National Institute of Standards and Technology • U.S. Department of Commerce

WORK AND WORKER AUTHORIZATION BASED ON HAZARD REVIEWS ("HAZARD REVIEW")

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1. PURPOSE

The purpose of this suborder is to define the requirements and associated roles and responsibilities for authorizing both hazardous activities ("work") and workers based on a systematic level of work planning and control commensurate to the hazards, job complexities, and physical location, *i.e.*, based on hazard reviews.

2. BACKGROUND

a. This suborder describes NIST's graded approach to managing the safety of a wide range of hazardous activities, from those that are relatively simple and routine to those that are highly complex one-time projects. The graded approach is based on the severity of the consequences of hazardous events or exposures to hazards and the likelihood of such events or exposures.

b. While this suborder primarily focuses on hazardous activities performed under normal and off-normal operating conditions, there are provisions for authorizing work and workers under abnormal operating conditions in which external factors may alter the risk assessment or present additional hazards to those directly associated with performance of the activity.

c. This suborder supersedes NIST Administrative Manual Subchapter 12.06, *Hazard Analysis and Control*.

3. APPLICABILITY

a. The requirements of this suborder apply to all activities conducted by NIST employees and associates as part of their assigned duties under normal operating conditions except for the following:

(1) *Common Everyday Tasks Performed Routinely by Members of the General Public at Work and Home and that Do Not Involve Extraordinary Hazards.* This exception recognizes that NIST staff members possess the knowledge, skills, and abilities to perform a wide variety of common everyday tasks safely without written hazard reviews. Examples of such common everyday tasks include working at a computer, reviewing documents, walking, climbing stairs, picking up objects, and using scissors or short step stools.

(2) *Inherently Low-Risk Activities.* This exception applies to activities that are considered to present low safety risks without NIST personnel having to implement any safety controls to mitigate those risks.[1,2] The following activities are considered to present low safety risks:

(a) Activities that could result in injuries requiring first aid but only infrequently; and

(b) Activities that could result in injuries requiring medical treatment beyond first aid but are very unlikely to do so.

Examples of inherently low-risk activities include calibrating a balance, preparing non-hazardous solutions, and using an optical microscope to examine non-hazardous samples.

b. The requirements of this suborder apply to any activity, regardless of the hazardous nature of the activity itself, when performed under abnormal operating conditions (see Section 2.b) where external factors may present hazards or pose additional risk beyond those associated with performance of the activity, except when:

(1) Following the general requirements and/or guidance associated with the abnormal condition provides sufficient protection from the hazards associated with the abnormal condition;

(2) No activity-specific instructions are needed to implement the general requirements and/or guidance associated with the abnormal operating conditions; and

(3) The activity-specific risks do not change as a result of the abnormal conditions.

[1] This presumes that if such an activity involves the use of equipment with built-in safety features, these features do not require written safe work practices, are not easily defeated, and will not be intentionally defeated or separated from the equipment.

[2] The requirements of this suborder apply to any activity for which PPE is *required* to mitigate the activity's safety risks. They do not apply to the following uses of PPE: PPE required solely for entry into the space in which the inherently low-risk activity is conducted, not for protection from the hazards associated with the activity; PPE used *voluntarily* as an additional layer of protection; and PPE worn solely to protect equipment or materials.

c. The exemptions provided in Section 3a do not relieve NIST staff members or management from their responsibility to manage the safety risks associated with common everyday tasks and inherently low-risk activities. NIST focuses on these using a variety of mechanisms, including general safety training, safety-related communications, and incident awareness and reduction efforts. In addition, the exemptions do not relieve NIST of its responsibility to evaluate the compatibility of such activities with more hazardous activities in the same spaces.

4. REFERENCES

a. 29 Code of Federal Regulations 1910.132, Personnel Protective Equipment.

5. APPLICABLE OCCUPATIONAL SAFETY AND HEALTH (OSH) SUBORDERS

a. NIST S 7101.04: Safety and Health Requirements for Minors;

b. NIST S 7101.21: Personal Protective Equipment;

c. NIST S 7101.58: Respiratory Protection;

d. NIST S 7101.55: Hearing Protection;

e. NIST S 7101.22: Hazard Signage;

f. Other OSH suborders that contain sections focused on the identification, assessment, and mitigation (*i.e.*, control) of hazards in specific OSH areas, *e.g.*, chemical hazard communication, chemical management, cryogen safety, dispersible engineered nanomaterials, hearing protection, and magnetic-field safety, to name several; and

g. NIST S 7101.23: Safety Education and Training.

6. REQUIREMENTS

Requirements are provided for the risk-assessment methodology to be used in conducting hazard reviews; the content, conduct, and approval of hazard reviews; the authorization of work and workers; the re-review, and re-approval, of hazard reviews and the re-authorization of work that falls outside the scope of current hazard reviews; retraining and reauthorization of workers according to updated hazard reviews; records; activities involving workers from multiple OUs; and Organizational Unit (OU) implementing procedures. Appendix B illustrates the processes for authorizing work and workers and the role of hazard reviews.

a. Risk-Assessment Methodology

Procedures for implementing this suborder shall use the risk-assessment matrix in Appendix C as the basis for conducting risk assessments. Once a hazard has been identified, the risk of a hazardous event or exposure associated with that hazard shall be characterized, as indicated in Appendix C and below, by a Relative Hazard Index (RHI) based on the severity of the consequences of a hazardous event or exposure to a hazard and the likelihood of such an event or exposure.

(1) Severity of the consequences of a hazardous event or exposure to a hazard ("Severity")

(a) The severity categories in Appendix C provide qualitative measures of the consequences of the worst credible hazardous event (see definition of "Worst Credible Hazardous Event") or exposure associated with an identified hazard due to design inadequacies; procedural deficiencies; human error; environmental conditions; or system, subsystem, or component failure or malfunction. The severity categories that shall be used are:

i. CATASTROPHIC: Death or permanent disability; system or facility loss; major property damage, lasting environmental or public-health impact.

ii. SEVERE: Serious injury; temporary total disability (more than 3 months); subsystem loss or significant facility/property damage, temporary environmental or public-health impact.

iii. MODERATE: Medical treatment beyond first aid; lost workdays; more than slight facility/property damage; external reporting requirements; more than routine clean-up.

iv. MINOR: First aid or minor medical treatment; negligible or slight facility/property damage; no external (outside NIST) reporting requirements, routine cleanup.

(2) Likelihood of a hazardous event or exposure ("Likelihood")

(a) The likelihood categories in Appendix C broadly estimate the probability that a hazardous event or exposure involving an identified hazard will occur in carrying out an activity. The likelihood categories that shall be used are:

i. FREQUENT: Likely to occur frequently or repeatedly.

ii. PROBABLE: Likely to occur multiple but infrequent times.

iii. OCCASIONAL: Likely to occur at some time.

iv. REMOTE: Possible, but not likely to occur.

v. IMPROBABLE: Very unlikely: can reasonably be assumed not to occur.

To the extent practical, likelihood should be assigned based on research, analysis, experience, or evaluation of historical safety data from work with similar hazards.

(3) RHIs

(a) RHIs shall be associated with identified hazards by assigning both severity and likelihood categories as indicated above and by identifying the corresponding RHIs at the intersection of the severity column and likelihood row in the risk-assessment matrix in Appendix C. The RHI levels that shall be used are:

i. Critical (RHI = 4)

ii. Serious (RHI = 3)

iii. Medium (RHI = 2)

iv. Low (RHI = 1)

v. Minimal (RHI = 0)

The RHI for an identified hazard provides a measure of the risk associated with that hazard *assuming* that some set of controls has been implemented, where that set of controls could range from inherent/built-in controls only to inherent/built-in controls plus additional controls. In this sense, *RHIs are based on mitigated hazards*.[3]

b. Hazard-Review Process

Hazard reviews shall consist of the following primary elements, each of which must be documented: (1) activity description, (2) activity hazard identification, (3) physical-location review, (4) compatibility assessment, (5) initial hazard assessment, (6) hazard mitigation, (7)

[3] RHIs are sometimes conceptualized as being based on (a) severity *taking into account inherent/built-in controls only* and (b) likelihood *after the implementation of additional controls.* This is valid to the extent that additional controls reduce, or are considered to reduce, *only* likelihood, *not* severity.

incident-response plan, and (8) risk assessment. Appendix D provides a flowchart illustrating the relationship of these elements.

(1) Activity Description
Hazard reviews shall:

(a) Fully and accurately describe the activity being reviewed, including its intended outcome or expected result, in a way that is detailed enough for someone outside of the division or group to understand it;[4]

(b) Define the activity boundaries by identifying what is included in the activity as well as what is specifically excluded from the activity, *e.g.*, commissioning, normal operations, and maintenance of an instrument could be considered separate activities with their own hazard reviews, depending on how different the hazards and associated controls are in the three phases;

(c) Identify distinct subtasks within an activity based on significant differences in the nature of the work and associated hazards (hazards may differ from task to task and must be managed accordingly);

(d) Specify the physical location in which the activity is to be conducted; if the activity is to be conducted in multiple locations, describe the general environment in which the activity will be conducted and describe any specific restrictions, if applicable. When the restrictions vary from location to location, subtasks should be assigned by location.

(2) Activity Hazard Identification
The activity hazard identification shall:

(a) Identify the hazards associated with the activity, or, if the activity comprises distinct subtasks, the hazards associated with each of those subtasks; and

(b) Note, reference, or include as attachments to the hazard review the results of any exposure assessments or calculations conducted to characterize or quantify identified potential hazards associated with the activity.

(3) Physical-Location Review
The physical-location review shall determine if the venue in which the activity is to be conducted is appropriate and adequate. Routine laboratory, shop, or mechanical activities

[4] An activity description similar to a scientific abstract would represent a best management practice.

are typically acceptable in spaces intended for such activities. OSHE should be consulted, however, when unique, atypical, or unusual activities may not be consistent with the proposed venue, and the results of the consultation should be noted in the review. For example, OSHE should be consulted when the activity involves unusual quantities or classes of hazardous materials or requires specialized fire and life-safety systems or emergency-response equipment, and the results should be noted in the review.

(4) Compatibility Assessment

The compatibility assessment shall examine the hazard reviews associated with the totality of activities conducted in the proposed physical location, both in the actual space itself and, when applicable, neighboring spaces, to identify any potentially negative or antagonistic interactions, taking into account both planned operations and off-normal conditions that could reasonably be expected to occur.

(5) Initial Hazard Assessment

The initial hazard assessment shall:

(a) Identify for each identified hazard the key stages in the activity, or its subtasks, at which a hazardous event or exposure could occur, focusing on those stages essential to safe conduct of the activity or its subtasks; and

(b) Assign severity levels to each of the identified hazards, taking into account inherent/built-in controls only, *i.e.*, prior to identifying any other controls (see definition of "Inherent/Built-In Controls");

(c) Consider any synergistic, negative, or antagonistic interactions identified in the compatibility assessment.

(6) Hazard Mitigation

(a) Hazard mitigation shall employ the following "hierarchy of controls" (*i.e.*, preferred order of implementation of controls) to mitigate each of the identified hazards, with each subsequent control category being less effective and reliable than the previous category:

i. Elimination;

ii. Substitution;

iii. Engineering controls;

iv. Administrative controls (including signage, warnings, alarms, and training), and;

v. Personal protective equipment (PPE).

Hierarchy of controls shall be employed until enough controls have been identified to mitigate the hazards to acceptable levels; in some cases, a combination of controls may be necessary, *e.g.*, engineering controls such as machine guarding and local exhaust ventilation could be used in conjunction with training and PPE to mitigate a hazard. There must be a clear connection between the hazards, the controls, and the mitigation of the hazards.

(b) Hazard mitigation shall stipulate the engineering controls required for an activity, *e.g.*, chemical fume hood, gas cabinet, enclosures, interlocks, blast wall, safety interlock.

(c) Hazard mitigation shall specify the alarms and other warnings required for an activity, *e.g.*, toxic gas alarms, oxygen sensors, warning lights, hazard signage.

(d) When engineering controls and alarms and other warnings must be integrated into the building infrastructure, the hazard review shall confirm that the physical location in which the activity is to be conducted contains, or will contain, such equipment.

(e) Hazard mitigation shall specify safe operating guidelines, as applicable (see definition of "Safe Operating Guidelines"), and incorporate these explicitly in the hazard review, either in their entirety or by reference.

(f) Hazard mitigation shall specify any restrictions on employees conducting activities alone or out of hours, and if there are such restrictions, the additional safety measures that must be implemented, e.g., buddy system, safe operating guideline.

(g) Hazard mitigation shall specify any ongoing direct supervision required for employees to engage in the activity when ongoing direct supervision is deemed a necessary administrative control.

(h) Hazard mitigation *should* specify any restrictions on:

i. The number of hours employees spends on the activity during a workday;

ii. The time of day employees conduct the activity; and

iii. The environmental conditions under which employees conduct the activity.

(i) Hazard mitigation shall specify the PPE required for conduct of the activity or subtasks of the activity.

i. All PPE, including employee-owned PPE, shall be of safe design and construction for the work to be performed.

ii. PPE shall be selected in accordance with the requirements in the PPE and other OSH suborders (*e.g.*, Biosafety, Cryogen Safety, Hearing Protection, Respiratory Protection, *etc.*), as applicable.

iii. PPE that properly fits each affected employee shall be selected.

(j) Hazard mitigation shall, based on the physical-location review, identify any additional controls necessary to conduct the activity safely in the proposed physical location.

(k) Hazard mitigation shall, based on the compatibility assessment, identify any additional controls necessary to conduct the proposed activity safely in proximity to other activities in the space and, when applicable, neighboring spaces.

(l) Hazard mitigation shall specify the activity-specific training, to be provided by the OU, required for employees to engage in the activity, or distinct subtasks of the activity, in the proposed physical location, and, when applicable, in proximity to other activities in the space and neighboring spaces.

i. The Safety Education and Training suborder requires employees to complete the training specified in OSH suborders (*e.g.*, Biosafety, Cryogen Safety, Magnetic Fields, *etc.*) applicable to the work they are to conduct. This training is documented and recorded in accordance with the requirements of the Safety Education and Training suborder and need not be specified in the hazard review.

ii. When activities involve the use of PPE, the activity-specific training must result in employees being able to demonstrate an understanding of the following requirements, and any special activity-specific abilities needed to use the applicable PPE properly, before they are permitted to perform work with that PPE:

(i) What PPE is necessary;

(ii) When PPE is necessary;

(iii) How to properly don, doff, adjust, and wear the PPE;

(iv) The limitations of the PPE; and

(v) The proper care, maintenance, useful life, and disposal of the PPE.

This activity-specific training must address only those activity-specific aspects of the PPE not covered in either (1) the training provided by OSHE on the PPE program, or (2) the training completed previously by affected employees for other activities. This training shall be provided by OU employees, or others, who have demonstrated an understanding of the activity-specific aspects of the applicable PPE and any activity-specific ability to use that PPE properly.

(m) Voluntary use of controls should be documented in the hazard mitigation section of the Hazard Review when such use is subject to requirements in other OSH suborders.[5]

(7) Incident-Response Plan (Activity Specific)
Planning for incidents, including off-normal conditions[6], as applicable, is a critical element of the hazard review process. In addition to providing guidance during an emergency, the development of incident-response plans may result in the identification of hazardous conditions that could aggravate or compound an emergency situation. Additionally, the planning process may bring to light deficiencies, such as the lack of resources (equipment, trained personnel, supplies) or adequate controls that can be rectified before an emergency occurs. Hazard reviews shall include activity-specific incident-response plans that:

(a) Stipulate any activity-specific equipment and supplies required for incident response, *e.g.*, emergency shut-off switch, spill containment, special-purpose vacuum cleaner;

(b) Include the following when necessary to protect employee safety and health, the physical location, and the environment:

[5] For example, the voluntary use of respiratory protection is governed by specific requirements in the Respiratory Protection suborder.
[6] Examples of off-normal conditions, *i.e.*, conditions outside of expected operating limits, include over or under pressure, over or under temperature, over or under flow rates, and loss of electrical power.

i. Procedures for shutting down or placing systems in a safe configuration;

ii. Plans for responding to off-normal conditions resulting from the failure of one or more controls in the activity itself and, when necessary, other activities conducted in the same space or neighboring spaces;

iii. Plans for responding to events such as utility losses, *e.g.*, power or water, and building evacuations; and

iv. The identification of additional controls deemed necessary to reduce risks to acceptable levels;

(c) Ensure that decisions regarding employees working alone or out of hours fully consider the need to respond promptly, if necessary, to incidents that threaten employee safety and health or the environment; and

(d) Specify the activity-specific incident-response training, to be provided by the OU, required for employees to engage in the activity or distinct subtasks of the activity.

(8) Risk Assessment

(a) Hazard Reviews shall include an assessment of the risks by assigning RHIs to each of the identified hazards subsequent to the application of controls.

(b) If the risk assessment subsequent to hazard mitigation results in RHIs that feasibly could be lower, additional steps to mitigate the hazards shall be taken to reduce the RHIs to those lower levels.

(9) Additional Requirements

(a) Hazard reviews shall meet the additional requirements established in other OSH suborders, when applicable;[7]

(b) Hazard reviews shall flag, *e.g.*, using checkboxes, activities requiring the control of hazardous energy (lockout/tagout), confined-space entry, hearing protection,

[7] For example, hazard reviews of activities involving the use of biohazardous materials must include a Biohazardous Materials Registration and Authorization Form approved by the NIST Biosafety Officer; hazard reviews of activities involving the use of radioactive material at NIST Gaithersburg must include (among other things) a specific hazard assessment and hazard mitigation plan whose safety evaluation by the NIST Gaithersburg Radiation Safety Officer has been approved by the NIST Ionizing Radiation Safety Committee.

respiratory protection, fall protection, and assessments of exposure to carcinogenic chemicals;

(c) Hazard reviews shall be readily available in hard-copy or electronic form in or near the space in which the associated activities are to be conducted; and

(d) Hazard reviews shall identify hazardous wastes generated in the conduct of the activity and include management of those wastes, as applicable. Arrangements for disposal shall be coordinated with OSHE.

c. Conduct of Hazard Reviews

Hazard reviews shall be conducted by, or in consultation with, individuals with the knowledge, skills, and abilities to identify, assess, and mitigate the hazards associated with the activity under review, to conduct the physical-location review and compatibility assessment, and to develop plans for incident response.

(1) Hazard reviews shall be conducted by individuals who collectively[8] have taken the training provided by OSHE on the Hazard Review program and on all OSH programs pertinent to the activity under review.

(2) Hazard reviews should include subject matter experts from OSHE, the Office of Facilities and Property Management (OFPM), and other OUs when the OU conducting the hazard review requires additional safety or facilities expertise.

(3) Hazard reviews shall include consultation with the relevant groups in OSHE, ESO, and OFPM (*e.g.*, Fire and Facilities Safety Group, Police Services Group, Fire Protection Group, Facilities Maintenance Division) when activity-specific alarms must be tied into building or facility alarm systems.

d. Approval of Hazard Reviews[9, 10]

Completed hazard reviews shall be approved by line management, with the approval signifying that the RHIs associated with the activity represent an acceptable level of safety risk.[11]

[8] At least one member of the team must have taken the required training.
[9] Sections 6d-i focus on activities that involve workers from a single OU. Section 6j indicates how Sections 6d-i apply to activities that involve workers from multiple OUs.
[10] OUs may approve hazard reviews and authorize work at one time provided that the requirements in this section and Section 6e, respectively, are met.
[11] The approved hazard review serves as the Certification of Hazard Assessment required by 29 CFR 1910.132, *Personal Protective Equipment*.

(1) Hazard reviews shall be approved by line managers who have taken the training provided by OSHE on the Hazard Review program.

(2) Activities with any RHI = 4 shall not be conducted at NIST.

(3) Hazard reviews of activities involving minors (individuals under age 18) that could result in their being exposed to hazards with RHI = 2 shall be approved by OU Directors.[12, 13]

(4) With the exceptions noted in items (5) and (6) below, all other hazard reviews shall be approved at the following *or higher* levels of the line management of the OU responsible for the activity (see NIST 7101.00):[14]

(a) Group Leaders:

i. Activities with all RHIs ≤ 1.

(b) Division Chiefs:

i. Activities with some RHIs = 2 but no RHIs = 3.

(c) OU Directors:[15]

i. Activities with at least one RHI = 3.

(5) Activities for which the highest hazards have RHI = 2 and these are fully controlled to industry standards (see definition of "Fully Controlled to Industry Standards"), as determined by OSHE, may be approved by Group Leaders.

(6) Activities for which the highest hazards have RHI = 3 and these are fully-controlled to industry standards (see definition of "Fully Controlled to Industry Standards"), as determined by OSHE in consultation with experts in the OUs, may be approved by Division Chiefs.

[12] As indicated in Section 10. AUTHORITIES, OU Directors may delegate the authority to approve such hazard reviews to OU Deputy Directors or Division Chiefs.
[13] Activities with RHIs > 2 and a list of other specific activities are prohibited for minors; see the Safety and Health Requirements for Minors suborder.
[14] OUs may require lower levels of line management (and others, e.g., chairs of hazard review committees, OU/division safety personnel, and project leaders) to sign off on hazard reviews prior to those hazard reviews being approved at the levels of line management indicated.
[15] OU Directors may wish to establish (standing or *ad hoc*) Hazard Review Committees to conduct (or review) hazard reviews for such activities and recommend their approval or disapproval.

e. Authorization of Work[16]

Activities covered by approved hazard reviews shall be authorized to commence by line management, with the authorization signifying that controls other than training[17] have been verified to have been implemented and that the controls will continue to be implemented as a condition for the ongoing conduct of the work.[18]

(1) Activities shall be authorized by line managers who have taken the training provided by OSHE on the Hazard Review program.

(2) Activities with any RHI =4 shall not be authorized by NIST.

(3) With the exceptions noted in item (4) below, activities covered by all other hazard reviews shall be authorized at the following *or higher* levels of line management:[19]

(a) Group Leaders:

i. Activities with all RHIs ≤ 2.

(b) Division Chiefs:

i. Activities with at least one RHI = 3.

(4) Activities for which the highest hazards have RHI = 3 and these are fully-controlled to industry standards (see definition of "Fully Controlled to Industry Standards"), as determined by OSHE, may be authorized by Group Leaders.

(5) If an activity of one OU is to be conducted in space assigned to another OU, access to that space must be authorized by the line management of the second OU subject to any conditions established by that OU to protect other employees working in the space from the hazards associated with the activity. These conditions must be included as part of the formal authorization of work (see NIST 7101.00).

[16] OUs may approve hazard reviews and authorize work at one time provided that the requirements in this section and Section 6e, respectively, are met.

[17] Training is addressed not in the authorization of work, but in the authorization of workers; see Section 6f.

[18] So, for example, if a chemical fume hood is a required control, and the chemical fume hood is out of service or suspected to be functioning improperly, the work must stop until the fume hood is fully operational or an equivalent control is identified and implemented. Similarly, PPE must be in good working condition; defective or damaged PPE shall not be used.

[19] OUs may require lower levels of line management (and others, such as chairs of hazard review committees, OU/division safety personnel, and project leaders) to sign off on authorizations of work prior to work being authorized at the level of line management indicated.

f. Authorization of Workers

To engage in activities that have been authorized by line management, workers must themselves be authorized to perform that work by line management. This authorization signifies that:

- The workers have taken the training specified in the OSH suborders applicable to the work they are to conduct and the activity-specific training identified in Sections 6b(6)(i) (Hazard Mitigation) and 6b(7)(c) (Incident-Response Plan);

- Line-management has an appropriate degree of confidence, based on personal knowledge, observation, or reliable input from others, that the workers to be authorized:

    - Have the knowledge, skills, and abilities to perform the work safely and correctly; and

    - Fully understand the boundaries/conditions imposed on the activity by the activity hazard review, the need to work within those boundaries/conditions, and the process for requesting work that falls outside of those boundaries/conditions.

(1) Workers shall be authorized by line managers who have taken the training provided by OSHE on the Hazard Review program and, in the case of official first-level supervisors, on all OSH programs applicable to the work to be conducted;[20] and

(2) Workers shall be authorized by their official first-level supervisors, *or at that level and higher*.[21, 22]

g. Re-Review and Re-Approval of Hazard Reviews and Re-Authorization of Work and Workers

[20] The Safety Education and Training suborder requires official first-level supervisors to complete training on the OSH suborders applicable to the work to be conducted by employees they supervise. This training is documented and recorded in accordance with the requirements of the Safety Education and Training suborder and need not be specified in the hazard review.

[21] If a worker is to be authorized to carry out only a specified set of subtasks of a larger activity, that worker need only take the training applicable to that specified set of subtasks.

[22] If an activity involves workers from one or more groups or divisions within a single OU, the OU may wish to establish additional requirements for authorizing workers across organizational lines. For example, if an activity owned by one group involves workers from a second group and the two Group Leaders are the official first-level supervisors, the OU may wish to have the workers from the second group authorized first by their Group Leader and then by the Group Leader of the group that owns the activity.

(1) Hazard reviews shall be re-reviewed whenever:

(a) Changes in existing activity parameters would introduce new hazards or increase existing hazards; [23]

(b) Changes in engineering controls, administrative controls, or PPE would increase safety risks; or

(c) Previously unrecognized safety issues are identified, *e.g.*, through direct observation or discussion, relating to an incident or audit that indicates inadequate controls, or abnormal operating conditions which affect availability or efficacy of documented, planned controls.

(2) Hazard reviews shall be re-reviewed on a predetermined basis to verify that the hazards have not changed substantially since the hazard review was last approved or reviewed, and that existing controls are adequate. Predetermined review periods:

(a) Shall be established when hazard reviews are initially reviewed and approved and when they are re-reviewed;

(b) Shall not exceed three years;

(c) Shall be included in the hazard review documentation;

(d) Shall be based on risk and the potential for change, with higher-risk, more potentially variable activities being reviewed more frequently; and

(e) May be more frequent based on the likelihood for change within an activity.

(3) When re-reviews indicate that hazards *have not* changed *and* that existing controls are *adequate*, the re-reviewed hazard reviews shall include the date of the re-review, the signature(s) of the individual(s) conducting the re-review, and the signature of the responsible line manager.

(4) When re-reviews indicate that hazards *have* changed *or* that existing controls are *inadequate*:

[23] For example, changes in equipment, equipment operation, materials, maximum quantities of materials, concentrations, operating temperatures and pressures, power levels, or process rates, or changes in permit conditions for permit-required activities, that would introduce new hazards or increase existing hazards.

(a) The re-reviewed hazard reviews shall be re-approved in accordance with the requirements in Section 6d; and

(b) Work and workers shall be re-authorized in accordance with the requirements in Sections 6e and 6f, respectively.

The re-approval of the hazard review and the re-authorization of work shall take place at the levels of line management determined by the hazards that have changed or for which the existing controls are inadequate, or at a higher level of line management.

h. Retraining and Re-Authorization of Workers

(1) Employees who have been authorized to conduct work shall, as a condition of their authorization, complete retraining identified by the OUs whenever there is reason to believe that employees lack the knowledge, understanding, or skill necessary to conduct their work safely. Individual OSH suborders list specific circumstances under which such retraining is required. General circumstances under which retraining is required include, but are not limited to:

(a) An observation or other condition reveals that a worker lacks the necessary knowledge understanding or skill; or

(b) An inspection or audit points to a systemic deficiency warranting retraining.

i. Records

(1) Copies of all current hazard reviews and work and worker authorizations shall be maintained in hard copy or electronic form.

(2) Copies of hazard reviews and work and worker authorizations for activities that have ceased shall be maintained in hard copy or electronic form for at least one (1) year unless the hazard assessment involved exposure monitoring, in which case the hazard review and work and worker authorizations shall be submitted to OSHE for retention in accordance with the requirements of the Industrial Hygiene program.

(3) Training shall be documented and recorded in accordance with the requirements, roles, and responsibilities in the Safety Education and Training suborder.

j. Activities Involving Workers from Multiple OUs

(1) The activity shall be owned by the *de facto* lead OU or, if it is not obvious which OU is the *de facto* lead OU, by the OU determined to be the lead OU by discussion among the involved OUs.

(2) The hazard review shall be approved by the lead OU in accordance with the requirements in Section 6d, Approval of Hazard Reviews.

(3) Work shall be authorized by the lead OU in accordance with the requirements in Section 6e, Authorization of Work.

(4) Workers from the lead OU shall be authorized by the lead OU in accordance with the requirements in Section 6f, Authorization of Workers.

(5) Workers from OUs other than the lead OU shall be authorized by their respective OUs in accordance with the requirements in Section 6f *and* by the lead OU ("final authorization") in accordance with its own requirements.

(a) In authorizing workers from their OUs, OUs other than the lead OU should determine that the hazard review is adequate, that the safety risk to workers from their OUs is acceptable, and that the work has been authorized by the lead OU.

(6) Hazard reviews shall be re-reviewed and re-approved and work and workers from the lead OU shall be re-authorized by the lead OU in accordance with the requirements in Section 6g, Re-Review and Re-Approval of Hazard Reviews and Re-Authorization of Work and Workers.

(7) Workers from OUs other than the lead OU shall be re-authorized by their respective OUs in accordance with the requirements in Section 6g *and* by the lead OU ("final re-authorization") in accordance with its own requirements.

(8) Workers from the lead OU shall be retrained and re-authorized by the lead OU in accordance with the requirements in Section 6h, Retraining and Re-Authorization of Workers.

(9) Workers from other than the lead OU shall be retrained and re-authorized by their respective OUs in accordance with the requirements in Section 6h *and* by the lead OU in accordance with its own requirements.

(10) Records related to hazard-review documentation, the authorization of work, and the authorization of workers from the lead OU shall be maintained by the lead OU in accordance with the requirements in Section 6i, Records.

(11) Records of the authorization of workers from OUs other than the lead OU shall be maintained as follows:

(a) Records of the authorization of workers from OUs other than the lead OU shall be maintained by the workers' respective OUs; and

(b) Records of the final authorizations of such workers by the lead OU shall be maintained by the lead OU.

k. OU Hazard Review and Work and Worker Authorization Procedures
Written procedures, which, if followed, would result in the requirements in Sections 6a-j being met, shall be developed and maintained by each OU.

7. DEFINITIONS

a. Abnormal Conditions – Operational occurrences caused by external factors which are not expected to occur as part of normal and off-normal conditions and may alter the risk assessment or present additional hazards to those directly associated with performance of the activity. Examples include restricted access to campus or need to work in close contact with another staff member during pandemic conditions.

b. Activity – An experiment, operation, process, or job, often comprising subtasks, conducted to achieve a specific outcome.

c. Direct Supervision – Relative to an employee, a term meaning that a second employee, proficient in the activity being conducted by the first employee, shall be either present in the work area while the activity is being conducted or available for consultation within a reasonable amount of time commensurate with the need for consultation, based on the proficiency of the first employee.

d. Fully Controlled to Industry Standards (Used in Reference to Hazards) – Controlled by a device, apparatus, or system being designed in accordance with applicable regulatory and consensus standards and predicated upon that device, apparatus, or system being used in a prescribed manner. The mitigation of hazards that are fully controlled to industry standards relies primarily on built-in/engineering controls or inherent design features but may, in some cases, rely upon best practices. In either case, the control should be traceable to a broad industry, consensus-based set of controls.

e. Hazard – Source, situation, or act with a potential for harm in terms of human injury or ill health, adverse impact on the environment, damage or loss of equipment or property, or a combination of these (from NIST 7101.00).[24]

f. Hazard Identification – Process of recognizing that a hazard exists and defining its characteristics (from NIST 7101.00).

g. Hazard Review (Document) – A document describing the results of the hazard-review process.

h. Hazard Review (Process) – The formal process, aspects of which could be iterative, of describing an activity, identifying the hazards associated with the activity, reviewing the physical-location in which the activity will be carried out, assessing the compatibility of the activity with nearby activities, conducting an initial hazard assessment, identifying controls to mitigate the hazards, developing an incident-response plan, conducting a risk assessment, and developing plans for managing wastes generated during the conduct of the activity.

i. Hierarchy of Controls – A range of hazard control methods arranged in order of implementation preference from elimination to substitution, engineering controls, administrative controls, and personal protective equipment.

j. Inherent/Built-In Controls – Features of a system's design that prevent or limit the severity of the consequences of system failure. Inherent/built-in controls cannot be defeated or separated from the system without conscious or willful effort.

k. Likelihood of a Hazardous Event or Exposure ("Likelihood") – An estimate of the probability of a hazardous event or exposure.

l. Line Management – For the purposes of this suborder, the OU Director, Division Chief, and Group Leader, or equivalent.

m. Office-Like Space – A space, such as a conference room, copier room, break room, or ordinary computer room that has the same types of hazards as a typical office or office environment.

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[24] This definition parallels that in *Occupational Health and Safety Assessment Series (OHSAS) Standard 18001:2007, Occupational Health and Safety Management Systems – Requirements*. For comparison, *OSHA 3071, Job Hazard Analysis, 2002 (revised)* defines a hazard as "the potential for harm, often associated with a condition or activity that, if left uncontrolled, can result in injury, illness or damage to property or the environment", and *American National Standard for Occupational Safety and Health Management Systems, ANSI/AIHA Z10-2005,* defines a hazard as "a condition, set of circumstances, or inherent property that can cause injury, illness or death".

n. Off-Normal Conditions – Operational occurrences which may be expected to occur that are generally outside routine or planned operations. For example, loss of cooling water would be an "off-normal" condition which could cause a heat-sink to overheat and combust. Other examples include power failure, error at power-up or power-down, loss of cryogen containment, human error, *etc.*

o. Relative Hazard Index (RHI) – A measure of the risk of a hazardous event or exposure based on a combination of the severity of the consequences of the hazardous event or exposure to a hazard and its likelihood.

p. Risk – Combination of the likelihood of an occurrence of a hazardous event or exposure and the severity of injury or ill health that can be caused by the event or exposure (from NIST 7101.00).

q. Risk Assessment – Process of evaluating the risks arising from hazards, taking into account the adequacy of any existing controls, and deciding whether or not the risks are acceptable (from NIST 7101.00).

r. Safe Operating Guideline – A written set of requirements or practices developed or designed to enable a task to be carried out safely. Safe operating guidelines can include, but are not limited to, standard operating procedures, job hazard analyses, and instrument/equipment instruction manuals.

s. Severity of the Consequences of a Hazardous Event or Exposure to a Hazard ("Severity") – A qualitative measure of the consequences of the worst credible hazardous event or exposure associated with an identified hazard due to design inadequacies; procedural deficiencies; human error; environmental conditions; or system, subsystem, or component failure or malfunction.

t. Standard Operating Procedure – A written step-by-step procedure or operational protocol used to document how a given task **must** be carried out to ensure safe operation. Standard operating procedures are generally needed when failure to follow a prescribed set of steps results in significant increase in risk.

u. Worst Credible Hazardous Event – Most severe or serious event capable of being believed, taking into account all relevant considerations.

8. ACRONYMS

a. HR – Hazard Review

b. OSH – Occupational Safety and Health

c. OSHE – Office of Safety, Health, and Environment

d. OU – Organizational Unit

e. PPE – Personal Protective Equipment

f. RHI – Relative Hazard Index

9. ROLES AND RESPONSIBILITIES

a. NIST Director and Associate Directors:

(1) Concur or non-concur on approvals by OU Directors of hazard reviews of activities elevated to the directorship level.

b. OU Directors:

(1) Ensure that written OU procedures are developed, maintained, and implemented to ensure that the requirements of Sections 6a-j are met within their respective OUs.

c. Line Management:

(1) Take the training provided by OSHE on the Hazard Review program;

(2) Ensure that hazard reviews are conducted for all new activities;

(3) Involve employees in the conduct of hazard reviews as appropriate;

(4) Ensure that hazard reviews are conducted by individuals who collectively have taken the training provided by OSHE on the Hazard Review program and on all NIST OSH programs pertinent to the activity under review;

(5) Approve hazard reviews in accordance with the requirements of Section 6d, with the approval signifying that the RHIs associated with the activity represent an acceptable level of risk;

(6) Authorize activities in accordance with the requirements of Section 6e, with the authorization signifying that controls other than training have been verified to have been

implemented and that required safety equipment shall be maintained in proper working order in accordance with manufacturers' specifications and all applicable standards;

(7) Authorize workers in accordance with the requirements of Section 6f, with the authorization signifying that (a) the workers have taken the training provided by OSHE on all NIST OSH programs pertinent to the activity to be conducted and the training identified in Sections 6b(6)(l) and 6b(7)(d), (b) line management has an appropriate degree of confidence, based on personal knowledge, observation, or reliable input from others, that the workers to be authorized have the knowledge, skills, and abilities to perform the work safely and correctly, and (c) the workers fully understand the activity boundaries/conditions, the need to work within those established boundaries/conditions, and the process for requesting work that falls outside those boundaries/conditions;

(8) Re-review and re-approve hazard reviews and re-authorize work and workers in accordance with the requirements of Section 6g;

(9) While visiting laboratories, discussing work, or conducting management observations:

(a) Be vigilant for "scope creep", i.e., advertent or inadvertent changes in activity boundaries/conditions or controls that introduce new hazards, increase existing hazards, or otherwise increase safety risk; and

(b) If scope creep is identified, stop work and require re-review and re-approval of the hazard review and re-authorization of work and workers, as per Section 6g;

(10) Maintain records in accordance with the requirements of Section 6h.

d. Official First-Level Supervisors Authorizing Work (in addition to their responsibilities as part of Line Management):

(1) Complete the training provided by OSHE on all NIST OSH programs pertinent to the work to be authorized; and

e. Employees Conducting Hazard Reviews:

(1) Take the training provided by OSHE on the Hazard Review program.

f. Employees Authorized to Engage in Work:

(1) Complete the training provided by OSHE on all NIST OSH programs pertinent to the work to be conducted and the training provided by the OU identified in Sections 6b(6)(i) (Hazard Mitigation) and 6b(7)(c) (Incident-Response Plan), as applicable; and

(2) Work within the boundaries/conditions of the hazard review at all times and in accordance with required controls and training;

(2) If it is necessary or desirable to work outside the boundaries/conditions of a hazard review or change existing controls, request line management re-review of the hazard review as per Section 6g; and

(3) Be vigilant for scope creep, and if scope creep is identified, stop work and request line management re-review of the hazard review, as per Section 6g.

g. Employees Assigned Responsibility for Safety Equipment:

(1) Ensure that required safety equipment is maintained in proper working order in accordance with manufacturers' specifications and all applicable standards.

h. Employees:

(1) Participate in the conduct of hazard reviews as appropriate.

i. Chief Safety Officer:

(1) Maintain this suborder;
(2) Develop and maintain any necessary supporting NIST directives, including procedures, guidance, and notices;

(3) Review the efficacy of written OU procedures for meeting the requirements of this suborder and provide the results of those reviews to the respective OU Directors; and

(4) Support, through the OSHE staff, OU implementation of this suborder.

j. OSH Program Manager for the Hazard Review program:

(1) Make determinations that particular hazards are controlled to industry standards and maintain and make available to the OUs a list of such hazards and their associated RHIs;

(2) Develop and maintain any necessary deployment tools, including forms, instructions, IT applications, training, and user guides;

(3) Serve as the primary point of contact and subject matter expert on:

(a) Federal, State and local regulatory requirements and guidelines; and

(b) Consensus industry standards and best practices.

(4) Ensure effective communication with management and staff on program-related issues.

10. AUTHORITIES

For authorities applicable to all NIST OSH suborders, see NIST 7101.00. There are no authorities specific to this suborder alone.

11. DIRECTIVE OWNER

Chief Safety Officer

12. APPENDICES

Appendix A. Revision History

Appendix B. Processes for Authorizing Work and Workers

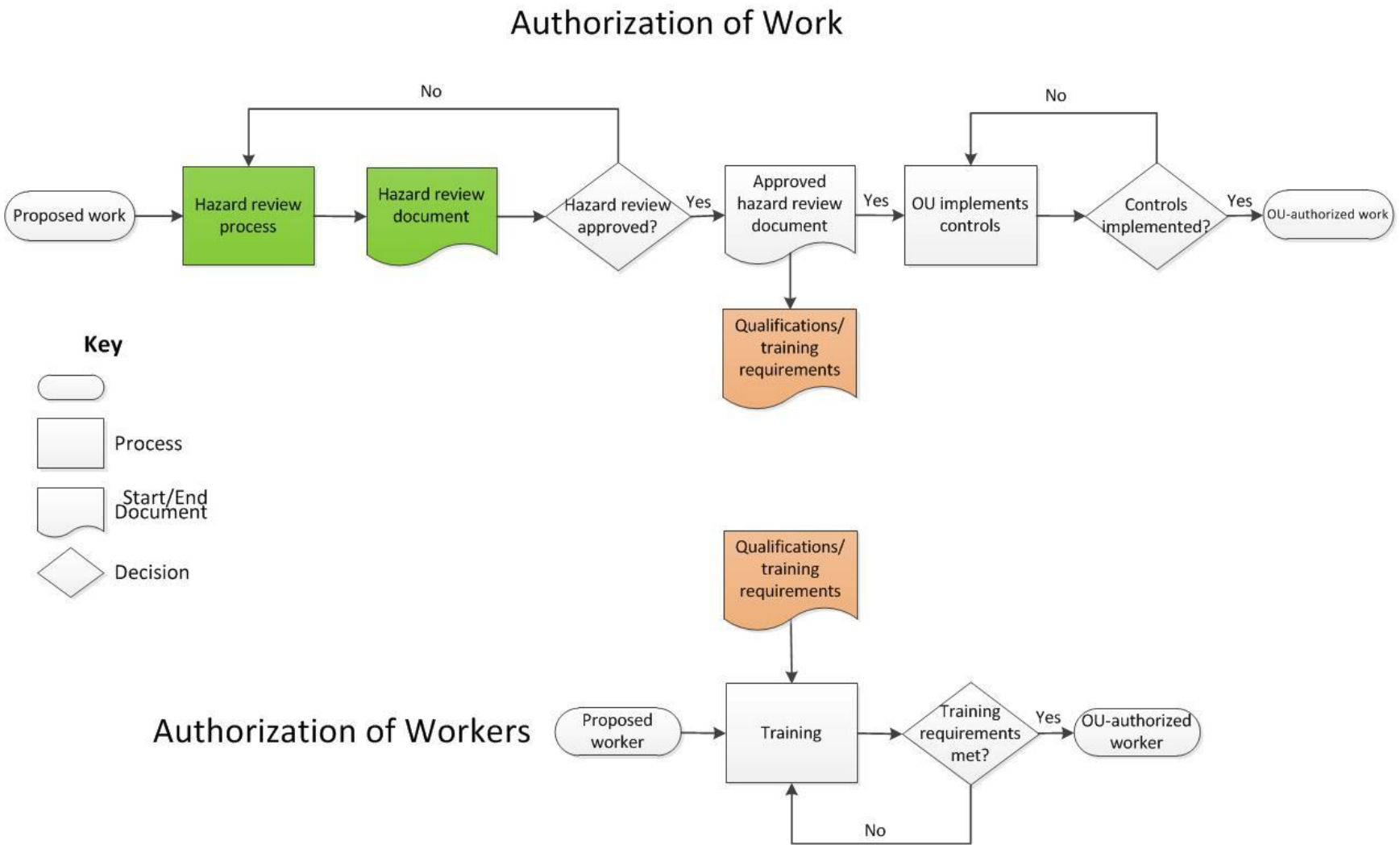
Appendix C. Risk-Assessment Matrix

Appendix D. Elements of the Hazard Review Process

Appendix A. Revision History

Revision	Date	Responsible Person	Description of Change
1	01/23/15	Richard Kayser	Modifications made to Section 3. Applicability, subsequent to Executive Safety Committee review.
2	11/07/17	Richard Kayser	Modified Section 6 to make more explicit the need for workers to understand the requirements of hazard reviews and the need to stay within scope or request re-review. Modified Section 9 to reflect the responsibilities necessary to fulfil the modified requirements in Section 6.
3	05/05/2020		• Modified Section 2.b to include abnormal conditions • Modified Section 3.b to include applicability of abnormal conditions. • Modified Section 6g(1)(c) to include abnormal conditions
4	12/23/2020	April Camenisch	Updated links under References and Applicable Suborders.

Appendix B. Processes for Authorizing Work and Workers (for details on the hazard-review process, see Appendix D)



Appendix C. Risk-Assessment Matrix

This matrix is used to determine the risk level, or Relative Hazard Index (RHI), for a given hazard.

		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	**Minor** First-aid only Negligible or slight facility/property damage No external reporting requirements; routine clean-up
LIKELIHOOD OF OCCURRENCE	**Frequent** Likely to occur repeatedly	**CRITICAL RHI=4**	**CRITICAL RHI=4**	**SERIOUS RHI=3**	**Medium RHI=2**
	Probable Likely to occur multiple but infrequent times	**CRITICAL RHI=4**	**CRITICAL RHI=4**	**SERIOUS RHI=3**	**Medium RHI=2**
	Occasional Likely to occur at some time	**CRITICAL RHI=4**	**SERIOUS RHI=3**	**Medium RHI=2**	**Low RHI=1**
	Remote Possible, but not likely to occur	**SERIOUS RHI=3**	**Medium RHI=2**	**Medium RHI=2**	**Low RHI=1**
	Improbable Very unlikely; can reasonably assume it will not occur	**Medium RHI=2**	**Low RHI=1**	**Low RHI=1**	**Minimal RHI=0**

Appendix D. Elements of the Hazard Review Process (see Section 6b)