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U.S. Government Publishing Office Indoor Air Quality Inspection

OIG Report Number 24-02


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MEMORANDUM
OIG-24-015

Date: February 14, 2024

To: Director, U.S. Government Publishing Office

From: Inspector General, U.S. Government Publishing Office

Subject: Final Report— Indoor Air Quality Inspection, Report Number 24-02

Enclosed is the subject final report. The Office of the Inspector General (OIG) conducted an inspection of GPO's indoor air quality. We reported two findings and one observation. We made six recommendations and two considerations intended to improve the indoor air quality at GPO. The recommendations and considerations focus on improving processes and management controls; improving safety, morale, and health; and initiating best business practices.

GPO reviewed the draft report and provided comments through the Director. In accordance with the Council of the Inspectors General on Integrity and Efficiency standards for inspections, we reviewed GPO's comments for relevance and completeness and included them in their entirety in Appendix E. We made changes to the report where relevant and informed by the management comments. For example, we amended recommendation 5 to clarify that GPO develop and implement a comprehensive renovation plan in accordance with the pending building utilization plan. Our office is always open to alternatives to meet the intent of the recommendations as the Agency is the best arbiter of how recommendations should be implemented.

GPO concurred with four recommendations and two considerations; and concurred with comment on two recommendations. GPO's proposed actions were responsive to the recommendations. We summarize management's comments and provide a detailed response throughout the body of the report. All recommendations remain open at this time.

We appreciate the courtesies extended to our staff throughout this review. If you have any questions or comments about this report, please contact Connie Greene, Assistant Inspector General for Inspections, at cgreene@gpo.gov or (202) 512-1597.

NATHAN J. DEAHL
Inspector General

RESULTS IN BRIEF

What We Did

The OIG inspection team sought to understand how the U.S. Government Publishing Office (GPO) maintains indoor air quality (IAQ) at the Central Complex Buildings in Washington, DC. Specifically, we assessed:

1. Whether GPO's ventilation and air cleaning system design(s) are in alignment with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 62.1.
2. Whether GPO is maintaining its ventilation and air cleaning system.

What We Recommend

Our report contains six recommendations and two considerations designed to improve the IAQ at GPO. The recommendations focus on developing and implementing a comprehensive renovation plan for the ventilation and air cleaning system; developing a plan to address and possibly replace the old and dirty air ducts; implementing a proactive air sampling program in accordance with ASHRAE design limits; and a lead testing program in accordance with GPO Directive 670-52A.

What We Found

Finding 1. The GPO chiller plant is nearing the end of its useful life, creating a critical operational risk. The potential for insufficient cooling due to chiller plant failure was identified as a concern by multiple GPO officials. GPO had one chiller that was inoperable from November 2022 through September 2023. The GPO chiller plant, installed in 2003, provides mission-critical cooling to Buildings A, B, and C. The chiller plant is nearing the end of its life expectancy based upon the American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE) estimates, as evidenced by bearing repairs completed on chiller #3 in 2023 and current signs of excessive bearing wear in chiller #1. This presents a significant operational risk that could result in the GPO Central Complex ceasing to operate.

Observation 1. We found no record that GPO's Central Complex ventilation and air cleaning system design is in alignment with ASHRAE 62.1. There is no record that ASHRAE guidelines were followed during the design or renovation of any portion of the ventilation and air cleaning system at the GPO Central Complex. This may have contributed to the 66 percent employee satisfaction rate with the IAQ at the GPO Central Complex. The ASHRAE standard is 80 percent satisfaction.

Finding 2. The GPO ventilation and air cleaning system is being maintained and indoor air is being tested. However, improvements could be made in both areas. Most of the AHUs and air ducts at GPO are old and dirty and there is no established cleaning program. There is no comprehensive design document that maps the current ventilation and air cleaning system. While there are hardcopy schematics showing AHU and duct locations, those schematics have not been updated to reflect renovations. GPO does not have a comprehensive plan to address future ventilation and air cleaning system requirements but has instead made limited renovations to the system concurrent with other building renovations. There is an operational IAQ testing program at GPO; however, the program could be improved.

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INTRODUCTION

The inspection team sought to understand how GPO maintains Indoor Air Quality (IAQ) at the Central Complex Buildings in Washington, DC. We assessed whether GPO's ventilation and air cleaning system design(s) are in alignment with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62.1, and whether GPO is maintaining its ventilation and air cleaning system. The report contains two findings and one observation.[1] Based on the results, we made six recommendations, and two considerations; see Appendix A. The scope and methodology are presented in Appendix B.

Background

Context of the Inspection

We initiated this review from our Fiscal Year 2023 annual work plan. The inspection was informed by a General Services Administration (GSA) OIG Management Alert outlining inadequate ventilation in the GSA Headquarters Child Care Center.[2] That alert identified the following areas of concern:

- GSA did not meet the ASHRAE standard for ventilation in the Child Care Center.
- The lack of ventilation meant that the occupants of the Child Care Center were not provided fresh air when the outside air temperature was below 40°F.
- Even when fresh air was provided, the space lacked ventilation due to the absence of return vents.
- GSA's mitigation steps to address the lack of fresh air would not enable the agency to meet the ASHRAE ventilation standard until the air handling unit (AHU) is replaced.

Since that time, GSA published an inspection report and an audit report outlining similar deficiencies throughout their organization. Additionally, the United States Postal Service OIG published a similar audit report outlining deficiencies in their organization. Based on the information used to inform the background, and takeaways from other applicable OIG reports, the objectives of this inspection determined if the air quality within the GPO Central Complex Buildings is in alignment with applicable standards or otherwise presents concerns.[3]

[1] Per the *Council of the Inspectors General on Integrity and Efficiency Quality Standards for Inspection and Evaluation*, December 2020 (Blue Book), a finding is an issue that may involve a deficiency, such as noncompliance with provisions of laws, regulations, contracts, or grant agreements. Per the *GPO OIG Inspections Division Policies and Procedures Handbook*, January 1, 2022, an observation is a conclusion about a condition where a standard (i.e., criteria) may not have been violated or may not exist, but where economy, efficiency, or effectiveness may be improved through corrective actions.

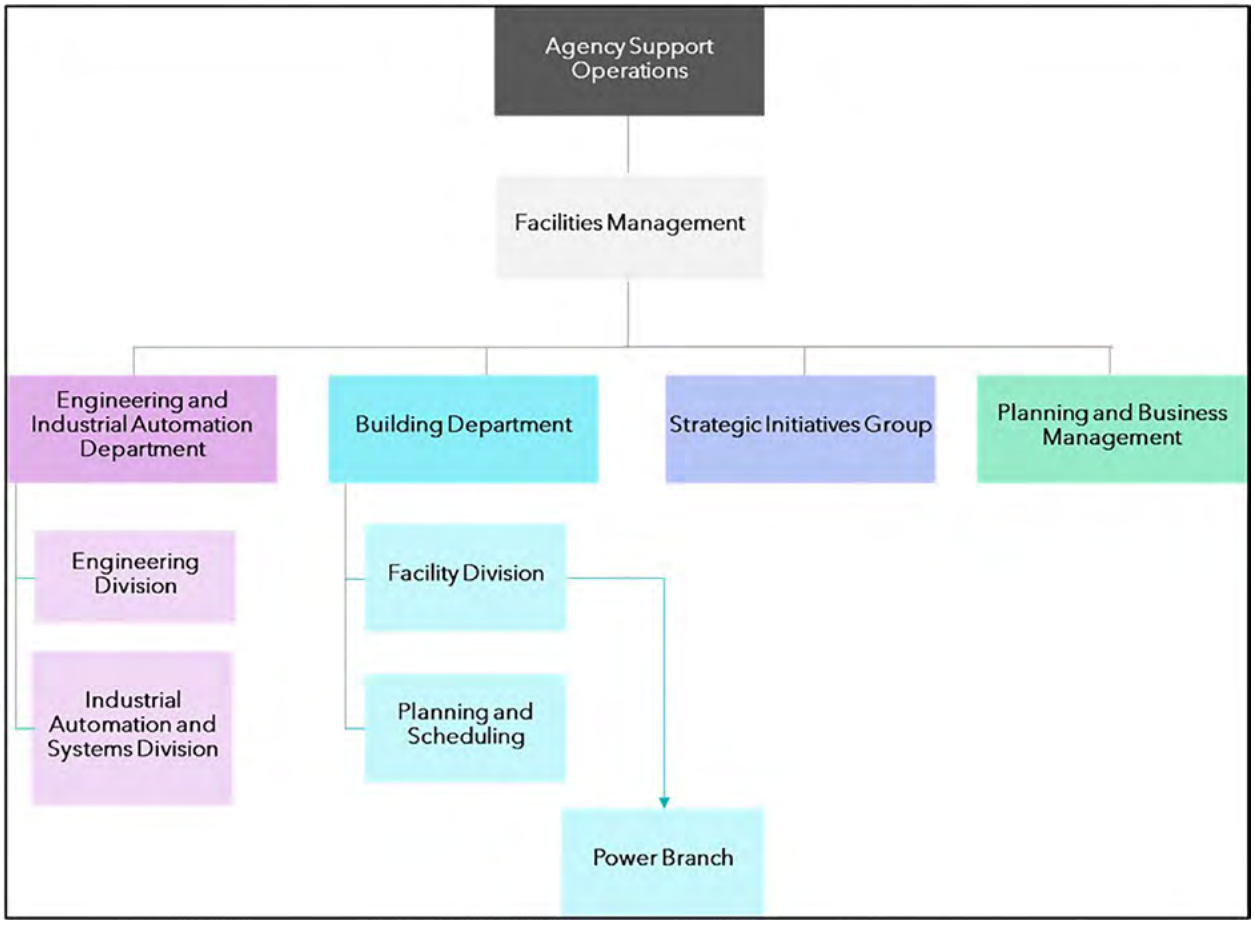
[2] GSA Management Alert: *Inadequate Ventilation in GSA Headquarters Child Care Center*, March 10, 2022, Report JE22-001 (Oversight.gov).

[3] The GPO Central Complex Buildings, the GPO Central Complex, and the Central Complex all refer to Buildings A, B, C, and D in Washington, DC.

Facilities Management Organization

Maintenance for GPO's ventilation and air cleaning system falls within Agency Support Operations/ Facilities Management. Specifically, the Facility Division, which includes the Power Branch. An organizational chart for Agency Support Operations/Facilities Management is shown in Figure 1. Within the Facility Division, the Power Branch is responsible for the mechanical maintenance of the AHUs; the Engineering Division is responsible for designing and integrating new or renovated systems; and the Industrial Automation and Systems Division, in coordination with the Facility Division, uses building automation tools to inform the preventive maintenance program. Also, in practice, the Industrial Automation and Systems Division assists the Engineering Division with its responsibilities.

Figure 1. Agency Support Operations/Facilities Management Organizational Chart



Source: GPO

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

ASHRAE is a diverse organization dedicated to advancing the arts and sciences of heating, ventilation, air conditioning, and refrigeration to serve humanity and promote a sustainable world. ASHRAE Standard 62.1, *Ventilation and Acceptable Indoor Air Quality* specifies minimum ventilation rates and other measures intended to provide IAQ that is acceptable to human occupants and minimizes adverse health effects. While compliance with ASHRAE is not mandatory by law or applicable administrative policy, compliance is recognized as an industry best practice.

The Issue

GPO's Central Complex Buildings were built between 1899 and 1940; however, there have been various renovations and upgrades over the years.[4] ASHRAE Standard 62.1 is the recognized standard for ventilation system design and acceptable IAQ. There is no applicable federal or local legislation governing IAQ. Although substantial legislation exists governing emissions from and air quality outside of buildings, multiple attempts to pass IAQ legislation have failed. Nevertheless, GSA regulations mandate compliance with applicable professional association standards (ASHRAE 62.1) for IAQ. Although GPO Central Complex Buildings are not GSA buildings, and therefore not subject to those regulations, alignment with GSA regulations would be a best practice.

Objectives

The overall objective was to assess how GPO maintains IAQ at the Central Complex Buildings in Washington, DC. Sub-objectives were:

1. Assess whether GPO's ventilation and air cleaning system design(s) are in alignment with ASHRAE 62.1.

2. Assess whether GPO is maintaining its ventilation and air cleaning system.

Prior Evaluation Coverage

- GPO OIG Report 23-08, *Top 10 Safety Hazards Program Inspection*, September 28, 2023.[5]

Other OIG Related Coverage

- GSA Report JE22-001, *Management Alert: Inadequate Ventilation in GSA Headquarters Child Care Center*, March 10, 2022.

- GSA Report JE23-001, V*entilation Issues Persist in Unrenovated Wings of GSA Headquarters Building*, November 28, 2022.

- GSA Report A201018/P/4/R22008, *COVID-19: PBS Faces Challenges in its Efforts to Improve Air Filtration in GSA-Controlled Facilities*, September 30, 2022.

- United States Postal Service Audit Report 21-118-R22, *Ventilation and Filtration in Postal Service Facilities*, February 4, 2022.

[4] When a building is initially designed, the ASHRAE standards of that time are applicable; the ASHRAE 62.1, 2022 standards apply to new construction; additions to existing buildings and replacement of components within an existing building; there are exceptions when an existing ventilation system is extended to serve an addition or when a replacement component is of like size and kind to the component it replaces; in these cases the standards that were in effect at the time of original construction apply.

[5] A portion of the inspection addressed ductwork that will also be addressed in this report.

Criteria

- GSA P100, *Facilities Standards for the Public Building Service*, October 2021.
- GPO Directive 670-52A, *Working with Lead*, June 5, 2019.
- ASHRAE 62.1, *Ventilation and Acceptable Indoor Air Quality*, (1973), as amended, 2022.

IAQ Survey Results

In accordance with Section 7.3.2 of ASHRAE 62.1, the inspection team administered a survey regarding IAQ at GPO's Central Complex in Washington, DC.[6] The survey was conducted from July 18-25, 2023.[7] The objective of the survey was to help understand the IAQ at GPO's Central Complex and address any concerns.

About the Survey

The survey was available to all 1,428 GPO Washington, DC area employees. We received 344 responses (24 percent response rate), a statistically significant sample with the following margin of error and confidence interval:

- Margin of error, ± 4 for each question.
- 95 percent confidence level (represents how often the true percentage of the population who would pick an answer).[8]

The inspection team provided all occupants with an electronic survey of questions, including, "Do you perceive the air quality in your environment to be acceptable or unacceptable?" According to ASHRAE 62.1, this subjective evaluation validates the acceptability of indoor air if 80 percent of respondents in the area do not express dissatisfaction.

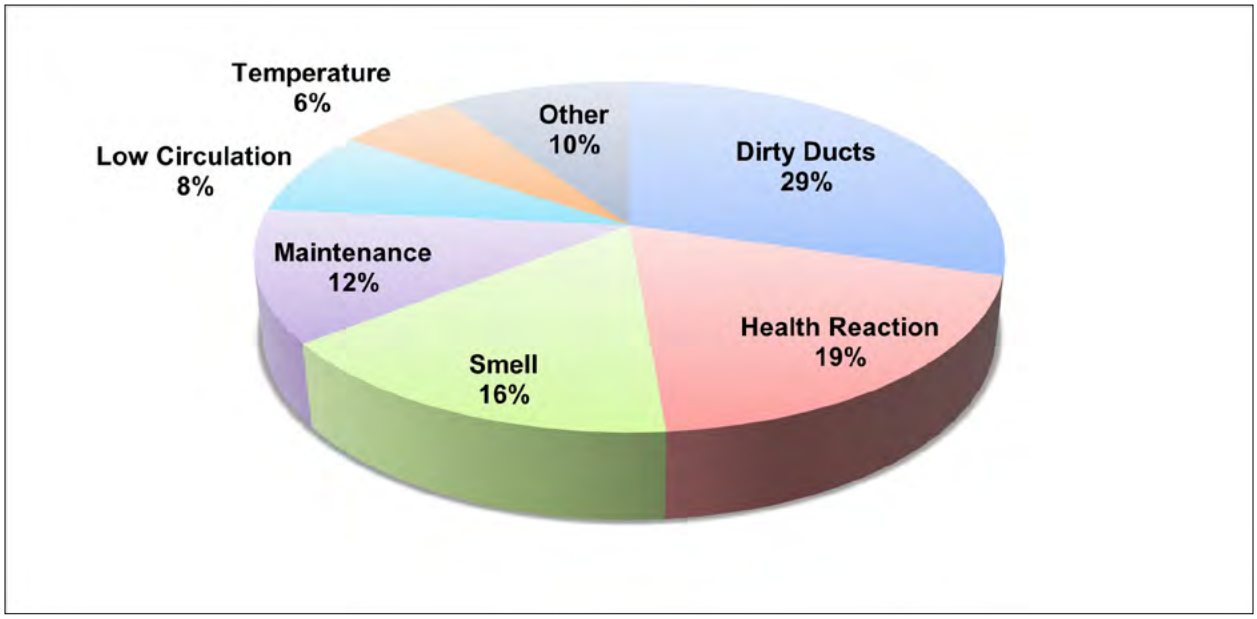
[6] 7.3.2 Subjective Evaluation. Using a subjective occupant evaluation conducted in the completed building, the survey test results shall demonstrate occupant level of acceptability of 80 percent or more within each zone served by the system.
[7] Because of the Canadian wildfires' effects on air quality in the National Capital Region we delayed the survey 2 weeks.
[8] Bluman, A. G. (2013). *Elementary Statistics: A Step-by-Step Approach*. McGraw Hill Education.

Summary of Results

Of the 344 survey respondents, 83 percent stated they worked at the GPO Central Complex in Washington, DC at least one day per pay period.

Regarding the question as to whether employees perceive the air quality in their environment at GPO to be acceptable or unacceptable, 66 percent of respondents indicated that the air quality at GPO was acceptable. The ASHRAE standard is 80 percent. Employees that rated the air quality as unacceptable were then asked to provide specific comments. Of the 115 comments, 48 percent were regarding either dirty duct work or health concerns. See Figure 2. Ductwork is further discussed in Finding 2.

Figure 2. Survey Comments



Source: OIG Analysis

IAQ Testing Results

The inspection team purchased a commercial air quality detector, Figure 3, and took spot readings (as opposed to 8-hour time-weighted averages) for a three-week period from July 13-27, 2023 (Phase I) and again for a three-week period from October 24-November 7, 2023 (Phase II).[9] This device can detect three of the fifteen potentially harmful substances listed in Table 6-5 of ASHRAE 62.1 (see Table 2 in this report): formaldehyde, carbon monoxide, and fine particulate matter (PM2.5). Of those three, formaldehyde was found to be in excess of the design limit throughout the entire Central Complex in most cases, and carbon monoxide was frequently found to be in excess of the design limit on the second floor of Buildings A and C.

Figure 3. Air Quality Detector

The inspection team also tested for Total Volatile Organic Compounds (TVOC) which can serve as a proxy for other design compounds. Although ASHRAE 62.1 does not address TVOC, many of the design compounds addressed by ASHRAE are included in TVOC. In the absence of more sophisticated testing equipment or laboratory analysis, the TVOC reading is an indicator that additional analysis is warranted. Testing was done over time at ten locations (Figures 4-6 depict three such locations) within the GPO Central Complex. Phase I was conducted during high outdoor temperatures and when both chambers of Congress were in session. Phase II had more variables; namely, low outdoor temperatures during a portion of testing which resulted in greater amounts of outdoor air being introduced into GPO spaces[10] and a recess of the House of Representatives which led to a lower production workload for GPO. Our results and conclusions are separated by phase.

Figure 4. C-240B

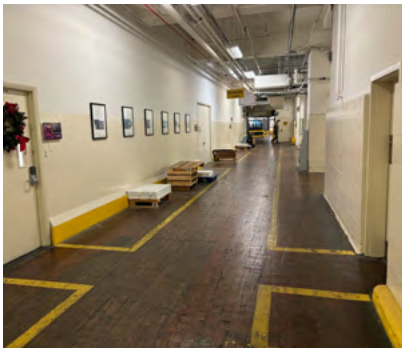


Figure 5. Bridge 21

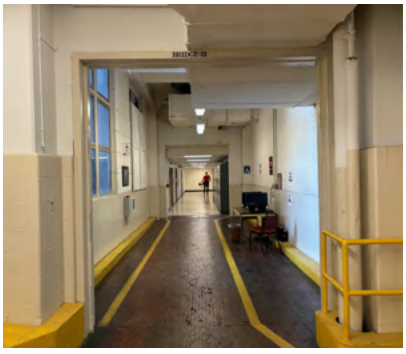


Figure 6. A203

[9] The air quality detector purchased is a Bosean T-Z01Pro.

[10] GPO uses 20-30 percent outdoor air in its ventilation and air cleaning system when the outdoor temperature is above 50°F and 100 percent outdoor air when the temperature is below 50°F.

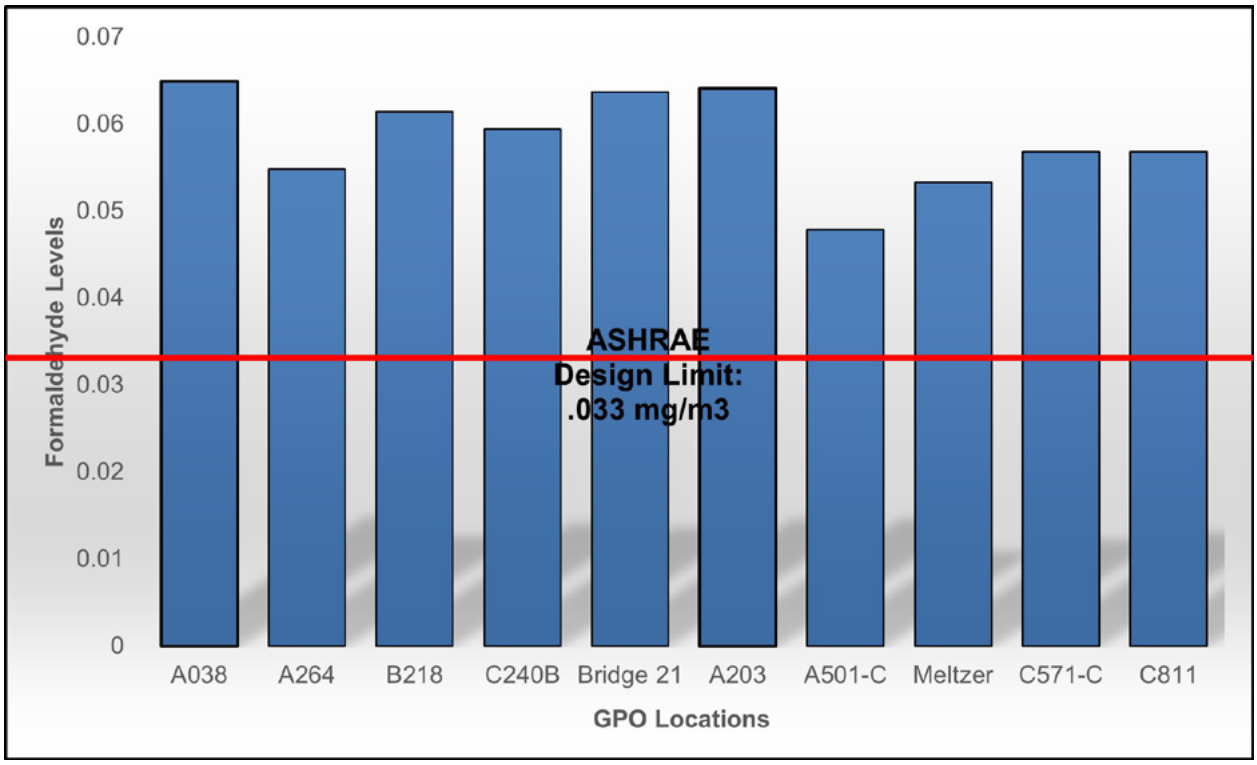
Weather and Congressional Schedule Phase I

The weather during Phase I was above 50°F for the entire period, and therefore GPO used 20-30 percent outside air. Both chambers of Congress were in session during the entire period (except for one day each) meaning higher levels of production.

Formaldehyde Phase I

Formaldehyde levels inside the GPO Central Complex consistently exceeded the ASHRAE design limit of 33 micrograms per cubic meter (µg/m3) or .033 milligrams per cubic meter (mg/m3).[11] Figure 7 depicts the average formaldehyde levels.

Figure 7. Average Formaldehyde Levels (mg/m3) Phase I

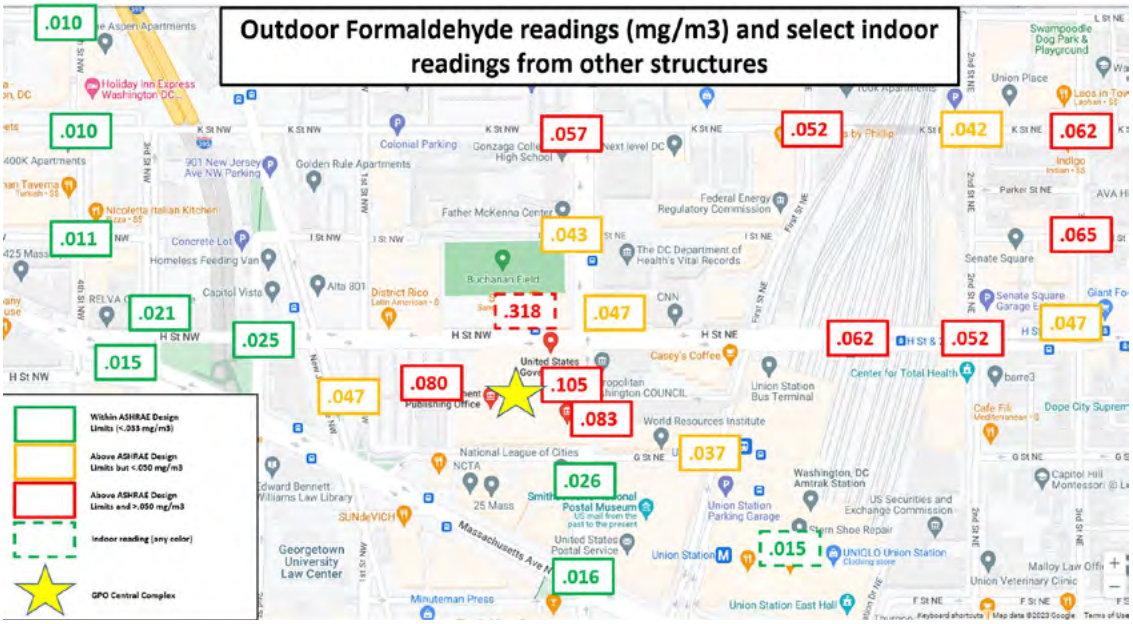


Source: OIG Analysis

These formaldehyde levels are consistent with ambient air immediately outside of the Central Complex. Within two blocks in any cardinal direction except for the northeast, the formaldehyde levels recede to below the ASHRAE design limit, see Figure 8. During this period, we were not able to conclusively determine the source of the formaldehyde; either GPO was the source or GPO was pulling it in from the outside and not filtering it out. There are myriad potential sources of formaldehyde, including but not limited to combustion gases, manufactured wood products, paper, glues, and other building products.

[11] Although OSHA has no IAQ standards, the GPO Industrial Hygienist follows the OSHA Permissible Exposure Limits (PELs) for substances. The OSHA PEL for Formaldehyde is .75 ppm.

Figure 8. Outdoor Formaldehyde Levels (mg/m3)

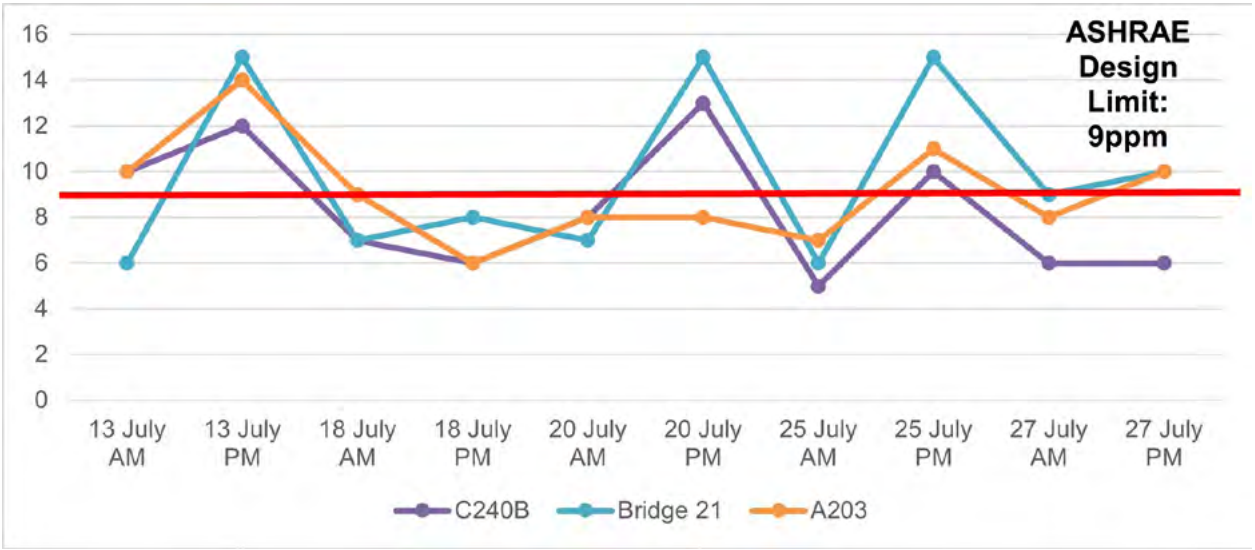


Source: OIG Analysis

Carbon Monoxide Phase I

During the testing period, the team found that the 2nd floor of Building C and significant portions of the 2nd floor of Building A frequently exceeded ASHRAE design limits of nine parts per million (PPM) for carbon monoxide.[12] The results are detailed in Figure 9. A GPO official stated employees have reported smelling vehicle exhaust fumes in this area, potentially due to the location of the outside air intake vents.[13]

Figure 9. Carbon Monoxide Levels (PPM) Phase I



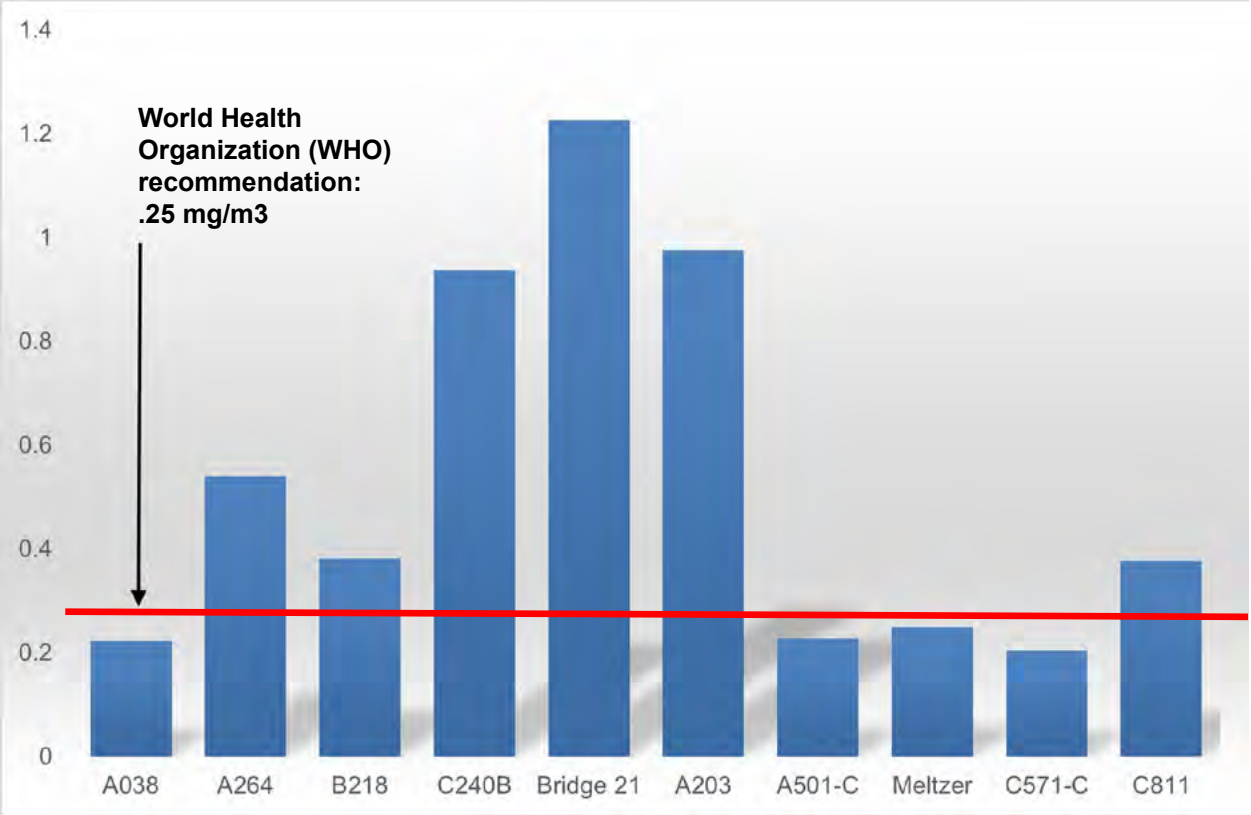
Source: OIG Analysis

[12] The OSHA PEL for carbon monoxide is 50 ppm (8-hour time-weighted average).
[13] On November 29, 2023, the Safety Office submitted a work order to have charcoal filters installed at the air intakes located on the second floor of Building C.

Total Volatile Organic Compounds (TVOC) Phase I

TVOC is often to blame for poor indoor air quality. TVOC is the summation of all volatile organic compounds found in a given volume of air. Volatile Organic Compounds are a large group of chemicals found in many building materials or everyday products we use in our homes and workplaces. Figure 10 depicts TVOC levels throughout the GPO Central Complex.[14]

Figure 10. Average TVOC Levels (mg/m3) Phase I



Source: OIG Analysis

[14] Various commercial sources stated the World Health Organization, an agency of the United Nations, has recommended a guideline value of 0.25 mg/m³ (milligrams per cubic meter) or less for TVOC levels.

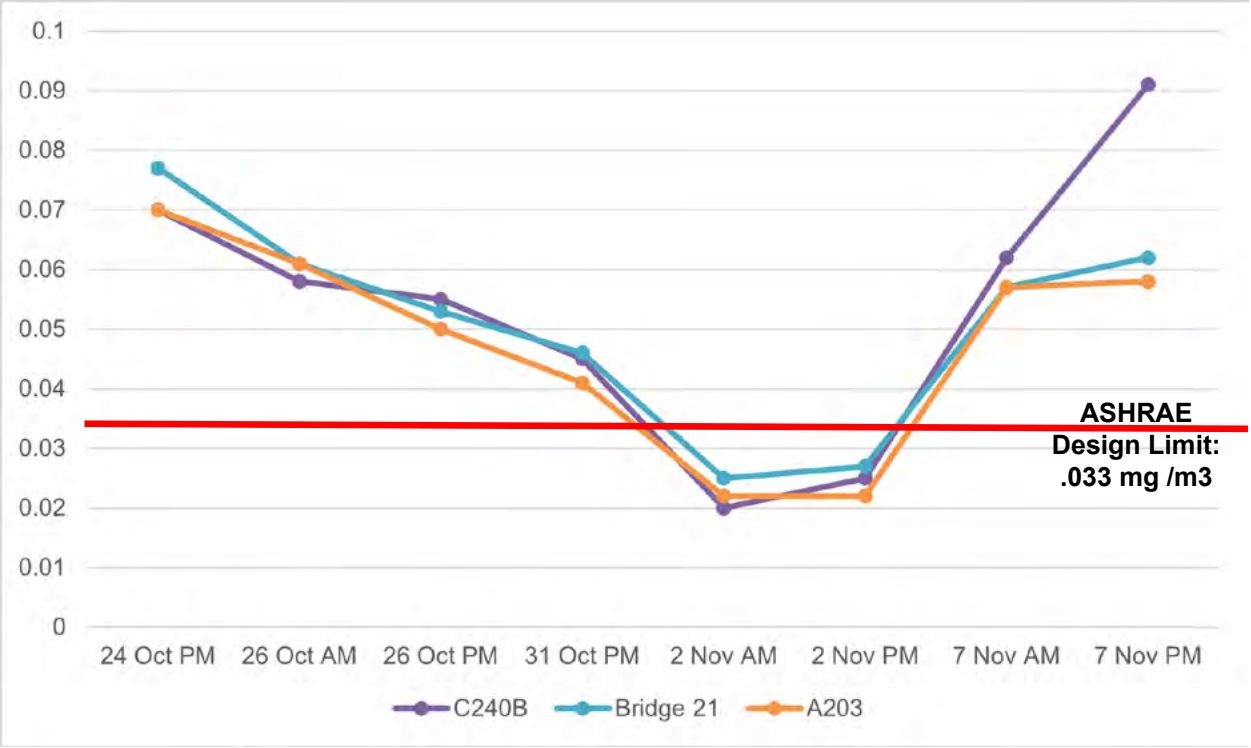
Weather and Congressional Schedule Phase II

The weather during Phase II fluctuated substantially. Readings were taken on October 24, 26, 31, and November 2 and 7. On October 24, 26, 31, and November 7, the outside temperature was above 50°F, meaning GPO pulled 20-30 percent of outdoor air through its air intakes. However, on November 2, the temperature was below 50°F for nearly the entire day. Therefore, GPO pulled 100 percent outside air. The Senate was in session during the entire period, but the House was not in session from October 27-November 6. Therefore, the last significant production for the House would have occurred overnight from October 25-26, 2023.

Formaldehyde Phase II

On October 24, when both chambers were in session and GPO was pulling 20-30 percent outdoor air through its air intakes, formaldehyde readings were similar to Phase I. Once the House recessed, formaldehyde readings lowered but generally remained in excess of ASHRAE design limits. However, when temperatures dropped below 50°F and GPO began pulling 100 percent outdoor air on November 2, all but one reading were below ASHRAE design limits. On November 7, after the House reconvened and temperatures rose to above 50°F—and GPO reverted to using 20-30 percent outdoor air—formaldehyde levels again exceeded ASHRAE design limits. Figure 11 details the reduced formaldehyde levels in the three locations that typically had the highest readings (C240B, Bridge 21, and A203). This data strongly suggests GPO is the source of the formaldehyde and can control the formaldehyde levels in the indoor air by adjusting the amount of outdoor air used.

Figure 11. Formaldehyde Levels (mg/m3) Phase II

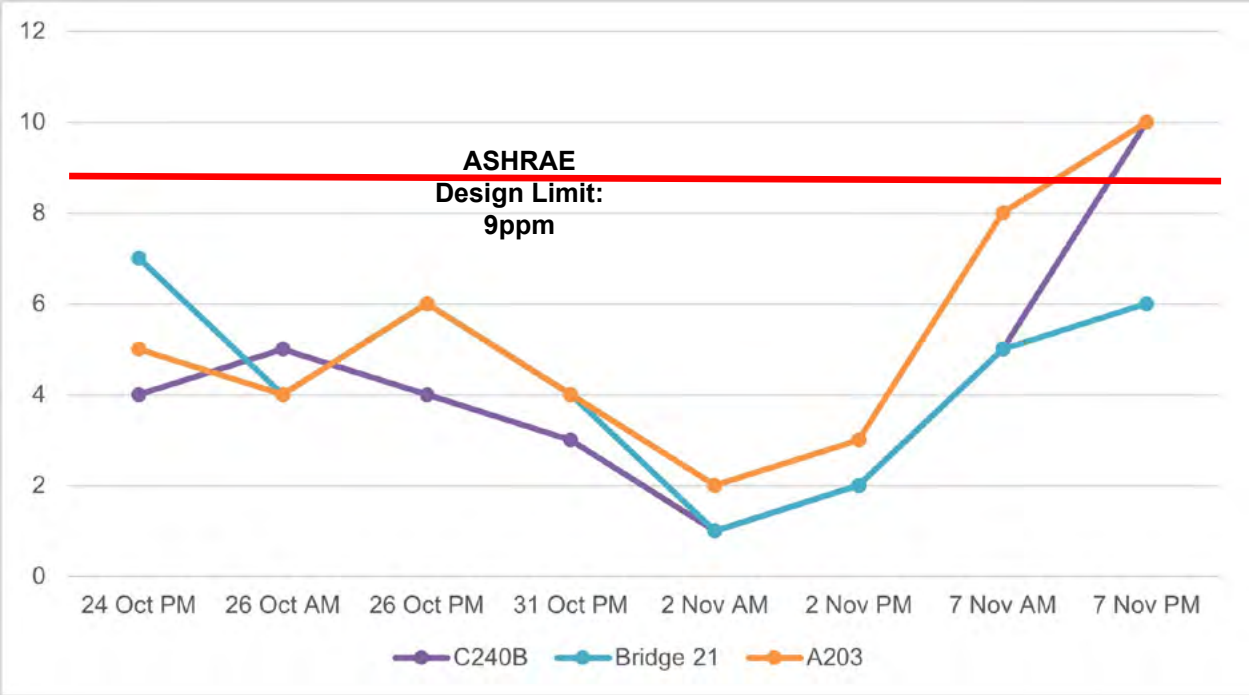


Source: OIG Analysis

Carbon Monoxide Phase II

Carbon monoxide readings followed the same pattern as formaldehyde during the same period, also suggesting that GPO can control carbon monoxide by adjusting the amount of outdoor air used. Carbon monoxide levels are shown in Figure 12 for the same three areas.

Figure 12. Carbon Monoxide Levels (PPM) Phase II

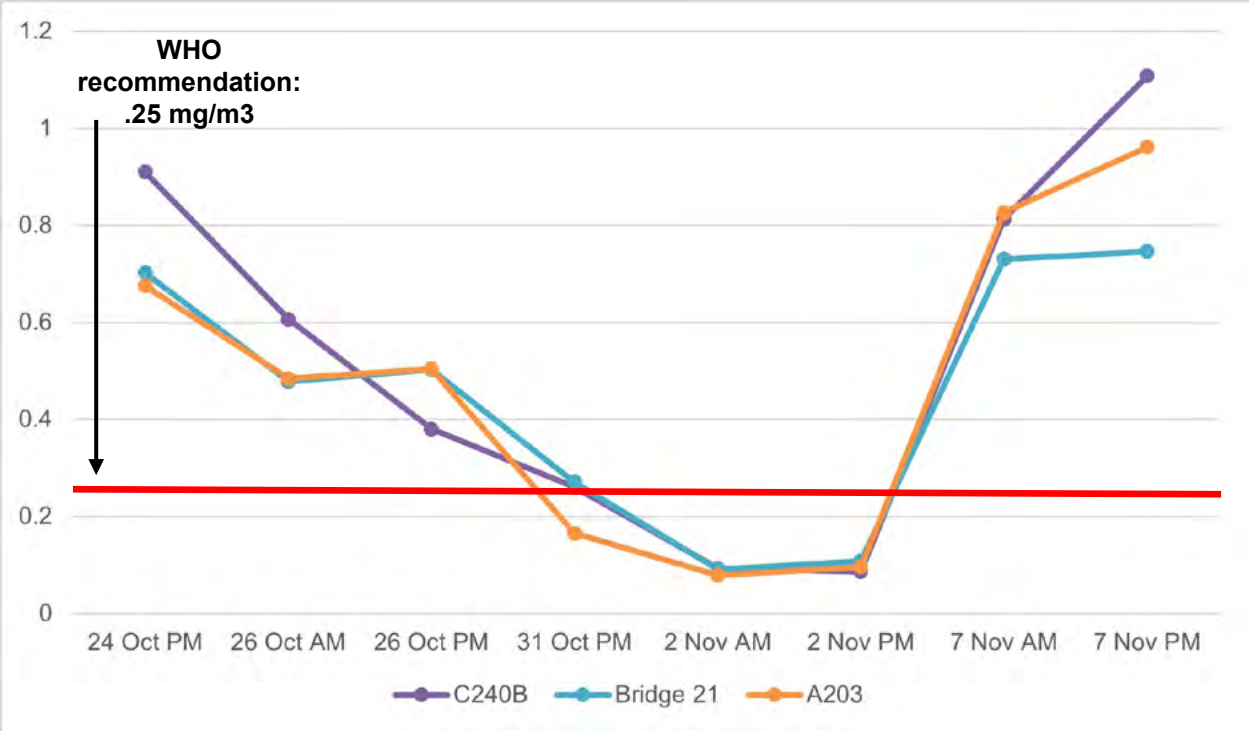


Source: OIG Analysis

Total Volatile Organic Compounds (TVOC) Phase II

TVOC followed the same pattern as formaldehyde and carbon monoxide during the same period also suggesting that GPO can control TVOC by adjusting the amount of outdoor air used. TVOC levels are shown in Figure 13 for the same three areas.

Figure 13. TVOC Levels (mg/m3) Phase II



Source: OIG Analysis

INSPECTION RESULTS

Finding 1. The GPO chiller plant is nearing the end of its useful life, creating a critical operational risk.

The potential for insufficient cooling due to chiller plant failure was identified as a concern by multiple GPO officials. GPO had one chiller that was inoperable from November 2022 through September 2023. The GPO chiller plant, installed in 2003, provides mission-critical cooling to Buildings A, B, and C. The chiller plant is nearing the end of its life expectancy based upon ASHRAE estimates, as evidenced by bearing repairs completed on chiller #3 in 2023 and current signs of excessive bearing wear in chiller #1. This presents a significant operational risk that could result in the GPO Central Complex ceasing to operate.

Criteria

- ASHRAE 62.1, *Ventilation and Acceptable Indoor Air Quality*, (1973), as amended, 2022.

Chiller #3 was inoperable from November 2022 to September 2023.

The GPO chiller plant consists of three centrifugal chillers. At least one chiller is operational anytime the outside air temperature is above 50°F, and two chillers are normally required during the warmer months to keep the GPO Central Complex at a temperature that allows the performance of mission-critical functions such as passport production and producing congressional records. The third chiller serves as a backup in the event one of the other two fails. Chiller #3, Figure 14, became inoperable in November 2022 at 67,628 hours due to bad bearings. External maintenance contractors completed repairs to chiller #3 in late September 2023. As a result, GPO lacked a backup chiller for 10 months. If two chillers become inoperable during the warmer months, the temperature and humidity in Buildings A, B, and C will rapidly increase. The building's smoke detectors will go into alarm mode 30 to 40 minutes after the chillers shut down, which will also trigger the building evacuation system. Within an hour of the second chiller shut down, all production areas in Buildings A, B, and C temperature and humidity levels will be too high for production to continue. After a few hours, the building would be too uncomfortable for employees to continue to work.

Figure 14. Inoperable Chiller

Chiller #1 exhibits excessive bearing wear and the chiller plant is nearing the end of its life expectancy.

Chiller use is routinely rotated to ensure all three are operational for a similar number of total hours. As of September 27, 2023, chiller #1 was used for 62,381 hours and there are indicators that bearings need to be replaced. For comparison, Chiller #2 was used for 62,589 hours, and, as previously noted, chiller #3 went offline at 67,628 hours.

The current chiller plant has been in service since 2003; ASHRAE indicates the median average life expectancy of a centrifugal chiller is 23 years. Failure of the chiller plant would result in the inability to maintain the appropriate temperature and humidity to operate equipment in both Plant Operations and Security and Intelligent Documents (SID), negatively impacting GPO's ability to complete critical missions such as producing passports or the Congressional Record.

In FY 2016, the Facilities Management's 5-year budget included funding to replace the chillers. The budgeted replacement has not yet occurred; however, during the reporting phase of this inspection, we were advised that GPO has contracted with an architectural and engineering (A&E) firm to replace the chiller plant. The project is currently in the design phase.

Recommendations

Recommendation 1. Perform identified needed repairs to chiller #1.

Management Comments

GPO concurred with this recommendation. The agency stated that although the entire chiller plant is expected to be replaced within a year of when repairs would be undertaken on chiller #1, implementing these interim repairs will help reduce the risk of operational failure in case there are delays in the replacement plan. Facilities Management will request funding to repair chiller #1 during the upcoming FY 2025 Strategic Investment Planning Committee process. Repairs to chiller #1 are estimated to be completed by March 2025.

OIG Response

GPO's concurrence and planned actions are responsive to this recommendation.

Recommendation 2. Fully assess the operational condition of the chiller plant and establish a replacement plan as warranted.

Management Comments

GPO concurred with this recommendation. The agency received approval from the Joint Committee on Printing to spend $7.1 M to replace the chiller plant. The project design is currently underway and is 30 percent complete. After the finalization of the design and receipt of an updated construction estimate, GPO will replace the chiller plant. The chiller plant replacement is expected to be completed by March 2026.

OIG Response

GPO's concurrence and planned actions are responsive to this recommendation.

Observation 1. We found no record that GPO's Central Complex ventilation and air cleaning system design is in alignment with ASHRAE 62.1.

There is no record that ASHRAE guidelines were followed during the design or renovation of any portion of the ventilation and air cleaning system at the GPO Central Complex. This may have contributed to the low 66 percent employee satisfaction rate with the IAQ at the GPO Central Complex. The ASHRAE standard is 80 percent satisfaction.

Criteria

- GSA P100, *Facilities Standards for the Public Building Servic*e, October 2021.
- ASHRAE 62.1, *Ventilation and Acceptable Indoor Air Quality*, (1973), as amended, 2022.

GPO lacks ASHRAE documentation.

GPO is unable to provide design documents of the ventilation and air cleaning system evidencing compliance with ASHRAE at any time during the design, renovation, or operation of the ventilation and air cleaning system at the GPO Central Complex.

Although multiple GPO officials stated it is a goal to comply with ASHRAE 62.1 for any future renovations, absent any design documents or GPO written guidance, we are unable to determine if the current ventilation and air cleaning systems are in alignment with ASHRAE. While many of the design documents reviewed for ongoing and upcoming renovations indicated a requirement for compliance with ASHRAE 62.1., there is no associated procedure or GPO policy mandating ASHRAE compliance.

There are strict regulations governing the standard of the air exiting a building. For example, under the Clean Air Act, the United States Environmental Protection Agency (EPA) limits emissions of air pollutants coming from sources such as chemical plants, utilities, and steel mills. However, there is no applicable federal or local legislation governing indoor air quality. As previously stated, compliance with ASHRAE 62.1 is considered an industry best practice.

The current version of ASHRAE 62.1 permits the use of three different procedures for the design of a ventilation and air cleaning system, none of which are performed by GPO. The three procedures are the Ventilation Rate Procedure (VRP), the Indoor Air Quality Procedure (IAQP), and the Natural Ventilation Procedure (NVP). The procedures are summarized in Table 1.

Table 1. ASHRAE Design Procedures

Procedure	Summary
1. VRP	Outdoor air intake rates are determined based on space type/ application, occupancy level, and floor area, shall be permitted to be used for any zone or system.
2. IAQP	An alternative to the VRP used to determine the design rate of outdoor airflow to maintain concentrations of design compounds and PM2.5 in the indoor environment to be less than design limits, based on indoor and outdoor sources, air cleaning, and other variables. These outdoor air requirements shall be calculated with mass-balance equations. Verification of occupant satisfaction and indoor design compound concentrations shall be performed after the building is Completed.
3. NVP	The prescriptive or engineered system design procedure in which outdoor air is provided through openings to the outdoors shall be permitted to be used for any zone or portion of a zone in conjunction with mechanical ventilation systems

Source: ASHRAE 62.1

The lack of visibility of GPO's compliance with ASHRAE and a lack of capital investment have resulted in a ventilation and air cleaning system that is not always well suited to the spaces it services and whose components are often beyond their useful life. GPO has no internal directives governing IAQ and the team assesses that this is a result of a lack of IAQ legislation. Survey results, coupled with results from the inspection team's IAQ testing, suggest non-compliance with ASHRAE. Much of the critical manufacturing equipment in Plant Operations, SID, and other business units require climate control. Given the inability to ascertain GPO's compliance with ASHRAE, we are unable to fully assess whether the present system can provide climate control appropriately.

Considerations

Consideration 1. Implement the Ventilation Rate Procedure, Indoor Air Quality Procedure, Natural Ventilation Procedure, or a combination of the three to determine compliance with ASHRAE 62.1.

Management Comments

GPO concurred with this consideration. The agency stated that they lack the expertise to implement any of these procedures. However, they can adhere to the intent of this consideration by requiring GPO-contracted A&E firms to develop designs that are ASHRAE compliant. The agency will also work with A&E firms to ensure that any future renovations are compliant with ASHRAE standards, when feasible.

OIG Response

GPO's concurrence and planned actions are responsive to this consideration.

Consideration 2. Develop and implement guidance to ensure future designs and renovations of the ventilation and air cleaning system comply with ASHRAE 62.1 and are linked with building utilization plans.

Management Comments

GPO concurred with this consideration. The agency stated that they have already implemented steps to ensure that future renovations adhere to ASHRAE 62.1 standards. GPO achieves this by providing the A&E firm with clear requirements in the design specification. The agency agrees with the suggestion to link future renovations with the building utilization plan. However, the building utilization plan is still being developed and is not expected to be finalized until December 2024. Until then, all designs will be tailored to meet production requirements and on-site occupancy in order to maximize the benefits of indoor air quality.

OIG Response

GPO's concurrence and planned actions are responsive to this consideration.

Finding 2. The GPO ventilation and air cleaning system is being maintained and indoor air is being tested. However, improvements could be made in both areas.

Most of the AHUs and air ducts at GPO are old and dirty and there is no established cleaning program. There is no comprehensive design document that maps the current ventilation and air cleaning system. While there are hardcopy schematics showing AHU and duct locations, those schematics have not been updated to reflect renovations. GPO does not have a comprehensive plan to address future ventilation and air cleaning system requirements but has instead made limited renovations to the system concurrent with other building renovations. There is an operational IAQ testing program at GPO; however, the program could be improved.

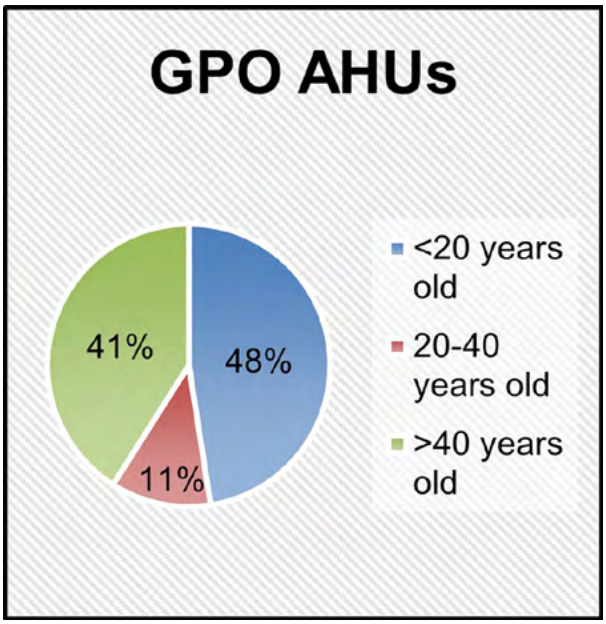
Criteria

- GPO Directive 670-52A, *Working with Lead*, June 5, 2019.
- ASHRAE 62.1, *Ventilation and Acceptable Indoor Air Quality*, (1973), as amended, 2022.

GPO's aging air handling units

Fifty-two percent of the AHUs (64 of 122) in the GPO Central Complex are more than 20 years old, 50 are more than 40 years old, and the oldest are more than 60 years old, see Figure 15. Various professional organizations estimate the normal lifespan of a well- maintained AHU is 20 years. The fact that the AHUs function as well as they do is a testament to the maintenance efforts within Facilities Management.

Figure 15. Age of GPO AHUs



Source: GPO

Manufacturer's specifications for most of the AHUs are no longer available due to the age of the equipment. The Power Branch has developed checklists in lieu of the missing documentation. Without manufacturers' specifications for the AHUs, we assess the use of these checklists as the best available solution until new equipment can be acquired.

The team assessed that as GPO changed its footprint, the ventilation and air cleaning system has not been fully considered. During the reconfiguration process, the legacy AHUs, designed for large manufacturing spaces, have generally been left in place. Instead of serving one large manufacturing space with substantial heat-generating machinery, the AHUs now service multiple small office spaces with limited heat-generating equipment. The current configuration is energy inefficient and causes uncomfortably low temperatures in some office spaces. From August 2022 to September 2023, facilities maintenance responded to 42 service calls for temperature issues. Additionally, one GPO official stated that GPO has new bindery and passport equipment but the infrastructure that supports the equipment is too old.

Due to the age of the AHUs, there is a substantial risk of them becoming inoperable at any time. As stated in Observation 1, much of the GPO equipment in Plant Operations, SID, and other business units require climate control. The present aging system threatens a shortfall in the ability to regulate the appropriate temperature and humidity necessary to operate critical equipment in both Plant Operations and SID.

Most of the ducts at GPO are old and dirty and there is no established cleaning program.

Like the AHUs, most of the air ducts at GPO are old and dirty. There is no current system for cleaning the ducts. In the past, GPO used outside contractors and GPO employees for cleaning limited sections of the ducts with mixed results. GPO purchased duct cleaning equipment that was operated by employees, but the program was discontinued. GPO is currently exploring externally sourced options to clean the ducts.

The AHUs and ducts contain potentially hazardous dust and debris, see Figures 16 and 17. This dust blows through the ducts, out of the diffusers, into workspaces, and is often found on top of employees' desks, causing employee complaints. According to the inspection team's survey of the IAQ at GPO, the presence of this dust and debris was the most common reason given by employees for dissatisfaction with the IAQ.

Figure 16. Buildup in Duct Before Cleaning

Figure 17. Duct During Cleaning

Additionally, according to multiple GPO officials, given the age of the AHUs, it is likely the dust contains lead from lead-based paint on pre-1980 AHUs, old Linotype machines, and the exhaust of vehicles operating on leaded gasoline from the 1960s-70s. Prior to this inspection, the last recorded lead testing in workspaces at the Central Complex was in February 2018 and was limited to the 5th floor of Building B. Three samples were taken, and the surface lead level ranged between 6 and 9.3 micrograms per square foot. These levels are below the United States Department of Housing and Urban Development clearance action level of 10 micrograms per square foot for floors and 100 micrograms per square foot for windowsills. GPO Directive 670-52A establishes an internal clearance level standard of 200 micrograms per square foot for floors and 250 micrograms per square foot for windowsills.

Previous testing was done in 2014 in response to lead being found on the second floor of Building D. This testing was done throughout the GPO complex in 22 air ducts and on one desk. The testing was recorded in ppm to compare to EPA standards for hazardous waste. All samples found the presence of lead, ranging from 159 ppm to 4060 ppm. Although there is no established standard for lead in air ducts, according to the EPA, any concentration greater than 100 ppm may fail a Toxicity Characteristic Leaching Procedure (TCLP) test and therefore would be considered hazardous waste if the ducts were disposed of.

During the inspection fieldwork, GPO conducted additional lead testing focused on AHUs and some of the duct work. The test results ranged from 740 micrograms per square foot in duct work to 14,000 micrograms per square foot on one AHU, Figures 18 and 19. The Safety Branch attributes the results of this testing to the discovery of lead-based paint on older AHUs acquired pre-1980. There are 49 AHUs at the GPO Central Complex that were acquired or are estimated to have been acquired prior to 1980, and therefore likely have lead-based paint. As a result, more expansive testing is currently underway, and the Engineering Division has initiated a contract for cleaning the ventilation and air cleaning system on the 3rd floor of Building C as a pilot for a more thorough cleaning program.

Figure 18. AHU w/ Lead-Based Paint

Figure 19. AHU Intake with Lead Residue

GPO lacks a comprehensive ventilation and air cleaning system design.

When interviewed, multiple GPO officials stated that there are no overall design documents for the ventilation and air cleaning system, but some old paper copies could exist. GPO provided blueprint-like diagram documents showing AHU and duct locations. However, the diagrams did not reflect more recent renovations.

Another GPO official stated a Facilities Condition Assessment (FCA) for the GPO Central Complex would be valuable to understand the system and its current state.[15] The FCA can also be used to help justify additional funding for renovations. Appendix D provides additional details about FCAs. During the reporting phase of this inspection, funding for a FCA was requested through the FY 2024 Strategic Investment Planning Committee.

The ventilation and air cleaning system has not been fully reconfigured to address new demands created by the changing use of the GPO Central Complex. When most of the ventilation and air cleaning systems were installed, the complex was configured for seven floors of heat generating manufacturing equipment and one floor of office space in Buildings A-C. Substantial portions of that manufacturing space have since been repurposed as office space. In more recent cases, the ventilation and air cleaning system has been redesigned to suit the new use. However, in many cases, the old system remains substantially in place. This creates energy inefficiency, as the old system pushes greater amounts of cold air than is now necessary due to the removal of heat producing sources. Because the system lacks variable air volume capability to modulate air flow, discomfort in repurposed office space is frequently reported. A GPO official stated it is

[15] FCAs are typically prepared for owners or managers of real estate portfolios to help optimize and maintain the physical condition and value of their assets, develop capital budgets, and prioritize short and long-term investments in their facilities.

common for stationary engineers to find cardboard placed under the air vents by office workers to block excessive cold air. Restricting airflow reduces ventilation and therefore decreases overall indoor air quality. Of the survey respondents indicating dissatisfaction with the indoor air quality, 14 percent specifically mentioned dissatisfaction with air temperature or low circulation as previously shown in Figure 2.

The GPO Central Complex layout continues to change. There is a new Building Utilization Plan in development as the agency attempts to optimize its real estate. The lack of visibility on the current state of the ventilation and air cleaning system and the fact that modifying the system to conform to new building use in the past has been haphazard present a risk that further changes to building utilization will compound the problems previously mentioned.

The repercussions associated with the lack of a comprehensive plan have manifested in several ways. First, the system is inefficient and incurs unnecessary energy costs. Second, maintenance efforts are made more difficult by the lack of situational awareness regarding the location of equipment. Third, as indicated by our survey, office workspaces are less comfortable due to the ventilation and air cleaning system servicing spaces for which it was not designed. Finally, because of the lack of a comprehensive plan driving capital investment, much of the system is beyond its lifecycle and prone to failure. Ventilation and air handling failure would negatively impact GPO's ability to complete critical missions such as producing passports or the Congressional Record.

The GPO IAQ testing program needs strengthening.

The Industrial Hygienist (IH) is responsible for the planning, coordinating, managing, continuous improvement, and implementation of the GPO Industrial Hygiene Programs which include: Hazard Communication; Ergonomics; IAQ; Respiratory Protection; and Asbestos and Lead Management. As part of their IAQ responsibilities, the IH tests the air quality at GPO; however, the testing program is purely reactive.

The IH has a sensor to test for carbon dioxide, PM2.5, and TVOC, a group of VOCs used to represent the entire pool of pollutants. The IH also has a GX-2009 gas monitor/alarm that detects carbon monoxide. Testing is done only in response to a complaint, when new equipment is installed, or when a new chemical is introduced. However, the sensor does not test for all 15 potentially harmful substances as defined by ASHRAE. This has led to an incomplete testing regimen within the Safety Branch. Since many GPO officials stated that it is a goal to comply with ASHRAE 62.1, the IH should ensure ASHRAE design limits are not exceeded.[16] As previously discussed, the inspection team purchased a commercial air quality detector with the ability to detect three of the 15 potentially harmful substances listed in Table 6-5 of ASHRAE 62.1. pictured in Table 2 on page 21, with the three substances highlighted.

[16] A design limit is the exposure limit of a design compound.

Table 2. ASHRAE Design Limits

Compound or PM2.5	Cognizant Authority	Design Limit
Acetaldehyde	Cal EPA CREL (June 2016)	140 µg/m^3
Acetone	AgBB LCI	1,200 µg/m^3
Benzene	Cal EPA CREL (June 2016)	3 µg/m^3
Dichloromethane	Cal EPA CREL (June 2016)	400 µg/m^3
Formaldehyde	Cal EPA 8-hour CREL (2004)	33 µg/m^3
Naphthalene	Cal EPA CREL (June 2016)	9 µg/m^3
Phenol	AgBB LCI	10 µg/m^3
Tetrachloroethylene	Cal EPA CREL (June 2016)	35 µg/m^3
Toluene	Cal EPA CREL (June 2016)	300 µg/m^3
1,1,1-trichloroethane	Cal EPA CREL (June 2016)	1000 µg/m^3
Xylene, total	AgBB LCI	500 µg/m^3
Carbon monoxide	U.S. EPA NAAQS	9 ppm
PM2.5	U.S. EPA NAAQS (annual mean)	12 µg/m^3
Ozone	U.S. EPA NAAQS	70 ppb
Ammonia	Cal EPA CREL (June 2016)	200 µg/m^3

Source: ASHRAE 62.1

Of those three substances, formaldehyde was found to be more than the design limit throughout the entire GPO Central Complex, and carbon monoxide was found to be in excess of the design limit on the second floor of Buildings A and C. When the IH was informed, they discovered their instrument was not capable of testing for formaldehyde. It is quite possible other harmful substances, such as those listed in ASHRAE Table 6-5, are present and undetected in the indoor air of the GPO Central Complex.

As previously discussed, given the age of the AHUs and air ducts, it is likely that the debris inside them contains lead from lead-based paint on pre-1980 AHUs, old Linotype machines, and the exhaust of vehicles operating on leaded gasoline from the 1960s-70s.

Given at least two of the 15 potentially harmful substances as defined by ASHRAE were found to exceed the design limits, and it is possible that other harmful substances are present and undetected in the indoor air of the Central Office Complex, further scrutiny of these compounds appears warranted in order to ensure the safety of GPO personnel.

Recommendations

Recommendation 3. Develop a plan to address and possibly replace the old and dirty air ducts. If duct replacement is not an option, develop a comprehensive cleaning schedule to address this concern.

Management Comments

GPO concurred with this recommendation. Facilities Management has submitted a request to contract for duct cleaning on the 3rd Floor of Building C. This will act as a test case for future duct cleaning projects. Prior to this cleaning, the agency will conduct IAQ tests, and then retest after the duct cleaning. If concerns about indoor air quality persist or if there are health issues that can be attributed to indoor air quality in this area, the agency will consider duct replacement. GPO will develop a plan based on the results,

outlining the anticipated cost and recommended approach for either duct cleaning or duct replacement. The agency expects to complete the initial review of the test case by the end of CY 2024. At that time, the duct cleaning/duct replacement plan must be synchronized with the building utilization plan. The agency anticipates a final cleaning schedule by the end of FY 2025.

OIG Response

GPO's concurrence and planned actions are responsive to this recommendation.

Recommendation 4. Update or prepare schematics to reflect the current locations of all ventilation and air cleaning components.

Management Comments

GPO concurred with this recommendation. The agency has PDF copies of archived schematics that accurately represent locations for approximately 90 percent of the system. However, changes have been implemented since the initial construction that are not properly captured in the drawings. GPO will request funding from the FY 2025 Strategic Investment Planning Committee and contract with an outside firm to conduct an analysis to determine the requirements to develop accurate schematics of the ventilation and air cleaning components. The agency expects this contract to be awarded by August 2025, and to determine the next steps by November 2025.

OIG Response

GPO's concurrence and planned actions are responsive to this recommendation.

Recommendation 5. Develop and implement a comprehensive renovation plan for the ventilation and air cleaning system at the GPO Central Complex in accordance with the pending building utilization plan.

Management Comments

GPO concurred with this recommendation with comments. As the agency completes and begins to execute its building utilization plan in the coming 18 months, GPO commits to ensuring that renovations and upgrades to the ventilation and filtration system will be part of any renovations the agency undertakes as part of that plan and will request funds as part of those renovations for ventilation upgrades. Under the current plan, investments will be focused to meet production requirements and on-site occupancy until the building space utilization plan is completed, which is projected to be in December 2024. Based upon available funding, the agency projects that completion of ongoing projects will take between five to eight years. Long-term projects will be determined based upon the building utilization plan, availability of funding, and agency priorities.

OIG Response

GPO's concurrence with comments and planned actions are responsive to this recommendation. As a result, we modified the recommendation to include a comprehensive plan in accordance with the pending building utilization plan.

Recommendation 6. Implement a proactive air sampling program in accordance with ASHRAE design limits and a lead testing program in accordance with GPO Directive 670- 52A and communicate results as appropriate with Facilities Management.

Management Comments

GPO concurred with this recommendation with comments. The agency concurs that the air sampling program at GPO should be improved. GPO currently enforces OSHA PELs and works toward ASHRAE standards as a goal. To evaluate the issue and to improve the air sampling program, GPO has committed $60,000 to conduct two phases of contractor air sampling. At the end of phase 2, the contractor will provide recommendations to correct the issues discovered and a recommended periodic survey schedule/ plan for follow-up monitoring. Each phase of the contractor's indoor air quality assessment is anticipated to require 30 days for completion, with both phases being completed by September 30, 2024.

OIG Response

GPO's concurrence and planned actions are responsive to this recommendation. However, the agency must also implement a lead testing program in accordance with GPO Directive 670.52A.

Appendix A. Table of Recommendations and Considerations

Recommendation	Management Response	Status	Return on Investment
Director, GPO			
1. Perform identified needed repairs to chiller #1.	GPO concurred with this recommendation. The agency stated that although the entire chiller plant is expected to be replaced within a year of when repairs would be undertaken on chiller #1, implementing these interim repairs will help reduce the risk of operational failure in case there are delays in the replacement plan. Facilities Management will request funding to repair chiller #1 during the upcoming FY 2025 Strategic Investment Planning Committee process. Repairs to chiller #1 are estimated to be completed by March 2025.	Open	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security. *Repairing the chiller plant would result in GPO being able to maintain the appropriate temperature and humidity to operate equipment in both Plant Operations and Security and Intelligent Documents (SID).* Monetary – Avoidance of unnecessary expenditures; reducing requirements for equipment. *Failure of the chiller plant would negatively impact GPO's ability to complete critical missions such as producing passports or the Congressional Record.*
2. Fully assess the operational condition of the chiller plant and establish a replacement plan as warranted.	GPO concurred with this recommendation. The agency received approval from the Joint Committee on Printing to spend $7.1 M to replace the chiller plant. The project design is currently underway and is 30 percent complete. After the finalization of the design and receipt of an updated construction estimate, GPO will replace the chiller plant. The chiller plant replacement is expected to be completed by March 2026.	Open	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security. *Replacing the chiller plant would result in GPO being able to maintain the appropriate temperature and humidity to operate equipment in both Plant Operations and Security and Intelligent Documents (SID).* Monetary – Avoidance of unnecessary expenditures; reducing requirements for equipment. *Failure of the chiller plant would negatively impact GPO's ability to complete critical missions such as producing passports or the Congressional Record.*

Recommendation	Management Response	Status	Return on Investment
Director, GPO			
3. Develop a plan to address and possibly replace the old and dirty air ducts. If duct replacement is not an option, develop a comprehensive cleaning schedule to address this concern.	GPO concurred with this recommendation. Facilities Management has submitted a request to contract for duct cleaning on the 3rd Floor of Building C. This will act as a test case for future duct cleaning projects. Prior to this cleaning, the agency will conduct IAQ tests, and then retest after the duct cleaning. If concerns about indoor air quality persist or if there are health issues that can be attributed to indoor air quality in this area, the agency will consider duct replacement. GPO will develop a plan based on the results, outlining the anticipated cost and recommended approach for either duct cleaning or duct replacement. The agency expects to complete the initial review of the test case by the end of CY 2024. At that time, the duct cleaning/ duct replacement plan must be synchronized with the building utilization plan. The agency anticipates a final cleaning schedule by the end of FY 2025.	Open	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security. *Cleaning or replacing the old and dirty ducts will eliminate the current lead hazard and reduce the number of employee complaints.*
4. Update or prepare schematics to reflect the current locations of all ventilation and air cleaning components.	GPO concurred with this recommendation. The agency has PDF copies of archived schematics that accurately represent locations for approximately 90 percent of the system. However, changes have been implemented since the initial construction that are not properly captured in the drawings. GPO will request funding from the FY 2025 Strategic Investment Planning Committee and contract with an outside firm to conduct an analysis to determine the requirements to develop accurate schematics of the ventilation and air cleaning components. The agency expects this contract to be awarded by August 2025, and to determine the next steps by November 2025.	Open	Non-Monetary – Improve management controls; improve systems/processes. *Outdated schematics make maintenance efforts more difficult due to the lack of situational awareness of the current locations of ventilation and air cleaning system components.*

Recommendation	Management Response	Status	Return on Investment
Director, GPO			
5. Develop and implement a comprehensive renovation plan for the ventilation and air cleaning system at the GPO Central Complex in accordance with the pending building utilization plan.	GPO concurred with this recommendation with comments. As the agency completes and begins to execute its building utilization plan in the coming 18 months, GPO commits to ensuring that renovations and upgrades to the ventilation and filtration system will be part of any renovations the agency undertakes as part of that plan and will request funds as part of those renovations for ventilation upgrades. Under the current plan, investments will be focused to meet production requirements and on-site occupancy until the building space utilization plan is completed, which is projected to be in December 2024. Based upon available funding, the agency projects that completion of ongoing projects will take between five to eight years. Long-term projects will be determined based upon the building utilization plan, availability of funding, and agency priorities	Open	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security. *Developing and implementing a comprehensive renovation plan will ensure office workspaces are more comfortable.* Monetary - Avoidance of unnecessary expenditures. *Developing and implementing a comprehensive renovation plan will increase system efficiency and reduce unnecessary energy costs.*
6. Implement a proactive air sampling program in accordance with ASHRAE design limits and a lead testing program in accordance with GPO Directive 670-52A and communicate results as appropriate with Facilities Management.	GPO concurred with this recommendation with comments. The agency concurs that the air sampling program at GPO should be improved. GPO currently enforces OSHA PELs and works toward ASHRAE standards as a goal. To evaluate the issue and to improve the air sampling program, GPO has committed $60,000 to conduct two phases of contractor air sampling. At the end of phase 2, the contractor will provide recommendations to correct the issues discovered and a recommended periodic survey schedule/plan for follow-up monitoring. Each phase of the contractor's indoor air quality assessment is anticipated to require 30 days for completion, with both phases being completed by September 30, 2024.	Open	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security; initiate best business practices. *Implementing a proactive air sampling program will help the Industrial Hygienist detect potentially harmful design compounds and implement control measures.*

Considerations	Management Response	Status	Return on Investment
Director, GPO			
1. Implement the Ventilation Rate Procedure, Indoor Air Quality Procedure, Natural Ventilation Procedure, or a combination of the three to determine compliance with ASHRAE 62.1.	GPO concurred with this consideration. The agency stated that they lack the expertise to implement any of these procedures. However, they can adhere to the intent of this consideration by requiring GPO-contracted A&E firms to develop designs that are ASHRAE compliant. The agency will also work with A&E firms to ensure that any future renovations are compliant with ASHRAE standards, when feasible.	N/A	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security; initiate best business practices. *Verifying ASHRAE compliance will help determine if the present ventilation and air cleaning system can provide the necessary climate control for the critical manufacturing equipment in Plant Operations and SID.*
2. Develop and implement guidance to ensure future designs and renovations of the ventilation and air cleaning system comply with ASHRAE 62.1 and are linked with building utilization plans.	GPO concurred with this consideration. The agency stated that they have already implemented steps to ensure that future renovations adhere to ASHRAE 62.1 standards. GPO achieves this by providing the A&E firm with clear requirements in the design specification. The agency agrees with the suggestion to link future renovations with the building utilization plan. However, the building utilization plan is still being developed and is not expected to be finalized until December 2024. Until then, all designs will be tailored to meet production requirements and on-site occupancy in order to maximize the benefits of indoor air quality.	N/A	Non-Monetary – Improve management controls; improve systems/processes; improve safety, morale, health, and security; initiate best business practices. *Developing and implementing guidance to ensure future ASHRAE compliance will help GPO design a ventilation and air cleaning system that is suited for the spaces it services.* Monetary – Avoidance of unnecessary expenditures. *Ensuring an ASHRAE compliant ventilation and air cleaning system will increase system efficiency and reduce unnecessary energy costs.*

Appendix B. Scope and Methodology

Scope

Our team of inspectors performed this inspection of GPO's Indoor Air Quality. Our inspection focused on GPO Business Units that manage and maintain all GPO facilities, machinery, and equipment; address life health and safety issues; and provide architectural and engineering services. We reviewed GPO's adherence with federal, professional, and internal policies and standards for a timeframe of five prior years from the date of the announcement of the inspection.

Methodology

The inspection team:

- Interviewed:
    - Managers, Supervisors, and other personnel within:
        - Security Services
        - SID
        - Facilities Management
        - Human Capital
- Reviewed GPO Directives, policies, and procedures; design documents; and electronic databases and records, including work orders, spot assessments, and after-action reports.
- Conducted a survey of the Indoor Air Quality at the GPO Central Complex and analyzed results.
- Conducted Air Sampling in and around the GPO Central Complex and documented results.
- Performed walk-throughs of the GPO Central Office Complex.

This inspection was conducted in accordance with the *Quality Standards for Inspections and Evaluations of the Council of the Inspectors General on Integrity and Efficiency*, December 2020 (Blue Book).

Appendix C. Abbreviations

A&E	Architectural and Engineering
AHU	Air Handing Unit
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
CY	Calendar Year
DC	District of Columbia
EPA	United States Environmental Protection Agency
FCA	Facilities Condition Assessment
FY	Fiscal Year
GSA	General Services Administration
IAQ	Indoor Air Quality
IAQP	Indoor Air Quality Procedure
IG	Inspector General
IH	Industrial Hygienist
NVP	Natural Ventilation Procedure
OIG	Office of the Inspector General
PEL	Permissible Exposure Limit
PPM	Parts Per Million
SID	Security and Intelligent Documents
TCLP	Toxicity Characteristic Leaching Procedure
TVOC	Total Volatile Organic Compounds
VRP	Ventilation Rate Procedure
WHO	World Health Organization

Appendix D. Facilities Condition Assessment Information

Facility Condition Assessments (FCAs) are typically prepared for owners or managers of real estate portfolios to help optimize and maintain the physical condition and value of their assets, develop capital budgets, and prioritize resources. A Facility Condition Assessment can also be used to secure additional funding for renovations. They are a vital tool for owners and managers of real estate portfolios to plan and prioritize short- and long-term investments in their facilities.

The most critical parts of the FCA are the Immediate Repairs Table and the Replacement Reserve Table. The Immediate Repairs Table identifies capital needs and prices for all failing or damaged building systems and life safety issues. The Replacement Reserve Table identifies long-term capital expenses (typically within 12 years of inspection) based on the expected useful life of the building systems and components.

The FCA involves a thorough property inspection by a team of one or more specialists, typically architects, engineers, or skilled-trade technicians. The goal of the FCA is to identify the following:

- Routine and/or deferred maintenance
- Systemic deficiencies
- Remaining useful life of all major building systems
- Capital replacement needs
- Overall system compliance with the original design/engineering intent
- Compatibility with contiguous systems
- Prioritized list of repairs
- Total building replacement cost

FCAs are typically constructed through a customized scope that can include a site inspection(s) of all major building systems, a meticulous review of pertinent building documents and records, and customized data analysis and calculation based on the consultant's engineering expertise, experience, field observations, and accepted cost. An FCA report is designed to serve as a functional tool to maintain the property over time and is generally requested by asset managers with long-term capital expense planning needs. Therefore, it contains a thorough accounting of the material components of each system, usually in the form of inventory tables, as well as detailed estimates for the repair and replacement of systems and equipment than those you would find in a PCA report. Ideally, this data will culminate in a realistic projection of expenses for the ongoing maintenance of the property over a defined period of time. This will help investors and owners maximize the return on investment of their assets.

In addition to year-over-year budget planning, an FCA can be a helpful component of annual preventive maintenance tasks. Facilities managers can track the scores in a computerized maintenance management system to have accurate information about the facility's ability to meet organizational needs, measure individual system performance over time, and know exactly when to replace or repair units and parts. The headaches, equipment breakdowns, and costly emergency repairs are worth the initial investment of time and labor.

An important component of the FCA is the method of data delivery. Because an FCA is a working document from which asset or portfolio managers project capital expenditures and maintenance expenses, delivery via a digital platform that can interface with client-side Integrated Workplace Management Systems is often preferred.

To make the most of your FCA, engage the help of professional consultants with advanced levels of knowledge, training, and extensive experience performing superior-quality assessments. Your team's credentials should include engineers, architects, commercial building inspectors, construction managers, and certified energy managers.[17]

[17] Brett Hayes, "What is a Facility Condition Assessment?" *Partner, Engineering and Science, Inc*, September 26, 2019.

Appendix E. Management Comments

HUGH NATHANIAL HALPERN
Director

MEMORANDUM

Date: February 1, 2024

To: Inspector General

Subject: Agency Response to the OIG Draft Report on the Indoor Air Quality Inspection 23-02-II

Thank you for the opportunity to offer the Agency's response to the draft report on the Indoor Air Quality Inspection (IAQ) 23-02-II . The Agency appreciates the OIG's efforts in giving added attention to this important matter. Indoor air quality has the potential to impact the health, comfort, and productivity of our employees, tenants, and visitors.

In General

GPO plans on using the findings in the report to enhance our existing programs. By implementing effective ventilation systems, ensuring regular maintenance of HVAC systems, and raising awareness about IAQ, the agency can create healthier indoor environments that enhance productivity while safeguarding our health.

Agency Response to Recommendations in the Draft Report

Recommendation 1

Perform identified needed repairs to chiller #1.

GPO concurs with this recommendation.

Although the entire chiller plant is expected to be replaced within a year of when repairs would be undertaken on chiller #1, implementing these interim repairs will help reduce the risk of operational failure in case there are delays in the replacement plan.

The Agency estimates the cost to repair chiller #1 at $250,000. Facilities Management will request the funding during the upcoming FY 2025 Strategic Investment Committee process.

The Agency expects to meet the following milestones to complete repairs:

Milestone	Target Date
JCP approves funding request	December 2024
Award contract for repairs	February 2025
Repair of chiller #1 complete	February – March 2025

Recommendation 2

Fully assess the operational condition of the chiller plant and establish a replacement plan as warranted.

GPO concurs with this recommendation.

The Agency received approval from the Joint Committee on Printing to spend $7.1 M to replace the chiller plant. Facilities Management engaged Henry Adams, an Architectural and Engineering Design Firm, to develop a design for the replacement system. The project design is currently underway and is 30 percent complete. After the finalization of the design and receipt of an updated construction estimate, GPO will replace the chiller plant.

The Agency expects to meet the following milestones to complete repairs:

Milestone	Target Date
A&E design complete	December 2024
Construction contract awarded	August 2025
Constructor mobilization	November 2025
Chiller plant replacement work	November 2025 – March 2026

Recommendation 3

Develop a plan to address and possibly replace the old and dirty air ducts. If duct replacement is not an option, develop a comprehensive cleaning schedule to address this concern.

GPO concurs with this recommendation.

Facilities Management has submitted a request to contract for duct cleaning on the 3rd Floor of Building C. This will act as a test case for future duct cleaning projects. Prior to proceeding with the cleaning, the Agency will conduct indoor air quality tests, and then retest after the duct cleaning to assess its effectiveness. If concerns about indoor air quality persist or if there are health issues that can be attributed to indoor air quality in this area, the agency will consider duct replacement.

GPO will develop a plan based on the results, outlining the anticipated cost and recommended approach for either duct cleaning or duct replacement. Due to the scale of the project, which includes 122 AHUs, an extensive network of ductwork, and filters, its implementation across the Agency is expected to span multiple years.

The Agency expects to complete the initial review of the test case by the end of CY 2024. At that time, the duct cleaning/duct replacement plan must be synchronized with the building utilization plan. The Agency anticipates a final cleaning schedule by the end of FY 2025.

Recommendation 4

Update or prepare schematics to reflect the current locations of all ventilation and air cleaning components.

GPO concurs with this recommendation.

The Agency currently has PDF copies of archived schematics that accurately represent locations for approximately 90 percent of the system. However, changes have been implemented since the initial construction that are not properly captured in the drawings. Additionally, older schematics are not digitized in AUTOCAD, except where the Agency has had new design and construction.

GPO will request funding at the FY2025 Strategic Investment Committee and contract with an outside firm to conduct an analysis to determine the requirements to develop accurate schematics of the ventilation and air cleaning components.

The Agency expects to meet the following milestones to update its schematics:

Milestone	Target Date
Request JCP approval for funding	August 2024
Receive JCP approval	December 2024
Contract firm for report	August 2025
Assess report and determine next steps	November 2025

Recommendation 5

Develop and implement a comprehensive renovation plan for the ventilation and air cleaning system at the GPO Central Complex.

GPO concurs with this recommendation with comments.

The Agency agrees with the intent of this recommendation, namely that GPO eventually replace and upgrade the entirety of its ventilation and filtration system. We also believe that, all things being equal, a comprehensive renovation plan for the ventilation and air cleaning system at the GPO Central Complex is ideal. However, the Agency cannot responsibly commit to a distinct plan to replace and upgrade its ventilation and air cleaning systems isolated from the overall plans for building renovations. As the Agency is currently in the midst of a space utilization study and planning for its implementation, we believe that an approach that focuses on highly utilized space is more appropriate.

Cost is also a critical factor. GPO estimates the cost of just replacing the air handling units—exclusive of the associated costs of replacing duct work or filtration systems— approaches the entirety of GPO's net income in FY 2022.[1] We have concerns about the availability of funds to implement any comprehensive plan in the near term without negatively impacting the Agency's ability to invest in other critical priorities.

As the Agency completes and begins to execute its space utilization plan in the coming 18 months, GPO commits to ensuring that renovations and upgrades to the ventilation and filtration system will be part of any renovations the Agency undertakes as part of that plan and

[1] GPO estimates that the total cost to replace 40 AHUs at $750 thousand per unit to be approximately $37.5 million, versus FY 2022's total net income of $46.02 million.

will request funds as part of those renovations for ventilation upgrades. GPO believes that this systematic, albeit piecemeal, approach stands a better chance for incremental success than a comprehensive plan with potentially greater barriers to adoption. Under the current plan, investments will be focused to meet production requirements and on-site occupancy until the building space utilization plan is completed, which is projected to be in December 2024. This approach seeks to maximize the advantages of indoor air quality and ultimately leads to a solution that is feasible, affordable, executable, and operationally relevant.

The following is a list of ventilation and air cleaning system projects that are currently undergoing renovations or have been already completed. Future investments will be aligned with the building utilization plan in the long-term.

Location	Description	Status
BUILDING A		
2nd Floor	Facilities/USCP/Union Offices	Design complete; awaiting construction
3rd Floor	NARA Archival Storage Space Phase I	Complete
4th Floor	NARA Archival Storage Space Phase II and AOC SAA Offices	Design complete; awaiting construction
6th Floor	Finance and Security Services	In design
7th Floor	OGIS and OFR Spaces	Complete
8th Floor	Phase I — Cafeteria Phase II — Other spaces	Complete Awaiting A&E Design Contract Award
BUILDING B		
5th Floor	ASO QCIM Laboratory Project	In design
8th Floor	IT Data Center Project	In design
BUILDING C		
4th Floor	Plant Production	Awaiting design contract award
BUILDING D		
Basement	SID Storage/ASO Storage	Design complete; construction in progress
2nd Floor	SID Production	Design complete; construction in progress
3rd Floor	SID Production	Design complete; construction in progress

Based upon available funding, the Agency projects that completion of the ongoing projects listed above will take between five to eight years. Long-term projects will be determined based upon the building utilization plan, availability of funding, and Agency priorities.

Recommendation 6

Implement a proactive air sampling program in accordance with ASHRAE design limits and a lead testing program in accordance with GPO Directive 670-52A and communicate results as appropriate with Facilities Management.

GPO concurs with this recommendation with comments.

The Agency concurs that the air sampling program at GPO should be improved. However, GPO believes that air sampling to ASHRAE design standards is not useful until the Agency has installed ASHRAE certified equipment and systems. GPO currently enforces OSHA air quality standards and works toward ASHRAE standards as a goal.

To evaluate the issue and to improve the air sampling program, GPO has committed $60,000 to conduct two phases of contractor air sampling. During phase 1, the GPO Main facility will be sampled widely in all areas where employees work more than two days a week for total Volitile Organic Compounds (VOCs), formaldehyde, carbon monoxide, PM2.5, and carbon dioxide. After sampling, the contractor will submit a report with the locations where sampling took place and the sampling results. The report will also include recommendations based on the results that will help formulate the strategy of phase 2. Phase 2 will conduct follow-up sampling that will determine the source and extent of contaminants. At the end of phase 2, the contractor will provide recommendations to correct the issues discovered and a recommended periodic survey schedule/plan for follow-up monitoring.

Each phase of the contractor's indoor air quality assessment is anticipated to require 30 days for completion. However, any delays in contracting or unexpected air quality issues that necessitate further investigation may prolong the process. Nevertheless, based on our estimations, we expect Phases 1 and 2 to conclude by September 30, 2024.

Consideration 1

Implement the Ventilation Rate Procedure, Indoor Air Quality Procedure, Natural Ventilation Procedure, or a combination of the three to determine compliance with ASHRAE 62.1.

GPO concurs with the intent of this consideration.

While GPO acknowledges this consideration, it is important to note that the agency lacks the expertise in this particular skill set and relies on architectural and engineering design firms for this expertise. Nevertheless, GPO can adhere to the intent of this consideration by requiring GPO-contracted A&E firms to develop designs that are ASHRAE compliant. The specific methodology used by an A&E firm to comply with the standard is not as significant as their cability to produce a design that meets requirements set by ASHRAE.

The Agency will work with A&E firms to ensure that any future renovations are compliant with ASHRAE standards, when feasible.

Consideration 2

Develop and implement guidance to ensure future designs and renovations of the ventilation and air cleaning system comply with ASHRAE 62.1 and are linked with building utilization plans.

GPO concurs with this consideration.

GPO has already implemented steps to ensure that future renovations adhere to ASHRAE 62.1 standards. GPO achieves this by providing the architectural and engineering firm with clear requirements in the design specification. The Agency's Smart Manufacturing Facility in Building D was such a case because that design surpassed the ASHRAE 62.1 standards. GPO included anti-microbial coatings in the air handlers and opted for MERV 13 filters, which are of a higher standard, instead of the mandated MERV 11 filters specified by ASHRAE 62.1.

The agency agrees with the suggestion to link future renovations with the building utilization plan. GPO's ongoing designs are focused on the future and not associated with past requirements. For example, GPO will not merely replace existing air handler units on a one-for-one basis. The replacements will be aligned with mission requirements and the building utilization plan to avoid wasting resources.

GPO considers the design consideration as complete. However, the building utilization plan is still being developed and is not expected to be finalized until December 2024. Until then, all designs will be tailored to meet production requirements and on-site occupancy in order to maximize the benefits of indoor air quality.

Thank you for the opportunity to provide the Agency's input on this product from your office. The Agency spent approximately 18 hours preparing this response.

If you have any questions, please contact me.

HUGH NATHANIAL HALPERN

cc: **Deputy Director**
Chief of Staff
General Counsel

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