Artificial Fog in the Film Industry

California Council of Industrial Hygienists

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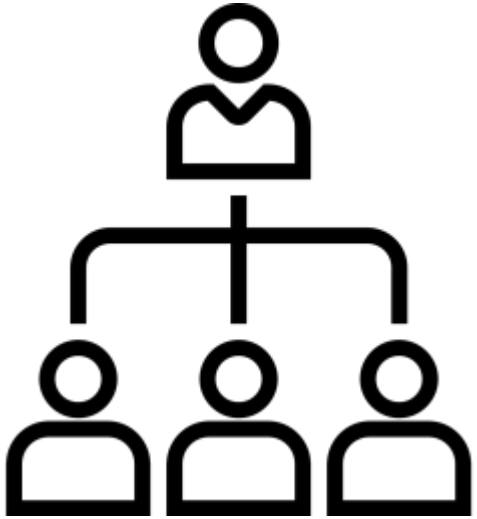
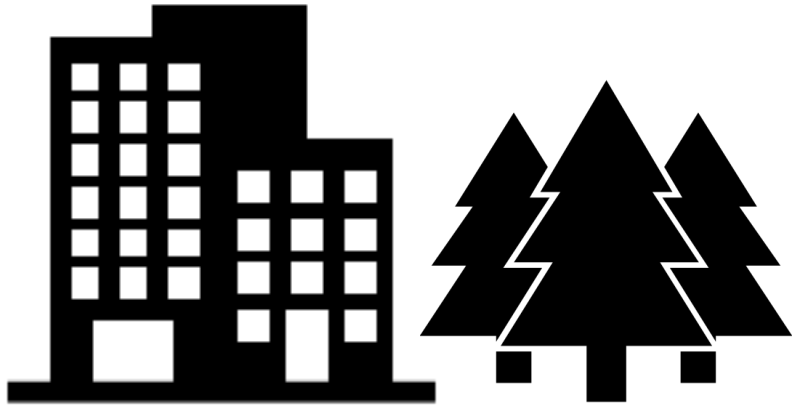
A UNIQUE INDUSTRY



STRUCTURE

HOURS & OPERATION



WORKSITES

WORKFORCE

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HISTORY

Opera/Theatre

American National Standards (ANSI / ESTA)

Film and Television

Industry Bulletins and Guidelines

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HOW FOG IS USED?

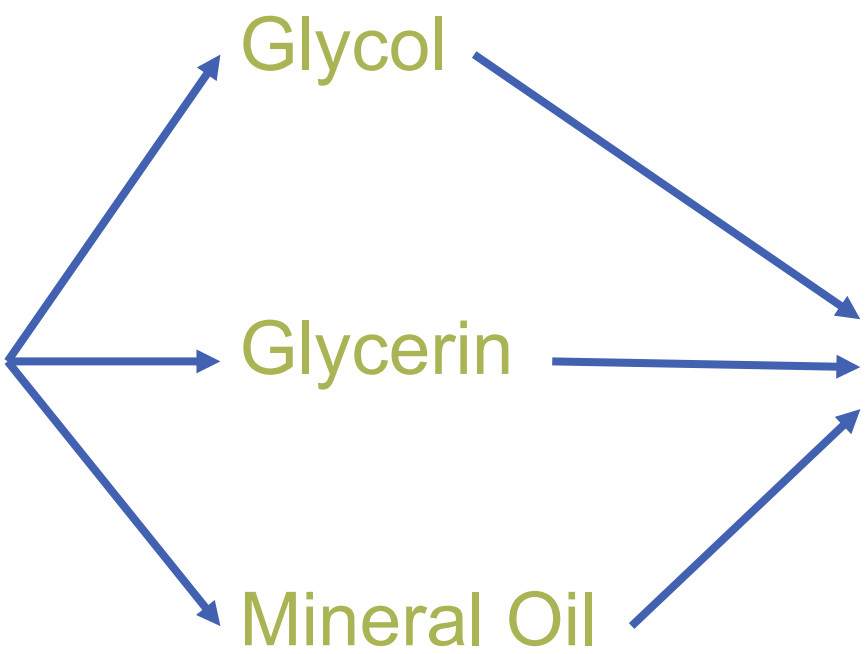
VISUAL EFFECT

ATMOSPHERIC HAZE

TYPES OF FOG

Inorganic → Liquid or Solid → Dry Ice
Liquid Nitrogen

Organic



Majority of aerosols have aerodynamic diameter < 1µm

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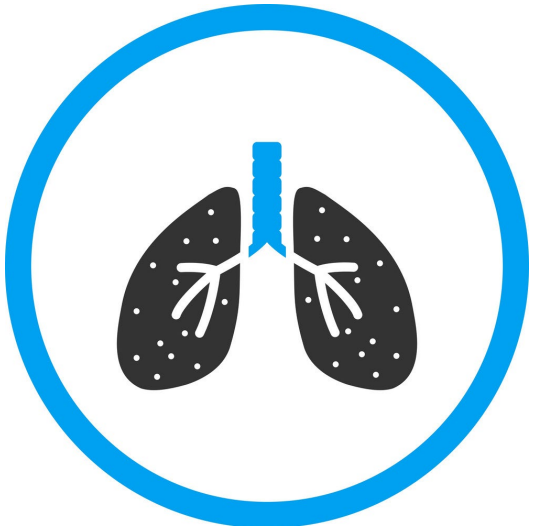
FOG AND HEALTH EFFECTS

Glycols, Mineral Oil

Slight Respiratory System Irritation



Glycerin

No Available Research

?

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CURRENT REGULATIONS

Glycols

ANSI
American National Standards Institute

TWA-EL

10 mg/m^3

Ceiling

40 mg/m^3

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Glycerin

TWA-OEL

3 mg/m^3

(Resp)

Excursion Limit

15 mg/m^3

(Resp)

Mineral oil

(severely-refined)

WORK SAFE BC

TWA-OEL

1 mg/m^3

Excursion Limit

5 mg/m^3

HOW TO MEASURE FOG

Active Sampling

Glycols

NIOSH 5523

Glycerin

NIOSH 0500

Mineral Oil

NIOSH 5026

Direct Reading

DustTrak

pDR 1000AN
Personal DataRAM

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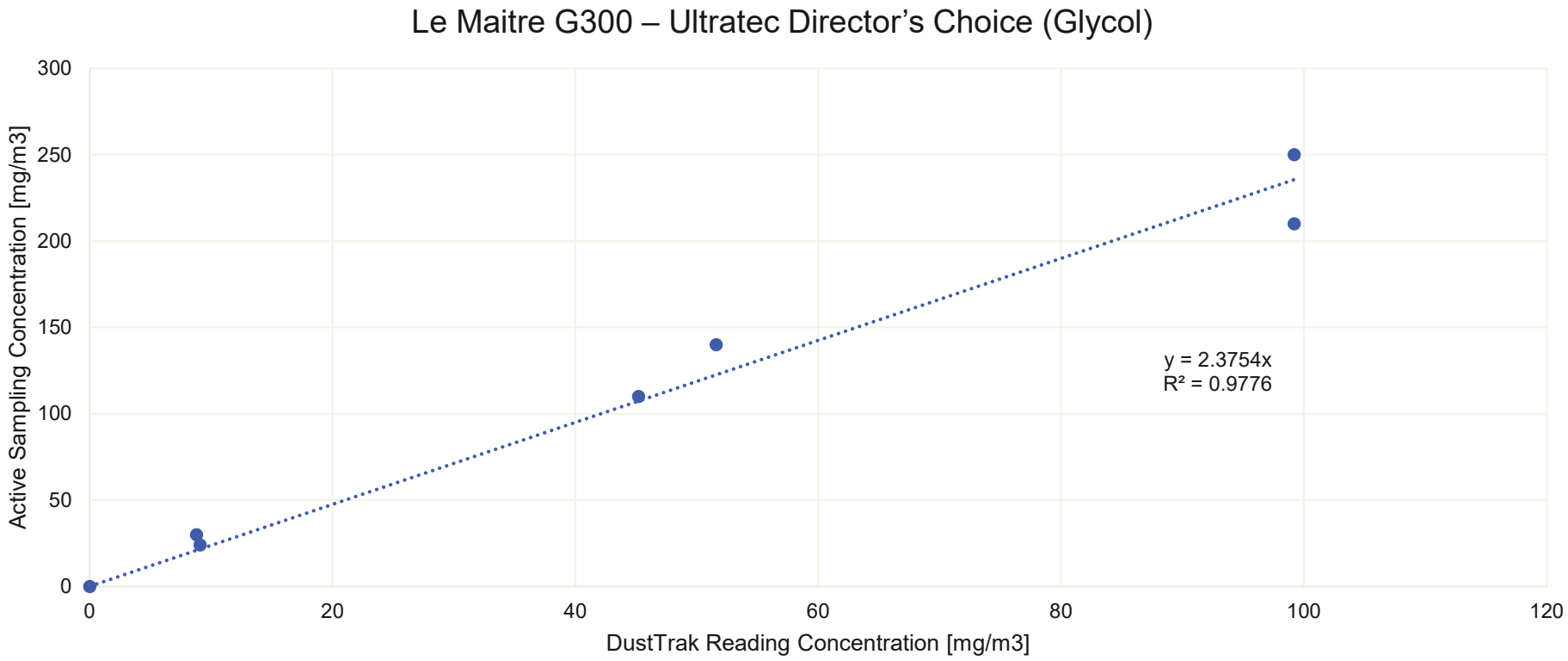
CALIBRATION FACTOR CURVE



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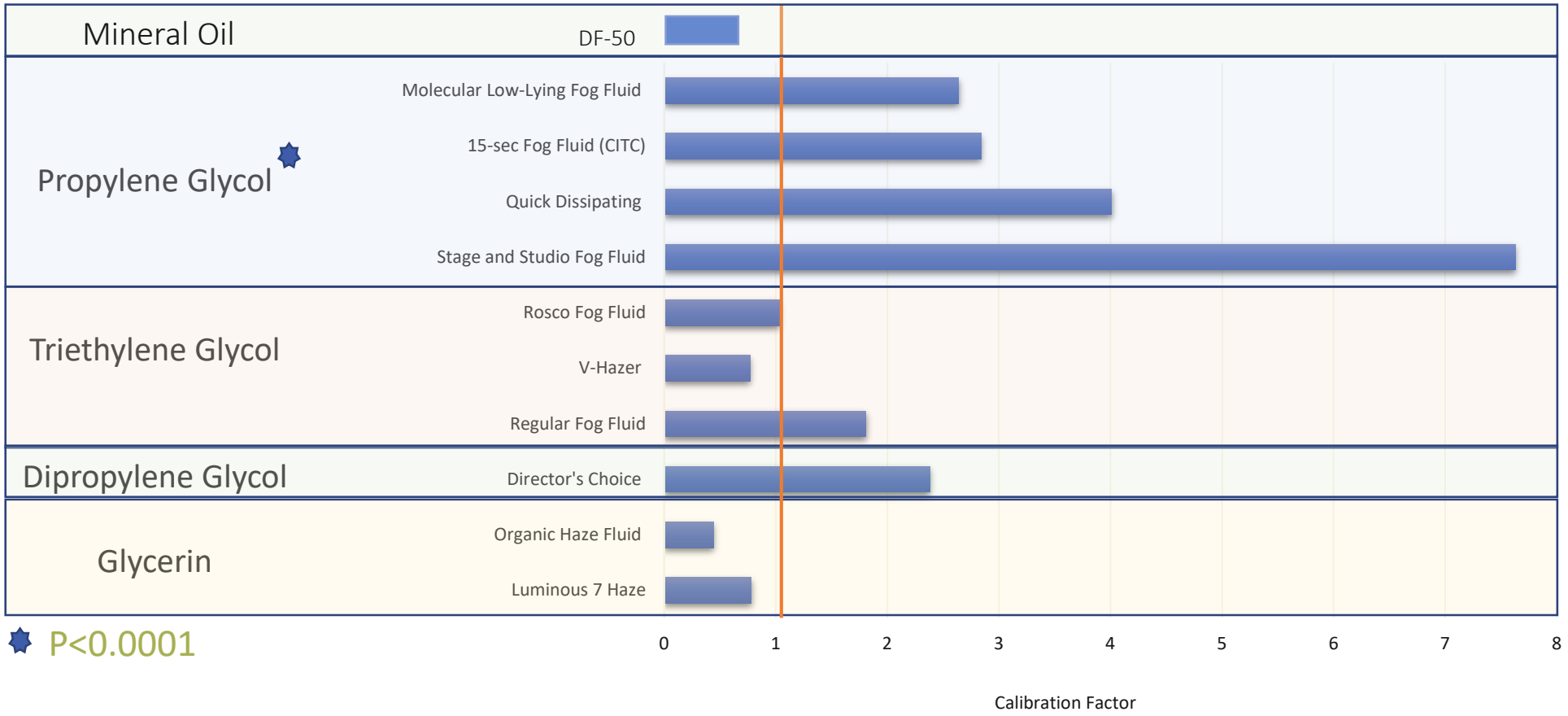
CALIBRATION FACTORS



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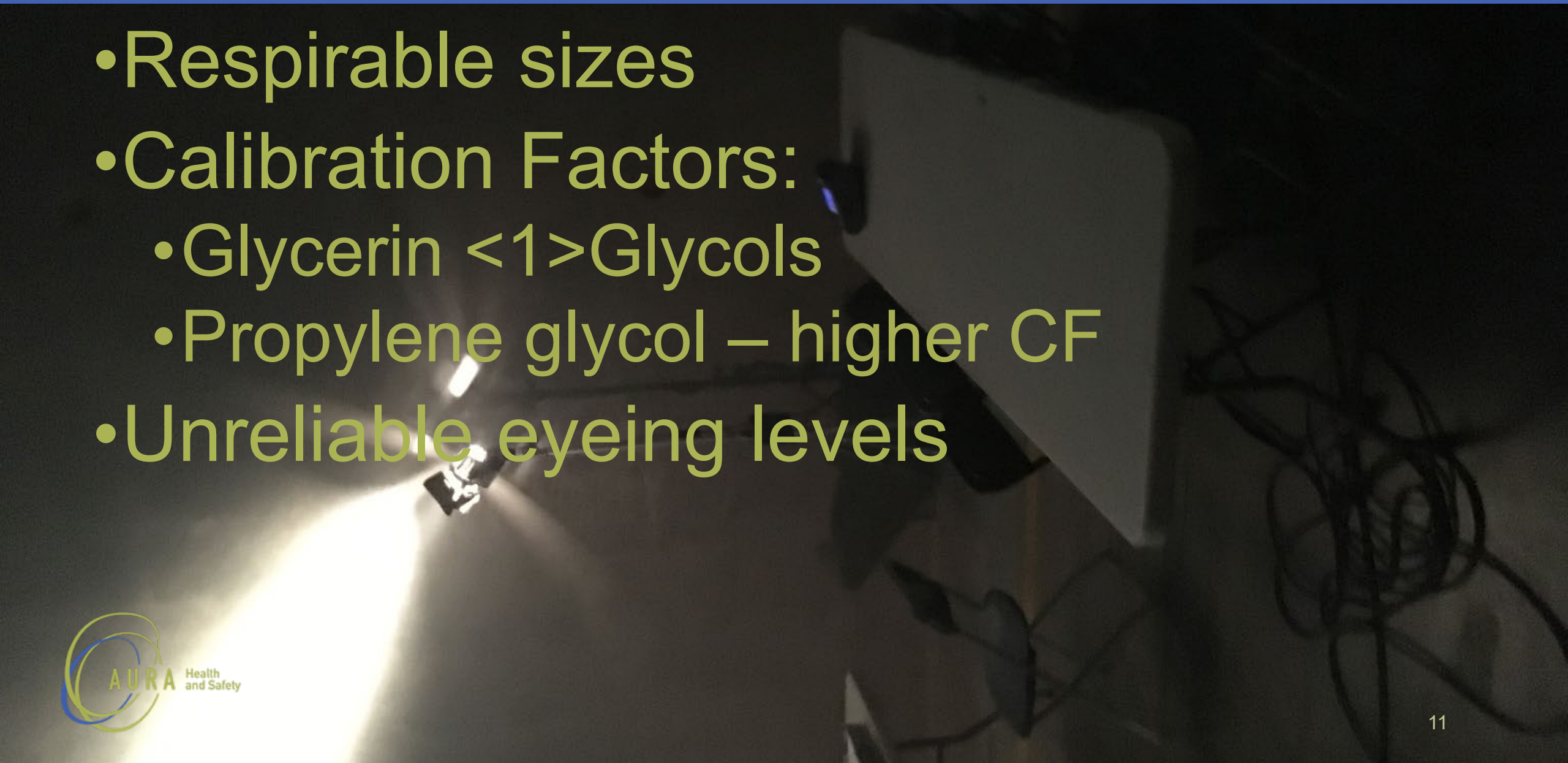

- Respirable sizes
- Calibration Factors:
  - Glycerin <1>Glycols
  - Propylene glycol – higher CF
- Unreliable eyeing levels

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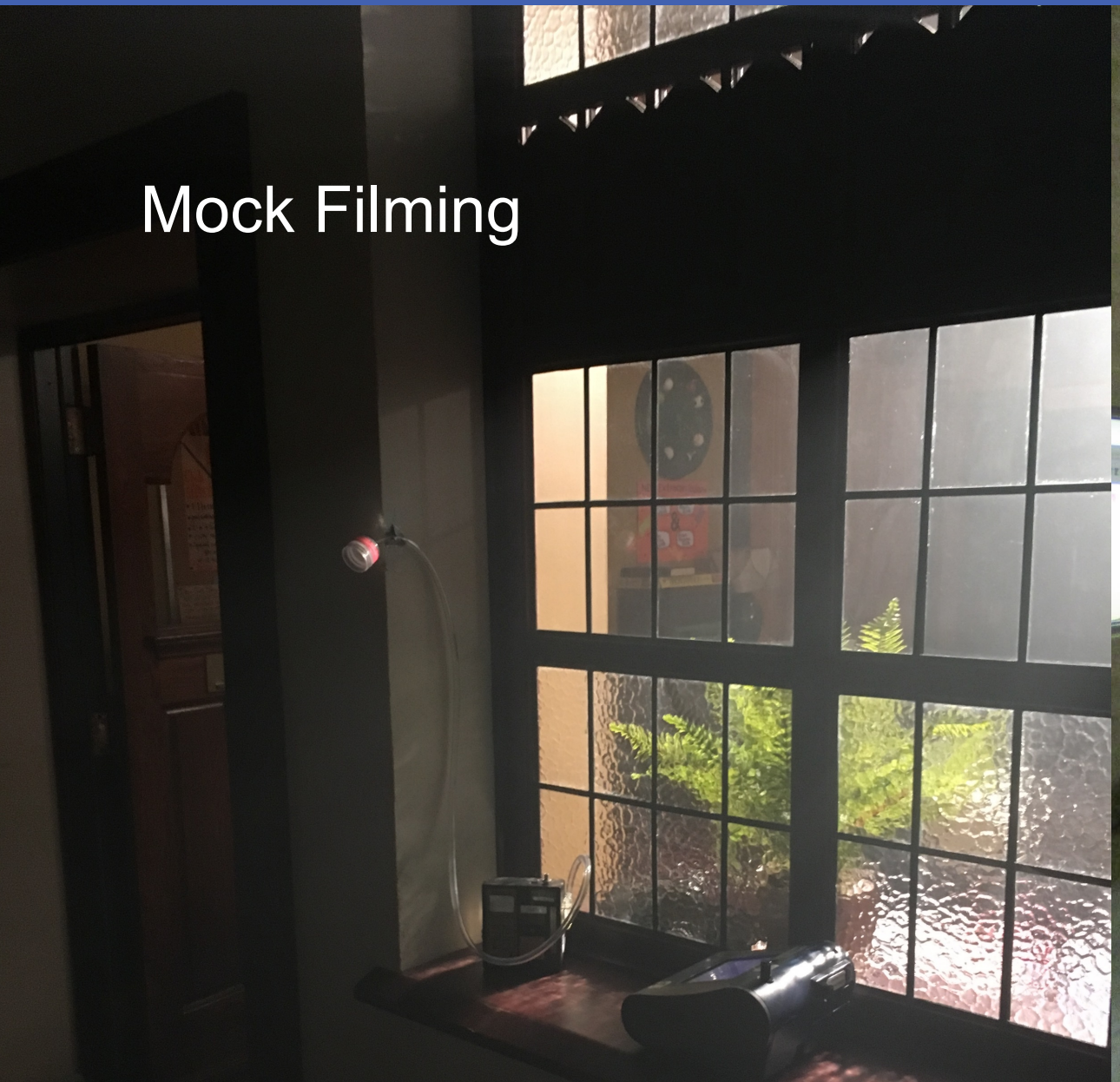
EXPOSURE ASSESSMENTS

PRE-FILMING



Mock Filming

Simulated Fog Levels

FILMING

Most common method

RESULTS

HIGH	MODERATE	LOW
Camera	Lighting	Props
Grips	Stand-Ins	Make-Up
Sound	Cast	Hair
Set Decoration	SPFX	Locations
	Direction / Production	

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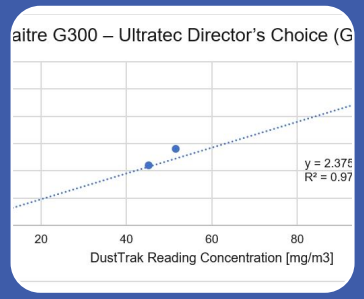
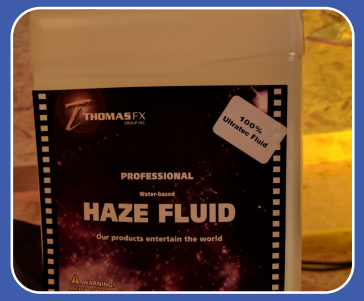
Similar Exposure Groups

RECOMMENDATIONS



Calibration Factors

- Utilize available ones
- Develop new ones when needed



Consider Ingredients

- If glycol or glycerin
- Is there a fog with lower CF?

Use Available Threshold Limits

- Glycol: 10 mg/m^3 (8-hr), 40 mg/m^3 (C)
- Glycerin (resp): 3 mg/m^3 (8-hr), 15 mg/m^3 (C)

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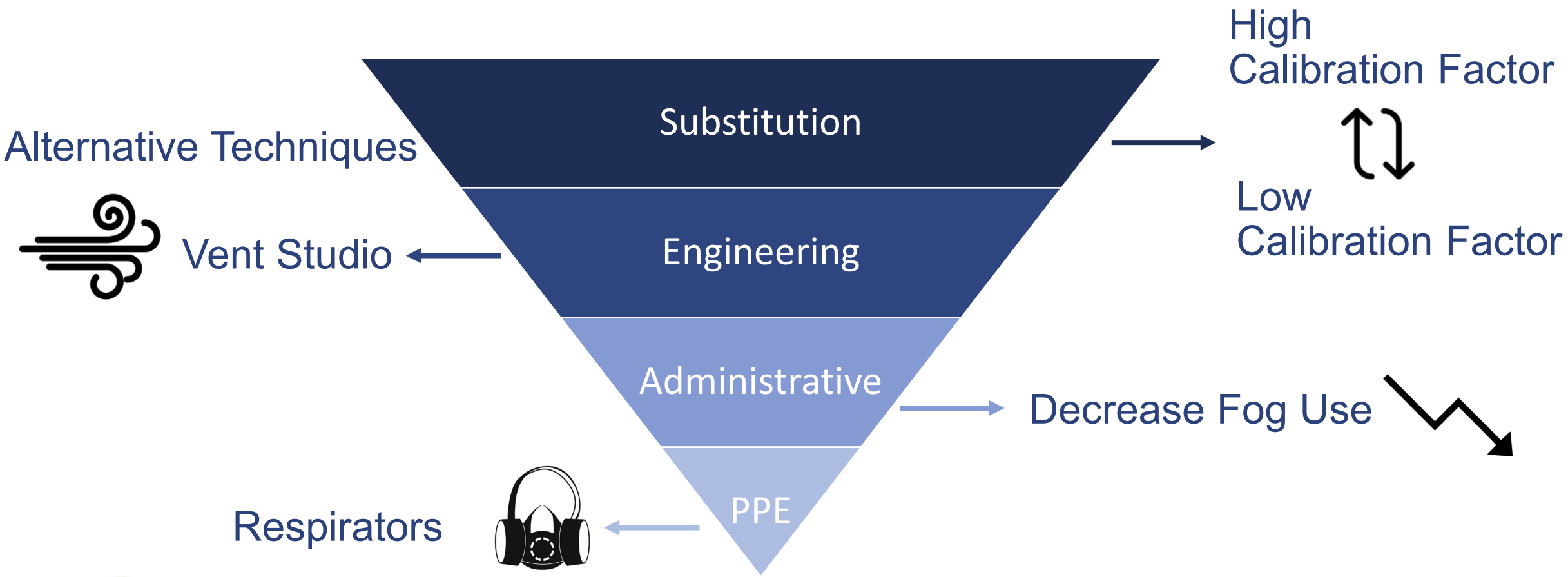
RECOMMENDATIONS - Controls



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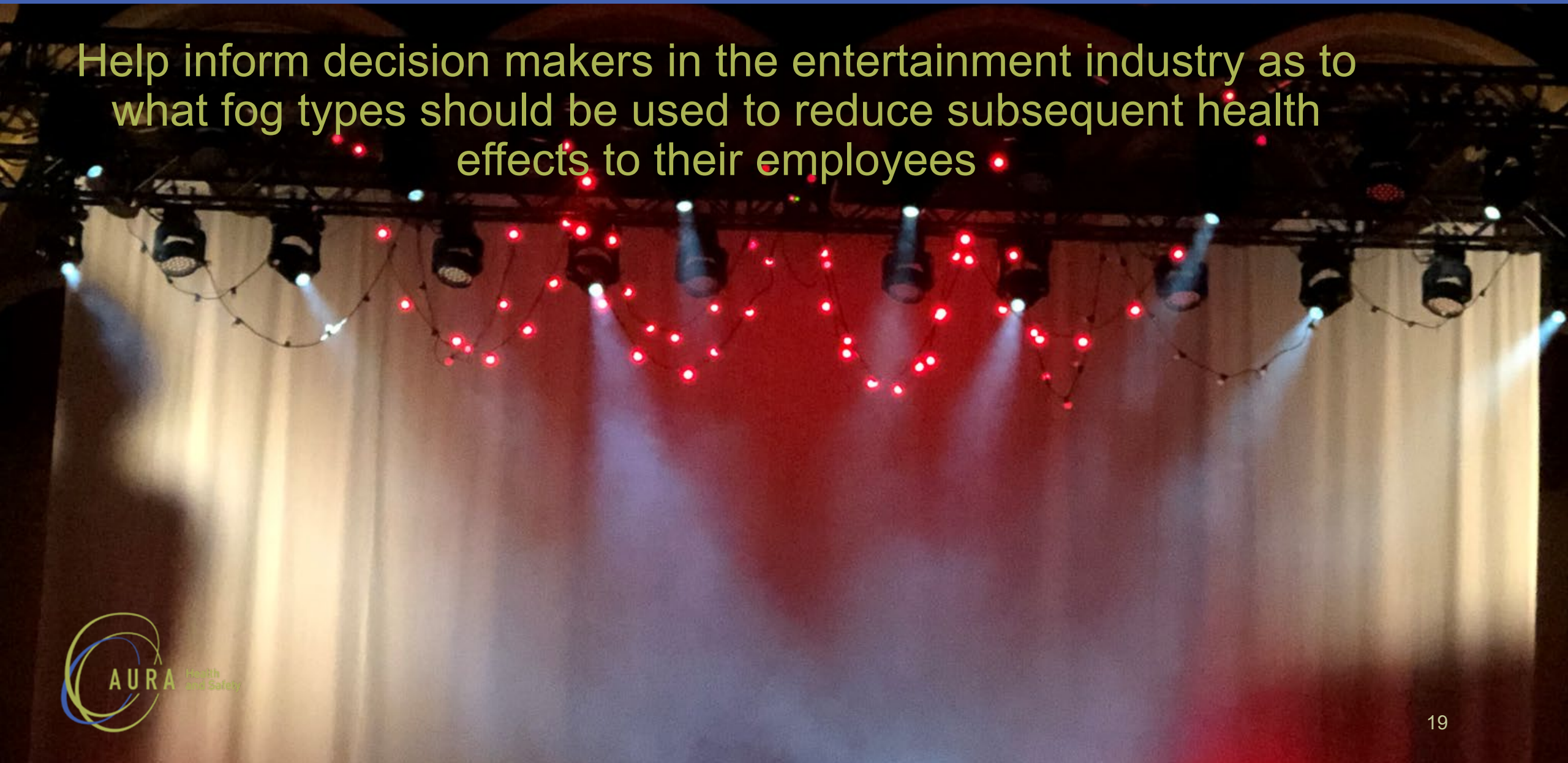
Innovation at Work

OBJECTIVE



Help inform decision makers in the entertainment industry as to what fog types should be used to reduce subsequent health effects to their employees

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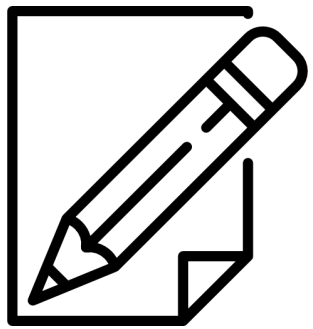
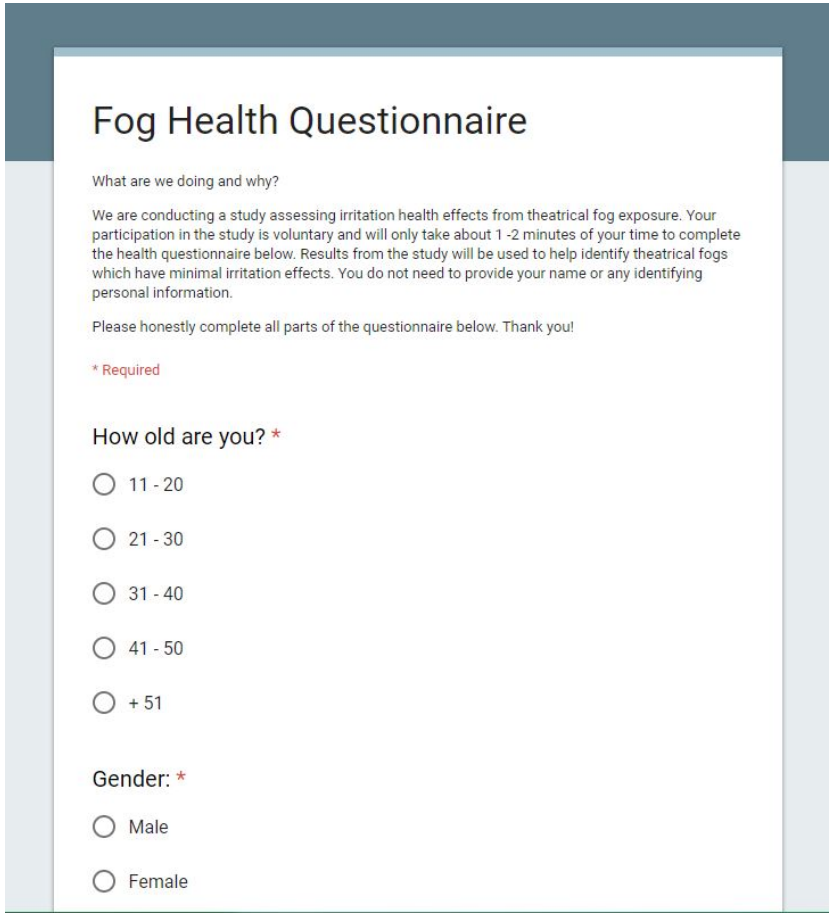
METHODS

- Measure fog concentrations (glycerin or glycol)
- Questionnaire (paper and online)





Fog Health Questionnaire

What are we doing and why?

We are conducting a study assessing irritation health effects from theatrical fog exposure. Your participation in the study is voluntary and will only take about 1 -2 minutes of your time to complete the health questionnaire below. Results from the study will be used to help identify theatrical fogs which have minimal irritation effects. You do not need to provide your name or any identifying personal information.

Please honestly complete all parts of the questionnaire below. Thank you!

* Required

How old are you? *

- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- + 51

Gender: *

- Male
- Female

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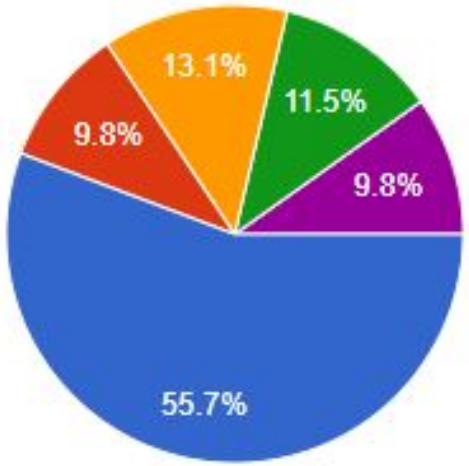
PRELIMINARY RESULTS

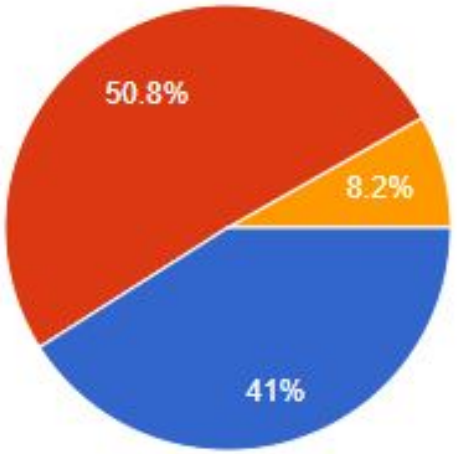
How long have you worked in the entertainment industry?

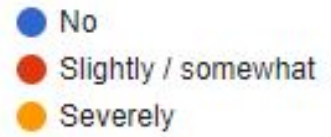
61 responses



Does your nose feel irritated, itchy, stringing, or dry?

61 responses





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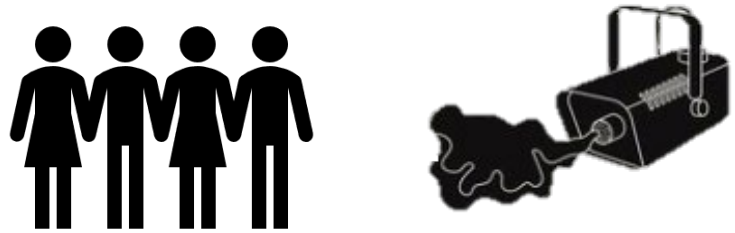
PRELIMINARY RESULTS

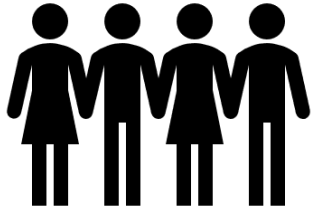
- Fog-exposed group reported a higher incidence of symptoms, for all symptoms, than the non-exposed group

- Fog-exposed group was more likely to report severe symptoms compared to the non-exposed groups



Fog-Exposed Group

vs.



Non-Exposed Group

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CORPORATE COMPLIANCE

Sony Pictures Entertainment

- 1/5 Major Studios
- “International Arms Dealer of Content”
- 12 Feature Films Annually
- 50 SPTV Productions in prep-production-wrap
  - 5 Countries
  - 5 US States
  - 2 Canadian Provinces

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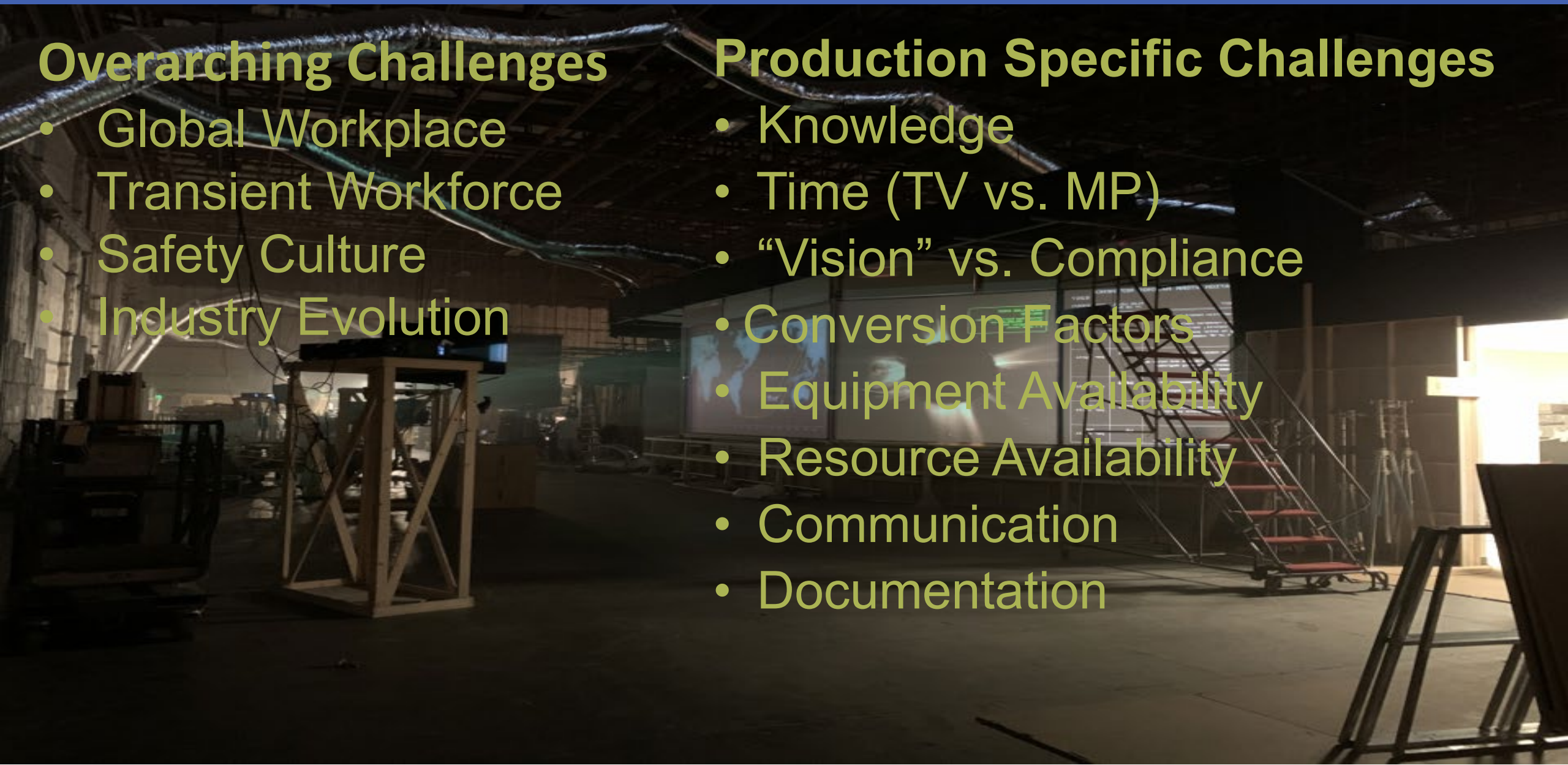
CORPORATE COMPLIANCE-CHALLENGES



Overarching Challenges

- Global Workplace
- Transient Workforce
- Safety Culture
- Industry Evolution

Production Specific Challenges

- Knowledge
- Time (TV vs. MP)
- “Vision” vs. Compliance
- Conversion Factors
- Equipment Availability
- Resource Availability
- Communication
- Documentation

COMPLIANCE-SAFETY BULLETINS/AMPTP

INDUSTRY WIDE LABOR-MANAGEMENT SAFETY COMMITTEE

SAFETY BULLETIN #10

GUIDELINES REGARDING THE USE OF ARTIFICIALLY CREATED ATMOSPHERIC FOG & HAZE

Artificial fog and haze are commonly generated using a machine or generator, which releases a chemical solution as an airborne aerosol to create various atmospheric effects during filming/performing. This bulletin does not address combustion-based smoke effects, such as free burning wood products, diesel fuels, etc.

There are no known long-term effects from exposure to artificial fog or haze. However, it is important to realize that every individual is different and temporary reactions to artificial fog or haze may range from having no effects to:

- Irritation to the eyes
- Dry throat
- Minor respiratory irritation

Control Measures

The Production should implement one or more of the following:

- Limit cast and crew exposure, in both amount and duration, to artificial fog or haze.
  - Keep the area clear of non-essential personnel.
  - Use additional control measures at worksites where workers are exposed to extended durations of artificial fog or haze.
- Ventilate or exhaust interior sets or stages at appropriate intervals.
- Provide breaks to all personnel and animals at appropriate intervals.
- Protection from the cold and asphyxiation risks in low-lying areas when cryogenic liquids or gases are used.
- The Production may monitor airborne levels to ensure they do not exceed Permissible Exposure Limits (PELs).
- Utilize qualified technicians to generate artificial fog or haze.
- Technicians will follow the manufacturer's guidelines in the use and cleaning of equipment and use only fluids and gasses specified by the manufacturer.

Communications

When fog or haze effects are scheduled to be used, the Production should notify all personnel in advance. Regular communications with cast and crew, including background, should also occur to discuss operations and precautions associated with the use of artificial fog or haze.

The following methods may be used to notify the cast and crew when artificial fog or haze will be used:

- Notification on the Call Sheet
- Safety Data Sheets (SDSs)
  - Should be available at the worksite
  - A supervisor or another member of department leadership will help to locate a copy of the SDS.
- Safety Meetings

A safety meeting should be held by the First Assistant Director, and may include the Special Effects Coordinator or qualified technicians, and should address, but not be limited to, the following topics:

- When and where atmospheric effects will be used.
- Ways to limit one's exposure to artificial fog or haze, and options to obtain adequate fresh air.
- Availability and use of respiratory protection if airborne levels are expected to exceed PELs.
- How to seek medical care
- Where to find the SDS

Individuals with Sensitivities

The elderly, children, and people with respiratory conditions or other ailments may have a higher sensitivity to artificial fog or haze. These persons should inform the Production of their sensitivity.

When there is an infant present at a Production using artificial fog or haze, steps should be taken to prevent the infant from being exposed. Please consult Safety Bulletin #33, "Special Safety Considerations When Employing Infant Actors (Fifteen Days to Six Months Old)".

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For further information on how to protect workers from overexposure to airborne chemicals generated when using artificial fog or haze, please refer to "**Addendum A**" the "**Atmospheric Fog & Haze – Technical Awareness Sheet**".

INDUSTRY WIDE LABOR-MANAGEMENT SAFETY COMMITTEE

SAFETY BULLETIN #10

GUIDELINES REGARDING THE USE OF ARTIFICIALLY CREATED ATMOSPHERIC FOG & HAZE

"ADDENDUM A"

ATMOSPHERIC FOG & HAZE – TECHNICAL AWARENESS SHEET

INTRODUCTION

This document is intended to give recommendations to protect workers from overexposure to artificial fog and haze (e.g. theatrical haze, fogs, mists, etc.). Artificial fog and haze are commonly generated using a machine or generator, which releases a chemical solution as an airborne aerosol to create various atmospheric effects during filming/performing.

DEFINITIONS

- Permissible Exposure Limit (PEL) – The maximum amount or concentration of a chemical that a worker may be exposed to under OSHA regulations.
- Time-Weighted Average (TWA) – The average exposure to a contaminant over a given period of time, typically 8-hours.
- Short Term Exposure Limit (STEL) – The maximum exposure level averaged over a short-term, generally 15 minutes.
- Peak – The maximum amount of safe exposure to a substance.

CHEMICAL PRODUCT GUIDELINES AND REGULATIONS

Various chemical solutions and mixtures are used to generate artificial fog and haze. Some artificial fog or haze components have PELs regulated by Fed/OSHA and/or Cal/OSHA, while others are regulated as simple asphyxiants.

Products containing the following chemicals/substances should **not** be used for atmospheric effects due to their possible health effects:

- Known human carcinogens, including tobacco smoke (except when required to film a scene where such smoke results from an actor smoking tobacco);
- Fumed and hydrolyzed chlorides;
- Ethylene glycol and diethylene glycol;
- Aliphatic and aromatic hydrocarbons including petroleum distillates;
- Hexachloroethane and cyclohexylamine; and
- Butylene glycol 1,4.

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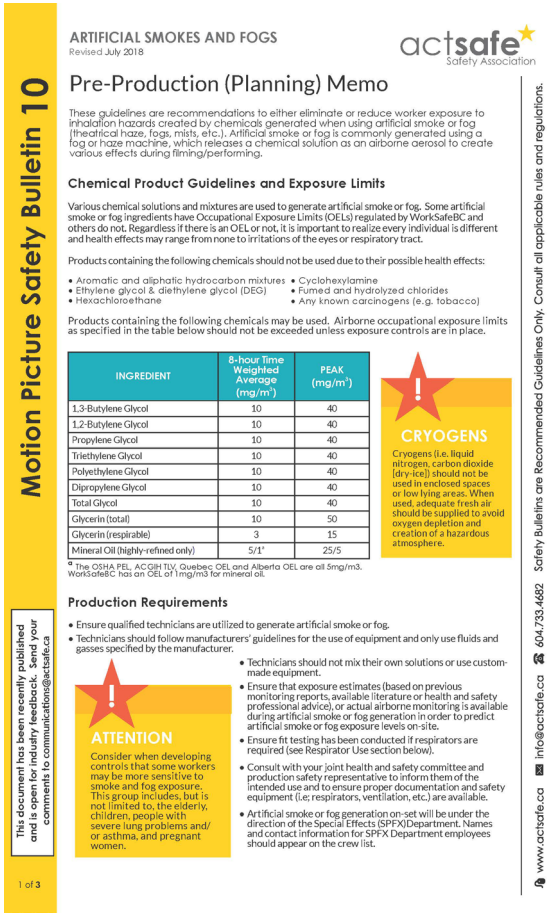
COMPLIANCE- SAFETY BULLETINS/BC



Motion Picture Safety Bulletin 10

ARTICLE SMOKES AND FOGS
Revised July 2018

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Pre-Production (Planning) Memo

These guidelines are recommendations to either eliminate or reduce worker exposure to inhalation hazards created by chemicals generated when using artificial smoke or fog (theatrical haze, fogs, mists, etc.). Artificial smoke or fog is commonly generated using a fog or haze machine, which releases a chemical solution as an airborne aerosol to create various effects during filming/performing.

Chemical Product Guidelines and Exposure Limits

Various chemical solutions and mixtures are used to generate artificial smoke or fog. Some artificial smoke or fog ingredients have Occupational Exposure Limits (OELs) regulated by WorkSafeBC and others do not. Regardless if there is an OEL or not, it is important to realize every individual is different and health effects may range from none to irritations of the eyes or respiratory tract.

Products containing the following chemicals should not be used due to their possible health effects:

- Aromatic and aliphatic hydrocarbon mixtures
- Ethylene glycol & diethylene glycol (DEG)
- Hexachloroethane
- Cyclohexylamine
- Fumed and hydrolyzed chlorides
- Any known carcinogens (e.g. tobacco)

Products containing the following chemicals may be used. Airborne occupational exposure limits as specified in the table below should not be exceeded unless exposure controls are in place.

INGREDIENT	8-hour Time Weighted Average (mg/m³)	PEAK (mg/m³)
1,3-Butylene Glycol	10	40
1,2-Butylene Glycol	10	40
Propylene Glycol	10	40
Triethylene Glycol	10	40
Polyethylene Glycol	10	40
Dipropylene Glycol	10	40
Total Glycol	10	40
Glycerin (total)	10	50
Glycerin (respirable)	3	15
Mineral Oil (highly-refined only)	5/1*	25/5

* The OSHA PEL, ACGIH TLV, Quebec OEL and Alberta OEL are all 5mg/m3. WorkSafeBC has an OEL of 1mg/m3 for mineral oil.

CRYOGENS

Cryogens (i.e. liquid nitrogen, carbon dioxide [dry-ice]) should not be used in enclosed spaces or low lying areas. When used, adequate fresh air should be supplied to avoid oxygen depletion and creation of a hazardous atmosphere.

Production Requirements

- Ensure qualified technicians are utilized to generate artificial smoke or fog.
- Technicians should follow manufacturers' guidelines for the use of equipment and only use fluids and gasses specified by the manufacturer.
- Technicians should not mix their own solutions or use custom-made equipment.
- Ensure that exposure estimates (based on previous monitoring reports, available literature or health and safety professional advice), or actual airborne monitoring is available during artificial smoke or fog generation in order to predict artificial smoke or fog exposure levels on-site.
- Ensure fit testing has been conducted if respirators are required (see Respirator Use section below).
- Consult with your joint health and safety committee and production safety representative to inform them of the intended use and to ensure proper documentation and safety equipment (i.e; respirators, ventilation, etc.) are available.
- Artificial smoke or fog generation on-set will be under the direction of the Special Effects (SPFX)Department. Names and contact information for SPFX Department employees should appear on the crew list.

ATTENTION

Consider when developing controls that some workers may be more sensitive to smoke and fog exposure. This group includes, but is not limited to, the elderly, children, people with severe lung problems and/or asthma, and pregnant women.

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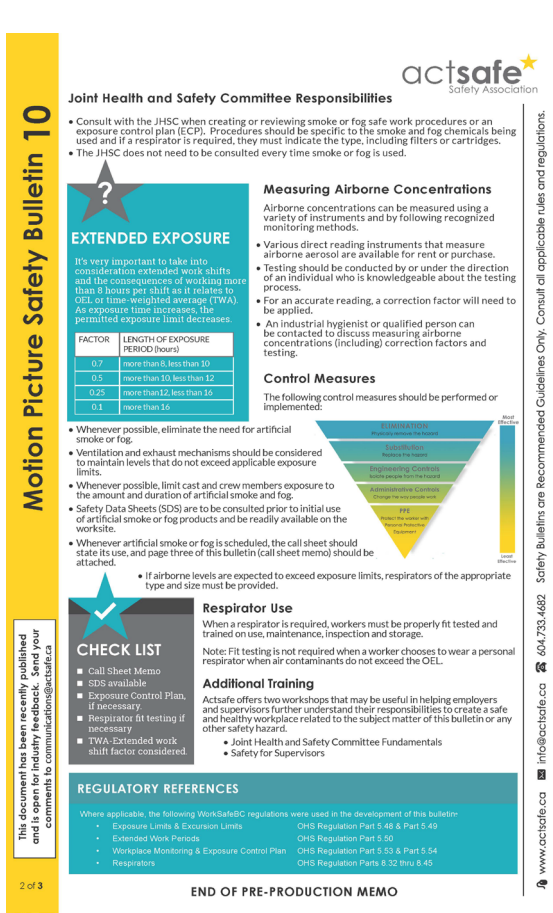

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Joint Health and Safety Committee Responsibilities

- Consult with the JHSC when creating or reviewing smoke or fog safe work procedures or an exposure control plan (ECP). Procedures should be specific to the smoke and fog chemicals being used and if a respirator is required, they must indicate the type, including filters or cartridges.
- The JHSC does not need to be consulted every time smoke or fog is used.

EXTENDED EXPOSURE

It's very important to take into consideration extended work shifts and the consequences of working more than 8 hours per shift as it relates to OEL or time-weighted average (TWA). As exposure time increases, the permitted exposure limit decreases.

FACTOR	LENGTH OF EXPOSURE PERIOD (hours)
0.7	more than 8, less than 10
0.5	more than 10, less than 12
0.25	more than 12, less than 16
0.1	more than 16

Measuring Airborne Concentrations

Airborne concentrations can be measured using a variety of instruments and by following recognized monitoring methods.

- Various direct reading instruments that measure airborne aerosol are available for rent or purchase.
- Testing should be conducted by or under the direction of an individual who is knowledgeable about the testing process.
- For an accurate reading, a correction factor will need to be applied.
- An industrial hygienist or qualified person can be contacted to discuss measuring airborne concentrations (including) correction factors and testing.

Control Measures

The following control measures should be performed or implemented:

- Whenever possible, eliminate the need for artificial smoke or fog.
- Ventilation and exhaust mechanisms should be considered to maintain levels that do not exceed applicable exposure limits.
- Whenever possible, limit cast and crew members exposure to the amount and duration of artificial smoke and fog.
- Safety Data Sheets (SDS) are to be consulted prior to initial use of artificial smoke or fog products and be readily available on the worksite.
- Whenever artificial smoke or fog is scheduled, the call sheet should state its use, and page three of this bulletin (call sheet memo) should be attached.
- If airborne levels are expected to exceed exposure limits, respirators of the appropriate type and size must be provided.

CHECK LIST

- Call Sheet Memo
- SDS available
- Exposure Control Plan, if necessary
- Respirator fit testing if necessary
- TWA-Extended work shift factor considered.

Respirator Use

When a respirator is required, workers must be properly fit tested and trained on use, maintenance, inspection and storage.

Note: Fit testing is not required when a worker chooses to wear a personal respirator when air contaminants do not exceed the OEL.

Additional Training

Actsafe offers two workshops that may be useful in helping employers and supervisors further understand their responsibilities to create a safe and healthy workplace related to the subject matter of this bulletin or any other safety hazard.

- Joint Health and Safety Committee Fundamentals
- Safety for Supervisors

REGULATORY REFERENCES

Where applicable, the following WorkSafeBC regulations were used in the development of this bulletin:

Exposure Limits & Excursion Limits	OHS Regulation Part 5.48 & Part 5.49
Extended Work Periods	OHS Regulation Part 5.50
Workplace Monitoring & Exposure Control Plan	OHS Regulation Part 5.53 & Part 5.54
Respirators	OHS Regulation Parts 8.32 thru 8.45

END OF PRE-PRODUCTION MEMO

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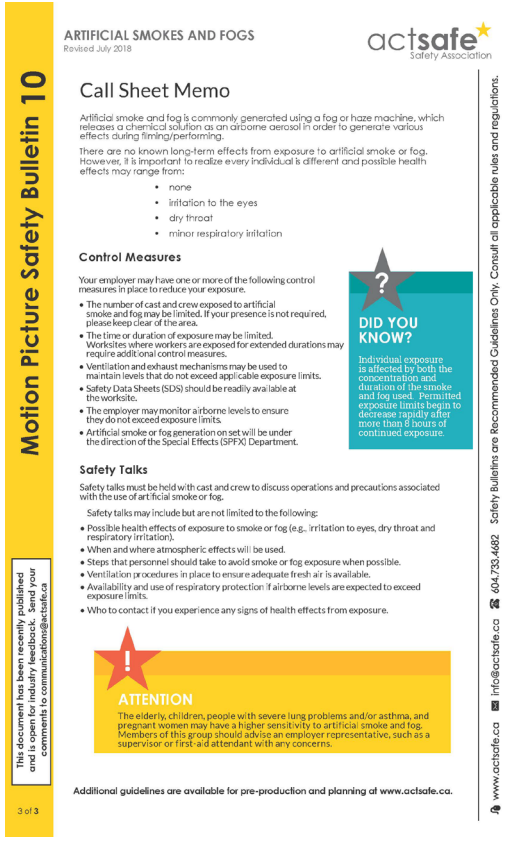

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ARTICLE SMOKES AND FOGS
Revised July 2018

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Call Sheet Memo

Artificial smoke and fog is commonly generated using a fog or haze machine, which releases a chemical solution as an airborne aerosol in order to generate various effects during filming/performing.

There are no known long-term effects from exposure to artificial smoke or fog. However, it is important to realize every individual is different and possible health effects may range from:

- none
- irritation to the eyes
- dry throat
- minor respiratory irritation

Control Measures

Your employer may have one or more of the following control measures in place to reduce your exposure.

- The number of cast and crew exposed to artificial smoke and fog may be limited. If your presence is not required, please keep clear of the area.
- The time or duration of exposure may be limited. Worksites where workers are exposed for extended durations may require additional control measures.
- Ventilation and exhaust mechanisms may be used to maintain levels that do not exceed applicable exposure limits.
- Safety Data Sheets (SDS) should be readily available at the worksite.
- The employer may monitor airborne levels to ensure they do not exceed exposure limits.
- Artificial smoke or fog generation on set will be under the direction of the Special Effects (SPFX) Department.

DID YOU KNOW?

Individual exposure is affected by both the concentration and duration of the smoke and fog used. Permitted exposure limits begin to decrease rapidly after more than 8 hours of continued exposure.

Safety Talks

Safety talks must be held with cast and crew to discuss operations and precautions associated with the use of artificial smoke or fog.

Safety talks may include but are not limited to the following:

- Possible health effects of exposure to smoke or fog (e.g., irritation to eyes, dry throat and respiratory irritation).
- When and where atmospheric effects will be used.
- Steps that personnel should take to avoid smoke or fog exposure when possible.
- Ventilation procedures in place to ensure adequate fresh air is available.
- Availability and use of respiratory protection if airborne levels are expected to exceed exposure limits.
- Who to contact if you experience any signs of health effects from exposure.

ATTENTION

The elderly, children, people with severe lung problems and/or asthma, and pregnant women may have a higher sensitivity to artificial smoke and fog. Members of this group should advise an employer representative, such as a supervisor or first-aid attendant with any concerns.

Additional guidelines are available for pre-production and planning at www.actsafe.ca.

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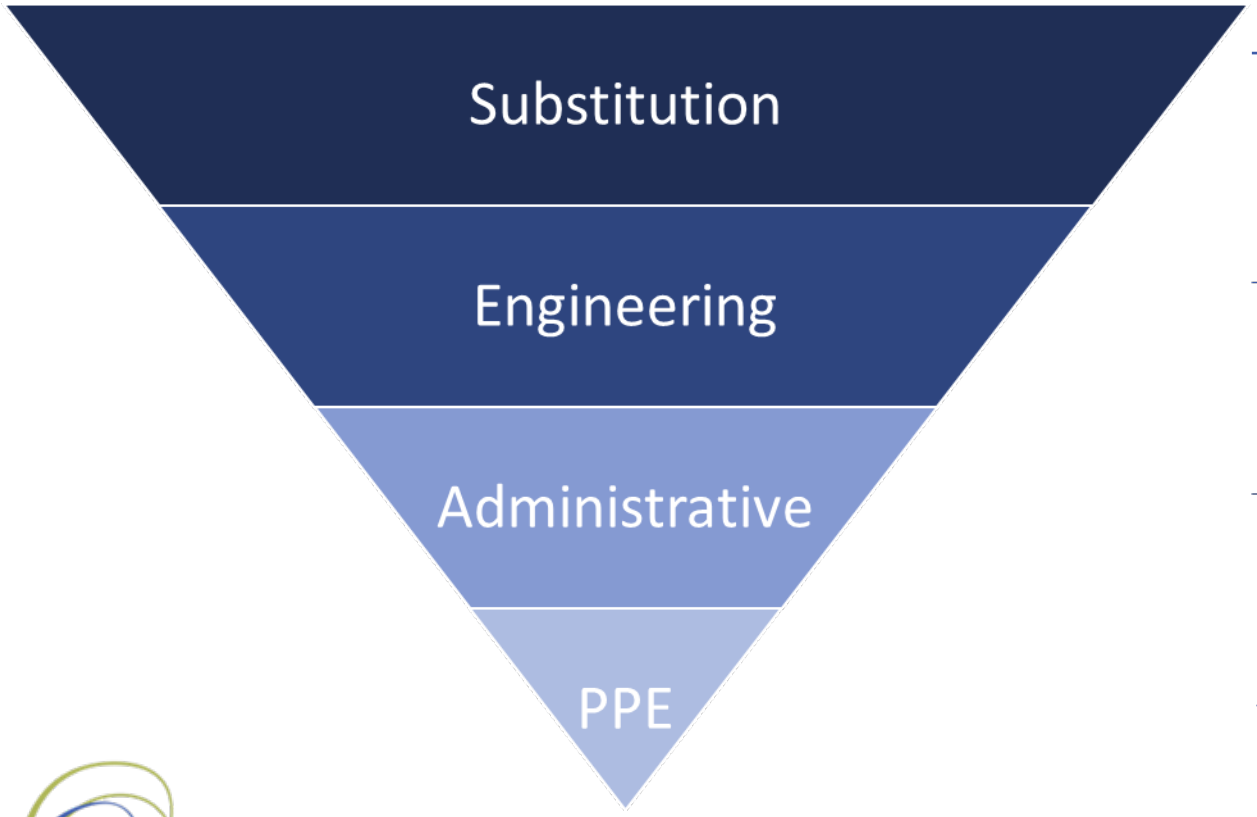
CORPORATE COMPLIANCE-ACHEIVEMENT

Hierarchy of Control



Determine need, offer options, work with production, unions to find common ground, effective action plan

Minimize use, establish pre-determined levels, Local exhaust, higher PEL materials Glycerin v Glycol

Access control, shift rotation, frequent breaks as needed

Respiratory protection=last resort
Not practical or feasible in most settings

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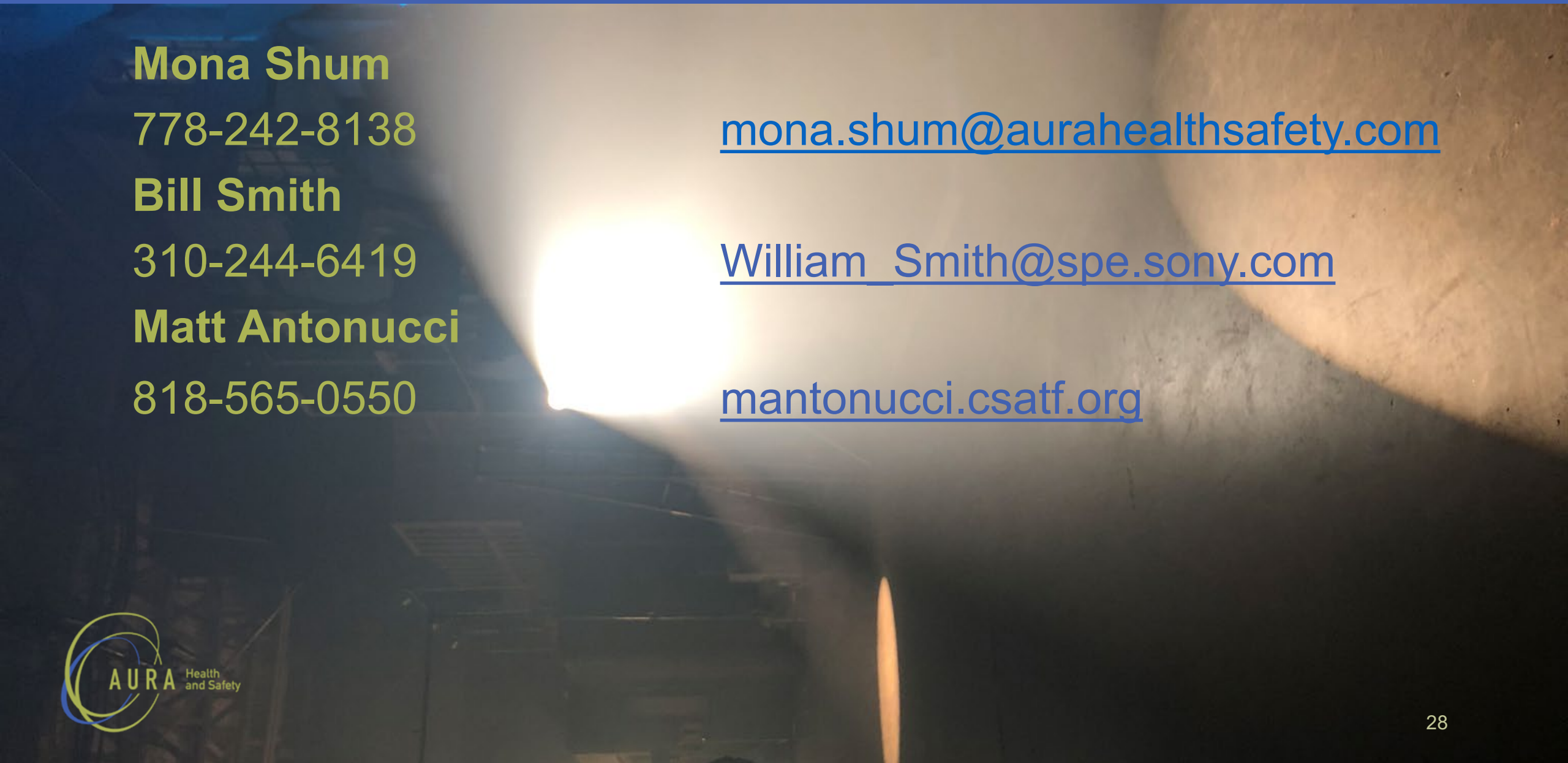
Questions?



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