water aerosols is inherent to these systems. This is a concern because condenser water is typically in a temperature and pH range that will support microbial growth. Hence, the potential for aerosols to contain pathogenic microorganisms such as legionellae is a concern. All cooling tower systems must therefore be maintained, operated, and chemically treated in a manner that reduces the health-related risk associated with these systems.

Good risk reduction practices are therefore warranted above and beyond practices for operational goals because the inherent risk of aerosol release requires an effective and well-documented program that includes...

- stringent water treatments,
- microbial monitoring and control,
- proper mechanical maintenance and operation, and
- Regular clean and disinfect.

The possible risks associated with the cooling systems warrant a legionellae risk reduction program. Risk is highlighted below.

Utility Water Uses:

- East Cooling Towers (DHT, CT#3, CT#4) Process Cooling
- North Marley Tower Loop (CT cells 1-9, EPA CT) Process Cooling

At Risk Users

The following users may have general factors that increase risk for waterborne pathogen disease.

- Visitors, Contractors and/or Employees who may have...
 - an immunocompromised health condition:
 - various forms of cancer
 - a history of smoking
 - a history of chronic health conditions
 - persons older than age 65

High Risk Areas

- Maintain awareness for cooling tower proximity to points of entry with the facility and proximity to people surrounding the systems due to ground level locations of Cooling Towers.

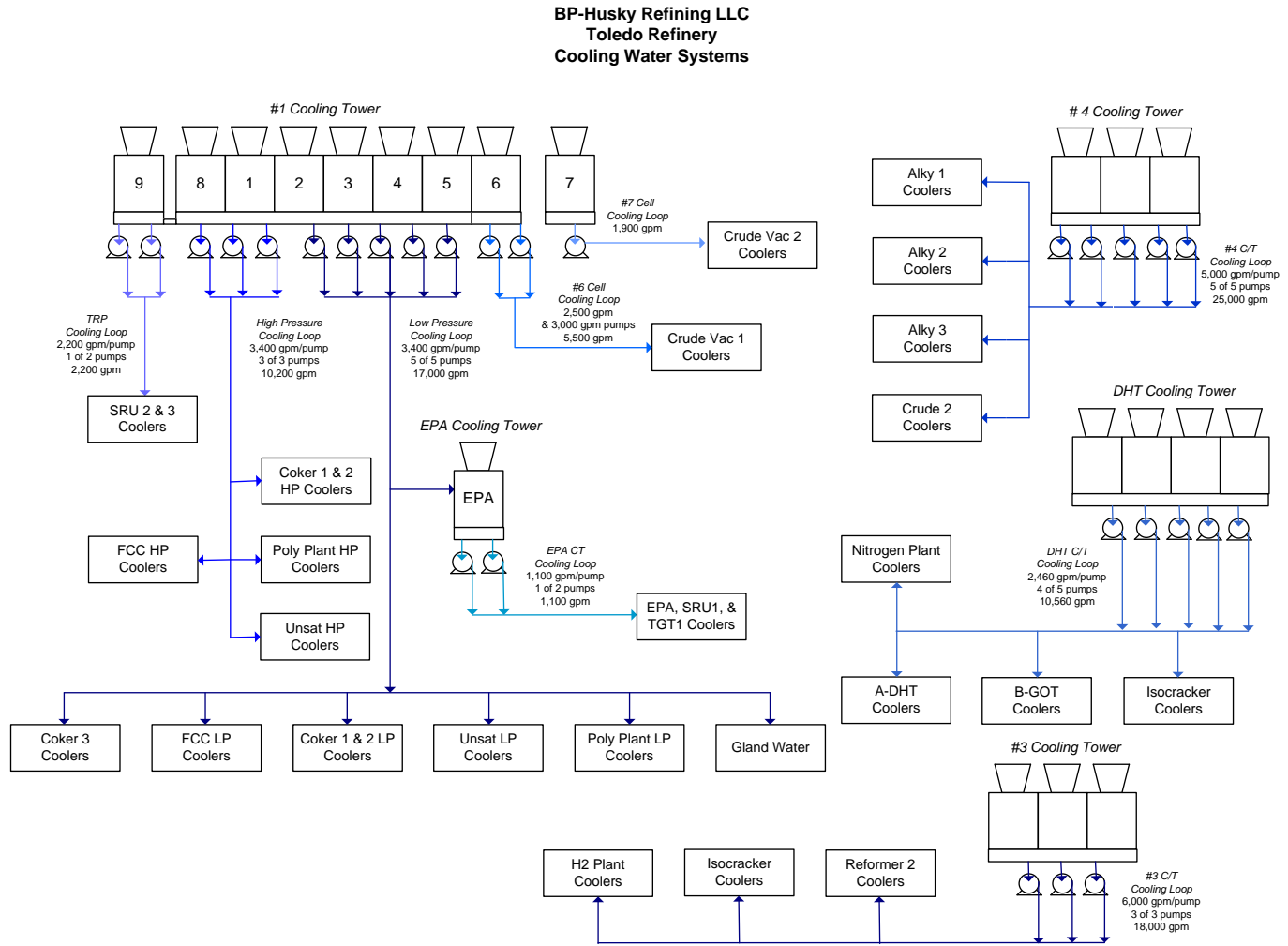
Proliferation Risk

- Microbial proliferation can occur since water temperatures are between 68-122°F (20-50°C), and more ideally 90-105°F (32-41°C).
- Risk of microbial proliferation is increased because there are potentially for hydrocarbon in the Cooling waters along with operational temperature maintaining in the 68-105 °F range.

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2.1 Process Flow Diagram

The following figure is a simple line diagram showing associated with the facility utility water streams. A system walkthrough is then completed and summarized in the next section followed by a hazard analysis of each process step in the section that follows the system walkthrough.



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2.2 System Walkthrough

DIAGRAM A: East Cooling Tower CT #3

Mechanical & Siting	Observation
Location	Ground Level
Proximity to points of entry	Open to refinery unit
Proximity to people	Unlimited – Ground level
Fan Vibrations, Water Flows	Good; no issues reported
Fill Pack, Drift Eliminator	Good; no issues reported
Dead-legs, Cross Connections	Good; no issues reported
Contaminants	
Scale / Corrosion	Good; no issues reported other than typical
Biological Slimes	Good; no issues reported other than typical
Sediments / Sludge	Good; no issues reported other than typical
Airborne Sources	Good; no issues reported
Operation & Maintenance	
Defined Operation & Inspection Schedule	Systems filled and operated 24/7/365 to maintain water treatments.
Defined Clean & Disinfect Procedure	Operations and Nalco perform online disinfection prior to shut down and confined space entrance.
Defined Maintenance of any side device	none
Monitoring & Control	
Oxidizing Biocide	Bleach Manual pump adjustment to maintain. Free chlorine test run daily to verify by operators.
Non-Oxidizing Biocide	Gluteraldehyde (Nalco H-550) and Bio dispersant (Nalco 7348), Contingency control for leak response.
Bacteria Testing	Dipslide Weekly (Total)
Legionella Testing	Not Tested
Scale & Corrosion Inhibitor	Nalco 3DT191 3DT184; 3DT198 3DT controller



CT #3



3DT Controllers



Chemical feed tanks and pumps

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DIAGRAM B: East Cooling Tower DHT

Mechanical & Siting	Observation
Location	Ground Level
Proximity to points of entry	Open to refinery unit
Proximity to people	Unlimited – Ground level
Fan Vibrations, Water Flows	Good; no issues reported
Fill Pack, Drift Eliminator	Good; no issues reported
Dead-legs, Cross Connections	Good; no issues reported
Contaminants	
Scale / Corrosion	Good; no issues reported other than typical
Biological Slimes	Good; no issues reported other than typical
Sediments / Sludge	Good; no issues reported other than typical
Airborne Sources	Good; no issues reported
Operation & Maintenance	
Defined Operation & Inspection Schedule	Systems filled and operated 24/7/365 to maintain water treatments.
Defined Clean & Disinfect Procedure	Operations and Nalco perform online disinfection prior to shut down and confined space entrance.
Defined Maintenance of any side device	none
Monitoring & Control	
Oxidizing Biocide	Bleach. Manual pump adjustment to maintain. Free chlorine test run daily to verify by operators.
Non-Oxidizing Biocide	Gluteraldehyde (Nalco H-550) and Bio dispersant (Nalco 7348), Contingency control for leak response.
Bacteria Testing	Dipslide Weekly (Total)
Legionella Testing	Not Tested
Scale & Corrosion Inhibitor	Nalco 3DT191 3DT184; 3DT198 3DT controller



DHT CT



3DT Controllers



Chemical tanks and pumps

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DIAGRAM C: East Cooling Tower CT #4

Mechanical & Siting	Observation
Location	Ground Level
Proximity to points of entry	Open to refinery unit
Proximity to people	Unlimited – Ground level
Fan Vibrations, Water Flows	Good; no issues reported
Fill Pack, Drift Eliminator	Good; no issues reported
Dead-legs, Cross Connections	Good; no issues reported
Contaminants	
Scale / Corrosion	Good; no issues reported other than typical
Biological Slimes	Good; no issues reported other than typical
Sediments / Sludge	Good; no issues reported other than typical
Airborne Sources	Good; no issues reported
Operation & Maintenance	
Defined Operation & Inspection Schedule	Systems filled and operated 24/7/365 to maintain water treatments.
Defined Clean & Disinfect Procedure	Operations and Nalco perform online disinfection prior to shut down and confined space entrance.
Defined Maintenance of any side device	none
Monitoring & Control	
Oxidizing Biocide	Bleach Manual pump adjustment to maintain. Free chlorine test run daily to verify by operators.
Non-Oxidizing Biocide	Gluteraldehyde (Nalco H-550) and Bio dispersant (Nalco 7348), Contingency control for leak response.
Bacteria Testing	Dipslide Weekly (Total)
Legionella Testing	Not Tested
Scale & Corrosion Inhibitor	Nalco 3DT191 3DT184; 3DT198 3DT controller



CT #4



3DT Controllers



Chemical tanks and pumps

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DIAGRAM D: EPA Cooling Tower – 1 Cell System

Mechanical & Siting	Observation
Location	Ground Level
Proximity to points of entry	Open to refinery unit
Proximity to people	Unlimited – Ground level
Fan Vibrations, Water Flows	Good; no issues reported
Fill Pack, Drift Eliminator	Good; no issues reported
Dead-legs, Cross Connections	Good; no issues reported
Contaminants	
Scale / Corrosion	Good; no issues reported other than typical
Biological Slimes	Good; no issues reported other than typical
Sediments / Sludge	Good; no issues reported other than typical
Airborne Sources	Good; no issues reported
Operation & Maintenance	
Defined Operation & Inspection Schedule	Systems filled and operated 24/7/365 to maintain water treatments.
Defined Clean & Disinfect Procedure	Operations and Nalco perform online disinfection prior to shut down and confined space entrance.
Defined Maintenance of any side device	none
Monitoring & Control	
Oxidizing Biocide	Bleach /bromine program fed at 4:1 ratio. Manual pump adjustment to maintain. Free chlorine test run daily to verify by operators.
Non-Oxidizing Biocide	Gluteraldehyde (Nalco H-550) and Bio dispersant (Nalco 7348), Contingency control for leak response.
Bacteria Testing	Dipslide Weekly (Total)
Legionella Testing	Not Tested
Scale & Corrosion Inhibitor	Nalco 3DT193 3DT184; Manual adjustment



EPA Tower

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DIAGRAM E: Marley Cooling Tower – 9 cell system

Mechanical & Siting	Observation
Location	Ground Level
Proximity to points of entry	Open to refinery unit
Proximity to people	Unlimited – Ground level
Fan Vibrations, Water Flows	Good; no issues reported
Fill Pack, Drift Eliminator	Good; no issues reported
Dead-legs, Cross Connections	Good; no issues reported
Contaminants	
Scale / Corrosion	Good; no issues reported other than typical
Biological Slimes	Good; no issues reported other than typical
Sediments / Sludge	Good; no issues reported other than typical
Airborne Sources	Good; no issues reported
Operation & Maintenance	
Defined Operation & Inspection Schedule	Systems filled and operated 24/7/365 to maintain water treatments.
Defined Clean & Disinfect Procedure	Operations and Nalco perform online disinfection prior to shut down and confined space entrance.
Defined Maintenance of any side device	none
Monitoring & Control	
Oxidizing Biocide	Bleach /bromine program fed at 4:1 ratio. Manual pump adjustment to maintain. Free chlorine test run daily to verify by operators.
Non-Oxidizing Biocide	Gluteraldehyde (Nalco H-550) and Bio dispersant (Nalco 7348), Contingency control for leak response.
Bacteria Testing	Dipslide Weekly (Total)
Legionella Testing	Not Tested
Scale & Corrosion Inhibitor	Nalco 3DT193 3DT184; Manual adjustment



Marley CT 1-6 8-9 cells



Marley CT 7 Cell



Marley Tower chemical feed

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2.3 Hazard Analysis

DIAGRAM A: Utility Water Systems								
Process Step	Biological (b)	Aerosol (a)	Chemical (c)	Physical (p)	Sig.*	CP	CCP	Hazard Control Strategies
Water Softener Boiler supply water	YES Resin beds are known to become contaminated with microorganisms.	MAYBE Not a likely source of aerosols under typical use. Maintenance activities may produce aerosols.	NO None	NO None	NO	A1b A1a		Perform required maintenance for optimum performance. Take precautions to prevent aerosol exposure.
Boiler System House Steam Supply	NO Heating steps will eliminate biological risk.	NO Not a likely source of aerosols.	YES Treatment chemicals	YES Scald risk	NO	A2c A2p		Take precautions to prevent chemical exposure. Take precautions to prevent scald risk.
Heating Water Loop & Exchangers Heating water supply	YES Heating water loops are known to support biological growth when water temperatures permit growth or during stagnant periods.	MAYBE Not a likely source of aerosols under typical use. Maintenance activities may produce aerosols.	YES Treatment chemicals	YES Scald risk	NO	A3b A3a A3c A3p		Perform required maintenance and water treatment for optimum performance. Take precautions to prevent aerosol exposure. Take precautions to prevent chemical exposure. Take precautions to prevent scald risk.
Air Handling Units Heating, Cooling, Ventilation	YES Systems are known to contain bacteria and fungi.	MAYBE Not a likely source of aerosols under typical use. Maintenance activities such as coil cleaning may produce aerosols.	YES Treatment chemicals	NO None	NO	A4b A4a A4c		Use high efficiency air filters to maximize particle capture and filter life. Maintain clean coils and condensate pans to control biological growth and maximize chill coil efficiency. Take precautions to prevent aerosol exposure. Take precautions to prevent chemical exposure.
Chilled Water Loop & Chillers Chilled water supply	YES Chilled water loops are known to support biological growth when water temperatures permit growth or during stagnant periods.	MAYBE Not a likely source of aerosols under typical use. Maintenance activities may produce aerosols.	YES Treatment chemicals	NO None	NO	A5b A5a A5c		Perform required maintenance and water treatment for optimum performance. Take precautions to prevent aerosol exposure. Take precautions to prevent chemical exposure.

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DIAGRAM A: Utility Water Systems								
Process Step	Biological (b)	Aerosol (a)	Chemical (c)	Physical (p)	Sig.*	CP	CCP	Hazard Control Strategies
Condensing Water Loop & Cooling Towers Condensing cooling water CCP	YES Systems are known to become contaminated with microorganisms including <i>Legionella</i> . Systems operate in an optimum growth range. Systems can become contaminated with nutrients from the air, make-up water or other sources.	YES Cooling towers by design produce aerosols.	YES Treatment chemicals	NO None	YES	A6b A6a A6c	A6b A6a	Maintain an effective biocide program to ensure biological control. Clean and disinfect systems according to best practice protocols during start up, shutdown, commissioning, after idle periods and as needed during operation. Maintain mechanical (e.g. drift eliminators) and operational elements of the system through regular inspection and review to ensure limited aerosol release within design. Maintain a water treatment program for scale and corrosion control. Take precautions to prevent aerosol exposure. Take precautions to prevent chemical exposure.
Side Stream Device Sand Filter	YES Filter systems are a known source of microorganisms including <i>Legionella</i> .	MAYBE Not a likely source of aerosols under typical use. Maintenance activities may produce aerosols.	NO None	NO None	NO	A7b A7a		Perform required maintenance (e.g., back-flushing) for optimum performance and to limit microbial growth. Take precautions to prevent aerosol exposure.

* Is risk and severity significant?

2.4 Recommended Verification Treatment Plan

The following plan is recommended based on industry best practice. These recommendations will be considered by the management team to help define the Legionella Management Plans.

Process Step	Monitoring Task	Monitoring Method	Control Limit	Frequency
Cooling Towers	Legionella Culturing	ISO 11731 culture test	<100 CFU/mL	Quarterly
	Aerobic Count	Dip slide field test	<10,000 CFU/mL	Weekly
	Halogen Residual	Nalco 3DT Automation	Measurable shown to maintain microbial control (KPI >0.3 ppm)	Continuous
	On-Line Clean & Disinfect	Clean Surfaces and System	Visual inspection	Disinfection prior to Cooling Tower outage with confined space entry
Side Stream Devices (None currently)	Back-flushing	Backpressure	Backpressure	As required
	Clean & Disinfect	Clean Surfaces and System	Visual inspection	Completed during system C&D

The Legionella testing control parameters are as follows and reaction to positive test is recommended.

Action Level	Cooling Water	Recommended Action
A	100 or less	Acceptable control. No remedial action required
B	More than 100 and up to 1,000	Prompt cleaning and/or biocide treatment of the system.
C	More than 1,000	Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.

*Cleaning and biocide treatment to follow Nalco recommended dosages contained in addendum to this report.

** Upon disinfection retest for legionella bacteria cfu in tower.

Protocol for disinfection of affected Cooling Tower is to be with Oxidizing Biocide and Bio-dispersant or Non-oxidizing biocide and Bio-dispersant. (see addendum)

3. Analytical Testing

3.1 Sample locations and Analytical testing associated

Samples will be taken from the basin at each of the cooling towers. The cooling tower sample locations are as follows:

- A. - #3CT Cooling Tower – exit of basin to supply water sump
- B. - DHT Cooling Tower – exit of basin to the supply water sump
- C. - #4 Cooling Tower – exit of basin to the supply water sump
- D. - EPA Cooling Tower – exit of basin to the supply water sump
- E. - Marley Cooling Tower –
 - 1 - 7 Cell – exit of basin to the supply water sump
 - 2 - 6 Cell – exit of basin to the supply water sump
 - 3 - HP/LP system – exit of basin to the supply water sump

Necessary sampling equipment is as follows:

P/N 500-PO228.88 Legionella water shipper with 4 sterile vials (50 ml tubes) neutralizing agent, Ziploc and cold pack

Lab analysis of Cooling Water sample for Legionella species

All samples will be collected by Nalco Representative and sent out for analysis.

Revision history:

Revision history

The following information documents at least the last 3 changes to this document, with all the changes listed for the last 6 months.

Date	Revised By	Changes
05/15/14	M. Chambers	New Policy added to SAF 117. MOC#M20141470-001

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