

Decon 2.0: Emerging Decontamination Technologies

Vaporized Hydrogen Peroxide (VHP) and Chlorine Dioxide Gas Decontamination Field Studies:

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Goals of Decontamination

- Eliminate contamination through disinfection as validated w/biological indicators
- Reach all surfaces
- Contain chemical to target decontamination area
- Ventilate and/or neutralize chemical
- Do so safely and with minimal impact on materials in area

Concerns with Formaldehyde

- Safety Issues: real and perceived
 - WHO carcinogen
 - low PEL (.75 ppm)
- OSHA regulated
- Residue
- Different applications may require different technologies

Decontamination Alternatives: The Options

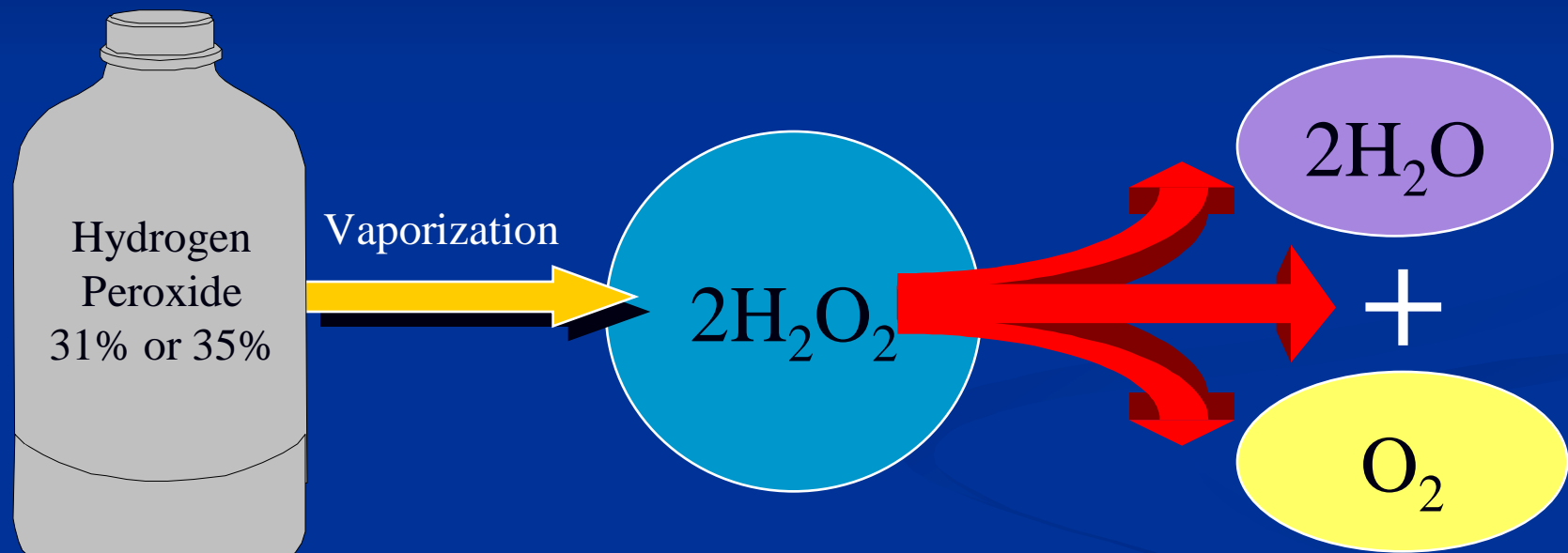
- Chlorine Dioxide Gas (ClorDiSys)



- Vaporized Hydrogen Peroxide (Steris 100P)



Vaporized Hydrogen Peroxide (VHP)

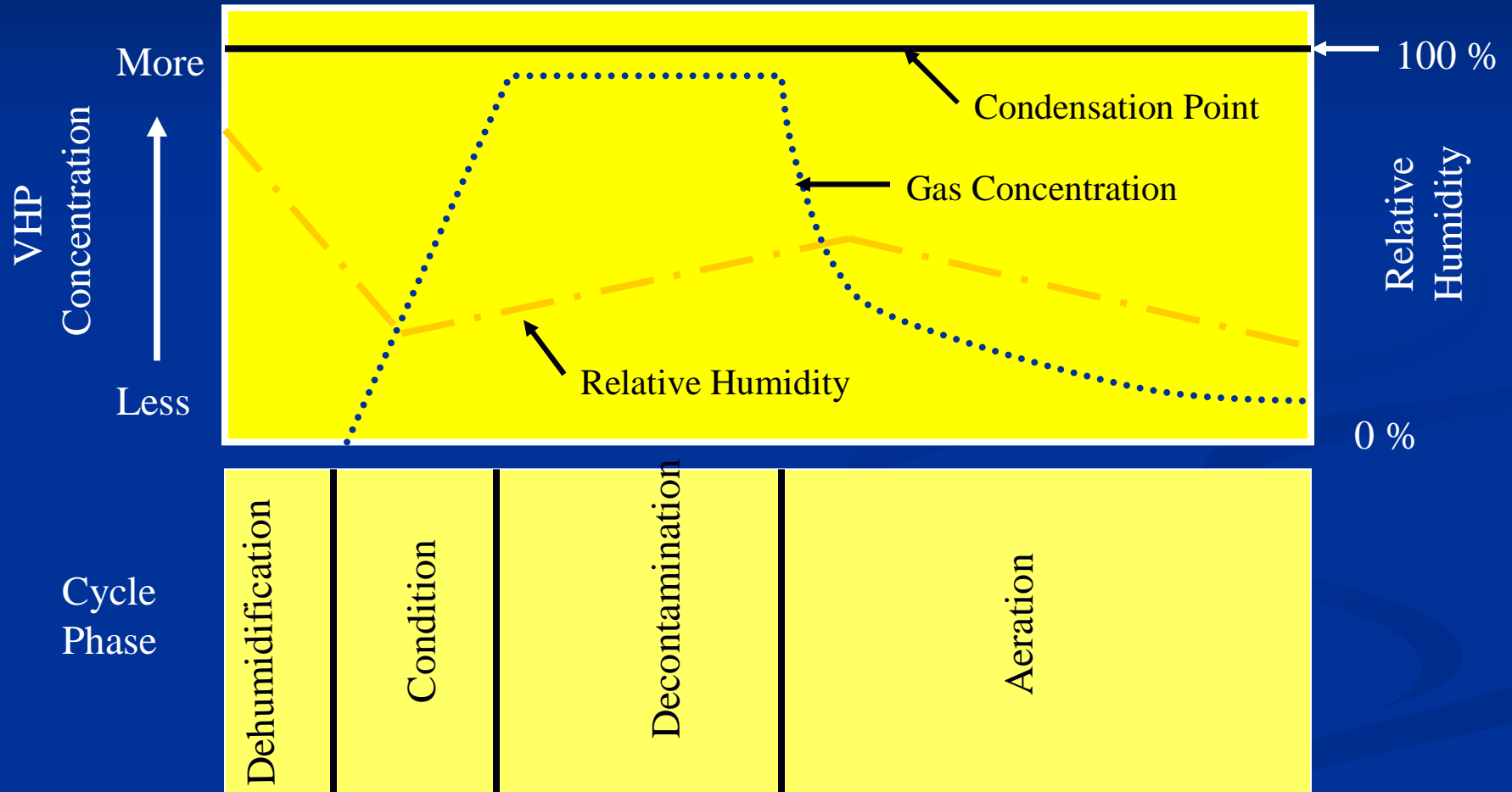


Sporicidal at Low
Concentrations

By Courtesy of Steris Corporation



Typical Vaporized Hydrogen Peroxide Bio-decontamination Cycle



By Courtesy of Steris Corporation



H₂O₂ Vapor Concentration Versus D-Value

Temp (°C)	Concentration (mg/L)	PPM	Typical D-Value
4	0.3 - 0.5	350	8 - 12 min.
25	1 - 2	700 - 1500	1 - 2 min.
37	3 - 4	2000 - 3000	0.5 - 1 min.
55	10 - 12	7000+	1 sec.

Note: Using *Geobacillus stearothermophilus*

By Courtesy of Steris Corporation



H₂O₂ Vapor Exposure Limits

- **Permissible Exposure Limit (PEL/8 hrs)**
1.0 ppm
- **Immediately Dangerous to Life or Health (IDLH/30 minutes)** **75 ppm**
- **No STEL**



Chlorine Dioxide Gas



Chlorine Dioxide Gas (ClO₂) Cycle

- **Humidification (65% + RH)**
- **Charge -- Raise ClO₂ concentration**
- **Exposure**
- **Aeration**
- **D-value .1-.8 min 10-30 mg/L**

ClO₂ Exposure Limits

- **Permissible Exposure Limit (PEL/8 hrs)**
0.1 ppm
- **Short-term Exposure Limit (STEL/15 minutes) 0.3 ppm**
- **Immediately Dangerous to Life or Health (IDLH/30 minutes) 5.0 ppm**



Field Studies: VHP and ClO₂



Decontamination Procedure

- Reach target temp/humidity; monitor
- Prepare area (BIs, fans, monitors, seal) for large scale, consider pre-test for seals
- Create safety perimeter/signage
- Introduce chemical and bring to target concentration for target exposure time; monitor
- Monitor surrounding areas for leakage
- Ventilate and/or neutralize to below PEL
- Incubate/analyze BIs

Class II biological safety cabinets (BSCs)



- Class II A2s and B2s
- Multiple manufacturers
- 4-8 BIs per cabinet: work area, exhaust HEPA, supply plenum/HEPA

Space Decontaminations



- Pharma aseptic production areas
- Laboratory Animal Research areas
- Pilot plant production areas
- Cold Rooms



Biological Indicators (BIs)

- *Geobacillus stearothermophilus* (10^6)



Cycle Parameters for six log kill: VHP and ClO₂ gas

- VHP
 - Humidity < 50% RH
 - stable temp 22 C
 - 400 - 1400 ppm-hrs
 - Aeration 1-4 hrs.
- ClO₂
 - Humidity > 65% RH
 - stable temp 22 C
 - 900 - 1500 ppm-hrs
 - Aeration .5 hrs - 1.5 hrs



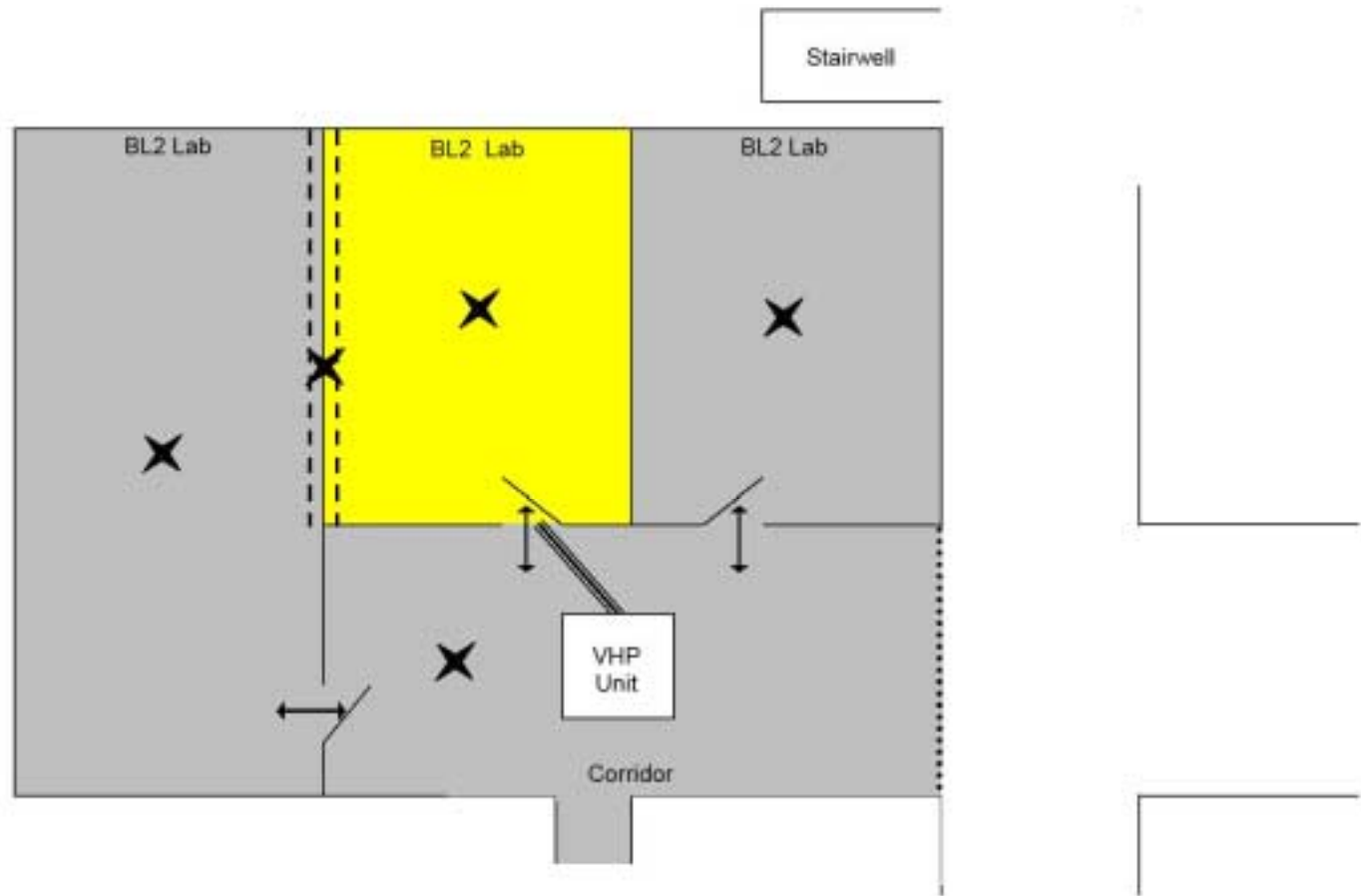
Case Study: Vaporized Hydrogen Peroxide



BSL2 TC Lab
1,500 ft³
Standard
Drop Ceiling



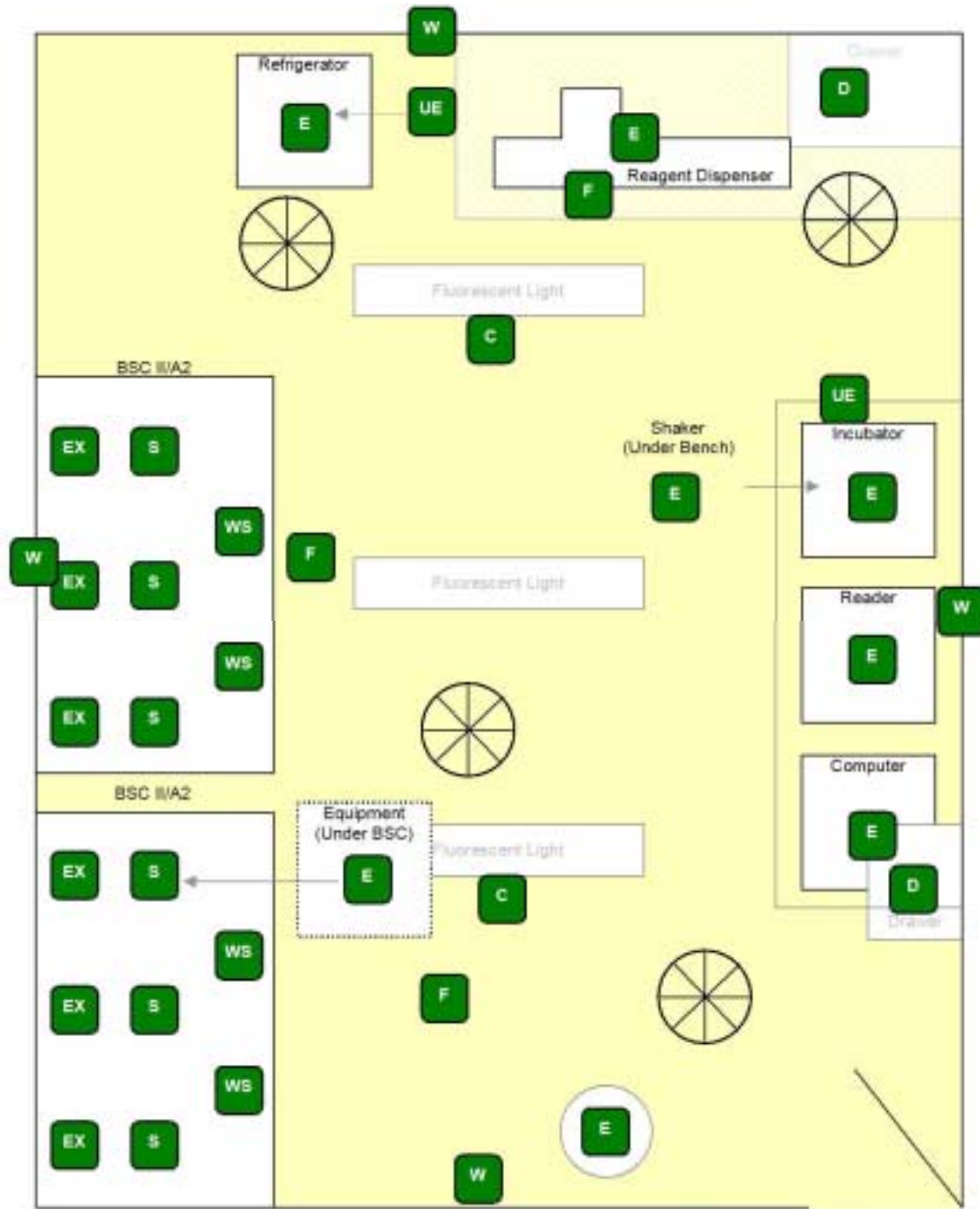
BL2 TC Lab Decon Schematic



Unconventional Application: BSL2 TC Lab 1,500 ft³

Concerns: Unsealed ceiling, open ceiling plenum to adjacent lab, unsealed penetrations, volume of cellulose (ceiling tiles, supplies, etc.)





BI/Fan Location

Geobacillus

Stearothermophilus

10^6

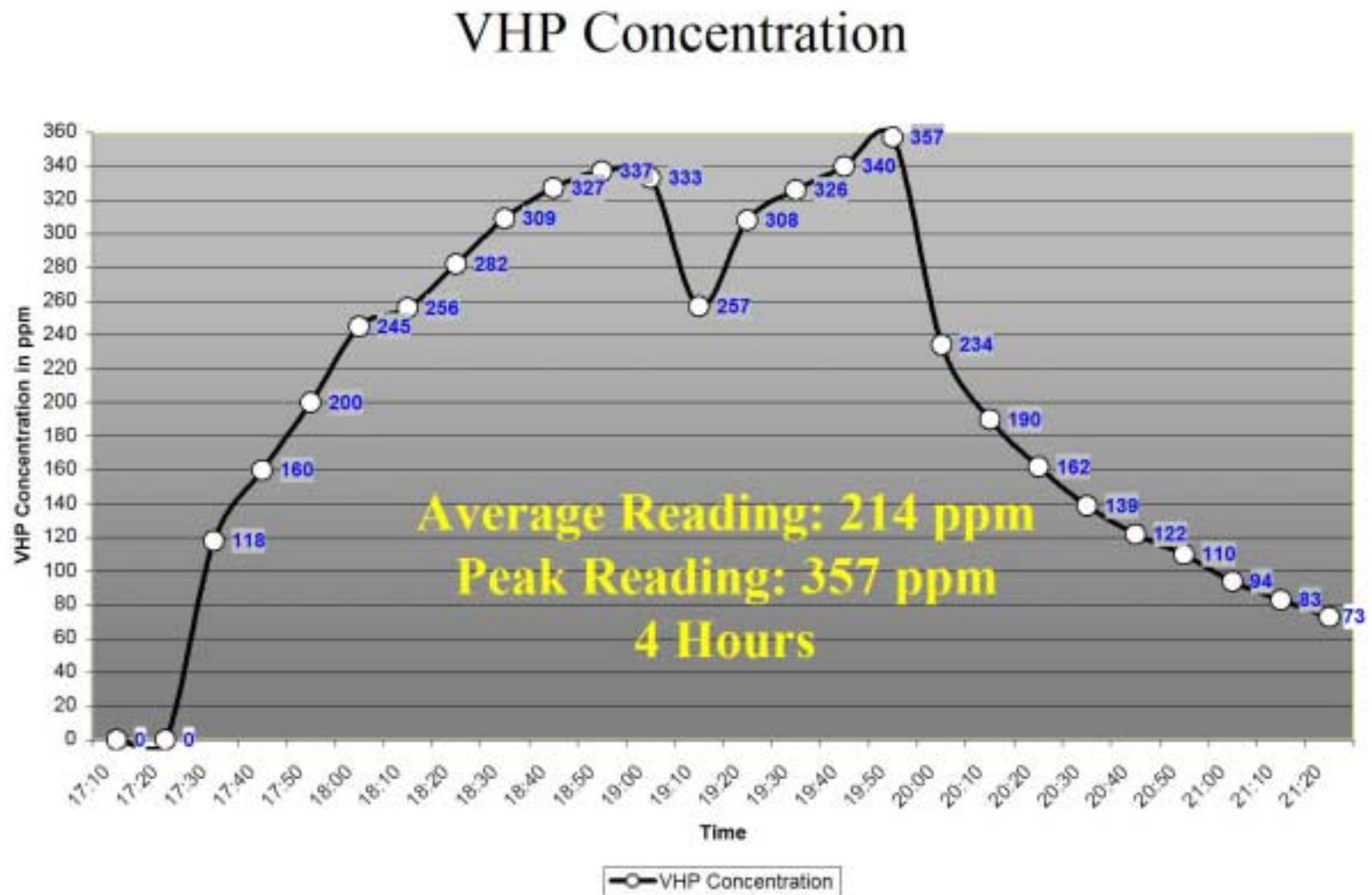




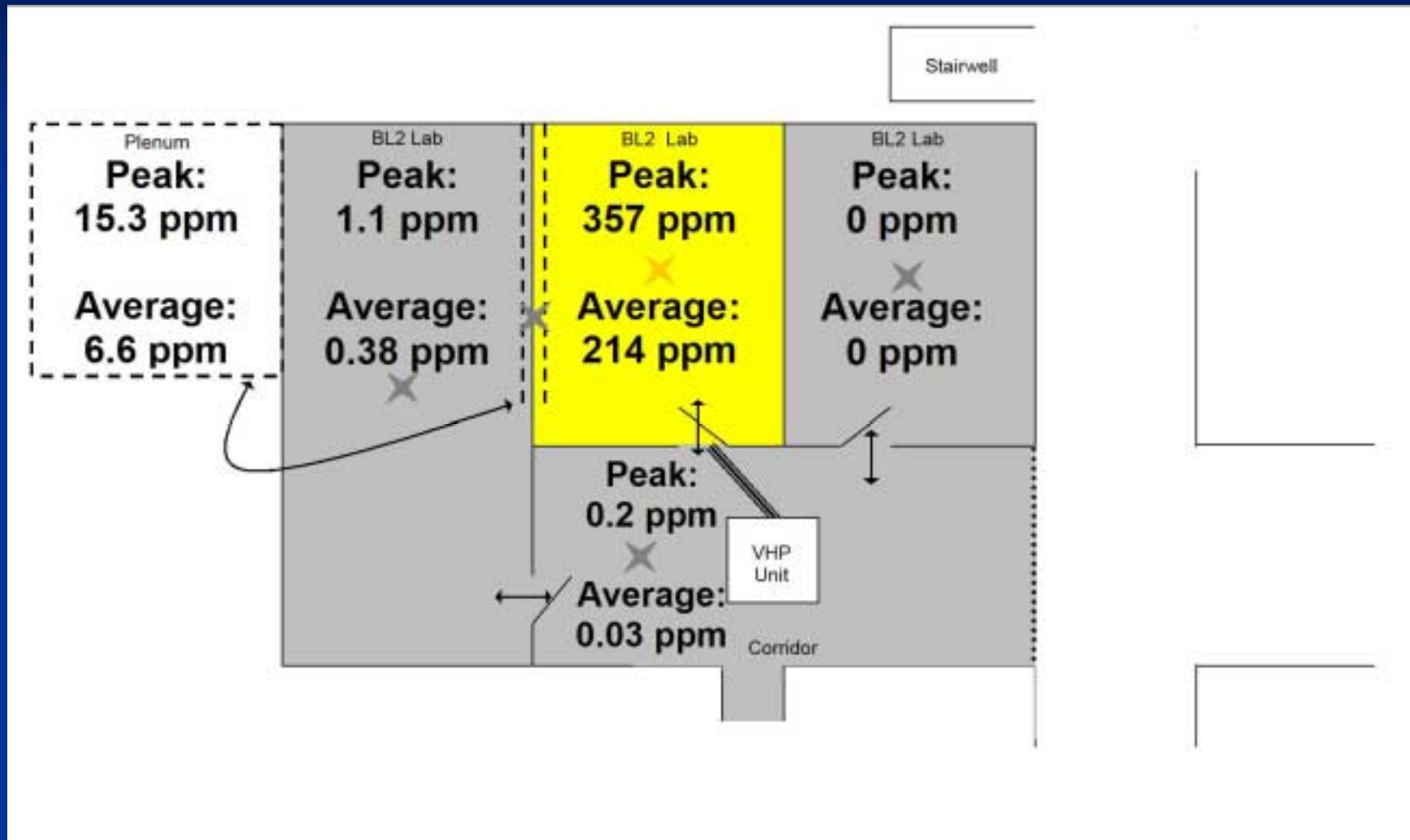
Conditions and Cycle Parameters

- Humidity (RH): 17.7%
- Temperature: 22°C
- Room to Exterior Pressurization: 0.0" w.g.
- Injection Rate: 10 g/min
- Injection Duration: 121 minutes
- Peroxide Used: 1224 grams

BL2 TC Lab VHP Concentration



VHP Concentration Levels





Results

- 17 BIs no growth/20 growth
- Adjacent labs below PEL



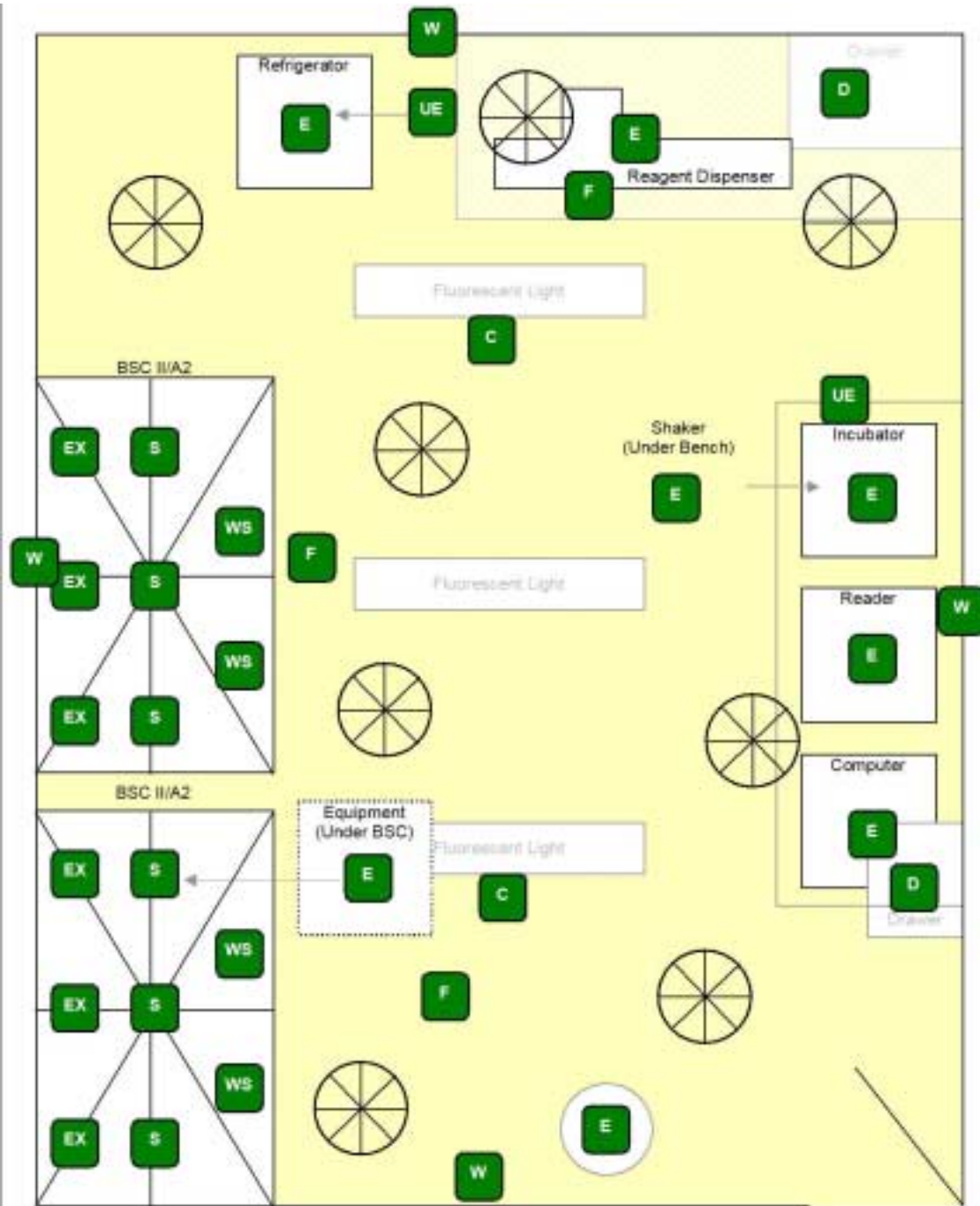
Take II

BI/Fan Location

Geobacillus

Stearothermophilus

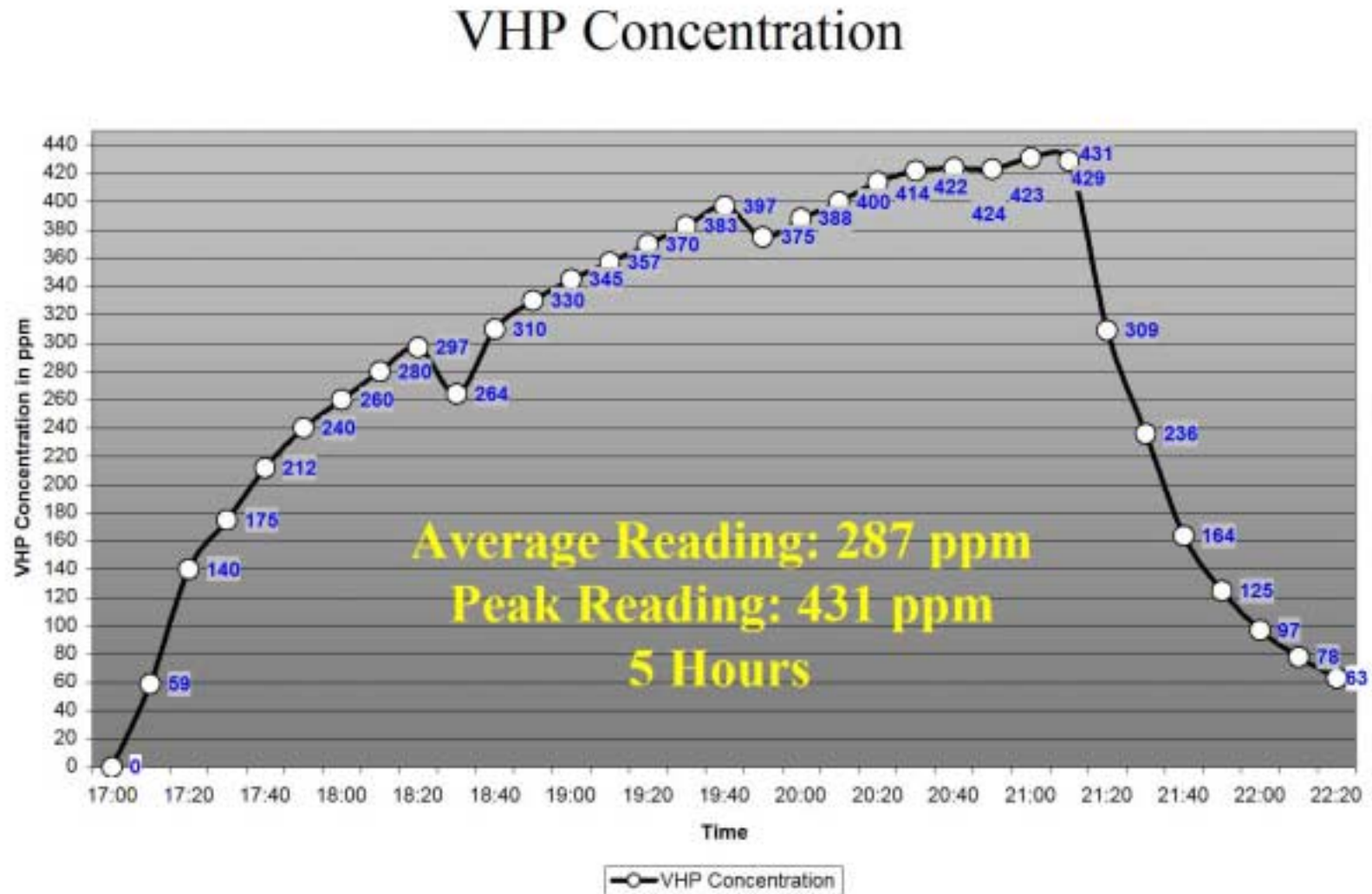
10^6



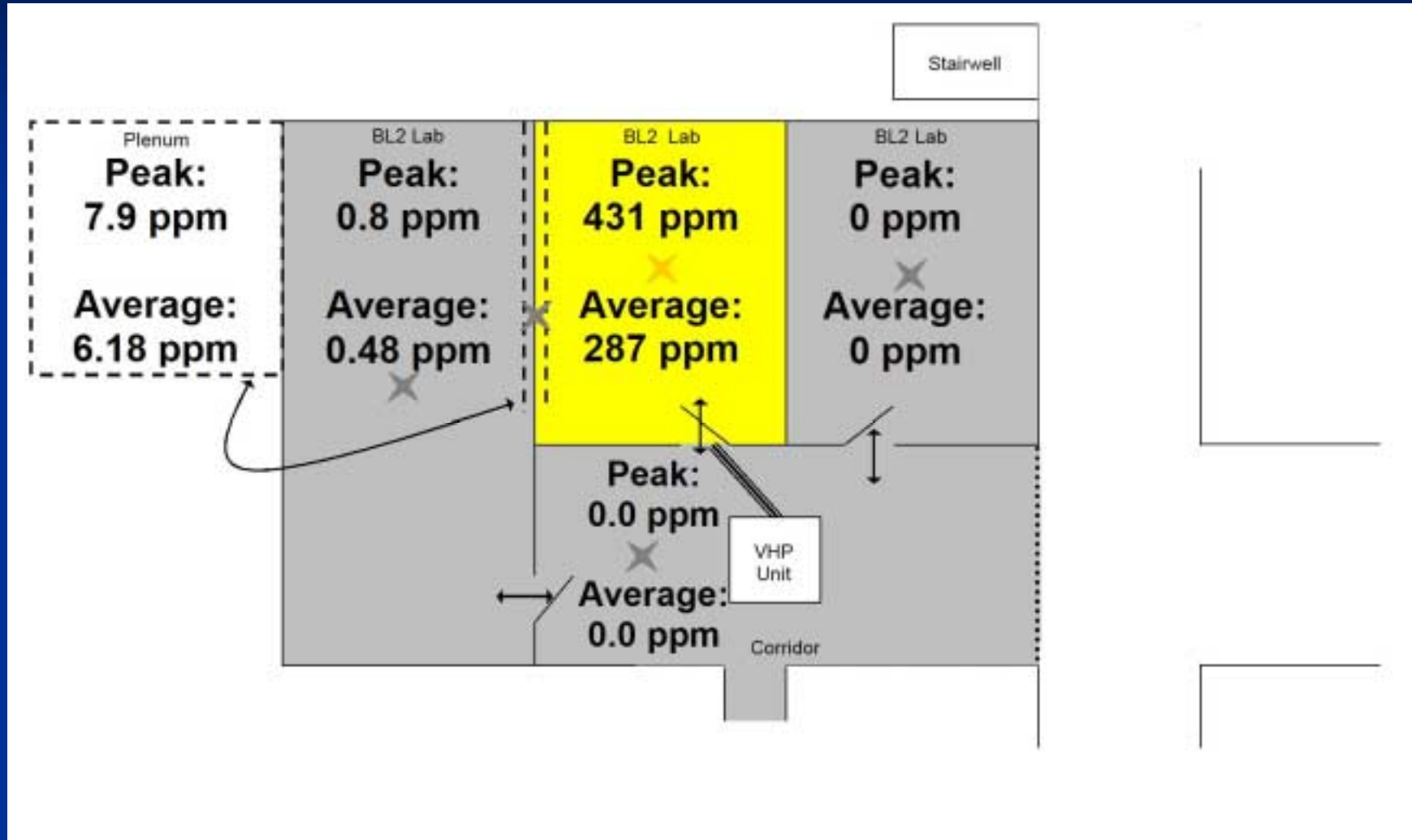
Conditions and Cycle Parameters (II)

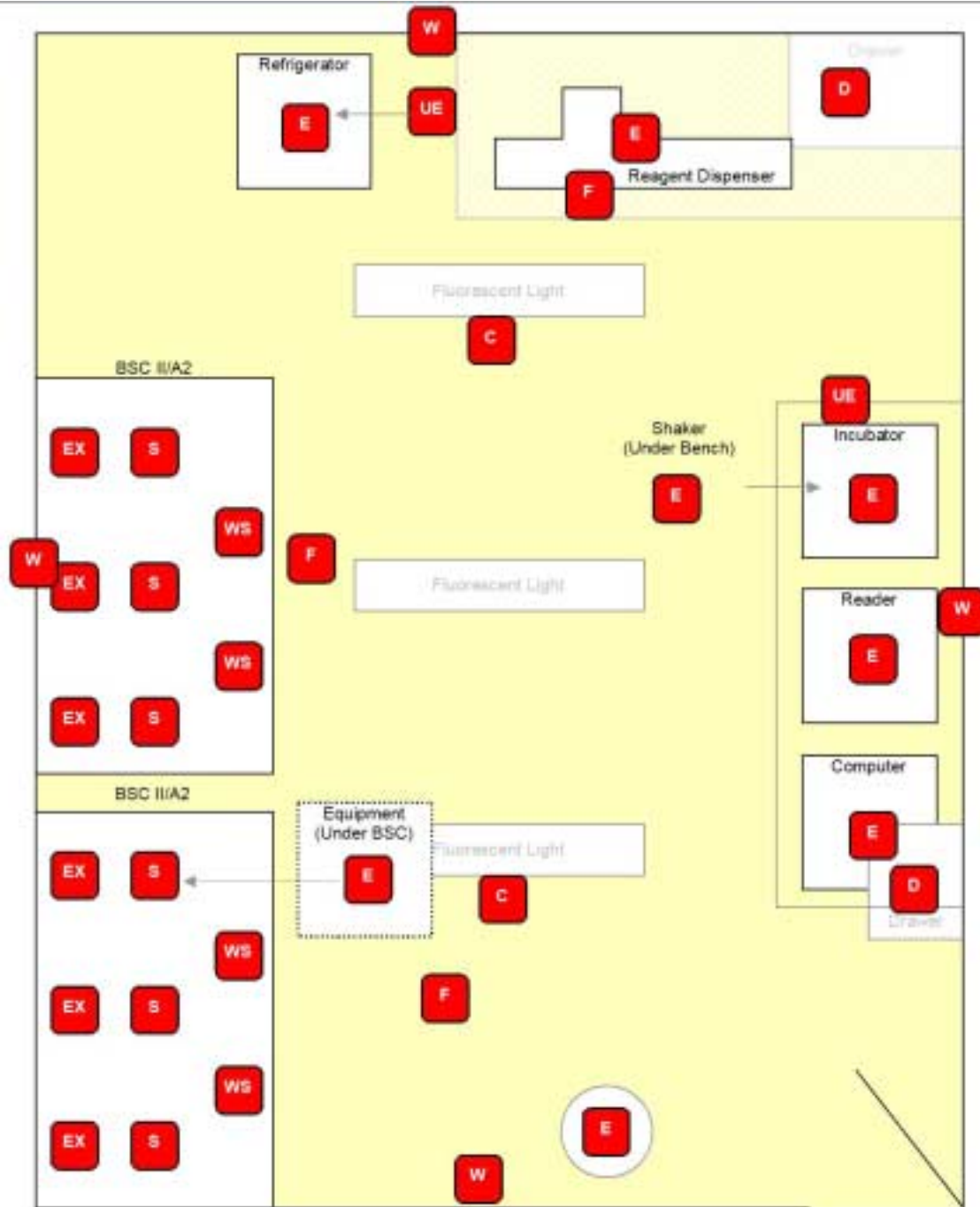
- Humidity (RH): 15.0%
- Temperature: 22°C
- Room to Exterior Pressurization: 0.0" w.g.
- Injection Rate: 10 g/min
- Injection Duration: 250 minutes
- Peroxide Used: 2406 grams

BL2 TC Lab VHP Concentration Levels (II)



VHP Concentration Levels (II)



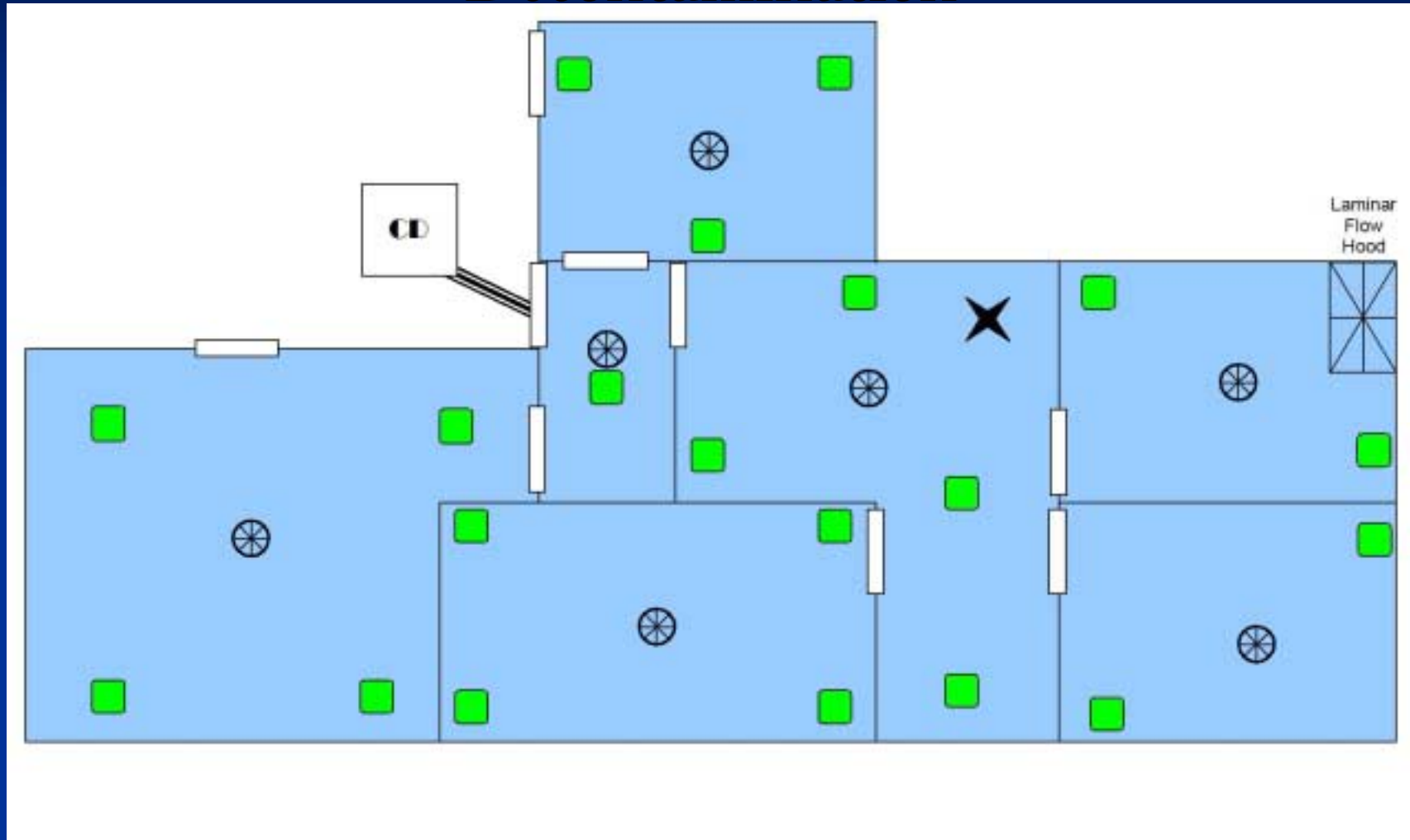


Results

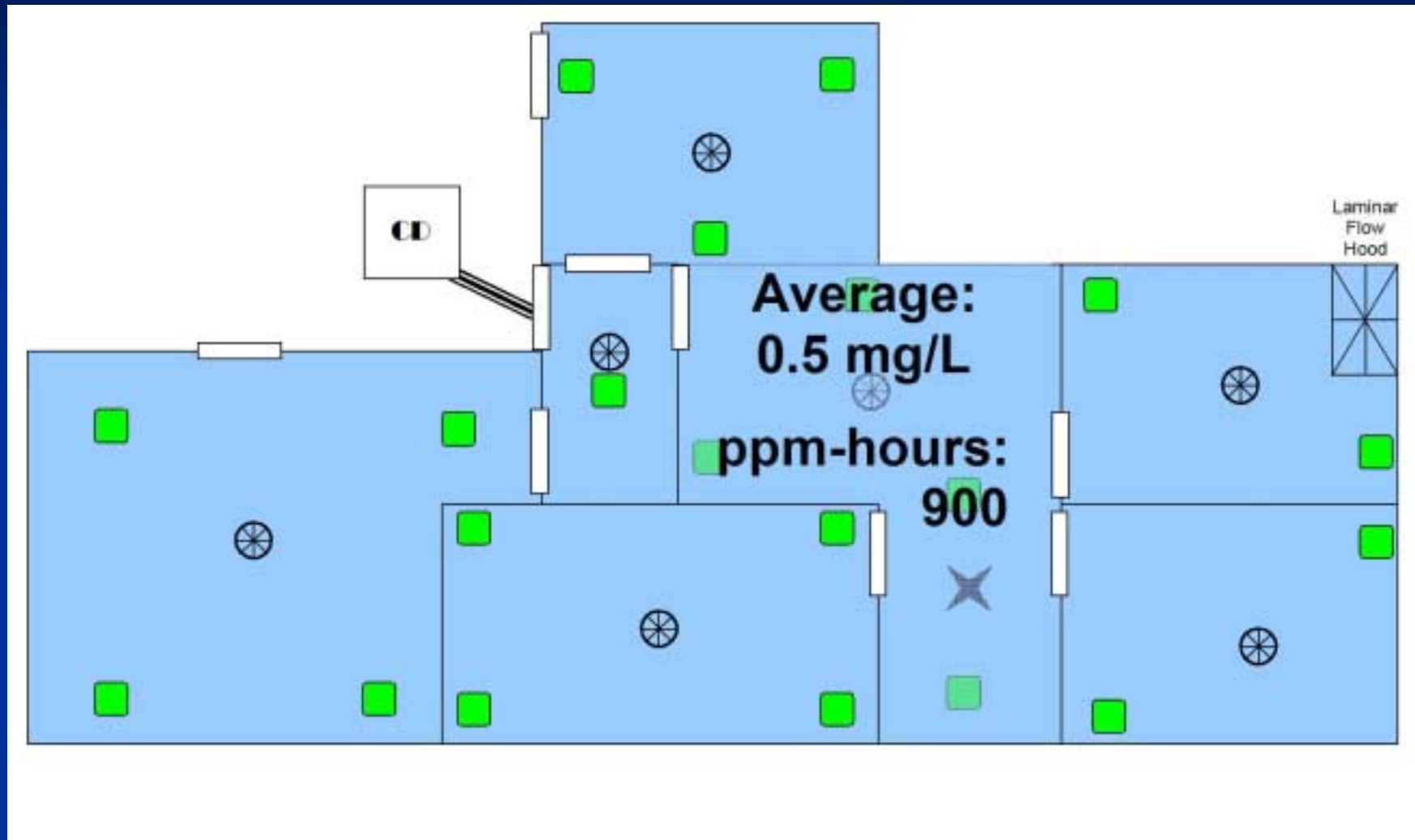
- All 37 BIs no growth
- Adjacent labs below PEL



Case Study: 20,000 ft³ Pharma Pilot Plant ClO₂ Gas Decontamination

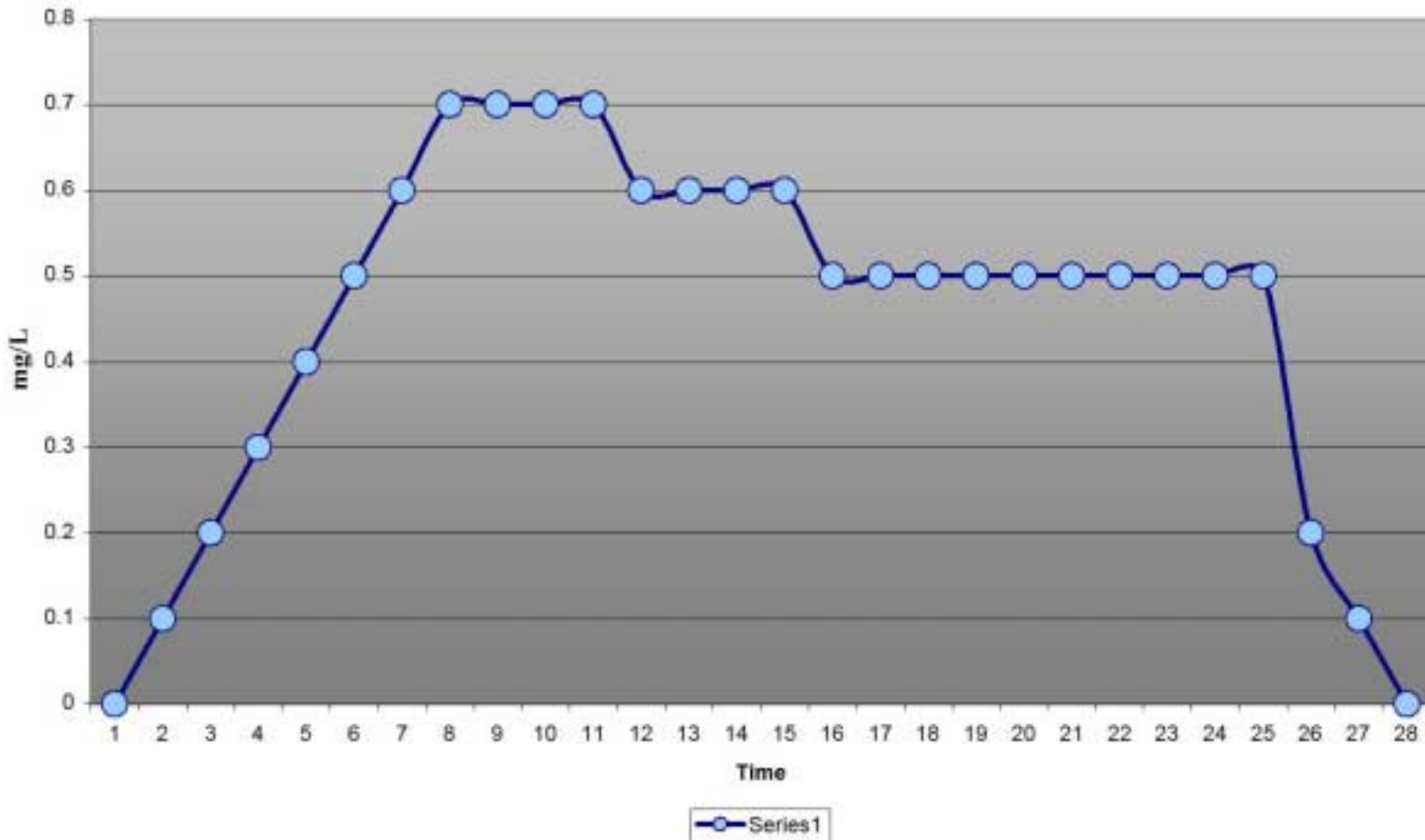


Pharma Pilot Plant ClO_2 Decontamination

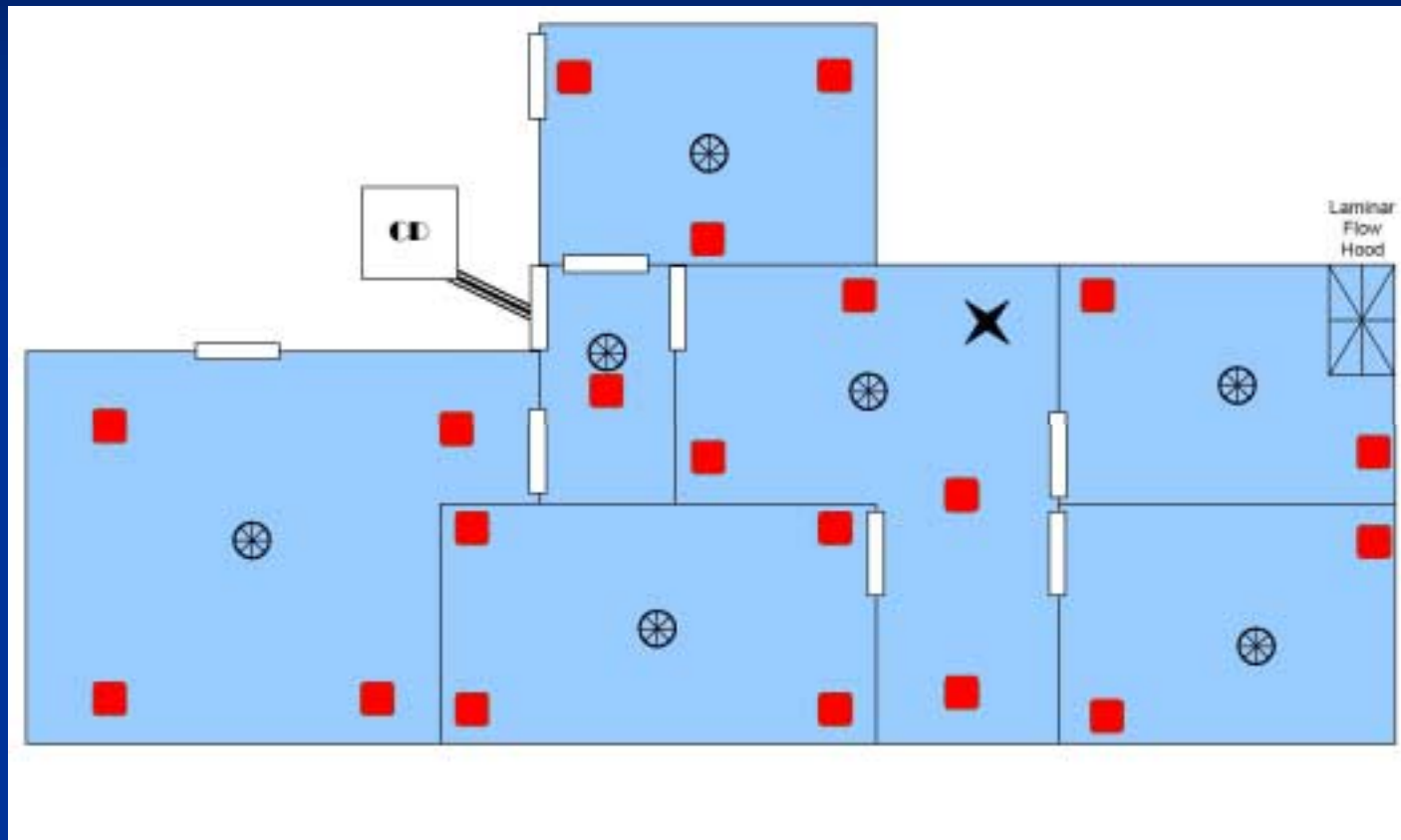


Pharma Pilot Plant ClO_2 Decontamination

Chlorine Dioxide



Pharma Pilot Plant ClO_2 Decontamination Results



Results

- All 20 BIs
no
growth

Summary

- Viable alternatives to formaldehyde gas exist for efficacious and safe decontamination of laboratory equipment and space
- It is important to understand the physical properties and behavior of your decontaminant of choice to ensure efficacy and safety
- Different decontaminants may be appropriate for different applications