

Virtual Audit and Assessment Process Manual

For Consultants and Customers

This document is a guideline for consultants and customers interested in proceeding with Virtual Audits and/or Assessments. Check back for updates as we learn more about the Virtual Audit and Assessment process.

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1 Introduction

This Virtual Audit and Assessment (VAA) Guide is intended to guide practices and procedures for data collection needed to perform energy audits and assessments for commercial, industrial, and multifamily facilities. VAA procedures may be applied to:

ASHRAE Level 1+ Audits, including

- **Whole Building Audits** – audits which assess all energy using systems in a facility
- **Targeted Building System Audits and Assessments** – audit that is focused on certain systems (such as lighting or HVAC), or the purpose of the audit is to gather data for long-term energy planning or energy roadmap.

Operational Assessments identify operational, maintenance, and/or energy management improvements that can be made at a building and yield cost effective energy savings. It prioritizes low cost and no cost improvements but may make note of potential capital improvements to be assessed in the future.

1.1 Definitions

The following terms are commonly used throughout this document:

Customer: Recipient of energy auditing and assessment services from a service provider. Relevant staff may include business office staff, facility director, site engineer, HVAC technician, electrician, building manager, etc.

Program: An initiative offered by the New York State Energy Research and Development Authority (NYSERDA), New York State utilities, or public agency that provides funding, technical assistance, or other benefits to the customer to engage in energy efficiency activities.

Service Provider: The organization that performs energy audits and analyses for the customer. Service provider staff may include account managers and energy professionals.

1.2 Potential for VAA

The VAA process may be most successful for facilities with the following characteristics:

- Buildings with simple mechanical systems and easily defined equipment and operations, such as schools, commercial office buildings, or multifamily properties.
- Smaller buildings <200,000 square feet and those with repeated typical room layouts.
- Facilities with knowledgeable staff available with little to no time constraints. Knowledgeable staff are those with familiarity with their building systems, operations, and maintenance.

- Facilities with an organized library of electronic building drawings (as-builts and renovation projects).
- Buildings with equipment that has high maintenance costs and/or imminent replacement of equipment.

To identify the level of VAA potential, consider the following:

- How much of the data needed for energy calculations can be acquired by the customer?
- Consider the data available (type and accuracy), complexity of systems, building size, building age, staff availability and comfort levels, utility bill complexities, etc.
 - A whole building audit requires enthusiastic engagement from the customer as well as knowledgeable staff that are willing to facilitate the virtual audit and available for possible follow up questions. If the customer cannot provide staff resources to assist in site data collection, the likelihood of success is low.
- For Operational Assessments, consider the capabilities of the existing Building Management System (BMS) and the building operator’s level of skill with the system. Both need to be strong for an effective operational assessment.

Since the building complexity, staff knowledge and capabilities, and scope/goals of the audit will vary with each opportunity, there is a certain amount of judgement needed to determine if a VAA will be effective. In some cases, the service provider may choose to take a combined VAA approach, where most of the data collection is performed remotely, followed by a pared down site visit. The following table provides general guidelines to assist with that determination.

Table 1 - Approaches to VAA

	Approach A	Approach B
Best	<p>Full Virtual Walkthrough</p> <p>Knowledgeable staff (lighting, HVAC) is available and comfortable with VAA (preferably a building engineer, electrician, and/or HVAC technician)</p> <p>Buildings have simple system types and are moderately sized</p> <p>Floor plans and supportive information can be provided to facilitate the VAA</p> <p>All required information can be obtained to complete energy calculations</p> <p>Auditor will guide facility staff through a virtual walkthrough of their building</p>	<p>Part Virtual Walkthrough</p> <p>Coach staff through a few spaces and outline what data must be collected</p> <p>Provide staff with data collection sheets, photo checklist, and guidance</p> <p>Customer completes data collection sheets and returns to auditor</p> <p>Requires additional coordination and back/forth with customer</p>

	Approach A	Approach B
Better	<p>Virtual Walkthrough + Site Follow Up</p> <p>Knowledgeable staff is available and comfortable with VAA (preferably someone very familiar with building with access to mechanical spaces)</p> <p>Buildings have simple systems and/or buildings are moderately sized</p> <p>Floor plans and equipment lists can be provided to facilitate the VAA</p> <p>Most required information can be obtained to complete the majority of energy calculations</p> <p>May require a brief site visit follow up by the auditor to confirm a small portion of the data needed</p> <p>Auditor will guide facility staff through a virtual walkthrough of their building</p>	<p>No Virtual Walkthrough</p> <p>Use a full set of mechanical and electrical drawings, documentation of any upgrades since, and comprehensive equipment lists (location, quantity, capacity, make, model, year built) and an in-depth phone facility interview to capture existing conditions. All data must be reasonably correct and current (more likely if built after 2010).</p> <p>Request a detailed list of photos for documentation</p> <p>Required information can be obtained to accomplish the majority of energy calculations and report</p> <p>May require a brief site visit follow up by the auditor to confirm a small portion of the data needed</p>
Good	<p>Virtual Audit + Site Visit</p> <p>Staff is available and comfortable with VAA</p> <p>Buildings have some complex systems and/or buildings are large (e.g., >200,000 sq. ft.)</p> <p>Floor plans can be provided to facilitate the VAA</p> <p>Required information can be obtained to accomplish up to 50% of energy calculations and report</p> <p>Requires on-site visit to collect the remainder of information/data</p> <p>Auditor will guide facility staff through a virtual walkthrough of part of their building</p>	<p>No Virtual Walkthrough</p> <p>Required information can be obtained to complete up to 50% of calculations and report</p> <p>Requires a brief site visit follow up by auditor to confirm data on a system or area of the facility</p>

1.3 VAA Toolbox



A toolbox of materials for use during the VAA process is available, including email templates, discussion guides, and data collection forms. Throughout this document, toolbox items are denoted with the toolbox icon, as shown at left.

The full VAA Toolbox includes:

- Planning Call scheduling email template
- Planning Call follow-up email templates
- Planning Call Discussion Guide
- In-depth Facility Interview scheduling email template
- In-depth Facility Interview follow-up email templates
- In-depth Facility Interview Discussion Guide
- Virtual Walkthrough scheduling email template
- Virtual Walkthrough reminder email template
- Virtual Walkthrough Discussion Guide
- Virtual Walkthrough follow up email template
- Customer Guidance: Virtual Audit Guide
- Building Information Form
- System Information Form

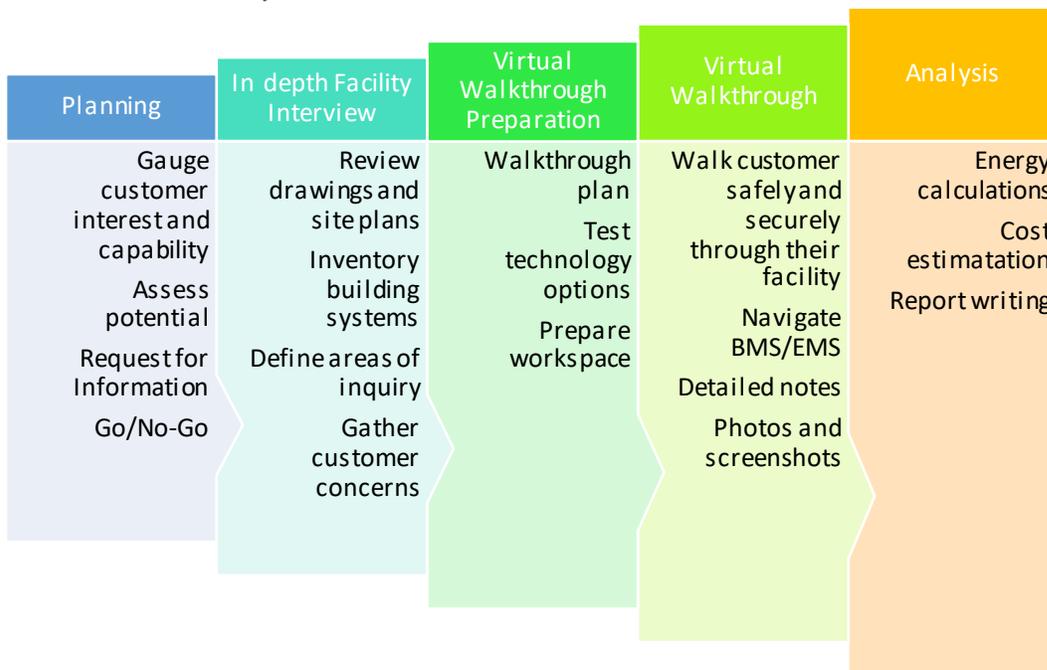
2 VAA Process

In a virtual audit, the customer participates in the energy audit process by gathering building information on behalf of the energy auditing team. Using the customer staff in this way allows the service provider to minimize or eliminate time spent on-site. It is intended to provide a positive and educational experience for the customer. Building a relationship with the customer over time will help establish a strong collaborative process where the service provider can obtain the information needed to perform their analysis, and the customer gains a higher understanding of their property.

The VAA process has five parts:

1. **Planning:** Determine whether the customer is a good candidate for a VAA; define roles and responsibilities, establish a timeline, and set energy efficiency goals.
2. **In-depth Facility Interview:** Interview customer staff about their building systems and performance.
3. **Virtual Walkthrough Preparation:** Build a plan to walk through the site for data collection via videoconference. Section 4 discusses potential videoconferencing applications.
4. **Virtual Walkthrough:** Walk through the site with the customer using videoconference to observe existing conditions and gather detailed building systems, operation, and performance information.
5. **Analysis:** Use the information collected to perform energy calculations and modeling to develop program-specific deliverables.

Figure 1. VAA Process Summary



Utility Bill Analysis

The VAA process assumes the service provider has already or will acquire energy use data independently of this process. Most auditing teams already have a process for obtaining energy use data and performing a utility bill analysis and should continue to use that process.

2.1 Planning Call

The planning call is an introductory conversation with the customer to determine their level of interest and ability to participate in the VAA process. It reviews their energy efficiency goals and explains how the VAA can help them achieve those goals. The customer is not expected to have technical information about their facility on-hand. The planning call is meant to establish the capability and interest of the customer to participate.

Length:	30 minutes to one hour
Participants:	Program account manager, customer point of contact and/or other team members (e.g., facility director, site engineer, HVAC technician, electrician, building manager, etc.)



Toolbox

Building Information Form
Planning Call Discussion Guide
Email Template – Planning Call Scheduling
Email templates – Planning Call Follow-up

2.1.1 Agenda

The agenda detailed in the following table, in conjunction with the Planning Call Discussion Guide, will help guide the conversation with the customer.

Planning Call Agenda		
#	Agenda Item	Detail
1	Introductions	Introduce the program team attendees
3	Customer Energy Efficiency Goals	High level discussion about what the customer hopes to achieve in their facility.
4	VAA Overview	<p>Educate the customer about this as a collaborative approach to data collection</p> <p>Facility interviews would normally happen on-site, but this can also be achieved remotely using videoconferencing technology</p> <p>Data collection requires customer collaboration</p> <p>The remainder of the auditing and assessment process is the same - the identification of energy improvements, energy analysis, cost estimates and report writing are not negatively impacted by virtual data collection</p> <p>Identify significant issues that would preclude a facility from participating in a virtual site visit.</p>
	Customer Reaction and Interest	Gauge the customer's interest and ability to continue.
5	VAA Process	<p>Provide a high-level look at next steps and the time required for the customer's understanding:</p> <p>Facility Interview - up to one hour per building</p> <p>Virtual Walk-through – up to one day per building</p>
6	Next Steps	<p>Explain the next steps:</p> <p>Determine who will lead the customer's data collection efforts</p> <p>Request for Information</p> <p>In-depth Facility Interview</p>
7	Wrap Up	<p>Close out the call:</p> <p>Explain you would like to develop a plan that meets their needs.</p> <p>Confirm next steps.</p> <p>Thank them for their time.</p>

2.1.2 Follow Up



The follow-up performed after the Planning Call will depend on whether the customer is a good candidate for a VAA.

If the customer is interested in proceeding: send a Go post-screening email to the customer that contains the following:

- Request for any available electronic building information (drawings, site plans, equipment information)
- Scheduling logistics for setting up the kick off call.

If the customer is NOT interested in proceeding – send a no-go post-planning email:

- Thank them for their time and attention in attending the call.
- Offer to continue to engage them as field work requirements continue to evolve.

2.1.3 Considerations

Service providers may consider the following in planning and delivering the planning call:

- Customers may not be confident about their ability to capture all information remotely or over a virtual walkthrough. Be careful about overwhelming them, while being clear about the need for their assistance.
- Consider designating one customer representative as the data collection lead, who can receive and respond to Requests for Information. Defining customer roles and responsibilities will help to reduce confusion and email clutter.
- Establish a file submission procedure that accommodates electronic files of various sizes. This may include email, organizational Sharepoint sites, or third-party file hosting (e.g., Dropbox). Service providers should consult with their internal IT staff about any security limitations or concerns.

2.2 In-Depth Facility Interview

The in-depth facility interview is the first half of performing the virtual audit, with the second half being the virtual walkthrough. Service providers should be prepared to document detailed information during this call. At interview's conclusion, energy auditors should be able to:

- Have a full understanding of existing conditions and areas of inquiry
- Have the basis for a preliminary energy improvement list
- Map out the virtual walkthrough

Service providers should use at least two staff members during the virtual walkthrough to facilitate complete note taking.

- Primary Auditor – Update data collection devices, verify data against drawings and provided information
- Assistant –take notes, support navigation

Length: Up to one hour per building, depending on size and complexity

Participants: Auditing team, knowledgeable customer team members (e.g., facility director, site engineer, HVAC technician, electrician, building manager, etc.)



Toolbox

- System Information Form
- In-depth Facility Interview Discussion Guide
- In-depth Facility Interview scheduling email template
- In-depth Facility Interview follow-up email template

2.2.1 Pre-interview Preparation

While careful preparation is essential for a productive and efficient on-site audit, it is even more essential with a VAA, where building information is relayed through the customer. The auditing team should be familiar with all materials regarding the project, making sure to:

- Review materials received to date including utility bill analyses; site plans, drawings, equipment lists, etc.
- Identify missing information or questions.
- Perform or review energy analysis to identify potential areas of inquiry. Note any anomalies that should be discussed with the site.

2.2.2 Agenda

The agenda detailed in the following table, in conjunction with the In-depth facility interview discussion guide, will help guide the conversation with the customer.

In depth Facility Interview Agenda		
#	Agenda Item	Detail
1	Introductions	Introduce the service provider attendees and customer representatives, especially those who did not attend previous calls. If recording the call, receive permission to do so.
2	Materials Received	Acknowledge materials received to date from the customer. Identify missing items. Review questions on the Building and/or System Information Forms needing resolution.
3	Utility Data Analysis (optional)	If the utility data analysis has been completed, consider reviewing the results of that analysis with the customer.
4	System Information Form	<p>Review building operation details (per unique area/use)</p> <p>Review information about energy systems at their sites: HVAC system type (packaged Dx, chilled water, hot water, unit ventilators, split ACs, etc.) Lighting system type (fluorescent T8, LED, HID, etc.) Presence of a building energy management systems Other energy intensive systems (data center, pool, well pump, etc.)</p> <p>Interview site contact for items related to equipment operation, equipment controls and strategies, schedules, etc.</p> <p>Review their critical O&M concerns (per system)</p> <p>Review other pertinent information</p> <p>Use the Systems Information Form as a guide, but note that: Unique buildings or systems may require additional questions. Navigate the discussion based on answers to previous questions. Aside from obvious questions about the equipment itself, ask additional questions about the system.</p> <p>For example: What type of heating system is present? If there is a hot water heating system, you would ask questions about an OAT, does the return water temperature go below 130°F, are there 2-way or 3-way valves in the system, etc. If there is a steam system, ask questions about steam traps (is there a maintenance program?), are radiators controlled by manual valves or TRVs, etc.</p> <p>If all heating is provided by RTUs, ask if they have economizers or if any serve a large area with DCV, ask if the supply fans have VFDs, how they are controlled, etc.</p>

In depth Facility Interview Agenda		
5	Technology Options	Discuss technology options for the Virtual Walkthrough. Suggest scheduling a test run to identify bugs in the chosen platform.
6	Next Steps	Schedule the Virtual Walkthrough. Follow up any missing or required information. Optional: test run of technology applications to identify bugs or problems.

2.2.3 Follow Up



Confirm the dates and times of the virtual walkthrough with participating customer staff.

2.2.4 Considerations

Service providers may consider the following in planning and delivering the in-depth facility interview:

- Take breaks when on long calls and let the customer know they can stop at any time.
- Sometimes, not sticking to the system information form line by line and creating a conversation can be effective, especially with HVAC systems. Allow the customer to provide an overview of the HVAC systems and then ask specific questions to fill in the gaps.
- For sections of the building that were added after original construction, covering this section separately may be effective, as these spaces may have separate HVAC systems.
- When there are multiple buildings of same category, it may be more effective to complete the interview system by system rather than by each building. For example, consider discussing interior lighting for multiple buildings at once.
- If the customer provides several drawings or other materials, consider quickly skimming through the drawings before the interview. The interview will provide the most accurate answers on existing conditions. The drawings can help the auditing team understand the details of building systems after the interview.
- Remember to thank the customer for their time, keep appreciating their efforts on gathering information on your behalf. Note where they are already following good energy management practices. It can help keep a conversation going and keeps them motivated during long interview calls.

2.2.4.1 Example Approach to the In-depth Facility Interview

A high school undergoing a VAA was a three-story building with multiple wings and two separate boiler rooms. Due to the physical structure of the school, the auditor took the following approach to the interview:

- Each wing was served by dedicated mechanical systems. The interview reviewed each system, wing by wing. For example, the A wing was served by water source heat pumps and a cooling tower, while the B wing was fully served by rooftop units with gas furnace heating.
- Reviewing the two boiler rooms separately was helpful in having a clear conversation about building systems.
- The site provided a digital floor plan prior to the interview. The interview walked through the floor plan, where site personnel were able to explain exactly where certain split systems were located.

2.3 Virtual Walkthrough Planning

The auditing team must thoroughly prepare for a productive and time effective virtual walkthrough. The auditing team must not only prepare their materials and data collection tools, but also make sure that the customer understands their critical role at the virtual walkthrough.

2.3.1 Prepare the Customer

The VAA process, from planning call and through the in-depth facility interview, prepares the customer representative who will walk the site to understand the importance of their role. In the period immediately preceding the virtual walkthrough, the auditing team should reinforce this messaging and give specific instructions about what the customer should do to prepare.

Scheduling Email



Once the date(s) and time(s) have been chosen for the virtual walkthrough, confirm the schedule via email. Advise the customer of items they will need, including but not limited to:

- Personal protection equipment, as needed
- Comfortable walking shoes
- Charged smartphone/device
- Room keys (if required for accessing areas of the building or meter locations)
- Tools to open HVAC units to see the motor
- External battery for smartphone/device, if available
- Flashlight and tape measure
- Liquids for hydration

Reminder Email



Reconfirm the date(s) and time(s) of the virtual walkthrough and the materials needed. This is also a good time to describe how the virtual audit will be conducted. Provide a high-level “routing plan” that explains where the walkthrough will start and what comes next so that those spaces can be prepared and accessible. Encourage the customer to let you know about any questions they might have about preparing for the virtual walkthrough or site safety.

2.3.2 Review Materials

Review the information already on hand.

- Collect digital copies of building drawings (mechanical, controls, lighting, architectural etc.) as available.
- Collect any supporting information the customer indicated was available either during one of the calls or in the Building/System Information Forms.

- Use online tools such as Google Earth to get additional insights about the building.
- Review the utility data in conjunction with the any new information to see if any additional questions arise regarding the energy use profiles.

2.3.3 Develop Walkthrough Plan

Use the information in hand to develop a room by room for the virtual walkthrough. Several shorter walkthroughs may prove as, if not more, effective than one long call but will require additional effort to schedule.

- Determine what data is needed for each system/equipment
- Review data collection spreadsheets to support this plan
- Remind client to have a fully charged device
- Develop a script
- Practice your script
 - Auditors should plan a practice run with another auditor prior to their first client facing virtual audit
 - Take turns from the client perspective
 - Guide one another as if it were the real virtual audit
 - Consider keeping a Virtual Audit Journal to note lessons learned.
- Be prepared to navigate data collection spreadsheets and/or tools to populate during the video conference
- Take screenshots, photos, and/or use snipping tool to collect photos for analysis and report writing
- Have a backup plan if the call is unexpectedly dropped

2.3.4 Prepare Workspace

Service providers may wish to have multiple staff members attend the call to facilitate complete note taking.

- Primary Auditor: Update data collection tools, take notes, verify data against drawings and provided information
- Assistant: Record videoconference, take photos, take notes, support navigation

Use multiple monitors wherever possible. Minimum recommendations are either one large monitor with a split screen or two monitors.

- Screenshots: Have file folder to save screenshots ready to go

- Screenshots can be taken via your preferred method and could include the Microsoft Office snipping tool or other third-party application
- Save a test snip and navigate to the appropriate folder. This should stay mapped for easy navigation during the walkthrough
- Number screenshots instead of labeling to save time during walkthrough
- Ensure equipment information is visible (e.g., nameplate details) before moving to the next step
- Have folder where building drawings and information provided by client are readily available for you to compare to reality during the walkthrough
- Make sure your computer is plugged into power, connected to highspeed internet, and VPN (where applicable)
- Turn off notifications and other distractions
- Know how to navigate your data collection tools quickly and efficiently. Prepopulate data as much as possible prior to the walkthrough

2.4 Virtual Walk-through

The virtual walkthrough is the second half of performing the virtual audit, with the first half being the in-depth facility interview. The service provider should be prepared to document detailed information during this call. At the walkthrough's conclusion, the auditor should:

- Have documentation of existing equipment and systems
- Have the data needed to perform energy calculations and modeling

Length:

The length of time needed to complete the virtual walkthrough will vary based on building size and complexity, amongst other variables. The virtual walkthrough can take up to one day per building.

- Best Case: virtual walkthrough takes roughly the **same** amount of time as an in-person audit, where
 - Contact is knowledgeable, prepared, and engaged
 - Drawings/information is readily available
- Typical Case: virtual walkthrough takes roughly 1.5 times longer, where
 - Contact is somewhat knowledgeable
 - Partial documentation is available
- Worst Case: virtual walkthrough takes roughly twice as long, where
 - Contact is not knowledgeable, no tools to open equipment

- No data is provided ahead of time
- Requires multiple requests for information and follow up

Participants:

On the auditor side, a minimum of two people is recommended:

- One person takes screenshots, photos, and reading data/speaking out loud for team member to verify
- At least one person verifying data, taking notes, and correcting/populating info in energy analyses models or calculators

From the customer side, one person with access to required spaces is typically enough for the virtual walkthrough.



Toolbox

- System Information Form
- Virtual Walkthrough Discussion Guide
- Virtual Walkthrough reminder email template
- Virtual Walkthrough follow up email template

2.4.1 Agenda

The agenda detailed in the following table, in conjunction with the virtual walkthrough script, will help guide the conversation with the customer.

Virtual Walkthrough Agenda		
#	Agenda Item	Detail
1	Introductions	Introduce the program team attendees
2	Safety Briefing	<p>Safety message to ensure safe movement through the site (e.g., slips, trips, and falls; ladder safety)</p> <p>Filming only while standing – no walking while filming</p> <p>Stay focused on where you are walking and keep an eye out for potential hazards</p> <p>Review spaces where the customer may be uncomfortable navigating</p> <p>Encourage the customer to communicate concerns at any point during the virtual audit</p>
3	General Review	<p>Request consent to record the video, which is used for field note documentation</p> <p>Be mindful of recording file size and potential data streaming costs at their end—consider turning the video recording on and off</p>

Virtual Walkthrough Agenda		
		<p>Provide some tips before getting started, develop a rapport with the client</p> <p>Encourage them to make suggestions about how to proceed through their site</p> <p>Encourage them to take their time and ask questions through the process</p> <p>Thank them for their time and effort with this virtual audit</p> <p>Be patient and navigate the customer slowly</p> <p>Speak slowly and clearly; take a methodical approach</p> <p>Understand you are guiding, teaching, and collaborating with site staff</p> <p>Minimize the use of acronyms or abbreviations.</p>
4	Camera Operations Review	<p>Review Basic Video Terminology and Techniques</p> <p>The auditor requests the customer to repeat certain video shooting functions throughout the walkthrough; therefore, standard terminology and techniques should be reviewed so that the customer understands the terms and what is needed when prompted for action.</p> <p>Framingshot</p> <p>Focus</p> <p>Zoom in/out</p> <p>Panning shot (to get a wide view), Pan left/right and from/to</p> <p>Close-up</p> <p>Hold the video</p>
5	Walkthrough	<p>Guide the customer to specific areas of interest and equipment. If possible, record the walkthrough for future use. For a whole building audit, at a minimum, the site walk should cover:</p> <p>Lighting systems</p> <p>This is the most time intensive aspect of the virtual site walk. Develop a sampling plan that covers various activity areas, fixture types, etc. For sampled areas get precise information regarding fixture types and counts. Make sure you are clear about how many and which rooms at the site are represented by the sampled spaces.</p> <p>HVAC</p> <p>Cover major HVAC systems. Gather unit and zone level information. Always proceed from the mechanical space level (mechanical room, roof, etc.), to the overall equipment (complete pump assembly), to specific equipment (pump motor), to equipment detail (motor</p>

Virtual Walkthrough Agenda		
		<p>nameplate). For each piece of equipment confirm what it serves and how it is operated and controlled.</p> <p>Envelope</p> <p>Collect building construction details including glazing type, any insulation, construction materials, etc. Have the customer take an overall photo of each building façade.</p> <p>Plug/Process Load</p> <p>Collect information on plug or process loads.</p> <p>Building/Energy Management System (BMS)</p> <p>Review BMS system and guide the site contact to set up trends and/or screens for photographs.</p> <p>If the facility BMS trending capability is limited and dataloggers must be installed on site, review datalogger launching plan. Provide appropriate logger equipment to the customer for installation at a later date.</p> <p>On rare occasions, remote access to the BMS may be available. If so, coordinate access to the BMS to collect the information needed.</p>
6	Check ins (repeat as necessary)	<p>Check in to see how they're doing</p> <p>Ask (every two hours at a minimum) if they need a break</p> <p>Opportunity for feedback from the client</p>
7	Wrap Up	<p>Discuss energy improvement potential based on the information collected.</p> <p>Show gratitude and describe next steps, including:</p> <ul style="list-style-type: none"> missing information and method for obtaining it timeline for the analysis and deliverables other program-specific next steps and guidance

2.4.2 Follow Up



Toolbox

Once the virtual walkthrough is complete, send a follow up email to the entire customer team which includes:

- Confirmation that the walkthrough was completed
- Request(s) for Information (as needed) with deadline for submission
- Time estimate for completing the energy analysis

2.4.3 Considerations

Primary challenges to the virtual walkthrough are based on technology and the knowledge of the customer. On the technology side, issues with device battery life, adequate connectivity, and blurry video are common. Wi-Fi-based internet connectivity while on roofs or in basements may be limited or nonexistent. Video quality may also be poor when moving too quickly.

On the knowledge side, the customer representative may have limited knowledge about building system operation, maintenance, and performance. Repeatedly stressing the importance of access to relevant building areas during the planning phase is also recommended.

2.5 Analysis

With the completion of the virtual walkthrough, organized notes and photos/screenshots will assist you in performing analyses and developing deliverables as you typically would after a site visit.

1. Analyze the information collected from the virtual site walk and perform energy calculations using appropriate tools. The virtual audit process should not impact the energy calculations process. Utilize standard energy modeling tools.
2. The virtual walkthrough may have some impacts on estimating measure costs. Add appropriate assumptions in your cost estimation calculations and highlight them in the audit report.
3. In some cases, missing data might require the service provider to base their analysis on reasonable assumptions. Be sure to explicitly state assumptions.
4. Develop a draft and final audit report or other required deliverables.

2.6 Quality Assurance

Managing virtual data collection can be complex, especially during the virtual walkthrough. Using two service provider team members to guide and capture information provides a second set of eyes and ears, which can minimize errors.

Remote data collection may present a service provider with the need to make educated guesses regarding building system operation, specifications, and performance. Clearly noting these assumptions will alert their internal quality assurance and review team to check these assumptions for reasonableness and potential impacts upon the analysis.

3 Customer Safety

Customer safety is of primary importance. The virtual walkthrough agenda includes a safety briefing. General safety topics include:

- Review of customer safety concerns
- Filming only while standing still—no walking while looking at the camera
 - General tips for moving about the building and site
 - Highlight awareness of avoiding slips, trips, and falls
- Review of ladder safety (where applicable). Avoid the use of ladders if possible
- Review of equipment-specific safety (e.g., motor belts and moving parts and loose-fitting clothes)
- Be aware of your well-being—it is okay to take breaks, drink water, and/or rest

The service provider should consider these and other relevant safety aspects:

1. Facility Staff personal check in

- Make sure you are feeling well and up for the walkthrough the day of. If not, we may reschedule.
- If you feel fatigued or tired, stop immediately and let us know.
- If you have any pre-existing medical conditions that would make walking or climbing stairs challenging, please let us know.
- If there are any spaces, you're uncomfortable navigating, please let us know.

2. Potential Equipment List

- Personal protection equipment, as defined by the site
- Room keys (if required for accessing areas of the building or meter locations)
- Tools to open HVAC units to see the motor
- Comfortable walking shoes (or boots for a significant amount of mechanical spaces)
- External battery for smartphone/device, if available
- It's okay to take a break for water, lunch, and snacks
- Flashlight and tape measure

3. General Tips for the Walkthrough

- Stop walking and stand when videoing something or entering data. Make sure to look in the direction you are walking. It may be tempting to look at the smartphone/device that you are video conferencing on.
- If providing a virtual tour of the roof, practice safe ladder climbing. Keep smartphone/device and any writing pads in a shoulder bag, backpack, or pocket. Ensure you can use both hands to firmly hold the ladder. Always keep three points of contact while climbing.
- If any door handle, knob, or lever is too hard to move, rotate, open or seems jammed; do not use excessive force which could cause injury to you.
- If you feel you are not comfortable going into a space/area, immediately express the concern to the auditing team on the call with you.
- We will check in frequently and may take needed breaks during the day(s) of the walkthrough.
- Feel free to hydrate, eat, or use the bathroom whenever needed.

Identifying Hazards and Suggested Actions

Potential Hazard	Suggested Precaution/Action
Is there anything on walkways or steps that could cause slips, trips, or falls? (For example, a build-up of leaves, wet grass, supplies on the ground, etc.)	Make sure to have the path cleared before walking around
Are there any ramps or slopes in or around the workplace?	Make sure lights are on and be alert when you arrive in such areas
Are edges of steps hard to see, rounded, damaged, or slippery?	Make sure lights are on so you can see step edges clearly. If not, you may want to highlight such areas with labels or notes such as watch your step.
Are any walkways or areas unusable or blocked?	Ensure a clear walkway throughout the areas we would need to walk through and perform housekeeping, in advance if necessary
Are lighting levels too low to see the floor clearly in any of the spaces?	Improve lighting and use a flashlight, if necessary, before walking in such areas
Are there dirty or slippery floor areas in the facility?	Please be aware of such areas and thoroughly clean and dry them before walking there

Potential Hazard	Suggested Precaution/Action
Are there any locations where there are sudden changes in ground level that are not easy to see? (For example, small slopes or steps)?	Make sure lights are on so you can see areas edges clearly. If not, you may want to highlight such areas with labels or notes such as watch your step.
Are there areas with poor drainage or leakages?	Have such areas cleared of drainage or leakages before accessing them.
Is there exposed dust, mold, or asbestos (pipe insulation), volatile chemicals or constant buildup of chemical vapor anywhere in the facility? (For example, AHU/boiler rooms, chemical storage rooms, basement spaces)	Exercise increased caution. Do not enter unsafe spaces. Do not touch pipes/materials with asbestos. Ensure the space has enough ventilation and you have protective equipment such as respiratory masks, if needed.
Are there rooms with vibrating machinery that is very loud?	Use protective equipment such as ear plugs.
Is there any mechanical equipment with exposed and moving motors, fans, blades, or rusted parts?	Do not touch any motor belts or moving parts. Make sure you don't have any lanyard, straps, jewelry, or loose-fitting clothing (sweaters, vests, etc.) that could get caught in moving machinery. If needed, make sure to switch off any equipment before accessing it.
Are you aware of any areas with exposed electrical wiring or high voltage?	Do not enter such spaces unless the customer is trained and maintain minimum safe approach distances.
Are there any spaces/areas which have low ceiling height and could be potential hazard to the head or eyes?	Exercise increased caution. Watch your head!
Is there equipment with exposed/uninsulated steam or hot water piping or hot surfaces?	Do not touch. Exercise increased caution.
Do you anticipate the need for using a portable/step ladder?	Perform a safety/quality check of ladder prior to use. Are there any loose steps/rungs, screws, hinges, or damaged metal parts? Make sure the ladder is free of defects.

4 Technology Options

The virtual walkthrough relies on the use of videoconferencing, where the customer is the eyes of the auditor by using a handheld smartphone or tablet. The customer must be willing and able to use the device over a long period of time (2+ hours at minimum).

There are many videoconferencing applications available. Choosing the right application for the customer and auditor teams will require an upfront conversation, typically during the planning call.

Table 2 – Recommended Videoconferencing Applications presents a list of commonly used videoconferencing options, along with pros and cons and general recommendations for use. Auditors should confirm any privacy or security concerns and/or protocols with their customers prior to selecting an application.

Recommended Videoconferencing Applications

Application	Pros	Cons	Use if:
Facetime	Free software on all Apple phones and tablets Push button Pictures while in video mode	Only works with Apple products Only iPhone 8 and above can record videos	Ease of use for site No downloading Must have newer smart phone and connectivity
Google Duo	Free software on all Android phones and tablets	Only works with Android products	If the customer has Android device – auditing team must also have one
Microsoft Teams	Works on Apple and Android products Allows full video and audio recording Videos can be pinned to allow for full size and quality screenshots Auditor/inspector uses the computer, while the on-site designee uses their phone Phone application is free to download and use Multiple people may join	Requires on-site designee to download a free app prior to the audit or inspection Recordings are required	Successfully tested for this use

Application	Pros	Cons	Use if:
	the call		
Skype	Works with both Apple and Android products Full audio and video recording Clear images using the print screen or Snipping Tool? Instigate call from PC so phone is available for Field App input and facilitate photos of video with phone.	Site must download free software Must have newer smart phone and good connectivity	Full audio and video recording are needed Highest quality performance
Stream	Demos indicate smooth functionality with ease of picture taking and video recording Some minor calculations, such as room dimensions possible. Consistent approach and records for multiple virtual sites	Pricing based on minutes used. Different pricing levels depending on anticipated usage. Unproven advantages over Teams or Skype	Multiple sites and/or high volume of audits Program wants to use the latest technology Pilot to discover additional attributes
Zoom	Free software	No recording functions Requires download	Lightly recommended, with hesitancy based on past security

In addition to the applications above, additional applications were tested by are not recommended for use.

Not Recommended Videoconferencing Applications

Application	Pros	Cons	Use if:
Google Hangout	Free software	No recording functions Requires download	Not recommended
Skype Add-Ons	Supposedly can allow for extra abilities and recording options.	Both versions tested crashed Skype	Not recommended.
WhatsApp	Free software Used by many people High quality video	No audio recording functions Requires download	Not recommended

Note: Be sensitive to personal information when using personal devices. Many organizations cannot guarantee the security of information from devices not distributed by the organization.



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