Audit of Milwaukee Water Works Data Center Controls

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Office of the Comptroller

September 18, 2019

Honorable Tom Barrett, Mayor
The Members of the Common Council
City of Milwaukee
Milwaukee, WI 53202

Dear Mayor and Council Members:

The attached report summarizes the results of the Audit of the Milwaukee Water Works Data Center Controls. The scope of the audit included the Milwaukee Water Works data center's physical security, environmental, and back-up control activities and included the alternate data processing site. The time period covered includes the current state of operations and one complete data back-up cycle.

The primary focus of the audit was to evaluate whether the internal controls in place over the data center are adequately designed and operating effectively. The audit objectives were as follows:

1. Assess whether the data center physical and IT environmental controls are compliant with department policy, best practice criteria and standards outlined by Information Systems Auditing and Control Association (ISACA), Federal Information System Controls Audit Manual (FISCAM), and the National Institute of Standards and Technology (NIST), and

2. Assess whether the data center controls over data back-up, offsite storage and system restoration procedures are performed in accordance with department policy, best practice criteria and standards outlined by ISACA, FISCAM and NIST.

Overall, the audit concluded that the controls in place over policy and procedure, disaster recovery and business continuity planning are adequately designed and operating effectively. However, gaps exist in the operational effectiveness of physical access and environmental controls. This report identifies five recommendations to address these issues.

Audit findings are discussed in the Audit Conclusions and Recommendations section of this report, and are followed by management's response.

Sincerely,

Aycha Sawa, CPA, CIA
Deputy Controller and Interim Audit Manager

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AUDIT REPORT HIGHLIGHTS

Audit of Milwaukee Water Works Data Center Controls

OBJECTIVES

The objectives of the audit were to assess whether the data center physical and IT environmental controls, and controls over data back-up, offsite storage and system restoration were in compliance with department policy and best practice criteria and standards.

BACKGROUND

The Water Works mission is to provide a safe and reliable supply of water to customers at a competitive price. From its Howard Avenue and Linnwood water treatment plants, Water Works pumps and treats water from Lake Michigan for distribution to approximately 860,000 customers in the City of Milwaukee and 15 suburbs.

Water Works administers its own technology operation encompassing network infrastructure, software management, and desktop servicing. Water Works maintains two independent server rooms at Howard Avenue and Linnwood, as well as a server room at ITMD's data center at 809 North Broadway.

Water Works is regulated by the State of Wisconsin Public Service Commission and the Wisconsin Department of Natural Resources.

OVERVIEW

The audit concluded that the controls in place over policy and procedure, disaster recovery and business continuity planning are adequately designed and operating effectively. However, gaps exist in physical access and environmental controls to protect against the risk of damage from fire, water, and temperature & humidity irregularities.

This report includes **five** recommendations to address these issues, the **three most significant** of which relate to environmental controls, particularly at the Linnwood location, as summarized in the Recommendation Summary below. (Detail on all five recommendations can be found in the Audit Conclusions and Recommendations section of this report.)

RECOMMENDATION SUMMARY

1. **Fire Prevention: Enhance and establish fire prevention controls.**

   ▪ Develop and implement a complete fire suppression plan at Linnwood including fire extinguishers, smoke detectors, fire alarms, and sprinkler or halon or other fire suppression system.

   ▪ Implement the new fire suppression system as soon as possible at the Howard location.

2. **Flood Protection: Enhance flood prevention controls.**

   ▪ Consider installation of floor drains, leak detection system and raised floors at Linnwood.

   ▪ Consider installation of floor drains and leak detection system at Howard.

3. **Enhance temperature and humidity controls including:**

   ▪ Periodic monitoring of temperature and humidity to ensure server room stays within criteria established by Water Works Standard (All server rooms).

   ▪ Redesigning Linnwood server room to meet best practice standards.

   ▪ Implementing best practice temperature and humidity controls at the Linnwood location.

I. Audit Scope and Objectives

The scope of the audit encompassed the Milwaukee Water Works (Water Works) data center's physical security, environmental and backup control activities and includes the alternate data processing site. The time period covered includes the current state of operations and one complete data backup cycle.

Audit activities consisted of process walkthroughs, observations, review of policies and procedures and testing of controls. During the performance of these audit activities, the data center's controls were evaluated using the environmental and back-up control standards as published by the Information Systems Auditing and Control Association (ISACA), Federal Information System Controls Audit Manual (FISCAM), and the National Institute of Standards and Technology (NIST). The data center was also evaluated based on adherence to City policy, procedure and best practice criteria.

Objectives

The objectives of the audit were as follows:

1. Assess whether the data center physical and IT environmental controls are compliant with department policy, best practice criteria and standards outlined by ISACA, FISCAM, and NIST, and

2. Assess whether the data center controls over data back-up, offsite storage and system restoration procedures are performed in accordance with department policy, best practice criteria and standards outlined by ISACA, FISCAM, and NIST.

The audit was conducted in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for the findings and conclusions based on the audit objectives. Internal Audit believes that the evidence obtained provides a reasonable basis for the audit's findings and conclusions based on the audit objectives.

Methodology

Audit methodology included developing an understanding of the processes and controls over the Water Works data center. To establish appropriate evaluation criteria for this audit, controls and procedures specific to the Water Works data center were compared to a best practice based controls testing program. The audit program was developed using ISACA, FISCAM, and NIST. These best practice standards present a methodology for performing information system control audits of federal and other governmental entities in accordance with professional standards as presented in Government Auditing Standards, (also known as the "Yellow Book") which was used as a reference and program development guide for the planning of this audit. The audit program and procedures also included elements from best practice criteria COBIT, COSO[1], and NIST 800-14, 800-53 (Revision 4), 800-84. These standards were relevant during audit testing, finding identification, and recommendation development.

The audit procedures developed to evaluate the processes and controls to meet the audit objectives included process walk-throughs, inspection of relevant control documentation, and the testing of controls as follows:

- ➤ Review of internal policies, procedures, and guidelines;
- ➤ Review of physical access controls to the Howard & Linnwood data centers, the Water Works server room at ITMD, and Plant Automation sites, based on the principle of least privilege;
- ➤ Assessment of environmental controls to protect against the risk of damage from fire, water, temperature and humidity irregularities, and unauthorized persons;
- ➤ Assessment of data backup, offsite storage and system restoration procedures; and
- ➤ Evaluation of the business continuity plans to recover from a service outage.

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[1] - Control Objectives for Information and Related Technology (COBIT)

  - Committee of Sponsoring Organizations of the Treadway Commission -2013 (COSO)

II. Organization and Fiscal Impact

Water Works Mission[2]

Water Works Mission is to provide a safe and reliable supply of water to customers at a competitive price. Water Works administers its technology operations encompassing network infrastructure, software management, and desktop servicing. To support their technology operation, the positions of IT Manager, IT Supervisor, Systems Analyst, Programmer Analyst, and Network Coordinators are maintained. The technology operations are dependent upon a well maintained and functioning data center. Water Works maintains two independent data centers, Howard and Linnwood, as well as a server room at ITMD at 809 North Broadway. Planning and design for a renovated Linnwood facility is currently underway.

Water Works is regulated by the State of Wisconsin Public Service Commission and the Wisconsin Department of Natural Resources. From its Howard Avenue and Linnwood treatment plants, Water Works pumps and treats water from Lake Michigan for distribution throughout the area. It delivers this water through 1,960 miles of mains to approximately 860,000 customers in the City of Milwaukee and 15 suburbs. Budgeted annual revenues for 2018 and 2019 were $139 and $136 million respectively with corresponding budgeted expenses of $134 and $135 million.

III. Audit Conclusions and Recommendations

Overall, the audit concluded that the controls in place over policy and procedure, disaster recovery and business continuity planning are adequately designed and operating effectively. In particular, Water Works business continuity plans, including disaster recovery policy and procedures, are well documented and designed. Water Works has detailed business continuity and disaster recovery plans, as well as other policies and procedures to address emergency situations and recovery processes to collectively assist the disaster recovery response. Water Works also conducts periodic test, training and exercise programs to ensure its policies and procedures function as planned.

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[2] City of Milwaukee, *2019 Plan and Budget Summary,* pages 211-215

However, gaps exist in physical access and environmental controls to protect against the risk of damage from fire, water, and temperature & humidity irregularities. This report identifies five recommendations to address these issues.

1. Perform and document periodic physical-access reviews.
2. Enhance flood prevention controls.
3. Enhance fire prevention controls.
4. Enhance temperature and humidity controls.
5. Eliminate all windows on exterior walls

Additional details regarding the recommendations for improvement are provided in the remaining sections of this report.

A. Physical Access Security

In accordance with best practice requirements, including FISCAM,[3] access to facilities should be limited to personnel having a legitimate need for access to perform their duties. Management should regularly review the list of persons authorized to have physical access to sensitive facilities, including contractors and other third parties. In addition, procedures should be implemented to remove access privileges for terminated or separated employees or contractors. Finally, Water Works policy "IT System Security Policy" requires periodic physical access reviews to be performed.

Based on the testing of physical access, seven (or 5%) individuals had inappropriate access to Plant Automation sites, and one (or 2%) individual had inappropriate access to the Linnwood data center.

Recommendation 1: Perform and document periodic physical-access reviews.
- Water Works should perform periodic, formal physical access reviews for all individuals with access to the Howard & Linnwood data centers, and Plant Automation sites for appropriate access levels, including the removal of access for employees separated from City service or transferred to areas that do not require access.

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[3] US Government Accountability Office, *Federal Information Systems Controls Audit Manual (FISCAM)*, 2009, Page 260.

- Retain the documentation evidencing the completion of the periodic review, any changes made because of the review, and document management approval with signature and date.

B. Flood Protection

Environmental controls prevent or mitigate potential damage to facilities and interruptions in service and can diminish the losses from some interruptions such as floods or other water damage by detecting potential problems early so that they can be remedied.[4] Water Works "Environmental Standard for IT Rooms" requires floor drains and critical alarms related to the physical environment of the room.

There is no leak detection system, floor drain, or raised floor at both the Howard and Linnwood data center locations.

Recommendation 2: Enhance flood prevention controls including consideration of:
- Floor drains and leak detection systems at Howard and Linnwood, and
- Incorporation of raised floors into the design for the new Linnwood server room.

C. Fire Prevention

Fire prevention controls to prevent or mitigate potential damage to facilities and interruptions in service from fire and smoke damage[4] were inadequate at both the Howard and Linnwood data centers. Water Works "Environmental Standard for IT Rooms" requires an adequate fire suppression system and critical alarms.

At the time of the walkthrough in April 2019 the Howard data center was in the process of implementing an FM-200 fire suppression system. As a result, smoke detectors and alarms were inoperable at the time.

At the Linnwood data center there were no fire suppression controls noted including the lack of fire extinguishers, smoke detectors, fire alarms and fire suppression system.

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[4] US Government Accountability Office, *Federal Information Systems Controls Audit Manual* (FISCAM), 2009, CP-2.2, pages 320-321.

Recommendation 3: Enhance and establish fire prevention controls including:

- Implementation of the fire suppression system as soon as possible at the Howard location.

- Development and implementation of a complete fire suppression plan at Linnwood, including fire extinguishers, smoke detectors, fire alarms and sprinkler or halon or other fire suppression system.

D. Temperature and Humidity

FISCAM requires humidity and temperature to be controlled within acceptable ranges[5]. Water Works "Environmental Standard for IT Rooms" requires room cooling and humidity control via an independent AC system with a return air design point temperature and relative humidity of 72°F (±2°F) and 45% (±5%) respectively, as well as critical alarms related to the functioning of the A/C system.

Daily average temperatures were not within established standards for any day during the sample period reviewed (4/1-4/30/19) at either the Howard or Linnwood data centers. At Howard, temperatures were always below standard, and at Linnwood always above standard.

Daily average humidity levels were below standards for 16 of the 30 days of the sample period at Howard, and above standards for 15 of the 30 days at Linnwood.

Recommendation 4:   Enhance temperature and humidity controls including:

- Periodic monitoring of temperature and humidity to ensure server room stays within criteria established by Milwaukee Water Works Standard (All server rooms).

- Redesign of server room to meet best practice standards (Linnwood).

- Implementing best practice temperature and humidity controls (Linnwood).

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[5] US Government Accountability Office, *Federal Information Systems Controls Audit Manual* (FISCAM), 2009, CP-2.2.6, page 325.

E. Linnwood Data Center Exterior Window

Best practices[6] and Water Works Environmental Standard for IT Rooms specify that data rooms should not have windows (for security, sound, and environmental management reasons.) The Linnwood data center is located on the first floor and is directly accessible from the outdoors through a window on an exterior wall.

Recommendation 5: During the planning & design for the renovated Linnwood facility, eliminate windows on exterior walls.

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[6] US Government Accountability Office, *Federal Information Systems Controls Audit Manual* (FISCAM), 2009, CP-2.2, pages 320-321.

September 3, 2019

Aycha Sawa
Audit Manager
Comptroller's Office
200 East Wells Street, Room 404
Milwaukee, WI 53202

RE: **Response to the Audit of Milwaukee Water Works Data Center Controls**

Dear Ms. Sawa,

The Milwaukee Water Works (MWW) appreciates the opportunity to collaboratively work with the Comptroller's Office in completing the Audit of the Milwaukee Water Works Data Center Controls and would like to offer the following response to the report recommendations.

Recommendation 1: Perform and document periodic physical-access reviews.

- Water Works should perform formal periodic physical access reviews for all individuals with access to the Howard and Linnwood data centers and to also include Plant Automation sites for appropriate access levels, this process should include the removal of access for employees separated from City service or transferred to areas that do not require such access.
- Retain the documentation evidencing the completion of the periodic review noting any changes made because of the review, and document management approval with signatures and date.

Management Response:

The utility is in agreement with these findings and is developing a Preventative Maintenance Work Order (PM) in our Computerized Maintenance Management System (CMMS) that will automatically generate this work order to the Water Security manager to be completed on an annual basis in December. Completing this work and attaching the required access lists to the report will meet the recommended requirements of item two.

Recommendation 2: Enhance flood prevention controls including consideration of:

- Floor drains and leak detection systems at Howard and Linnwood.
- Incorporation of raised floors into the design for the new Linnwood server room.

Management Response:

The utility will review the cost effectiveness of added floor drains and a raised floor in the new Linnwood data center based on the risk associated with a 100-year flood at these locations. The utility agrees to install an early

warning system for water by adding water detection sensors to both the Linnwood and Howard data centers that will be tied to our SCADA system to report the water in the data center condition to our 24/7 control center at each site. Additionally, the utility will develop procedures to address this condition along with adding an actuating valve to close the humidification line (only water internal to the data center) outside the data center in the event of an alarm. All data center alarms (heat/humidity/water/fire) will continue to generate a WIN 911 text message to IT staff with responsibility for the data center in question

Recommendation 3: Enhance and establish fire prevention controls including:

- Implementation of the fire suppression system as soon as possible at the Howard location.
- Development and implementation of a complete fire suppression plan at Linnwood, including fire extinguishers, smoke detectors, fire alarms and sprinkler, halon or other fire suppression systems.

Management Response:

The utility agrees with the recommendation and has completed the installation of the Howard Data Center fire suppression system and is awaiting final approval from the authority having jurisdiction. The Linnwood data center fire suppression has been designed and we are in the process of purchase and installation. Linnwood Data Center is scheduled to be completed and operational 11/1/2019.

Recommendation 4: Enhance temperature and humidity controls including:

- Periodic monitoring of temperature and humidity to ensure server room stays within criteria established by Milwaukee Water Works Standard (All server rooms).
- Redesign of server room to meet best practice standards (Linnwood).
- Implementing best practice temperature and humidity controls (Linnwood).

Management Response:

The utility agrees with the finding and has adjusted our standard to meet the ASHREA TC9.9 Data Center Networking- Issues and Best Practice whitepaper supplied by the Comptroller Office. The utility will develop a PM to quarterly review all trend data associated with cooling and humidification of data center in an effort to maintain to stay within standards and find issues early and repair. The utility will develop procedures to address these conditions in the event of an alarm. All data center alarms (heat/humidity/water/fire) will continue to generate a WIN 911 text message to IT staff with responsibility for the data center in question

Recommendation 5: During the planning & design for the renovated Linnwood facility, eliminate windows on exterior walls.

- The utility agrees with this finding that was completed as of 8/12/2019 for the new Linnwood Data Center.

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The utility will work to complete the initiatives noted above within this calendar year to mitigate the risks noted in the audit report.

Sincerely,
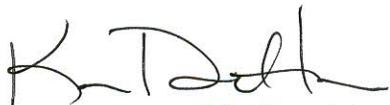
Karen Dettmer, P.E., Superintendent
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Office of the Comptroller

September 18, 2019

Honorable Tom Barrett, Mayor
The Members of the Common Council
City of Milwaukee
Milwaukee, WI 53202

Dear Mayor and Council Members:

With this letter, the Office of the City Comptroller acknowledges receipt of the preceding report, which communicates the results of the Audit of Milwaukee Water Works Data Center Controls. I have read the report and support its conclusions. Implementation of the stated recommendations will help improve City processes.

As the City Comptroller, I was not involved in any portion of the work conducted in connection with the audit. At all times, the Internal Audit Division worked autonomously in order to maintain the integrity, objectivity, and independence of the audit, both in fact and in appearance.

Sincerely,

Martin Matson

Martin Matson,
Comptroller

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