

## NSC Serious Injury & Fatality (SIF) Prevention Model: Safety Beyond Compliance

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## Objectives

- ❑ Review the data
- ❑ Understand Serious Incident & Fatality Prevention Model
- ❑ How can you use HOP Principles to drive SIF Risks down
- ❑ Share some learnings from others

## Definition – SIF

- **SIF: Serious Incident or Fatality**
  - Cases or incidents considered life threatening, life altering, a workplace related death, major impact to operations, environment or a community.
- *An incident in the workplace under this model includes: Serious injuries and illnesses, fatality, environmental impacts, workplace fires and explosions, and significant property damage.*

## Definition – pSIF

**pSIF = Potential Serious Incident or Fatality**

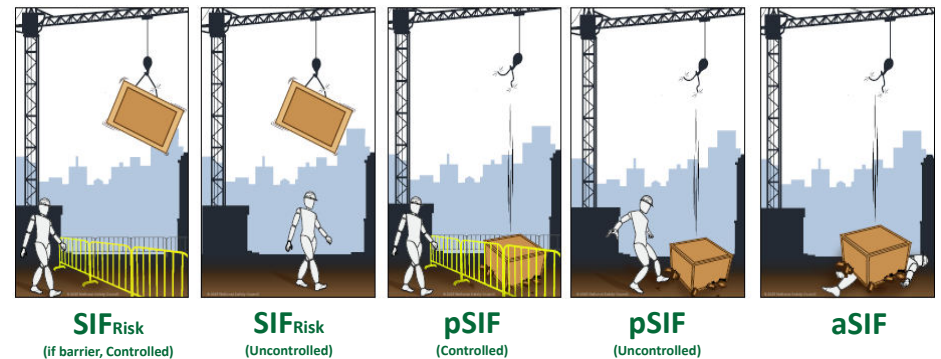
- pSIF (ASTM definition) = “potential SIF is a near-miss incident or hazardous event that could have resulted in a serious injury or fatality, but did not, due to luck or the presence of specific barriers or countermeasures.”

## What is SIF?

**SIFRisk:** Conditions created by systems and processes that likely have the energy or potential to result in an aSIF

**pSIF:** POTENTIAL SIF

**aSIF:** ACTUAL SIF



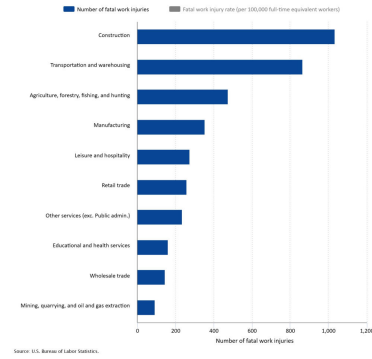
## Why is a SIF Prevention Model Needed?

- More than **5,000 fatalities** occur annually in U.S. **workplaces**, highlighting a critical need for more effective preventative measures and systems.

Bureau of Labor Statistics. (2024). Retrieved from [www.bls.gov](http://www.bls.gov)

## 2024 Fatalities by Industry

Number and rate of fatal work injuries, by selected private industries, 2024



<https://injuryfacts.nsc.org/>

## A Closer Look at Fatalities

Establishment Size	All Industries Fatalities (2011-2022)	% of Total
1-10 Employees	24,145	40%
11-19 Employees	4,160	7%
20-99 Employees	9,658	16%
100+ Employees	11,171	19%
Size unknown	10,789	18%
<b>Total</b>	<b>59,923</b>	

- Construction fatality rate 4X higher
  - Fatalities per 100,000 workers
  - Construction: 166
  - Non-construction: 40
- **At least >63% occur at small businesses (<100 employees)**

## The Things That Hurt People Are Not the Same as the Things That Kill People: Key Differences in the Proximal Causes of Low- and High-Severity Construction Injuries ([ascelibrary.org](http://ascelibrary.org))




**The Things That Hurt People Are Not the Same as the Things That Kill People: Key Differences in the Proximal Causes of Low- and High-Severity Construction Injuries**

Arnaldo Bayona, S.M.ASCE<sup>1</sup>; Matthew R. Hallowell, A.M.ASCE<sup>2</sup>; and Siddharth Bhandari, A.M.ASCE<sup>3</sup>

**Abstract:** The safety profession has been shaped by the assumption that there is a fixed ratio of low- to high-severity injuries and the notion that injuries of all severity levels share the same general causes. There is now very strong empirical evidence that this ratio is not fixed, which has led to a new hypothesis that serious injuries and fatalities (SIFs) happen for different reasons than lower-severity injuries and the idea that a targeted approach is needed for SIF prevention. To better understand this phenomenon, this study explored the question: *what, if anything, is different about the causes of SIFs?* To answer this question, a research team of construction safety experts and academics hypothesized seven factors that may be unique to high-severity injuries. Concurrently, details of serious injuries and fatalities (SIF, n = 13), potential serious injuries and fatalities (PSIF, n = 12), and low-severity injuries (LSI, n = 13) were collected from utility, oil and gas, commercial, pipeline, and specialized construction trades. Blind to each injury outcome, the team assessed the presence or absence of the seven potential differentiators. The samples were then compared using Fisher's exact test to determine if any factors explained the differences among the injury types. Although there were no differences between SIF and PSIF cases, two factors differentiated LSI and PSIF/SIF: (1) absent direct controls; and (2) absent or not followed work plan. Surprisingly, no human factors were significant. The results indicate that the control of high-energy hazards through effective work planning, discipline, and execution is vital for targeting SIFs, supporting the theory that a differentiated approach is needed to avoid the concerning plateau in the rate of construction fatal injuries. DOI: 10.1061/(JCEM)4.COENG-14545. This work is made available under the terms of the Creative Commons Attribution 4.0 International license, <https://creativecommons.org/licenses/by/4.0/>.

## NSC SIF Prevention Model

- Model was rolled out at the 2024 NSC Congress and Expo
- It contains guidance documents and tools designed to help organizations better understand, assess and control *SIF* and *pSIF* events
- Built around the Plan-Do-Check-Act (PDCA) continuous improvement framework
- The risk assessment process evaluates physical hazards and considers the impact of systems, culture, and human behavior



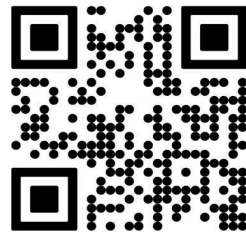
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## NSC's SIF Prevention Lifecycle (PDCA):

- **PLAN:** Leader commitment to understand and address SIF risks
- **DO:** Identify and prioritize SIF risks with critical safeguards
- **CHECK:** Observe, verify and monitor work and safeguards
- **ACT:** Improve work, systems and processes based on learning and discovery



## NSC: SIF Prevention Model



<https://www.nsc.org/workplace/sif>



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## Key Aspects of the Model

**Proactive Risk Management:** The Model promotes a proactive approach to identifying, prioritizing and mitigate risks before they lead to serious incidents.

**Systems and Risk-Based Approach:** Provides a comprehensive understanding of how different systems interact within an organization

**Comprehensive Framework:** By integrating both behavioral and technical aspects of safety, the SIF Prevention Model offers a more complete view of workplace safety challenges, facilitating more effective and sustainable solutions.



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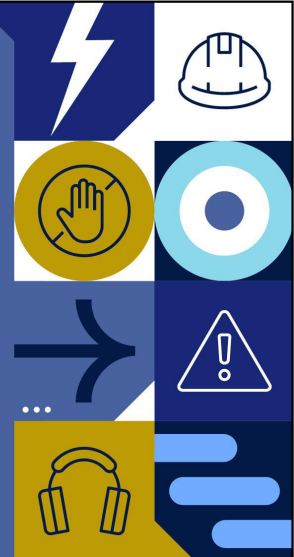
## 6-Steps in the SIF Model

- **Step 1:** Assess existing organizational capacity for SIF prevention and preparing organization for SIF prevention work
- **Step 2:** Conduct initial hazard identification and determine the risk given existing controls
- **Step 3:** Implement defenses/controls/safeguards where needed
- **Step 4:** Verify that defenses/controls/safeguards are sufficient and working properly
- **Step 5:** Monitor defenses/controls/safeguards over time
- **Step 6:** Address SIF-related management system gaps and build infrastructure for continuous improvement.



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## Step 1: Plan



## Step 1: Plan – Organizational Readiness

Effective prevention of SIF requires thorough planning and preparation. Identifying and comprehending organizational strengths and weaknesses concerning SIF, involving key stakeholders (workers), and securing leadership support are crucial steps in the process.



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## Step 1: Tools 1 - 4

The PLAN stage of this model contains four tools designed to complement each other.

### Initial Documentation Review

This tool lists key organizational documents related to worker protection and SIF prevention that should be reviewed for accuracy and may be needed as the model is reviewed and implemented.

[Tool 1 \(.pdf\)](#)

### SIF-related Organizational Gap Analysis

Identify and assess key elements to SIF prevention, including management commitment and worker involvement.

[Tool 2 \(.docx\)](#)

### SIF-related Safety & Health Perception Survey

Confidential, blinded surveys promote candor and provide an unbiased look at the status of worker protection policies, practices and programs.

[Tool 3 \(.docx\)](#)

### Key Stakeholder Discussion Points

Discussion points to guide interviews and get a better understanding of SIF risks. Includes criteria for leadership to ensure engagement and buy-in from the top and examples for worker engagement.

[Tool 4 \(.pdf\)](#)



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## Steps 2-3: Do



### Step 2: Do - Understanding the Risks

#### Step 2. Conduct a General Site Assessment and Determine the Risk Factors

- Conduct a general site assessment and determine the risk factors that are applicable
- The general site assessment provides employers a determination of their hazards, level of risk, and the strength of existing controls.



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### Step 3: Do – Hazards, Risks & Controls

#### Step 3. Identify Hazards and Develop Defenses, Controls, and Safeguards

- Using the elements and criteria from the general site assessment (Step 2), create a baseline for the site/organization's safety and health "status" and begin the process of evaluating and classifying all the potential SIF hazards with these four tools.
- Tool 5: Identifying Potential SIF Hazards and High Hazard Activities
- Tool 6: Learning Teams
- Tool 7: Risk Prioritization Tool
- Tool 8: SIF Hazard Control Matrix

### “High Hazard Activity, Condition or Event”

- Mechanical Energy / Machine Guarding
- Confined Space Entry
- High Pressure
- Suspended Loads
- Engulfment Hazards
- Extreme Temperature Environment
- Powered Industrial Vehicles
- Driving Motor Vehicles
- Work at Height
- Toxic or Reactive Chemicals
- Flammable / Explosive Materials
- Electrical (Contact or Arc Flash)
- Non-routine Maintenance
- High Temperature Equipment / Processes
- Biological Hazards
- Radiation
- Air and Water Transportation



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## Step 3: Do – Risk Assessment Tools

Using the elements and criteria from the general site assessment (Step 2), create a baseline for the site/organization's safety and health "status" and begin the process of evaluating and classifying all the potential SIF hazards with these four tools.

### Identification of Potential SIF High Hazards

This tool provides guidance in identifying the most critical hazards examples are provided below.

[Tool 5 \(.pdf\)](#)

### Learning Teams

Facilitate a discussion among all individuals having knowledge and information about a process, procedure or piece of machinery to properly assess the strength of controls for given hazards.

[Tool 6 \(.pdf\)](#)

### Risk Analysis and Strength of Current Controls

Enter your high hazards identified in Tool 5 to determine the level of risk to workers in this tool. You can adjust controls, add controls, or create new controls to lower the level of risk in the next step.

[Tool 7 \(.xlsx\)](#)

### Determine the Controls - SIF Hazard Control Matrix

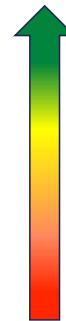
Once you have prioritized SIF hazards and evaluated effectiveness of existing controls, you can determine what additional controls are needed. This tool provides instruction and tables to guide you.

[Tool 8 \(.docx\)](#)



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## Do: Tool 7 – Strength of Controls



### • Elimination (Most effective)

- The best way to manage a hazard is to completely remove it from the workplace.

### • Substitution

- Replacing a hazardous substance, process, or equipment with something less hazardous.

### • Engineering Controls

- Designing or modifying equipment, processes, or structures to reduce exposure to hazards.

### • Administrative Controls

- Changing the way work is done to reduce exposure to hazards, often through policies, procedures, or training.

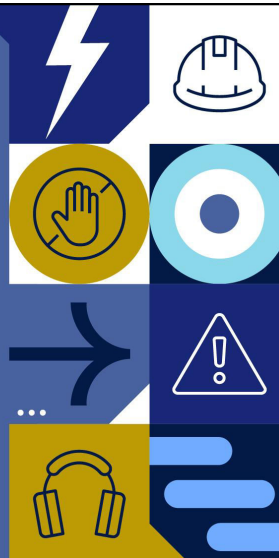
### • Personal Protective Equipment (Least effective)

- Using protective clothing, helmets, goggles, or other gear to reduce exposure to hazards.



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## Steps 4-5: Check



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## Step 4: Check – Initial Controls

- Using the controls identified and implemented to address opportunities for improvement identified within the risk assessment (Step 4). Controls should be implemented with input from those performing the work to ensure the controls are acceptable and do not create unexpected outcomes.
- Tool 5: Identifying Potential SIF Hazards
- Tool 6: Learning Teams
- Tool 7: Risk Prioritization Tool
- Tool 8: SIF Hazard Control Matrix



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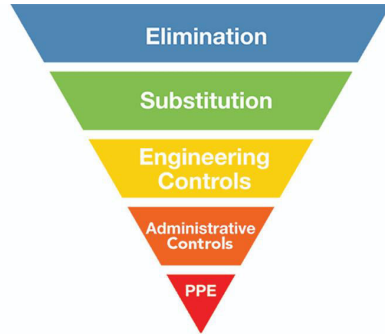
## Step 4: Control Verification



### SIF Model Step 4: Control Verification

Consider the following factors when verifying that controls are implemented and effective in mitigating risk. This list is not exhaustive and should serve as a reference during control analysis and verification.

CONTROL TYPE	EXAMPLES	CONSIDERATIONS WHEN VERIFYING CONTROL
Engineering Controls	<ul style="list-style-type: none"> <li>Mechanical Ventilation</li> <li>Machine Guarding</li> <li>Electrical/Thermal Interlocks</li> <li>Photo eye/light curtain</li> <li>Control/Robot/Intuitive Technology</li> <li>Physical Barriers</li> </ul>	<ul style="list-style-type: none"> <li>List of all electrical interlocks to check</li> <li>Mechanical guarding to secure and remove tool to remove</li> <li>Devices are appropriate to minimize the hazard</li> <li>Use technology is appropriate for working environments</li> <li>Use of technology does not add additional risk</li> </ul>
Administrative Controls	<ul style="list-style-type: none"> <li>Training</li> <li>Policy/Procedure</li> <li>Pre-task Inspection</li> <li>Signage</li> <li>Post-Review</li> </ul>	<ul style="list-style-type: none"> <li>Method to track training requirements by job site/location</li> <li>Method to validate training effectiveness (test, competency, etc)</li> <li>Pre-task inspection covers all critical safety checks</li> </ul>
Management Oversight	<ul style="list-style-type: none"> <li>Ensure controls are followed</li> <li>Conducting field "safety checks"</li> <li>Engage with workers on safety concerns</li> <li>Provide appropriate resources for controls</li> </ul>	<ul style="list-style-type: none"> <li>Method to document and communicate results of "safety walk"</li> <li>Continuous sharing of lessons learned throughout the work activity</li> <li>Follow up with worker on action taken on safety concerns</li> </ul>
PPE	<ul style="list-style-type: none"> <li>Selected based on hazard and exposure potential</li> <li>Examples include protection for hearing, respiratory, eye, face, hands, feet, and feet.</li> </ul>	<ul style="list-style-type: none"> <li>Verify employees were involved in PPE selection</li> <li>Check PPE manufacturer recommendation for inspecting and repairing PPE</li> <li>Verify the PPE is appropriate for the hazard identified</li> <li>Ensure variety of size and fit to accommodate the workforce who will be using it</li> <li>Validate that PPE is being used as intended in the work area</li> </ul>
Cultural	<ul style="list-style-type: none"> <li>Stop work authority and actual use</li> <li>Near-miss reporting systems</li> <li>Peer to peer safety coaching</li> </ul>	<ul style="list-style-type: none"> <li>Cross training employees to recognize hazards outside their work area</li> </ul>



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## Step 5: Check – Efficacy of Controls

- Conduct follow-ups to ensure controls are working as intended, and there are no unintended consequences such as “work arounds”
- Ensure any controls implemented or modified did not add to or create new hazards



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## Step 5: Optimizing Controls: Building System Capacity

- Hierarchy of Controls
- Defense Matrix
- Principles of Human & Organizational Performance (HOP)
  - Often referenced by the acronym “HOP”
  - Focus on understanding the context and actual conditions of work
  - Considers the impact of systems, culture, and human behavior
  - Provides a framework for creating more resilient organizations

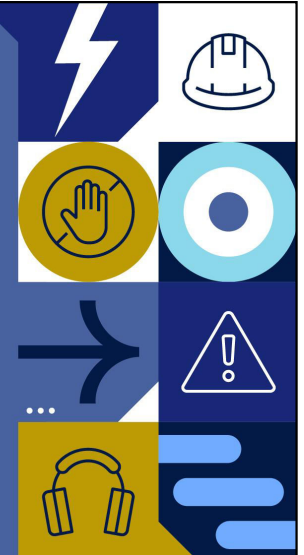


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## Step 6: Continuous Improvement



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## Step 6: Act – Continuous Improvement

Ensure a robust system is in place to continuously monitor performance, report on pSIF and near misses, engage with workers and leadership, and validate existing controls.



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## Learning Teams

- A problem-solving approach used to gather information and develop corrective actions
- Focuses on gathering information and knowledge from employees most closely involved in the task
- Emphasizes **how and why** things occur rather than assigning blame and helps in identifying applicable controls...Focus on IMPROVEMENT



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## Purpose of Learning Teams

- Harnesses the collective expertise in an organization
- Gathers individuals having knowledge and information on the process, job task, equipment, maintenance, engineering, safety and emergency response
- Facilitates a discussion to properly assess the strength of controls for given hazards.



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## Manage and Track Improvements & Actions

- Prioritization List
- Controls
  - Efficacy
  - New Technology
  - Systems
  - HOP Principles
- Operationalize risk assessment
- Lessons learned
- Establish learning teams for SIF/pSIF events



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# Lessons Learned



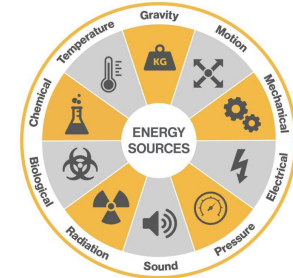
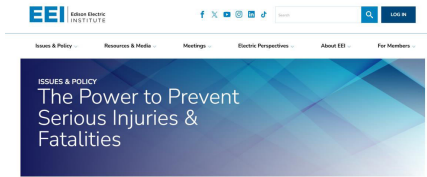
- ✓ **SIF Prevention is Not Linear**
  - Systems, Culture, and Human Behavior All Play a Part
  - SIF Prevention Involves a Degree of **Complexity** and is **Dynamic**
- ✓ **HOP Principles and a Positive Safety Culture**
  - Can Accelerate the ROI of Any Initiative
  - HOP Enables **Organizational Learning** and the Development of People
- ✓ **Success** Depends on How SIF Practices Are Applied at the Work Interface
- ✓ A **Simple Roadmap** for Establishing & Implementing SIF Prevention Strategy Applies to All
- ✓ **Customization is Necessary** and SIF Practices Should Remain Under Constant Revision



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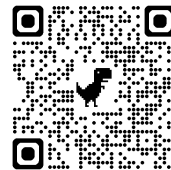
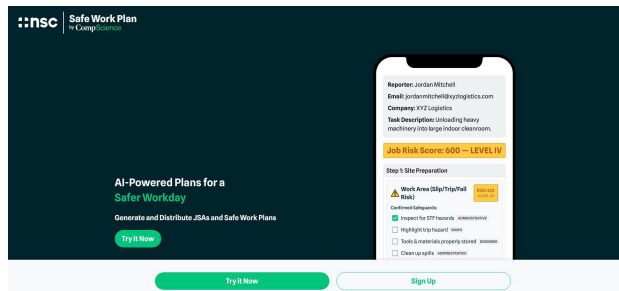
# STKY - (Stuff That Kills You)

- Energy based
- Developed by Edison Electrical Institute (EEI)
- Good Rule of Thumb for High Hazards



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# Safe Work Plan



<https://safety.compscience.com/nsc/>



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Thank you!

Thoughts, Discussions,  
Questions & Answers

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Disclaimer: The SIF Project is funded by U. S. Steel. The views expressed in this session are those of the individual speakers and do not necessarily reflect the views of the U. S. Steel.



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