NIST/HUD Healthy Homes Initiative Workshop:

Mold in Housing

Characterization, Prevention, and Remediation

Workshop Summary

Abstract

Mold has emerged as an important concern for the building industry. Beyond building occupants and owners, mold issues affect many other stakeholder groups, including building product manufacturers, designers, contractors, lenders, insurers, and the building research and regulatory communities. Issues range from health concerns to liability for the failure of products caused by mold and the moisture that acts as the catalyst for mold. Several stakeholder groups have begun to assess the problems and propose solutions. This NIST/HUD workshop was designed to bring together leading experts from a spectrum of affected stakeholder groups to investigate and propose collaborative, industry-wide approaches to address issues concerning mold in buildings.

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1. Introduction

Mold has emerged as an important concern for the building industry. Beyond building occupants and owners, mold issues affect many other stakeholder groups, including building product manufacturers, designers, contractors, lenders, insurers, and the building research and regulatory communities. Issues range from health concerns to liability for the failure of products caused by mold and the moisture that acts as the catalyst for mold. Several stakeholder groups have begun to assess the problems and propose solutions. This NIST/HUD workshop was designed to bring together leading experts from a spectrum of affected stakeholder groups to investigate and propose collaborative, industry-wide approaches to address issues concerning mold in buildings.

Mold issues have been of increasing concern in single-family construction. Resulting litigation and repairs have cost homeowners, insurance companies, and the construction industry a significant amount of money and divert valuable manpower resources and expertise away from other issues that need to be addressed.

Multi-family housing investors have also identified mold as a primary issue for rental housing building owners, managers, and tenants. At a recent forum of the National Multi Housing Council (NMHC), mold was identified as the number one concern of leading property risk managers.

It is generally agreed that mold problems in buildings can often be avoided by application of existing knowledge and "good practice." The NIST/HUD workshop sought to satisfy four basic objectives:

- Identify what we *know* and *do not know* about mold—mechanisms, effects, and impacts
- Determine how to apply existing knowledge to avoid moisture and mold problems
- Catalog effective remediation techniques and recommend methods for disseminating guidance to the building community
- Define knowledge gaps and research needs to address mold assessment and remediation

The issue of mold in residential buildings has been a topic of discussion at a wide variety of industry meetings over many years. This workshop differed from those held previously, however, by focusing on how to put existing knowledge into practice from the perspectives of a highly diverse range of stakeholder groups. Invited workshop participants were comprised of representatives from six categories of stakeholders:

- Owners and occupants: direct investors, building managers, homeowner and tenant associations
- Finance and underwriting: lenders, insurers, real estate agencies, etc.
- Producers: product manufacturers, builders, system contractors, etc.
- Delivery system gatekeepers: building code officials, inspectors, etc.
- Remediators: contractors and service providers
- Research and regulatory agencies: public and private sector organizations

The workshop was organized around a plenary session to introduce stakeholder perspectives presented by a lead, followed by concurrent breakout sessions to address each of the four above objectives in detail from the perspective of each stakeholder group. The breakout groups investigated a range of pertinent topics suggested by stakeholder participants, and, where possible, recommended follow-on mechanisms to achieve agreed upon objectives in the marketplace.

The stakeholder breakout sessions were attended by representatives of all six stakeholder groups. Each individual session addressed all four workshop objectives plus any additional objectives proposed during the orientation session for each particular stakeholder group. A NIST/HUD/BTI facilitator/scribe was assigned to each stakeholder breakout session to assist the session lead and record key aspects of the discussions.

The workshop culminated in six stakeholder breakout session reports to all participants on the afternoon of the second day.

2. Stakeholder Perspectives

The initial workshop plenary session oriented all participants to the problem of mold in buildings from the perspective of each stakeholder group. A lead representative of each group made a brief presentation answering the following questions:

From the perspective as a spokesperson for your stakeholder group and from your own perspective (the points of view may be different):

1. *How would you characterize the mold issue?*
2. *How does mold affect you and your stakeholder group directly (indirectly)?*
3. *What are the differences, if any, between single-family and multifamily housing related to the mold problem for your stakeholder group, for you?*
4. *What are the differences, if any, between the problem of mold in older buildings and newer buildings for your stakeholder group, for you?*
5. *What are the two most important things <u>related to new buildings</u> that, if implemented, would most assist you and your stakeholder group in dealing with the mold problem?*
6. *What are the two most important things <u>related to existing buildings</u> that, if implemented, would most assist you and your stakeholder group in dealing with the mold problem?*
7. *Four objectives have been suggested for consideration at this workshop. Should any others be added for your stakeholder group in particular?*

Results of the orientation session discussions were used as a platform for further elaboration in the stakeholder breakout sessions.

2.1 'Owner/Occupant' Perspectives

Eileen Lee of the National Multi Housing Council (NMHC) observed that the mold issue has demanded increasing resources to develop and provide reliable information to tenants in order to counter misleading, unreliable, and sensational information in mass media. The focus in multifamily (MF) housing is prevention of water intrusion.

Staff capability is the key to MF management success with regard to the mold issue, so the council focuses on training. NMHC developed the model operations and maintenance (O&M) plan for mold, but it involves no original thinking and is based largely on U.S. EPA materials (developed by conference participant Laura Kolb's group). The council expects constant revision to the document; it is seen as a 'baseline' undergoing customization in the field. The plan is basically a "routine maintenance" program for property management. Recognizing and knowing when to call in a professional for diagnostics or remediation is a key decision point in the mold prevention process.

From the perspective of NMHC:

- Medical science is unsettled about the extent and mechanisms of medical concerns
- Water intrusion is a long-standing phenomenon, not new in itself
- Liability related to mold is an issue at several levels of real estate management

In fact, insurance is emerging as a thorny issue for the entire building industry. It is not a trivial matter for the real estate industry—it may be all that matters. The insurance crisis continues and grows. It was bad before "September 11th," and now may be becoming disastrous. We are all experiencing larger deductibles, higher premiums, expanding exclusions, and claim caps.

The owner/occupant segment of the housing industry needs:

- Credible advice concerning the health consequences of mold exposure
- Identifiable indicators for when to pursue testing, evacuation, and aggressive remediation

- Coordination among and harmonization of competing code development activities. The industry puts a lot of faith in code development and believes enhanced enforcement is a key to solving the problem.

2.2 'Finance/Insurance' Perspectives

Mary-Pat Denney of Freddie Mac first thanked Eileen Lee and NMHC for the development of their O&M plan and noted that it has become an important baseline for much of what the industry is doing about mold in the field. Denney also observed that the finance and insurance segments of the housing industry are really in opposition on the issue of mold in housing. There are also clear differences between the single-family and multi-family segments of the industry.

Denney relayed an anecdotal example of the growing interest in mold. She had copied her boss on an email about mold last year and received a terse "Why? Aren't there a lot more important things to focus on?" in response. Now, it has a great deal of focus in the company. The changing circumstance may reflect the entire finance industry. It will take a while, but not long, until the reality of not having insurance has its effect of raising awareness of the problem.

The insurance sector has backed away almost entirely from the mold peril:

- Direct damage was never covered
- Following cover (consequential damages, such as water damage after a fire leading to mold) has historically been covered
- While rare, some properties have been razed rather than remediated.

Customs and standards can be set by government-sponsored enterprises (GSEs), such as Fannie Mae, in the single-family housing sector because of their dominant market position, but the same is not true in multifamily housing since it is just a sub-sector of the commercial buildings market. There are many leadership influences in that market. The companies in these various sectors are looking around at each others' behavior, not wanting to end up a "pioneer with an arrow in its back."

In general, echoing the owner/occupant perspective, finance people just do not understand insurance. The insurance industry has had to come to grips with the effects of underpricing and reduced coverages even before mold and "9/11."

For the rest of the finance sector, the hidden cost of not having insurance outweighs the simple cost of insurance. It will change the way business is done. Finance people have a narrow focus, worrying about asset value, income streams, and standards compliance. Mold presents a new third-party exposure to foreclosure that is presently unknown and unknowable.

To the question of whether financing deals are now being killed because of mold, Denney answered "no, but it is just around the corner."

2.3 'Producer' Perspectives

Kevin Powell of the National Association of Home Builders Research Center (NAHBRC) outlined the 'producer' perspective, particularly from the viewpoint of single-family homebuilders, in terms of defining the issue and identifying how mold affects producers.

- Mold – What's the Issue?
  - Builder/material manufacturer/supplier reputation: Producing inferior products
  - Perceptual: New homes or products more prone to mold; any and all mold is bad and "unnatural" – media has the public full of anxiety on the topic

- Legal: Mold is somebody's fault, leading to litigation; the adversity inhibits free flow of information about causes and cures
- Knee jerk reactions: Building codes; inspection requirements; material standards; Federal and state legislation
- Responsibilities and burdens shouldered by many parties: Material manufacturers; building material suppliers; builders, contractors, and remodelers; occupants
- Health effects poorly understood: No standards; uncertainly breeds fear
- Generally Accepted Health Effects: Mold can act as an allergen that causes hay fever-like symptoms and trigger asthma attacks in asthmatics; mold can actively infect and grow in persons with suppressed immune systems
- Alleged Health Claims: Neurological effects; severe health issues like pulmonary hemorrhage (CDC study)
- Health Data: Beyond these effects, there is little established data to address more severe health effect claims; *NAS Review* is due in April 2003
- Why is it so difficult to establish health effects?: Thousands of kinds of mold; different responses in different people; little dose/response data

- How Mold Affects Producers
  - Directly: Material refusals or returns; material handling; warranty costs; house buy-backs; call backs; litigation; insurance and liability; regulations
  - Indirectly: Industry reputation; growth of aligned industries (inspection/mitigation/testing; litigation; material treaters; specialized products)

- Single Family vs. Multifamily Differences — Problems Not Seen as a Single vs. Multi-family Issue
  - Most problems fall into one of three broad categories: Building material/construction site related; Occupant activity related; Building design/construction related
  - It's *critical* to note, however, that many problems are caused by multiple factors, a combination of the three categories
  - Building material/construction site related issues—Core issue is materials become wet and moldy before house is complete: Material conditions upon delivery; material storage on site; material exposure during construction
  - Occupant activity related: Over-humidification of the indoor environment; lack of maintenance and upkeep; alteration of site drainage characteristics; soaking the foundation; installing vapor-impermeable wall coverings in hot or humid climates; HVAC operation and overcooling of interior surfaces
  - Occupant habits/practices often work in tandem with other issues to create a moisture/mold problem. Examples: Cold climate house; humidified indoor environment for health reasons; one or two rooms with insufficient heating or circulation developed condensation problems

- New vs. Existing Structures
  - Prior research projects looking at health implications of damp buildings: groups like Harvard School of Public Health (10,000 homes), Canadian and Dutch Researchers; claim about 30 - 40% of homes had "damp or mold conditions"
  - Building forensics sources claim the vast majority of mold is due to plumbing leaks and rainwater intrusion
  - Bulk water intrusion may be more problematic for older structures: Foundation cracks; failing plumbing systems; sealant maintenance
  - Newer homes get more press: EIFS; construction is exposed; today's clientele more "aware"

- Important Implementations
  - New Construction: Proper moisture management; building operation instructions
  - Existing Construction: Maintenance; building operating instructions

- Other Objectives
  - Benefits and limitations of a regulatory approach
  - Establish baseline conditions – "don't put cart before the horse": What are acceptable mold standards? What is the extent of the problem in the housing stock?
  - Build an integrated solution: Pest management

2.4 'Gatekeeper' Perspectives

David Conover of the National Evaluation Service (NES) presented perspectives from building code organizations and related entities on mold in residential buildings.

- Overview
  - Stakeholder group - "Delivery System Gatekeepers" -includes code officials, home inspectors and others that have some involvement between the "deliverer" and "receiver" in the building construction or transaction process
  - Synopsis of building codes and other regulatory criteria related to moisture control
  - How the mold issue may affect this stakeholder group

- What are Building Construction Regulations?
  - Provisions to protect the public health, life-safety and welfare
  - Criteria that govern the design and construction of buildings and technology associated with buildings
  - Criteria that must be satisfied to secure approval for installation of a building technology and continued use of a building
  - Criteria that form a foundation upon which to base improved building performance

- What the International Residential Code (IRC), the U.S. model building code, Requires:
  - Minimum glazing and natural ventilation of habitable rooms (IRC R303)
  - Vapor retarders in all framed walls, floors and ceilings under certain conditions (R322.1)
  - Foundation waterproofing and damproofing (R406)
  - Ventilation of under-floor (e.g. crawl) spaces (R408)
  - Weather-resistant exterior wall envelope with flashing to prevent entry of water into the wall cavity or penetration of water to the building structural framing components (IRC 703.1)
  - Design and installation of exterior window systems (IRC 613.1)
  - Sheathing to be dry before applying exterior wall covering (R701.2)
  - Weather-resistant sheathing paper required in certain situations (R703.2)
  - Specific sealing requirements for EIFS (R703.9)
  - Ventilation of attics and enclosed roof rafter spaces (R806)
  - Roof weather protection (R903)
  - Roof covering requirements for new (R905) and re-roofing (R907)
  - Exterior air supply for fireplaces unless room is mechanically ventilated and controlled so it is not at a negative pressure (R1005)
  - Energy efficiency via insulation, fenestration performance and air infiltration control (IRC Chapter 11)
  - Exhaust systems for clothes dryers and range hoods (IRC M1501 and M1502)
  - Combustion air (IRC Chapter 17)

- What the other International Code Council (ICC) Codes (U.S. model building codes covering building structures other than homes) Require:
  - International Energy Conservation Code (IECC) addresses building insulation, vapor retarders, fenestration properties, air infiltration control and pipe and duct insulation
  - International Building Performance Code (IBPC)

    - Primary building elements, with only normal maintenance, must continue to satisfy the performance requirements of the code for the intended life of the building
    - Use an acceptable method for determining durability and service life
    - Walls and roofs must prevent water penetration that could damage building elements
  - International Mechanical Code (IMC) addresses mechanical exhaust of certain processes, ventilation of spaces, combustion air and HVAC system and equipment design, construction and installation
  - International Plumbing Code (IPC) addresses protection and insulation of piping as well as venting of fixtures and discharge of building effluents
  - International Property Maintenance Code (IPMC) addresses maintenance of a sound exterior structure, continued ability for ventilation and exhaust and maintenance of the plumbing system

- Building Code Compliance
  - Compliance in New Buildings
  - Compliance in Existing Buildings

- Characterization of the Mold Issue
  - Mold poses a potentially significant problem that can be addressed by those who design, construct, own and operate buildings
  - It will take a concerted effort of researchers, product developers, designers, specifiers, builders, contractors, building regulatory officials, and consumers to develop, deploy and evolve strategies to address this issue
  - Many of those strategies will need to focus on keeping moisture out of building assemblies, keeping moisture from developing on building materials and removing moisture that occurs in them and within the building spaces
  - Some strategies will be capable of being implemented through building codes and others will require other means of implementation

- How Mold Affects Building Regulators
  - Building regulators are responsible for enforcement of building regulations based on national model codes and standards that tend to respond to rather than anticipate issues
  - Building regulators can only enforce what is in their regulations and those regulations may not provide them what they need to fully address the mold issue
  - Mold does not become evident until after a building is constructed when most building regulators have only a property maintenance to apply and a possibly limited ability to enforce that code
  - Building regulators are seen as a key mediator in addressing the issue and are often called in to address "failures" that are found in existing buildings

- Differences Between Single and Multiple-Family Buildings
  - Nothing from a code enforcement standpoint other than single family dwellings (SFDs) can be addressed by different codes than multifamily dwellings (MFDs)
  - Potentially different individuals involved in design and construction
  - Potential for different building materials and different designs that might result in an increase or decrease in mold potential in MFD compared to SFD
  - Potential for different moisture generation capability as a function of conditioned volume or number or availability of concealed spaces
  - Level of involvement of the building owner during construction and after occupancy

- Differences Between Older and Newer Buildings
  - Rate of air infiltration
  - Moisture production as a function of conditioned volume

  - Ventilation availability and use
  - Building materials and construction practices used
  - Type of HVAC system
  - Sources of combustion air
  - Means of venting combustion products
  - Type and number of moisture producing appliances
  - Existence of a vapor retarder and insulating materials
  - Window type and area
  - Durability of building products and materials
  - Existence of trees and "mature" landscaping and grading

- Two Most Important Things for New Buildings
  - More definitive research on the source of mold in new buildings and guidelines that would provide guidance on how to more effectively address mold in building design and construction
  - Education and training for builders and contractors on how to comply with those guidelines and increased resources for building regulators to monitor construction to ensure that those guidelines are followed

- Two Most Important Things for Existing Buildings
  - Information on how to predict what will lead to specific mold problems and guidelines that provide the details for addressing those items before they become problems
  - Support for increased inspection of existing properties, identification of problem areas and support for an infrastructure to ensure those problems are corrected

- Additional Workshop Objectives
  - Determine means to pay for identification and implementation of ways to address the mold issue
  - Determine the best vehicles for achieving compliance and reporting on successes

2.5 'Remediator' Perspectives

Alan Wozniak of Pure Air Control Services, Inc. directly answered the seven questions posed to the lead representatives to describe the perspectives of the 'remediators' stakeholder group.

- How Would You Characterize The Mold Issue?
  - Characterize as a three fold issue: the agent (mold); the host (occupant); the environment (workplace, building, home, etc.)
  - The Agent (Mold): Source (Building-related microorganism); pathway (air, water, mechanical); receiver (host)
  - The Host (occupant): Age—Young (infant), Adult, Elderly; Health—Healthy, Immuno-compromised, Susceptible
  - The Environment: New buildings (age); old buildings (age); single family residence; multi-family
  - The construction industry: Geography; climate; quality
  - Mold is a contaminant with potential health hazard risks
  - Mold is "real" but there are many misconceptions and misinterpretations of the effects of mold on buildings and health. We have an "uncertainty of understanding" and thus the solution is difficult to define
  - Mold is one of many potential dangerous indoor environmental contaminants. Consideration of other contaminants and aeroallergens is needed.
  - Perception vs. Reality
  - Quality of supporting evidence (health issues) varies considerably

  - Health, Medical, Scientific issues of exposure, duration, and susceptibility remain to be answered
  - How "Clean is Clean"?

- How Does Mold Affect Your Stakeholder Group Directly (Indirectly)?
  - Mold is a primary driver of indoor air quality (IAQ) assessments, laboratory analysis, and remediation strategies
  - Equipment for testing and remediation procedures and technologies are paramount to successful diagnosis and mitigation
  - Technical expertise, personnel qualifications and specialized training is required
  - Health and safety of employees and the occupants

- What Are The Differences, If Any, Between Single-Family and Multifamily Housing Related to the Mold Problem For Your Stakeholder Group?
  - Ventilation and exhaust requirements
  - Risk ratio factors (Risk Management) for litigation
  - Common area contamination
  - Multi-tenant conditions with cross-contamination and disbursement potential
  - Habitat and hygiene issues
  - Confidentiality issues between residents (known defects)
  - Buildings may be "designed for failure" and not designed for mold considerations (negative pressurization by design).
  - Underestimating the impact of mold on building and health

- What Are The Differences, If Any, Between the Problem of Mold in Older Buildings and New Buildings for Your Stakeholder Group?
  - Old Buildings: Hygiene conditions; maintenance of HVAC and building operations; building use (function) changes
  - New Buildings: "Cleaner" than older buildings; mold problems predominantly associated with construction-related problems, design, and workmanship; handling of construction materials
  - The basic differences: Structural (new) vs. maintenance (old), which affect the costs to remediate.

- What Are The Two Most Important Things Related to New Buildings That, if Implemented, Would Most Assist Your Stakeholder Group in Dealing with Mold Problems?
  - Adequate access to known areas of pollutant pathways and mechanical systems (such as above ceiling "pancake" style units, elevator shafts, etc.)
  - Strict accountability for building design and HVAC design, as well as access to "as built" prints, specifications (i.e., mechanical), change orders from original design, and IEQ commissioning documents

- What Are The Two Most Important Things Related to Existing Buildings That, if Implemented, Would Most Assist Your Stakeholder Group in Dealing with Mold Problems?
  - A Proactive Indoor Air Quality Preventive Maintenance Program (IAQ PMP)
  - Accessibility to all facility-related records: Design prints; specifications; original building "Change Order" documents; building material documentation; maintenance records

- Four Objectives Have Been Suggested For This Workshop. The 'Remediator' Stakeholder Group Should Also Consider *"Standardized" training programs for all levels of Indoor Air Quality Professionals*:
  - Industry Standards and/or Guidelines.
  - Qualified Remediation Professionals
  - Qualified Diagnostic Professionals

- Qualified Laboratory Professionals
- Qualified Medical Professionals

2.6 'Research/Regulation' Perspectives

Laura Kolb of the U.S. Environmental Protection Agency (EPA) described current research conducted through the federal government and provided a general overview of the 'researcher/regulation' stakeholder perspective on mold in housing.

The National Academy of Sciences (NAS) has in progress a study called *Damp Indoor Spaces and Health*. The study will include the examination of mycotoxin information. For more information, see the NAS website:
http://www4.nas.edu/cp.nsf/Projects+_by+_PIN/HPDP-H-00-06-A?OpenDocument

Molds are allergenic and can trigger asthma attacks in mold-allergic individuals. Some molds can produce mycotoxins. There is a lot of information about molds in agricultural settings. Health effects information on mycotoxins and inhalation exposure is sparse; research is ongoing.

Zero mold exposure is impossible to achieve, but it is recommended that mold should not be growing within the building.

In response to a question, Ms. Kolb did not know of a ready source to determine the relative resources expended on research of disease 'vectors' versus the sums spent investigating 'prevention' of mold in buildings.

Media attention to mold is an issue for all concerned. Approximately one-half to two-thirds of calls to the EPA Indoor Air Clearinghouse hotline (800-438-4318) are mold related. The government is trying to take a balanced approach to information delivery. EPA provides guidance, not regulations. EPA mold documents are available online at: www.epa.gov/iaq/molds. An enhanced residential mold guide is also planned and will be available for review in 2003.

Data from an EPA survey of large commercial buildings is available from the EPA Indoor Environments Division website (www.epa.gov/iaq/largebldgs/index.html). The survey is called BASE. All are welcome to mine the database for insights. The new I-BEAM software for managing IAQ in large buildings is also available at the site and includes checklists and other materials to assist with building maintenance.

3. Recommended Stakeholder Needs and Actions

Each stakeholder breakout session addressed all workshop objectives and orientation session recommendations primarily from the perspective of the topic stakeholder group. Participation in each breakout session was not limited to representatives from just the topic stakeholder group, however; representatives from all six stakeholder groups participated in each session in order to better explore possible areas of consensus. Each stakeholder "lead" guided discussions to explore recommendations and identify that particular stakeholder group's information needs, opportunities for information exchange and collaboration with other stakeholder groups, and actions that stakeholder group should undertake to achieve each specific objective:

- What information/tools does that stakeholder group need?
- What information can that stakeholder group share with or obtain from other stakeholder groups?
- What coordinated actions can that stakeholder group undertake to mitigate the problem of mold in housing?

Scribes for each breakout session produced summary lists of 'needs' and 'action items' identified for each of the four workshop objectives. These materials were reviewed by each stakeholder discussion group and used to prepare a breakout session report that reflected the consensus recommendations of the breakout session participants. Summaries of the needs and actions reported by each stakeholder group at the final plenary session are presented in the following sections.

3.1 'Owner/Occupant' Breakout Session Summary

The table below lists the participants in the 'Owner/Occupant' Breakout Session led by Eileen Lee of the NMHC.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
EILEEN C. LEE VP of Environment, Nat'l Multi Housing Council LEAD	JAMES AMENT State Farm Fire and Casualty Company (via conference call)	DOUGLAS BIBEE The Dow Chemical Company	DAVID CONOVER National Evaluation Service, Inc.	PAUL BEERS Glazing Consultants, Incorporated	DORR DEARBORN CWRU	Robert Chapman scribe
JOE MAHEADY National Association of Realtors		MARK HALVERSON APA (Engineered Wood Products)	PAUL LYNCH Director, Residential Inspection Division, Fairfax Co.	GARY DEWALT Quantech	LAURA KOLB Indoor Environments Division, USEPA	Ellen Taylor
		DAWN COLE James Hardie Building Products				William Freeborne
		MILES HABER Monument Construction Inc./NAHB				Victor Ferrante
		JOHN FESTA AFPA				Chi Leng

Observations and recommendations of the session participants were organized around the four basic workshop objectives:

- Identify what we *know* and *do not know* about mold—mechanisms, effects, and impacts
  - Owner/Occupants believe that standards will help
  - There is a lot of good information on prevention, assessment, and remediation
  - If mold is growing, a failure has occurred somewhere—in production, construction, or use
  - Owner/Occupants need a compelling rationale to drive change, because the current reality is: pay now or pay much more later

  - o There are many ways to approach remediation—most cost-effective approach is prevention
  - o Mold differs from radon—the radon standard has a scientific technological basis
  - o PCR method will change how we measure mold problems
    - It is very sensitive and very quantitative
    - New insights emerge as the method moves into market
  - o Major unknown is critical exposure (see Research Needs and Knowledge Gaps)
  - o Sampling technology needs to be tied to an objective
  - o "GOAL POST" PARADIGM
    - If you can see or smell mold, get rid of it
    - Difficult choice is when you can't see or smell the presence of mold
    - How do we find the practical intermediate solution? (see research needs and gaps)

- Determine how to apply existing knowledge to avoid moisture and mold problems
  - o Pull information together—prevention, assessment, and remediation
  - o Package information via consensus process—voluntary industry standards (e.g., ASTM)
  - o Pull freely from public domain (e.g., EPA)
  - o Need an easy-to-use document published by a recognized authority
  - o Check list format would be appropriate
  - o Best building practices need to be encouraged by mechanisms other than codes
  - o Home inspections for all real estate transactions—a mechanism to protect owner/occupants
  - o Educate stakeholders
  - o Media / Message / Audience

Media	Message	Audience
Code	Do this	O/O, Builder, etc.

- Catalog effective remediation techniques and recommend methods for disseminating guidance to the building community
  - o Need to think of remediation and prevention together
  - o Produce an owner's manual
  - o We are moving toward a single building code
  - o Incorporate IRC into college/university courses
  - o Incorporate information on mold-related issues into the IRC
  - o Continuing education programs for code officials/building inspectors/builders/contractors on mold-related issues
  - o NAHB could produce a document on how to keep materials dry during construction
  - o NAHBRC quality program—training opportunity through success stories

- Define knowledge gaps and research needs to address mold assessment and remediation
  - o Gaps
    - Skill levels of installers
    - Is mold a growing problem OR are we better at detecting it?
  - o Research needs
    - New materials/practices are making the problem worse
    - Learn what it would take to induce property owner or lender to make a change
    - Identify wood extractions that inhibit mold, which could be incorporated into new products
    - Dose-response data—relate exposure to health risk—acute exposure biomarkers and chronic exposure biomarkers—NIH
    - Whole house dehumidification vs. air-conditioning
    - Dehumidification added to HVAC system—analyze life-cycle cost consequences and strategies to inhibit mold growth
    - Establish "Goal Post"—practical intermediate solution [Research, objective # 1]

- How to construct and ventilate attic and crawl spaces and integrate these practices into the IRC [Research, objectives # 2 and #3]

3.2 'Finance/Insurance' Breakout Session Summary

The table below lists the participants in the 'Finance/Insurance' Breakout Session led by Mary-Pat Denney of Freddie Mac.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
BRIAN KELLER Oakwood Properties	MARY PAT DENNEY FreddieMAC LEAD	THERESA KENINGER Pella Corporation	DONALD COLLIVER ASHRAE/UKY	RICHARD GARRISON LAW Engineering	MCGREGOR PEARCE University of Minnesota School of Public Health	Andrew Persily
REBECCA MORLEY Executive Director National Center for Healthy Housing	JOE BEGGINS GEMSA Loan Services (via tel)	MARY LYNN PICKEL NAHB Environment	ERIC BURNETT BTEC/Civil and Environ. Engineering Penn State	ALAN L. WOZNIAK Pure Air Control Services	STEPHEN REDD Center for Disease Control	Christopher White
	WALTER WRIGHT Mitchell, Williams (via tel)	JAMES KIRBY Nat'l Roofing Contractors Assn (NRCA)		PATRICK CONNOR Connor Env.Services		
		JOHN MCFEE Window and Door Manufacturers Association (NWDA)				David Hattis scribe
		THERESA WESTON DuPont Nonwovens				Eric Axelrod

Observations and recommendations of the session participants were organized around the basic workshop objectives:

- "Identify what we *know* and *do not know* about mold—mechanisms, effects, and impacts"
  - We Know:
    - Causes of moisture: "focus on moisture over mold"
      - Maintenance
      - Design
      - Construction methods: avoid constructing "self-composting buildings"
    - Relative vulnerability to moisture: need more refined knowledge and predictive capability; "know only roughly"
    - Known vulnerability points
      - Rubber water hoses (washers)
      - Ventilation into "wrong" spaces
      - Number and characteristics of concealed spaces
      - Finished space below grade
      - Inappropriate building materials for climate
      - Envelope
      - Grading
      - Active humidity control
  - We Do Not Know:
    - Risk assessment: concern over point-in-time, "focus on prevention/O&M"
    - Operations and Maintenance:
      - How to enforce/require
      - Consensus development of O&M practices
        - Time to develop
        - Who to develop
      - Really a "prevention plan"

- "Determine how to apply existing knowledge to avoid moisture and mold problems" and "Catalog effective remediation techniques and recommend methods for disseminating guidance to the building community" (for finance/insurer stakeholder group, how to influence building techniques and encourage moisture/mold prevention):
  - Building codes? Not seen as an effective means
    - Not in synch with moisture issues
    - Regional climate differences
    - Codes are minimal, not optimal
    - Enforcement weaknesses
    - Existence of multiple standards
  - Insurers?
    - Offer incentives for homeowners to manage moisture
    - Offer incentives for builders
    - Single-family v. multi-family: cost to monitor
  - Lenders?
    - Not good regulators: no technical expertise
    - Insufficient legal remedies
    - Competitive environment

- Define knowledge gaps and research needs to address mold assessment and remediation
  - Knowledge Gaps: Education, primarily—need a 'marketing strategy' (such as 'energy star')
    - Design, materials, and construction methods
    - For homeowners and property managers
    - Use universities and accreditation groups
    - Involve builders, architects and manufacturers
    - "Home Manual of Operation" (such as EPA's residential mold brochure and forthcoming guide)
    - Plain English standards for owners/managers regarding prevention
  - Research Needs:
    - Moisture levels and causes of mold for various climates and materials
    - Claims data from insurers; old info is probably poor, so influence future data collection and analysis details and procedures
    - More depth and predictive capability regarding relative vulnerability in underwriting

3.3 'Producer' Breakout Session Summary

The table below lists the participants in the 'Producers' Breakout Session led by Kevin Powell of the NAHBRC.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
NICK FARR Executive Director (ret.) National Center for Healthy Housing	RENATA HARRISON FNMA	STEVEJOHNSON Andersen (via tel.)	ROB PATERKIEWICZ ASHI	RAJIV SAHAY Pure Air Control Services	ARIF QURAISHI Institute for Environmental Assessment	Steven Emmerich
RUSSELL RIGGS Regulatory Policy National Association Of Realtors	BERNIE BROWN Ins. Advisors LLC (via tel?)	HENRY GREIST Lennox Industries	BILL ROSE Building Research Council		ANTON TENWOLDE USDA - Forest Service	William Whiddon scribe
	TED CUDAL Safety Dir. And Response Mgr., PRI (via tel.)	KEVIN POWELL NAHB Research Center LEAD				David Levitt
		CAREY MITCHELL Shaw Industries				Michael Blanford
		PAUL SHIPP USG Research Center				Dick Santangelo

Observations and recommendations of the session participants were organized around the four basic workshop objectives plus an additional objective identified through discussions among 'producer' participants:

- Define the mold problem from the producers' perspective ("currently at the whim of outside forces")
  - "We take it (the mold problem) seriously and are working assiduously to solve it."
  - There is a danger in viewing/addressing the issue as a "liability"—will distort response and may not improve buildings
  - Differences within "producer" community—"manufacturer" vs. "contractor"; "moisture is the issue" vs. "building materials focus."
  - Solutions may require new design approaches, such as, change "concealed" space to "revealed" space and do not hide plumbing and ducts.
  - Analogy to development of auto fuel and safety standards—we should expect a rough transition period to fix the problem.
  - Rules have changed for industry—same failure rate is no longer acceptable (hypothesis—based on anecdotal evidence only).
    - Recognize that mold is a significant health problem for individuals
    - But it is a building problem for the housing industry—must decide, are we trying to reduce the "failure" rate (such as from 6 percent to 4 percent) or trying to eliminate it entirely (which is not possible)?
  - Industry must integrate approaches and actions
    - Finance: "standards of care," "what every lender should know"
    - Product manufacturer: "handling/installation/maintenance"
    - Builder: "material selection," "best practices"
    - Owner/Occupant: O&M
  - Industry has history of contending with moisture problems
    - Circa 1951, the mantra "moisture is the invisible enemy" promoted the use of vapor barriers
    - Presence of mold has always reflected poorly on builders and craftsmen.

  - Tort reform may be key to avoiding disaster for the entire industry (drawing from the asbestos analogy, where there was an overwhelming number of suits involving no health damages).
  - Spend more money on housing research to build up the building research community.

- Identify what we *know* and *do not know* about mold—mechanisms, effects, and impacts
  - Across all objectives, there are strong differences in needs and actions between single-family and multi-family buildings
  - Across all objectives, there are strong differences in needs and actions between "new" and "existing" buildings
  - "Liability" leads to "uncertainty," and vice versa (see Research Needs and Knowledge Gaps)
  - Moisture content is a "moving" parameter (moisture is both necessary and unavoidable; it cannot be kept constant)
  - Despite prevalent misperception that "construction is low-tech", the reality is that "building construction is highly sophisticated"
  - Need greater awareness among building practitioners and increased training

- Determine how to apply existing knowledge to avoid moisture and mold problems
  - Increase building quality control by publishing more information about products (including handling, storage, and use)
  - Rather than focus on medical consequences, perhaps housing industry should try to "dry" our buildings (how "dry" should they be?—see research needs)
  - Must deal separately with "mold" and "moisture" problems
  - Finance perspective: "what can we do to promote good practices?" What are good practices (they must exist now)? How do we reduce the probability of mold occurrence?" (the finance industry does not have a "roadmap" yet)
  - Statement of the Problem: "What are the best practices over the life of the structure to minimize moisture and materials contributions to mold outbreak?" (Ready answers are not yet available.)
  - It is a complex problem, but "consumers seem to spend less time making the decision to buy a house than to buy household products"

- Catalog effective remediation techniques and recommend methods for disseminating guidance to the building community
  - Quality Control (QC) training for builders and contractors
  - Accelerate "drying" of building products as installed and in use
  - New study suggests "dry" construction practices can show life-cycle cost benefits (see research needs)
  - "Dry it, clean it, watch it"—(is that our best and only advice?)
  - Endow a university program(s) on building research ("and/or the NAHBRC" was suggested by one participant)

- Define knowledge gaps and research needs to address mold assessment and remediation
  - Repeating from above: "liability" yields "uncertainty," and "uncertainty" yields "liability"
  - Need to determine critical moisture level down to susceptibility of substrates as function of time and temperature
  - Three primary issues regarding building cavities/concealed spaces need investigation
    - Dust buildup mechanics and time change
    - Confirm over-emphasis on relative humidity (RH)-induced moisture (actual experience suggests damage most often involves entire section, not just cavity surfaces)
    - Know nothing about dynamic interaction between "concealed" and "open" spaces
  - Do not know/understand "threshold" levels for design parameters ("flying blind")

- Need to sort out priorities and differences between moisture standards and mold standards (ASHRAE is developing an information base and exposure standards)
- Need dynamic tools and analysis, but development should lead to simpler tools for screening and for lower life-cycle costs from builder perspective (industry must make product variety and quality appealing to consumer)
- What is the failure rate? Is the current rate acceptable? Should it be reduced? What is the definition of "failure" (failure can be observable and should be measurable, from an engineering standpoint)
- Do not recommend fungicides because may substitute one problem for another
- Need to confirm that incidence of allergy to mold presentation is very low
- We need to conduct risk analysis—what is the downside consequence of building failure? Is a guess useful? In terms of data, we need to know:
  - Number of occurrences annually
    - New vs. existing
    - SF vs. MF
  - Failure rates over time
    - New vs. existing
    - SF vs. MF
  - Cost of building remediation
  - Cost of medical care
  - As an example (and a guess): 4 percent failure rate x 1.5 million new units per year x $20,000 liability per failed unit would yield $1.2 billion additional liability annually for new construction

3.4 'Gatekeeper' Breakout Session Summary

The table following lists the participants in the 'Gatekeepers' Breakout Session led by David Conover of the NES.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
BRIAN KELLER Oakwood Properties	MARY PAT DENNEY FreddieMAC	DOUGLASBIBEE The Dow Chemical Company	DAVID CONOVER National Evaluation Service, Inc. LEAD	RAJIV SAHAY Pure Air Control Services	ARIF QURAISHI Institute for Environmental Assessment	Robert Chapman scribe
REBECCA MORLEY Executive Director National Center for Healthy Housing		MARK HALVERSON APA (Engineered Wood Products)	PAUL LYNCH Director, Residential Inspection Division, Fairfax Co.		ANTON TENWOLDE USDA - Forest Service	Ellen Taylor
		DAWN COLE James Hardie Building Products				William Freeborne
		MILES HABER Monument Construction Inc./NAHB				Victor Ferrante
		JOHN FESTA AFPA				Chi Leng

Rather than addressing each objective serially, the session participants focused on the needs of different types of 'gatekeepers' and what actions need to be undertaken for or by each. Answers to two basic questions were outlined:

- Who are the gatekeepers?
- What role do gatekeepers play?

[In the table below, "w" refers to interest or role in water issues, "m" refers to emphasis on mold issues; upper-case letters imply higher interest, lower-case letters imply only moderate interest; "+" or "-" following the "w" or "m" reflects growing or diminishing interest or role for that gatekeeper.]

GATEKEEPER	ROLE
CODE OFFICIALS	* W m * Develop, interpret, enforce, and communicate what is in place * Definitely water; future mold * Development: participate in process but do not lead
Needs/Action Items	→ Research on what is actionable in the property maintenance code → Research on which construction materials and techniques produce moisture problems **à** Modifications to existing code → Research on what water (moisture) levels contribute to mold in different regions and climates: link to codes and standards organizations; moisture, materials, climate; internal and exterior loads → Need more resources: staff, education, training → Broad-based education
MODEL CODE & STANDARDS	* W m * Develop criteria (protocols, guidelines) * Conduct research * Training
Needs/Action Items	→ Research link to code official topic moisture, material, climate, load → Education through research → Identify where codes are not in sync with moisture control → Standards Organizations could develop a method that produces a rating "Standard for Measuring and Expressing Exceeding Code;" Quality is beyond code
REALTORS	* w m * Communicate information * Recommend repairs and maintenance to promote marketability * Basic assessment walkthrough checklist
Needs/Action Items	→ Education for homeowners, homeowners manual—"Your New Home and How to Maintain It" → Information on the property—materials, systems, design, and structure: "How to Apply and Convey that Information" → Information for disclosure on prior moisture and mold problems → Database: Home History → "Rationale" paper directed at realtors detailing why they need to be active in this area
APPRAISERS	* w m * Determine value of home based on inspection and comparables for lender * Let mold and moisture mitigation measures add value—similar to an "energy star" designation
Needs/Action Items	→ Education course designed to deal with mold-related issues as part of continuing education program → Research/technical information as the foundation for housing material → "Rationale" paper documenting the impacts of these factors on value → Third-Party Certification and Branding of "High Performance" → Integrate with energy efficiency

GATEKEEPER	ROLE
HOME INSPECTORS	* W m+ * Can be agents for both owner and buyer * Make assessments, assign value, and offer recommendations * Same as appraisers except with emphasis on finding solutions to problems * Educate homeowners
Needs/Action Items	→ Recommend certification process for home inspectors to have master/super designation → Identify by appropriate certificate body (meet ISO criteria as determined by ANSI) → Could be third party with appraisers → Research on how to link homeowner maintenance to "High Performance" rating → Education and tools for homeowners (provide checklist, guidelines)
MEDIA	* Mass Media: w M; inform consumers, promote awareness * Trade Media: W m; educate industry audience, promote awareness
Needs/Action Items	→ Need credible information → Consensus on messaging → Need to develop links/relationships to media representatives about our ongoing process → Continue to feed latest research results to trade media representatives → Funding for research organizations to publish research findings—Clearinghouse (topical clearinghouse)
HEALTHCARE PROVIDERS	* w– (interest), m * Case management * Diagnosis, treatment, recommendations * Patient advocacy
Needs/Action Items	→ Need compelling argument and research with objective scientific information—NAS Study → Providers need to receive information from a credible source → Diagnosis and case management guidance (indoor environment quality, building environmental issues) → Interior humidity
PROFESSIONAL ASSOCIATIONS (BROADLY DEFINED)	* W m * Information, Policy, Education, Research, Best Practices, and Advocacy
Needs/Action Items	→ Training for professionals: Who they are, what their role is, what is their level of involvement (need for coordination, as with the blind men and the elephant)
GOVERNMENT AGENCIES	* W m * Regulation, Research, Information, Funding, Mandate, Training
Needs/Action Items	→ Who, what role, who has legislative authority, need to coordinate → Get good information to constituents; convene constituents to determine need for legislation—proactive, coordinated effort → Increased support for universities to teach building science (multi-hazard approach); need government health research strategy
TRIAL LAWYERS	* w M * Represent consumers seeking redress * Accelerant

The interest and roles of universities, environmental consultants, legislators, and consumers are to be determined.

3.5 'Remediator' Breakout Session Summary

The table following lists the participants in the 'Remediators' Breakout Session led by Alan Wozniak of Pure Air Controls.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
EILEEN C. LEE VP of Environment, Nat'l Multi Housing Council		STEVEJOHNSON Andersen (via tel.)	ROB PATERKIEWICZ ASHI	RICHARD GARRISON LAW Engineering	MCGREGOR PEARCE University of Minnesota School of Public Health	Steven Emmerich
JOE MAHEADY National Association of Realtors		HENRY GREIST LennoxIndustries	BILL ROSE Building Research Council	ALAN L. WOZNIAK Pure Air Control Services LEAD		William Whiddon scribe
		KEVIN POWELL NAHB Research Center		SHARI SOLOMON Connor Env.Services		David Levitt
		CAREY MITCHELL Shaw Industries				Michael Blanford
		PAUL SHIPP USG Research Center				Dick Santangelo

The group reviewed information developed by the staff at Pure Air Controls (presented in italics below) as a point of departure for the remediator perspective regarding each of the stated workshop objectives.

- Identify What We Know and Do Not Know About Mold – Mechanism, Effects, and Impacts
  - *From Pure Air Controls' perspective, We Know:*
    - *Buildings have been built for energy efficiency*
    - *"Deferred Maintenance" results in building deficiencies*
    - *Building product technology is always changing*
    - *If the industry allows for unprofessional practitioners and/or low-bid mindset, then the mold problems will get worse before they get better*
    - *Levels of indoor mold may be as varied as the situations in which they occur*
    - *There is no national framework to ensure a systematic examination to the mold situation*
    - *Indoor mold can be found at much greater levels than levels of concern outdoors*
    - *Mold requires moisture and a food source (substrate).*
    - *Mold can cause severe damage (degradation) to building materials and contents*
    - *HVAC systems may be primary transport system for the dispersion of mold spores*
    - *Mold detection requires scientific evaluation*
    - *Mold is ubiquitous (it is everywhere)*
    - *Most of the triggers of asthma and allergic (rhinitis) have not been subjected to rigorous study*
    - *Health effects from constant exposure to mixtures of indoor air molds are poorly understood*
    - *Some species can cause adverse health effects among humans as some are toxigenic/pathogenic.*
    - *Even with limited available data, the adverse healthy implications of mold have significant economic affects*
  - *From Pure Air Controls' perspective, We Don't Know:*
    - *What concentrations of specific molds (species) are considered harmful*
    - *The direct effect of mycotoxins on human health*
    - *Why some people become sensitized to varying levels of exposure*
    - *How "clean is clean" ?*
    - *What the long-term effects of exposure are, and at what dose*

    - *What remediation specifications and techniques will resolve the mold problem permanently, if at all possible*
    - *What the minimum level of remediation knowledge (practitioners) is necessary to protect the public from a mold problem becoming exacerbated*
  - "Energy efficient design" as bogey-man is undeserved (RH damage is over-emphasized)
  - "Durability" trumps "energy efficiency" every time (Joe Lstiburek via McGregor Pearce)
  - Mold is a preventable building failure issue and indicator
  - From the owner's perspective, the approach is simple: "see it, dry it, clean it, watch it"
  - Triggers for air (mold) testing: water event; physical evidence (water damage/mold growth); health symptoms
  - Food industry has robust mold monitoring and evaluation procedures: peer-reviewed methods for testing under different circumstances for different molds
  - Mold problems require moisture, food, temperature, and time

- Determine How to Apply Existing Knowledge to Avoid Moisture and Mold Problems
  - *Temporary Remedies (for intrusion of bulk water, floods)*
    - *Response times of 24 to 36 hours*
    - *Vacuum bulk water*
    - *Utilization of dehumidifiers and fans*
    - *Injection of dry air into walls (cavities)*
    - *With respect to water-damaged building materials, such as carpets, provide drying solution or replacement*
  - *Permanent Controls and Remedies:*
    - *Assessment of latent heat ratios of buildings*
    - *Adequate equipment selection and control location*
    - *Augment HVAC system with dehumidification*
    - *Balance exhaust and makeup air quantities*
    - *Roof and wall system design for differing climate regions in the U.S.*
    - *Minimize air infiltration (Demising / chick walls)*
    - *Avoid vinyl paper on walls with vapor pressure (interior/exterior)*
    - *Balance the air distribution system (supply and return)*
    - *Increase filtration efficiency (HVAC and housekeeping)*
  - In practice, measurement of air quality cannot be a single number: acceptable field method is to measure ambient, measure prior/current IAQ, measure post-remediation IAQ—best we can do is to state: "change was effected; levels (of measured parameters) were reduced"
  - Must note that no U.S. standards exist for IAQ based on level of exposure in buildings
  - ASTM standards used now by insurance and finance industries for other issues—ASTM-approved measurement methodologies would be a good first step for mold and water intrusion

- Catalog Effective Remediation Techniques and Recommend Methods for Disseminating Guidance to the Building Community
  - *Catalog Effective Remediation Techniques: Recommend a seven-step process*
    - *Define Goals and Objectives*
    - *Document Course of Action to be Taken*
    - *Establish Project Time Line (< 3 year plan)*
    - *Adopt Remediation Specifications*
    - *Select "Qualified" Contractor*
    - *Use Proven Technology*
    - *Consider Commissioning*
  - *Effective Remediation Techniques:*
    - *Industry-Approved Specifications: "Mechanical HVAC Duct Decontamination of Porous & Non-Porous Air Conveyance Systems"*

- *National Air Duct Cleaners Association (NADCA): "Mechanical Cleaning of Non-Porous Air Conveyance System Components" and "Introduction to HVAC System Cleaning"*
- *North American Insulation Manufacturers Association (NAIMA): "Cleaning of Fibrous Glass Insulated Air Duct Systems"*
- *New York City Department of Health: "Guidelines on Assessment and Remediation of Fungi in Indoor Environments"*
- *American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).*
- *National Fire Protection Association (NFPA)*
- *Occupational Safety and Health Administration (OSHA)*
- *Environmental Protection Agency (EPA)*
- *National Institute for Occupational Safety and Health (NIOSH)*
- *Federal Emergency Management Agency (FEMA)*
- *Centers for Disease Control and Prevention (CDC)*
- *Others*

o *Recommend Methods for Disseminating Guidance to the Building Community:*
- *Indoor air quality seminars*
- *Builders association meetings*
- *Public sector (state and local health departments)*
- *Private sector (manufacturer, supplier, environmental firms)*
- *Media*
- *Governing agencies / Associations: EPA, CDC, OSHA, NIOSH, AIHA, ACGIH, Other*

o Many stakeholders already involved in education, but high-profile hysteria dominates

o Recommend use of 'triage' approach"
- Remediate new event (set of immediate actions/steps)
- Establish baseline (and increase understanding) through research
- Perform preventive maintenance to avoid moisture (and mold)

o Sequestration of information is a problem: industry should seek mechanisms for sharing information and understanding

o Seek ways to overcome adversarial positions among industry participants—will enable discovery of 'common sense'

o Focus on implementation of good practices (we may be looking for sophisticated problems where common sense practices are available)

o Education is key! Proactively focus on moisture intrusion prevention—"reasonable care" will mitigate lawsuits and assist in underwriting

- Define Knowledge Gaps and Research Needs to Address Mold Assessment and Remediation

o *Knowledge Gaps: Many practitioners of mold remediation do not understand the indoor air environment or the health effects of mold on humans, and do not possess sufficient mold remediation training/experience. Possible Reasons:*
- *Lack of proper technical training (licensure)*
- *Lack of building construction knowledge*
- *Lack of building evaluation knowledge*
- *Lack of economic incentive*
- *Lack of regulatory control, promotes the scan industry, where "knowledge is not a prerequisite."*

o *Research Needs: In order to address the research needs for mold assessment / remediation, resolution of the following is required:*
- *The problem needs to be defined. (What levels, types and exposures are of concern).*
- *The detection process and protocols need to be refined and presented universally.*
- *The specifications required to abate and mitigate the "problem".*
- *Determine the industry which will be "licensed" to provide remediation services (carpet cleaners, chimney sweeps, duct cleaners, construction firms, restoration firms, self-professed professionals, or the remediation firm?).*

  - *The clearance testing process and protocols (how clean is clean?) for the specific environment.*
  - *Determine if single-family and multi-family dwellings can be managed with respect to mold problems equally.*
- Need: establish what is 'normal' IAQ (baseline); determination of simple 'a, b, c' levels may be a good starting point
- Large remediator firms have collected data in the normal course of doing business and may offer opportunities to expand current efforts to include focused collection of data on mold and water intrusion
- Database development will take several years; the key question is—"is this researchable?" (we do not yet have good candidates for parameters)
- There have been limited/narrow scope studies (such as reservation housing) that suggest five underlying indices of building performance/failure:
  - crawl spaces
  - site drainage
  - wall/ceiling connection detail
  - plumbing fixtures
  - catastrophic water entry

  These indices should be confirmed for the broader population of housing.
- Catalog site mold/IAQ/water measurement techniques (NIST should lead)—suggested title: "Mold Measurement in Buildings, State-of-the-Art"
- Measurement techniques should include practitioner qualifications
- Recommend MOU among federal agencies to leverage resources to address mold (in partnership with industry)
- Research finds two independent axes, arrays, empirical values, and is done (need NIST/federal government to find axes)—we need numbers/data, but more importantly we need units
- Key practical questions include: "What's clean? What's normal? What is the design condition?" (Corollaries: "What are the intents/expectations of designers? Owners?")
- Housing product manufacturers should incorporate feedback mechanisms/indicators for preventive maintenance and (failure) event occurrence; make products and systems as 'smart' as possible
- Need: prioritization of who we try to help, when—we should focus on managed properties first to leverage resources and understanding
- Research community must better control quality of published research (and reduce incidence of misinformed conclusions) through better peer review
- Industry should focus on investigation of moisture conditions relative to health outcomes (rather than mold)
- Mold is a 'liability-driven' issue—no fatalities; no disease—industry needs publications to counter scare tactics

3.6 'Research/Regulation' Breakout Session Summary

The table following lists the participants in the 'Research/Regulation' Breakout Session led by Laura Kolb of the U.S. EPA.

Owners/Occupants	Finance/Insurance	Producers	Gatekeepers	Remediators	Research/Regulation	NIST/HUD
NICK FARR Executive Director(ret.) National Center for Healthy Housing	RENATA HARRISON FNMA	THERESAKENINGER Pella Corporation	DONALD COLLIVER ASHRAE/UKY	PAUL BEERS Glazing Consultants, Incorporated	DORR DEARBORN CWRU	Andrew Persily
RUSSELL RIGGS Regulatory Policy National Association Of Realtors	TED CUDAL Safety Dir. And Response Mgr.,PRI (via tel.)	MARY LYNN PICKEL NAHB Environment	ERIC BURNETT BTEC/Civil and Environ. Engineering Penn State	GARY DEWALT Quantech	LAURA KOLB Indoor Environments Division, USEPA LEAD	Christopher White
		JAMES KIRBY Nat'l Roofing Contractors Assn (NRCA)				
		JOHN MCFEE Window and Door Manufacturers Association (NWDA)				David Hattis scribe
		THERESA WESTON DuPont Nonwovens				Eric Axelrod

The group elected to narrow its discussion to the identification of specific action items that could be undertaken to address mold issues for both the near term and longer term in the context of the environment for mold in housing.

- Environment of mold in housing
  - Reduce moisture: Climate analysis and home outdoor air supply
  - Reduce food for mold
  - Improve moisture dissipation/drying through better materials selection and construction practices
  - Detect system failures

- Action items: recommended Actions; focus on the major actions; describe who, what, and why.
  - Do we know medical effects? Several decades of study are needed
  - Develop tools to measure and understand exposure biomarker
  - Add moisture management to CAD
  - Checklist on moisture sources
  - Climate Research (seasonal, short term)
    - Effects of climate on building moisture?
    - Effects of micro-climate?
  - Recommended practices for outdoor air management
  - Tools for failure detection
  - Moisture management demonstration project in multi-family housing

4. Consensus Recommendations

Several common threads underlay the summary report recommendations from the six stakeholder breakout sessions. Highlight action items include:

- Focus on moisture control and mold prevention

- Expand education and training
  - Designers and architects
  - Builders and installers: Proper storage and use of building materials
  - Owner/occupants: Homeowner's manual, maintenance history, prevention guidelines, failure detection
  - Remediators: Technical, construction, and evaluation knowledge

- Improve public awareness
  - Need credible, recognized authority
  - Better dissemination of peer-reviewed research
  - Consensus messages, shared information
  - Counter misinformation from mass media

- Improve data
  - Measurement of IAQ, detection of mold
  - Benchmarks, goal posts
  - Health effects and outcomes, critical exposure
  - Susceptibility of construction materials
  - Predictors of building failure
  - Costs of failure (including medical) and remediation

- Identify incentives for good practices for:
  - Builders
  - Owners and occupants
  - Lenders
  - Insurers

Appendix A: NIST/HUD HHI Mold In Housing Workshop Agenda

DAY #1: Wednesday, October 30, 2002

8:30am	Welcome and Introductions	Ellen Taylor, HUD/HHI Robert Chapman, NIST
	Plenary Session: Stakeholder Orientation--the problem of mold in single-family and multifamily housing from the perspective of each stakeholder group	
8:45	"Owners/Occupants" Perspectives	Eileen Lee, NMHC
9:15	"Finance/Insurance" Perspectives	Mary Pat Denney, FreddieMac
9:45	"Producers" Perspectives	Kevin Powell, NAHB/RC
10:15	BREAK	
10:30	"Gatekeepers" Perspectives	David Conover, NES/ICC
11:00	"Remediators" Perspectives	Alan Wozniak, Pure Air Controls
11:30	"Research/Regulators" Perspectives	Laura Kolb, USEPA
NOON	LUNCH (NIST Cafeteria)	
1:00pm	**Concurrent Breakout Sessions (assigned participation): address all workshop objectives and added orientation recommendations solely from the perspective of the topic group** • "Owners/Occupants" Stakeholder Needs and Actions • "Finance/Insurance" Stakeholder Needs and Actions • "Producers" Stakeholder Needs and Actions (note: a break will be provided from 3:00-3:15)	
4:15	Recess	

DAY #2: Thursday, October 31, 2002

8:30am	Reconvene	Robert Chapman
8:45	**Concurrent Breakout Sessions (assigned participation): address all workshop objectives and added orientation recommendations solely from the perspective of the topic group** • "Gatekeepers" Stakeholder Needs and Actions • "Remediators" Stakeholder Needs and Actions • "Research/Regulators" Stakeholder Needs and Actions (note: a break will be provided from 10:00-10:15am)	
NOON	WORKING LUNCH (stakeholder group review and consensus on report out recommendations)	
	Plenary Session: Stakeholder Report Out Presentations—consensus summary recommendations of 'needs' and 'action items' identified in each breakout session	
1:00	"Owners/Occupants" Recommendations	Eileen Lee, et al
1:30	"Finance/Insurance" Recommendations	Mary Pat Denney, et al
2:00	"Producers" Recommendations	Kevin Powell, et al
2:30	BREAK	
2:45	"Gatekeepers" Recommendations	David Conover, et al
3:15	"Remediators" Recommendations	Alan Wozniak, et al
3:45	"Research/Regulators" Recommendations	Laura Kolb, et al
4:15	Closing Comments	Ellen Taylor Robert Chapman
4:30	Adjourn	

Appendix B: List of Acronyms

Acronym	Definition
ACGIH	American Conference of Governmental Industrial Hygienists Inc.
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BASE	Building Assessment, Survey and Evaluation
BTI	Building Technology Incorporated
CAD	Computer-aided design
CDC	Centers for Disease Control and Prevention
EIFS	Exterior insulation and finish systems
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GSE	Government-sponsored enterprise
HHI	Healthy Homes Initiative
HUD	Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air-Conditioning
IAQ	Indoor air quality
I-BEAM	IAQ Building Education and Assessment Model
IBPC	International Building Performance Code
ICC	International Code Council
IECC	International Energy Conservation Code
IEQ	Indoor Environmental Quality
IMC	International Mechanical Code
IPC	International Plumbing Code
IPMC	International Property Maintenance Code
IRC	International Residential Code
ISO	International Organization for Standardization
MFD	Multi-family dwelling
MOU	Memorandum of understanding
NADCA	National Air Duct Cleaners Association
NAHB	National Association of Home Builders
NAHBRC	NAHB Research Center
NAIMA	North American Insulation Manufacturers Association
NAS	National Academy of Sciences
NES	National Evaluation Service
NFPA	National Fire Protection Association
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMHC	National Multi Housing Council
O&M	Operations and maintenance
OSHA	Occupational Safety and Health Administration
PCR	Polymerase chain reaction
PMP	Preventive maintenance program
QC	Quality control
RH	Relative humidity
SFD	Single-family dwelling

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