Assessment and Remediation of Fungi in Indoor Environments SOG

1. Purpose / Background

   This document establishes the procedures at MIT for preventing mold problems and for managing problems when they do occur. Because of the potential health impact, principally allergic effects, MIT works to prevent mold growth and to remediate mold problems.

   There is considerable information that indicates that mold growth in indoor environments can have adverse health consequences for susceptible individuals under some circumstances. Mold may also cause serious health problems in immune-compromised individuals or in healthy people where a serious mold contamination problem exists. Although the effects of high indoor mold counts have not been fully studied, long-term exposure to high indoor mold counts may result in chronic health problems for a susceptible population, and some studies have linked exposure to toxins produced by molds to adverse health effects in both humans and animals. In addition, mold can damage property and interfere with some research in some cases. Therefore, prevention and remediation of mold problems constitute good environment, health, and safety practice.

   At this time, there are no federal, state, or local regulatory standards or benchmarks for evaluating the potential health effects of fungal contamination or exposures, and there are no established exposure limits for fungal contamination. However, EPA and NIOSH have provided guidance for management of air quality in buildings that includes identification and remediation of mold problems. These existing guidance documents do provide recommendations for the identification and elimination of mold and/or moisture problems. It should be clear that all fungi or mold require moisture for growth, control of indoor air fungal levels is best managed by prevention of and immediate remediation of water leaks and water damage. Thus the central tenant of management of indoor air fungal/mold levels is a facility management program for the control or prevention of leaks and immediate clean up and drying out of all materials in case of leaks.

2. Scope

   These guidelines apply to any MIT building where mold is found or suspected. They outline the responsibilities for assistance and communication by DLCs. They apply to Environment, Health, and Safety (EHS) staff and their assessment responsibilities, and to the Department of Facilities or DSL Housing Office or Lincoln Laboratory and their responsibility for remediation and/or prevention, either in house or by contract.

   These guidelines cover (1) the process for personnel to report mold or to request assistance in identifying mold problems; (2) the services provided by the EHS Office in response to a request for indoor assessment; (3) the steps that should be taken with regard to remediation; (4) the steps that should be taken to establish a system for communication of activities to affected staff or students; and (5) guidance for preventative maintenance such as routine building inspection to identify water problems or spot mold growth. The primary aim is to protect the health of MIT employees, students, and visitors. A
secondary benefit is to protect research and property that may be adversely affected by mold.

3. Prerequisites

N/A

4. Procedures

4.1. Initial Reporting

Suspected problems of mold growth and other IAQ concerns may be reported by occupants (including AOs, building managers or other personnel), by the EHS coordinator for the DLC, or by Facilities personnel.

4.1.1. All water leaks or damage, regardless of the presence or absence of mold, should be reported to the Facilities Department for prompt attention. The normal procedures for requesting critical maintenance or clean up after a water leak should be followed.

4.1.2. Visible mold growth should be reported to the EHS Coordinator who can then contact EHS by calling 2-EHSS (2-3477). EHS can also be contacted directly by the concerned party, but going through the coordinator will assure DLC management awareness, which will be necessary for problem resolution. If the DLC does not have a Coordinator then contact your Administrative Officer or EHS directly.

4.1.3. Air quality concerns that may or may not be related to mold growth should be reported to the EHS Coordinator who can then contact EHS at 2-EHSS. As noted above, EHS can also be contacted directly by the concerned party.

4.2. Initial Screening

When the EHS Office receives a call or complaint, EHS Office staff will conduct a survey or initial screening. The objective is to make a determination of the potential causes of the complaint, including the possible presence of mold. The survey may include gathering information on occupant symptoms; a visual inspection that will include the air handling system for the building if the problem is not readily apparent in the complaint location; a history of water damage in the area; and any distinctive or unusual odors. In addition, EHS staff should contact Facilities to see if there was a recent leak or flood and whether Facilities had conducted a “moisture map” of the area prior to drying the area and any remediation steps.

“Moisture maps” are constructed using moisture meters as a means of determining the size and scope of water damage in an area, in furniture, wall board, and rugs, etc. It helps determine what got wet, how wet it remains, when and if materials are dry, how much if any wall board or ceiling tiles must be removed, etc. This helps Facilities personnel determine the scope of the remediation effort and the required removal and renovation work.

If mold is suspected based on the information, a more thorough assessment is done by the Biosafety Program (BSP) in the EHS Office. However, it should be made clear that initial assessments of indoor air issues should be done by EHS Industrial Hygiene Program (IHP). If IHP assessment indicates a potential mold or fungal contamination problem then BSP may conduct tests to measure indoor mold levels.

It should be noted that indoor air quality problems can be transitory, e.g., off-gassing from carpet, high
levels of carbon dioxide, etc. A detailed study will be undertaken if mold is suspected on the basis of the initial screening; the next step is assessment and characterization of the problem. This may include air monitoring and bulk and/or surface sampling. In addition, as far as it is possible, the source of the water or moisture problem should be determined during the assessment. Assistance from the Facilities Department may be required for determining the source of the water problem. If mold is detected, a determination will be made, as best as possible, regarding how extensive or pervasive the mold is; what portion of the surfaces (walls, ceiling, etc.) are contaminated; and the mold types. A report is written, and results are communicated to the parties from whom the complaint originated. This could include the occupants and typically the Department of Facilities. Copies also go to others who may have input into the process or complaint (e.g., MIT Medical Department). The report includes recommendations on the approach to remediation.

4.3. Development of a Remediation Plan

If the indoor air testing indicates a possible mold problem, EHS BSP will develop recommendations for remediation of the problem and will provide these recommendations to the appropriate Facilities group for incorporation into the remediation plan. The EHS recommendations are relatively standard and will provide guidance on:

4.3.1. Procedures needed to contain the mold to prevent further airborne exposure to building occupants,

4.3.2. The personal protective clothing and equipment needed by the remediators,

4.3.3. The type of cleaning procedures and products to be used

4.3.4. The training required, if any, for the remediators.

The EHS recommendations will be incorporated by Facilities into a plan for remediation of the problem. The plan should include:

4.3.5. The specification on protective equipment to be used;

4.3.6. The identification of the remediation team,

4.3.7. A timeline for the remediation.

4.3.8. A communications plan, e.g., when occupants will be notified about the remediation

4.3.9. Information on the cause of the water problem and the strategy for fixing the water problem

4.3.10. The procedures for containment of the area before removing the mold growth to prevent release of high levels of spores into the air.

A plan is best developed with input from the building occupants, especially when a workspace must be isolated for remediation. (Note: Mold must have both food and water to grow. There are abundant food sources in buildings for mold, so the basic strategy for control of mold problems is to control water problems.)


Facilities will be responsible for conducting or overseeing the remediation work. If some or all of the work is contracted, a remediation manager from Facilities should be named. If contracted, the contractors will be expected to follow the guidance in the remediation plan. If, upon implementation of the plan, additional mold growth is found, EHS should be contacted for an additional assessment. The plan may need to be
modified.

4.5. Post-Remediation Inspection.

After the remediation, EHS should be contacted to check the work completed. The EHS Office can be asked by Facilities or the DLC to do this inspection that may include a visual inspection and air sampling. A post-remediation report or a “clearance” report is a good practice especially for large remediation projects and is generated by the EHS Office with copies for Facilities and for occupants.


The communication plan should be part of the remediation plan, as noted above. The purpose of a communication plan is to assure concerned parties are kept informed of activities with respect to the investigation and remediation. The nature of the plan will depend on the complexity of the problem and the number of people involved, but as a minimum, it must name a point contact for the DLC, usually the EHS coordinator, a point contact for the Facilities Department, and a point contact for EHS.

4.7. Prevention and Correction of Water Problems.

Facilities Department should establish periodic inspection programs to assure water problems are identified and fixed. Such problems may arise due to building envelope problems, water table and flooding problems, as well as problems with indoor plumbing, sprinkler systems, or condensation. Moisture problems may occur in air-handling units as well, and checking for this should be included as part of a routine building inspection program. In addition, Facilities should implement the routine use of moisture meters to determine whether an area is thoroughly dried or further remediation needed before release to area occupants for use.

5. Roles & Responsibilities

5.1. Faculty, Staff or Students Will

5.1.1. Report concerns about mold to their DLC EHS Coordinator or directly to EHS.

5.1.2. Report water damage, leaks, etc. promptly to Facilities. The normal procedures for requesting critical maintenance should be followed.

5.1.3. Follow recommendations made by EHS to assist with the identification, characterization, and remediation of the problem.

5.2. DLCs, Through Their EHS Coordinator, Will:

5.2.1. Assist, as needed, with the EHS assessment of the problem.

5.2.2. Assist as needed, with remediation by assuring spaces are accessible, and vacated, if needed.

5.2.3. Assure concerned or impacted personnel in the DLC are kept informed of actions being taken to address the problems.

5.3. EHS Will:
5.3.1. Provide a preliminary assessment of the problem and determine if mold is involved.

5.3.2. Where mold is suspected, conduct additional evaluations to characterize the nature and extent of the problem.

5.3.3. Contact Facilities Department to initiate remediation, and make recommendations for control and remediation of the mold.

5.3.4. Monitor, as deemed necessary, during remediation and after remediation is completed.

5.3.5. Communicate with the EHS Coordinator regarding findings, recommendations, and remediation actions being taken.

5.4. **Facilities Department Will:**

5.4.1. Maintain programs for identifying and fixing or eliminating water problems in buildings before mold growth occurs.

5.4.2. Promptly address all reports of water leaks or damage in a building.

5.4.3. Contact EHS when mold growth has been found during building inspection or maintenance.

5.4.4. Conduct or arrange for remediation, when required.

5.4.5. Collaborate with EHS to establish appropriate precautions for conducting remediation.

6. **Training**

The MIT Biosafety Program offers cross training for EHS staff and other interested parties and individuals on how to conduct an IAQ investigation where mold and other biological agents are a concern. This training can be arranged through the EHS office by calling 2-EHSS. In situations where EHS determines that respirators or other Personal Protective Equipment will be needed by MIT employees to perform job duties related to mold assessment or remediation, EHS will provide the necessary training and fit testing (required for use of respirators).

7. **Monitoring**

The BSP has the following capabilities to test for mold in the air or on surfaces:

<table>
<thead>
<tr>
<th>Sample Method</th>
<th>Target</th>
<th>Type</th>
<th>Quantification</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCS Biotest</td>
<td>Air</td>
<td>Cultured</td>
<td>CFU/m³</td>
<td>high volume sampling pump + cassettes</td>
</tr>
<tr>
<td>Allergenco</td>
<td>Air</td>
<td>Non-Cultured</td>
<td>Spores/ m³</td>
<td>Allergenco sampler + greased slides</td>
</tr>
<tr>
<td>Bulk</td>
<td>Bulk/Dust</td>
<td>Non-Cultured</td>
<td>CFU/g</td>
<td>microscope</td>
</tr>
<tr>
<td>Swab</td>
<td>Bulk/Dust</td>
<td>Cultured</td>
<td>CFU/m²</td>
<td>sterile swab (Q-tip or cotton ball will work). Microscope</td>
</tr>
<tr>
<td>Tape Lift</td>
<td>Bulk/Dust</td>
<td>Non-Cultured</td>
<td>ID only</td>
<td>clear sticky tape (scotch, etc...) and microscope</td>
</tr>
</tbody>
</table>

Note that air sampling is not always required and is not routinely done.
8. Record Management

IAQ field reports (see Appendix A BSP IAQ Assessment Questionnaire) are kept by EHS staff doing the investigation and are used to generate the assessment report form (see Appendix B Sample Assessment Report Form). A copy of the report form should be filed according to building number in the BSP building files.

9. References

This section lists additional resources that may be useful in performing mold assessment and remediation.

9.1. Standards

Currently there are no regulatory standards or requirements for mold remediation or assessment. In addition, there are no federal or state standards for the type or total number of fungi permissible in the workplace atmosphere. However, the EPA has published guidelines for remediation of mold in schools and commercial buildings. These guidelines are available in booklet form through the EHS office or through the internet from the following link: http://www.epa.gov/mold/index.html

In addition, another frequently cited guide to mold remediation was published by the New York City Department of Health & Mental Hygiene entitled Guidelines on Assessment and Remediation of Fungi in Indoor Environments. This publication is available through the EHS office or can be accessed online at the following link: http://www.nyc.gov/html/doh/html/epi/mold.shtml

The following links can also be accessed for further information:
American Industrial Hygiene Association Mold Resources: http://www.aiha.org/Pages/default.aspx

California Indoor Air Quality Program: http://www.cal-iaq.org/mold/about-mold

Links to mold and other IAQ topics on the web:
Canadian Center for Occupational Health and Safety (Canada’s OSHA): http://www.ccohs.ca/oshanswers/biol_hazards/iaq_mold.html

Indoor Air Quality – Molds and Fungi:
U.S. Centers for Disease Control and Prevention National Center for Environmental Health -- Mold, General: http://www.cdc.gov/mold/

9.2. Supplementary Documents

The following documents are included in the appendix of this SOP:

9.2.1. BSP IAQ Assessment Questionnaire - used by EHS staff during initial IAQ assessment when mold is suspected.

9.2.2. Sample Assessment Report Form - Standard form used to communicate assessment findings to interested parties.

9.2.3. Mold Assessment and Remediation Process Map
10. Definitions

10.1. **Air monitoring** means using a variety of mechanical air samplers to discover or detect mold in the indoor environment.

10.2. **Assessment** is the process of systematically evaluating the indoor environment, including all surfaces and the air, for potential presence of mold.

10.3. **Bulk sampling** refers to the collection of carpet, Fiberglas, or adequate-representative samples of wallpaper, wallboard, and/or ceiling tiles suspected of growing mold or with visible mold contamination. These samples are used to assess the presence or absence of mold.

10.4. **Boroscope** refers to a hand-held machine with an eyepiece and flexible tubing that are connected by fiber optic cable, allowing examination in small spaces, behind walls, etc., for presence of mold.

10.5. **Contaminate** means to soil or stain something that previously was clean, by being present in or on a substance or in the environment. In the case of mold, contamination occurs and is encouraged in cloth, carpets, leather, wood, sheet rock, insulation, and human foods when moist conditions exist.

10.6. **Fungi** are organisms that typically live embedded in some form of food (e.g., trees) where they absorb simple, soluble nutrients through the wall and cell membrane. They need external organic food sources and water to be able to grow. They get energy from decaying other organic material. Examples include yeasts, molds, mildews, smuts, rusts, as well as large mushrooms, puffballs, and bracket fungi that grow on dead trees.

10.7. **Mold** is a subset within fungi and the term will be used interchangeably with fungi in this document.

10.8. **Personal protection equipment (PPE)** includes equipment and clothing that minimizes exposure for the remediation and assessment work. It includes respirators, specialized clothing, gloves, and protective eyewear. OSHA may require training before the use of certain PPE. Use of respirators requires medical clearance and fit testing.

10.9. **Remediation** refers to the process of removing the sources of moisture or water; removing or cleaning all mold-contaminated surfaces; rebuilding, if necessary, all or a portion of the building infrastructure; and implementing preventive measures to support a mold-free healthier environment.

10.10. **Surface sampling** refers to obtaining suspicious material from a wall, ceiling, a pipe, or other surfaces. It is usually done by wiping, using a cotton swab, or stripping the surface with clear tape.

10.11. **Indoor Environmental Quality** review (IEQ) refers to the assessment of temperature, odors, carbon dioxide levels, humidity, and other parameters not necessarily related to mold but which may cause discomfort and complaints by building occupants. Such an assessment may be necessary if mold is not found by the aforementioned methods and can be performed by EHS staff.
Appendix A

INDOOR AIR COMPLAINT

Date: ____________________

1. Referral from Industrial Hygiene Program?  □ Yes  □ No

2. Complaint Information

   Name: ____________________________________________________________
   Department: _______________________________________________________
   Room Number: _____________________________________________________
   Phone Number: _____________________________________________________

3. Background Information

   Timeframe of problem: _____________________________________________

   □ Yes  □ No
   New Rugs?
   □ Yes  □ No
   Construction in room/area?
   □ Yes  □ No
   New furniture/partitions?
   □ Yes  □ No
   Water damage?
   □ Yes  □ No

   Nature of complaint (headaches, itchiness, soreness, sinus congestion, runny eyes, asthma, etc.)

   ____________________________________________________________

   □ Yes  □ No
   Is there an odor associated with the complaint?
   If yes, check the most appropriate description.
   □ Smoke  □ Rotten Egg  □ Dry/Stale  □ Bleach  □ Fragrant  □ Food
   □ Food  □ Paint  □ Earthy  □ Damp  □ Garbage  □ Pungent
   □ Other? ______________________________________________________

   □ Yes  □ No
   Is the odor lingering or passing: ________________________________
   How long approximately: ________________________________________

   □ Yes  □ No
   Was a physician consulted?
   □ Yes  □ No
   Are others experiencing symptoms?
   □ Yes  □ No
   Do symptoms subside overnight?
   □ Yes  □ No
   Do the symptoms subside over the weekend?
   □ Yes  □ No
   Are the symptoms worse during the morning?
   □ Yes  □ No
   Are the symptoms worse during the afternoon?
   □ Yes  □ No
   Does the person have allergies?
   □ Yes  □ No

4. Inspection of Problem Area

   Water damage?  □ Yes  □ No
   If Yes, what is damaged, has it dried or is it still wet, and what is the extent of the damage

   ____________________________________________________________
   ____________________________________________________________

   □ High  □ Medium  □ Low (clean)
   Dirt/dust level:
   Last cleaning of draperies/blinds:
   □ Yes  □ No
   Are there plants in the area?
   □ Yes  □ No
   Are there many books/papers?
   □ Yes  □ No
   Does the area have ventilation?
   □ Yes  □ No
INDOOR AIR COMPLAINT

Date: ____________________

If no, refer the complaint to the Industrial Hygiene Program. If the area is ventilated by HVAC system, check the system.
Note fresh air source:

____________________________________________________________________________________

5. Inspection of HVAC System
Are the filters in place? □ Yes □ No
Do the filters require changing? □ Yes □ No
Is there fiberglass insulation? □ Yes □ No
If yes, intact? □ Yes □ No
Is the air intake near a loading dock? □ Yes □ No
Is the air intake near a dumpster? □ Yes □ No

6. Sampling

Date Samples Taken: ____________________________________________
Testing Method: ________________________________________________
Media Used: ____________________________________________________
Sample locations: _______________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
Other information: _______________________________________________
________________________________________________________________
________________________________________________________________
Results: _________________________________________________________
________________________________________________________________
________________________________________________________________

7. Medical Referral
Person referred to Medical Department: □ Yes □ No
Person referred to EHS Director: □ Yes □ No

Attach memos issued
cc. David Diamond, M.D. E23-209
Building File - ____________________
Appendix B

To:

From:

Date:

RE:

Summary: Include a summary statement about findings and extent of the problem.

Background: This section should include information on the background of the problem including who discovered what and when. Who it was reported to and how you became involved in the assessment.

Description of the area: Include a general description of the area what type of flooring, ceiling, and walls. How large is the area? What type of air conditioning? Are there plants? How dirty, dusty is it and general upkeep if applicable. Include pictures of the area or floor plans if available.

Description of the complaint (including time frame, history, symptoms, etc.):

Inspection of the area: Describe what was found during the initial inspection. Include pictures if available.

Sampling:

Report on when sampling was done. What type of sampling and what the results of the sampling. You should also include interpretations to help readers understand what information the results provide and any conclusions that can be drawn from analysis of the data. Often a table format can be helpful to present this information an example is given below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Fungal Colony Forming Units (CFU) per cubic meter of air.</th>
<th>Fungal species</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-056</td>
<td>920 CFU/m³ (92 colonies on 100 L)</td>
<td>590 CFU/m³ Penicillium spp. (59 colonies), 70 CFU/m³ Aspergillus spp. (7 colonies), 180 CFU/m³ Cladosporium spp. (18 colonies), 8 Colonies of other fungi, overgrown and unidentifiable.</td>
</tr>
<tr>
<td>26-152</td>
<td>50 CFU/m³ (5 colonies on 100 L)</td>
<td>20 CFU/m³ Penicillium spp. (2 colonies), 20 CFU/m³ Cladosporium spp. (2 colonies), 10 CFU/m³ unidentified fungi (1 colony).</td>
</tr>
<tr>
<td>Outdoor control</td>
<td>320 CFU/m³ (32 colonies on 100 L)</td>
<td>Heterogenic mixture of numerous mold species. At least 120 CFU/m³ Cladosporium spp. (12 colonies), and 30 CFU/m³ Penicillium spp. (3 colonies).</td>
</tr>
</tbody>
</table>

1000L = 1 m³
Please note that there are no federal or state standards for the type or total number of fungi permissible in the workplace atmosphere. Whether the level of airborne or surface microorganisms in the work environment is a potential problem is based on a comparison of problem areas with background controls taken on the same day.

Samples from the air in 26-056 are nearly three times outdoor concentrations. This is expected based on the visible mold present in the room. Mold counts in 26-152 were much lower, even though supplied air comes from the same air handling unit (AHU). Therefore it is unlikely that the AHU is contaminated.

Recommendations:

Include in this section recommendations. These recommendations should be directed towards the individual(s) to whom the report is addressed. Recommendations to occupants may be different than the recommendations given to the remediation team. Recommendations should be based on the NYC Guidelines and/or the EPA Guidelines.
Appendix C

Mold Remediation Process

Decision based on clinical symptoms of occupants, visual inspection, history of water damage, moldy odor, etc., covered in the survey.

IAQ Complaint

Survey by EHS

Is it Mold related?

Yes

Assess size of problem, location and type of damaged material

Plan Remediation

Communicate with occupants throughout process as appropriate

Write up Assessment Report

No

Pass to IHP for IEQ

Air, surface and bulk sampling may be necessary

Identify source or cause of water problem

Select remediation manager

Select PPE and containment

Select remediation personnel or team

In house Contractor

Develop written remediation plan

Fix water or moisture problem

Hidden mold found; Reevaluate plan

Remediate

Clean and dry moldy materials

Discard moldy items that can’t be cleaned

Dry non-moldy items within 48 hrs

Conduct post remediation inspection and sampling if necessary; check for return of moisture and mold problem