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The Power to Prevent Serious Injuries and Fatalities

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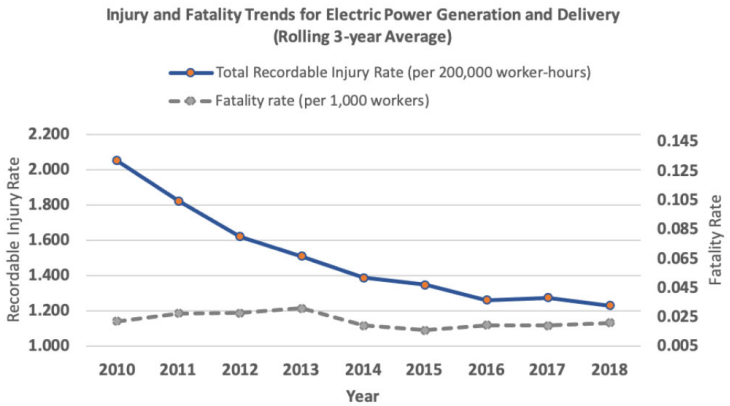
Motivation



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Safety Classification and Learning (SCL) Model

6

Analogy for Current Practice



EEI 7

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SCL Mission and Objectives

- **Prevent Serious Injuries and Fatalities (SIF) as a community**
- Create a defendable approach to defining and categorizing safety learning opportunities
- Test the consistency and reliability of the approach on diverse cases in the electric utility sector
- Create a standardized set of definitions of safety incident and observation types (e.g., define P-SIF in the context of all learning opportunities)
- **There is no 'right answer' only what we can agree upon**

EEI 8

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What is an event/incident?

EEI 9

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Case 1

- Worker is at 70 feet of height with a 8 lb tool
- No protection below
- No lanyard on the tool
- Work is under way but the wrench has not been dropped
- No one is injured

EEI 10

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Case 2

- Worker is at 70 feet of height with a 8 lb tool
- No protection below
- No lanyard on the tool
- Worker drops the wrench and it falls to the ground
- No one is injured

EEI 11

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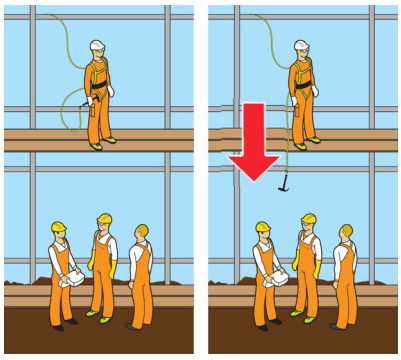
Case 3

- Worker is at 70 feet of height with a 8 lb tool
- No protection below
- Lanyard on the tool
- Worker drops the wrench and it is caught by the lanyard
- No one is injured



EEI 12

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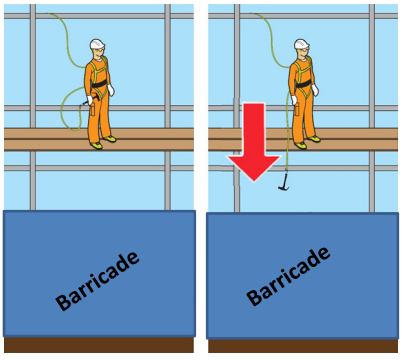
Case 4

- Worker is at 70 feet of height with a 8 lb tool
- Barricade below
- Lanyard on the tool
- Worker drops the wrench and it is caught by the lanyard
- No one is injured



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Observed Problem

There is high variability in responses and high personal confidence.

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What is the most likely severity?

Choices:

1. First aid
2. Medical Case
3. Lost-Work Time
4. Disabling/Fatal

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What is the most likely severity?

A man working on a ladder on the soffit of his roof.

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What is the most likely severity?

Carpenter works on an unsupported wall.

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What is the most likely severity?

Workers stand underneath an untethered tool.

EEI 18

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Observed Problem

There is high variability in responses and high personal confidence.

EEI 19

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Why is this so important?

- A common understanding of P-SIF and other event types is needed to support the learning process
- Example: Is Pluto a planet?
- What is the definition of a planet?
- A common understanding lays the foundation for how we learn about an issue, how we communicate and share, or whether we see something as relevant at all.
- **There is no 'right answer' only what we can agree upon**

EEI 20

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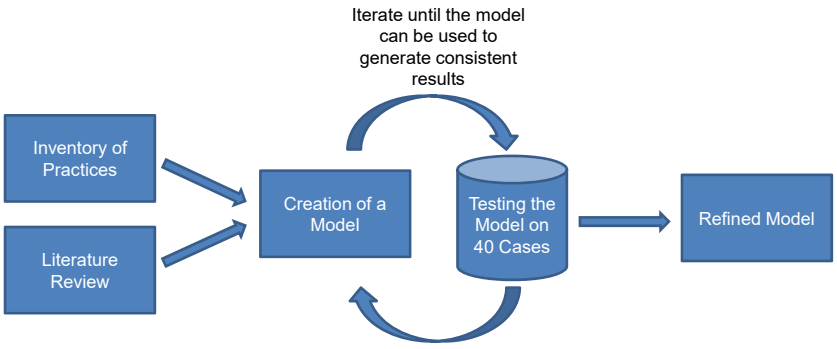
Our Process



EEI 21

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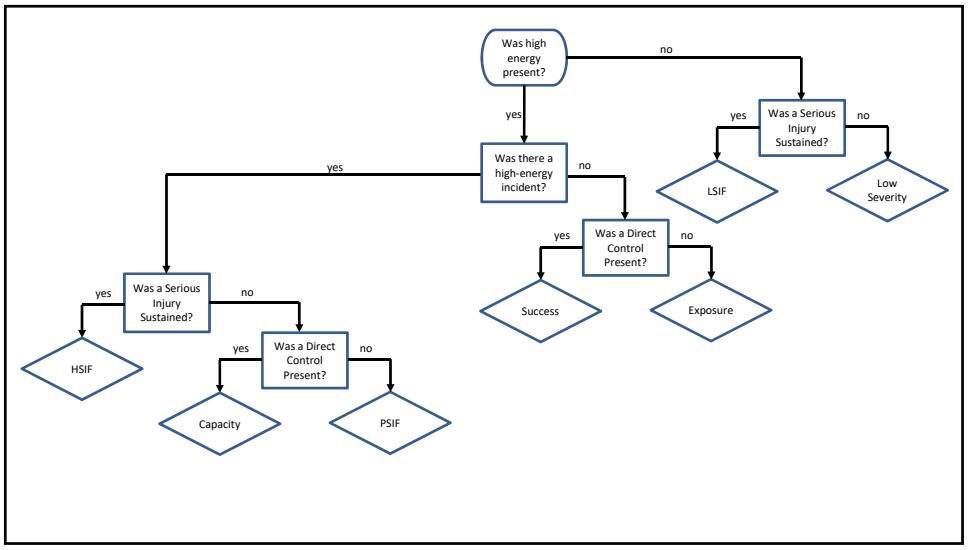
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Exposure
HSIF
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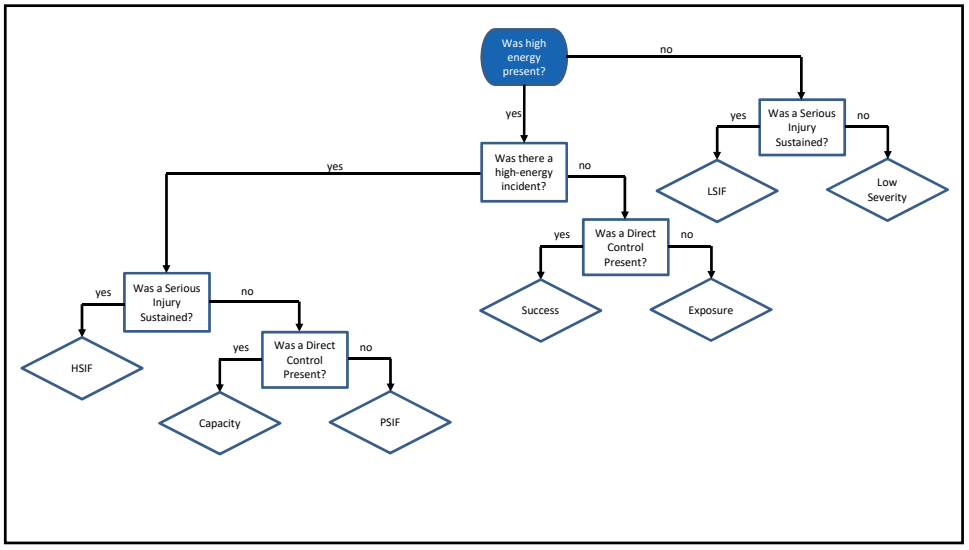
Capacity
PSIF

22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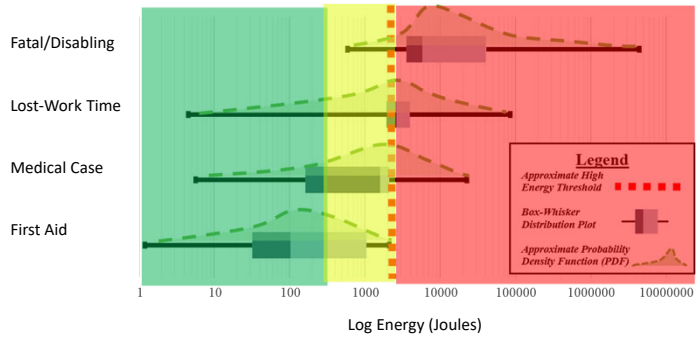
Background Knowledge



Hallowell, M.R., Alexander, D., Gambatese, J.A. (2017). "Energy-based safety risk assessment: Does magnitude and intensity of energy predict injury severity?" *Construction Management and Economics,* 1-14.

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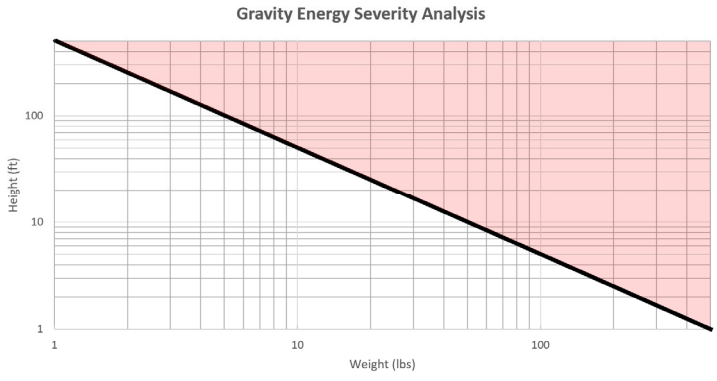
What is "High Energy?"



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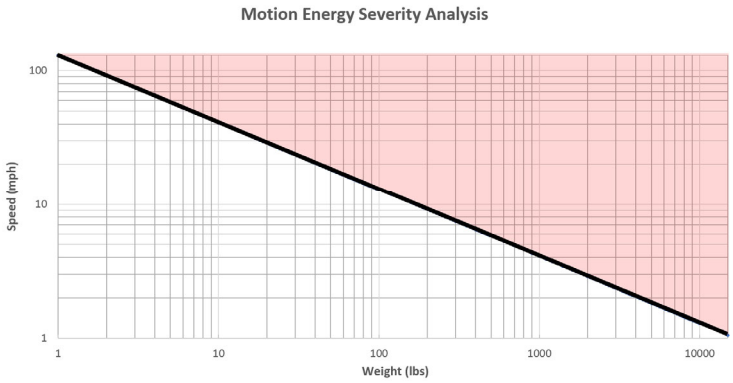

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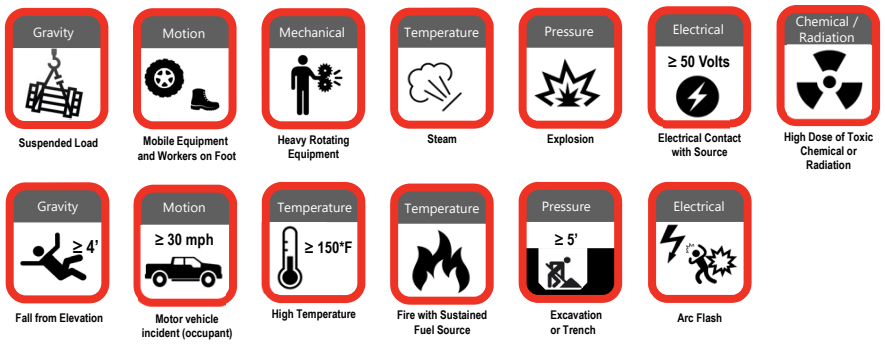

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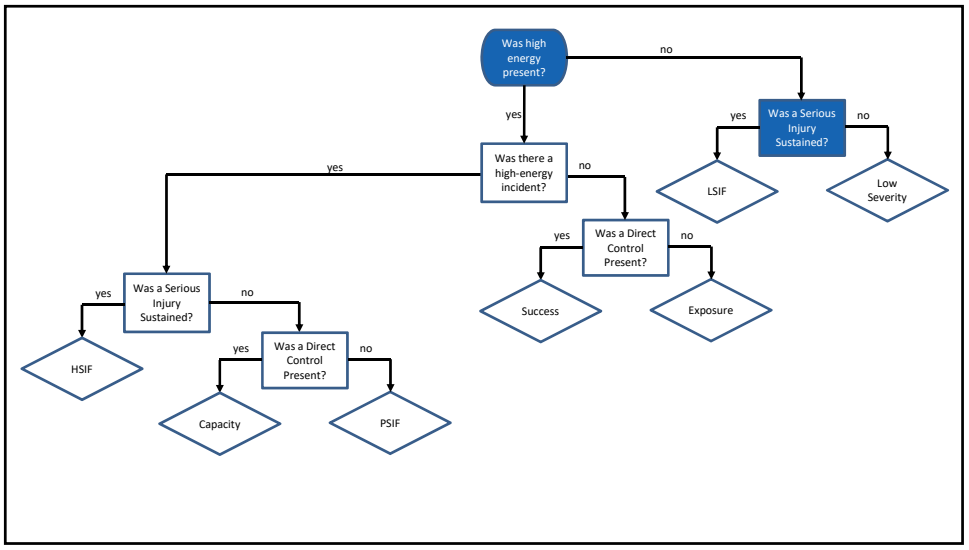

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Was a Serious Injury Sustained?

- We defer to the EEI SIF criteria.

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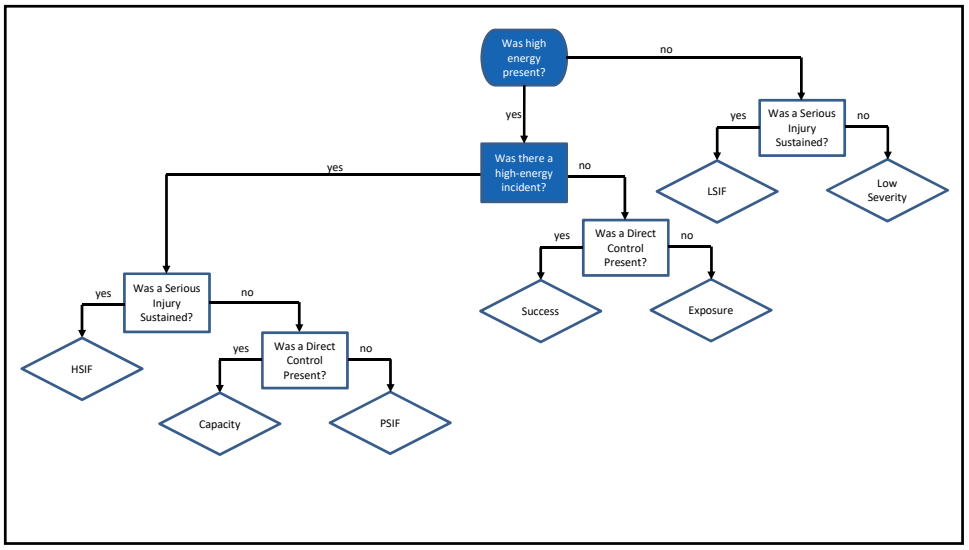

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Was there a high-energy incident?

- **An instance where the high-energy source was released and where the worker came in contact with or proximity to the high-energy source**
- "Released" is defined as:
  - Instance where energy source changes state while exposed to the environment
- "Contact" is defined as:
  - Instance when high energy is transmitted to the human body
- "Proximity" is defined as:
  - A hazardous circumstance where the boundary of the high energy exposure is within 6 feet of a worker who has unrestricted egress
  - Any distance to a high energy source when there is a confined space or situation with restricted egress where a worker cannot escape the energy source

EEI 31

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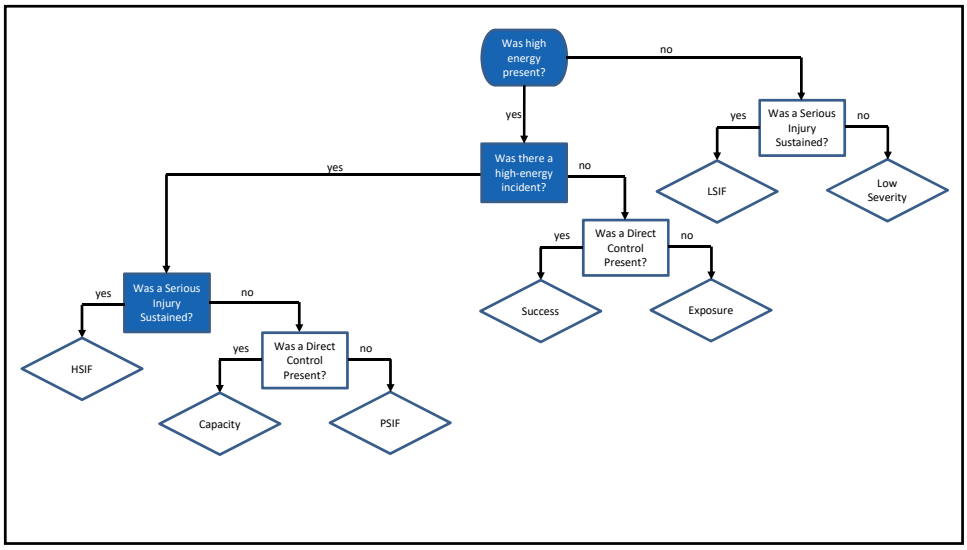
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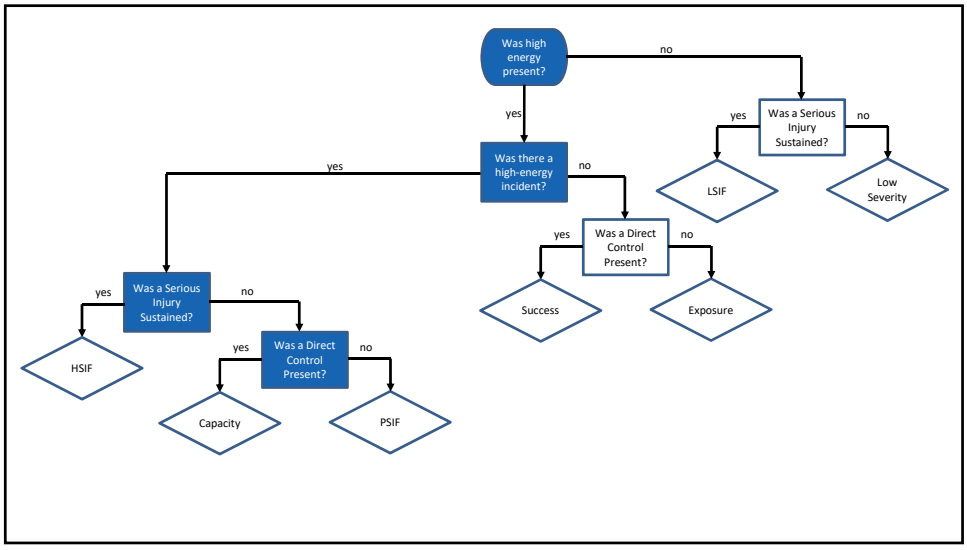
32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Was a Direct Control Present?

For each high energy source, a direct control is present if:

1. The control is specifically targeted to the high-energy source
2. The control effectively mitigates exposure to the high energy source when installed, verified, and used properly (i.e., a SIF event cannot reasonably occur)*
3. The control is effective even if there is unintentional human error during the work period (unrelated to the installation of the control)

Examples of direct controls:
- LOTO/De-energization
- Machine guarding
- Hard physical barriers
- Fall protection
- Cover up on conduit

Examples that are NOT direct controls:
- Training
- Warning signs
- Hard hat
- Rules
- Cones
- Experience

*reduced to below 500 ft-lb threshold

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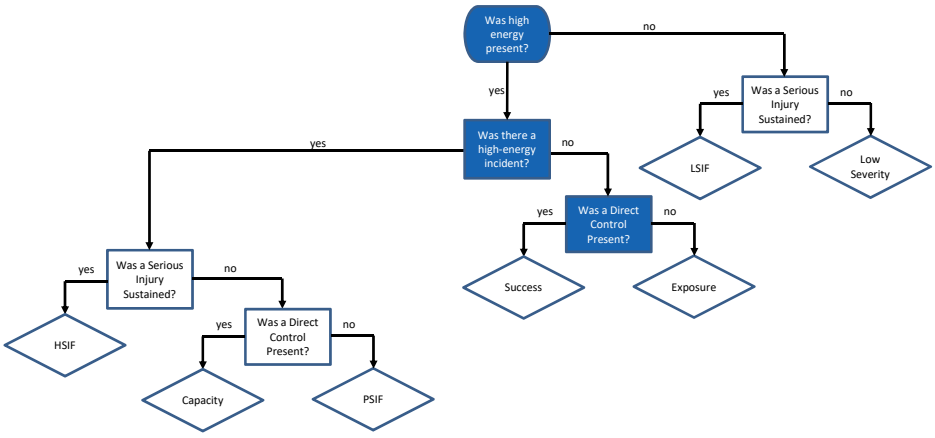

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Definitions

- **H-SIF:** Incident with a release of high energy in the absence of a direct control where a serious injury is sustained
- **L-SIF:** Incident with a release of low energy in the absence of a direct control where a serious injury is sustained
- **P-SIF:** Incident with a release of high energy in the absence of a direct control where a serious injury is not sustained
- **Capacity:** Incident with a release of high energy in the presence of a direct control where a serious injury is not sustained **(Prepared)**
- **Exposure:** Condition where high energy is present in the absence of a direct control **(Stop Work)**
- **Success:** Condition where high energy is present but is not released because of a direct control **(Ideal)**

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Controversial Case

- Worker is at 20 feet of height and falls. He is caught by his fall arrest system, which was designed and used property. The worker is not injured.

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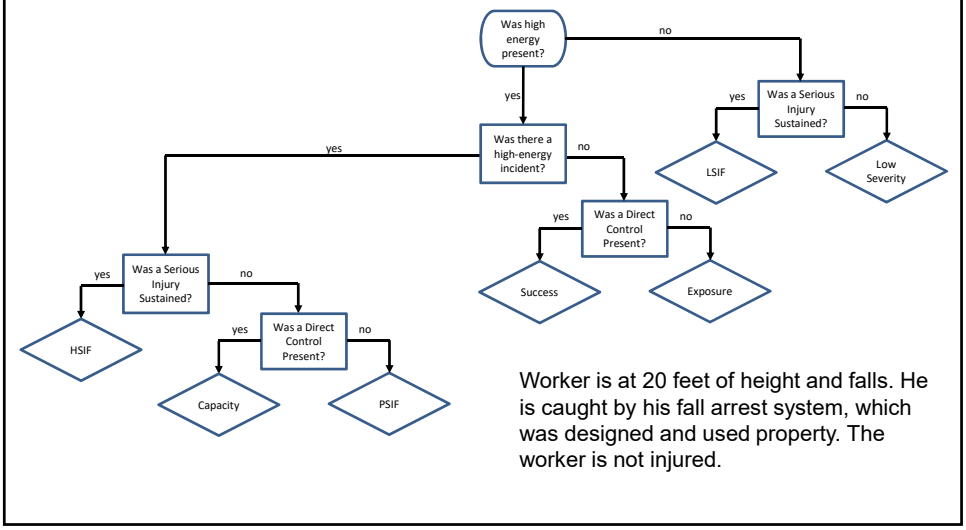
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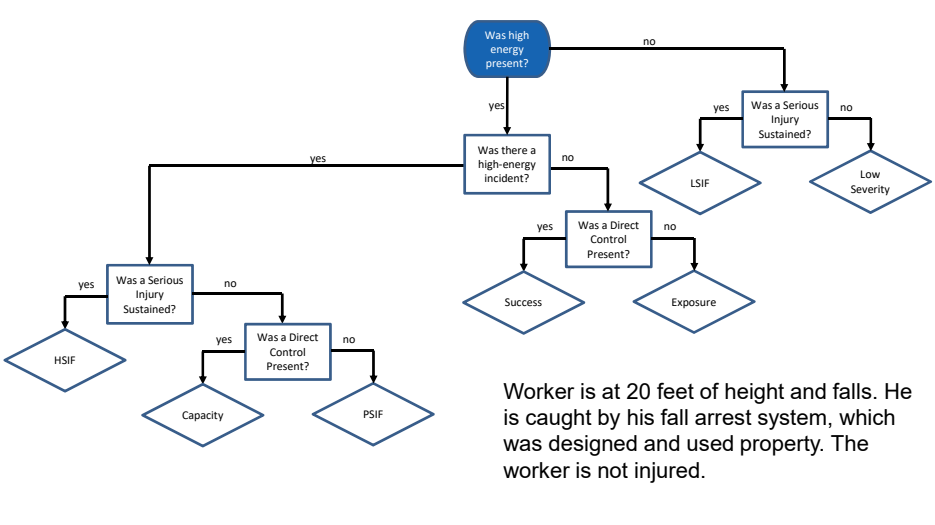
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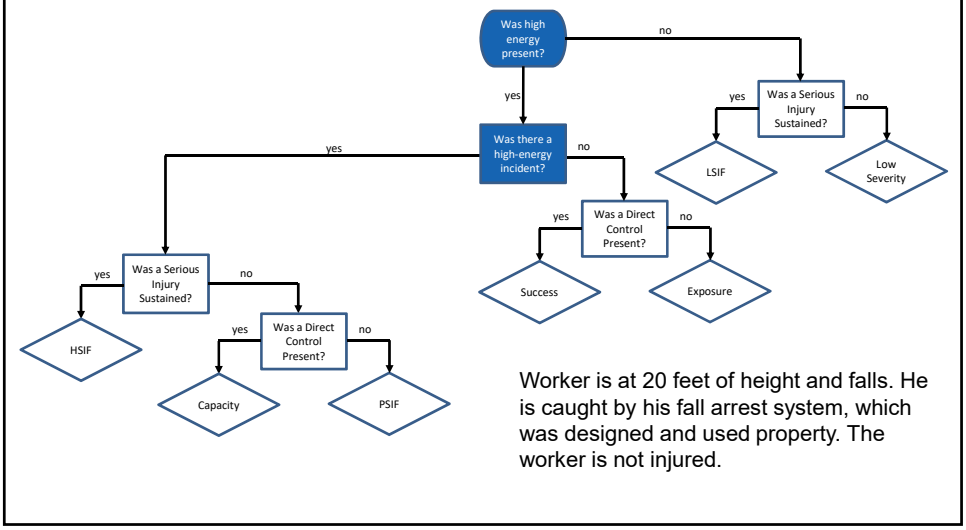
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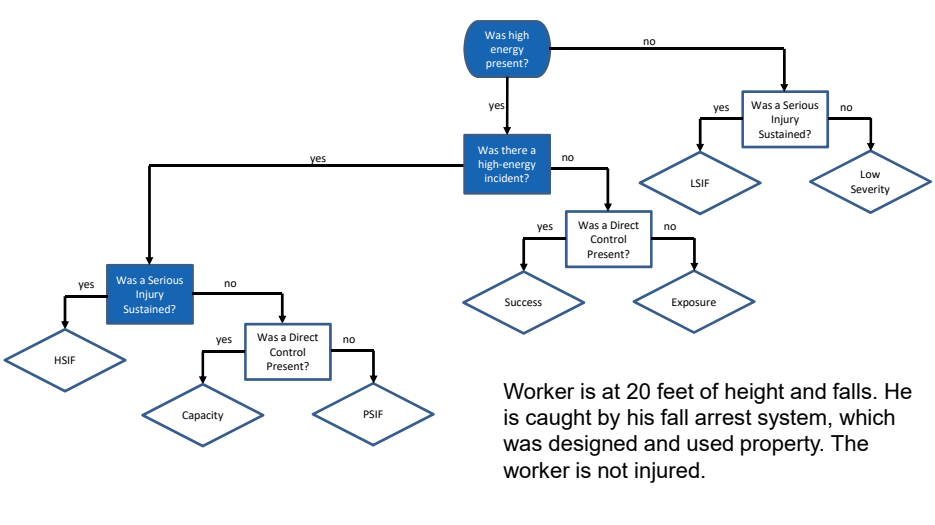
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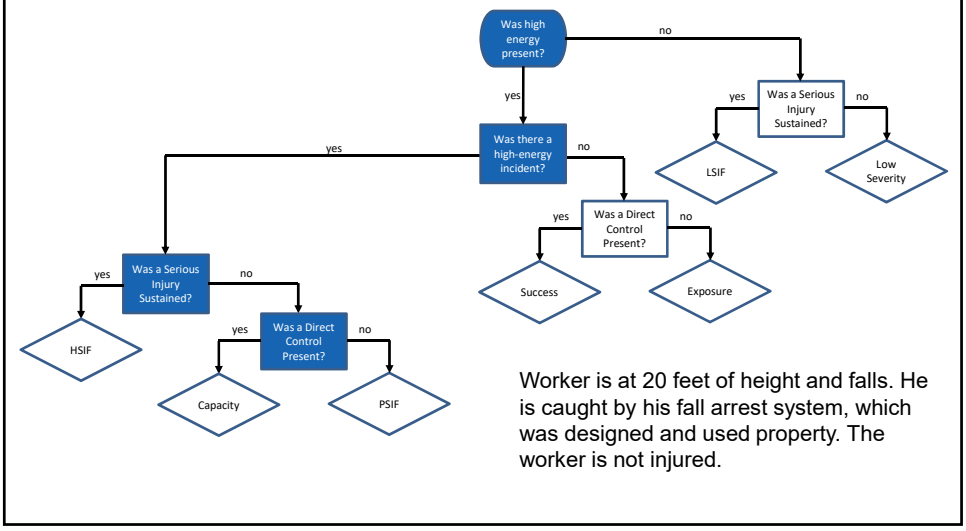
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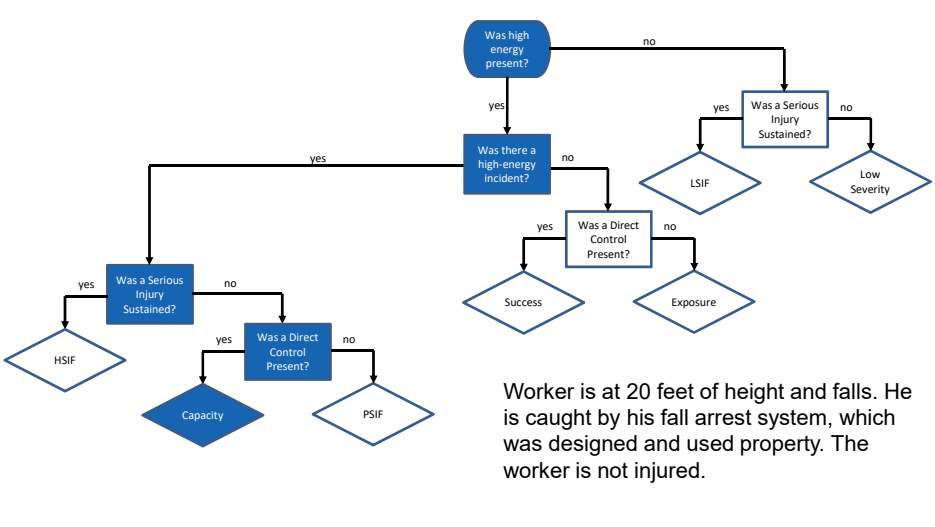
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Yet Another Layer…

- Worker is at 20 feet of height and falls. He is caught by his fall arrest system, which was designed and used property. However, the worker falls within the minimum approach distance of an unprotected energized system.

- This is a two-energy case.
- **Capacity for the gravity**
- **P-SIF for the electrical**

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Example A

An employee was on the top of a de-energized transformer at 25 feet of height with a proper fall arrest system. While working they tripped on a lifting lug, falling within two feet from an unguarded edge. When the employee landed, they sprained their wrist.

45

45

Example B

An employee was working alone and placed an extension ladder against the wall. When he reached 10 feet of height the ladder feet slid out and he fell with the ladder to the floor. The employee was taken to the hospital for a bruise to his right leg and remained off duty for three days

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Example C

A crew was closing a 7-ton door on a coal crusher. As the door was lowered, an observer noticed that the jack was not positioned correctly and could tip. The observer also noted that workers were nearby, within 4 feet of the jack.

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Example D

A master electrician was called to work on a new 480-volt service line in a commercial building. When working on the meter cabinet, the master electrician had to position himself awkwardly between the cabinet and a standpipe. He was not wearing an arc-rated face shield, balaclava, or proper gloves. During the work, an arc flash occurred causing 3rd degree burns to his face.

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Example E

An employee was descending a staircase and when stepping down from the last step she rolled her ankle on an extension cord on the floor. She suffered a torn ligament and a broken ankle that resulted in persistent pain for over a year.

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Resources

- Safety Classification & Learning Model Report
- SCL Model
- Energy Icons
- SIF Learning Center (coming soon!)

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EEI SIF Learning Center

Vision and Sample Data Options

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Why?

In pursuit of SIF elimination

- Develop a common set of SIF definitions and metrics
- Increase the number of learning opportunities
- Develop tools for predicting and preventing SIF
- Trend and learn from SIF as an EEI community

- There is a new focus to:
  - **Improve** SIF learning
  - **Measure** and track indicators of SIF
  - **Prevent** serious incidents and fatalities

We can only achieve SIF elimination together

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Evidence-Based Approach

High Energy
- Work at height
- High-Voltage
- Heavy Machinery

Direct Controls
- Fall protection
- Cover-up
- Physical barrier

Precursors
- Knowledge
- Work Pressure
- Normalization

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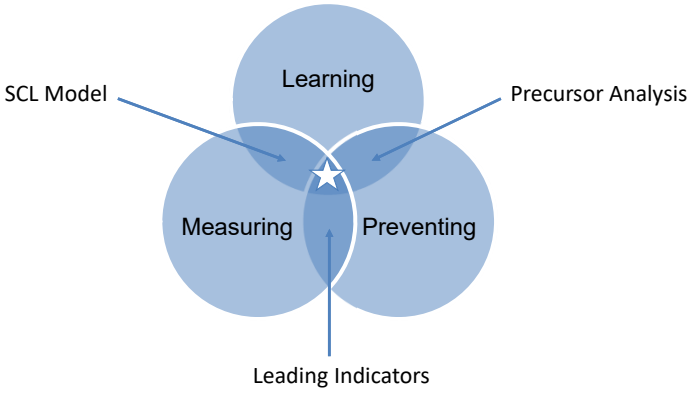
EEI SIF Learning Center



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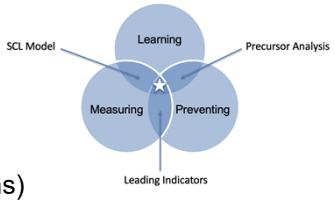
Vision

SCL Model

- Clear and consistent definitions of incidents and observations
- Enables shared learning
- SIF-oriented leading metrics (observations)
- SIF-oriented lagging metrics (incidents)



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Vision

Precursor analysis

- Collected from field safety engagements
- Based on each specific situation, immediate actions can be taken to prevent SIF (tactics)
- Learning can be spurred when we determine why certain precursors are trending

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Vision

Leading Indicators

- Measures of the quality and quantity of what is done to keep people safe (safety system)
- When targets are not met, action can be taken to prevent SIFs
- Tracked and shared regularly

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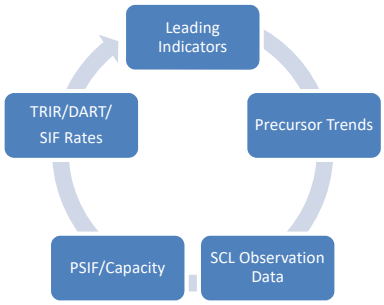
Measuring and Learning



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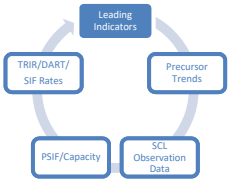
Measuring and Learning

Leading Indicators Data Input

- Regular measures of the safety program
- SIF-Oriented Examples:
  - Proportion of high-energy tasks with JHA
  - Proportion of PSIF with event learning
  - Corrective action close outs for SIF and PSIF
  - Proportion of site observations that meet quality standard
  - Use of the SCL model

Note: Work in progress for 2020

Goal: To create indicators that are consistently defined and measured



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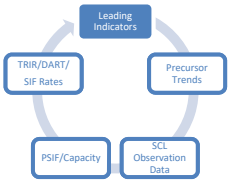
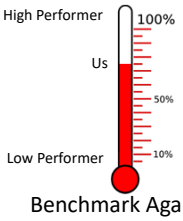
Measuring and Learning

Leading Indicators Intelligence

- What are my indicator trends?
- How do we compare to others?



Measure Progress toward Goals



Benchmark Against Peers

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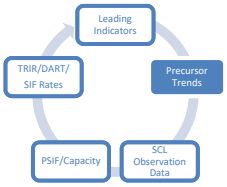
Measuring and Learning

Precursor Data Input

- Data entered for each field safety engagement of high-energy work
- Enter conditions existing *before* intervention
- Each precursor is present or absent (yes/no checkbox)
- Tagged by work type (pull-down)
- No names, organizations, projects, locations
- Entered into EEI SIF Learning Center



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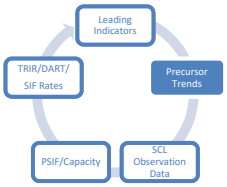
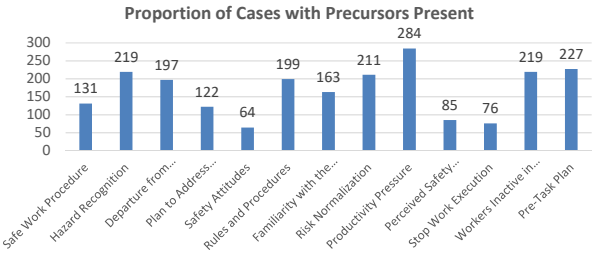
Measuring and Learning

Precursor Intelligence

- What precursors are commonly present?
- Fodder for improvement and targeted EEI teams





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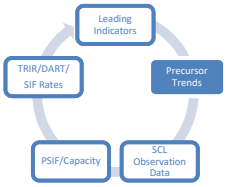
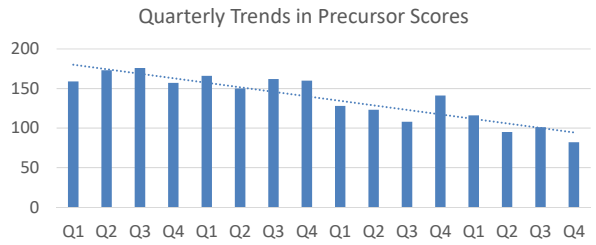
Measuring and Learning

Precursor Intelligence

- Trends in precursor scores over time (are we getting better?)





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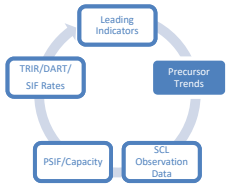
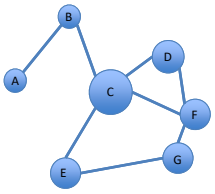
Measuring and Learning

Precursor Intelligence

- What precursors tend to appear together?
- How do they interact to cause SIF?
- More data allow for more insight





	Safe Work Procedure	Hazard Recognition	Departure from Routine	Plan to Address Change	Safety Attitudes	Rules and Procedures
Safe Work Procedure	1.00					
Hazard Recognition	-0.15	1.00				
Departure from Routine	-0.18	-0.17	1.00			
Plan to Address Change	-0.10	0.61	-0.39	1.00		
Safety Attitudes	-0.10	-0.18	-0.12	0.20	1.00	
Rules and Procedures	-0.10	0.17	-0.12	0.20	-0.07	1.00

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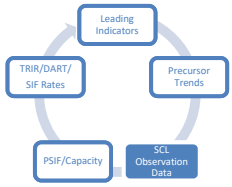
Measuring and Learning

SCL Data Input

- Was the condition dangerous enough that someone could have been killed (high-energy)? YES/NO
- What high situation was it? (Pull down high-energy icons)
- Was there a high-energy incident? YES/NO
- Was a direct control present? YES/NO
- What control was relevant (Pull down of controls)
- Was a serious injury or fatality sustained? YES/NO



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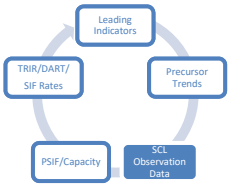
Measuring and Learning

SCL Observations Input Data

- Each observation of high-energy work can be classified as <success> or <exposure>
- Difference is the presence/absence of a direct control
- Can be integrated with existing observation programs
- Measurement and reporting can be frequent and consistent
- Data can be reported in EEI SIF Learning Center
- Note high-energy source and relevant controls



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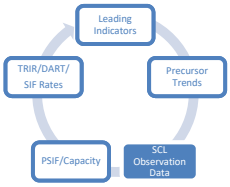
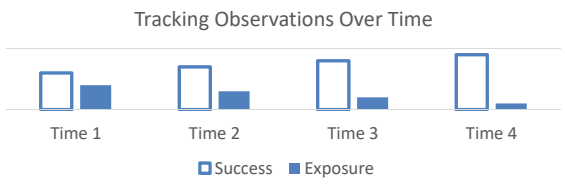
Measuring and Learning

SCL Observation Intelligence

- Proportion analysis
- Bars below would add to 100% at each time
- Goal: increase success proportion and decrease exposure by better controlling work





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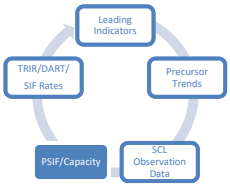
Measuring and Learning

PSIF/Capacity Input

- High-energy incidents that do not result in SIF, can be classified as <capacity> or <P-SIF>
- Difference is presence/absence of direct control
- Difference between PSIF and SIF is outcome
- Both events trigger learning opportunities
- Short-term focus on learning
- Long-term aspiration is a P-SIF metric as reporting cultures mature



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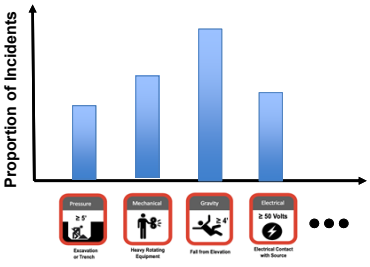
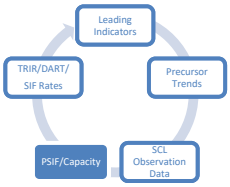
Measuring and Learning

PSIF Intelligence

- Trends in high-energy sources





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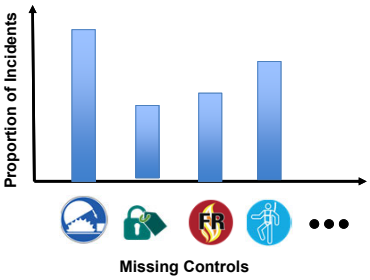
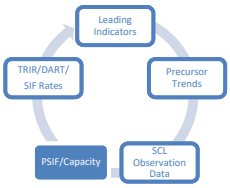
Measuring and Learning

PSIF Intelligence

- Trends in missing controls





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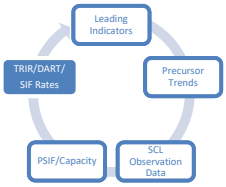
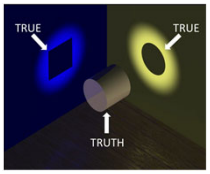
Measuring and Learning

TRIR/DART/SIF Rates

- Traditional data reporting
- Has statistical limitations because of low-numbers
- Useful for balanced scorecard and comparison
- Traditional intelligence, emphasis on SIF sharing





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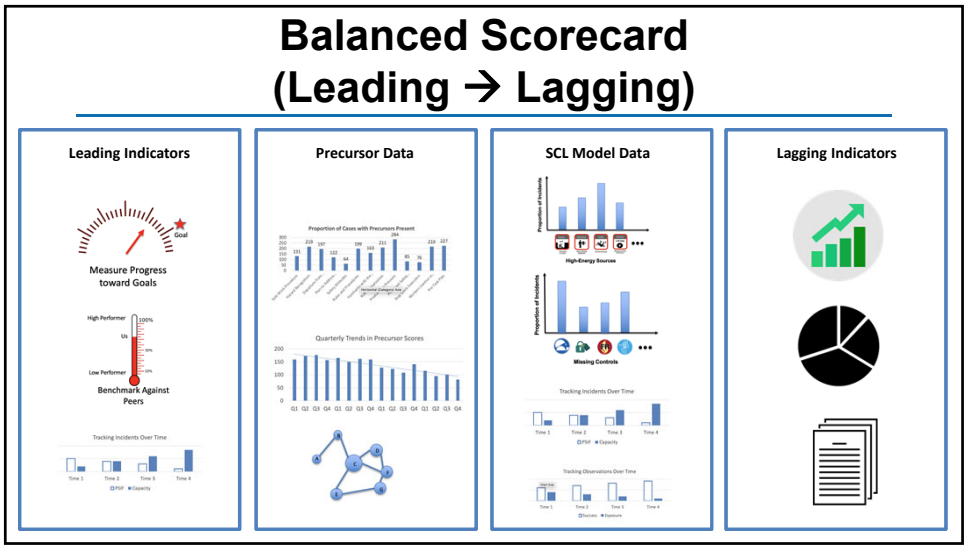
Balanced Scorecard
(Leading → Lagging)
Leading Indicators
Measure Progress toward Goals
Benchmark Against Peers
Precursor Data
SCL Model Data
Lagging Indicators

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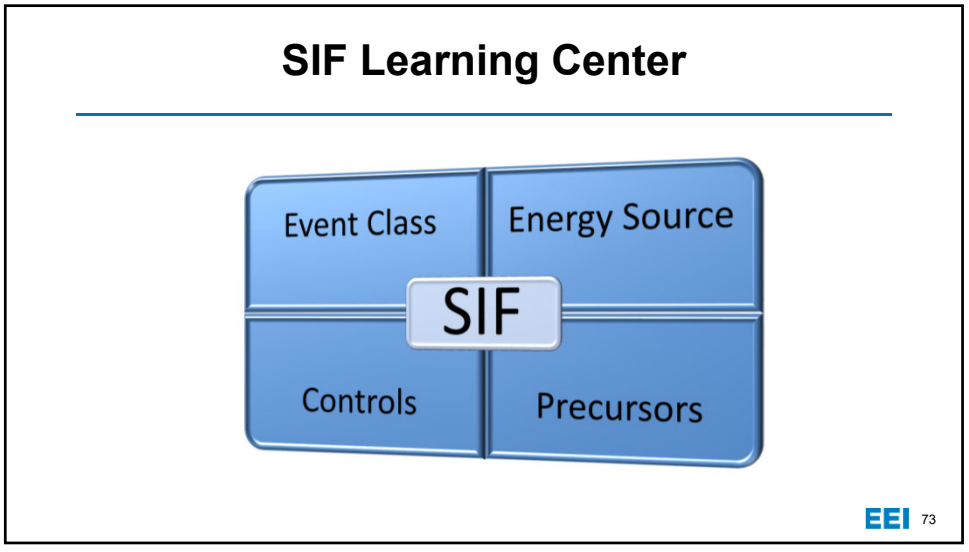
SIF Learning Center
Event Class
Energy Source
SIF
Controls
Precursors
EEI
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