

Chapter 2: [Work Planning and Control](#)

Enhanced Rigor Work Planning and Control Procedure

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URL: <https://www-esh.slac.stanford.edu/eshmanual/references/wpcProcedEnhanced.pdf>

1 Purpose

The purpose of this procedure is to protect SLAC personnel, property, and programs by ensuring enhanced rigor work planning and control (ERWPC) is applied to all *high-consequence work*, defined as tasks or activities where errors or incidents during the work have the highest potential adverse consequences.

It covers identifying and categorizing high-consequence work, analyzing its hazards, and selecting controls.

It applies to workers (as *persons-in-charge*, *responsible individuals*, and technicians), project and system managers, responsible engineers, ESH coordinators, ESH program managers and other subject matter experts, associate laboratory directors, and the work planning and control program manager.

This procedure and its controls are in addition to, not substitutes for, standard work planning and control requirements (see [Work Planning and Control: Work Planning and Control Procedure](#)).

2 ERWPC Categorization and Minimum Work Control Elements

One of the guiding principles of work planning and control is to ensure that error prevention, including hazard control, is commensurate to the work being performed.

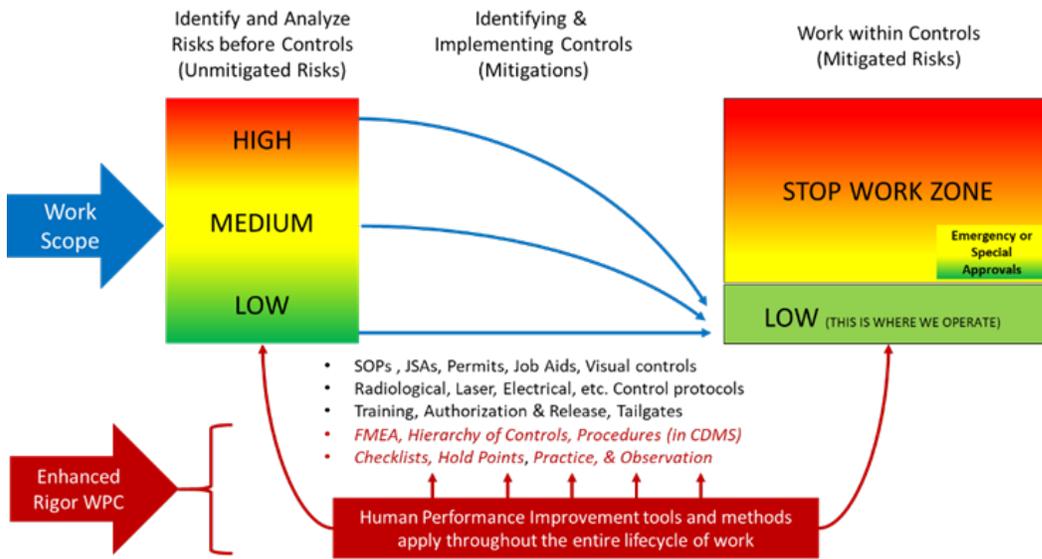


Figure 1 Work Planning and Control Model

Tasks where risks or errors have the highest potential adverse consequence are to be considered high-consequence work, defined as follows:

High-consequence work. Tasks or activities where errors or incidents during the work have the highest potential adverse consequence to SLAC personnel, property, or programs. Work would be considered high-consequence if there is the potential for any of the following conditions:

- Any work that has risk of serious injury or fatality that is not fully eliminated through normal WPC
- Could result in release to the environment of radionuclides or other hazardous substances that could result in on- or off-site personnel exposure above permissible limits or exceed local, state, or federal reportable quantities
- Cost to replace or repair the item or system or delay in operations would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitments
- Item or system being worked on is unique and if damaged would be irreplaceable or not repairable and is vital to a system, facility or project operation
- *Deactivation and decommissioning (D&D)* activities of legacy systems or infrastructure

Note SLAC and each directorate may identify supplemental requirements to the criteria above to mitigate unacceptable risks to the laboratory, its mission, and stakeholders.

Work determined to be high consequence will in turn be categorized as either Category 1 or Category 2.

- Category 1 tasks require the highest level of engineering rigor and analysis in identification and implementation of error and safety mitigation.
- Category 2 tasks are designated as high consequence but require fewer structured engineering risk analyses to ensure error and safety mitigations are in place.

Each directorate will identify, assess, and categorize all potential high-consequence work tasks planned in their areas. These tasks will be subject to this procedure.

Projects ([DOE 413.3B](#) as well as non-413.3B projects) will specifically identify and document Category 1 and Category 2 work activities that will be performed at SLAC, from receiving, installation, testing, and commissioning through to the completion of transition to operations (TTO).

Tasks that have not been designated high-consequence Category 1 or 2 must be performed using standard [work planning and control](#) and [conduct of engineering](#) procedures.

2.1 Determining High-consequence Work

Once a work activity has been identified, the SLAC responsible individual must assess the potential risks and consequences by addressing the following questions.

Important Assess each question thoroughly with the relevant SMEs, ESH program managers and coordinators, and stakeholders. Use the current list of examples, in Table 1, for guidance.

1. Does the planned activity involve an item or system where, if it were damaged, the cost for replacement or repair or the delay in operations would affect program commitments?
2. Does the planned activity involve a unique item that is vital to a system, facility, or project operations, and if it were damaged if would be irreplaceable or not repairable?
3. Could a significant release of radioactivity or hazardous material occur if an error, or incident occurs during the work activity?
4. Does the activity have a potential risk of serious injury or fatality if nominal work planning and control controls are insufficient?
5. Does the work activity involve decontamination, decommissioning, or demolition of legacy equipment and/or infrastructure?

If the answer to any of these questions is yes, the activity is high-consequence work and the next step is to determine the category, either Category 1 or Category 2. (See Figure 2 for an illustration of the process.)

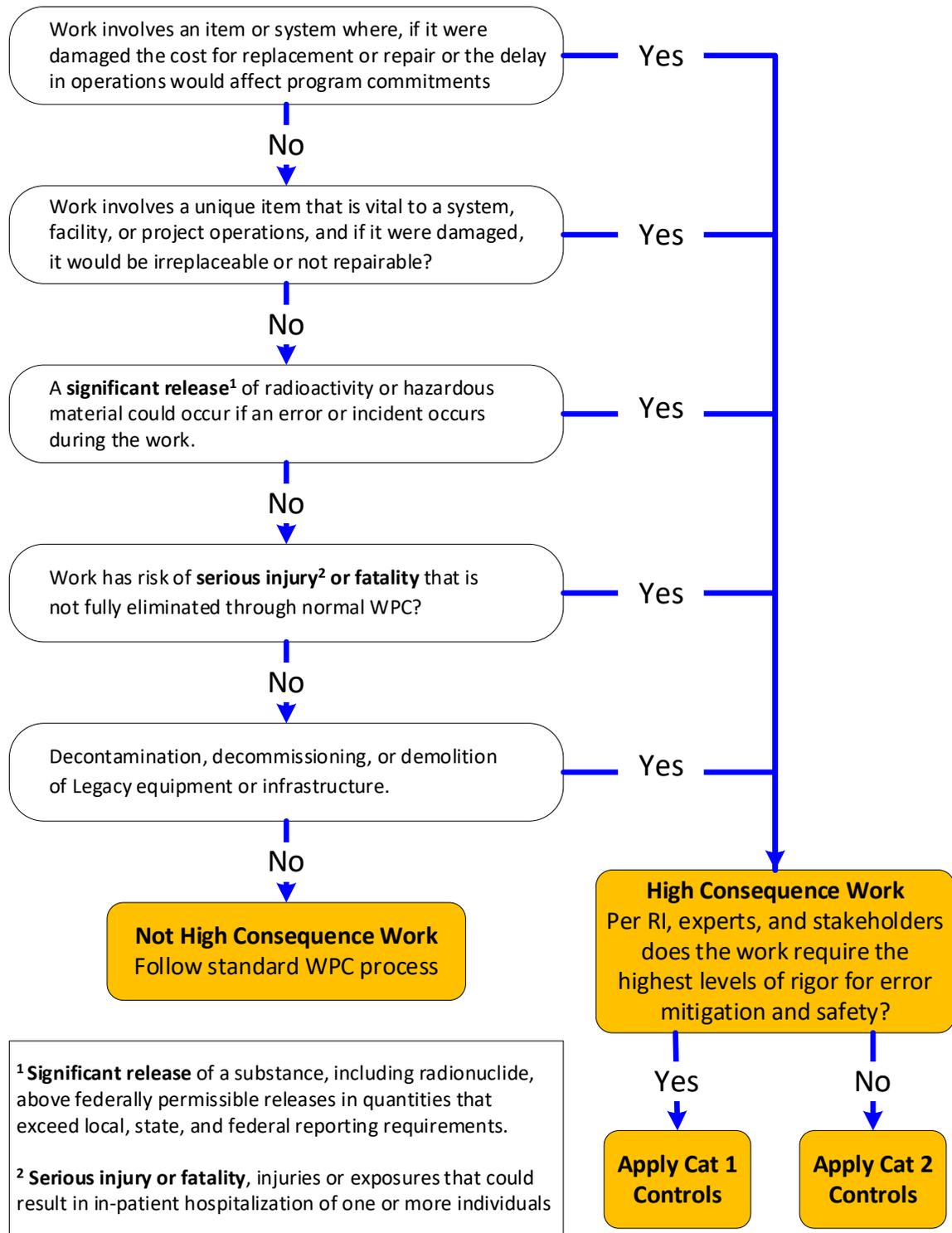


Figure 2 High-consequence Activity / Task Identification Process

Table 1 provides examples of high-consequence work.

Table 1 Examples of High-consequence Work

High Consequence Questions	Example Activities or Consequence
Does the planned activity involve an item or system where, if it were damaged, the cost for replacement or repair or the delay in operations would affect program commitments?	<ul style="list-style-type: none"> ▪ Cryomodule work ▪ Calibrated HXR and SXR undulators ▪ SC linac injector ▪ LSST camera and systems ▪ 6 MW generator testing
Does the planned activity involve a unique item that is vital to a system, facility, or project operations, and if it were damaged if would be irreplaceable or not repairable?	<ul style="list-style-type: none"> ▪ LSST camera lenses and filters ▪ X-ray mirrors at LCLS
Could a significant release of radioactivity or hazardous material occur if an error or incident occurs during the work activity?	<ul style="list-style-type: none"> ▪ Personnel, either on or off site, could receive radiological dose in excess of permissible limits ▪ Personnel exposure to hazardous substances could exceed permissible limits ▪ Release of radioactive or hazardous material could exceed local, state, or federal limits
Does the activity have a potential risk of serious injury or fatality if nominal work planning and control controls are insufficient?	<ul style="list-style-type: none"> ▪ Work on energized systems (electrical, gas, liquid) where LOTO cannot be utilized ▪ Lifts that have potential for personnel to be working under a load ▪ Work that requires the removal of barricades or machine guards ▪ Manual operation of electrical switches with NFPA 70E category 3 or 4 arc flash potential
Does the work activity involve decontamination, decommissioning, or demolition of legacy equipment and/or infrastructure?	Babar calorimeter dismantling and removal

2.2 Determining Category 1 or Category 2 Work

Once the activity has been determined to be high consequence, the responsible individual along with the appropriate technical SMEs, ESH program managers and coordinators, WPC program manager, and key stakeholders will determine the categorization for the activity, based on the potential consequences. Work requiring the highest levels of rigor is Category 1.

If the work is similar to already categorized activities (see Table 2), the current activity should be categorized at the same level.

Table 2 Examples of Category 1 and Category 2 Work

Category 1	Category 2
<ul style="list-style-type: none"> ▪ Cryomodule unloading, handling and installation ▪ Cryomodule beamline absorber installation ▪ Cryomodule beamline ultra-high vacuum/particle free interconnections and cold-to-warm transitions ▪ LSST camera and camera systems handling, shipping, and installation ▪ 6 MW generator testing ▪ Cryomodule removal from linac beamline 	<ul style="list-style-type: none"> ▪ Cryomodule connection work such as: <ul style="list-style-type: none"> ▪ RF waveguide connections ▪ Electrical connections ▪ JT valve connections ▪ Helium pipe interconnections and welding ▪ Particle free/UHV warm beamline connections ▪ Undulator (HXR and SXR) handling and installation after calibration ▪ RFBPM handling, testing, and installation ▪ X-ray mirror handling and installation ▪ Electron beam dump installation and removal ▪ Cryopant subsystem commissioning ▪ Xenon shipment to SURF ▪ X-ray inspection of welds ▪ Removing the lamp chamber from TMO ▪ Exchange of Cs2Te puck in SC Injector

2.3 Minimum ERWPC Required Work Controls

The minimum ERWPC work control elements for Category 1 and 2 work are listed in Table 3.

Note Line management may require additional ERWPC elements for activities at their discretion.

Table 3 Minimum ERWPC Required Work Controls

Work Control Element	Category 1	Category 2
1. Process FMEA (PFMEA) (see Section 2.3.1) (including implementation of actions/mitigations)	X	Recommended
2. Documented activity hazard analysis for deactivation, decommissioning, and demolition of legacy equipment or infrastructure (see Section 2.3.2)	X	X
3. Approved and controlled procedures utilizing travelers or checklists, and drawings (SLAC CDMS, TeamCenter/SEDA, or equivalent)	X	X
4. Roles and responsibilities documented in procedures	X	X
5. Personnel identified and qualified (including authorized worker(s) and person-in-charge)	X	X
6. Preparation checklists: area, tools, fixtures, materials, etc. (recommend inclusion within procedures and checklists)	X	X

Work Control Element	Category 1	Category 2
7. Job-specific travelers or checklists (see Section 2.3.3)	X	X
 		
8. Current SLAC WPC process, permits, and forms as required	X	X
9. Procedure evaluated and validated for effectiveness (for example, practice run, mockup, tabletop review, field walkthrough)	X	Recommended
10. Evaluation, review, and approval of items 1 through 9 by ALD or designate, project manager, system manager, responsible engineer, technical SME, WPC program manager, ESH, and DOE SSO (optional)	X	Not required
11. Notify ALD or designate, project director, project manager, WPC program manager, ESH, and DOE SSO one week in advance of start of work (not applicable to emergency work)	X	Not required
Note: notification only required for first-time execution.		
12. Pre-activity readiness review (minimum, prior to each first unique instance)	X	Not required
13. Area manager release	X	X
14. Documented pre-job briefing (must include detailed review of critical steps, hold points, error precursors, and stop work criteria)	X	X
15. Post-activity debrief review and report	X	X



To be placed at each hold or pause point for critical or irreversible steps.



To be used to add WARNING or CAUTION where there are important items to check or validate

2.3.1 Process Failure Modes and Effects Analysis

Category 1 work requires a *process failure modes and effects analysis (PFMEA)*, defined as a systematized group of activities to recognize and evaluate the potential failure of a product, or process and its effects, identify actions that could eliminate or reduce the occurrence of the potential failure and document the process. The SLAC process and procedure is defined in [Failure Modes and Effects Analysis Work Processes and Controls](#).

Participants in the PFMEA process must include the following:

- Responsible individual for the work to be performed
- Appropriate technical SMEs
- ESH program manager for each relevant hazard
- Person-in-charge or technician responsible for overseeing/performing the work

2.3.2 Activity Hazard Analysis for Deactivation and Decommissioning and Demolition of Legacy Equipment and Infrastructure

Deactivation and decommissioning (D&D) is defined as follows:

- *Deactivation.* The process of placing a contaminated (nuclear, radiologically, or radioactive), excess facility in a stable condition to minimize existing risks and protect workers, the public and the environment.
- *Decommissioning.* The final process of closing and securing the facility consistent with established end states to provide adequate protection from radiation exposure and isolation from the human environment.

D&D includes the removal of hazardous and radioactive materials to ensure adequate protection of workers, public health and safety, and the environment; placing the facility in a stable condition, thereby limiting the long-term cost of surveillance and maintenance, after which demolition/disposition occurs. D&D presents unique hazards that must be addressed from a safety, programmatic, environmental and technological standpoint.

Legacy equipment or systems are defined as facilities, systems, and equipment that are no longer required to support SLAC operations.

Any D&D work on associated out-of-service equipment must be treated as high-consequence work and be reviewed and analyzed as follows to ensure that hazardous energy is controlled consistent with both the control of hazardous energy (CoHE) program ([Chapter 51, “Control of Hazardous Energy”](#)) and the [Guideline for Control of Hazardous Energy in Out-of-Service Equipment](#).

Analysis will include system configuration and specifications, hazards, process analysis of the proposed procedure, and participation by the appropriate SMEs and stakeholders.

2.3.2.1 System Configuration and Specifications Analysis

System configuration and specifications will be performed utilizing drawings of the system in its current state of configuration, any engineering or design specifications, or other similar information that can be verified as accurate by the system owner or SME.

2.3.2.2 Hazard Analysis

Identification of Hazardous Energy Sources

For out-of-service equipment and/or infrastructure, hazardous energy sources are those that present a risk of injury to a worker or the public, risk of equipment damage or fire, or a risk to the environment. (See [Chapter 51, “Control of Hazardous Energy”](#).)

To ensure continuity of safe state until decommissioning and/or demolition begins, robust methods to control hazardous energy must be used. Depending on the chosen method, surveillance of out-of-service equipment and/or infrastructure may be necessary. For example, if equipment and/or infrastructure is placed in the disconnected state by permanently disconnecting hazardous energy and eliminating the potential for stored energy, then the equipment and/or infrastructure is deactivated and surveillance of the equipment to confirm elimination of hazardous energy on an ongoing basis is not necessary.

Important If, however, administrative lock and tag is used to mitigate hazardous energy, the equipment is not deactivated, and periodic surveillance of the administrative locks must be performed to verify continuing mitigation of hazardous energy in the out-of-service equipment/infrastructure.

2.3.2.3 Process Analysis

The process analysis will evaluate each step in the activity proposed procedure/work instructions for hazards in the workplace and those introduced from chosen work methods. This process is accomplished most effectively by performing a walkdown of the work area, as needed, feasible, and permissible, based on existing facility hazards (for example, high radiation areas), using the workers who will perform the task. The analysis should review task steps and evaluate hazardous substances and physical hazards.

2.3.2.4 Analysis Participants

The analysis will involve a multi-disciplinary team with the appropriate technical SME of the legacy equipment/infrastructure, ESH program manager for each hazard, and workers who will be performing the activities.

2.3.3 Use of Travelers

Category 1 and 2 work require the use of job-specific *travelers* or checklists, defined as a standalone document (paper or electronic) that serves as a record of procedure completion, also often used to sequence procedures. The data or history in the traveler would typically include the instrument/device serial number; worker initials and date when a task is completed; values recorded from instrument readings; acceptance criteria; approval hold points before proceeding with the next task.

Travelers must be designed to be used where work is being performed, taking into account, for example, lighting conditions, work being performed outdoors, and limited space for writing.

Travelers may be incorporated into procedures; they must include hold points and visual controls.

3 Forms

The following forms and systems are required by this procedure:

- None

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- The responsible individual keeps documentation of the required analyses and controls for 12 months.

5 References

[SLAC Environment, Safety, and Health Manual](#) (SLAC-I-720-0A29Z-001)

- [Chapter 2, “Work Planning and Control”](#)
 - [Work Planning and Control: Authorization and Release Summary](#) (SLAC-I-720-0A21S-006)
 - [Work Planning and Control: Work Planning and Control Procedure](#) (SLAC-I-720-0A21C-002)
 - [Work Planning and Control: Construction Work Planning and Control Procedure](#) (SLAC-I-720-0A21C-005)
 - [Work Planning and Control: Pre-job Briefing Procedure](#) (SLAC-I-720-0A21C-007)
 - [Work Planning and Control: Stop Work Procedure](#) (SLAC-I-720-0A21C-003)
 - [Work Planning and Control](#) (includes online tools)
- [Chapter 8, “Electrical Safety”](#)
- [Chapter 51, “Control of Hazardous Energy”](#)
 - [Guideline for Control of Hazardous Energy in Out-of-Service Equipment](#)

Other SLAC Documents

- [SLAC Conduct of Engineering Policy](#) (ENG-2018-018)
- [Failure Modes and Effects Analysis Work Processes and Controls](#) (SLAC-I-030-097)

Other Documents

- Site Compliance Plan for Department of Energy Order 413.3B, Change 7, “Program and Project Management for the Acquisition of Capital Assets” ([DOE O 413.3B, Chg 7 \[Ltd Chg\] SCP](#))
- Department of Energy Guide 430.1-4, “Decommissioning Implementation Guide” ([DOE G 430.1-4](#))
- Department of Energy Standard 1120, “Preparation of Documented Safety Analysis for Decommissioning and Environmental Restoration Activities” ([DOE-STD-1120](#))
- Department of Energy Handbook 1028, “Human Performance Improvement Handbook” ([DOE-HDBK-1028](#))
- Department of Energy Handbook 1211, “Activity-Level WPC Implementation” ([DOE-HDBK-1211](#))
- Centers for Disease Control and Prevention (CDC), National Institute of Occupational Safety and Health (NIOSH). [Hierarchy of Controls](#)

6 Definitions

activity-level work (ALW). Any job, task, or sub-task performed where hazards are present, are introduced by the work, such as research and development (R&D), *deactivation and decommissioning (D&D)*, construction, operations, and maintenance; or are introduced by the work environment (regardless of who is performing the work or the organization with which they are affiliated). The hazards involved could be potentially adverse to worker health and safety, the public, the environment, or safeguards or security. ([DOE-HDBK-1211](#))

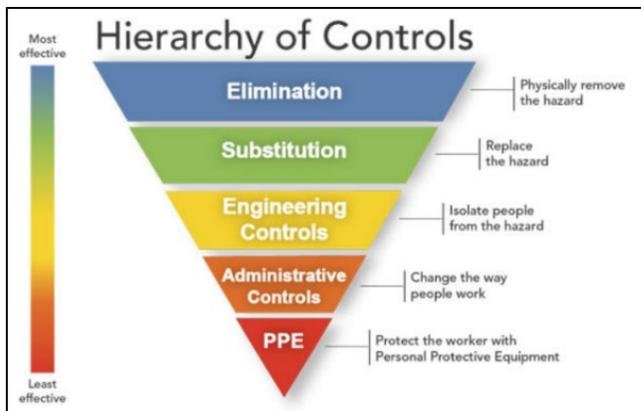
deactivation and decommissioning (D&D):

- *deactivation*. The process of placing a contaminated (nuclear, radiologically, or radioactive), excess facility in a stable condition to minimize existing risks and protect workers, the public and the environment.
- *decommissioning*. The final process of closing and securing the facility consistent with established end states to provide adequate protection from radiation exposure and isolation from the human environment.

D&D includes the removal of hazardous and radioactive materials to ensure adequate protection of workers, public health and safety, and the environment; placing the facility in a stable condition, thereby limiting the long-term cost of surveillance and maintenance, after which demolition/disposition occurs. D&D presents unique hazards that must be addressed from a safety, programmatic, environmental and technological standpoint.

error-likely situations (common error precursors). Schedule pressure, irreversible point of action, distractions, multi-tasking, unexpected equipment response, etc. (See [DOE-HDBK-1028](#), Volume 1, Page 2-32)

hierarchy of controls. A means of classifying the type and effectiveness of controlling exposures to occupational hazards ([NIOSH](#)):



- A key factor to consider in the hierarchy is that as one moves down the hierarchy there is a greater dependency on human behavior.
- For example, adherence to procedures, signage, and wearing PPE are entirely dependent on human behavior during work activity.

high-consequence work. Tasks or activities where errors or incidents during the work have the highest potential adverse consequence to SLAC personnel, property, or programs. Work would be considered high consequence if there is the potential for any of the following conditions:

- Any work that has risk of serious injury or fatality that is not fully eliminated through normal WPC
- Could result in release to the environment of radionuclides or other hazardous substances that could result in on- or off-site personnel exposure above permissible limits or exceed local, state, or federal reportable quantities
- Cost to replace or repair the item or system or delay in operations would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitments

- Item or system being worked on is unique and if damaged would be irreplaceable or not repairable and is vital to a system, facility or project operation
- *Deactivation and decommissioning (D&D)* activities of legacy systems or infrastructure

Note SLAC and each directorate may identify supplemental requirements to the criteria above to mitigate unacceptable risks to the laboratory, its mission, and stakeholders.

human performance improvement (HPI). A process of selection, analysis, design, development, implementation, and evaluation of programs to most cost-effectively influence human behavior and accomplishment. It is a systematic combination of three fundamental processes: performance analysis, cause analysis, and intervention selection, and can be applied to individuals, small groups, and large organizations.

legacy equipment or systems. Facilities, systems, and equipment that are no longer required to support SLAC operations. Any *deactivation and decommissioning (D&D)* work on the associated out-of-service equipment must be reviewed and analyzed to ensure that hazardous energy is controlled is consistent with both the SLAC CoHE policy ([Chapter 51, “Control of Hazardous Energy”](#)) and the SLAC [Guideline for Control of Hazardous Energy in Out-of-Service Equipment](#). (See Section 2.3.1)

procedure. A document that describes the work steps needed to execute the plan. Procedures generally limit the number of skills or disciplines involved in the same procedure

process failure modes and effects analysis (PFMEA). A systematized group of activities to recognize and evaluate the potential failure of a product, or process and its effects, identify actions that could eliminate or reduce the occurrence of the potential failure and document the process

step. A defined action that is to be done to complete a *task*. Steps are to be done sequentially and may be followed by additional steps until the task is complete.

task. A *step* (that is, action) or series of steps designed to contribute to a specified end result for an *activity*. It has an identifiable beginning and end that is a measurable component of the duties and responsibilities of a specific activity (for example, INITIATE cooling water system operation).

traveler. A standalone document (paper or electronic) that serves as a record of procedure completion, also often used to sequence procedures. The data or history in the traveler would typically include the instrument/device serial number; worker initials and date when a task is completed; values recorded from instrument readings; acceptance criteria; approval hold points before proceeding with the next task.