SERIOUS INJURY & FATALITY PREVENTION

Energy-Based Safety

Controlling Hazardous Energy to Prevent SIFs

Drawing on Matthew Hallowell's Energy-Based Safety: four core principles and practical tools for design, planning and daily operations.

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From Principles to Friday Morning

1. Why SIFs are different
2. Energy & the four core principles
3. Recognizing high-energy hazards
4. Direct & alternative controls
5. Human factors in energy control
6. Tools for design, planning & daily ops

QUICK POLL

Show of hands — who's in the room?

- Construction
- Manufacturing
- Other / consulting

Keep your hand up if your site has had a serious injury or a serious close call with high energy in the last 12 months.

The SIF Plateau

Non-fatal injury rates have been falling for decades. Fatality rates have flattened.

- The rate of non-serious injuries has declined and continues to decline
- The rate of serious injuries and fatalities has plateaued
- Lower recordable rates do not mean lower SIF exposure

Does preventing SIFs matter more than preventing non-SIF injuries?

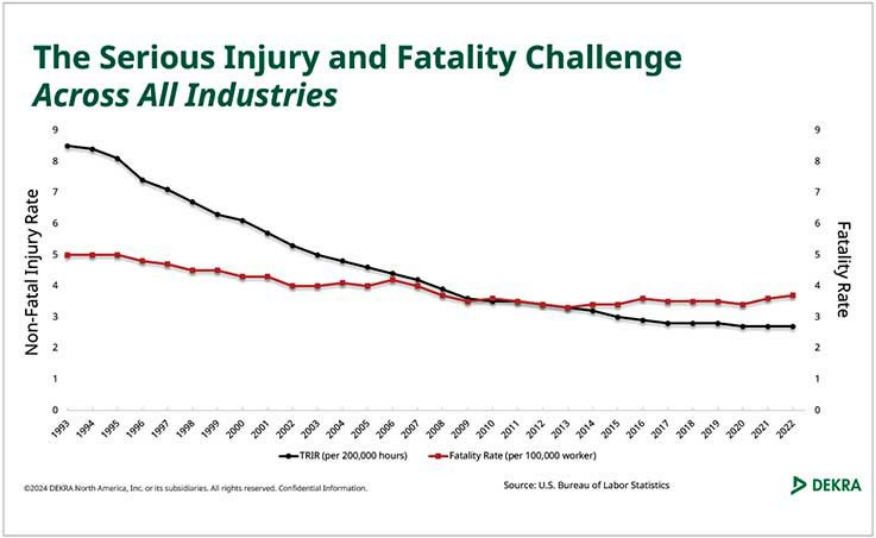


Chart: DEKRA North America; data from U.S. Bureau of Labor Statistics

What Is a SIF?



Life-ending

Loss of life — a fatality.



Life-threatening

Requires immediate medical intervention or life-saving support to keep the injured person alive.



Life-altering

The worker will not fully recover — permanent impairment or loss of use of a major organ, body function or body part.

The misuse of the safety pyramid

The things that hurt people are not the same as the things that kill people.

All hazards deserve attention — but not equal attention. Hazards with enough energy to make a SIF deserve special focus, more time and higher-order controls.

Injury Is a Transfer of Energy

To prevent SIFs, first understand how energy is stored, released and transferred.

Potential energy

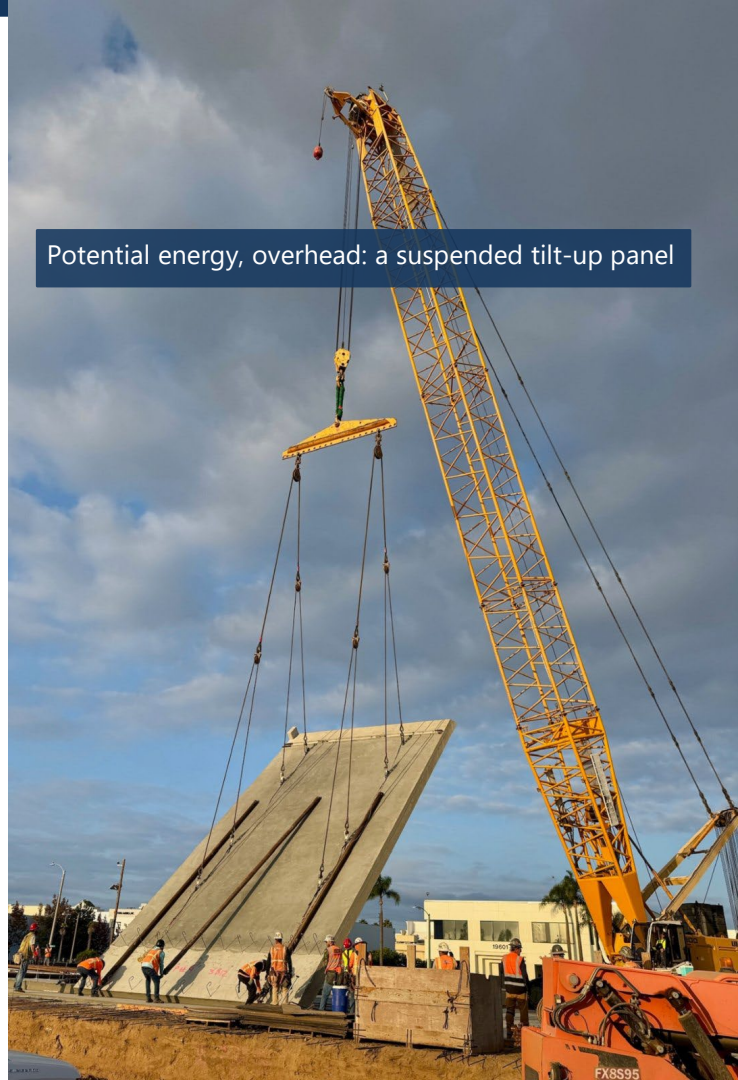
Stored, waiting to be released

Tool at height · compressed gas cylinder · cable under tension · suspended load

Kinetic energy

Energy in motion

Moving vehicles · swinging or rotating tools · heat · sound



Potential energy, overhead: a suspended tilt-up panel

Four Core Principles of Energy-Based Safety

1

Energy causes harm

Uncontrolled physical energy interacting with the body causes injury.

Use the Energy Wheel to find hazards

2

High energy causes SIFs

More energy, more harm. SIFs come from high-energy hazards — not slips and strains.

Prioritize the STKY

3

Controls save lives

Direct, reliable physical safeguards block or harness energy instead of relying on compliance alone.

Control the STKY

4

People drive performance

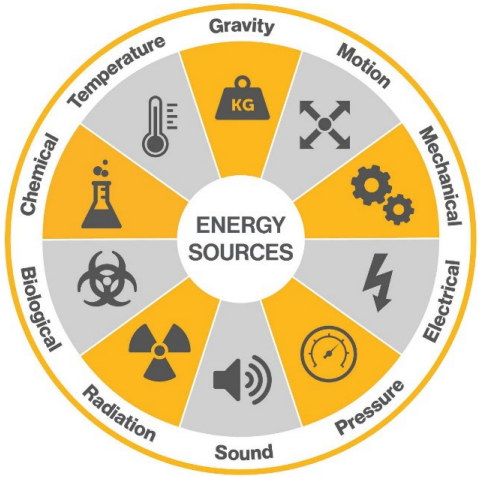
Design, systems and operational pressure shape human decisions and exposure.

Understand how context affects control

Safety is about managing energy: where it's stored, how it flows, and how it's controlled.

Hazard Recognition Is a Fundamental Skill

Situational awareness → **Hazard recognition** → Risk perception → Risk tolerance → Action



45% of hazards identified during planning in construction field studies

+30% average improvement in hazard recognition when crews use the Energy Wheel

- We tend to see gravity and motion — and overlook pressure, temperature, radiation, chemical and biological.
- Recognition skill is similar regardless of age or experience.
- Use instinct first, then the wheel. Once learned, it doesn't add time.



YOUR TURN · 60 SEC

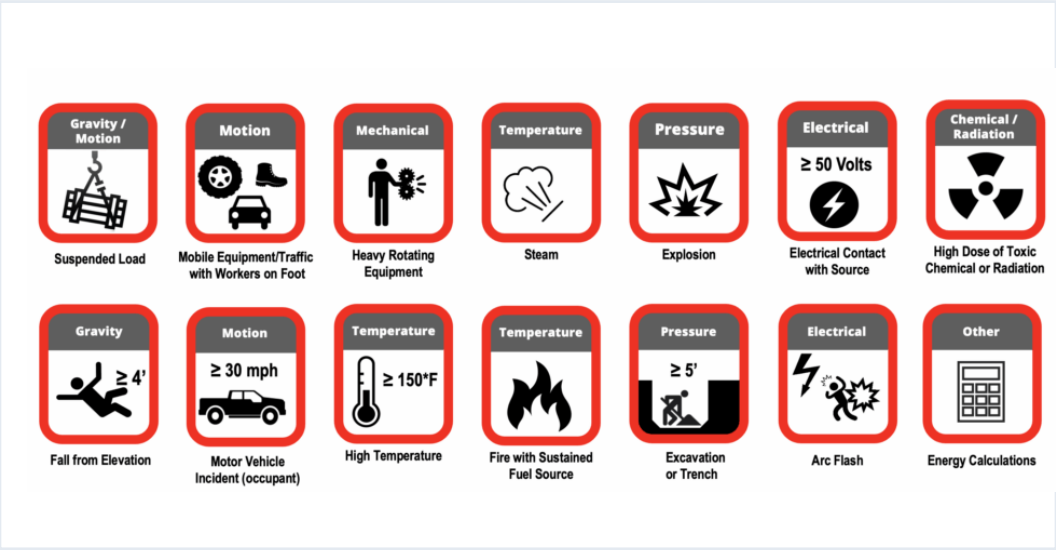
Spot the Energy

Use the Energy Wheel. Call out every energy source you can see in this photograph.

Gravity	Motion
Mechanical	Electrical
Pressure	Temperature
Chemical	Biological
Radiation	Sound

Then: which of these could kill someone?

Find the STKY: Stuff That Can Kill You



High-energy hazard icons (Safety Function / CSRA)

- Common high-energy hazards — not a complete list
- Where a stricter government standard applies, use it
- Icons must be governed to stay consistent

Three steps for any task

1 List

List every hazard from instinct and experience. (PPE and "paying attention" aren't energy.)

2 Expand

Walk the Energy Wheel to catch what you missed.

3 Screen

Check each hazard against the icons. High energy = STKY.

Rule of thumb: > 1,500 joules ≈ high energy (Equivalent to carrying a 150lb person 6ft)

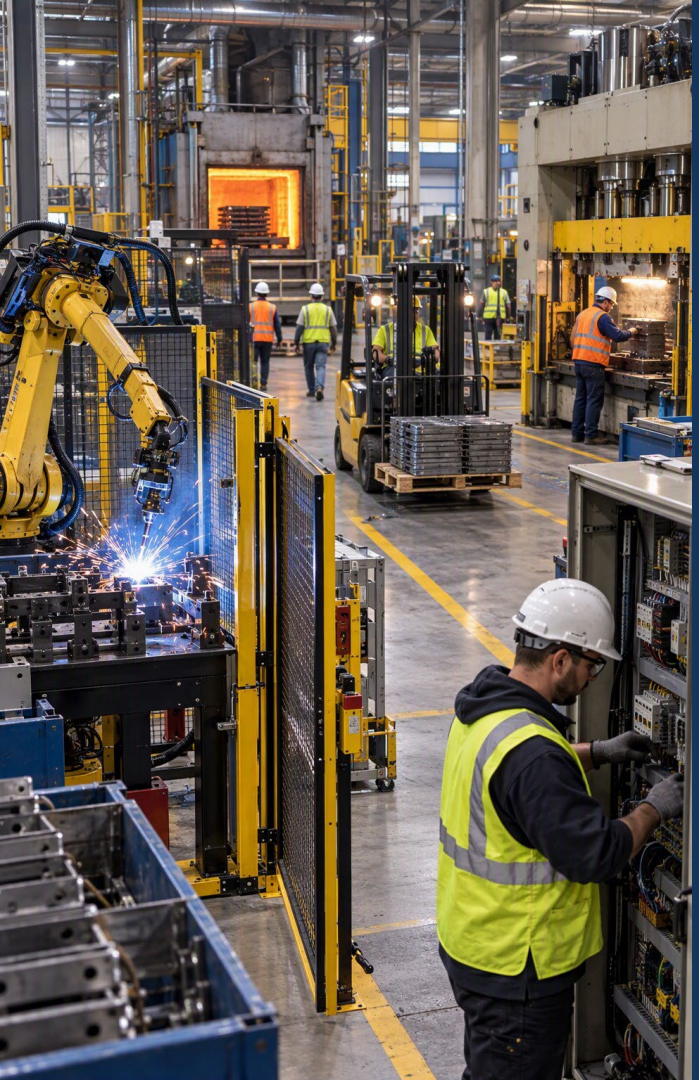


KAHOOT · STKY OR NOT?

Wind Turbine Blade Repair

Vote on each hazard: high energy (STKY) or not?

A	Technician working from a personnel basket high above the ground
B	Basket and rigging suspended over the ground crew
C	Rotor and blades turning if not locked out
D	A wrench dropped from the basket
E	Walking on uneven desert ground to the truck
F	Hot, sunny afternoon on the pad



KAHOOT · STKY OR NOT?

Metal Fabrication Plant

Vote on each hazard: high energy (STKY) or not?

A	Entering the robot welding cell to clear a fault while it’s in auto
B	Forklift carrying a loaded pallet down an aisle with workers on foot
C	Troubleshooting inside an energized 480 V control panel
D	Unloading parts from the heat-treat oven at 400°F
E	Hand-loading 10 lb brackets into a bin all shift
F	Removing a stuck die from a hydraulic press that’s “turned off”



KAHOOT · STKY OR NOT?

Steel Erection & Utilities

Vote on each hazard: high energy (STKY) or not?

A	Ironworker connecting steel two stories up
B	Steel beam swinging over the deck on the crane hook
C	Scissor lift driving across the deck near workers on foot
D	Utility trench about 7 ft deep beside the footing
E	Running an impact wrench to snug bolts on a column
F	Pebble-sized debris flicked up from the dirt by foot traffic

The Hierarchy of Energy Control

1. **Eliminate the energy**
   Remove the hazard entirely — design it out.
2. **Reduce the energy**
   Lower height, speed, pressure, voltage or mass below high-energy levels.
3. **Isolate the energy**
   Physically separate people from the energy: barriers, guarding, LOTO.
4. **Alternative controls**
   Procedures, training, signage, PPE, spotters — necessary, but they rely on people.

MORE RELIABLE ▲

Energy control must be…



Timely
In place before exposure begins



Tangible
Physical — you can see and verify it



Targeted
Aimed at the specific high-energy hazard

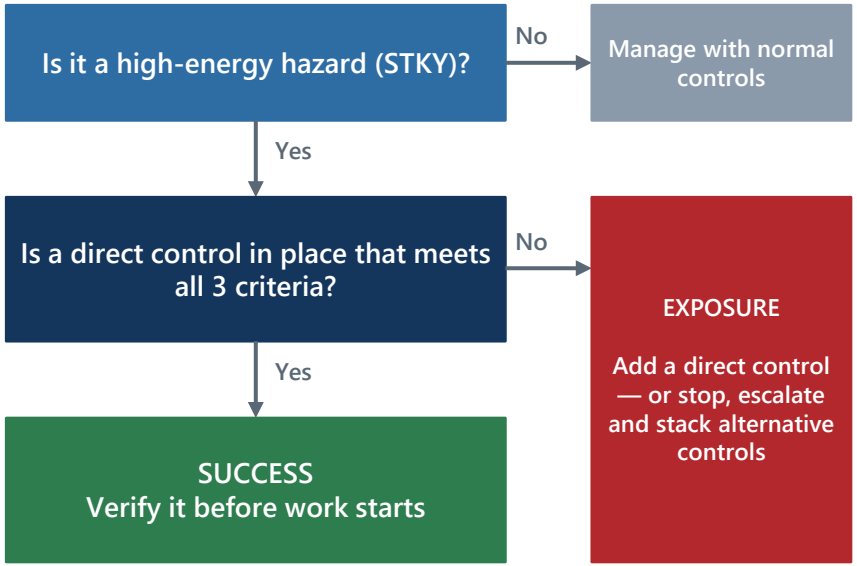
Direct vs. Alternative Controls

A DIRECT CONTROL…

1. Targets the high-energy hazard
2. Effectively mitigates it when installed, verified and used properly
3. Still works if someone makes an unintentional error during the work

ALTERNATIVE CONTROLS

Training, procedures, signs, spotters, PPE, awareness. Important, but they only work if people perform perfectly.



Simplified from Hallowell (2025) Fig. 5.3 and Oguz Erkal & Hallowell (2023)

If a control requires workers to be perfect, it isn't a direct control.

IN THE FIELD · CONSTRUCTION

Tilt-Up Panel Erection

Energy	Alternative (relies on people)	Direct (stops the energy)
Gravity — panel suspended over crew	Spotter; "stay clear" briefing	**Hard-barricaded fall zone; no one under the load**
Gravity — panel tipping after release	Visual check of braces	**Engineered braces installed and verified before rigging release**
Motion — crane swing & travel	Swing-radius signs and cones	**Physical swing-radius barricade with controlled entry**

> The jobsite changes by the hour — and so does the energy in play.



IN THE PLANT · MANUFACTURING

Stored & Hidden Energy

Energy	Alternative (relies on people)	Direct (stops the energy)
Mechanical — clearing a conveyor jam	Warning signs; "turn off the machine" policy	**Interlocked guarding; LOTO with zero-energy verification**
Pressure — hydraulic or pneumatic line	Verbal warning to the technician	**Bleed valves and blocking; verified zero pressure**
Electrical — panel service	PPE alone; standard checklist	**De-energize, lock out, test before touch**

A machine that is switched off can still hold deadly pressure or stored charge.



PRINCIPLE 4 · PEOPLE DRIVE PERFORMANCE

Human Factors of Energy Control

Controls are human too

Direct and alternative controls are designed, installed, verified and used by people.

Error is normal

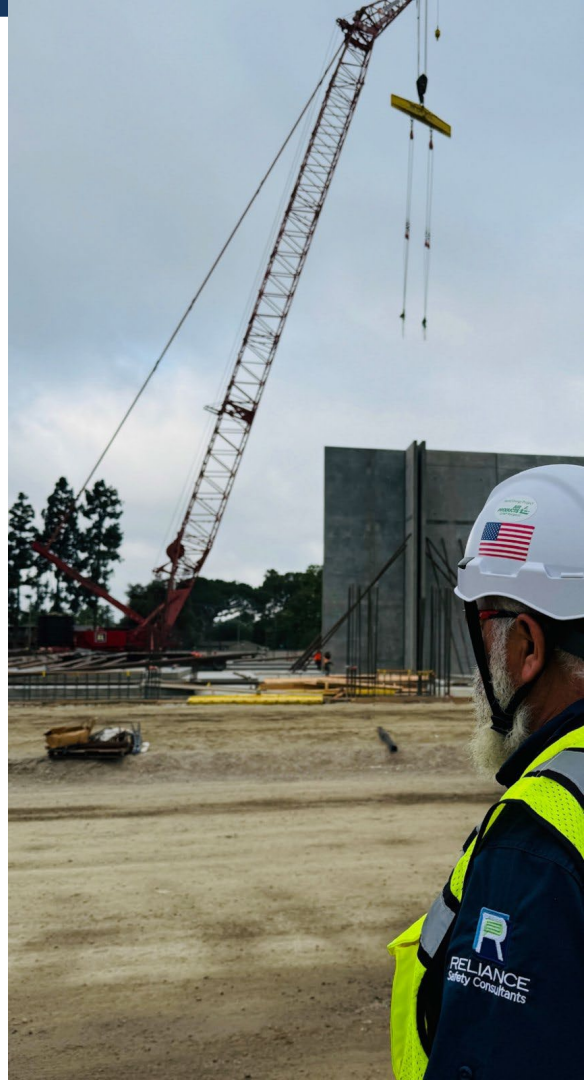
Error is a normal, expected part of the human condition. Everyone eventually makes a mistake.

Context shapes error

Time pressure, change, fatigue, unclear procedures and poor design set people up to fail.

Manage both together

Managing human error and its precursors together makes energy control more reliable.



TURN & TALK · 2 MIN

Where does a STKY control at your site depend on someone remembering, noticing or being perfect?

What would it take to turn it into a direct control?

"I did then what I knew how to do. Now that I know better, I do better."

— Maya Angelou

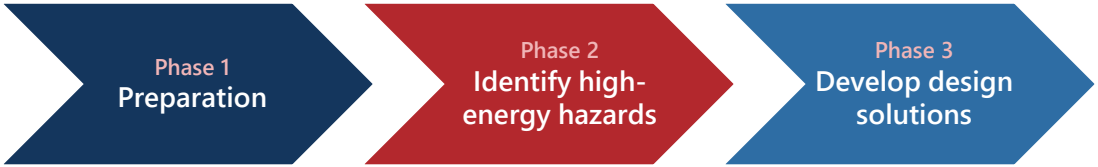


PRACTICAL TOOLS · DESIGN

Design Out the Energy Early

Prevention through Design: address high-energy hazards at the source — eliminate or reduce exposure.

SIF prevention design charrette



- Build safety into an existing review process — large capital and complex projects first
- Integrate early; safety can't be an afterthought
- Project delivery, contract terms, schedule and budget play a pivotal role

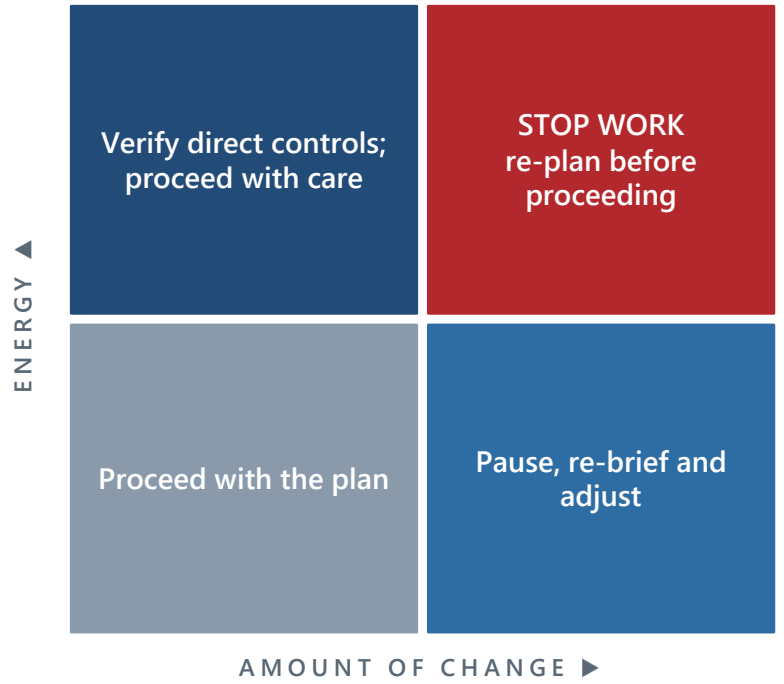
Pre-Job Briefs & Last-Minute Change

80% of SIFs are related to some form of change

SIF-related change: an unexpected condition or action during work that exposes someone to a high-energy hazard.

A strong pre-job safety brief

- Everyone on the task is present and participates
- Held at the work; task broken into steps
- High-energy hazards and their controls named
- A plan for change and stop-work reinforced
- Permits and emergency plans reviewed



Discussion framing inspired by Hallowell (2025) Fig. 8.1

PRACTICAL TOOLS · CHECK

Safety Walks That Verify Controls

Walk with a purpose

- Observe active work
- Know the work and the workers
- Look for anomalies — and celebrate positives
- Problems usually live in the system, not the person
- Act when necessary

Lead effectively

- Look the part
- Be attentive; ask questions
- Listen actively
- Ditch the clipboard
- Involve crew supervisors

End every walk with: “How can I help?”



Measure the Presence of Defenses

> *"Safety is not the absence of events; safety is the presence of defenses."* — Todd Conklin

STOP ASKING

"How many injuries did we have last month?"

START ASKING

"Of the high-energy hazards we saw today, how many had a direct control?"

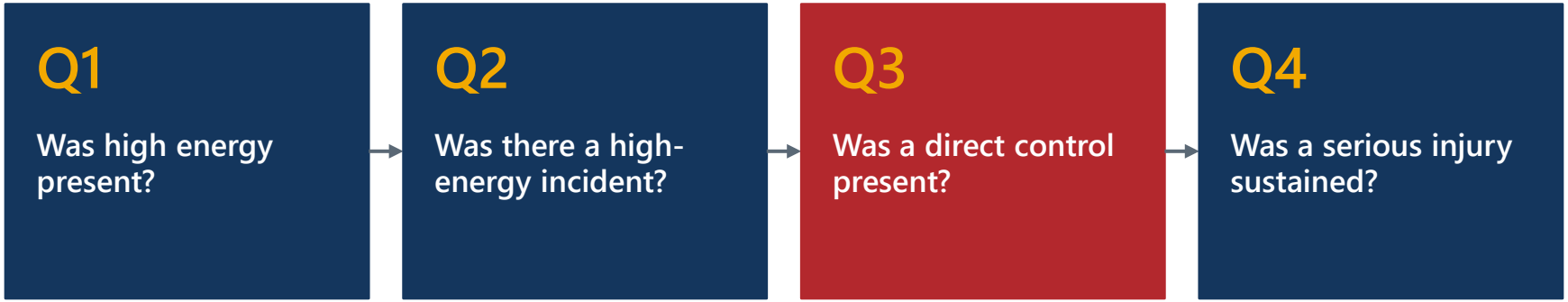
HIGH-ENERGY CONTROL ASSESSMENT (HECA)

$$\frac{\text{High-energy hazards with a direct control}}{\text{All high-energy hazards observed}}$$

A leading measure taken before the harm — it measures controls, not luck.

Learn from Every Event — Including Successes

Safety Classification & Learning (SCL) model: four questions to classify any event



Study trends to improve energy control. When high energy was released and a direct control prevented serious injury, that's a success worth learning from — not just luck to file away.

Ten Steps for Energy-Based Safety Integration

01 Secure leadership buy-in

02 Conduct a readiness review

03 Pilot with a small group

04 Develop supporting resources

05 Train field leaders first

06 Engage & train front-line workers

07 Integrate EBS across safety activities

08 Measure and adapt the safety system

09 Sustain

10 Collaborate

Prepare · Build & roll out · Sustain

FRIDAY MORNING

Five Things to Take Back to Your Site

1. Name the energy
2. Find the STKY
3. Verify the direct control
4. Plan for change
5. Measure the defenses

Questions & Discussion

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Based on: Hallowell, M.R. (2025). Energy-Based Safety: A Scientific Approach to Preventing Serious Injuries and Fatalities (SIFs). CRC Press.