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30.1 Policy

At LBNL, new work surfaces higher than 6 feet shall be designed to eliminate the need for fall protection. When feasible, existing work surfaces higher than 6 feet shall be modified to eliminate the need for fall protection. Eliminating the need for fall protection may be accomplished through the application of engineering controls (such as lowering the work surface or providing barriers such as parapets that prevent contact with the leading edge) or administrative controls (such as changing a process, sequence, or procedure so that workers do not need to work at heights).

When modification cannot be feasibly accomplished, workers shall use fall protection systems when working in any situation that presents an exposure to a fall hazard. Fall protection work controls include: guardrail systems; safety net systems; personal fall arrest systems; and platform ladders. See Work Process B for fall protection work control requirements and exclusions.

30.2 Scope

LBNL's Fall Protection Program is implemented to control the risk of falls while individuals are working at heights, through planning, training, installation and use of fall protection and rescue systems, and implementation of fall protection and rescue procedures.

30.3 Applicability

This policy establishes requirements for LBNL's Fall Protection Program. This Fall Protection Program applies to work on any walking or working surface having an unprotected side or edge that is 6 feet or more above a lower level. This program applies to the following categories:

1. LBNL employees
2. Construction contractors
3. Non-construction subcontractors, vendors, and guests

30.4 Roles and Responsibilities

30.4.1 Authorized Persons

An Authorized Person for fall protection has a working understanding of LBNL's Fall Protection Program, and has the knowledge and training necessary to properly wear and care for fall protection equipment and to follow all fall protection hazard controls developed by a Competent Person. To be an Authorized Person at LBNL, the individual must successfully complete course LBNL EHS 276, "Fall Protection" (or the equivalent for subcontractors) and be authorized by supervision either through an employee Job Hazards Analysis, construction Job Hazards Analysis, or, for service contractors, through the Subcontractor Job Hazards Analysis (SJHA).

30.4.2 Competent Persons

A Competent Person is responsible for identifying fall hazards of work tasks by conducting fall hazard surveys, stopping or limiting work at the hazard site, supervising selection and use of fall protection equipment, verifying equipment is compliant and workers are trained, participating in investigations, conducting equipment inspections, and removing damaged equipment from service. The Competent Person is authorized to take prompt corrective measures to eliminate or mitigate fall hazards, and is

knowledgeable in the application and use of the fall protection equipment. Competent Persons at LBNL must complete a training program approved by the LBNL EH&S Fall Protection Program Administrator.

30.4.3 Qualified Persons

A Qualified Person supervises the design, selection, installation and inspection of fall protection equipment and participates in the investigation of incidents. The Qualified Person has specialized training (such as a Registered Professional Engineer), extensive knowledge and experience in fall protection, and has successfully demonstrated his or her ability to solve problems relating to fall protection. The Qualified Person is responsible for designing specialized fall protection systems and equipment and evaluating and approving anchorage points. At LBNL, the Qualified Person is the Facilities Division Structural Engineer.

30.4.4 Program Administrator

The Program Administrator is responsible for developing, implementing, maintaining and evaluating the fall protection program, providing guidance to all others involved with the program, establishing a procedure to identify fall hazards, developing fall protection and rescue procedures, ensuring training, and participating in incident investigations. At LBNL, the Fall Protection Program Administrator is the EH&S Group Leader for Occupational Safety.

30.5 Definitions

The following terms and definitions have special meanings and apply to this, and other PUB 3000 chapters that discuss fall protection.

active fall protection system: an active personal fall restraint or personal fall arrest system (PFAS) requires specialized fall protection equipment that must be fitted to the user and worn to control the fall hazards. The user is secured to an anchorage point at all times, even while moving from point to point.

anchorage: a secure point of attachment for lifelines, lanyards, or deceleration devices. These points of attachment shall be independent of any anchorage being used to support or suspend platforms and be capable of supporting the employee attached.

- **certified anchorage:** an anchorage for fall arrest, work positioning, restraint, or rescue systems that a Qualified Person certifies to be capable of supporting forces that could be applied during a fall; or (b) meets the criteria of a certified anchorage, per ANSI Z359.2-2007.
- **noncertified anchorage:** a fall arrest anchorage that a Competent Person judges to be capable of supporting the predetermined anchorage forces.

body belt: a strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device. Body belts shall be at least one and five-eighths (1-5/8) inches wide. Body belts are only effective for fall restraint and work positioning, but **shall never be used for fall arrest.**

body harness: straps that may be secured about the user in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest, and shoulders with means for attaching it to other components of a personal fall arrest system.

compatible components: all individual components of a fall protection system must be approved as compatible by the manufacturer. Substitution with non-compatible component combinations or subsystems is not allowed unless authorized by the LBNL Fall Protection Program Administrator and approved by the Qualified Person (LBNL Structural Engineer).

connector: a device that is used to couple (connect) parts of the personal fall arrest system and positioning device systems together. It may be an independent component of the system, such as a carabiner, or it may be an integral component of part of the system (such as a buckle or D-ring sewn into a body harness, or a snap-hook spliced or sewn to a lanyard). These items should be made of corrosion resistant material and the edges smooth to prevent damage to other parts of the system.

control access zone: an area to which access is controlled and where certain work may take place without the use of guardrail systems, personal fall arrest system, or safety net systems; a control line (erected not less than 6 feet nor more than 25 feet from a leading edge) defines the control access zone. The control line is approximately parallel to, and extends the entire length of, the unprotected leading edge. Each end of the control line is connected to a guardrail system or a wall.

deceleration device: any mechanism, such as a specially woven lanyard, tearing or deforming lanyards, or automatic self-retracting lanyards, that serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on a user during fall arrest.

fall restraint system: a system that prevents a person from falling from an unprotected edge or opening by using a body holding device, a suitable length of connecting means (e.g. restraint lanyard), and an anchorage.

free fall distance: the amount of displacement, of the fall arrest attachment point on a user's body belt or harness, from the onset of the fall to just before the system begins to apply a force to arrest the fall. This distance does not include deceleration distance and/or lanyard expansion.

guardrail system: a barrier erected to prevent employees from falling to lower levels.

hole: a gap or void that is 2 inches or more in its least dimension, in a floor, roof, or other walking/working surface.

lanyard: a flexible line of rope, wire rope, or strap, which generally has a connector at each end for connecting the body harness to a deceleration device, lifeline, or anchorage. For situations in which a fall arrest may occur, LBNL requires lanyards with built-in shock absorbing mechanisms for added force distribution in the event of a fall arrest. For fall restraint systems, lanyards without shock absorbers may be used.

lifeline: a component consisting of a flexible line connected to an anchorage at one end to hang vertically, or connected to anchorages at both ends to stretch horizontally, and which serves as a means for connecting other components of a personal fall arrest system to the anchorage(s).

lifeline systems (vertical and horizontal): overhead attachments that allow horizontal movement, such as beam trolleys and, slide wires on cables or suspended vertical cables along un-caged equipment ladders.

passive fall protection system (PFPS): a system used to control fall hazards by means other than the wearing of personal protective equipment (PPE). Examples are: guardrails, safety nets, warning lines, etc.

personal fall arrest system (PFAS): a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a full-body harness, and a shock absorbing connecting device that may include a lanyard, deceleration device, lifeline, or suitable combination of these. Safety belts shall not be used as part of a fall arrest system.

personal fall protection system (PFPS): any dynamic system used to protect an employee from fall injury. It could be a personal fall arrest system, positioning device system, lifeline system, or retrieval system.

positioning device systems: a positioning/restraint system holds a worker in place while allowing a hands-free work environment at heights or restricts the worker's movement to avoid reaching a location where a fall hazard exists. A typical positioning/restraint system consists of an anchorage, body support consisting of either a full-body harness or a body belt, and a connecting device (positioning lanyard). These systems are not designed for fall arrest so a backup fall arrest system should be used.

retrieval systems: a retrieval system is used primarily when work is being done in a confined space such as tanks or manholes and may require retrieval from above in an emergency. A retrieval system typically consists of an anchorage and anchorage connector such as a tripod, a full-body harness, and a lifeline/retrieval unit.

rope grab: a deceleration device, which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of a user.

self-retracting lifeline/lanyard: A deceleration device containing a drum-wound line that can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

user: a person who is currently trained in LBNL fall protection training, has demonstrated appropriate skills in using fall protection equipment, and has been approved by his/her supervisor to take part in activities that may involve fall hazards.

warning line system: an edge proximity warning system used when working on a work surface higher than 6 feet and having an unprotected edge. The warning line physically denotes a 15-foot boundary (6-foot for roofers), inside of which workers can perform tasks without additional fall protection measures.

30.6 Required Work Processes

Work Process A. Written Fall Protection Plan

A written fall protection plan is required for any task requiring fall protection.

Table 1 below provides a matrix of required written fall protection plans.

Table 1. Matrix of Required Written Fall Protection Plans

Worker Category	Required Fall Protection Plan	Who Completes	Who Approves	PUB-3000 Reference
LBNL Employee: Facilities Personnel	Fall Protection Planning Matrix	LBNL Fall Protection Competent Person	Supervisor	Work Process C and Work Process S
LBNL Employee : Researcher, PI, Others	Fall Protection Planning Matrix	LBNL Fall Protection Competent Person	Supervisor	Work Process C and Work Process S
Construction Contractor	Written Fall Protection Plan	Construction Contractor Fall Protection Competent Person	Facilities Division responsible Project Manager	Work Process C and Work Process S
Directly Supervised Non-construction Subcontractors, Vendors and Guests	Fall Protection Planning Matrix	LBNL Fall Protection Competent Person	LBNL supervisor responsible for the work activity	Work Process C and Work Process S
Not Directly Supervised Non-construction Subcontractors, Vendors and Guests	SJHAWA Form (Subcontractor Job Hazards Analysis and Work Authorization Form)	Subcontractor, Vendor or Guest Who Is A Competent Person	LBNL Requisitioner	Chapter 31

Work Process B. Fall Protection Work Control Requirements

Requirements:

Fall protection work controls are required under the following conditions:

1. Any work task on a walking/working surface with an unprotected side or edge that is 6 feet or more above a lower level.
2. Any work task on an aerial lift (including a scissors lift only if an engineered anchor point is provided by the manufacturer) when working above the protection system at floor openings, unprotected perimeters higher than 6 feet, and whenever a fall of more than 6 feet could occur.
3. Any work task by steel erectors and sheet metal installers above 6 feet.
4. Any use of a portable ladder when working above 6 feet or above the third rung (from the top of the ladder).
5. Any use of a portable ladder when working above 6 feet and below the third rung when the user cannot maintain 3 point contact (consisting of two feet and one hand) at all times.

Exceptions:

Fall protection work controls are not required under the following conditions:

1. For Non-Roofers Only - Work on a flat or low sloped roof (slope less than 4 in 12), when all of the following conditions are met:
 - All work is conducted at least 15 feet from any unprotected edge;
 - A warning line is used to denote the 15-foot distance;
 - No work activities take place between the warning line and the unprotected edge;
 - Workers follow the work rule of not going past the warning line.
2. Work on scissor lifts if an engineered anchor point is not provided by the manufacturer.
3. During scaffold erection and dismantling, when all of the following conditions are met:
 - The designated Competent Person overseeing the operation has determined that active fall protection is infeasible;
 - The Competent Person has put a fall protection plan in writing that meets the Cal/OSHA requirements found in the Construction Safety Orders, Section 1635.1-1667;
 - The competent person has submitted the written fall protection plan to LBNL Project Management for review and approval prior to commencing the operation.
4. Climbing up and down ladders.
5. Work from ladders above 6 feet and below the third rung when the user can maintain 3 point contact (consisting of two feet and one hand) at all times.
6. Work from platform ladders when the user can demonstrate that he/she can work safely inside the rails of the ladder.

Work Process C. Work Control Processes

LBNL's Fall Protection Program is implemented through three work control processes applicable to the three categories of workers who may perform work tasks requiring fall protection. These three worker categories are:

1. LBNL Employees
2. Construction Contractors
3. Non-Construction Subcontractors, Vendors and Guests performing hands-on work.

1. LBNL Employee Work Control Process

Description of Work Control Processes

Fall protection work control for LBNL employees performing work tasks at heights is managed through the Individual Baseline JHA process and the Maximo work request system, as described in Flowchart 1 below.

For the purposes of describing fall protection work controls for LBNL employees, those employees who perform work at heights are divided into the two broad categories:

- Facilities Division maintenance or construction employees; and
- Other employees, including researchers.

Fall protection work controls for Facilities Division employees are managed through the Maximo work request system, and consist of:

- The identification through the Individual Baseline JHA process of job assignments that require working at heights, and
- The determination that such work can be accomplished as an Individual Baseline JHA task, with the subsequent completion of the work by an employee having an appropriate Individual Baseline JHA, or
- The determination that such work requires a Task-Based Job Hazards Analysis (Type 3 Task), with the subsequent development of a Task-Based JHA through either completion of a Fall Protection Matrix or application of an Engineered Fall Protection Plan (roof HVAC work) as applicable.
 - The Fall Protection Matrix is developed by an LBNL Fall Protection Program Competent Person and approved by the employees' supervisor or work lead.
 - When required, an Engineered Fall Protection Plan is developed by the Qualified Person (Facilities Structural Engineer) and implemented by an LBNL Fall Protection Program Competent Person

Fall protection work controls for other employees are managed through the Fall Protection Matrix process, and consist of:

- The identification of job assignments through the Individual Baseline JHA process that require working at heights, and
- The development of a Task-Based JHA through completion of a Fall Protection Matrix.
 - The Fall Protection Matrix is developed and implemented by an LBNL Fall Protection Program Competent Person and approved by the employee's supervisor or work lead.

Individual Baseline Job Hazards Analysis

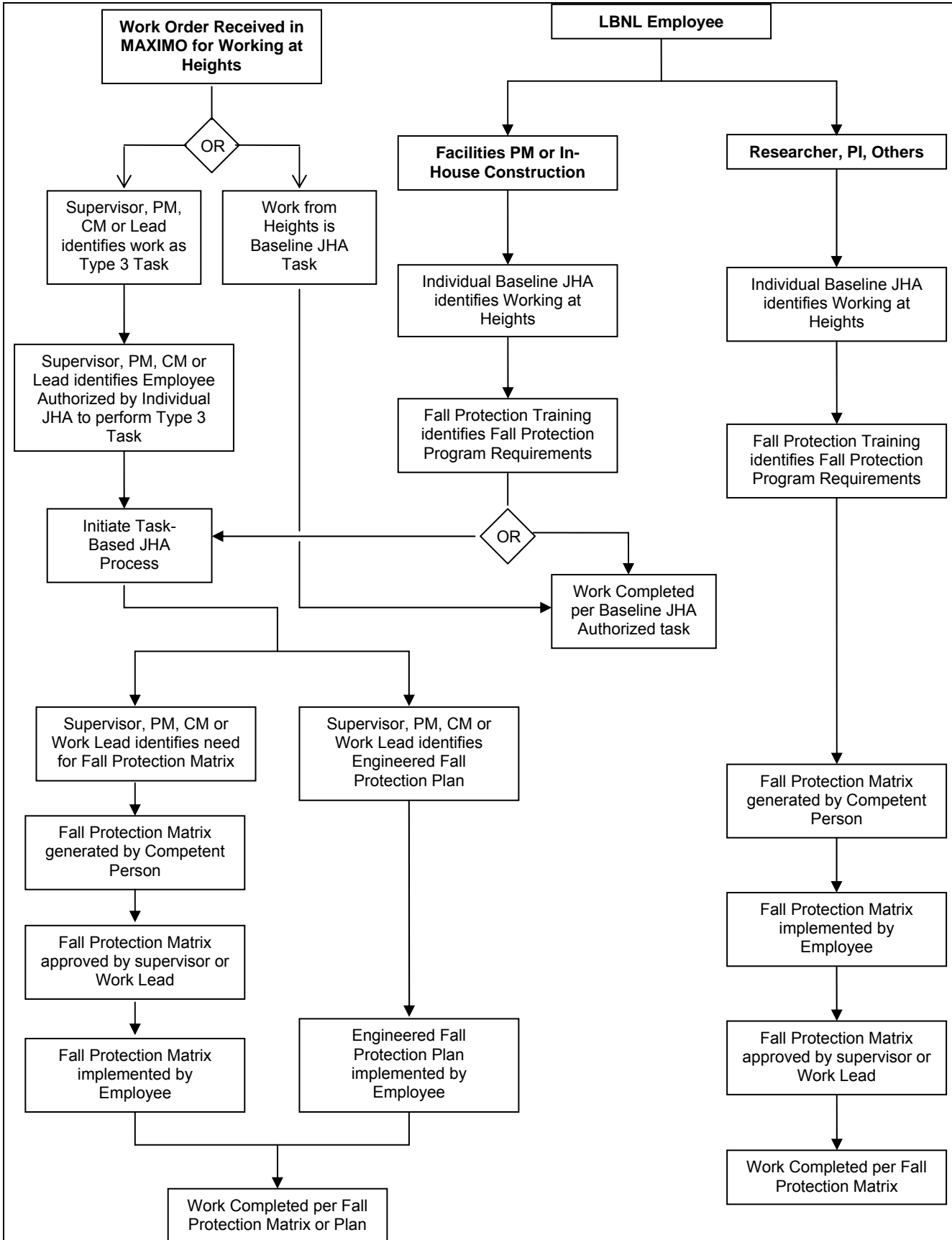
All LBNL employees are required to have an approved Individual Baseline Job Hazards Analysis (JHA) or a Task-Based JHA in place before performing work (see PUB-3000, Chapter 32). The Individual Baseline JHA identifies the tasks, hazards, and controls that the worker encounters on a

regular basis as part of his/her normal work assignments. If the Individual Baseline JHA identifies working at heights as a normal job assignment, fall protection training is required.

Task-Based Job Hazards Analysis

A Task-Based Job Hazards Analysis identifies the tasks, hazards, and controls that apply to specific processes or work conditions that fall outside the Individual Baseline JHA. Task-Based JHAs are generally used for work that is unpredictable, short-term, or unusual. Under the Fall Protection Program, Task-Based JHAs are developed through development and implementation of a Written Fall Protection Planning Matrix.

Flowchart 1: Fall Protection Work Control for LBNL Employees



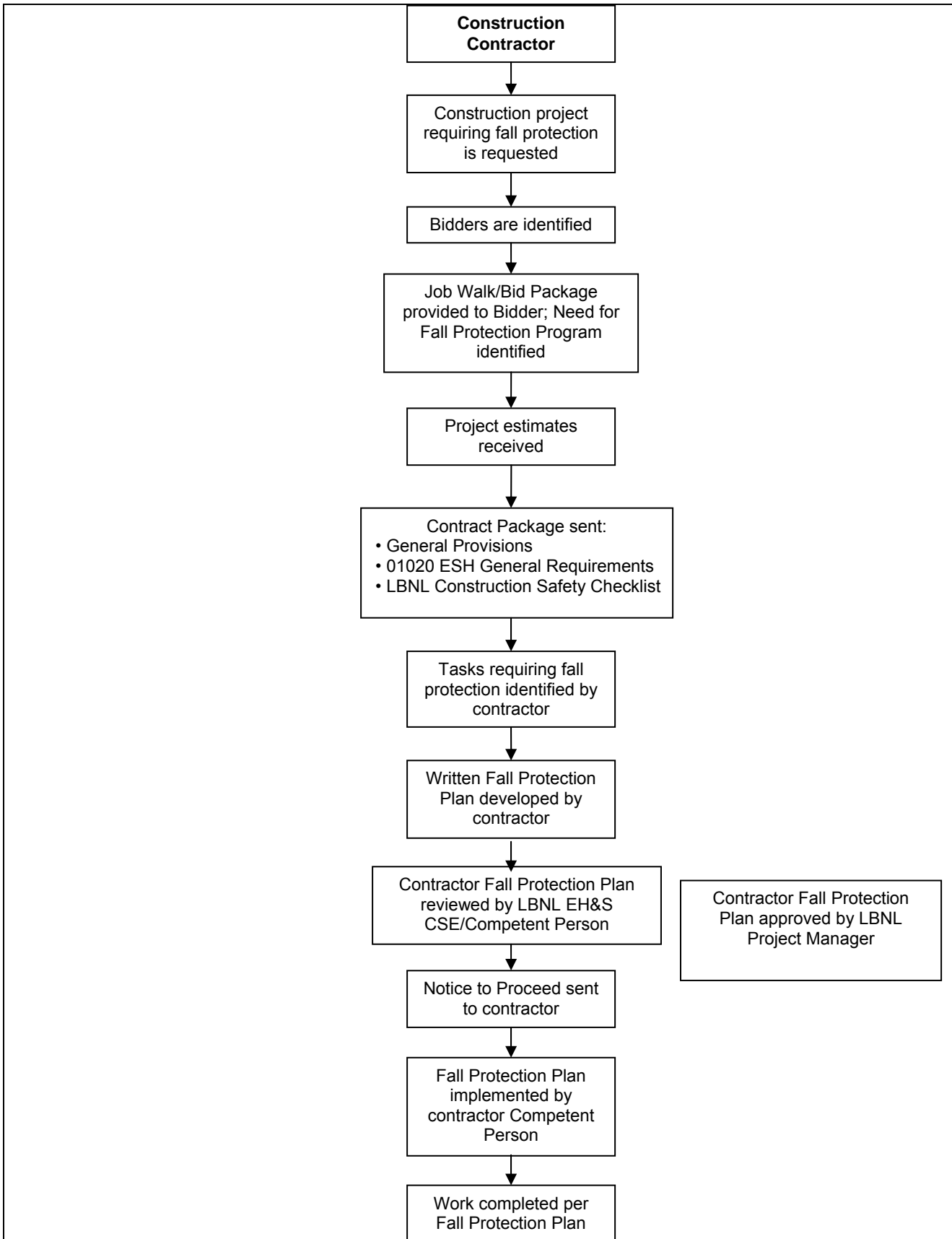
PM, Project Manager; CM, Construction Manager.

2. Construction Contractor Work Control Process

Fall protection work control for construction contractors performing work tasks at heights is managed through the LBNL contractor bid, selection, and fall protection plan approval process described in Flowchart 2 below.

When a construction project requires working at heights, LBNL notifies project bidders of such tasks during the bid job walk. Requirements for fall protection work controls are then identified through the construction package documents and the Construction Safety Checklist. A Written Fall Protection Plan is then developed by the contractor and submitted to the EH&S Construction Safety Engineer who is also an LBNL Fall Protection Program Competent Person. Upon review and approval of the Fall Protection Plan, the contractor is issued a notice to proceed and the Fall Protection Plan is implemented by the contractor Competent Person.

Flowchart 2: Fall Protection Work Control for Construction Subcontractors



3. Non-Construction Subcontractors, Vendors, and Guests Work Control Process

Fall protection work control for Non-Construction Subcontractors, Vendors, or Guests performing work tasks at heights is managed through the LBNL Non-Construction Subcontractor, Vendor, or Guests work control process described in Flowchart 3 below.

While working at LBNL, Non-Construction Subcontractors, Vendors, or Guests are either under the direct supervision of Lab personnel or work independently of such supervision.

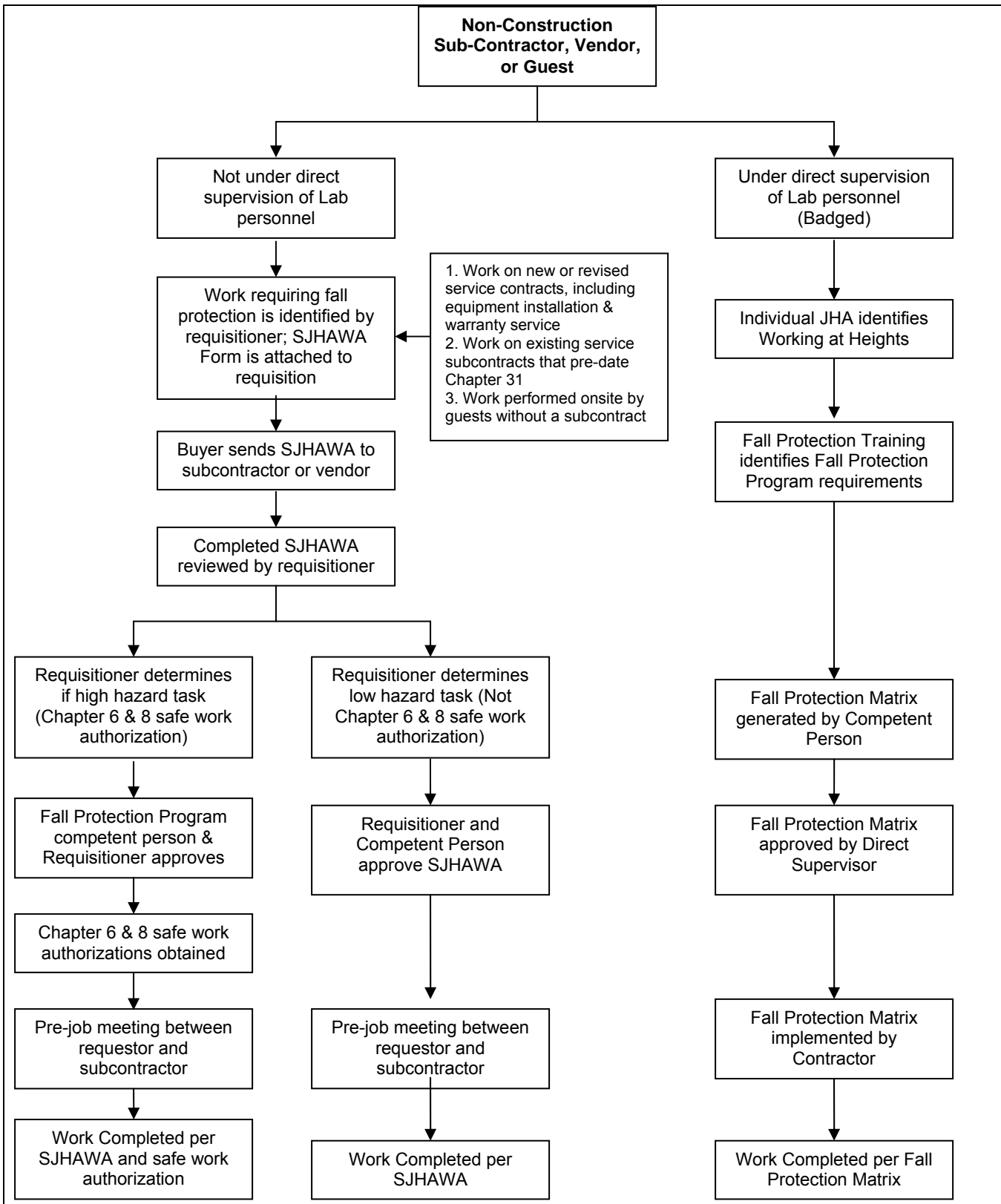
Fall protection work controls for Non-Construction Subcontractors, Vendors, or Guests who are under the direct supervision of Lab personnel are managed through the Fall Protection Matrix process, which consists of:

- The identification of job assignments, through the Individual Baseline JHA process, that require working at heights, and
- The development of a Task-Based JHA through completion of a Fall Protection Matrix.
 - The Fall Protection Matrix is developed and implemented by an LBNL Fall Protection Program Competent Person.

Fall protection work controls for Non-Construction Subcontractors, Vendors, or Guests who are not under the direct supervision of Lab personnel are managed through the Subcontractor Job Hazards Analysis and Work Authorization (SJHAWA) Form, which requires:

- The identification of job assignments that require working at heights by the requisitioner;
- Submission of the blank SJHAWA Form by the LBNL Buyer to the subcontractor or vendor;
- Completion of the SJHAWA Form by the requisitioner;
- Determination of low or high hazard task by the requisitioner; and
- Review and approval of the SJHAWA Form by the SME and Program Manager if the work involves high hazard tasks, or
- Review and approval of the SJHAWA Form by the Requestor, DSA and Program Manager if the work involves low hazard tasks.

Flowchart 3: Fall Protection Work Control for Non-Construction Subcontractors, Vendors, or Guests



Work Process D. Passive Fall Protection Systems

A passive fall protection system (PFPS) means that the fall hazard is controlled by means other than the wearing of personal protective equipment (PPE). Examples are: guardrails, safety nets, warning lines, etc.

All passive fall protection systems require vigilance, whether in the form of pre-work inspections, group instructions, or other means of communication.

A hazard evaluation may determine that a personal fall protection system or other protective means may be required for the worker(s) protection even though working from a ladder or scaffold does not normally require fall protection. For example, if the task requires working from a step stool, or level above the working surface next to the guardrail, the guardrail is no longer 42 inches above the “new” working surface.

1. Guardrails

The most common passive fall protection system is a guardrail. The height of the top rail of a guardrail system must be 42 plus or minus 3 inches above the walking/working surface. When conditions warrant, the height may exceed the 45 inch height if all other criteria are met.

Mid-rails, screens, mesh, or intermediate vertical members shall be installed midway between the top rail and the walking/working surface, unless a parapet wall of 21 inches, or more has been installed.

Top rails shall be a minimum of 1/4-inch diameter (preferably 3/8-inch cable) or suitable thickness to meet the strength and rigidity requirements. If wire rope is used, it shall be flagged at 6 foot intervals with high-visibility material.

Many roof activities, such as servicing HVAC units, HEPA filters and fans, are done on a semi-annual or as-needed basis. If the activity does not warrant the installation of a permanent guardrail, temporary guardrail systems are available from the Facilities Division Maintenance Department. Personal fall arrest systems may also be used, but the walking/working area must be surveyed by a Competent Person and approved anchorages must be designated (either by a Competent Person or a Qualified Person).

2 Safety Nets

Safety nets are an option in certain cases. For specific information, see the Work Smart Standard B106, OSHA 29 CFR 1926 Subpart M, Fall Protection

3. Warning Line Systems

Roofers

A warning line shall be erected not less than 6 feet from the roof edge.

No worker shall be allowed in the area between the warning line and the roof edge without active fall protection or a safety monitor (see Work Process E: Active Fall Protection Systems).

The warning line must meet, or exceed, the requirements in 1926.502(f)(2), which requires the warning line to: (1) be constructed of rope, wire or chain that is flagged at intervals no greater than 6 feet; (2) be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches above the walking/working surface and its highest point is no more than 39 inches above the walking/working surface; (3) be capable of resisting a knock over force of at least 16 pounds applied horizontally against

the stanchion at 30 inches above the walking/working surface, perpendicular to the warning line, and in the direction of the floor, roof, or platform edge; (4) possess a minimum tensile strength of 500 pounds; and (5) be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

Non-Roofers

A warning line shall be erected not less than 15 feet from the roof edge.

No employee shall be allowed in the area between the warning line and the roof edge without active fall protection. There are no exceptions.

The warning line must meet, or exceed, the requirements in 1926.502(f)(2), which requires the warning line to: (1) be constructed of rope, wire or chain that is flagged at intervals no greater than 6 feet; (2) be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches above the walking/working surface and its highest point is no more than 39 inches above the walking/working surface; (3) be capable of resisting a knock over force of at least 16 pounds applied horizontally against the stanchion at 30 inches above the walking/working surface, perpendicular to the warning line, and in the direction of the floor, roof, or platform edge; (4) possess a minimum tensile strength of 500 pounds; and (5) be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

4. Hole Opening Covers

The following shall be covered: any gap or void 2 inches or more in its least dimension in a floor, roof, or other walking/working surface, and any gap or void in a wall or partition 30 inches or more in height and 18 inches or more in width through which a person may fall.

Hole opening covers in roofs, floors, and other walking/working surfaces shall be secured in place and capable of supporting the weight of any load that may be imposed at any one time. All hole opening covers shall have "HOLE" or "COVER" clearly written on the cover to provide warning of the hazard.

Temporary covers for roadway holes are to be steel street plates capable of supporting twice the axle weight of the heaviest vehicle expected to cross the cover.

5. Ladder Wells/Cages

Design criteria for ladder wells and cages vary greatly depending on the type, height, and/or use of the ladder. For guidance on specific design criteria for ladder wells and cages, contact the EH&S Occupational Safety Group, or refer to 29 CFR 1910 Subpart D, Walking-Working Surfaces (1910.27).

6. Safety Monitors

A safety monitor is a trained and authorized worker on a roof whose only job is to ensure that previously trained roofers are warned when moving too close (within 6 feet) to a dangerous edge. The monitor must be competent in recognizing fall hazards and be positioned on the same level, within vocal distance of the worker(s) being monitored. Constant vigilance is required because lateral movement, even backward movement, of 4 to 5 feet per second is not uncommon.

Safety monitors are not permitted for use on roofs with greater than a 4 in 12 pitch, or that have equipment that obstructs vision or has a noise level that prevents any worker from immediately hearing a verbal warning of danger.

Duties of the Safety Monitor include:

- Warning the worker when it appears that the worker is unaware of a fall hazard or is acting in an unsafe manner;
- Remaining on the same walking/working surface and within sighting distance of the worker being monitored;
- Remaining close enough to communicate orally with the worker;
- Having no other responsibilities other than serving as a safety monitor; and
- Monitoring not more than 6 employees in a controlled area (area between the warning line and the roof edge).

Work Process E. Active Fall Protection Systems

An active fall protection system or personal fall arrest system (PFAS) requires the use of specialized fall protection equipment that must be fitted to the user and worn to control fall hazards. In other words, the user is to be secured to an anchorage point at all times, even while moving from point to point. Fall protection systems and equipment are to be used for personnel protection only.

Active systems may include the following:

- Positioning devices
- Lifeline systems (standard and self-retracting)
- Rope Grabs
- Retrieval systems
- Full body harnesses
- Body belts **Note: Body belts are not to be used for fall arrest at LBNL.**
- Connectors
- Lanyards
- Snap-hooks
- Ladder safety devices
- Anchorages

1. Fall Dynamics

The following elements combine to make a fall hazardous:

- Lanyard length
- Free-fall distance
- Shock absorption at impact
- Body weight
- Swing
- Suspension Trauma

Lanyard length:

The lanyard length must be selected to allow freedom of movement to do the work, yet be short enough to minimize the fall distance. The maximum length of the lanyard and shock absorber combination is 6 feet. The minimum total vertical distance from the anchor point with a 6 foot lanyard is 18.5 feet, allowing a 3 foot safety factor.

Free-fall distance:

If the trigger height for fall protection is 6 feet above the walking/working surface, a 6 foot lanyard does not offer good protection if the anchor point of the lanyard is connected at head height. To be effective, the

anchor point is required to be as high as practicably possible above the user's head without interfering with the work being done.

The D-ring on the harness moves from the back at shoulder blade height to a position at the head when supporting full body weight. A 6-foot fall can result in forces exceeding 10 times body weight. A worker weighing 200 pounds can experience more than 2,000 pounds of dynamic force from the harness unless the user has a shock-absorbing lanyard. A 2,000 pound force is capable of causing heart damage, a severe internal injury, and possibly a fatal injury.

Serious consideration must be given to the equipment being approved for each situation evaluated based on the total fall distance and impact forces that could be encountered. A good rule of thumb is to limit the free-fall to 2 feet whenever possible, by using a minimum lanyard length and/or raising the anchor point. Consider using self-retracting lanyards, some of which can activate within 1-2 feet.

Use the following formula as a guide for Minimum Anchorage Point Height (MAPH):

$$\text{MAPH} = (6' + L) - H + D + S + C$$

6' = Harness D-ring height

L = Lanyard length (typically is 6 feet)

H = Anchorage point height (positive if below D-ring)

D = Deceleration or shock absorbing distance (typically is 3.5 feet)

S = Harness stretch (typically 1 foot)

C = Min. required clearance to lower level (3 feet)

Shock absorption at impact:

Even a relatively short free-fall distance of 6 feet on a solid lanyard, or cable can create serious impact problems as seen above. Shock absorption devices stretch by more than 3 feet 6 inches depending on the type of unit. The use of shock-absorbing lanyards is required at LBNL.

Body weight:

Body weight adds to the impact load on the body of the worker and on the fall arrest system. How the harness is worn and the tightness of the straps, if adjusted for comfort, can create harmful stress and abrasions on the body during a fall arrest. The correct size harness must be worn and all harness straps are to be adjusted for a snug fit.

Swing:

If the fall is not a direct drop, pendulum action will come into play. The worker may be relatively uninjured from the fall due to the fall protection system, but then could swing into another object and become impaled or forcibly strike a solid object. Use the shortest lanyard practical for the task to minimize swing effect.

Suspension trauma:

A person suspended, immobile in a harness may experience suspension trauma leading to death in as little as 5 minutes. Whenever a worker is suspended for longer than 5 minutes in an upright posture, with legs relaxed straight beneath the body, gravity pulls blood into the lower legs which have a very large storage capacity. Enough blood eventually accumulates so that return blood flow to the right chamber of the heart is reduced and the heart's output begins to fall. The harness leg straps compound the problem by restricting the flow of blood up to the heart. To minimize the effects of Suspension Trauma, the worker should be trained to try to move the legs in the harness, push against any object, and, if possible, raise the legs to a horizontal position.

For prolonged suspension, a harness with a seat rather than straps alone should be used to help position the upper legs (and lower legs if conscious) horizontally.

2. Work Planning

A written work plan (Fall Protection Planning Matrix or Fall Protection Plan) is required when a Personal Fall Protection System (PFPS) is to be used. A Competent Person selects the appropriate PFPS equipment for the fall scenario and ensures that it properly fits each user. General work planning guidelines are as follows and are carried out by the Competent Person:

- Determine whether an engineered fall protection system is required. In collaboration with the Qualified Person (LBNL Structural Engineer) ensure it is satisfactory (for example, determine whether guardrails or cages are necessary). If an engineered fall protection system is not required, list each fall scenario that workers will be exposed to.
- For each fall scenario, analyze the fall hazards and determine the PFPS components that will be needed.
- Maintain and inspect the PFPS components needed to ensure that equipment is available when needed.
- Determine the worker's vertical and horizontal movement requirements in each scenario.
- Plan the anchoring system. Identify and evaluate the strength of all anchor points.
- Select and obtain the appropriate equipment (e.g., harness, lanyard, or self-retracting lifeline).
- Confirm training status of all users. The requirements are LBNL fall protection training (EHS 276) and written training documentation by the subcontractor.
- Review the planned work with workers to ensure their understanding of the requirements and approach to the job.
- Review the planned method of self rescue, anticipated time of hanging in the harness, and personal actions to minimize Suspension Trauma.

3. Limits On Use Of Personal Fall Protection Systems Equipment

Competent Persons shall ensure that PFPS equipment is used only for worker safeguarding. This safeguarding includes harnesses that combine the features of a full-body harness and a body belt.

Competent Persons and/or Supervisors shall ensure that any device that has been subjected to a fall load (i.e., a device that has protected a worker in an actual fall) has all components immediately removed from service, destroyed, and not used again for worker safeguarding.

4. Active Fall Protection System Components

Note: All components shall be from one manufacturer unless the Qualified Person (LBNL Structural Engineer) determines otherwise in writing with supporting calculations.

Full Body Harness

The full body harness has been designed to distribute arresting forces over the buttocks and shoulders. Typically, newer harnesses can be worn by men and women alike. The chest strap serves a retainer function and should be worn high on the chest, but under the collarbone.

D-ring locations may vary, so make sure the harness is the correct one for your task. Most harnesses have the D-ring on the upper back, but for ladder climbing systems the D-ring is located on the chest or rib area. D-rings on the hips are for work positioning and on the shoulders are for retrieval. Long hair may be caught in the D-ring, so the hair must be worn under the hardhat.

The most common misuse of the harness involves failure to connect the leg straps. This is also the most dangerous practice, as slipping through and out of the harness when the actual arresting action takes place is a very real possibility if the leg straps are not connected. The common practice of having loose leg straps is also dangerous, as it can lead to severe contusions to the upper thighs and groin area.

Note: Body belts are not to be used for fall arrest at LBNL.

Body belts are NOT fall arrest devices! Body belts, waist belts, or safety belts, as they are sometimes called, are only to be used as work positioning supports, that is, when the worker is standing, leaning out, and needs support to hold his/her position. Thus the term “work positioning.”

A single D-ring on the body belt should be positioned in the middle of the waist, in front of the body. More commonly, the body belt will have two D-rings to be connected to two lanyards, one from each side, similar to that used for a window washer. Body belts have either a tongue buckle or a friction buckle, both, if worn properly, will support the weight of a worker.

Connectors

Two shock-absorbing lanyards, at least one of which is always attached to a secure anchorage, is required for foot travel beyond the limits of a single lanyard when exposed to a fall greater than 6 feet. The use of a positioning device and an additional shock-absorbing lanyard while climbing is also acceptable.

Lanyards

A lanyard is a short, flexible rope or strap webbing that connects a worker's body harness to an anchorage point or the grabbing device on a lifeline. There is no limit to the length of a lanyard, but lengths of 2, 4 and 6 feet are common to help limit falling beyond a maximum free-fall of 6 feet. The lanyard should be as short as possible, without restricting movement. An adjustable lanyard provides workers the flexibility to adjust the length of their lanyard to suit any fall arrest application. The design of the adjustable lanyard must allow the user to easily identify the length of the adjustment at a glance through a “tape measure” feature or similar design.

The minimum attachment height should be at or above the D-ring height to ensure the free-fall distance will be less than 6 feet.

Unlike basic cable, web, or rope lanyards, shock-absorbing lanyards not only significantly reduce arresting forces on the body, but also provide a means to determine in-service use. Obvious deformation makes it evident that they have been stressed. All lanyards are to be destroyed and replaced after having been shock loaded.

Y-Lanyards

A Y-lanyard is two or three lanyards, generally shock-absorption types, connected to a center ring or snap hook that allows workers to move horizontally from one anchorage point to another.

The user must be trained in the use of the Y-lanyard and constantly be aware of the location of both lanyards. There have been several instances of the lanyards becoming entangled or actually causing a fall when they have snagged on an obstruction and thrown a worker off balance.

Do not connect the lanyard to an unauthorized anchorage as travel progresses. Consider a horizontal lifeline system as an alternate solution.

Snap Hooks

Snap-hooks shall be of a self-closing and self-locking type. The self-locking gate meets the 3600-pound breakage strength requirements and shall not be directly connected to: webbing, rope, or wire rope; horizontal lifelines (a separate ring or carabiner should ride on the horizontal lifeline); or to any object whose shape or dimensions are incompatible with the snap-hook such that unintentional disengagement (e.g., roll-out) could occur. A snap-hook shall not be connected directly to another snap-hook.

Snap-hooks may only be used with compatible components. Snap-hooks are not to be attached directly to cables, ropes, chains, or the lanyard itself, as in looping the lanyard over a pipe and hooking the snap-hook on the lanyard, unless approved by the manufacturer. Only approved anchor points shall be used to connect to the lanyard snap-hook.

Retractable Lifelines**Self-retracting Lanyards (Locking):**

Self-retracting lanyards with locking devices are designed to arrest free-falls within inches by eliminating the slack inherent in fixed-length lanyards. The Competent Person will determine the free-fall distance. One main consideration is that to be effective, overhead installation is required. A major advantage is that arresting forces can be kept to the 650-pound range, almost one-third of that associated with a 6-foot free-fall. This system is especially attractive when working near the edge, on roofs, and when frequent ladder climbs are required.

Lifeline Systems:

Lifeline systems provide a means for connecting components of a personal fall arrest system to an anchorage. They consist of either:

- a flexible line for connection to an anchorage at one end, to hang vertically (vertical lifeline), or
- a flexible line for connection to anchorages at both ends, to stretch horizontally (horizontal lifeline).

For all lifeline systems, vertical or horizontal, a Qualified Person must approve the anchorages and the selection of the type of lifeline to ensure proper design of the system.

Vertical Lifeline Systems:

A vertical lifeline allows the worker to move up and down the entire height of the line rather than having to disconnect and find a new tie-off point on the tower or ladder he/she is climbing. Workers connect to the lifeline by a "rope grab" deceleration device that travels along with the worker as he/she moves higher or lower.

The diameter and composition of the line may vary, but it must have a 5,000-pound breaking strength. Polypropylene rope has become popular, but the stretch factor must be taken into account.

The rope grab is a deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of the user. A rope grab usually employs the principle of inertial locking, cam/level locking, or both. Rope grabs can be either manual or mobile and must be suited to the lifeline fabric. Squeezing and releasing a locking cam operates the manual grabs. The grab should be located above shoulder height, and a short (3-foot) lanyard is recommended to prevent exceeding the 6-foot free-fall requirement.

Ladder Safety Devices:

Ladder safety devices are similar to vertical lifeline systems with the exception that they attach to the front harness D-ring with a 9-inch maximum connector and limit free fall to 2 feet.

Horizontal Lifeline Systems:

A horizontal lifeline is a flexible line rigged in a horizontal plane secured at each end to an anchorage; it provides fall protection for work requiring horizontal mobility along elevated surfaces. A worker connects to the line using a personal fall arrest system that moves with the worker between the two anchorages. By providing a sliding connection along the entire walkway the anchorage is kept overhead, reducing the hazard of dangerous swing falls that can occur if the worker moves to a location where the anchorage is no longer directly overhead.

Horizontal lifeline systems are common in work areas lacking overhead anchor points available for personnel tie-off. In its simplest form, the horizontal lifeline consists of a cable attached to two or more anchor points on a roof-top, crane runway, bridge, or outdoor construction site, or any other elevated work area that poses a fall risk to personnel. When used in combination with personal protective equipment, a horizontal lifeline can arrest a fall, limiting the amount of force that is transferred to both the worker and the fall arrest system.

Horizontal lifelines shall be designed, installed, and used, under the supervision of a Qualified Person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two. Although installing a horizontal lifeline may appear to be as simple as stringing a line between two supports, determining the loads applied to the anchorages and the clearance required below the working surface in the event of a fall can be extremely complicated. In this respect horizontal lifelines are among the most complex types of fall protection equipment.

Anchorage

Personal fall protection systems are dependent on an adequate anchor point. Without this the harness, lanyard, and shock-absorption are useless.

ONLY ANCHORAGE POINTS IDENTIFIED BY A QUALIFIED OR COMPETENT PERSON ARE TO BE USED.

Guardrails, handrails, fire sprinkler piping, and roof ducting are NOT acceptable anchorage points. Questions on anchorages should be directed to a Fall Protection Program Competent Person.

Anchorage are to be:

1. Independent from the work object whenever possible.
2. Permanent anchorages are to be clearly marked and identified as approved by a Qualified Person.
3. Located at suitable attachment heights.
4. Have sufficient strength when used for the intended purpose.
5. Be inspected regularly and before each use.

Connecting devices (e.g., shock absorbing lanyards) should be secured above the point of operation to an anchorage or structural member capable of supporting a minimum dead weight of 5,000 pounds per worker and limiting the fall distance to 6 feet or less.

Work Process F. Scaffolding

The exposure hazard during erection and dismantling of a scaffold is many times what the exposure is while working on a scaffold. OSHA requires that the Competent Person develop a written fall protection plan that meets the OSHA standard. The written plan must be submitted for approval by the LBNL Construction Project Manager for review prior to commencing the operation.

The employer shall provide safe means of access for each employee erecting or dismantling a scaffold where the provision of safe access is feasible and does not create a greater hazard. The employer shall have a Competent Person determine whether it is feasible or would pose a greater hazard to provide and have employees use a safe means of access. This determination shall be based on site conditions and the type of scaffold being erected or dismantled.

Work Process G. Steel Erection

Steel erection is a high fall hazard activity. Plan erection prior to work, at the ground level, coordinating with the fabricator for the attachment of anchorages and cables for the majority of the erection sequence. Plan the routes of travel. Use quick-release methods for the release of rigging where possible.

Free climbing up or down columns is prohibited. Walking on beams that have a top flange of less than a 6-inch width is also prohibited.

Decking work is the most dangerous phase of steel erection. A Controlled Decking Zone shall be established and all affected workers shall be trained in accordance with OSHA 29 CFR 1926.761. Perimeter cables shall be erected as soon as decking is installed.

Work Process H. Tree Trimming

Elevated tree work at LBNL may be done from aerial lifts, in which landscaping personnel are protected from falls by fall restraint systems. Working at heights is also done from ladders, and workers must conform to Chapter 10, Section A.12 "Ladders".

A professional tree service must complete a detailed JHA (see JHA for Arboricultural). The JHA must be submitted to an LBNL Construction Safety Engineer (CSE) for review and approval by the supervisor contracting with the professional tree service prior to the start of work.

Work Process I. Roofing Installation and Repair

Roofers must:

Complete a JHA (see JHA for Roofers). The JHA is to be submitted to LBNL EHS Construction Safety Engineer (who is a competent person) for review and supervisor approval prior to the start of work.

- Have specified training
- Always set up a warning line system at least 6 feet back from the edge
- May use a monitor system instead of fall protection when working outside the warning line system.

Work Process J. Non-Roofers Performing Work On Roofs

Non-roofers performing work on roofs shall complete a Fall Protection Matrix to help evaluate the hazards of the job and select the most appropriate hazard control. If a warning line is selected as the appropriate work control, the warning line system will be set up 15 feet from the edge of the roof in compliance with Federal OSHA Interpretation of November 15, 2002, This document states “OSHA has determined that 15 feet is sufficient distance from an edge or hole to be expected to prevent workers from unintentionally approaching the edge and would not place the worker in immediate risk of falling off the edge.” (for more information, see section: 30.7 References in this chapter). Note: OSHA interpretations are enforceable as standards and LBNL is required to follow OSHA interpretations.

Exceptions:

Note: These are only applicable after careful evaluation has determined that fall protection cannot be used.

- Provisions do not apply when employees are making:
 - An inspection (no tools or papers)
 - Investigation
 - Assessment of work place conditions
 - Prior to the start of work
 - After all work has been completed
- Work can be done on a flat or low sloped roof without fall protection if it is performed at least 15 feet from an unprotected edge and a warning line has been established.

Work Process K. Fixed Ladders

Cages or wells shall be provided on ladders of more than 24 feet to a maximum unbroken length of 30 feet. If cages are not feasible, then ladder safety devices may be used on ladders over 24 feet in unbroken length in lieu of cage protection. No landing platform is required in these cases. All ladder safety devices, such as those that incorporate life belts, friction brakes, and sliding attachments, shall meet the design requirements of the ladders that they serve.

All ladders and ladder safety devices shall be maintained in a safe condition and be inspected at 6-month intervals or less, with shorter intervals determined by use and exposure. Inspection records shall be maintained by the Facilities Division.

Work Process L. Maintenance at Elevated Locations

Maintenance personnel are often faced with repairs and service of roof-mounted or unguarded platform-mounted equipment. All fall protection requirements stated in this document are required for maintenance personnel, including the specified training and the use and care of equipment. In lieu of using personal fall arrest systems, other systems are available for the protection of workers, at the discretion of the Competent Person, including temporary guardrails, safety nets, fall restraints, warning line systems, controlled access zones, and fall protection plans, as discussed in this document. Contact your EH&S Fall Protection SME or specific information on fall protection requirements.

Work Process M. Confined Space Considerations

In most confined space situations the use of harnesses are for rescue and extraction purposes. However, due to the almost unlimited configurations of confined spaces, normal fall protection may also be a consideration. See Chapter 4, Section 4.9, "Permit Required Confined Space" for more information on the use of fall protection in confined spaces. .

Work Process N. First-Person Up Situations

If access is required to an elevated surface that does not contain any fall protection anchorage, or protected access, the first-person up principal may be used. Only trained and skilled persons, under the direct supervision of a Competent Person may access an elevated surface without fall protection for the purpose of installing the necessary fall protection equipment, prior to the start of the work activity.

Work Process O. Identifying and Obtaining Required Fall Protection Equipment

1. Selection and Fit

Personal fall protection systems (PFPSs) consist of 3 components: an anchorage, commonly referred to as a tie-off; body support, usually a full body harness; and a connecting device, such as a shock-absorbing lanyard. Individually, these components will not provide protection from a fall. Used properly in conjunction with each other, they form a personal fall arrest system (PFAS), an important element of the overall fall protection program.

Four functional categories of PPE for fall protection are available: fall arrest systems, positioning/restraint systems, suspension systems, and retrieval systems. Only a fall arrest system will protect a worker who has fallen from elevation.

The Competent Person shall ensure an Authorized Person who uses fall protection equipment is provided with the appropriate equipment and the equipment fits properly. The specific type of fall protection required is determined by the Competent Person.

2. Obtaining Fall Protection Equipment

LBNL organizations purchase their own personal fall arrest equipment – the fall protection program administration assists these organizations in selecting the right equipment. An adequate supply of regularly used harnesses, lanyards, anchorage point connectors, and other equipment in appropriate sizes should be available near the work area. PFAS equipment is a controlled item for procurement purposes, and procurement personnel shall ensure that the EH&S Division approves all purchases.

Work Process P. Inspection of Fall Protection Equipment

Two types of inspections, pre-use and formal are required.

Formal inspections are performed by a competent person. The competent person performing the formal inspection shall inspect each piece of PFAS equipment semi-annually. The EH&S Occupational Safety Group maintains an inventory of PFAS equipment which serves for an inspection database as well. When equipment is inspected, a metal tag is placed on the equipment with the date the inspection expires.

Equipment should only be used if the inspection is current. The formal inspection procedure is specified below.

Users shall inspect their own fall protection equipment, prior to each use, for damage, wear, and other defects.

CAUTION

Only the manufacturing company or parties with written authorization from the manufacturer may make repairs to the equipment.

Procedures for Formal Inspection of Fall Protection Equipment

The Formal Inspection Procedure is similar to the user's inspection before each use. However, it differs in three important respects: (1) it is performed by a Competent Person who is trained and authorized to perform a Formal Inspection for the user's organization; (2) it is more detailed and is methodically recorded in a Formal Inspection Log that is kept on file for future reference; and (3) it results in final disposition of the equipment as either "acceptable" or as "not acceptable" followed by destruction of the product. The described detailed inspection record keeping is needed to trace detected defects to their causes. An inspection log shall be kept and inspection forms maintained for 1 year after the date of inspection. The Formal Inspection Log has been developed following the guidelines set forth by and in compliance with the manufacturer's instructions.

The equipment shall be inspected by a Competent Person, other than the user, at least semiannually. The Competent Person should perform a methodical and thorough visual and tactile inspection by following the appropriate inspection procedure (see the paragraphs below in this section). If the equipment passes Formal Inspection, the competent person shall attach an inspection tag to the equipment

Harness Inspection:

Hold the harness by the back D-ring. Starting at the top of the harness, grasp one strap and run your hand along the entire length. While running your hand along the strap, bend the webbing over your index fingers. The resulting surface tension makes damaged fibers or cuts easier to see. Follow this procedure for all shoulder straps, back straps, leg straps, and the chest strap. Watch for frayed edges, broken fibers, pulled stitches, cuts, or chemical damage.

- a. D-Rings: Check D-rings and their metal or plastic wear pads (if any) for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90-degree angle to the long axis of the belt and should pivot freely.
- b. Attachments of Buckles: Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles or D-rings. Rivets should be tight and immovable with fingers. The body-side rivet base and outside rivet burr should be flat against the material. Bent rivets will fail under stress.
- c. Inspect for Frayed or Broken Strands: Broken webbing strands generally appear as tufts in the webbing surface. Any broken, cut, or burned stitches will be readily seen. See Table 1 for detailed information on visual inspections for chemical, heat, and corrosive damage.
- d. Tongue or Billet: The tongue or billet of a belt or strap receives heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted, or broken grommets. Belts and straps should not have additional punched holes.
- e. Buckle Tongues: Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their sockets. The roller should turn freely on its frame. Check the roller for distortion or sharp edges.

- f. Friction and Mating Buckles: Inspect the buckle for distortion. The outer bars and center bars must be straight. Pay special attention to corners and attachment points of the center bar. Look for burrs and cracks.

Lanyard Inspection:

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention.

- a. Hardware
 - Snaps: Visually inspect the hook and eye for distortions, cracks, corrosion, or pitted surfaces. The keeper (latch) should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper locks must prevent the keeper from opening when the keeper lock is not depressed.
 - Thimbles: The thimble must be firmly seated in the eye of the splice. The splice should have no loose or cut strands. The edges of the thimble must be free of sharp edges, distortion, or cracks.
- b. Steel Lanyard
 - While rotating the steel lanyard watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard. With a gloved hand, slide a piece of cotton swabbing along the length of the lanyard. Cotton tufts will indicate the presence of broken wire strands.
- c. Web Lanyard
 - While bending the webbing over a pipe or mandrel, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Examine the web for swelling, discoloration, cracks, and charring. These are signs of chemical or heat damage. Observe closely for any breaks in the stitching.
- d. Shock-absorbing Lanyards
 - Shock-absorbing lanyards should be examined using the method described above for web lanyards. However, also look for the warning flag or signs of deployment. If the flag has been activated, remove the shock-absorbing lanyard from service.

Table 1. Examples of Lanyard Damage

Type of Webbing	Heat	Chemical	Molten Metal or Flame	Paint and Solvents
Nylon, Polyester (Dacron*), Duraflex	In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed. Should not be used above 180°F.	Change in color usually appearing as a brownish smear or smudge. Transverse cracks when belt is bent over a mandrel. Loss of elasticity in belt.	Webbing strands fuse together. Hard shiny spots. Hard and brittle to the touch.	Paint that penetrates and dries restricts movement of fibers. Drying agents and solvents in some paints will appear as chemical damage.

NOTE: Lanyards made of nylon or polyester rope will show the same visual indications of damage as nylon webbing*Du Pont trademark.

Log for Semi-Annual Inspection of Equipment by Qualified Inspector

This log may be used in accordance with equipment inspection procedures and manufacturers' instructions.

Date _____
 Organization _____ Location _____
 Equip. No. _____
 Equip. Description _____
 Competent Person/Inspector _____

NOTE: Any "YES" answers indicate that the equipment must be removed from service for repair, or destroyed and discarded.

Harness Inspection:

- _____ Damaged, cut fibers
- _____ Frayed edges
- _____ Pulled stitches
- _____ Chemical, heat, corrosion damage
- _____ D-ring distortion, cracks, breaks, rough or sharp edges
- _____ D-ring attachment points – unusual wear, frayed or cut fibers
- _____ D-ring attachment points – rivets loose, not flush
- _____ Strap Tongue/Billet – loose, broken, or missing grommets
- _____ Strap Tongue/Billet – punched holes
- _____ Buckle – distorted, stiff, frozen roller, sharp edges
- _____ Buckles – bars not straight, burrs, cracks

Lanyard Inspection:

- _____ Snaps – distortion, cracks, corrosion, pitted surface
- _____ Keeper latch – not seating, spring weak
- _____ Thimble – not in eye of splice, cracks, splice with cut or lose strands
- _____ Steel lanyard – frayed, cut strands, wear
- _____ Web lanyard – cuts, breaks, discoloration, charring, stitching breaks
- _____ Shock-absorbing lanyard – signs of deployment

Procedure for Pre-Use Inspection of Fall Protection Equipment

Procedure for inspection before each use:

Step 1: Inspect the labels to verify that they are present and legible. Check to be sure a Formal Inspection has been performed within 6 months. This can be indicated by colored tape on the item or inspection labels indicating the date inspected or date due. If the Formal Inspection has not been performed within 6 months or if any labels are missing or illegible, remove the equipment from use and mark it as "UNUSABLE" until a formal inspection is performed by a Competent Person.

Step 2: Inspect all webbing and stitching for cuts, fraying, pulled or broken threads, abrasion, excessive wear, altered or missing straps, burns, and heat or chemical exposures.

Step 3: Inspect all metallic parts (e.g., D-rings, oval rings, buckles, adjusters, and grommets) for deformation, fractures, cracks, corrosion, deep pitting, burrs, sharp edges, cuts, deep nicks, missing or loose parts, improper function, and evidence of excessive heat or chemical exposure.

Step 4: Inspect all plastic parts (e.g., strap collars, labels, tool belt support clips) for cut, broken, excessively worn, missing, and loose parts. Inspect for evidence of burns and excessive heat or chemical exposures.

Step 5: Inspect each component and subsystem of the complete system in accordance with the associated manufacturer's instructions.

CORRECTIVE ACTION: Defects, damage, excessive wear, and/or aging are generally not repairable. If detected, immediately remove the equipment from use and mark it as "UNUSABLE" until destroyed. For final disposition, submit the equipment to a Competent Person who is authorized to perform a Formal Inspection.

Control of Equipment

Any equipment that is found to be defective, damaged, or in need of maintenance must be immediately removed from use, marked as "UNUSABLE," and immediately destroyed or repaired if possible, according to manufacturer's directions.

Storage and Maintenance

The Competent Person and Authorized Person shall ensure that PFPS equipment is stored to avoid cutting, excess bending, stress on components, excessive heat, and contact with water or chemicals. Maintenance, including cleaning, is only to be performed as directed by the manufacturer.

Work Process Q. Fall Protection Training Requirements

Required Training for Authorized Persons (LBNL workers including employees, guests, and directly supervised subcontractors)

Authorized Persons are LBNL employees (including guests and directly supervised subcontractors) who perform work tasks where the use of fall protection equipment is required. Authorized Persons must successfully complete LBNL training course EH&S 276, "Fall Protection" and be authorized by their supervisor or work lead. The training program instructs employees to recognize fall hazards; follow specific procedures to minimize these hazards; and properly select, use, and maintain the equipment. Only trained Authorized Persons shall use fall protection equipment.

Required Training for Competent Persons

A Competent Person must be qualified in identifying the fall hazards of work tasks, conducting fall hazard surveys, stopping or limiting work at the hazard site, supervising selection and use of fall protection equipment, verifying that equipment is compliant and workers are trained, participating in investigations, conducting equipment inspections, and removing damaged equipment from service. To be a Competent Person at LBNL, the individual must have completed an outside training program administered by a third party (such as Gravitech) and approved by the Fall Protection Program Administrator.

Required Certification of Training for Construction Subcontractors Using the SJHA System

All subcontractors are required to provide training documentation for each worker who might be exposed to a fall hazard. Training documents shall be provided prior to work and must include the following statement of certification: "Certification of training per 1926.503(b)(1)"

Work Process R. How to Complete the LBNL Fall Protection Matrix

FALL PROTECTION MATRIX



- INPUT GENERAL INFORMATION [\My Documents\X-Matrix.xls](#)
- STEP ONE: ASSES THE FALL HAZARD
- CHECK THE BOX THAT ID'S THE HAZARD
- NEXT ENTER THE HEIGHT OF THE FALL HAZARD
- THE NUMBERED CIRCLES ARE CONTROL METHODS FOR THIS HAZ.

Step I: Assess the Fall Hazard

Greater than 6 ft. above Lower Safe Level Height: _____ ft.

Landing Hazard: (Machinery, Liquids, Debris, Chemicals)

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FALL PROTECTION MATRIX



- STEP TWO: SELECT A SECONDARY SYSTEM
- AFTER SELECTING A FALL SYSTEM, FOLLOW THE COLUMN (RIGHT) TO DETERMINE THE SECONDARY SYSTEM
- EHS COMPENT PERSONS CAN ASSIST YOU IN THIS PROCESS
- CONTINUE TO FOLLOW THE COLUMN TO MORE CIRCLED NUBERS AND BLACK BULLETS

Step II: Select a Secondary (Backup) System

Eliminate the Hazard or the Reason for Being There

- Traditional Fall Protection: (Guardrails/Ladder Cages/Slide Guards)
- Floor/Hole/Hatch Cover: (Secured in Place, Marked)
- Fall Restraint System: (Harness/Belt, Lanyard/Lifeline & Anchorage)
- Fall Arrest System:
 - Direct Coupled to Anchor (Lanyard)
 - Ladder Climbing System
 - SRL System
 - Vertical Lifeline System
 - Horizontal Rigid Rail System
 - Permanent Horizontal Lifeline System
 - Temporary Horizontal Lifeline System
 - Safety Nets
 - Lead Climbing Techniques (2 Person)

Fall Protection Plan

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FALL PROTECTION MATRIX



- STEP THREE: SELECT/CONFIRM/RECORD DETAILS OF SECONDARY SYSTEM
- AT CIRCLE NUMBER (⊙) OR A BLACK BULLET (●) INDICATE RANKED SUGGESTIONS FOR ANCHORAGE SELECTIONS AND BODY SUPPORT DEVICES.
- BLACK BULLETS INDICATE LEGAL REQUIREMENTS MUST BE FOLLOWED; FALL CALCULATIONS, FALL PLAN, RESUE PLAN, AND EMERGENCY EGRESS SYSTEM OR PLAN MAY BE REQUIRED

Step III: Select/Confirm/Record Details of the Secondary System

Guardrails: (42" ± 3" top rail with minimum 200 lb. strength, mid-rail minimum 150 lb. strength)

Ladder Cages: (Landings every 30 ft. in General Industry, 50 ft. in Construction)

Slide Guards (minimum 4' high at roof eave)

Floor/Hole Hatch covers: (2x Heaviest Worker, Vehicle or other Load, Minimum 200 lbs.)

Select Anchorage:

- > 3000 lbs. (Work Positioning) Describe: _____
- Strength Factor of Safety > 2 Describe: _____
- _____ Describe: _____

Body Support:

- Full Body Harness: Dorsal Attachment to the Fall Arrest System
- Waist Belt (FALL RESTRAINT ONLY EXCEPT FOR LADDER CLIMBING SYSTEMS)

Estimate Required Clearance: Free Fall = _____ ft. Lockoff & Deceleration = 3 ft. (Stretch + Buffer) = _____ ft.

Measure Available Clearance: Estimated Clearance Requirement (Caution) _____ ft.

Fall Protection Plan:

- Written Reasons Why Positive Fall Protection is Infeasible
- Written Work Procedures Posted (Available at the Worksite)
- Safety Advisor Name or Other Designation: _____

Rescue & Emergency Provisions: Phone Number: _____ Equipment/Procedures/Personnel On-site

Emergency Egress System or Plan: Details: _____

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FALL PROTECTION MATRIX



- STEP FOUR: QUALIFICATIONS/INSPECTIONS/APPROVALS
- AGAIN FOLLOW THE COLUMN TO RIGHT-TO-LEFT AND THE CIRCLE NUMBER (⊙) OR A BLACK BULLET (●) INDICATES RANKED SUGGESTIONS FOR COMPETENT OR QUALIFIED PERSONS
- BLACK BULLETS INDICATE LEGAL REQUIREMENTS MUST BE FOLLOWED
- INSPECT ALL FALL PROTECTION EQUIPMENT, ENSURE ALL EMPLOEES HAVE BEEN TRAINED AND BRIEFED ON ANCHORAGE LOCATION, USE OF EQUIPMENT, CLEARANCE & RESCUE REQUIREMENTS. SIGNATURES ARE REQUIRED FOR ALL PERSONAL USING THE FALL MATRIX PLAN

Inspect all Equipment and Systems Prior to Each Use

All Persons Have Been Properly Trained and Briefed

Approved or Installed By a Competent Person

Designed, Approved and Installed by a Qualified Person

Step IV: Qualifications/Inspections/Approvals

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<input type="checkbox"/> Open Sides: <input type="checkbox"/> Floors or Platforms <input type="checkbox"/> Stairs <input type="checkbox"/> Catwalks <input type="checkbox"/> Scaffolds <input type="checkbox"/> Unguarded Machinery	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Wall Openings:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Floor Openings: <input type="checkbox"/> Hatchway <input type="checkbox"/> Manhole <input type="checkbox"/> Pit <input type="checkbox"/> Tank <input type="checkbox"/> Shaft <input type="checkbox"/> Skylight	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Leaving the Guarded Floor Surface: of a <input type="checkbox"/> Manlift (Any Type) <input type="checkbox"/> Scaffold <input type="checkbox"/> Catwalk <input type="checkbox"/> Platform	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Working from inside a Properly Guarded Man-lift: (Scissor, Boom, Bucket, Articulating)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Working from a Suspended Platform: <input type="checkbox"/> Swing Stage <input type="checkbox"/> Manbasket <input type="checkbox"/> Boatswain's Chair <input type="checkbox"/> Descent Harness	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Fixed Ladder: <input type="checkbox"/> Working with Both hands	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Portable Ladder: <input type="checkbox"/> Working with Both hands	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Working on Steeply Sloping Roofs or Surfaces (> 4:12 pitch)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Working Within 15ft. Of an Edge on Flat or Low Slope Roofs or Surfaces	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Structural Climbing: (Bridge, Roof Truss, Towers, Drilling Rig, Pile Driver)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Activities Where a Fall Arrest System is NOT Practicable: i.e. (>) 15ft. of an unprotected edge	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<input type="checkbox"/> Other, Describe: _____	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Adapted for BC Regulation 296/97

FALL PROTECTION PLANNING MATRIX

This matrix provides general guidance only. It must only be used by trained and competent persons who have knowledge of the precise requirements of the applicable legislation. This form guides planning of fall protection ONLY - protective equipment and procedures for other types of hazards must also be in place.
 - TO USE: Proceed clockwise - record all required details. Blanken, at least one circle (from each number or letter series), at each corner to choose the system or option. Each series of circles is prioritized ("1" or "2" is the best choice). Solid bullets are mandatory.

Step I: Assess the Fall Hazard Equal to or greater than 6 Feet Height: _____ ft.
 Landing Hazard: (Machinery, Liquids, Debris, Chemicals)

Step II: Select a Secondary (Backup) System

Step III: Select/Confirm/Record Details of the Secondary System

Step IV: Qualifications/Inspections/Approvals

Eliminate the Hazard or the Reason for Being There

Traditional Fall Protection: Guardrails/Ladder Cages/Slides/Guard Floor/Hole/Hatch Cover: (Secured in Place, Marked)

Fall Restraint System: (Harness/Belt, Lanyard/Lifeline & Anchor)

Fall Arrest System: Direct Coupled to Anchor (Lanyard) Ladder Climbing System SRL System Vertical Lifeline System Horizontal Rigid Rail System Permanent Horizontal Lifeline System Temporary Horizontal Lifeline System Safety Nets Lead Climbing Techniques (2 Person)

Control Zone **Fall Protection Plan**

Guardrails: 102 cm - 112 cm (40" - 44") high, able to carry 550 N (125 lbs.)

Ladder Cages: (Landings every 30 ft. in General Industry, 50 ft. in Construction)

Floor/Hole Hatch covers: (2 x Heaviest Worker, Vehicle or other Load, Minimum 200 lbs.)

Slide Guards: (Minimum 4" at roof eave)

Select Anchorage: > 5000 lbs. Describe: _____ Strength Factor of Safety >2 Describe: _____ 4 x intended load, minimum 800 lbs. Describe: _____

Body Support: Full Body Harness, Dorsal Attachment to the Fall Arrest System Waist Belt (FALL RESTRAINT ONLY EXCEPT FOR LADDER CLIMBING SYSTEMS)

Estimate Required Clearance: (_____ ft. Free Fall) + (_____ ft. Lockoff & Deceleration) + 3 ft. (Stretch + Buffer) = _____ ft.

Measure Available Clearance: _____ ft. Exceeds Estimated Clearance Requirement (Safe) Less Than Estimated Clearance Requirement (Caution)

Fall Protection Plan: Written Work Procedures Posted (Available at the Worksite) Controlled Access Zone Defined by: Warning Line System Other: _____ Safety Monitor Name or Other Designation: _____

Rescue & Emergency Provisions: Phone Number: 510-486-7911 Emergency Radio: _____

Emergency Egress System or Plan: Details: Fire Pull # _____ • Radio check every 30 minutes

Work Process S. Fall Protection Rescue Plan

Rescue is an integral element of planning for work using a Personal Fall Arrest System. LBNL policy is to rely on the Alameda County Fire Department for rescue, if needed. The Alameda County Fire Department has an onsite fire station and the firefighters at this station are trained in technical rescue. In addition, the Alameda County Fire Department maintains a technical rescue team that can be called if needed. Interviews with the Alameda Fire Captain responsible for the LBNL Station, in preparation for the development of this LBNL standard, revealed that a response time of 4-6 minutes is expected from the LBNL fire station under normal circumstances.

LBNL uses the Fall Protection Matrix to document contact with the Alameda Fire Department to confirm that rescue services are available.

- 1) Phone contact: By cell phone dial 510-486-7911, or by LBNL land-line dial 7911

In addition, LBNL Cranes which have passenger cabs are mounted with Rescumatic Decent Devices to assist the rescue of crane operators.

30.7 References

Requirements Source Documents

- 10 CFR 851, Worker Safety and Health Program
- 29 CFR 1910, Occupational Safety and Health Standards for General Industry
 - 29 CFR 1910.25 – Portable Wood Ladders
 - 29 CFR 1910.26 – Portable Metal Ladders
 - 29 CFR 1910.27 – Fixed Ladders
 - 29 CFR 1910.28 – Safety Requirements for Scaffolding
 - 29 CFR 1910.29 – Manually Propelled Mobile Ladder Stands and Scaffolds (Towers)
 - 29 CFR 1910.67 – Vehicle-Mounted Elevating and Rotating Work Platforms
- 29 CFR 1926 Safety and Health Regulations for Construction
 - 29 CFR 1926.104 – Safety Belts, Lifelines, and Lanyards
 - 29 CFR 1926.105 – Safety Nets
 - 29 CFR 1926. Subpart L – Scaffolds
 - 29 CFR 1926. Subpart M – Fall Protection
 - 29 CFR 1926.760 – Fall Protection – Steel Erection
 - 29 CFR 1926 Subpart X – Ladders
- Title 8 CCR, Div 1, Chapter 4, Subchapter 4, Construction Safety Orders (for all construction safety unless 29CFR1926 is more strict) [*Cal/OSHA Standard*]
 - Article 21. Scaffolds – General Requirements (Sections 1635.1–1637)
 - Article 22. Scaffolds – Various Types (Sections 1640–1655)
 - Article 23. Suspended Scaffolds (Sections 1658–1667)
 - Article 24. Fall Protection (Sections 1669–1672)
 - Article 25. Ladders (Sections 1675–1678)
- Applicable OSHA Letters of Interpretation, including
 - OSHA Interpretation: November 15, 2002 “Harkins”, “Whether a warning line at 6 feet used to protect roofing workers may also be used to meet fall protection requirements for HVAC construction workers; §1926.502(b).”

Implementing Documents

Health and Safety Manual (LBNL/PUB-3000):

- Chapter 4, Section 4.9, Permit Required Confined Spaces
- Chapter 5, Section 5.2, Elevated Work Locations
- Chapter 10, Construction Safety, Appendix A Code of Safe Practices
 - A.6 Fall Protection
 - A.12 Ladders
 - A.20 Protection of Openings and Open Side Floors and Decks
 - A.21 Scaffolding

Best Management Practices

- ANSI Z359-2007 – Fall Protection Code (code sections below are those issued by April 1, 2010)
 - Z359.0 – 2007 “Definitions and Nomenclature Used for Fall Protection and Fall Arrest”

- Z359.1 – 2007 “Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components”
- Z359.2 – 2007 “Minimum Requirements for a Comprehensive Managed Fall Protection Program”
- Z359.3 – 2007 “Safety Requirements for Positioning and Travel Restraint Systems”
- Z359.4 – 2007 “Safety Requirements for Assisted Rescue and Self-Rescue Systems, Subsystems and Components”
- Z359.6-2009 “Specifications and Design Requirements for Fall Protection Systems”
- Z359.12-2009 “Connecting Components for Personal Fall Arrest Systems”
- Z359.13-2009 “Personal Energy Absorbers and Energy Absorbing Lanyards”
- American National Standards Institute (ANSI) A10.11, Safety Requirements for Personnel and Debris Nets
- ANSI A10.8 – Safety Requirements for Scaffolding
- ANSI A10.13 – Safety requirements for Steel Erection
- ANSI A14.1 – American National Standard for Ladders – Wood
- ANSI A14.2 – American National Standard for Ladders – Portable Metal
- ANSI A14.3 – Safety Requirements for Fixed Ladders
- ANSI A14.4 – American National Standard for Job Made Wooden Ladders
- ANSI A92.2 – Vehicle Mounted Elevating and Rotating Work Platforms
- ANSI A92.3 – Manually Propelled Elevation Aerial Platforms
- ANSI A92.6 – Self-Propelled Elevating Work Platforms