# Hazard Review and Approval System at the National Institute of Standards and Technology (NIST)

Sonja G. Ringen
Occupational Health and Safety Specialist
sonja.ringen@nist.gov

# History of Hazard Review at NIST

- NIST cited for poor safety culture in 2008 after plutonium spill
- DoE Tiger Teams reviewed labs; identified that hazards not evaluated, i.e. the "researchers didn't know what they didn't know"
- Collateral Duty Safety staff built on a hazard review process, adopted in 2009
- Hazard Review adopted NIST-wide, 2010
- Revised as Work and Worker Authorization Based on Hazard Reviews ("Hazard Review"), 2015

# Development of Program

- Collaborative approach with staff
- Flows from NIST's Occupational Safety and Health Management System based on OHSAS Standard 18001:2007
- Based on risk-assessment matrix

# Applicability

- All activities conducted at NIST must have hazard review, except:
  - Common everyday tasks performed routinely by members of the general public at work and home and that do not involve extraordinary hazards
    - Working at a computer, climbing stairs, using scissors
  - Inherently low-risk activities
    - Activities that could result in first-aid injuries but only infrequently or
    - Activities resulting in medical-treatment injuries but very unlikely to do so
  - Application shows almost all activities reviewed
- Creates effective and efficient use of resources--ROI

# Risk Assessment Methodology

## SEVERITY

- Catastrophic
- Severe
- Moderate
- Minor

## LIKELIHOOD

- Frequent
- Probable
- Occasional
- Remote
- Improbable

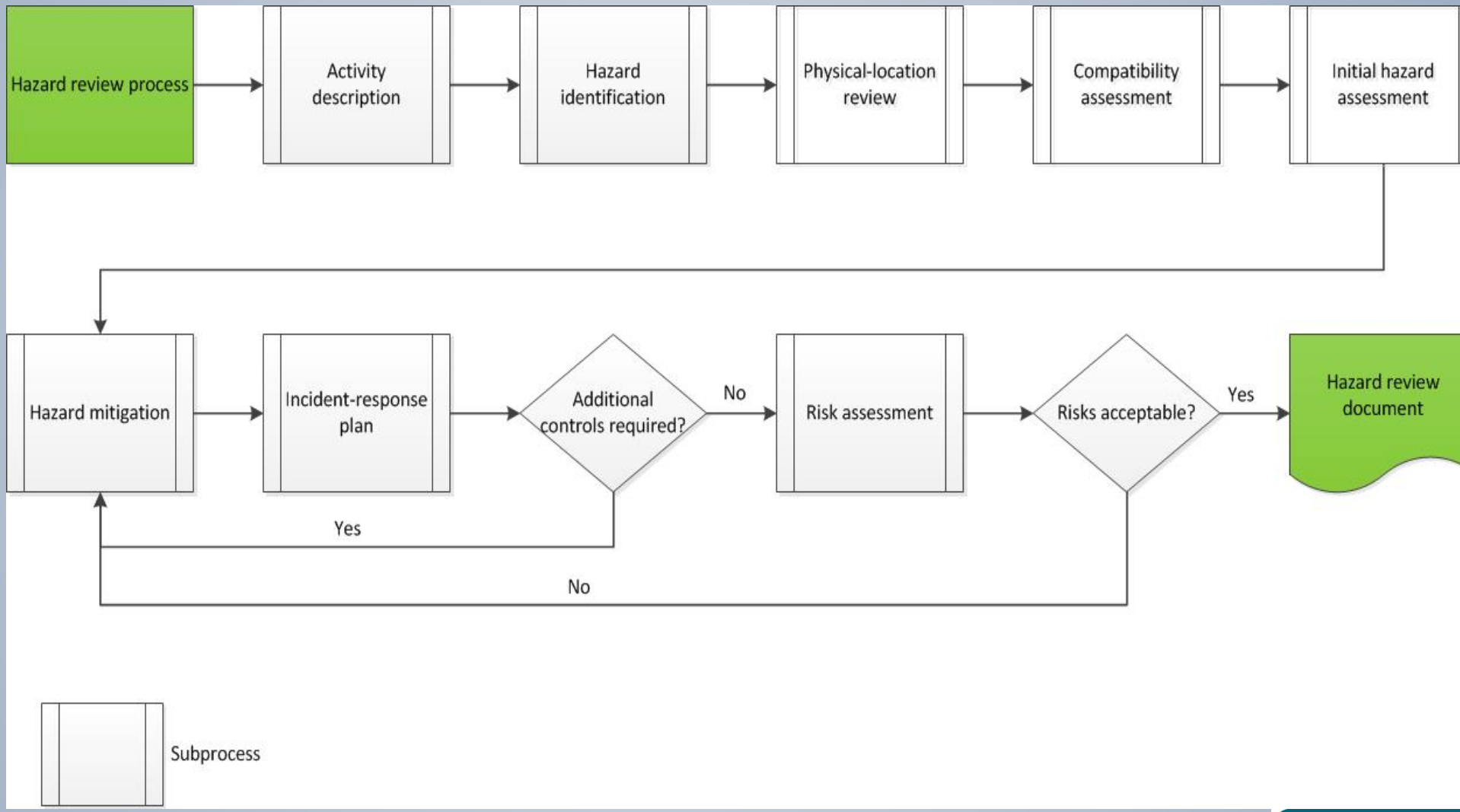
# Relative Hazard Index (RHI)

- Critical (RHI = 4)
- Serious (RHI = 3)
- Medium (RHI = 2)
- Low (RHI = 1)
- Minimal (RHI = 0)

(RHI = 4 prohibited at NIST)

| | | POTENTIAL SEVERITY OF THE CONSEQUENCES OF A HAZARDOUS EVENT OR EXPOSURE TO A HAZARD | | | |
|---|---|---|---|---|---|
| | | **Catastrophic** Death or permanent disability; System or facility loss; Lasting environmental or public-health impact | **Severe** Serious injury; temporary disability; Subsystem loss or significant facility/property damage; Temporary environmental or public-health impact | **Moderate** Medical treatment beyond first aid; lost-work-day(s); More than slight facility/ property damage; External reporting requirements; more than routine clean-up | **Mino** First-aid; Negligible facility/proper; No external requirements clean- |
| LIKELIHOOD OF OCCURRENCE | **Frequent** Likely to occur repeatedly | **CRITICAL RHI=4** | **CRITICAL RHI=4** | **SERIOUS RHI=3** | Mediu RHI= |
| | **Probable** Likely to occur multiple but infrequent times | **CRITICAL RHI=4** | **CRITICAL RHI=4** | **SERIOUS RHI=3** | Mediu RHI= |
| | **Occasional** Likely to occur at some time | **CRITICAL RHI=4** | **SERIOUS RHI=3** | **Medium RHI=2** | Low RHI= |
| | **Remote** Possible, but not likely to occur | **SERIOUS RHI=3** | **Medium RHI=2** | **Medium RHI=2** | Low RHI= |
| | **Improbable** Very unlikely; can reasonably assume it will not occur | **Medium RHI=2** | **Low RHI=1** | **Low RHI=1** | Minim RHI= |

# Hazard Review Process

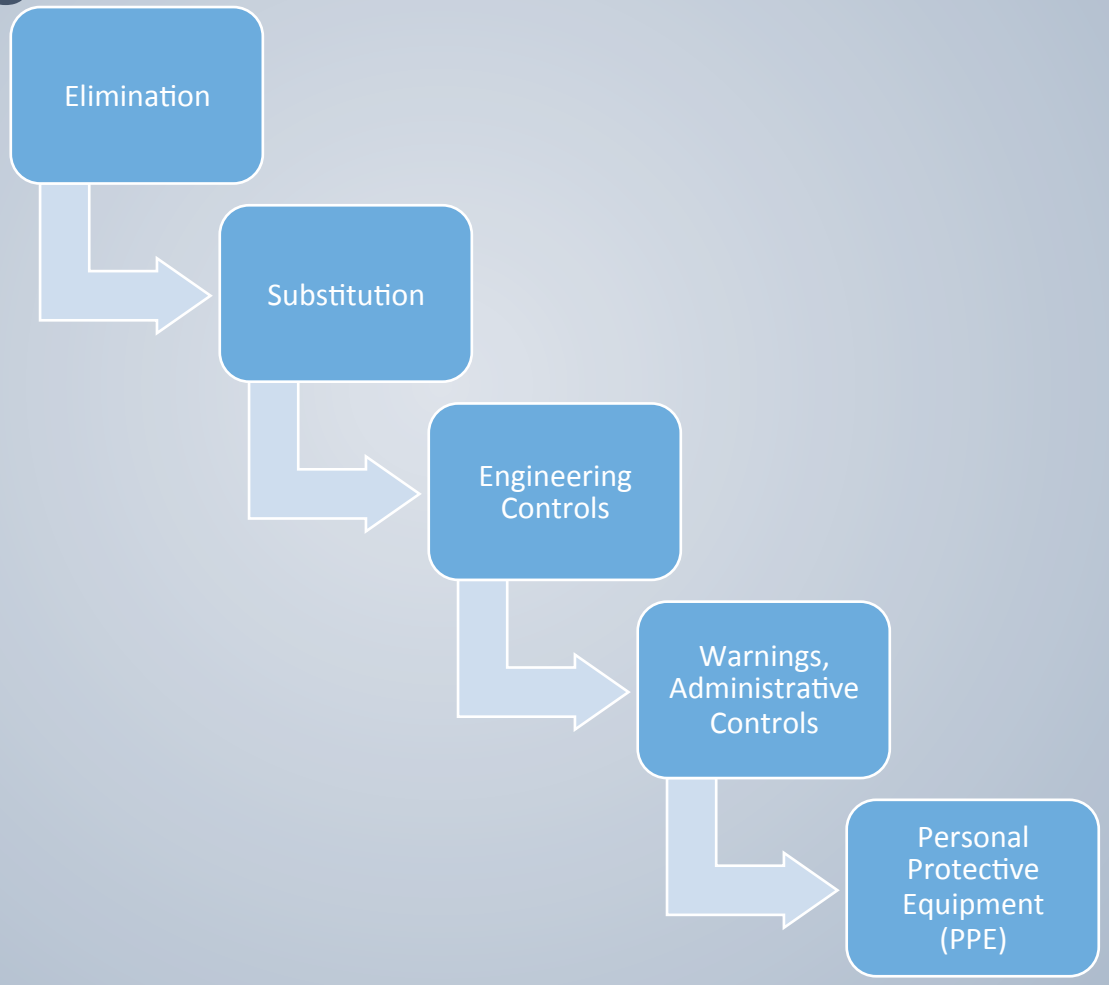


# Hazard Examples

| Hazard | Description |
|---|---|
| Asphyxiation/Oxygen Displacement | Lack of breathable oxygen resulting from the displacement of air in a room by sudden release of cryogenic fluids such as liquid nitrogen or liquid helium or in confined spaces such as manholes by the accumulation of noxious gases. |
| Biological* | Biological material or condition that presents potential risk to the health of humans or other organisms, either directly through infection or indirectly through damage to the environment. |
| Chemical (Carcinogen) * | A chemical that is capable of causing cancer. Mutagens are capable of damaging chromosomes. |
| Chemical (Corrosive) | A chemical that, when it comes into contact with skin, metal, or other materials, damages the materials. Acids and bases are examples of corrosives. |
| Chemical (Flammable) | A chemical that when exposed to a heat ignition source results in combustion. Typically, the lower a chemical's flashpoint and boiling point, the more hazardous the chemical. Check MSDS for flammability/combustibility information. In general, flammable (combustible) materials are those with flash points lower than 100 °F (38 °C) |
| Chemical (Teratogen) * | Teratogens are capable of damaging fetuses. |
| Chemical (Toxic) | A chemical that when absorbed through the skin, inhaled, or ingested causes illness, disease, or death. The amount of chemical exposure is critical in determining hazardous effects. Check Material Safety Data Sheets (MSDS), and/or OSHA 1910.1000 for chemical hazard information. |
| Dispersible Engineered Nanomaterial* | Intentionally-produced, dispersible material with one or more dimensions between approximately 1 nm and 100 nm |
| Dust/Particles (Irritant) * | Any solid material in powdered form with particles that may irritate eyes, or the respiratory tract. |
| Explosion (Chemical Reaction) | Sudden and violent release of a large amount of gas/energy due to a chemical reaction. |
| Explosion (Over Pressurization) | Sudden and violent release of a large amount of gas/energy due to a significant pressure difference such as rupture in a boiler or compressed gas cylinder. |
| Electrical (Shock/Short-Circuit) | Contact with exposed conductors or a device incorrectly or inadvertently grounded. Contact with high voltages. Contact with 60 Hz alternating current (common house current) is very dangerous because it can stop the heart. |
| Electrical (Fire) | Use of electrical power that results in electrical overheating or arcing to the point of combustion or ignition of flammable material, or electrical component damage. |
| Electrical (Static/ESD) | The moving or rubbing of wool, nylon, other synthetic fibers, and even flowing liquids can generate static electricity. This creates an excess or deficiency of electrons on the surface of material, which discharges (spark) to the ground resulting in the ignition of flammables or damage to electronics or the body's nervous system. |
| Electrical (Loss of Power) | Safety-critical equipment failure as a result of loss power. |
| Ergonomics (Strain) | Damage of tissue due to overexertion (strains and s or repetitive motion. |
| Ergonomics (Human Factor) | A system design, procedure, or equipment that is e provocative. (A switch goes up to turn something c |
| Excavation (Collapse) | Soil collapse in a trench or excavation as a result o improper or inadequate shoring. Soil type is critica determining the hazard likelihood. |
| Fall (Slip, Trip) | Conditions that result in falls (impacts) from heigh traditional walking surfaces (such as slippery floor housekeeping, uneven walking surfaces, exposed l etc.) |
| Fire/Heat | Temperatures that can cause burns to the skin or da other organs. Fires require a heat source, fuel, and |
| Mechanical/Vibration (Chaffing/Fatigue) | Vibration that can cause damage to nerve endings, material fatigue that results in a safety-critical failu (Examples are abraded slings and ropes, weakened and belts.) |
| Mechanical Failure | Self-explanatory; typically occurs when devices ex designed capacity or are inadequately maintained. |
| Mechanical | Skin, muscle, or body part exposed to crushing, ca between, cutting, tearing, shearing items or equipm |
| Noise | Noise levels (>85 dBA, 8 hr TWA) that result in h damage or inability to communicate safety-critical information. |
| Radiation (Ionizing) | Alpha, Beta, Gamma, neutral particles, and X-rays cause injury (tissue damage) by ionization of cellu components. |
| Radiation (Non-Ionizing) | High power lasers and ultraviolet, visible, infrared, microwave radiation that cause injury to tissue or e thermal, photochemical, or other means. |
| Struck By (Mass Acceleration) | Accelerated mass that strikes the body causing inju death. (Examples are falling objects and projectiles |
| Struck Against | Injury to a body part as a result of coming into con surface when the action was initiated by that perso example is when a screwdriver slips.) |
| Temperature Extreme Cold | Temperatures that result in hypothermia, frostbite, as may occur upon exposure to cryogens. |
| Temperature Extreme Heat | Temperatures that result in heat stress or exhaustio |
| Visibility | Lack of lighting or obstructed vision that results in or other hazard. |
| Weather (Snow/Rain/Wind/Ice) | Self-explanatory |

NISTS

# Hazard Mitigation—Hierarchy of Controls



# Hazard Review Process

- Requires mitigation to control hazards
- Requires activity-specific training
  - Documented in Safety Education and Training web application
- Must specify PPE
- Requires incident-response plans (activity-specific)
- High risk activities activities flagged
  - Lockout/tagout, confined-space entry, hearing or respiratory protection, fall protection, exposure to carcinogenic chemicals
- Ties into other safety programs
  - e.g., Chemical Management, Compressed Gases, Cryogens, Hazard Signage, Safety Education and Training

# Approval of Hazard Reviews

- All are signed by line management
- Hazard review committees required for RHI 3
- Authorization of Workers included in hazard reviews
- Must be re-reviewed and re-approved for changes in activities, controls, or if new hazard is identified
- Must be re-reviewed at least every 3 years
- Approvals by line management based on RHI:
  - Group Leaders for activities with RHI $\leq$ 1
  - Division Chiefs for activities with RHI = 2, but no RHIs = 3
  - OU Directors for activities with at least one RHI = 3

# Challenges and Lessons Learned

- Staff resistant if too much paperwork, called a box-checking exercise
- Considerations for change management
- Hazard Review of entire lab vs. single activity
- Cloning previous hazard reviews (stay for next presentation)
- Allowances for each OUs styles, formatting, documentation requirements

# Hazard Reviews

## Call to action!

Use this as a challenge and a tool to develop or improve your own hazard review system.