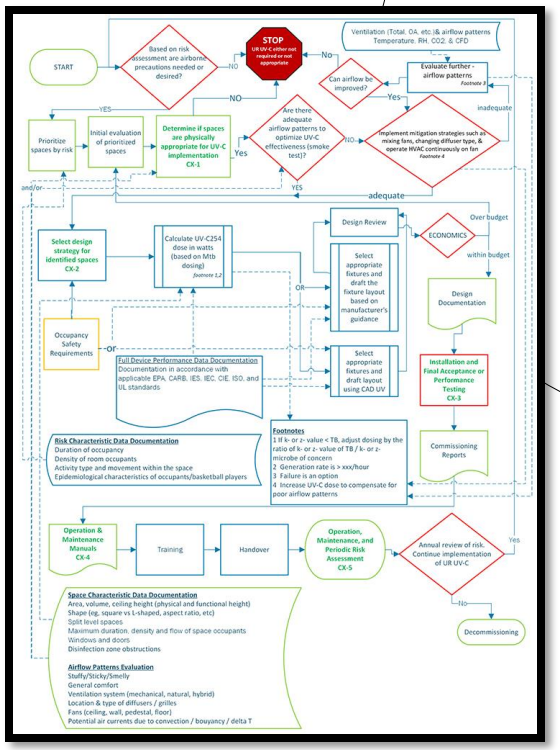
Applying the Commissioning Process Embedded in the ASHRAE GPC 37 Guideline.

LIGHT PROGRESS



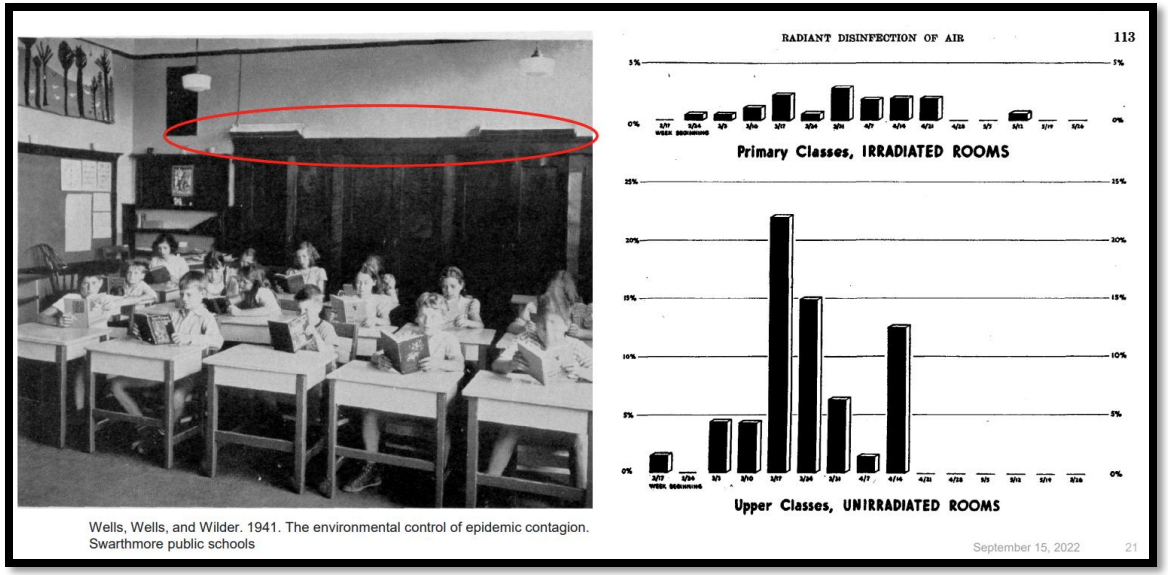
2023 IUVA WORLD CONGRESS

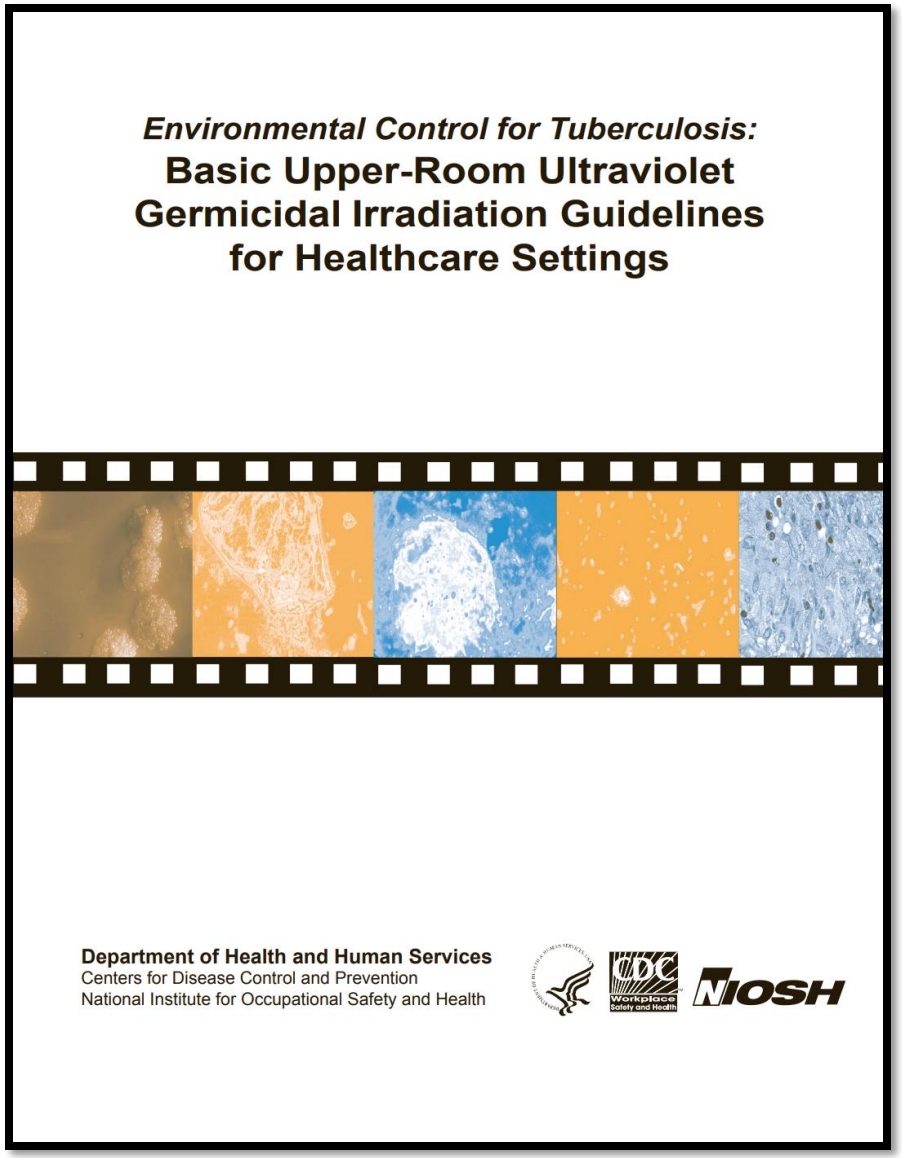
THE Upper Air Opening Slide

It was used back in the 1930s and '40s to reduce the spread of measles in…

NIOSH established guidelines for controlling Tuberculosis…

Upper room GUV is the most tried, tested, and proven method for air disinfection…





Our Expectations of the “General” Marketplace

Lack of Awareness

Largely Unadopted Technology

Lack of Resilience

Resistance to Complexity & Calculation

Lack of Trust

Poor Communication of Solution Effectiveness

Our Expectations of the “General” Marketplace

LIGHT PROGRESS

Lack of Awareness
Largely Unadopted Technology

Raise Awareness

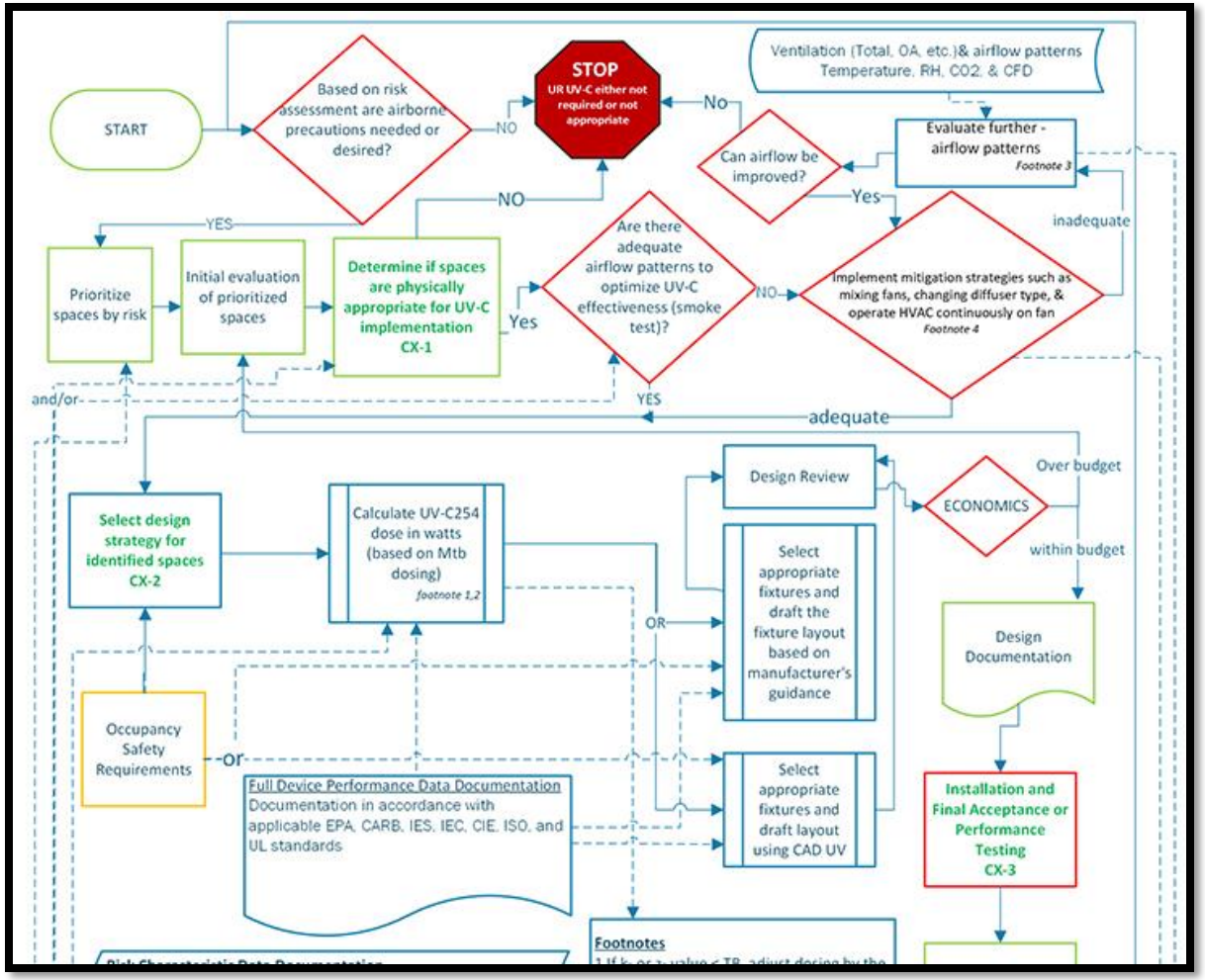
Lack of Resilience
Resistance to Complexity & Calculation

Simplify Solutions

Lack of Trust
Poor Communication of Solution Effectiveness

Share Benefits

WHAT DID WE DO?



We Followed the Flow Chart

Streamline Guidance – Commissioning Flowchart

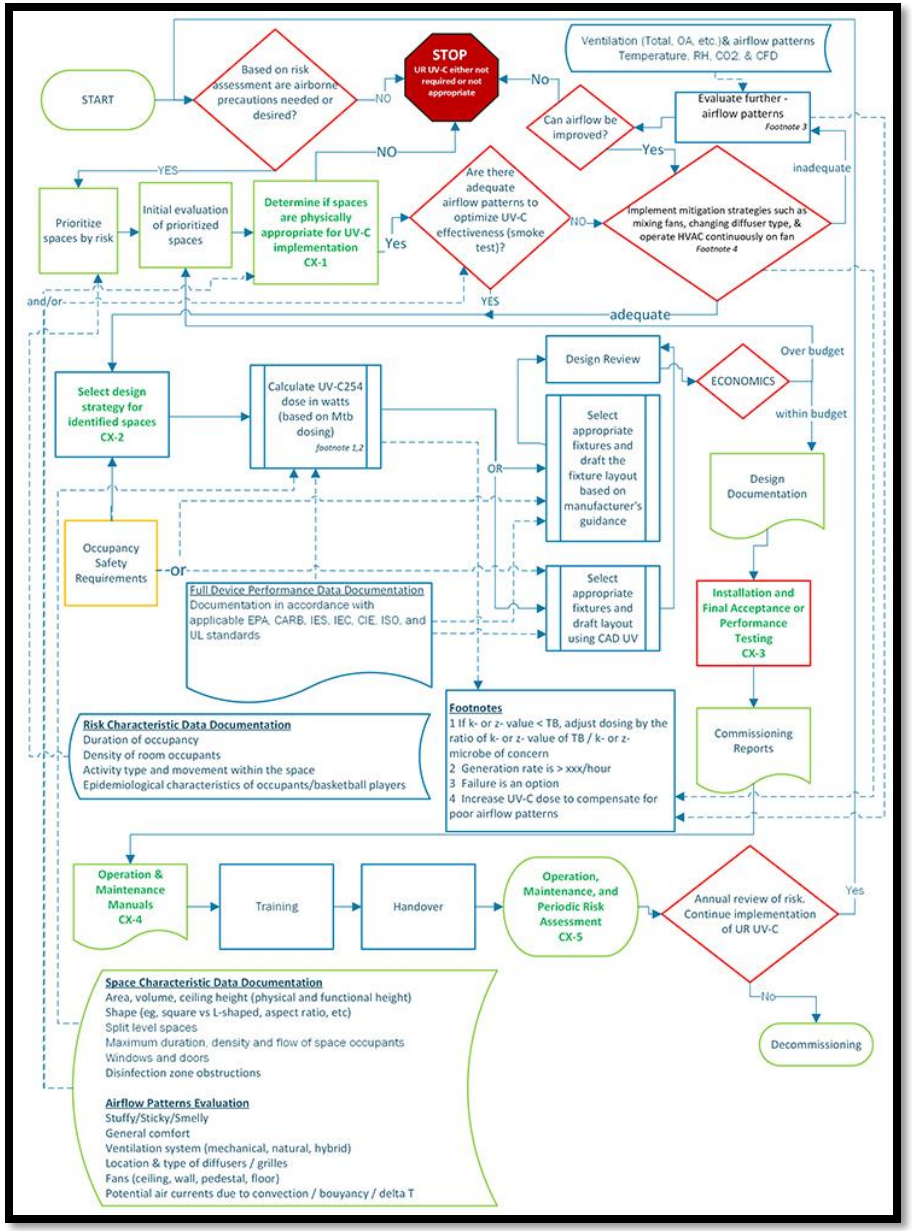
The proposed commissioning design flowchart (see Figure 1, Draft November 2022) maps the entire commissioning process from needs assessment to implementation to build the project brief.

The Commissioning process is embedded in the GPC 37 Guideline (ANSI/ASHRAE/IES 202 and 90.1) which states,

"commissioning is a quality-focused process for enhancing the delivery of a project"

that focuses upon verifying and documenting that a project is

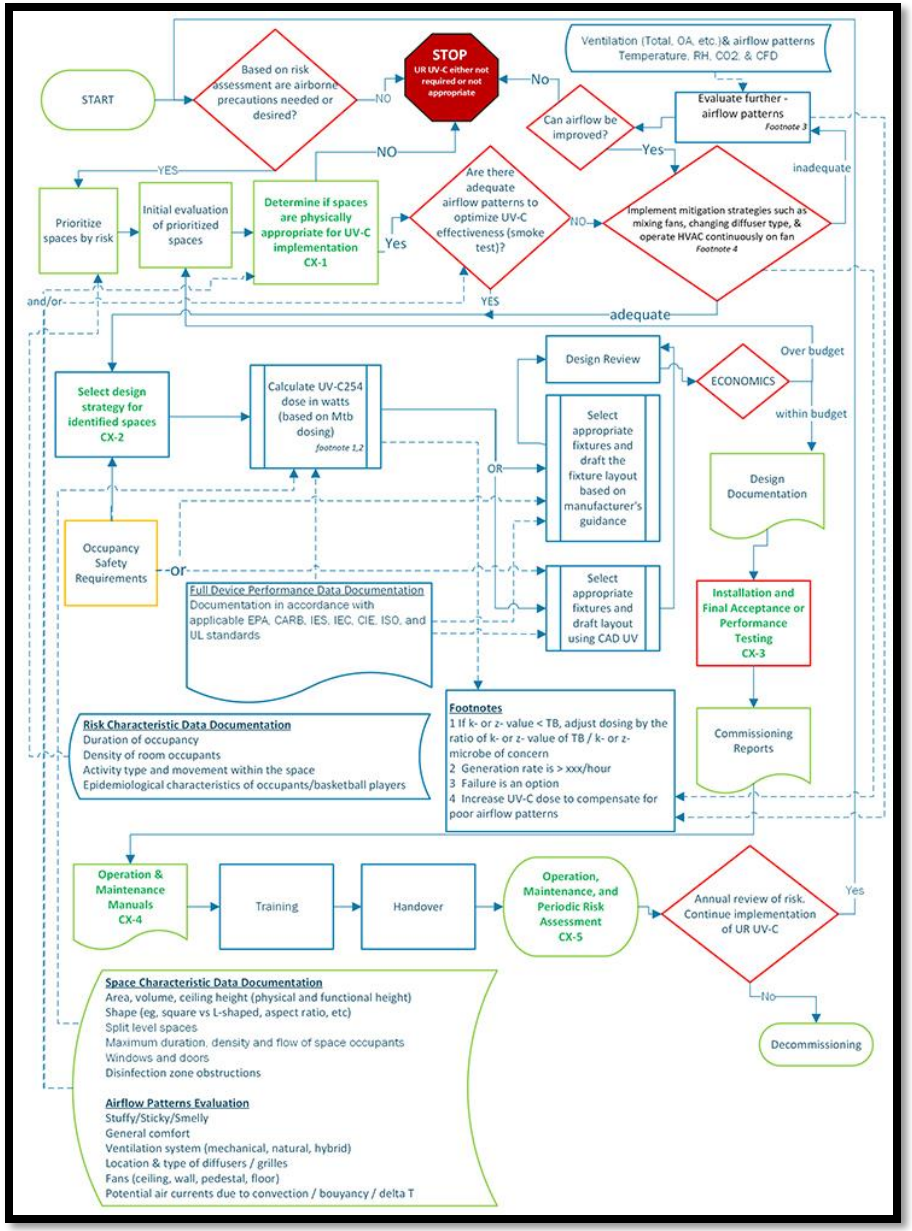
"planned, designed, installed, tested, operated and maintained to meet Requirements."



Following the Flow Chart

We used the Commissioning Steps outlined in five project phases:

1) Pre-Design
2) Design
3) Contruction/Installation
4) Acceptance/Operations
5) Post-Installation



LIGHT PROGRESS

PRE-DESIGN

Austin, TX

www.lhc.org

About Lake Hills Church Facilities

A community of 2,500 people of all ages and an average weekly attendance of 1,200 people.

Main Office ~2,000 ft² for administrative use.

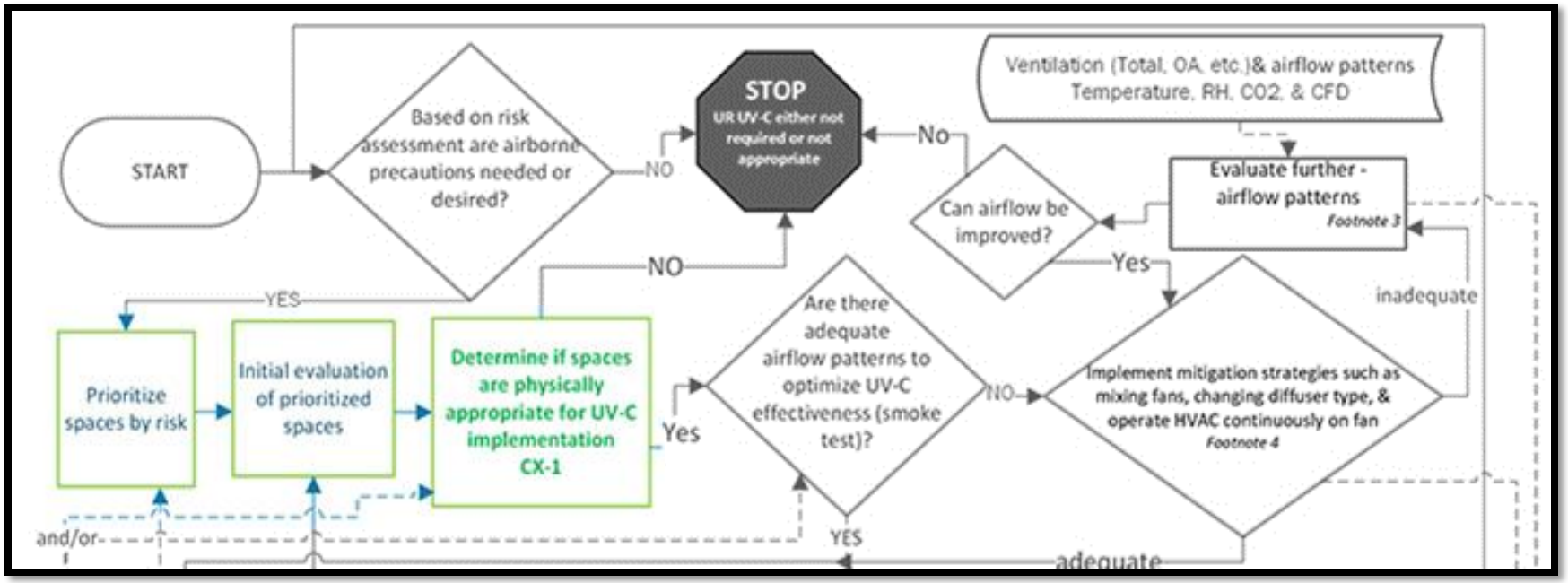
Warehouse ~3,000 ft² for storage and ministry operations

Student Building ~2,000 ft² used for youth ages 13-18

Kids Building ~19,000 ft² dedicated to children ages 3-12 with individual class rooms and large gathering areas.

Worship Center ~ 18,000 ft² with 1,200 seats, nurseries for kids age 0-2, as well as stage and production space.

Initial Analysis



We analyzed the building environments with their pastor and facility manager to evaluate the following factors:

Purpose, Size, Ventilation, Ceiling Construction, Layout, Furniture and Fixtures, Existing electrical appliances.

All the buildings have modern HVAC with contingencies for drastically increasing airflow in times of dense occupation.

The HVAC is well maintained and managed giving confidence that a meaningful amount of air mixing is occurring as a matter of standard practice.

About Lake Hills Church Facilities

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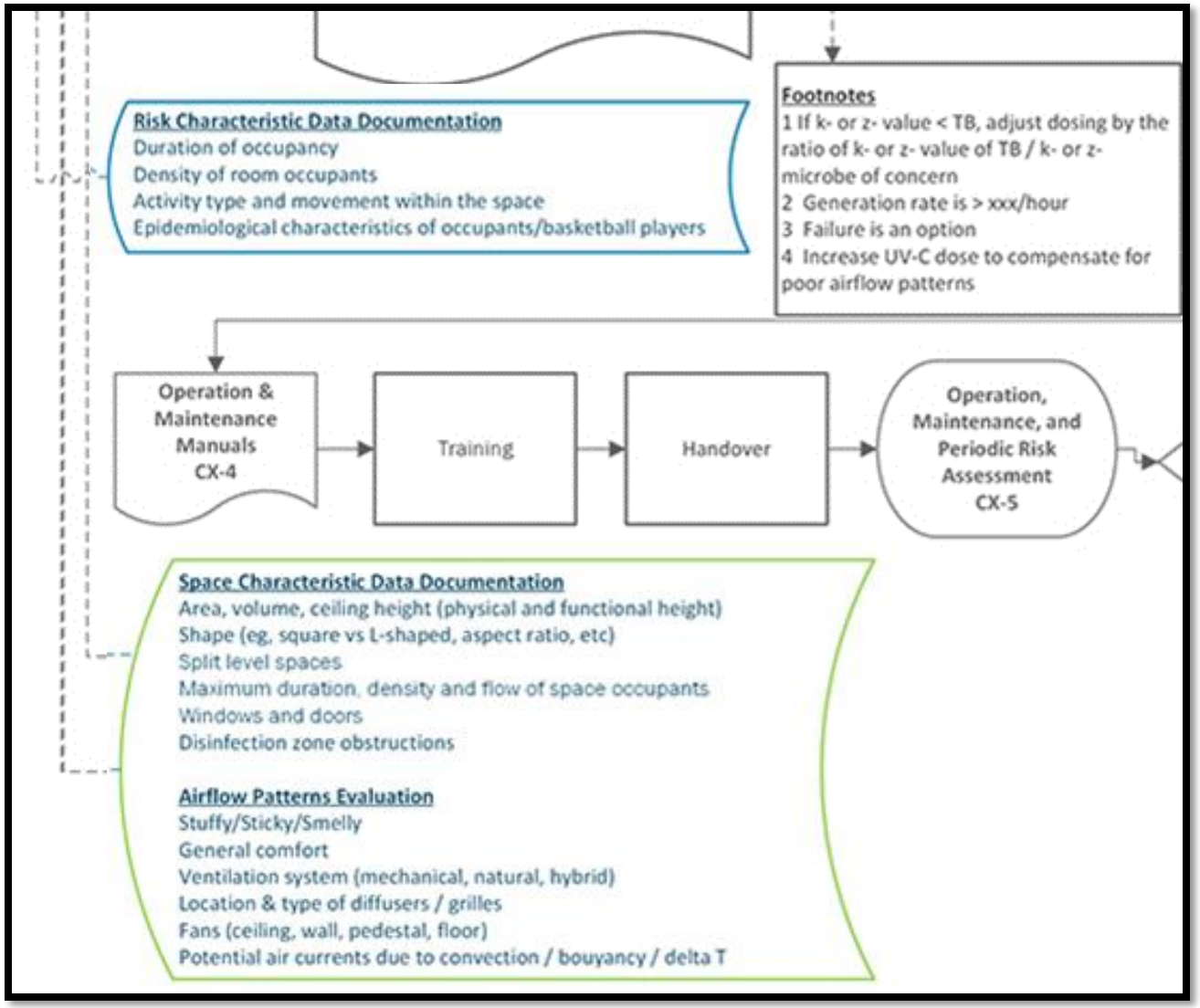
Risk Assessment & Room Selection

Ruling out large environments that were not regularly populated or had plenty of fresh air ventilation, we identified 5 potential areas for application in the Kids Building and Worship Center based on room usage, characteristics and primary occupants:

1: Adult Worship Center
2: 3 Nurseries
3: Club K12 Room
4: 345 Room
5: Kids Worship

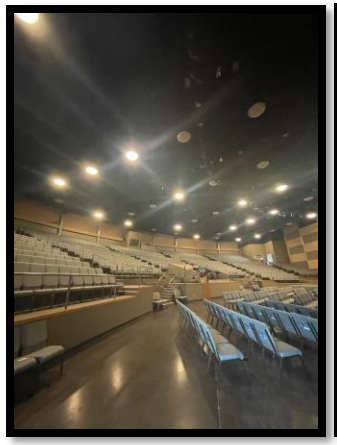
The budget priority reduced us to 3 areas mitigating risk for the oldest and youngest in the community:

1: Adult Worship Center
2: 3 Nurseries
3: Club K12 Room



Facility Evaluation

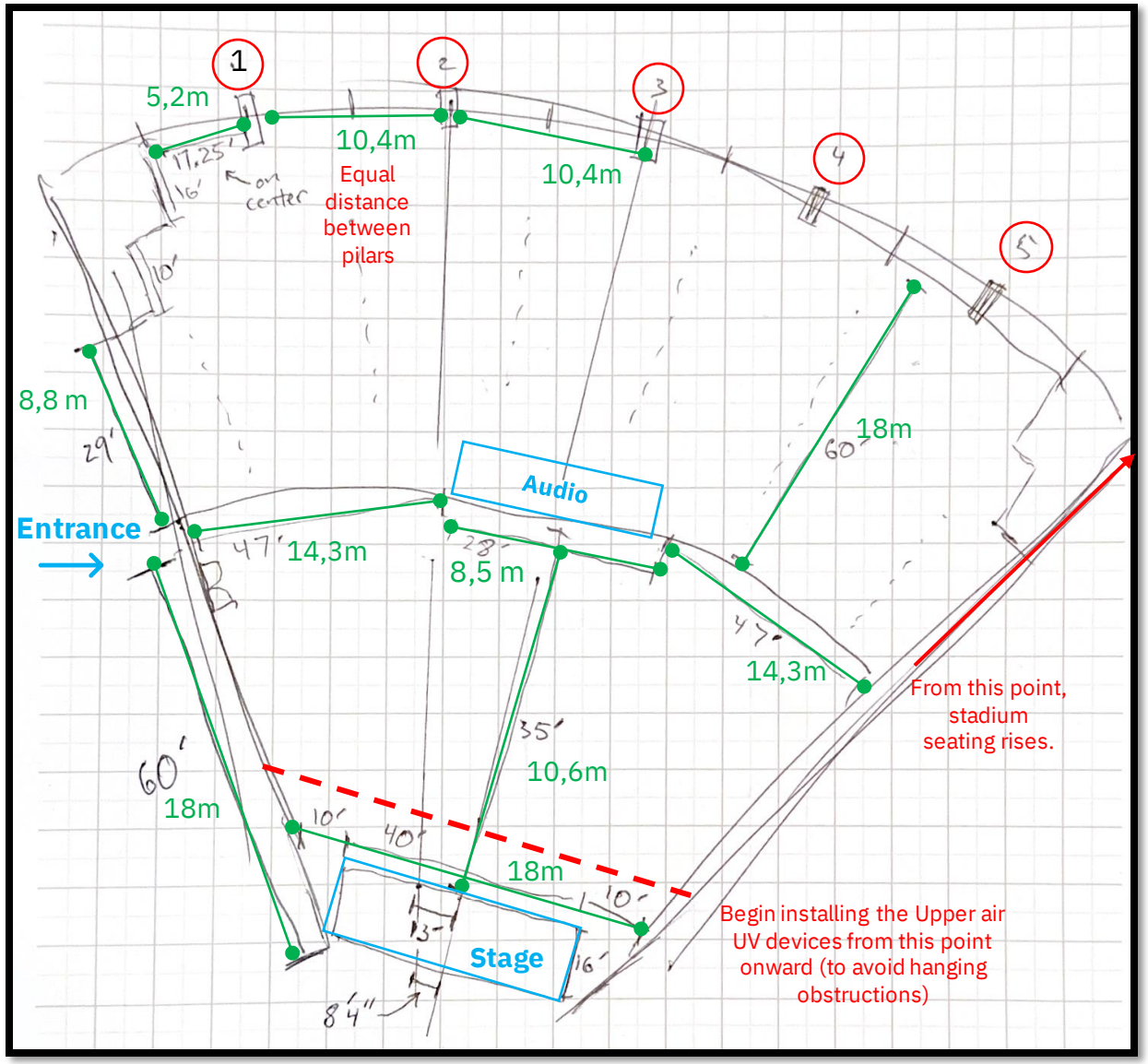
Area 1: Worship Center



Risk Characteristics	
Duration of Occupancy	1 day a week / 3 hours a week
Density of Room Occupants	1,200 seat capacity
Activity type	Sunday Service (Singing / Talking)
Epidemiological characteristics	General Population
Space Characteristics	
Sizes (+ ceiling heights)	115’ x 50’x Height from 11’ to 30’
Volume	~185,000 Cubic Feet
Shape	Sector
Windows and Doors	No windows, 2 doors
Any Obstructions	Lighthing fixtures, various audio appliances hanging
Airflow Patterns Evaluation	
Ventilation System	Air Conditioning
Location of Diffusers	(see illustration)
Potential Air Current	8-17 ACH

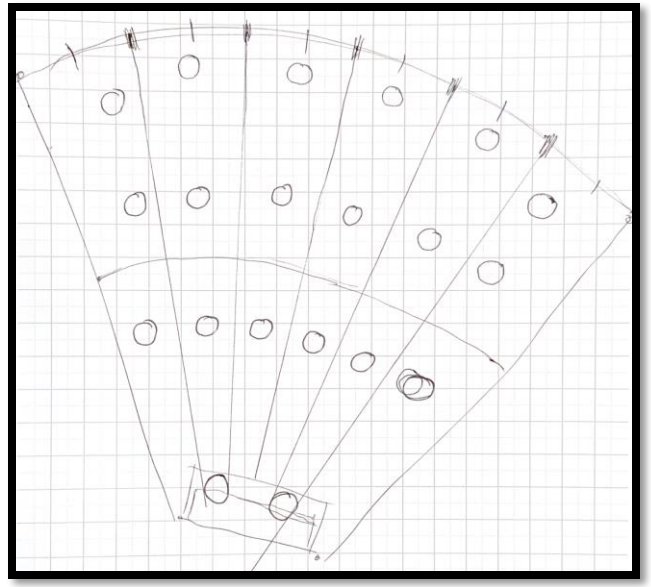
Lake Hills Church Evaluation

Area 1: Worship Center

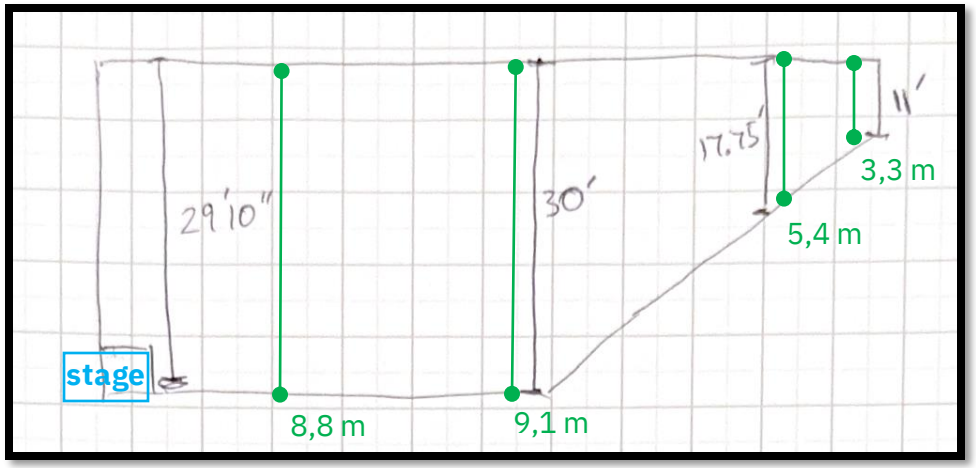


(1) = Location of the directors of the ceiling steel structure over which the power runs and where the lights are placed.

Air Vents

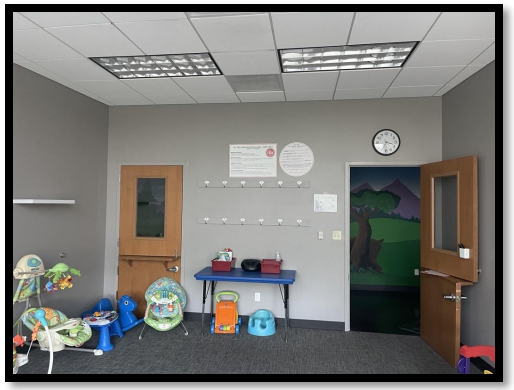


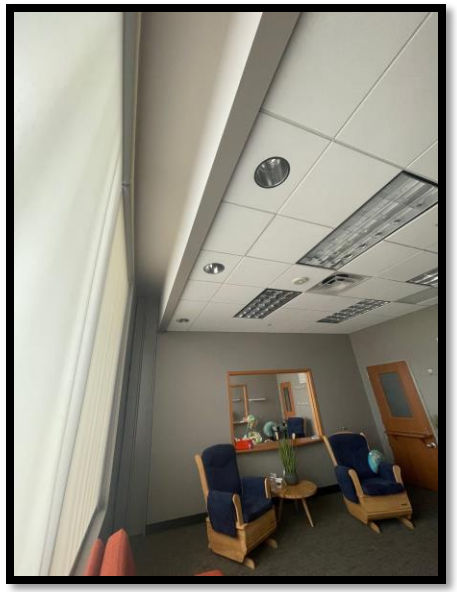
Ceiling Heights

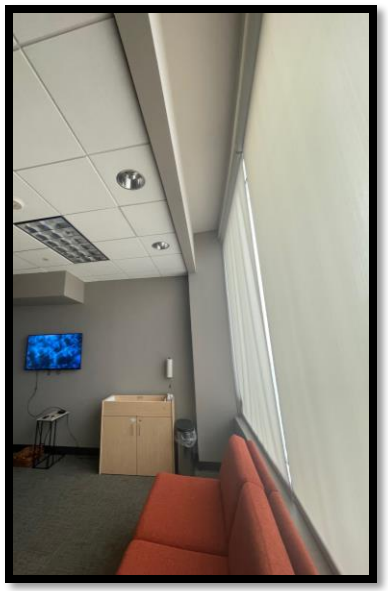


Facility Evaluation

Area 2: Nursery (3 identical rooms)







Risk Characteristics	
Duration of Occupancy	1 day a week / 5 hours a week
Density of Room Occupants	10 people (2 adults, 8 children)
Activity type	Caring and playing, breast feeding, diaper changing.
Epidemiological characteristics	Newborn to 2-year old children
Space Characteristics	
Sizes (+ ceiling heights)	14.9’÷ 16.8’ x 16.8’ x 9.7’ Height
Volume	~2,500 Cubic Feet
Shape	Rectangular
Windows and Doors	No opening windows, 1 door
Any Obstructions	No, counter ceiling.
Airflow Patterns Evaluation	
Ventilation System	AC
Location of Diffusers	(see draw)
Potential Air Current	8-17 ACH

Facility Evaluation

Area 3: K12 Room

Risk Characteristics	
Duration of Occupancy	1 day a week / 3 hours a week
Density of Room Occupants	Full capacity 100 people
Activity type	Singing / Talking / Play Activities)
Epidemiological characteristics	Children
Space Characteristics	
Sizes (+ ceiling heights)	49’ x 45’ x 12.6’ Height
Volume	~27,800 Cubic Feet
Shape	Square
Windows and Doors	No windows, 2 doors
Any Obstructions	Lighthing fixtures, various audio appliances hanging
Airflow Patterns Evaluation	
Ventilation System	Air Conditioning
Location of Diffusers	(see draw)
Potential Air Current	8-17 ACH

Facility Evaluation

Room Variance:

Wattage Recommendation: Each device has it's own shape of footprint and a wattage per square foot guidline does not account for rooms of all shapes.

Safety & Effficacy:

Safety and Efficacy are not linear, they are designed together. And manufacturers guidance can be incomplete.

Accountablility:

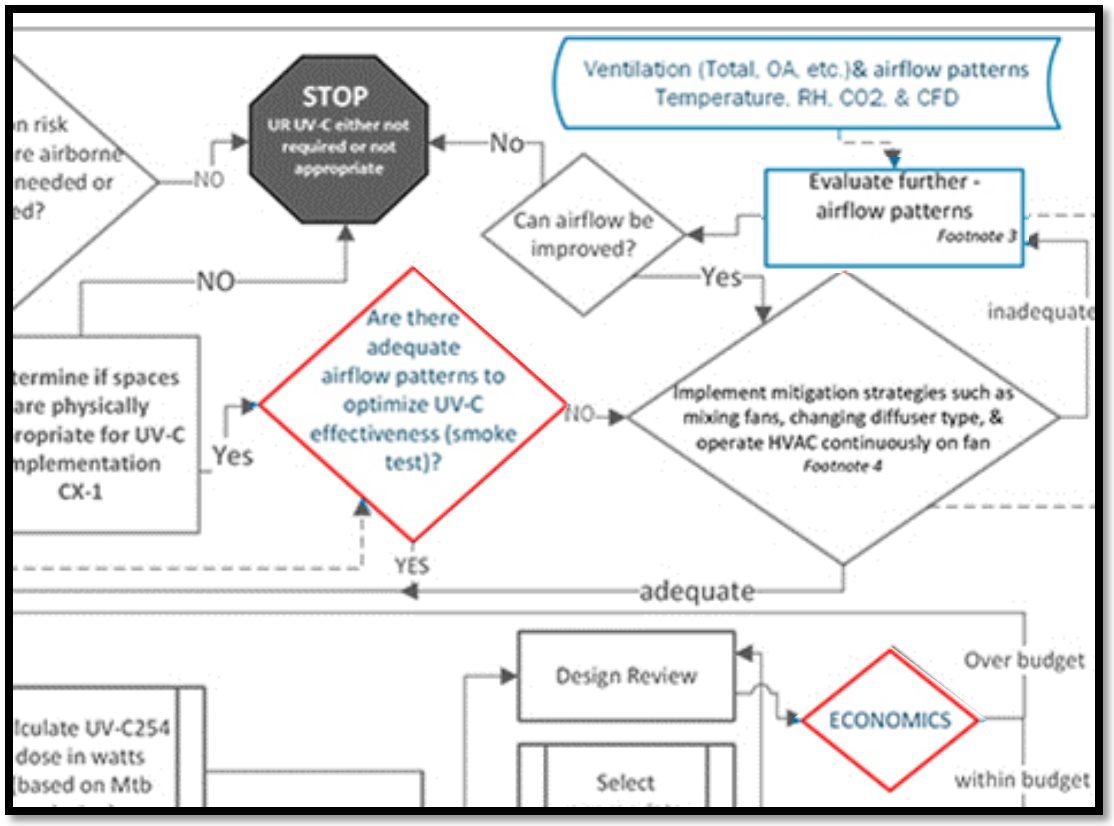
How will installers and manufacturers share responsibility for Safety and Efficacy?

Economics:

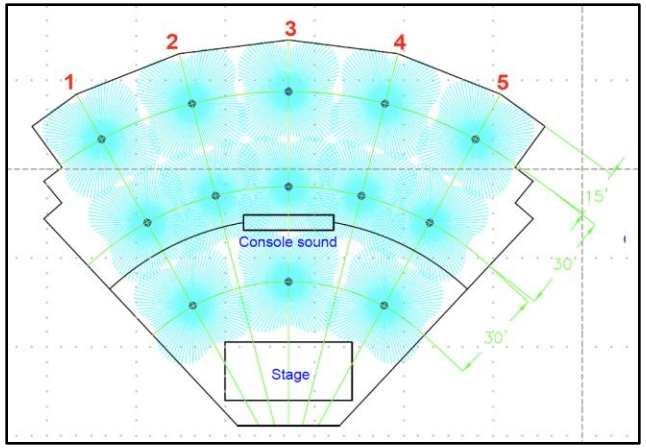
Solution Design, Fixture Selection and Placement, as well as Drafting by Mftr guidance & installer design is a heavy lift before economics are established. Makes for a complex sale.

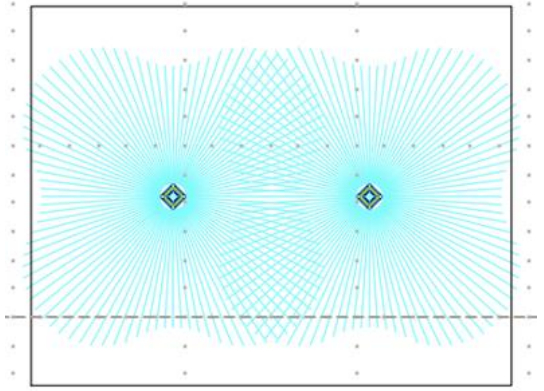
Airflow:

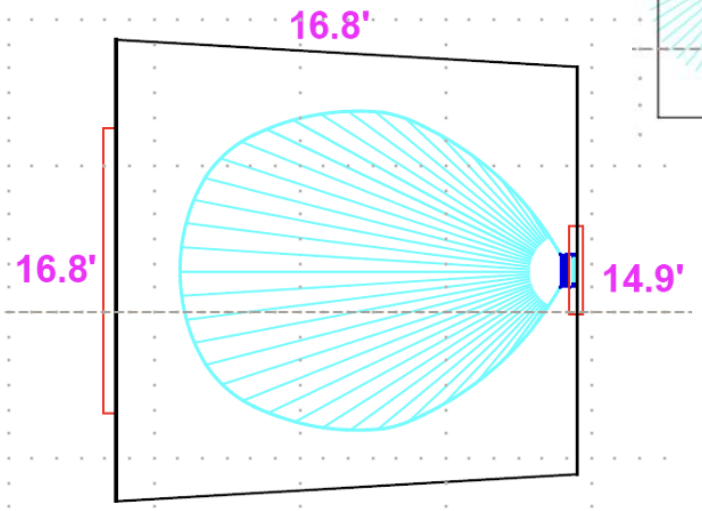
How should we consider appropriate assessment off airflow? When and where are smoke tests actually feasible and appropriate?



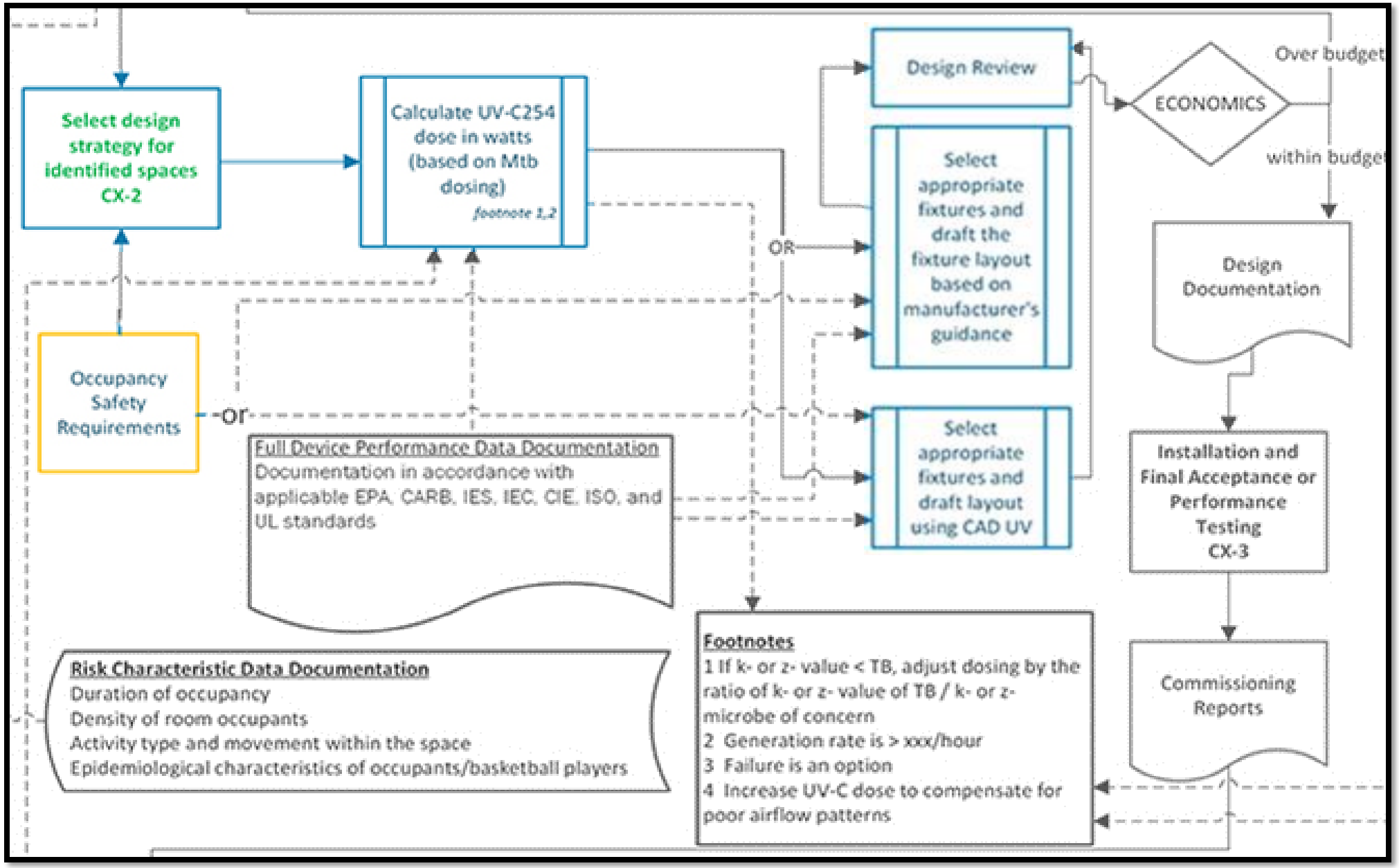
APPLICATION DESIGN







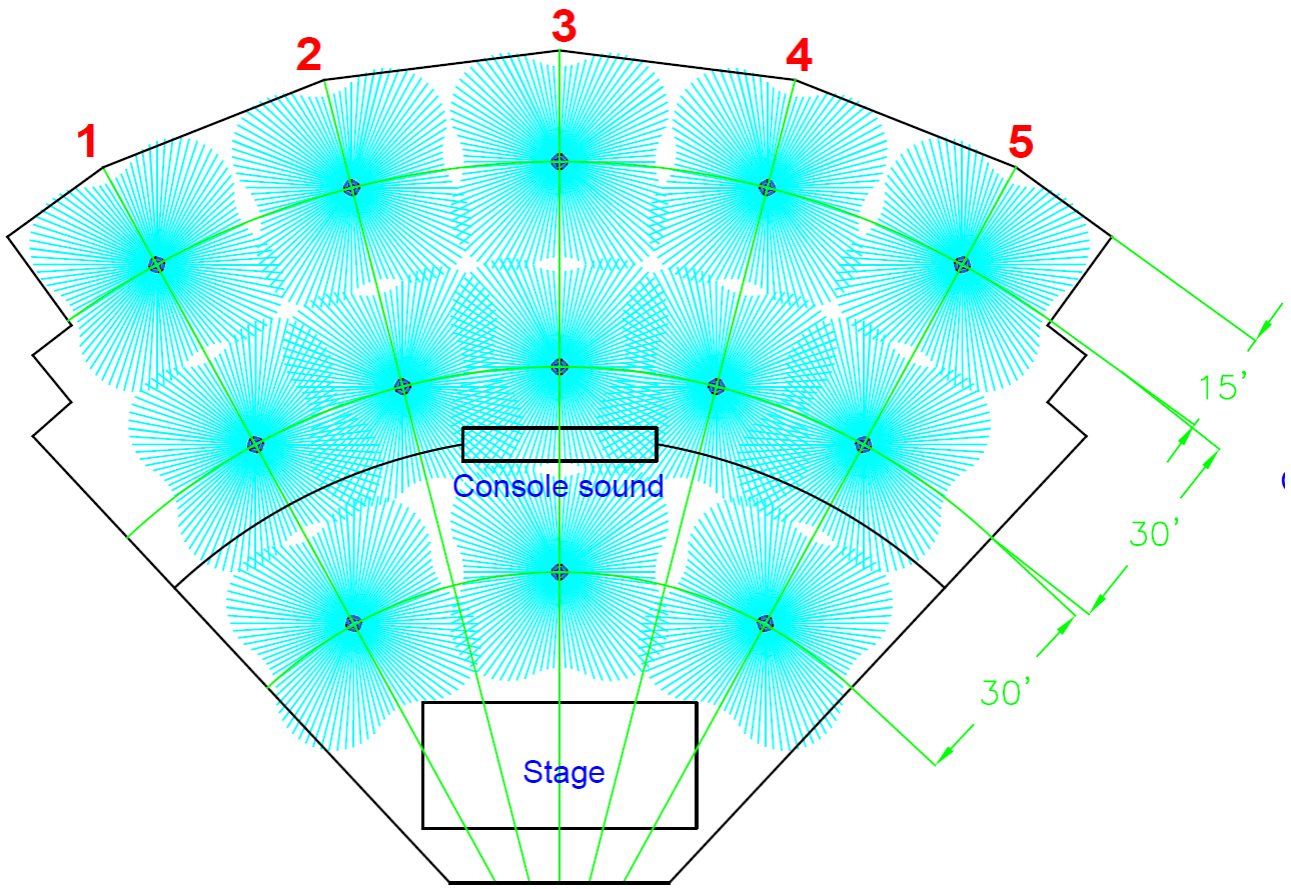
Application Design

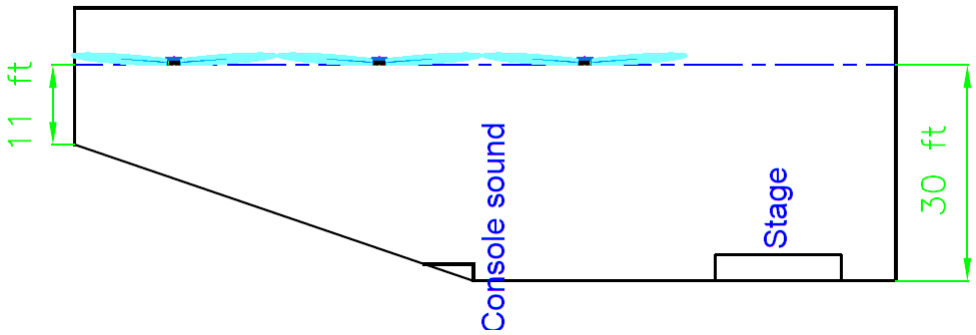


Application Design

Area 1: Worship Center

13 Devices (UV-FLOW 4/18P-CL)





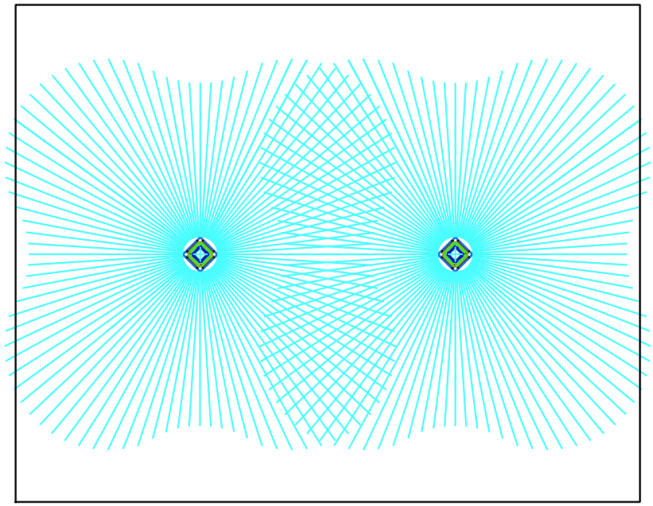
Application Design

Area 3: K12 room

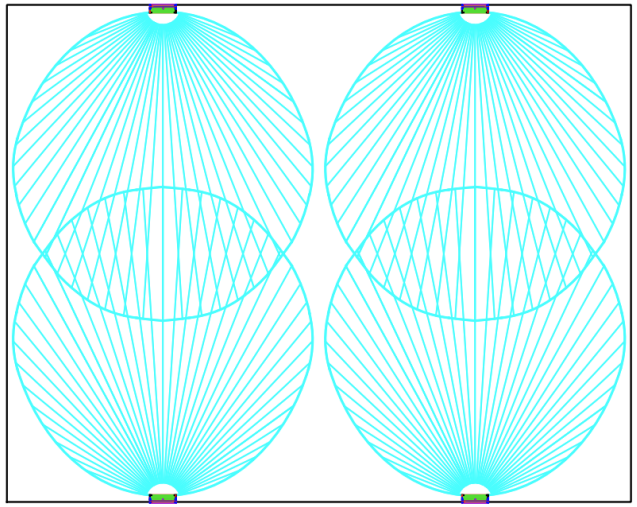
Option 1: 2 Devices (UV-FLOW 4/18P-CL)

Option 2: 4 Devices (UV-FLOW 16-WL)

Option 1



Option 2



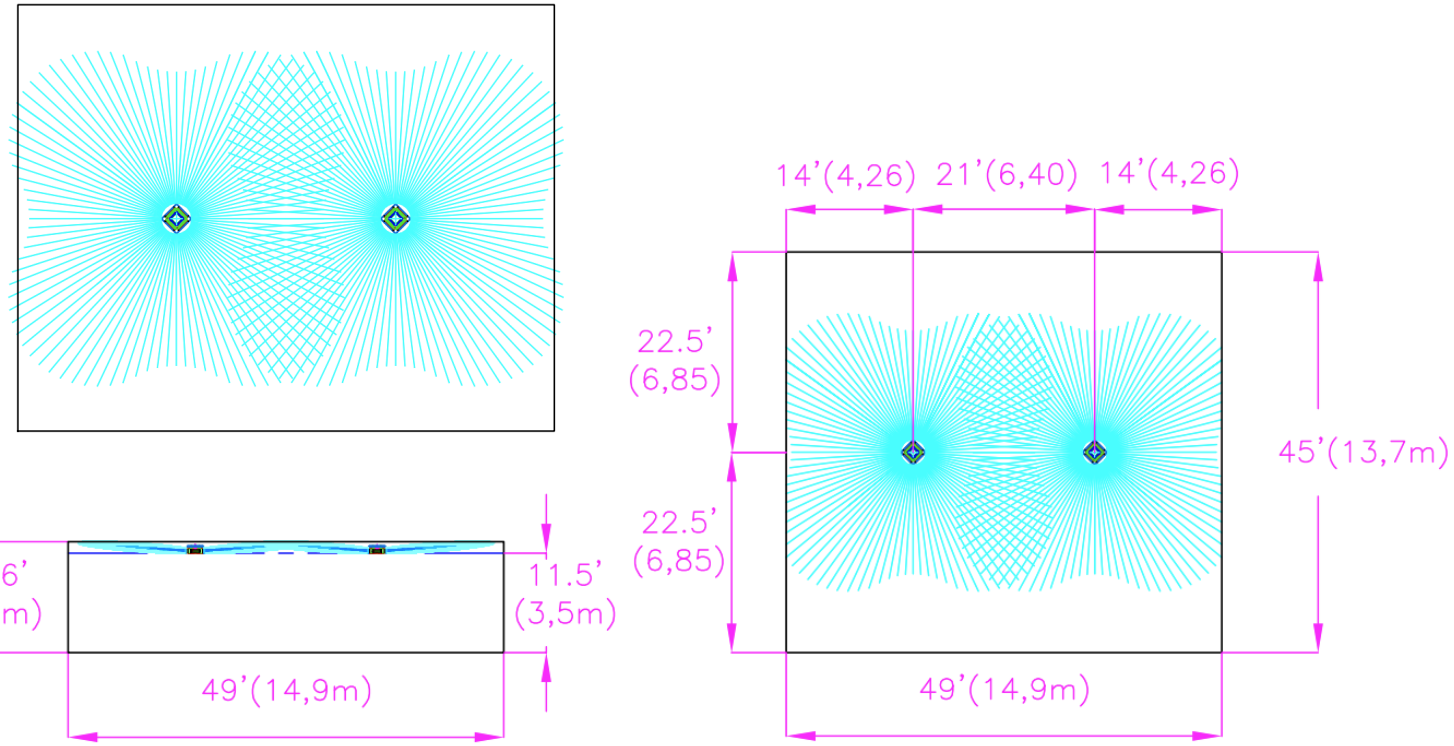
Application Design

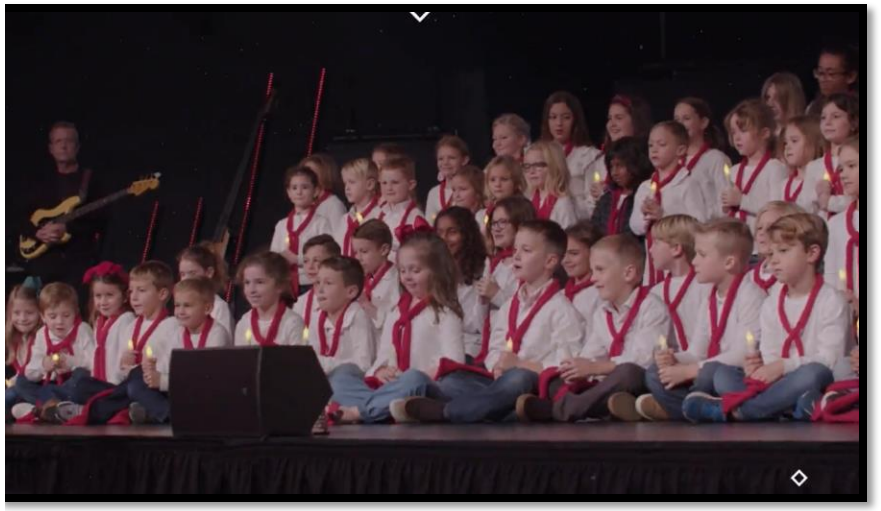
Area 3: K12 room

Option 1: 2 Devices (UV-FLOW 4/18P-CL)

~~Option 2: 4 Devices (UV-FLOW 16-WL)~~

Option 1

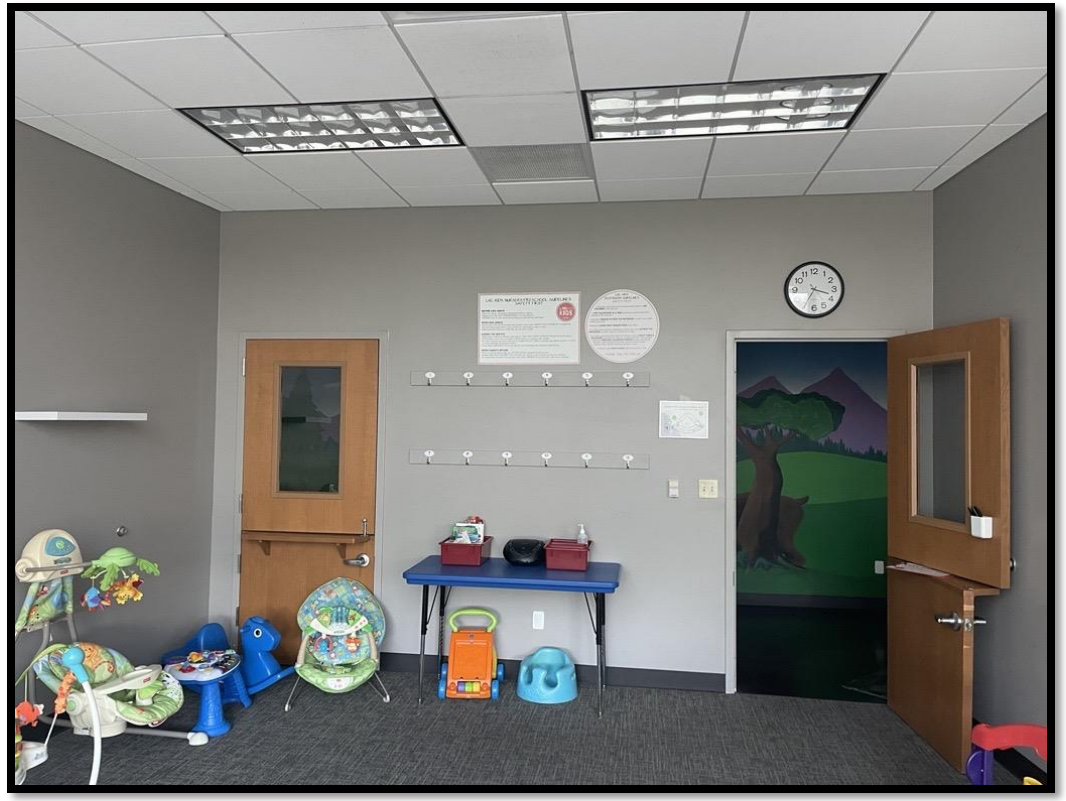


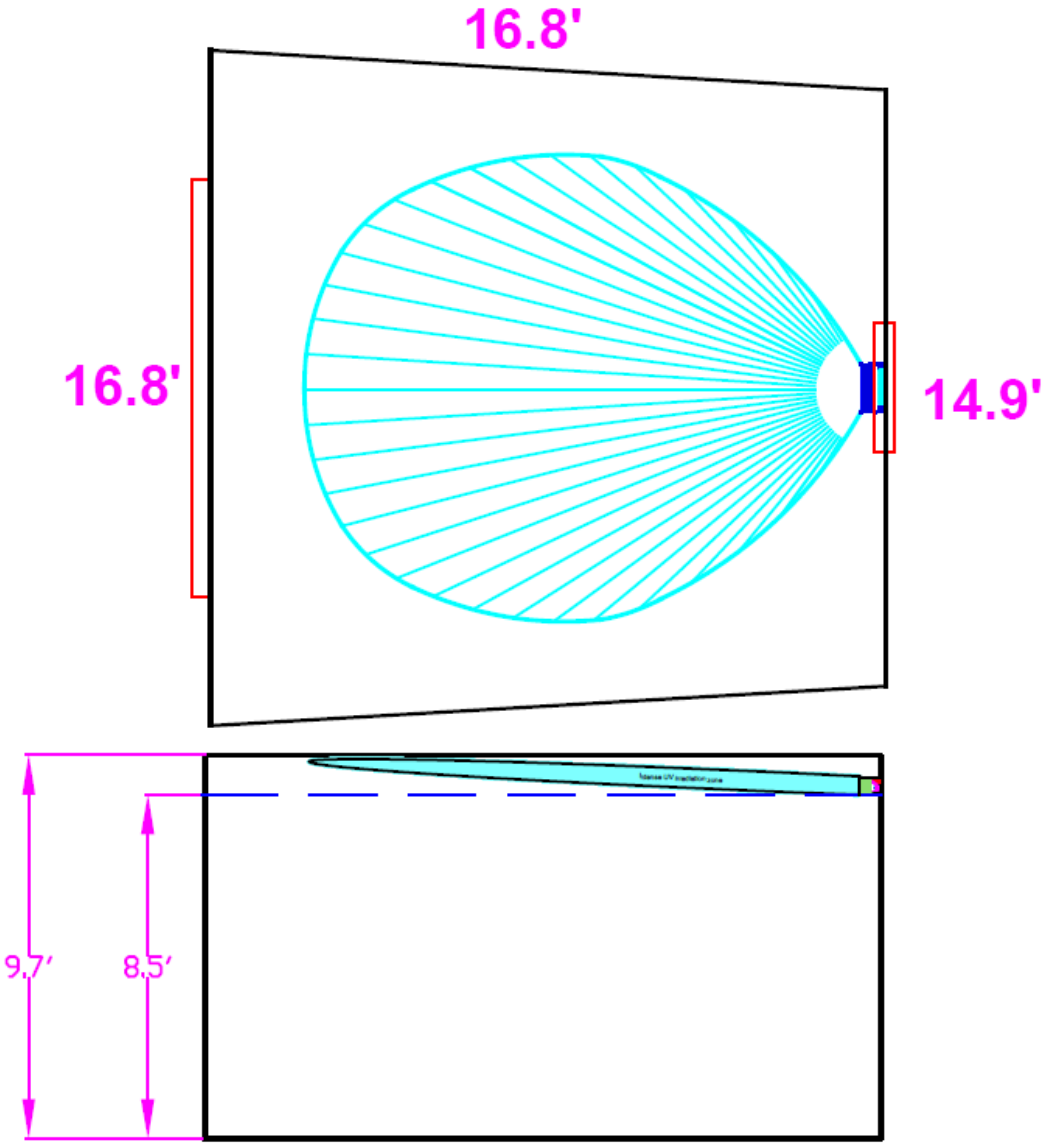


Application Design

Area 2: Nursery (3 identical rooms)

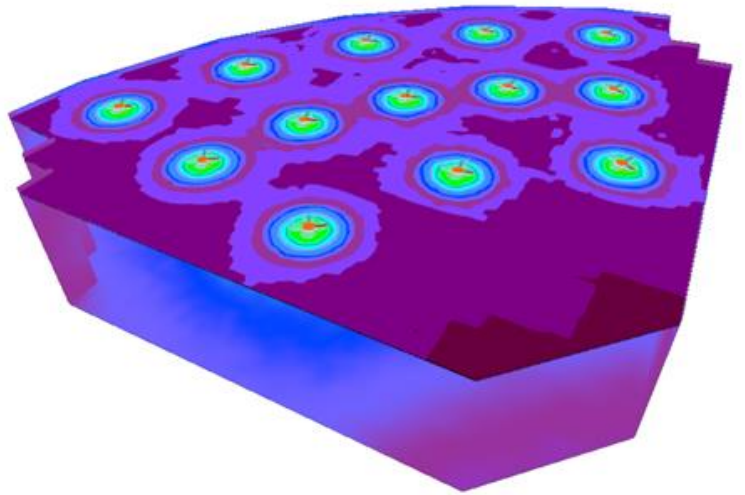
1 Device (UV-FLOW 8-WL)

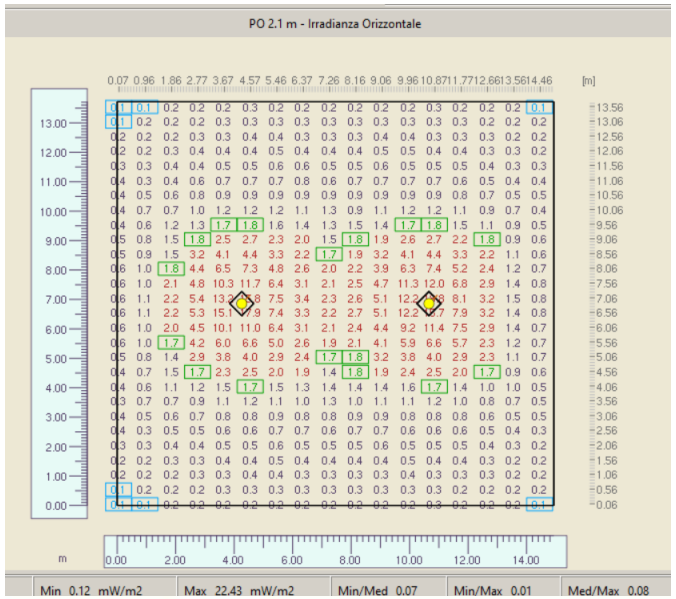


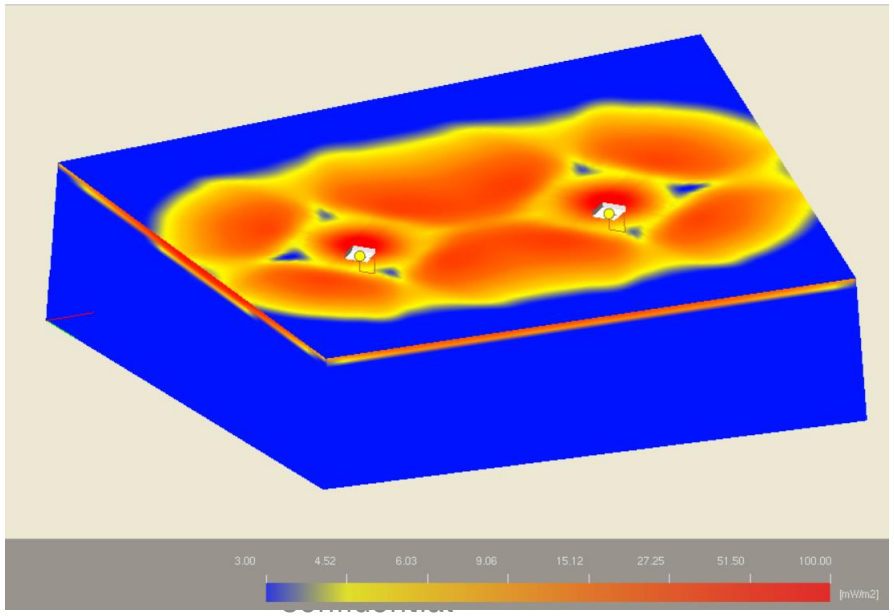


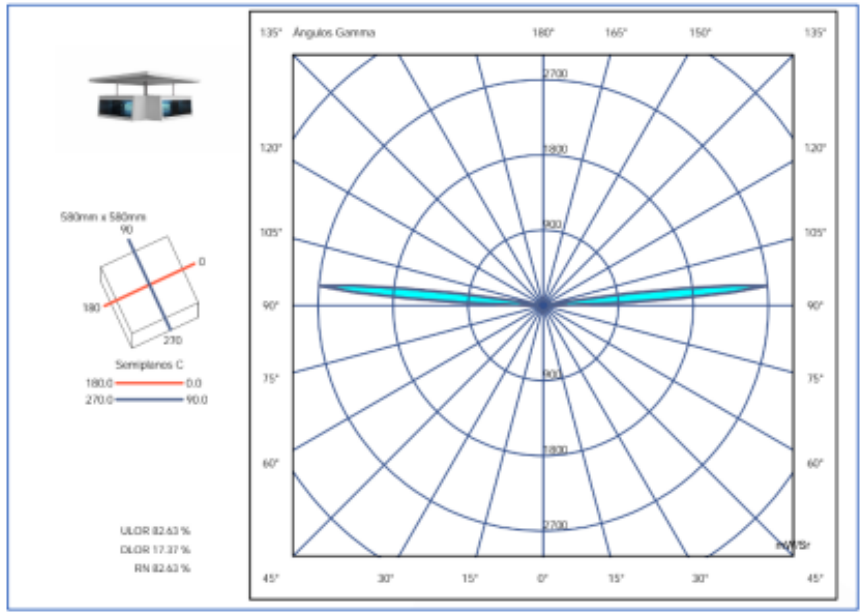
Application Design

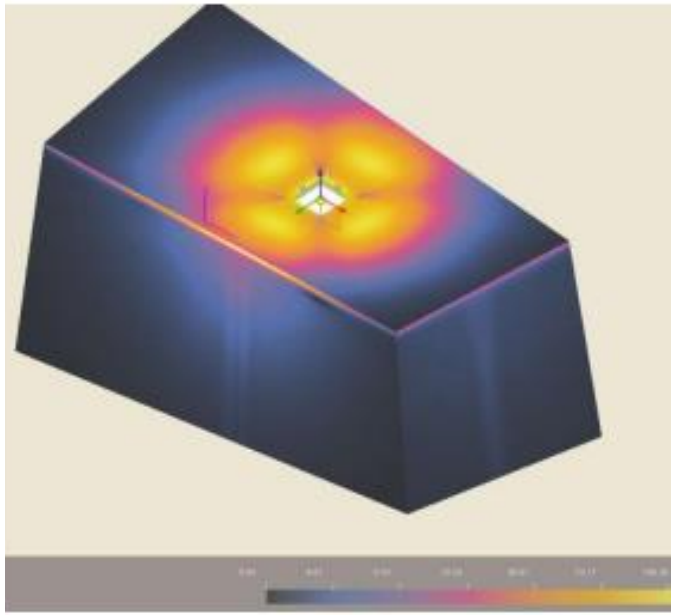
Beyond producing CAD Drawings, we modelled/calculated dosage and product performance using goniospectrophotometry (i.e., IES files) to select the products and placement.











Application Design

Area 1: Worship Center

Too visually disruptive when people are inside the dark.

Ceiling is not easily accessible for maintenance.

Alternative viable solution to add GUV to the HVAC system serving the Worship Center

Application Design

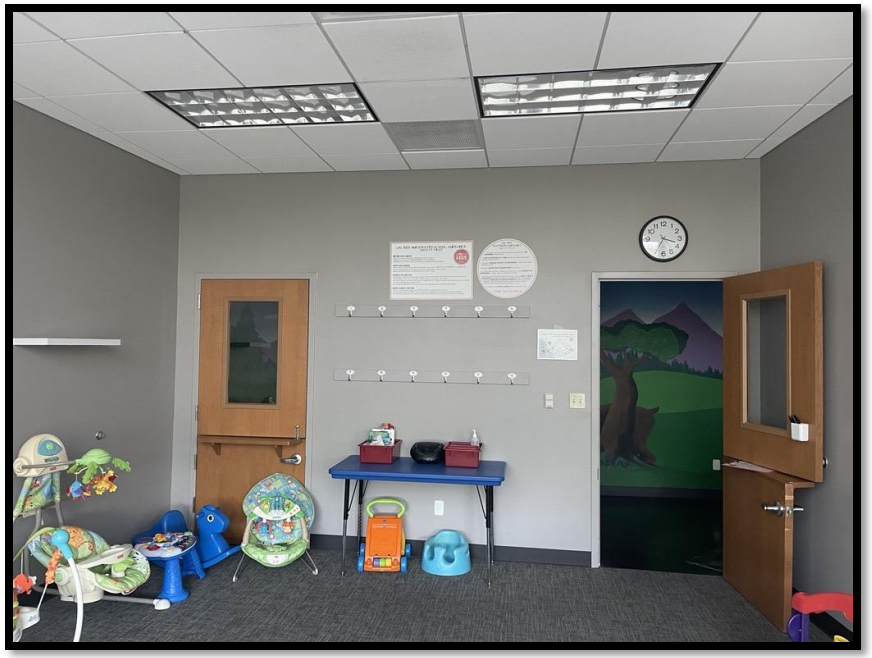
LIGHT PROGRESS

Final Area Selection:

~~1: Adult Worship Center~~

2: 3 Nurseries

3: Club K12 Room



Application Design

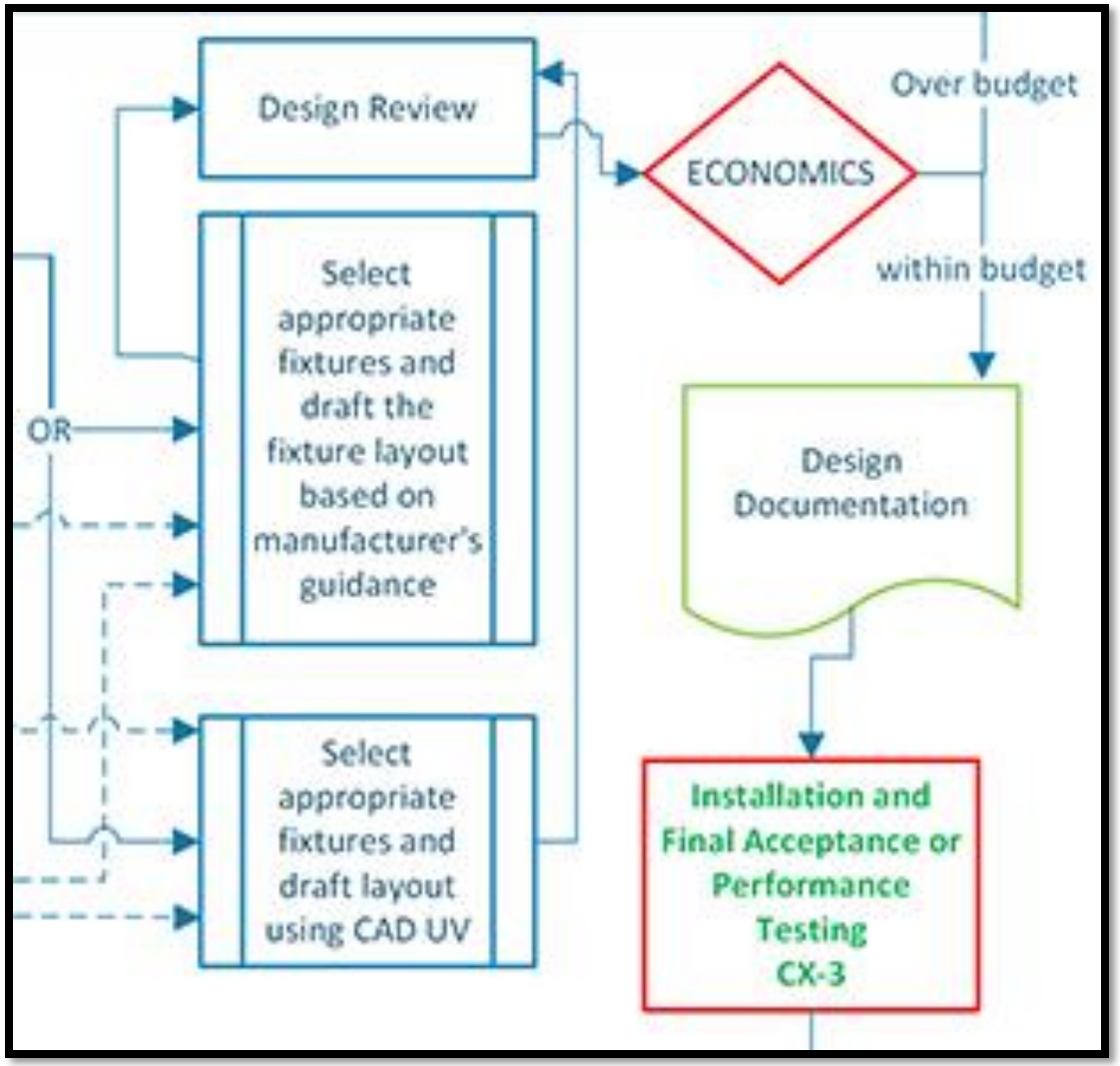
Learnings:

From Design to Installation there is also consideration for a variety of customer-centric issues:

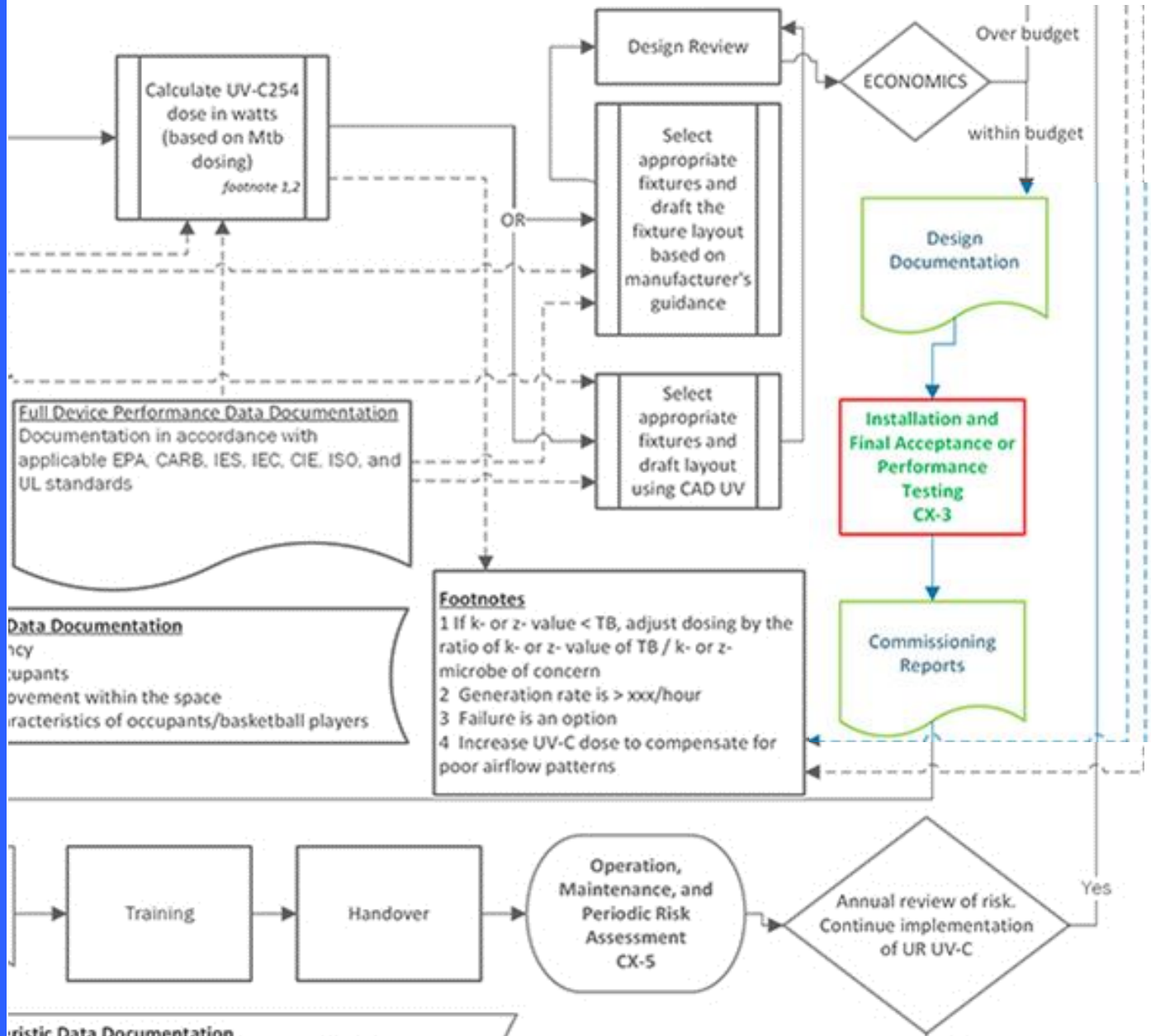
Usability and Maintenance.

Integration with other behaviors, practices, or protocols.

Aesthetic considerations.



INSTALLATION



Installation

Learnings:

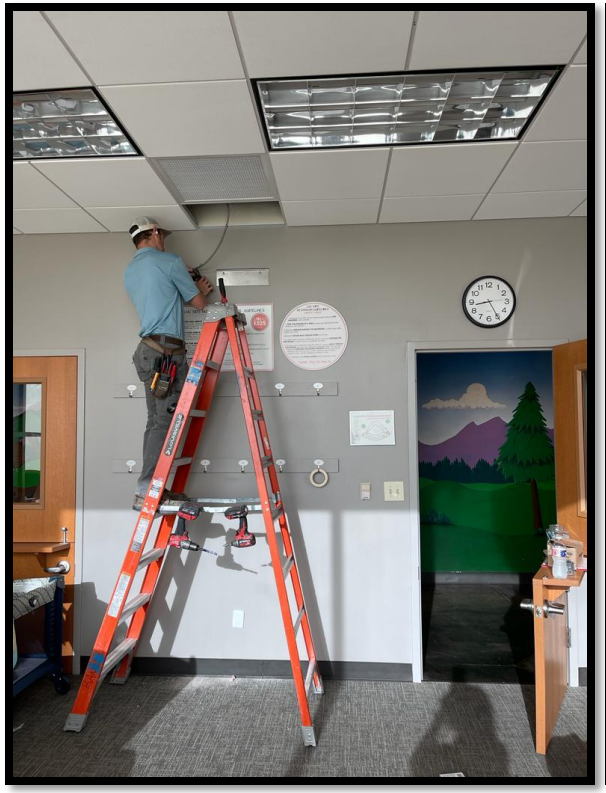
Teach the building to GUV Experts OR teach GUV to the building experts.

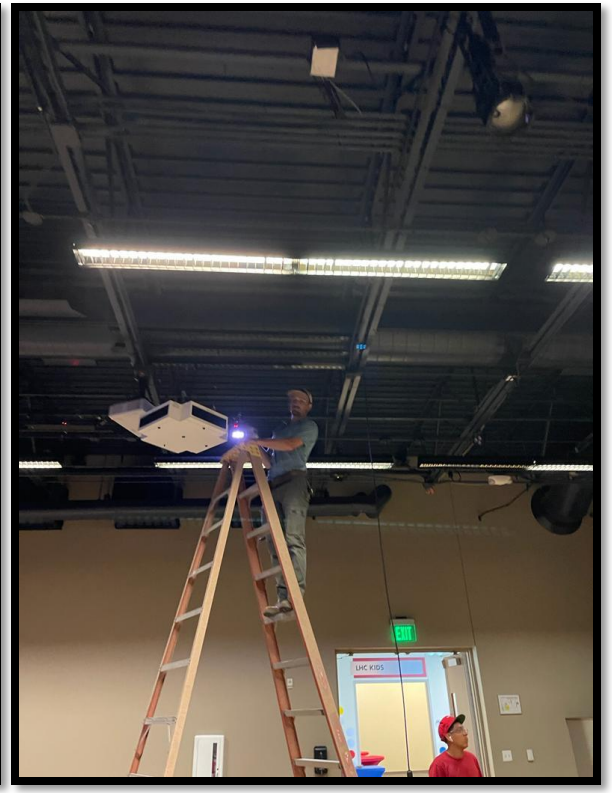
Installer training on safety & intended use of the devices. Read the manual!

Share precise installation instructions.

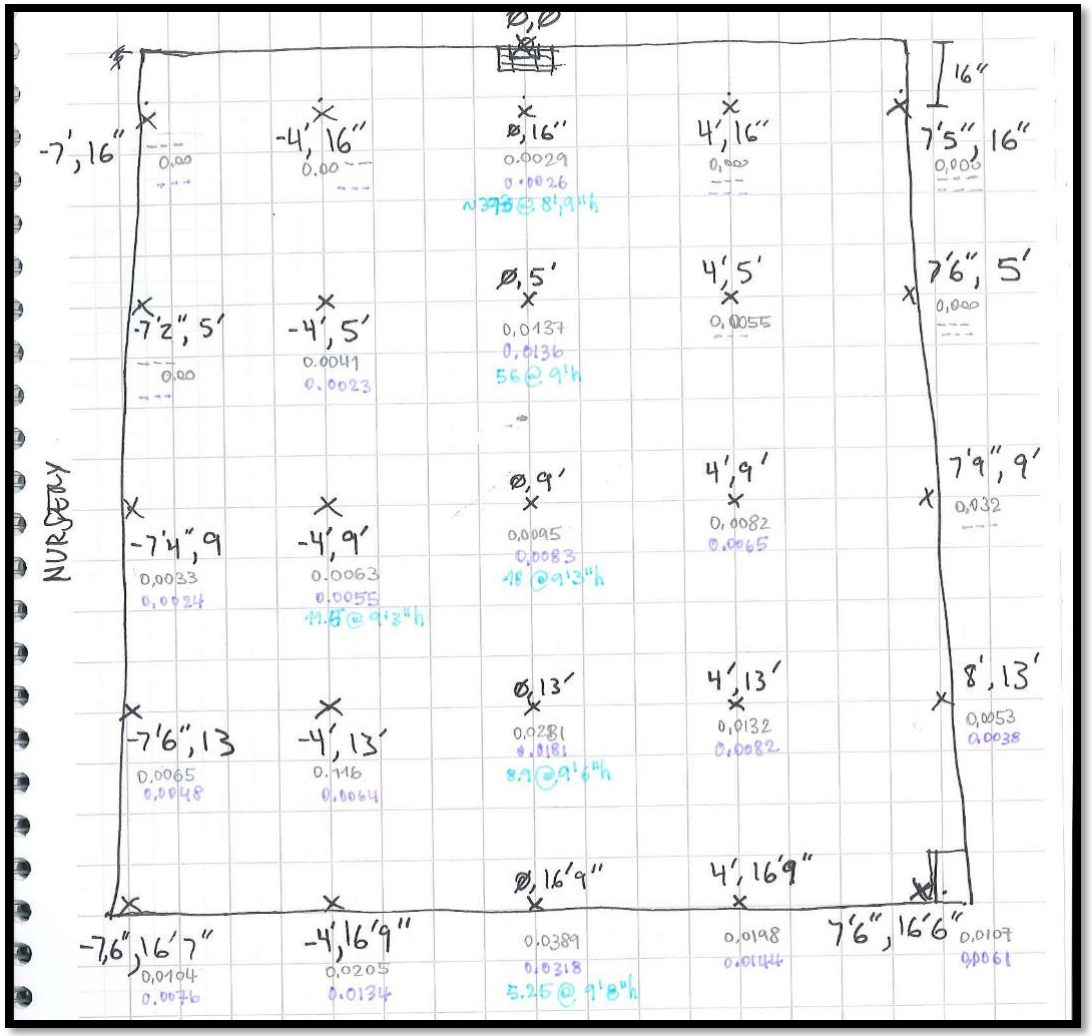
Provide project intent, design constraints, and exact desired positioning.

Hope you don’t discover physical realities change the economics.



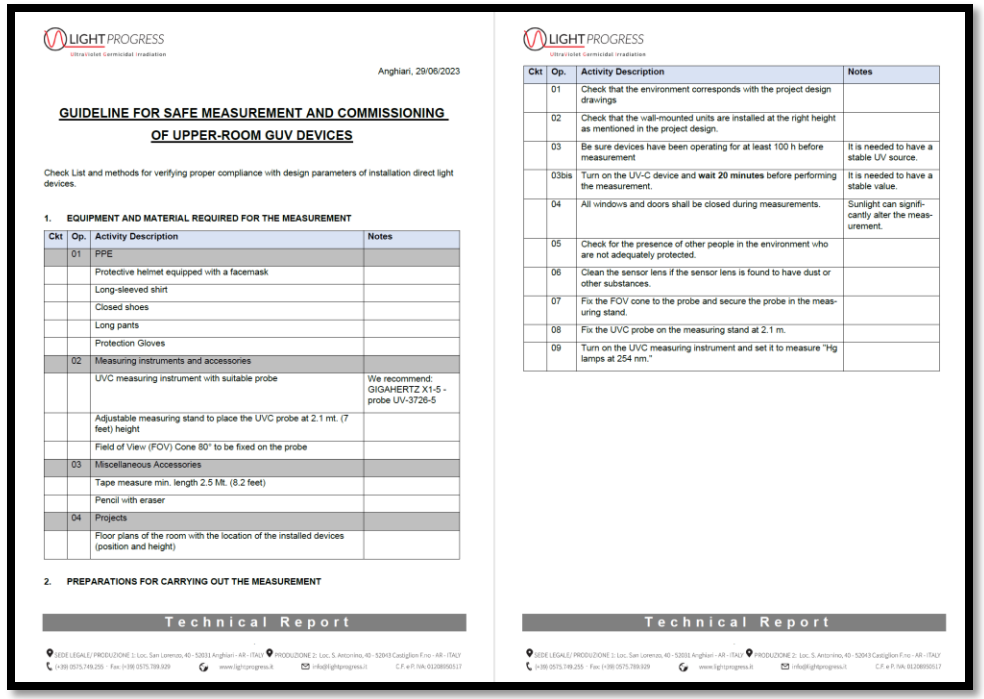


ACCEPTANCE & TESTING



Performance Testing

Clearly documented testing methodologies:



LIGHT PROGRESS
Ultraviolet Germicidal Irradiation

Anghiari, 29/06/2023

GUIDELINE FOR SAFE MEASUREMENT AND COMMISSIONING OF UPPER-ROOM GUV DEVICES

Check List and methods for verifying proper compliance with design parameters of installation direct light devices.

1. EQUIPMENT AND MATERIAL REQUIRED FOR THE MEASUREMENT

Ckt	Op.	Activity Description	Notes
	01	PPE	
		Protective helmet equipped with a facemask	
		Long-sleeved shirt	
		Closed shoes	
		Long pants	
		Protection Gloves	
	02	Measuring instruments and accessories	
		UVC measuring instrument with suitable probe	We recommend: GIGAHERTZ X1-5 - probe UV-3726-5
		Adjustable measuring stand to place the UVC probe at 2.1 mt. (7 feet) height	
		Field of View (FOV) Cone 80° to be fixed on the probe	
	03	Miscellaneous Accessories	
		Tape measure min. length 2.5 Mt. (8.2 feet)	
		Pencil with eraser	
	04	Projects	
		Floor plans of the room with the location of the installed devices (position and height)	

2. PREPARATIONS FOR CARRYING OUT THE MEASUREMENT

Technical Report

SEDE LEGALE/ PRODUZIONE 1: Loc. San Lorenzo, 40 - 52031 Anghiari - AR - ITALY PRODUZIONE 2: Loc. S. Antorino, 40 - 52043 Castiglion F.no - AR - ITALY
(+39) 0575.749.255 - Fax: (+39) 0575.789.929 www.lightprogress.it info@lightprogress.it C.F. e P. IVA: 01208950517

LIGHT PROGRESS
Ultraviolet Germicidal Irradiation

Ckt	Op.	Activity Description	Notes
	01	Check that the environment corresponds with the project design drawings	
	02	Check that the wall-mounted units are installed at the right height as mentioned in the project design.	
	03	Be sure devices have been operating for at least 100 h before measurement	It is needed to have a stable UV source.
	03bis	Turn on the UV-C device and **wait 20 minutes** before performing the measurement.	It is needed to have a stable value.
	04	All windows and doors shall be closed during measurements.	Sunlight can signifi-cantly alter the meas-urement.
	05	Check for the presence of other people in the environment who are not adequately protected.	
	06	Clean the sensor lens if the sensor lens is found to have dust or other substances.	
	07	Fix the FOV cone to the probe and secure the probe in the meas-uring stand.	
	08	Fix the UVC probe on the measuring stand at 2.1 m.	
	09	Turn on the UVC measuring instrument and set it to measure "Hg lamps at 254 nm."	

Technical Report

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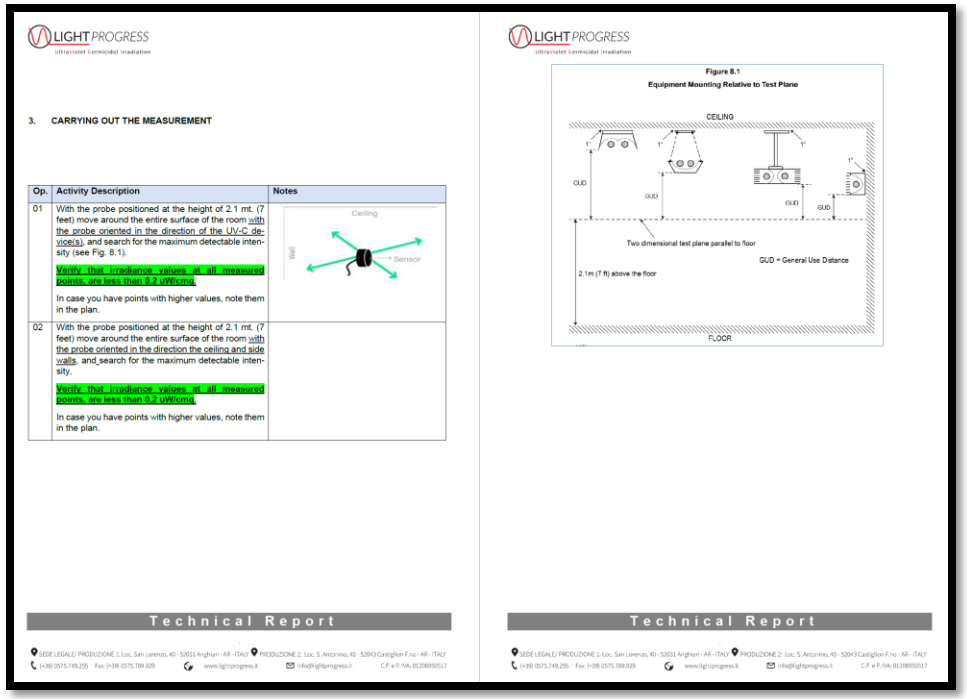
(+39) 0575.749.255 - Fax: (+39) 0575.789.929 www.lightprogress.it info@lightprogress.it C.F. e P. IVA: 01208950517



LIGHT PROGRESS
Ultraviolet Germicidal Irradiation

3. CARRYING OUT THE MEASUREMENT

Op.	Activity Description	Notes
01	With the probe positioned at the height of 2.1 mt. (7 feet) move around the entire surface of the room with the probe oriented in the direction of the UV-C de-vice(s), and search for the maximum detectable inten-sity (see Fig. 8.1). Verify that irradiance values at all measured points, are less than 0.2 uW/cm2. In case you have points with higher values, note them in the plan.	
02	With the probe positioned at the height of 2.1 mt. (7 feet) move around the entire surface of the room with the probe oriented in the direction the ceiling and side walls, and search for the maximum detectable inten-sity. Verify that irradiance values at all measured points, are less than 0.2 uW/cm2. In case you have points with higher values, note them in the plan.	

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LIGHT PROGRESS
Ultraviolet Germicidal Irradiation

Figure 8.1
Equipment Mounting Relative to Test Plane

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Performance Testing

Components of Testing:

- Room Mapping
- Sensor Selection
- UL Standards

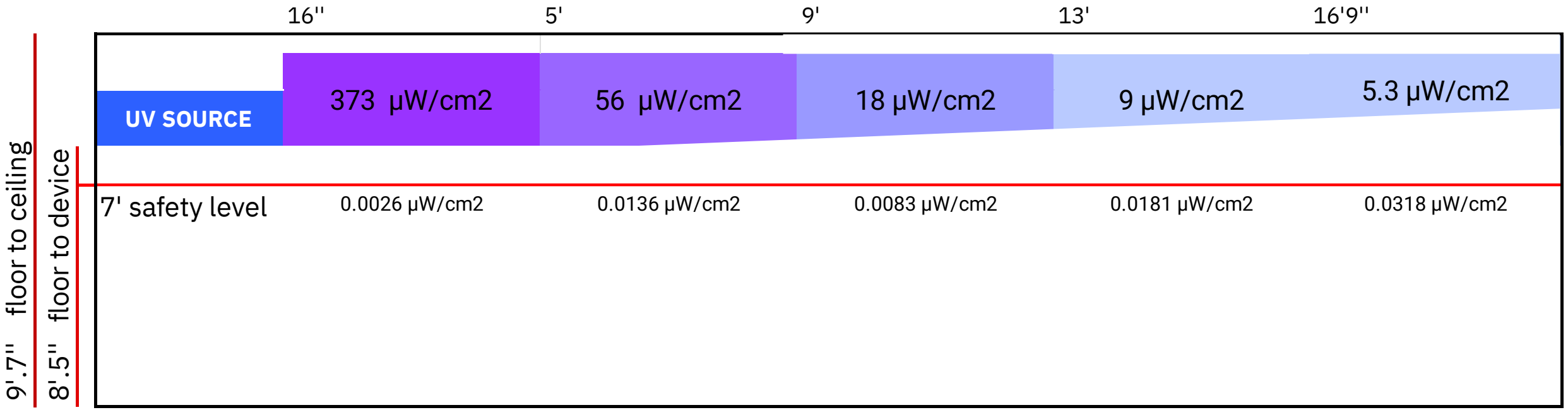
Photobiological safety testing is done as part of the UL1598 certification and in compliance with UL 8802 (proposed) test standard. It verifies an installation height and angle at which the luminaire falls into various risk groups.

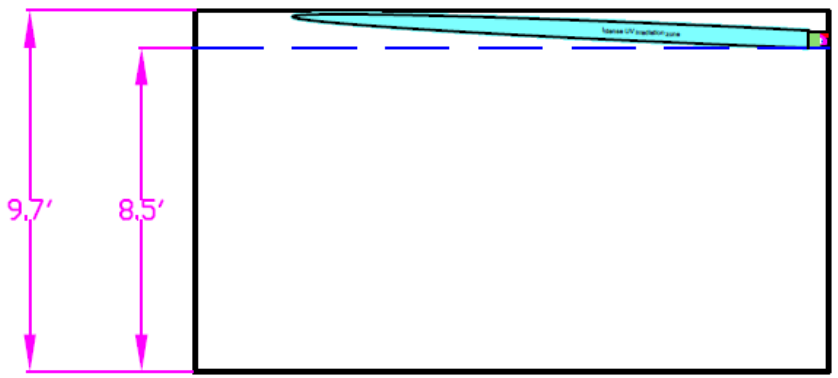
To ensure that UVC sources used in UR UV-C_{254} luminaires do not generate ozone, all UR UV-C_{254} designs shall be tested in compliance with UL standard UL 2998 to show zero ozone generation.

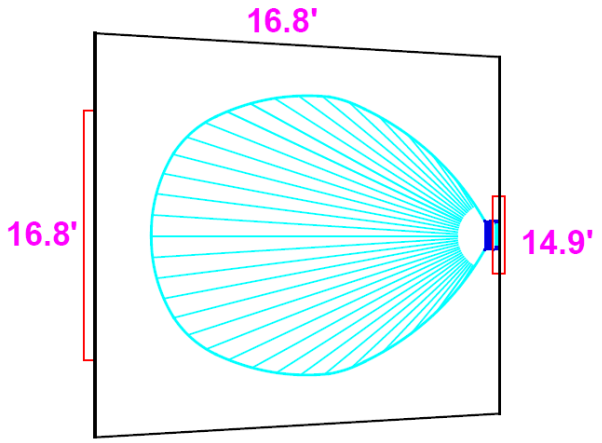
Performance Testing

LIGHT PROGRESS

Intended disinfection is being delivered:







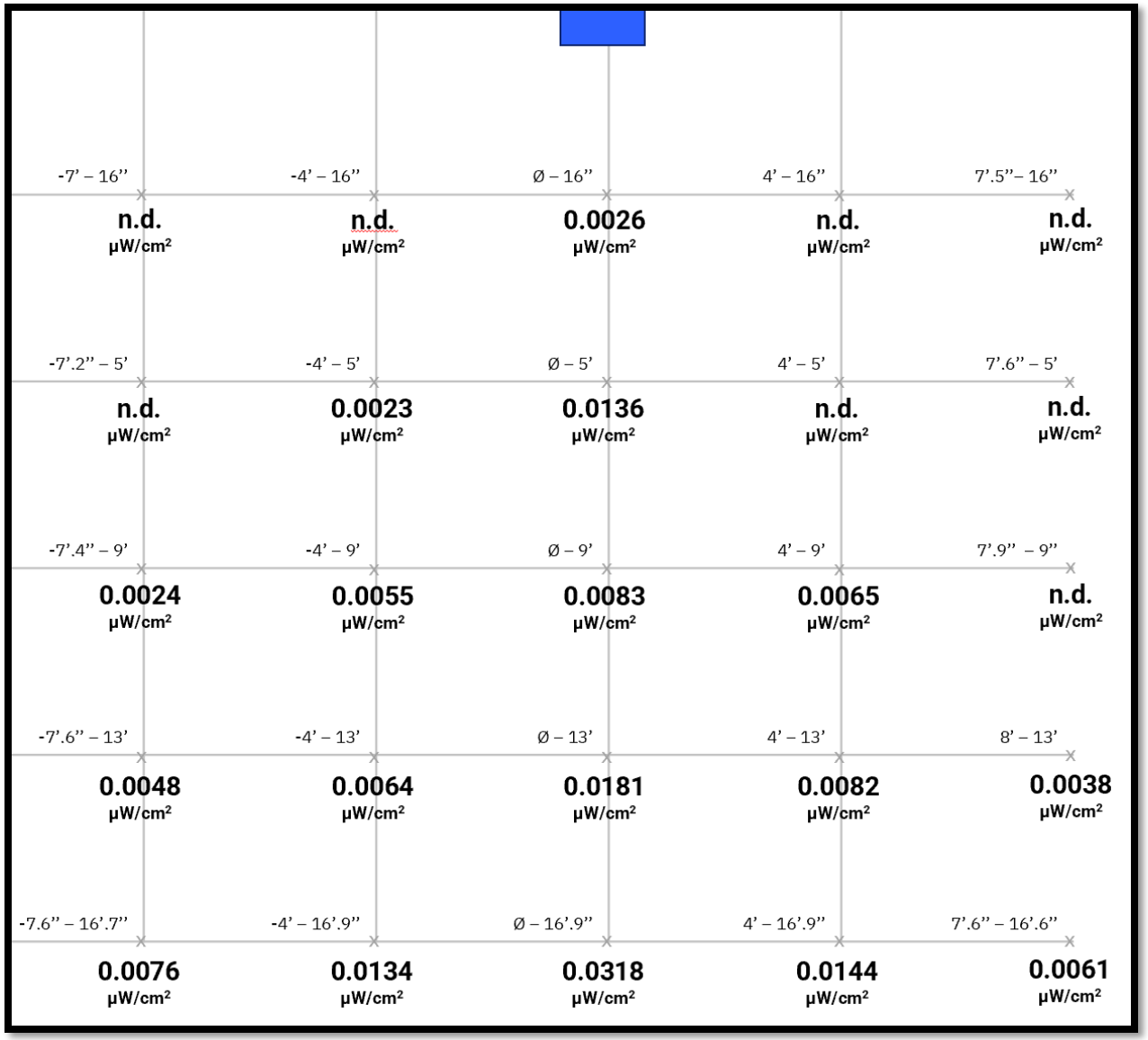
Performance Testing

Safety:

Grid of measured values at 7 feet from the ground.

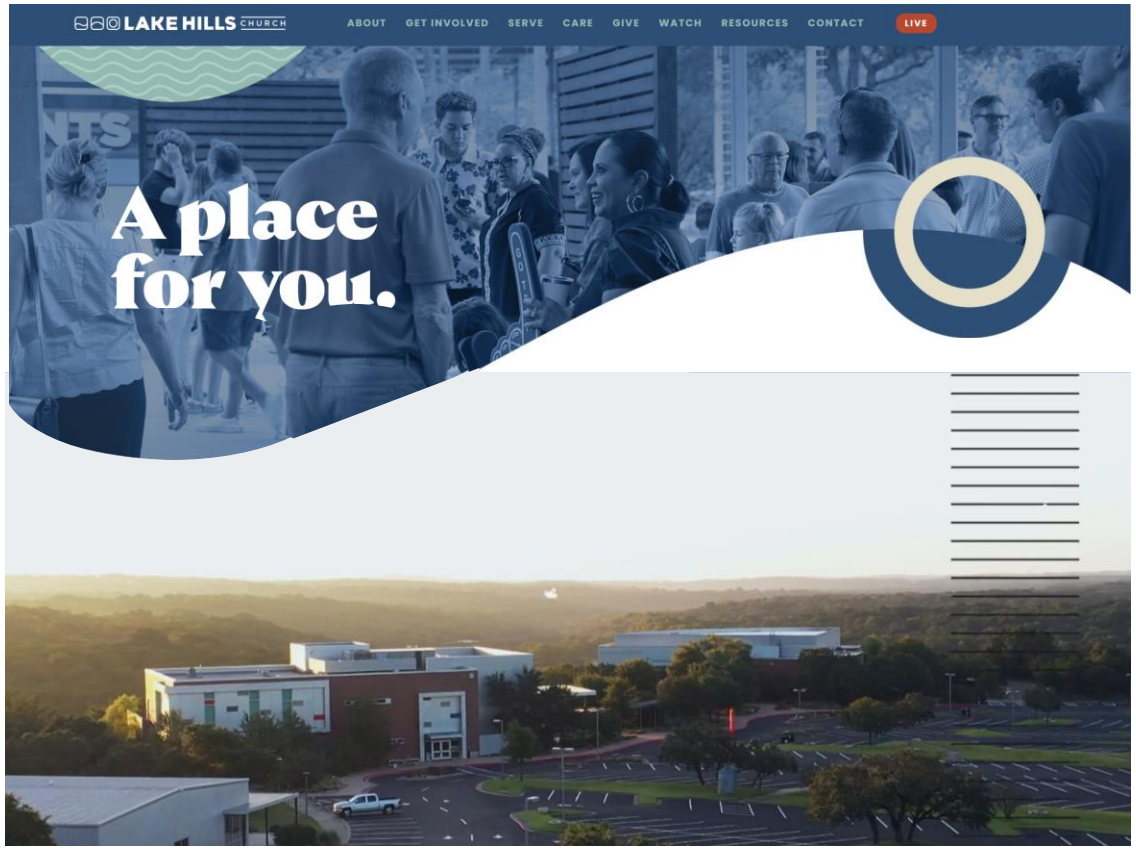
Accepted **T**hreshold **L**imit **V**alue established by ACGIH is 6,000 microjoules per 8 hours for eye exposure and 10,000 microjoules per 8 hours for skin exposure.

Eye Exposure Limit Maths = **.2 microwatt/cm²**



LIGHT PROGRESS

POST-INSTALLATION

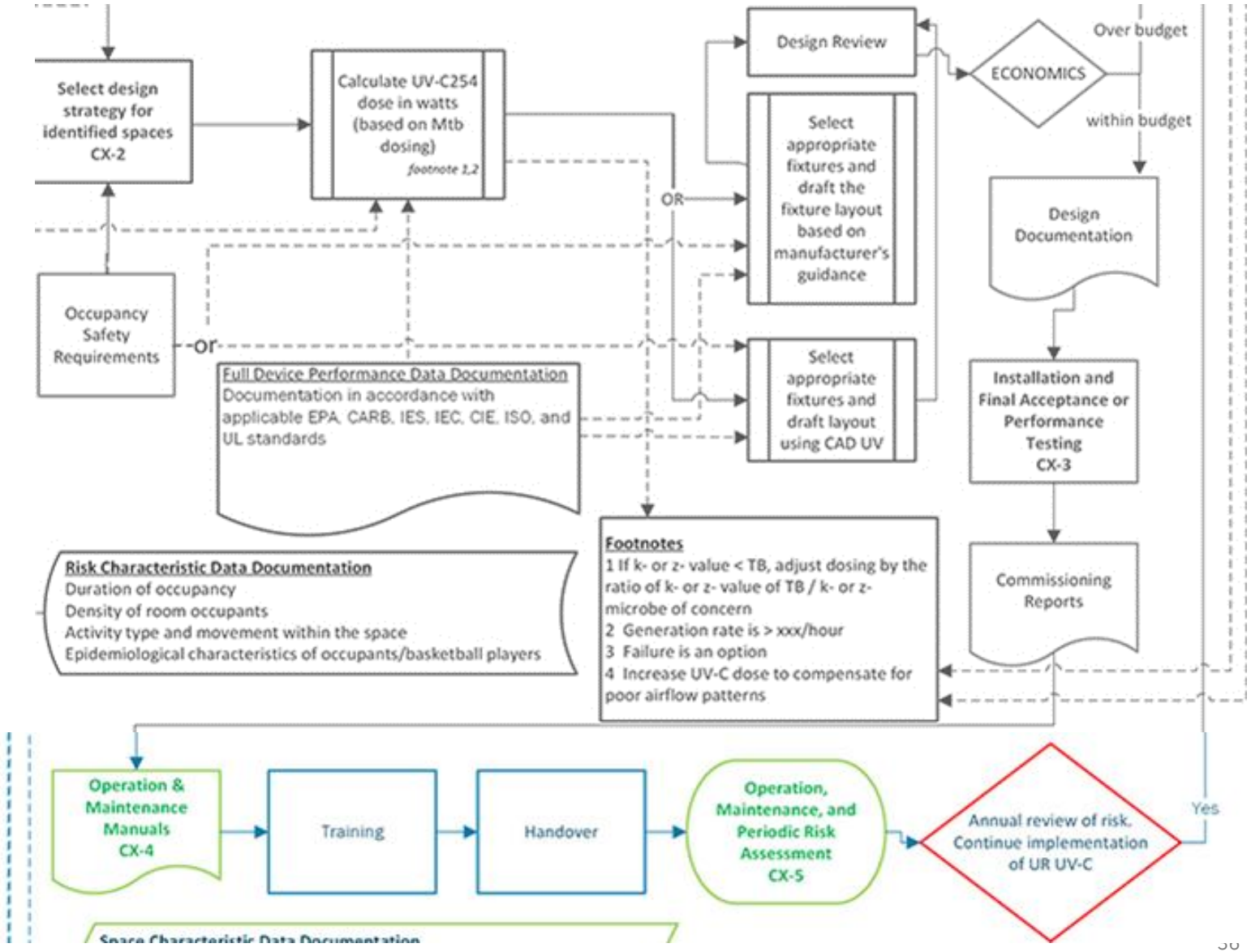


Handover

APPENDIX A — FIELD PROBLEMS NOTED IN SOME UVGI SYSTEMS

The CDC/NIOSH Health Hazard Evaluation (HHE) and Technical Assistance Program receives about 400 requests a year to conduct field investigations of potential health hazards. These requests are made by employers, workers, worker representatives, other Federal agencies, and State, foreign, and local agencies. From 1987 through 2000, the program received 14 TB-related requests for technical assistance that involved evaluations of UVGI systems [Boudreau et al. 1995; Buchta et al. 1993; Burton 1995; Burton and Martinez 1997; Decker 1993; Martinez 1995a, 1995b, 1999; Moss and Seitz 1990, 1991; Murray 1987; Seitz 1992; Seitz et al. 2000; Tubbs and Bresler 1992; Weber and Boudreau 2000]. These requests came from a variety of workplaces including hospitals (e.g., emergency rooms, waiting areas, and microbiology laboratories), neighborhood health centers, TB clinics, drug treatment centers, correctional facilities, a medical examiner's office, and a homeless shelter. A review of these requests for assistance indicates the following installation or maintenance problems were noted in at least one of the facilities during the investigations:

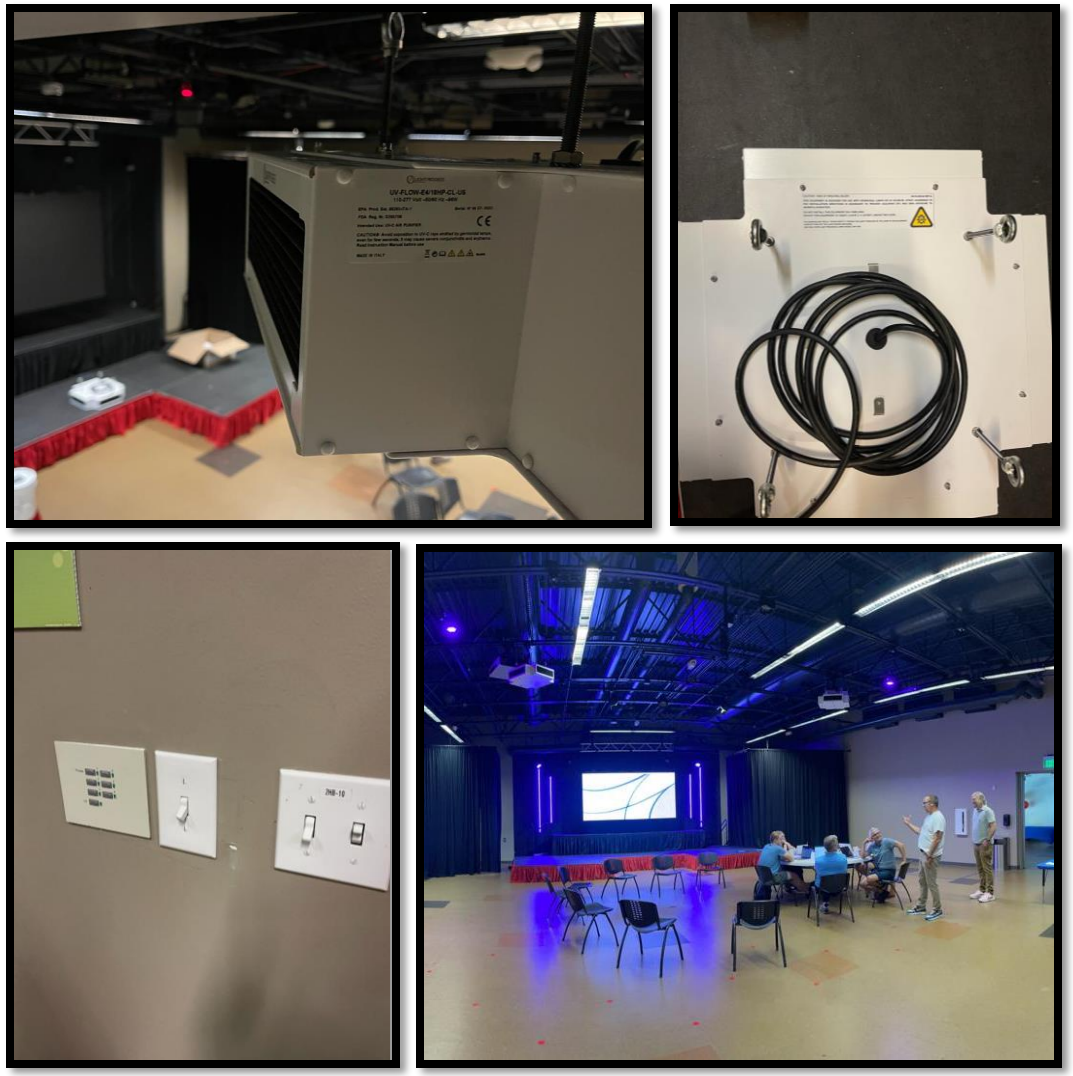
- Lack of preventive maintenance plans, resulting in numerous reports of dirty and/or old lamps that produced minimal UVGI levels.
- No wall switches to turn off UVGI lamps or fixtures during maintenance operations.
- UV fixture louvers bent or missing, allowing workers to look directly at the lamps.
- No warning labels on UVGI lamps or fixtures to warn of hazards from direct eye contact.
- No worker training on the potential hazards of UVGI.
- No lockout mechanisms or automatic shut-off mechanisms to rooms where the upper-room UVGI system was designed to be deactivated when people were present in the rooms.
- Polished metal and reflective paint surfaces that indirectly increased the UVGI level in the occupied space.
- No warning signs in areas with high UVGI levels.
- Improper planning and installation of fixtures.



Handover

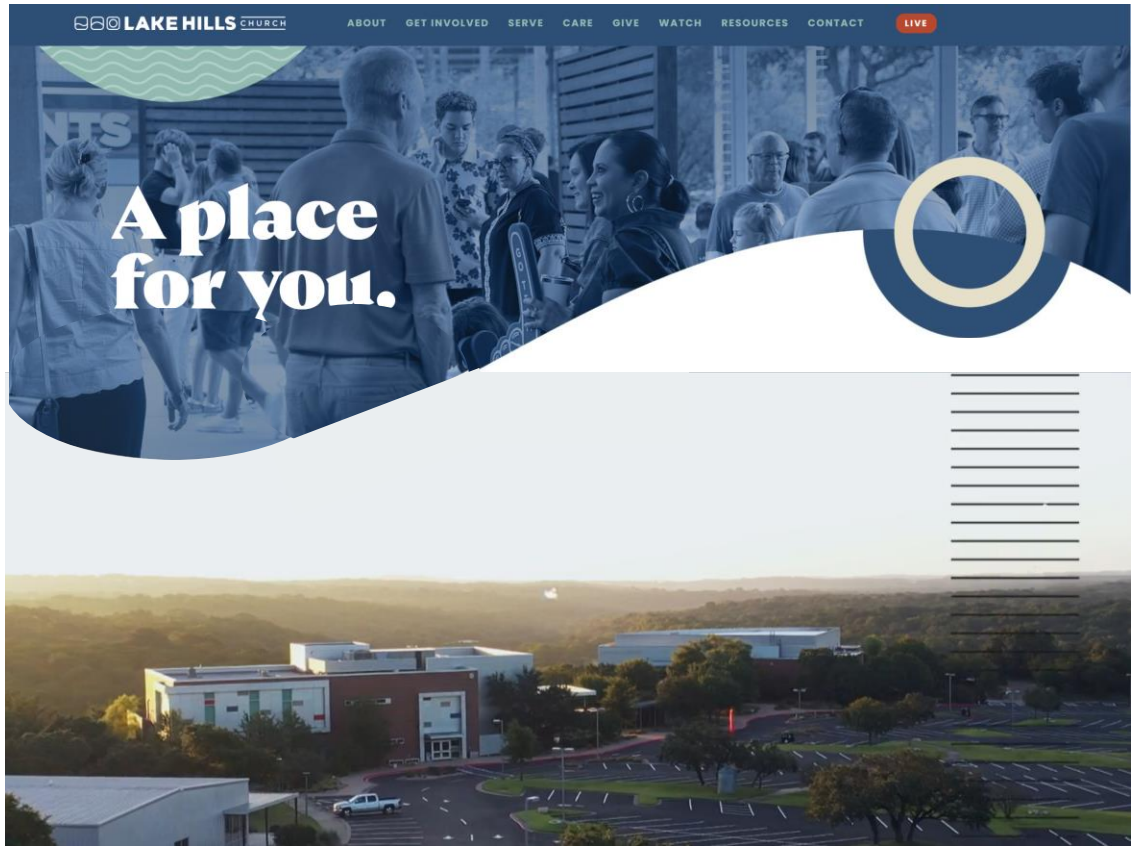
Operation, Maintenance, and Training:

- Dedicated Light Switches
- Device and Light Switch Labels
- Clear Safety Labels and Instructions
- User Education
- Maintenance Plan for Effective Operation and Identification of Intended Performance



LIGHT PROGRESS

CONCLUSION & REFLECTIONS



Reflections

This is a helpful execution document but practice highlights the opportunity for further guidance that support's the customer's decision making process.

Who else will say, ***"When 'X', you should install Upper Air GUV to 'Y', for all of the 'Z' benefits."***

The decision making process is not as linear as we might like it to be.

There is opportunity to encourage the alignment and cooperation of stakeholders in the process: manufacturer, re-seller, installer, buyer, users, etc.

THE PACIFIC NORTHWEST NATIONAL LABORATORY STUDY ON UPPER AIR GUV FOR THE U.S. DEPARTMENT OF ENERGY

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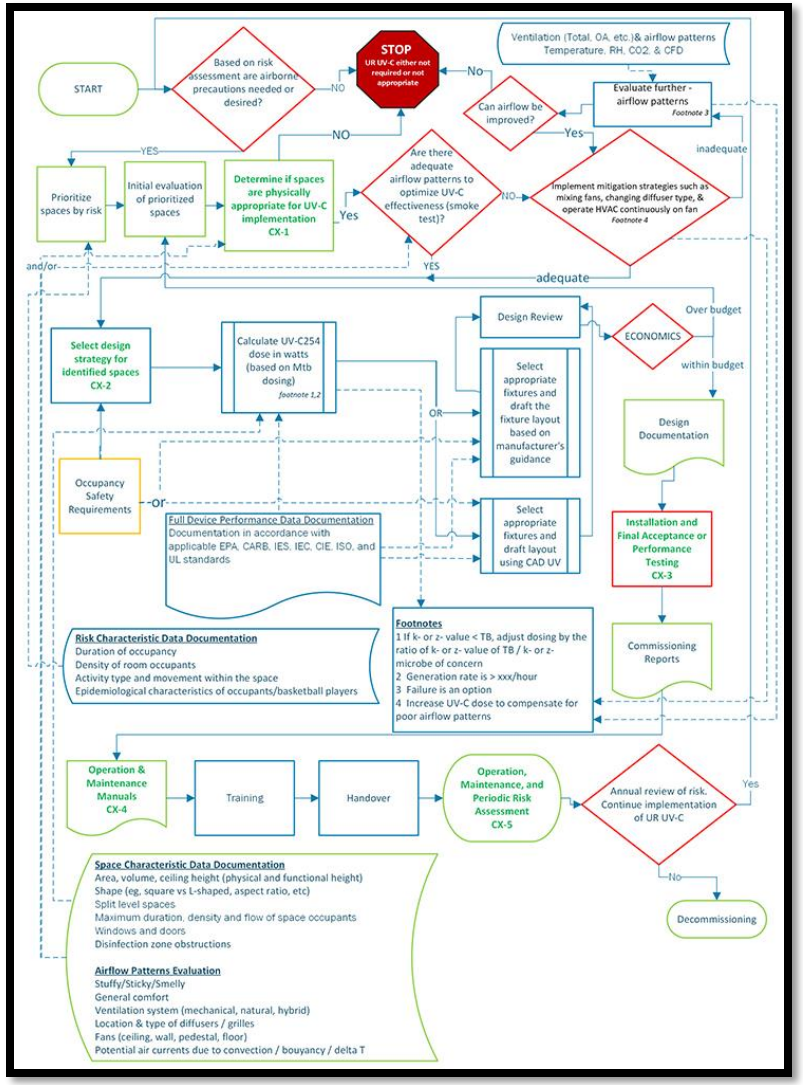
QUESTIONS?



Thank you.

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