

# Energy – Based Hazard Recognition

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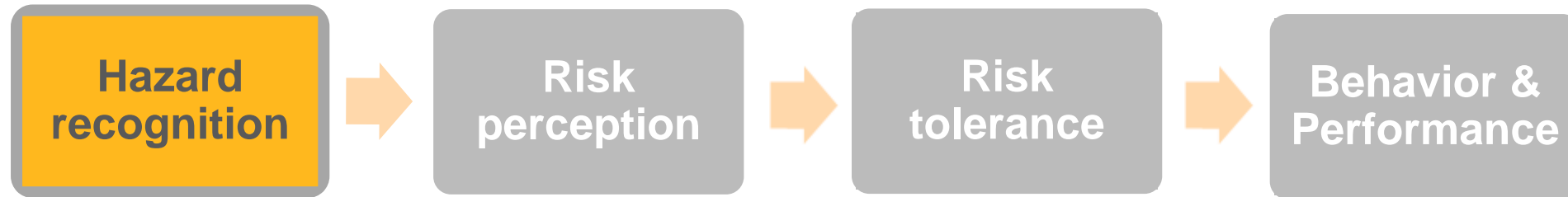
**John Jenkins**

Enbridge Project Safety Specialist



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**September 2017**  
Northern Region Safety Day



**Hazard recognition is the first step in situational awareness.**

# Hazard Recognition

- Heavy Equipment
- Sharp Blade
- Vehicular Traffic
- Uneven Surfaces



- Noise
- Flying Debris
- Heat
- Crush/Pinch Point

**What proportion of hazards can workers identify?**

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# Hazard Recognition

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Every injury is the result of the unwanted release of one or more energy sources.

Thus, every source of energy is a hazard.

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# Hazard Recognition

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**45%**

**Data from 4,800 worker-hours of observation (CII 2013)**

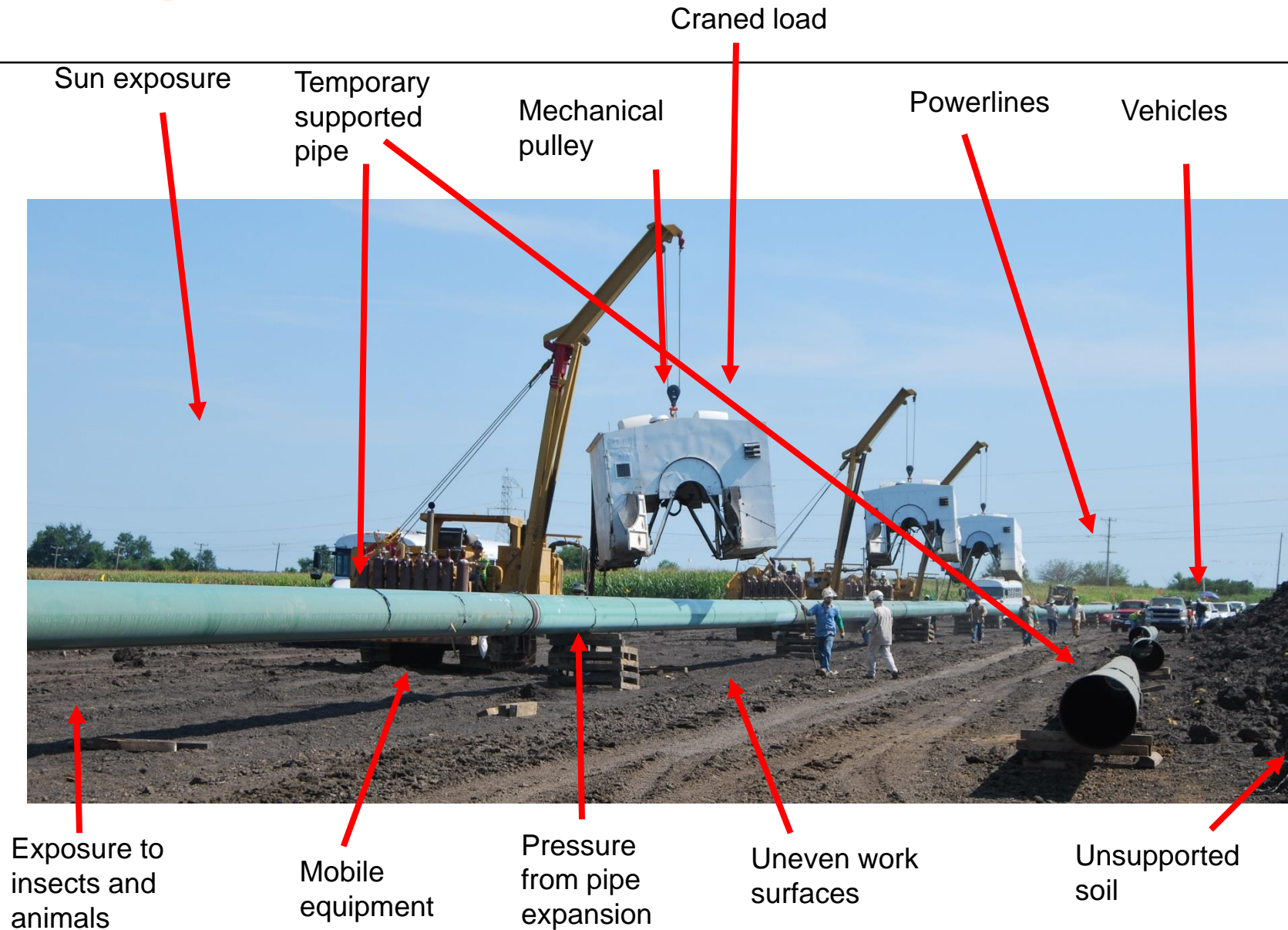
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# Hazard Recognition

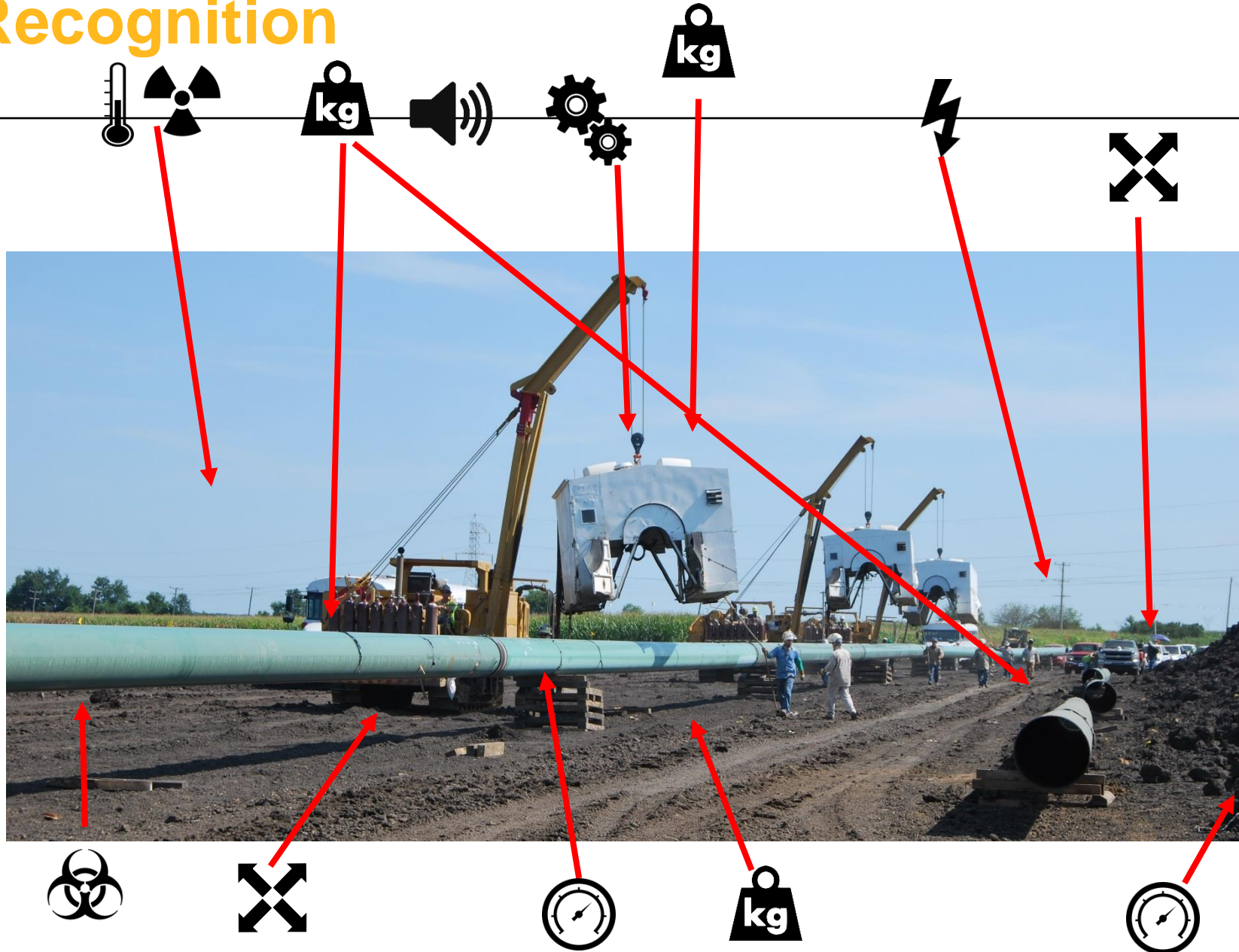
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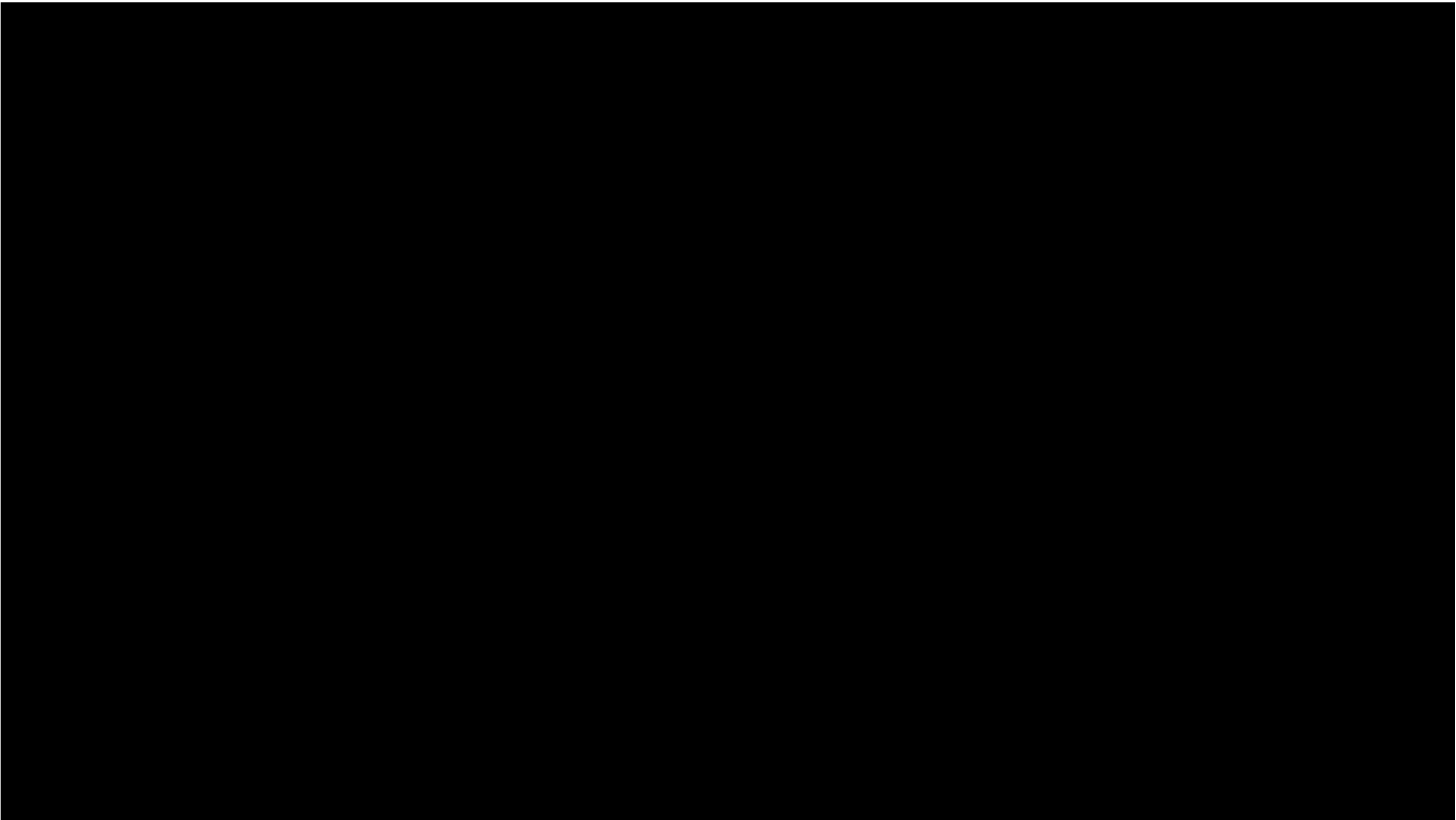
# Hazard Recognition



# Hazard Recognition







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# Hazard Recognition – Count the Fs

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FINISHED FILES ARE THE  
RESULT OF YEARS OF SCIENTIFIC  
STUDY COMBINED WITH THE  
EXPERIENCE OF YEARS

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# Hazard Recognition – Count the Fs

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TWO OF THE MOST POWERFUL  
OF ALL HUMAN FEARS ARE THE FEAR  
OF FAILURE AND THE FEAR OF  
SUCCESS

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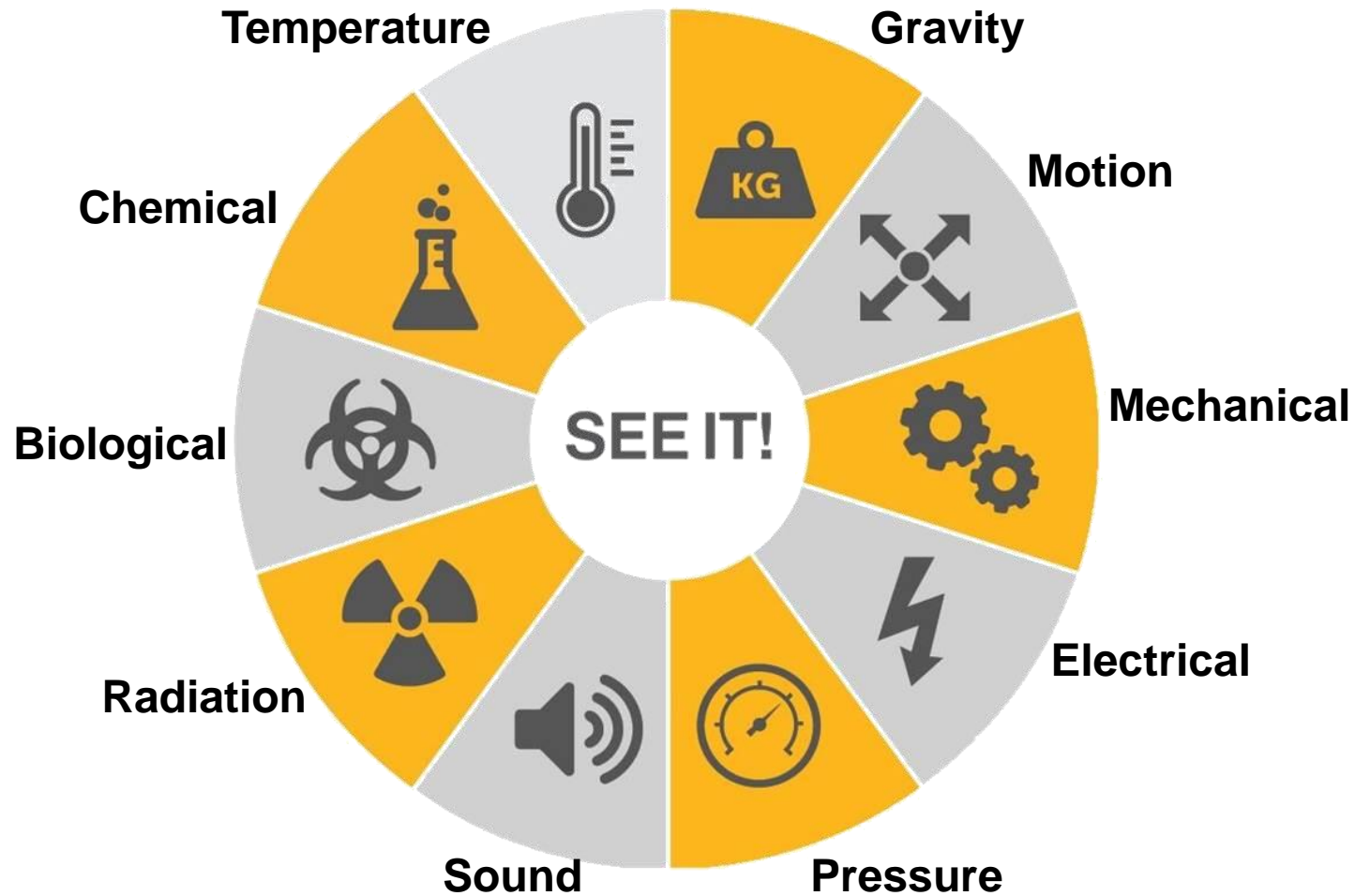
# Hazard Recognition – Count the Fs

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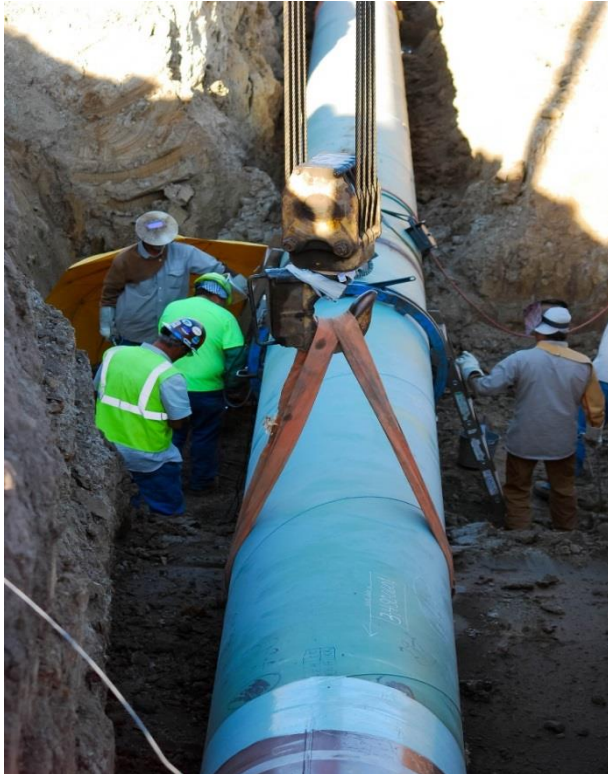
TWO OF THE MOST POWERFUL  
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9

# Hazard Recognition: The Energy Wheel



# Hazard Recognition: Parts of the Energy Wheel

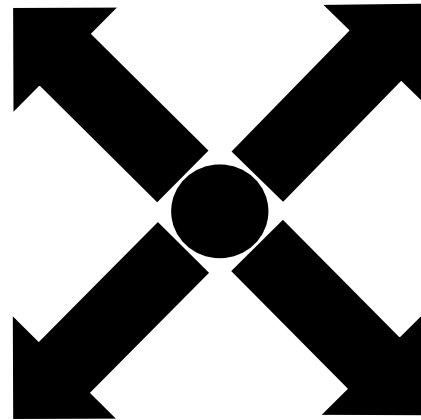


**Gravity: Force caused by the attraction of all masses to the mass of the earth**





# Hazard Recognition: Parts of the Energy Wheel



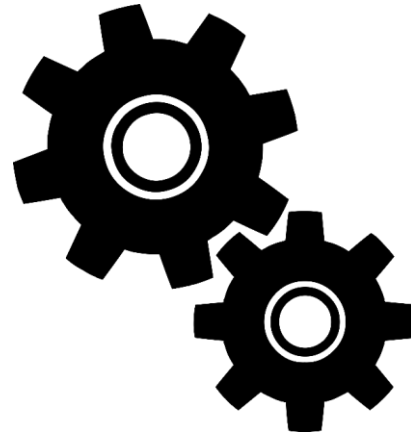
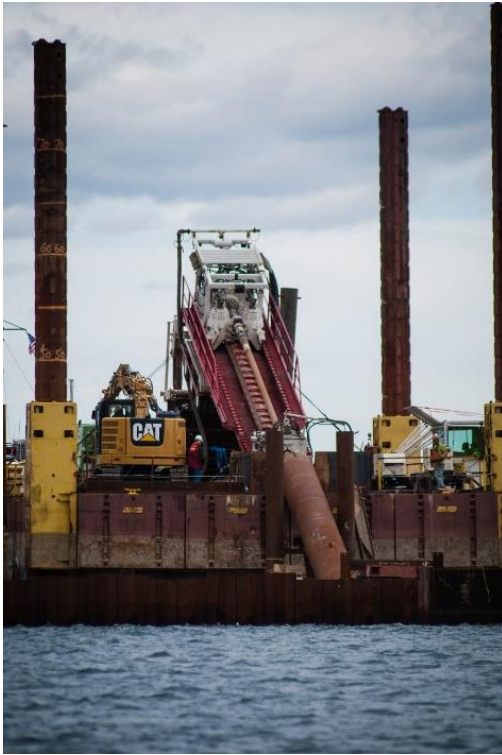
**Motion: Change in position of objects or substances**



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# Hazard Recognition: Parts of the Energy Wheel

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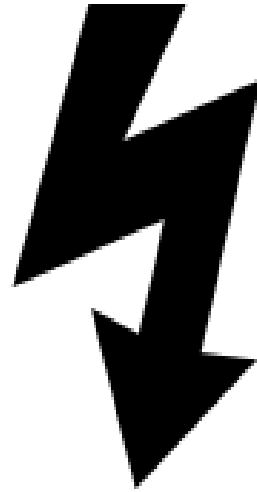


**Mechanical: Rotation, vibration, or motion of equipment, materials, or tools.**

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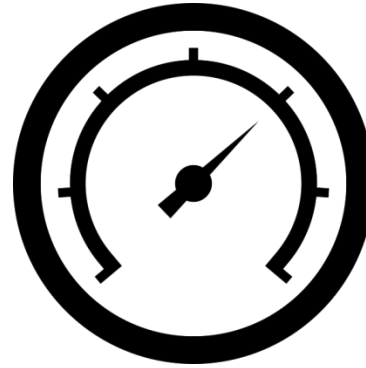
# Hazard Recognition: Parts of the Energy Wheel

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**Electrical: The presence of an electrical charge or current.**

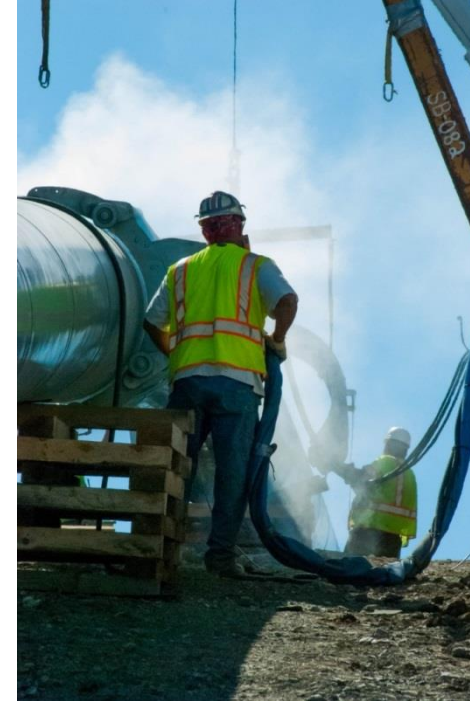
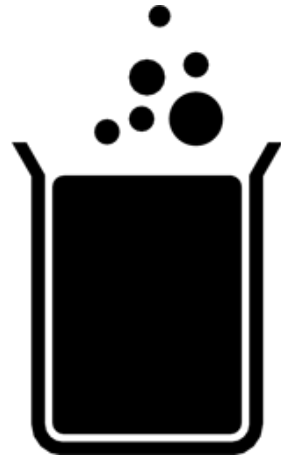
# Hazard Recognition: Parts of the Energy Wheel



**Pressure: Liquid or gas compressed or under a vacuum**



# Hazard Recognition: Parts of the Energy Wheel



**Chemical: Reactive elements in the environment**

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# Hazard Recognition: Parts of the Energy Wheel

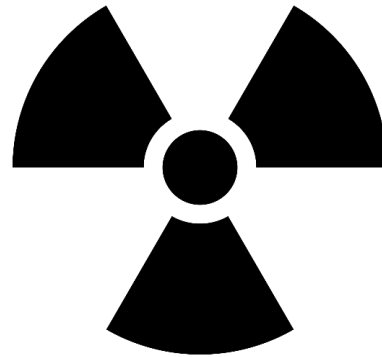
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**Biological: Living organisms that pose health risks**



# Hazard Recognition: Parts of the Energy Wheel



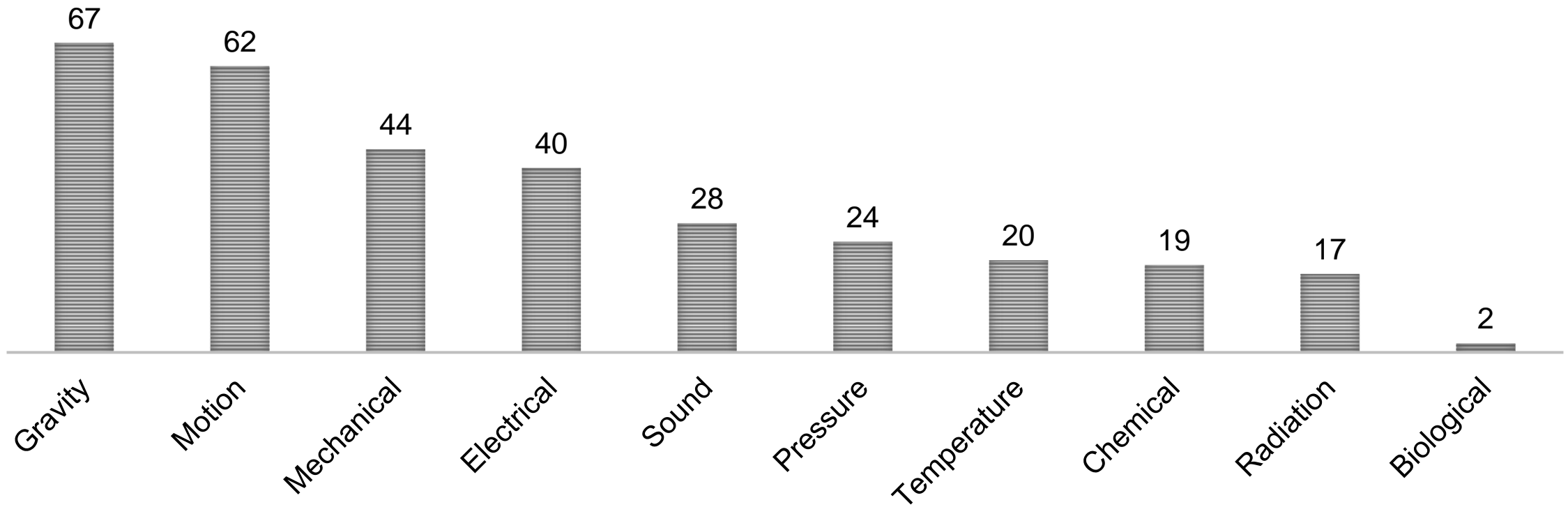
**Radiation: Elements that emit ions or atomic particles**

# Hazard Recognition: Parts of the Energy Wheel



**Sound: Audible vibrations caused from the contact of two or more objects**

# Hazard Recognition

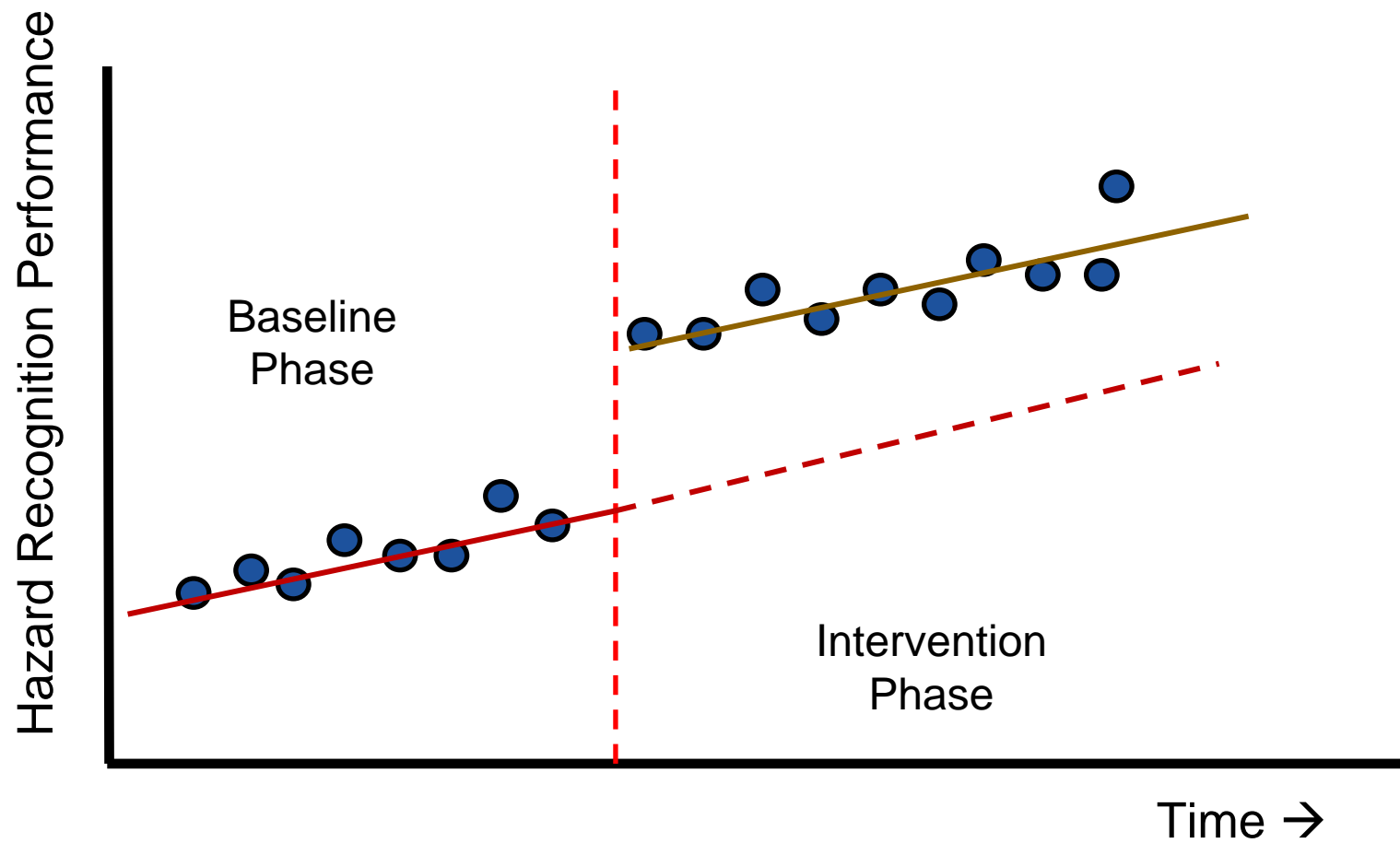


**Percent of hazards identified by type.**



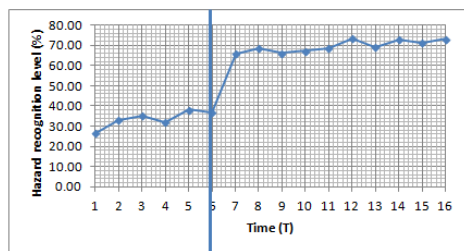
11.17.2010 15:49

**Do energy mnemonics CAUSE improvement?**

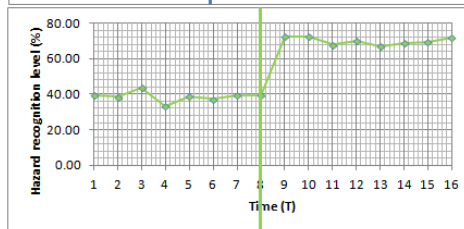


# Charleston Field testing

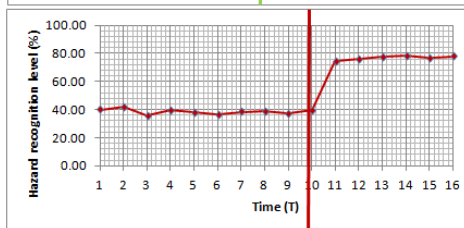
	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Crew 1	26.56	32.81	35.00	31.82	38.10	36.99	65.63	68.75	66.13	67.22	68.33	73.33	69.04	72.79	71.39	73.12
Crew 2	39.47	38.46	43.90	33.33	39.02	37.21	39.53	39.53	72.23	72.56	67.93	70.22	66.92	68.58	69.36	71.89
Crew 3	40.00	42.00	35.85	39.62	38.00	36.54	38.46	38.89	37.25	39.62	74.33	76.07	77.31	78.42	76.42	77.80



Crew 1	
The level change coefficient	26.006
The change is statistically significant	$p < 0.05$
95% confidence interval on level change	21.021
Standardized level change	12.51359



Crew 2	
The level change coefficient	31.155
The change is statistically significant	$p < 0.05$
95% confidence interval on level change	28.414
Standardized level change	11.45823



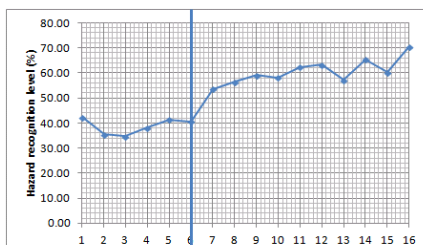
Crew 3	
The level change coefficient	38.102
The change is statistically significant	$p < 0.05$
95% confidence interval on level change	36.222
Standardized level change	23.06038

**35%**

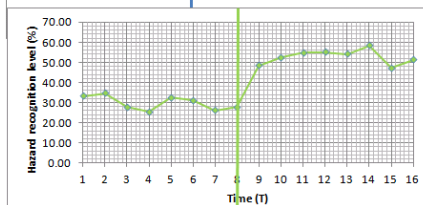
LC <sub>overall</sub>	34.98582
Lcoverall test stat	10.38849 $p=0.0$
Overall Std. Effect size	2.385697

# New Orleans Field testing

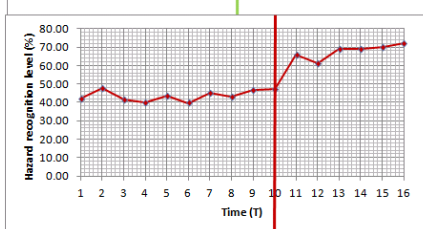
	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Crew 1	42.32	35.44	34.76	38.09	41.42	40.53	53.56	56.42	59.12	58.23	62.40	63.33	57.21	65.40	60.20	70.50
Crew 2	33.32	34.67	27.80	25.43	32.60	30.97	26.04	27.67	48.40	52.34	54.89	55.10	54.21	58.43	47.29	51.30
Crew 3	42.26	47.80	41.54	40.20	43.44	39.73	45.40	43.27	46.78	47.32	66.03	61.48	68.83	69.23	70.12	72.32



Crew 1		
	The level change coefficient	14.967
	The change is statistically significant	$p < 0.05$
	95% confidence interval on level change	6.919
	Standardized level change	4.461306



Crew 2		
	The level change coefficient	22.932
	The change is statistically significant	$p < 0.05$
	95% confidence interval on level change	19.06
	Standardized level change	6.349943



Crew 3		
	The level change coefficient	18.137
	The change is statistically significant	$p < 0.05$
	95% confidence interval on level change	12.172
	Standardized level change	6.594183

20%

$LC_{overall}$	19.8278
Lcoverall test stat	8.587392 $p=0.0$
Overall Std. Effect size	2.06252



# Backed by science

- › Hollowell, M.R., Albert, A.\*, Skaggs, M.\*, and Kleiner, B. (2017). “Empirical measurement and improvement of hazard recognition skill” *Safety Science*, 93, 1-8.
- › Hollowell, M.R. and Hansen, D.\* (2016). “Measuring and improving designer hazard recognition skill: Critical competency to enable prevention through design.” *Safety Science*, 82, 254-263.
- › Albert, A.\*, Hollowell, M.R., Lingard, H., and Kleiner, B. (2015). “Multiple baseline testing: An experimental method for drawing causal inferences in construction engineering and management research.” *Journal of Construction Engineering and Management*, ASCE, 04015012-1 to 04015012-13.
- › Albert, A.\*, Hollowell, M.R., and Kleiner, B. (2014). “Experimental field testing of a real-time construction hazard identification and transmission technique.” *Construction Management and Economics*, Taylor and Francis, 32(10): 1000-1016.
- › Tixier, A.\*, Hollowell, M.R., Albert, A.\*, van Boven, L., and Kleiner, B. (2014). “Psychological antecedents of risk-taking behavior in construction.” *Journal of Construction Engineering and Management*, ASCE, 140(11): 04014052-1 to 04014052-10.
- › Albert, A.\*, Hollowell, M.R., Kleiner, B., Golparvar-Fard, M., and Chen, A. (2014). “Enhancing construction hazard recognition with high fidelity augmented virtuality.” *Journal of Construction Engineering and Management*, ASCE, 04014024-1 to 04014024-11.
- › Albert, A.\*, Hollowell, M.R., and Kleiner, B. (2014). “Emerging strategies for construction safety and health hazard recognition.” *Journal of Safety, Health, and Environmental Research*, ASSE, 10(2): 152-161.
- › Albert, A.\*, Hollowell, M.R., and Kleiner, B.M. (2013). “Enhancing construction hazard recognition and communication with energy-based cognitive mnemonics and a safety meeting maturity model: A multiple baseline study.” *Journal of Construction Engineering and Management*, ASCE, 04013042-1 to 04013042-12.