Northeast Utilities

Connecticut Light & Power
Public Service of New Hampshire
Western Massachusetts Electric

HUMAN PERFORMANCE TOOLS

NU TRANSMISSION

Kevin E. Harris
Northeast Utilities
Transmission Field Supervisor
PPI Cert. #014

PPI Precept # 1: Things are the way they are because they got that way.

Proactive Approach Desired!

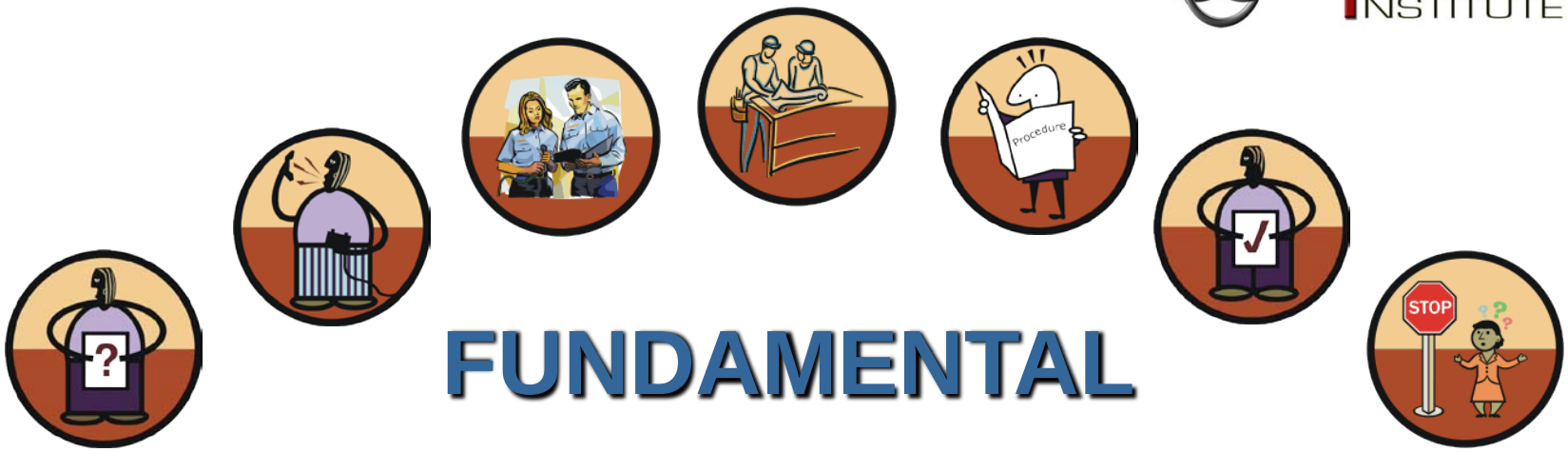
Practicing Perfection® Error Elimination TOOLs™

Where we apply solid habits to place barriers between our human condition to err and the potential for an event !

Congruent with Four (4) Practicing Perfection Institute Precepts!

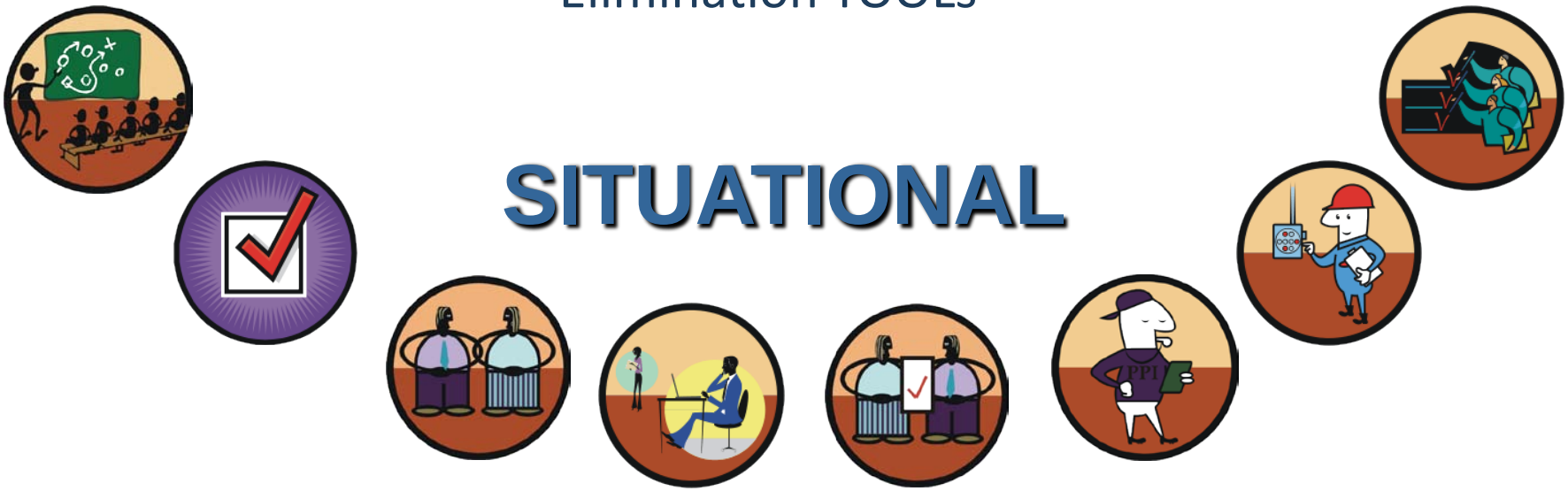
PRACTICING PERFECTION INSTITUTE

PRACTICING PERFECTION INSTITUTE



FUNDAMENTAL

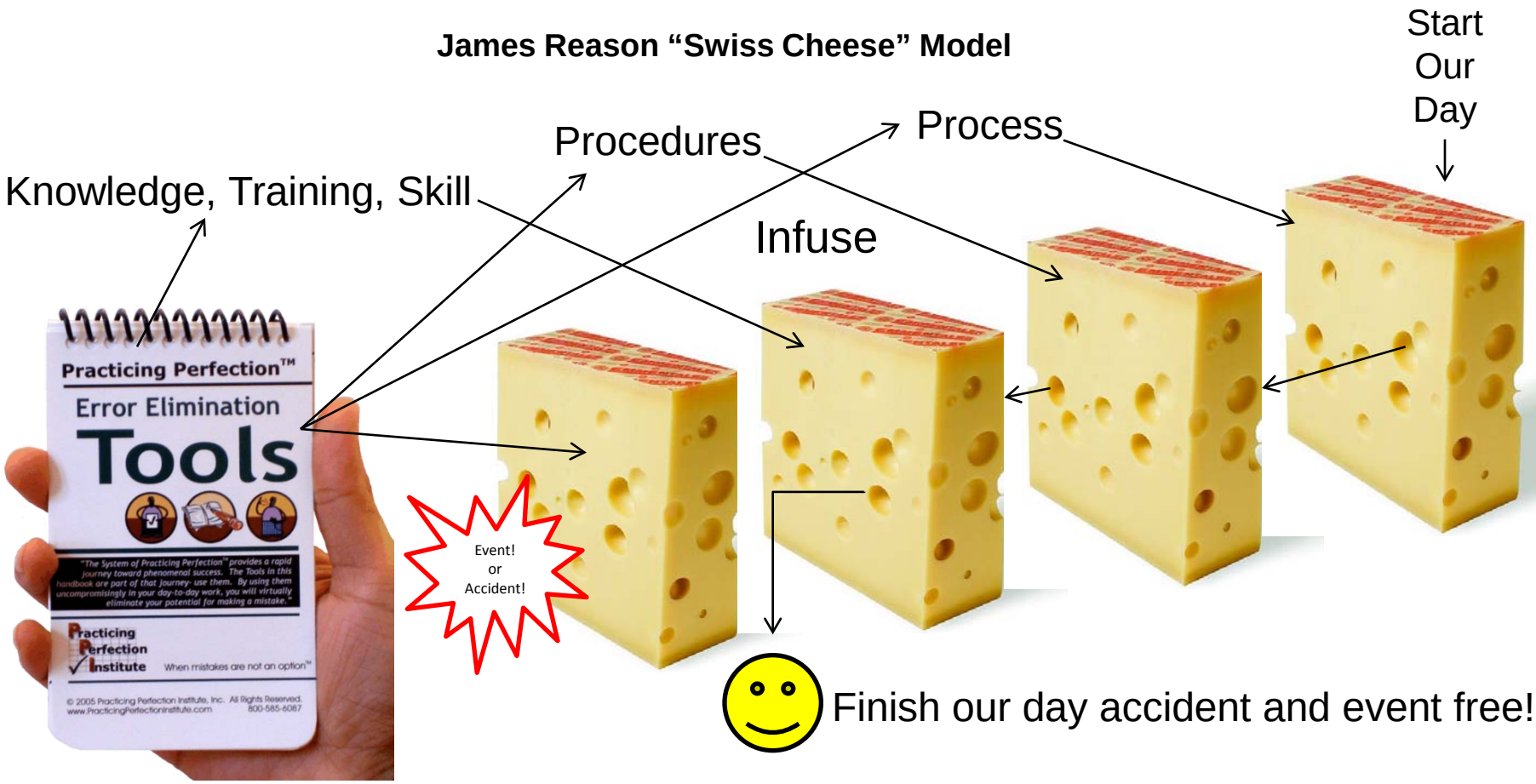
Practicing Perfection® Error Elimination TOOLs™



SITUATIONAL

Error Elimination Tools

James Reason "Swiss Cheese" Model



Using the Error Elimination Tools to enhance each barrier by strengthening existing barriers, i.e. reducing the size of the "holes in the cheese." And providing an opportunity to catch our initial errors prior to evolving into an event!

Enhanced our Lessons Learned

Post Event

Perform an analysis of each event and often created a Lesson Learned document to share with stakeholders!

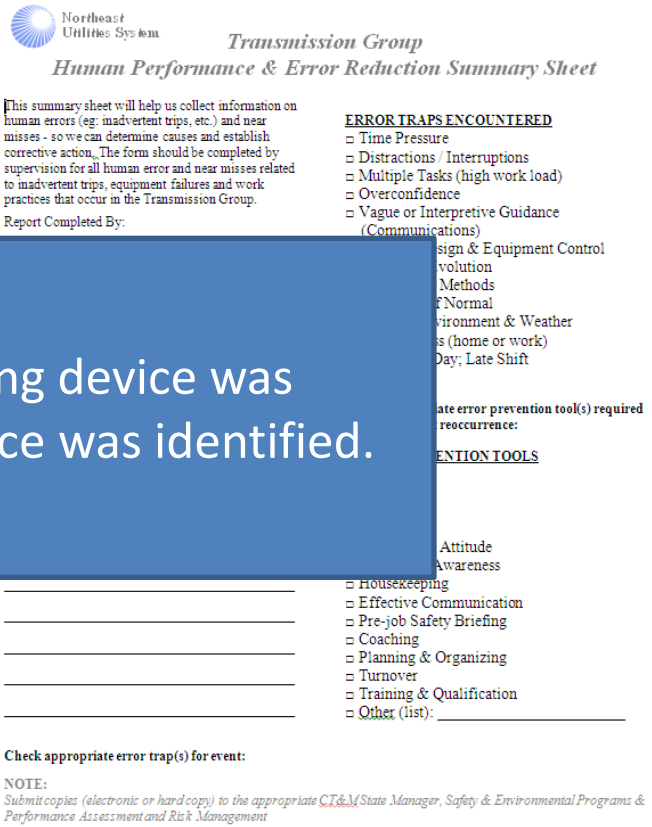
Partial Example:

Lessons Learned

D165-2007 8/31: Poor work practice of “placing a jumper on a contact”, without isolating the tripping device. Proper work practice would be to isolate the tripping device and then close expected path to desired circuit. This could have avoided the inadvertent trip caused by the human error. Po
was burnt out af
prior to beginnin

D176-2007 9/18
the incorrect dev
which resulted i
properly identifie
panel. Human e
down, questioni
nomenclature is
addressed, how
identify this human error “land mines” prior to ta
found that there are two relays nomenclatured "86P1/A". For this instance, the intended relay was the 86P1/A for the *345kV* A bus; however test personnel were working on the 86P1/A for the *115kV* A bus. Test personnel just finished testing the contacts from the 94P and 94B for the 1X and 2X. The 86P1/A (115kV bus) is mounted in the same panel at the 94P/1X. Looking further into this, there are multiple relays in Plumtree 30G with the same nomenclature. There is no distinction between any of the 345kV and 115kV A bus and B bus tripping relays on the nomenclature tags on the panels. There are two of all of the following relays: 86P1/A, 86P2/A, 94P/A, 86P1B, 86P2/B, 94P/B.

Correct work practice of isolating a tripping device was applied; unfortunately, the incorrect device was identified.



Northeast Utilities System

Transmission Group

Human Performance & Error Reduction Summary Sheet

This summary sheet will help us collect information on human errors (eg: inadvertent trips, etc.) and near misses - so we can determine causes and establish corrective action. The form should be completed by supervision for all human error and near misses related to inadvertent trips, equipment failures and work practices that occur in the Transmission Group.

Report Completed By:

ERROR TRAPS ENCOUNTERED

- □ Time Pressure
- □ Distractions / Interruptions
- □ Multiple Tasks (high work load)
- □ Overconfidence
- □ Vague or Interpretive Guidance (Communications)
- sign & Equipment Control
- volution
- Methods
- f Normal
- ironment & Weather
- s (home or work)
- Day; Late Shift

ate error prevention tool(s) required reoccurrence:

ENTION TOOLS

- Attitude
- Awareness
- □ Housekeeping
- □ Effective Communication
- □ Pre-job Safety Briefing
- □ Coaching
- □ Planning & Organizing
- □ Turnover
- □ Training & Qualification
- □ Other (list): _____

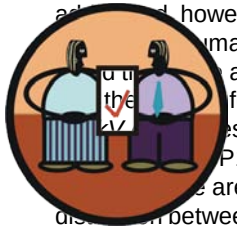
Check appropriate error trap(s) for event:

NOTE:
Submit copies (electronic or hard copy) to the appropriate CT&M State Manager, Safety & Environmental Programs & Performance Assessment and Risk Management

Sharing what went wrong opens the door to also sharing what went well as we learn from each event!

Enhanced our Lessons Learned

Post Event



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Human error elimination tools that would have applied are; task preview, job site walk down, questioning attitude, peer check and creating a plan identifying each task. Identified nomenclature is a Latent Organizational Weakness (LOW) or "land mine" which needs to be addressed, however, using the tools above may have afforded the test personnel an opportunity to identify this human error "land mine" prior to taking action.

"Land Mine" = Same nomenclature for 345kV Bus and 115kV Bus Relays!

…p
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…RAPS ENCOUNTERED
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…list): _____

Submit copies (electronic or hard copy) to the appropriate CT&M State Manager, Safety & Environmental Programs & Performance Assessment and Risk Management

Proactive Approach

- Error Elimination Tools roll out to NU Internal stakeholders.
    - Conducted by Field Supervisors
        - Listen to the people who do the work
        - Work together on solutions
        - Foster a work environment to allow for a healthy creative questioning attitude

PPI Precept # 4: The people who do the work are the ones who have the answers.

Proactive Approach

- Practicing Perfection Institute and Northeast Utilities Transmission Group developed Error Elimination Tools training Scenarios.
  - Kick off HU Tools awareness
  - Hands on Situational Scenarios to apply new knowledge and Error Elimination Tools with a Peer Coach present.

Peer Coaching Means We Care!

Practicing Perfection Institute — when mistakes are not an option™

Northeast Utilities System

Scenario 3	**REL512 Relay Removal**

DESCRIPTION

In this Scenario, Participants are to remove one ABB REL512 Primary Relay, located on Panel 2, associated with the Babu Junction 21J Station in the NU Protection and Controls Training and Development Lab. This relay, in need of repair, is associated with Line 1345.

During the scenario, Participants will encounter and deal with a series of built-in Human Error Traps / Latent Organizational Weaknesses (LOWs). These will include:

- Line nomenclature discrepancy ("Line 13" vice "Line 1345")
- Missing Labels
- Test device missing shorting tabs
- CT Shorting Block is not actually a shorting block
- Noisy/distractive environment

Termination Point:

The Scenario will terminate when the Participants **Flag** the rear of the panel after identifying that TB-LC is not a shorting block (and stop work accordingly).

OBJECTIVES

In this Scenario, participants will:

1. Gain awareness of / experience using the following Error Elimination Tools™:
   - **Questioning Attitude**
   - **Effective Communication**
   - **Task Preview**
   - **Job Site Review**
   - **Procedure Use**
   - **Self-Checking**
   - **STOP When Unsure**
   - **Pre-Job Brief**
   - **Placekeeping**
   - **Flagging**
   - **Peer Checking**
   - ***Turnover (*depending upon size of group; see Facilitator Notes)**
   - **Post Job Review**

Proactive Approach

Monday, March 05, 2012, Issue 117 Forward

::: Safety & "Human Performance"

Human Performance: Post-Job Review

Before a job even begins, we devote a great deal of energy to developing a plan to succeed. However, time allotted to conduct a post-job review can be very beneficial to assess the original plan, how things may have changed, and what can be learned to improve our likelihood of success in the future.

Why Conduct a Post-Job Review?

- To provide a forum for discussion among workers and supervision of what went well (and not so well) during performance of a specific job.
- To capture lessons learned (both positive and negative) during task performance.
- To positively influence future performance of the same or similar tasks.

When Should We Do a Post-Job Review?

- When completing any work during which complications occurred.
- Upon completion of non-routine or strategically important tasks.
- When any recurring/routine task goes better (or worse) than normal.
- Whenever workers discover anything of significance during task performance.

How Should a Post-Job Review be Conducted?

- Add a post-job review as a required part of the work package for appropriate tasks.
- Provide time for the review; however, keep the review concise and on topic.
- Provide time for conversation among all active participants and for documentation of feedback.
- Identify what worked well.
- Identify areas for improvement.
- Document results of the review and disposition for future reference/corrective action.
- Provide feedback to those involved on the resolution of high-interest issues.

For more information, contact a member of the Transmission Safety team.

- Highlight an Error Elimination Tool with employee communication!
  - Why?
  - When?
  - How?

Continued Communication Infused

Proactive Approach

Attachment A, Test P&C Scheme QC Guideline

Functional Tests – Initial operational test used to check the intention of a design a[illegible] is p[illegible] p[illegible] a[illegible] r[illegible] p[illegible] f[illegible] al w[illegible] a[illegible] a C[illegible] v[illegible] H[illegible] identify equipment to [illegible]erated and readiness to do so. Human performance tools such as, Pre Job Brief, Self Checking, Peer Review, Flagging, and STAR are also regularly employed. Resolution for discrepancies is accomplished via the Engineering Change Notice (ECN) process EN-MT-2012.

Human Performance tools such as Three Way Communication is employed to identify equipment to be operated and readiness to do so. Human Performance tools such as Pre job Brief, Self Checking, Peer Review, Flagging and STAR are also regularly employed.

Infused in Process or Procedure

PPI Precept # 2: 84 – 94 percent of all human error can be directly attributed to process programmatic, or organizational issues.

Error Elimination Tools Employed

Barriers
Include Human Performance
Tools being employed:

- Peer Check
- Drawings
- Procedures

Each Day starts with:

Job Site Walk Down

Task Review

Pre Job Brief

1189 Saybrook Road – RT 154
Haddam, CT 06438

MAJOR HAZARDS	BARRIERS Include Human Performance Tools being employed
Capacitor Bank ☑ Yes ☐ No CONVEX Contact @ Substation No	– peer check – drawings – procedures

WORK PROCEDURES	PEOPLE	PPE	TOOLS/EQUIPMENT	SPECIAL PRECAUTIONS
☑ Isolation of Equipment ☑ Check for Potential ☐ Proper Grounding ☐ Vehicle Grounds ☐ Working Clearances ☐ E-911 Protocol	☐ Worker Fatigue ☐ Assignments ☑ Other Work Groups ☐ Public Safety ☐ Pedestrian Control ☐ Other Utilities ☐ Power Plants ☐ Body Positioning/Ergonomics	☑ Hard Hat ☑ Safety Glasses ☑ FR Clothing ☐ Rubber Gloves ☐ Traffic Vest ☐ Hearing Protection ☑ EH Footwear ☑ Inspection of PPE	☐ Insulated Tools ☑ Fall Protection ☐ Inspection- Tools/Equip ☐ Special Tools/Equip ☐ Correct Tools for Job	☐ Weather Conditions ☐ Flagging of Work Area ☐ Post Guard-testing ☐ CT Circuits ☐ Equip Operate via Test ☐ Back Feed Potential

Page 1 of 2

TRANSMISSION TEST
DAILY PRE-JOB SAFETY BRIEFING

HUMAN PERFORMANCE / ERROR ELIMINATION

TRAPS PRESENT	TOOLS TO USE
☑ Time Pressure	■ Questioning Attitude
☐ Distractions / Interruptions	■ Effective Communications
☐ Multiple Tasks	■ Task Preview
☐ Overconfidence	■ Job Site Review
☐ Vague or Interpretive Guidance	■ Procedure Use
☐ First Shift / Last Shift	■ Self-Checking
☐ Peer Pressure	■ STOP When Unsure
☐ Change / Off-Normal	☐ Pre-Job Brief
☐ Physical Environment	☐ Place keeping
☐ Mental Stress	☐ Turnover
	☐ Independent Verification
	☐ Peer Checking
	☐ Peer Coaching
	☐ Flagging
	☐ Post-Job Review

EMERGENCY RESPONSE INFORMATION

QUESTIONS TO CONSIDER	NOTES/COMMENTS
What is your exact work location (physical address, town, ROW, structure number, nearest street crossing, etc.)?	1189 Saybrook Rd Haddam, CT 06438
Where will you meet Emergency Responders?	Gate of substation Saybrook Rd
Who will meet Emergency Responders?	available
Who will make emergency notification, and what will be used to make the notification?	available via cell phones
Are communications devices functioning properly?	yes
Are First Aid and other Emergency Response Supplies readily available?	Yes

OSHA MINIMUM ALLOWABLE WORKING DISTANCE FOR QUALIFIED WORKERS

VOLTAGE	PHASE TO GROUND Avoid Contact	PHASE TO PHASE Avoid Contact
50v TO 600v		2' 2"
1 kV to 15 kV	2' 1"	
23 kV / 28 kV	2' 4" (CL&P / WEMCO- 2' 6")	2' 7" (CL&P / WEMCO- 2' 7")
34.5 kV	2' 4" (CL&P / WEMCO- 3' 0")	2' 7" (CL&P / WEMCO- 3' 0")
69 kV	3' 0" (CL&P / WEMCO- 5' 0")	3' 6" (CL&P / WEMCO- 5' 0")
115 kV	3' 2" (CL&P / WEMCO- 6' 0")	4' 3" (CL&P / WEMCO- 6' 0")
345 kV	8' 6"	12' 6"

OSHA MINIMUM ALLOWABLE WORKING DISTANCE FOR UNQUALIFIED WORKERS

VOLTAGE	PHASE TO GROUND
0 to 50 kV	10'
69 kV	11'
115 kV	13'
138 kV	13'
230 kV	15'
345 kV	20'

Page 2 of 2

Ask? "What is the worst thing that could happen?

Error Elimination Tools Employed

Self Check: STAR = Stop Think Act Review

Peer Verified magnet ~ Flagging

“Trust but Verify”

“As Built Print of Record”

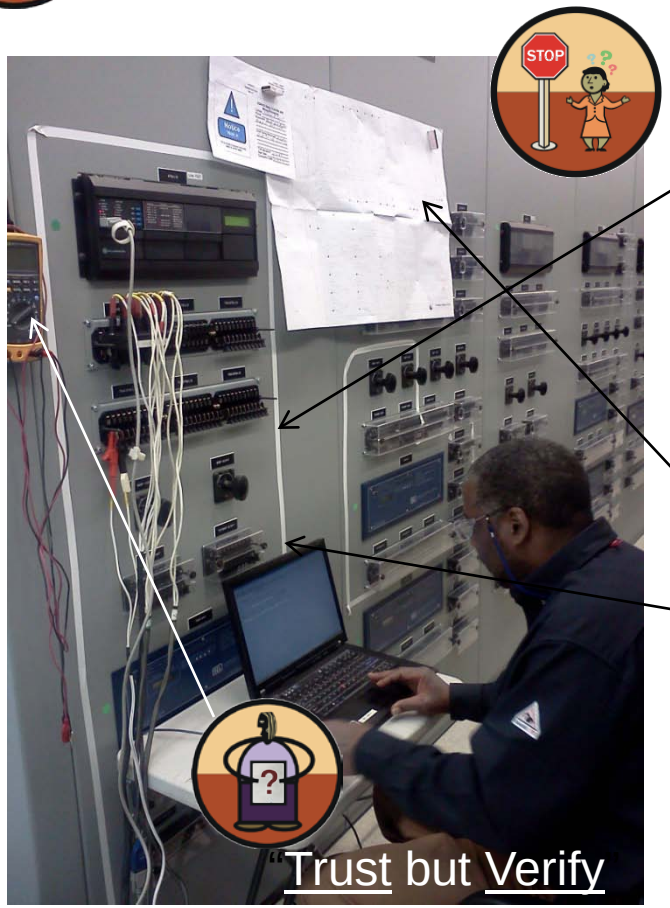
Procedure Use:

- Review Maintenance Manual
- Review Department Administrative Guide
- Review relay test plan
- Review “As Built Prints of Record”

PPI Precept # 3 People come to work wanting to do a good job.

Error Elimination Tools Employed

Self Check: STAR = Stop Think Act Review



Tape fence around relays under test ~ Flagging

"As Built Print of Record" Procedure Use:

- Review Maintenance Manual
- Review Department Administrative Guide
- Review relay test plan
- Review "As Built Prints of Record"

PPI Precept # 3 People come to work wanting to do a good job.

Error Elimination Tools Employed

Self Check: STAR
Stop Think Act Review

Each Switching evolution starts with:

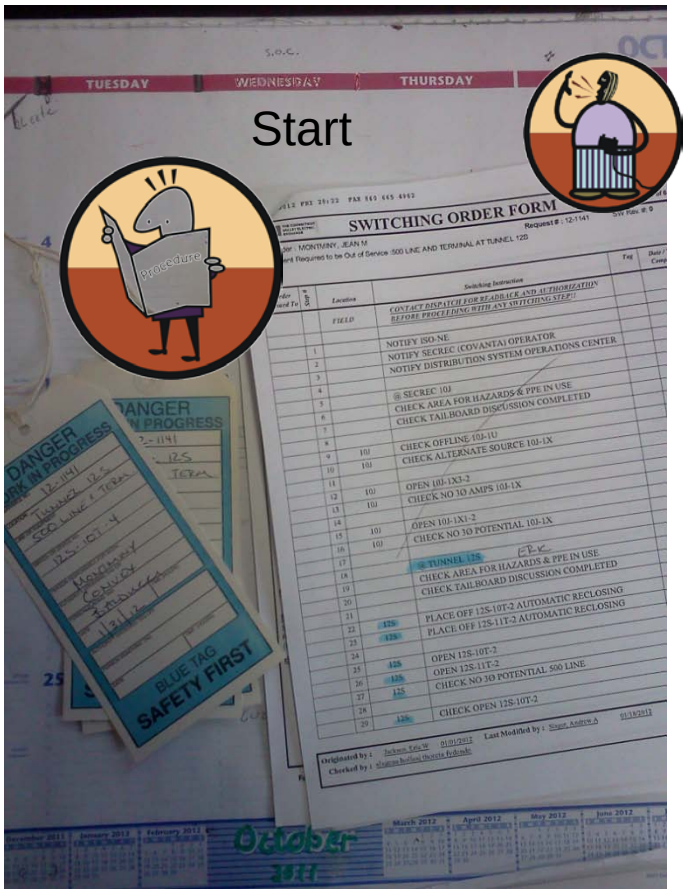
- Job Site Walk Down
- Task Review
- Flagging
- Independent Review
- Pre Job Brief

Employed throughout:

- Positive Questioning Attitude
- Effective Communication
  - Three Way while switching
  - STOP when unsure!!

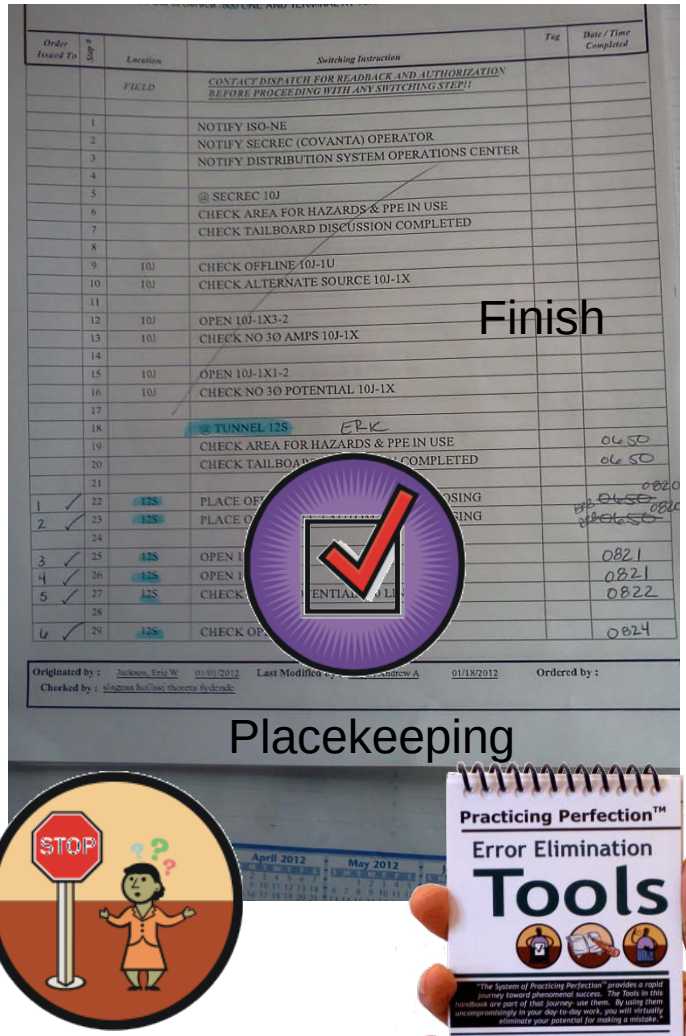
Error Elimination Tools Employed

Self Check: STAR
Stop Think Act Review



Procedure Use:

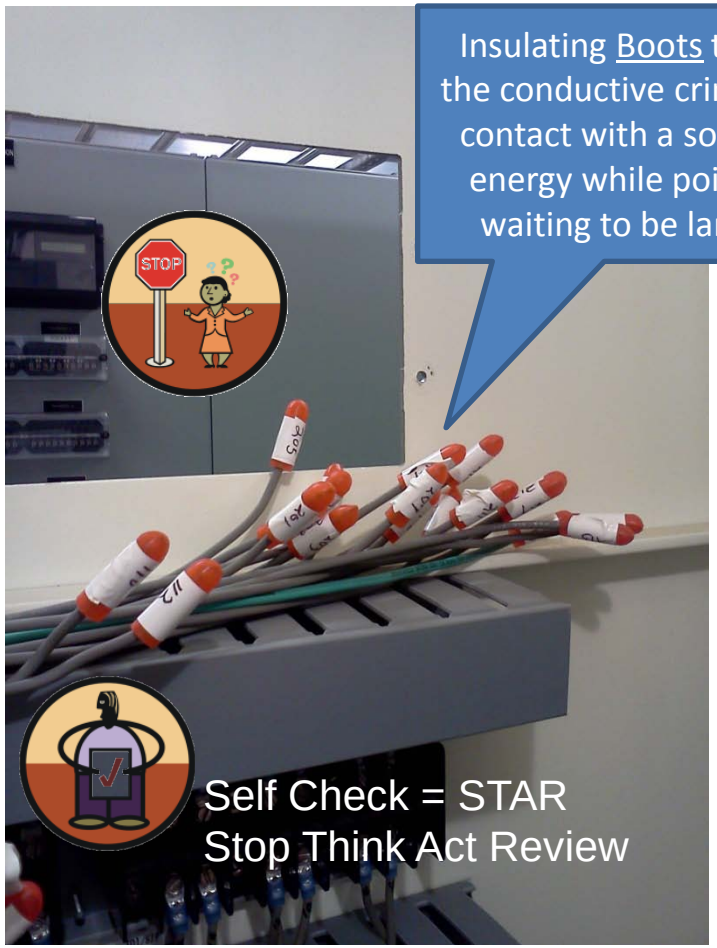
- Highlight steps during walkdown.
- Receive switching verbal commands from operator and repeat back.
- Number and write time each step completed during execution.
- Check off each switching step as they are read back to operator.
- Operator confirms or not.

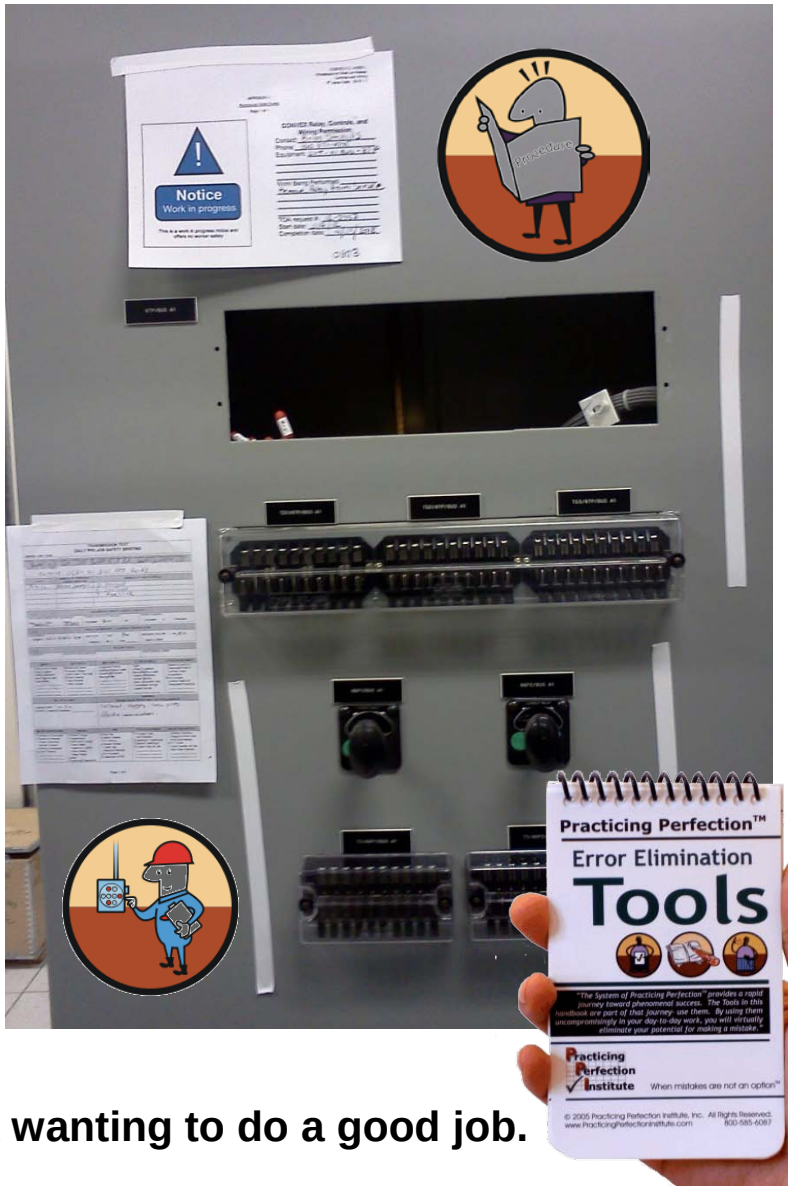


PPI Precept # 3 People come to work wanting to do a good job.

Error Elimination Tools Employed

Relay Removed for Repair

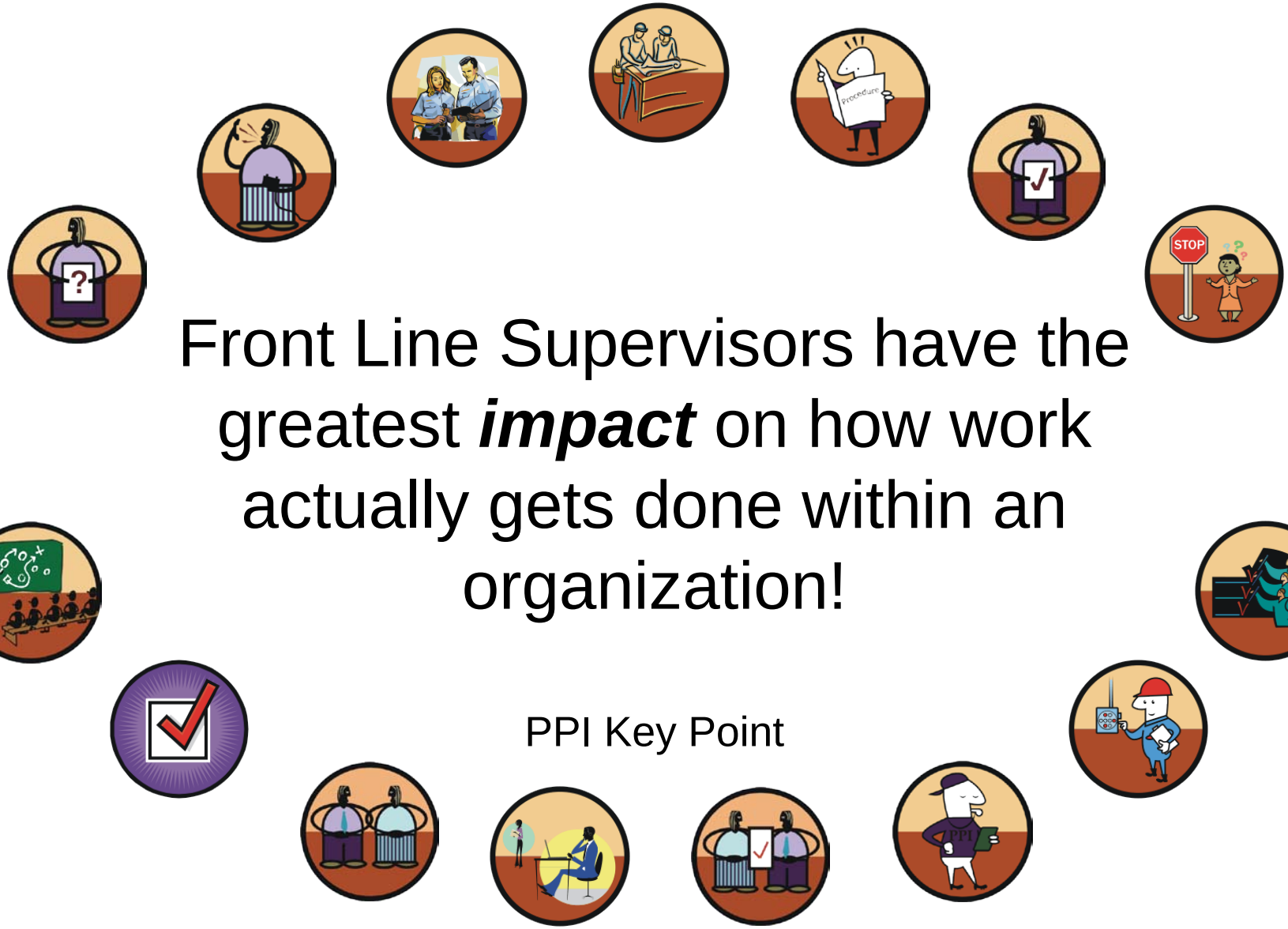




PPI Precept # 3 People come to work wanting to do a good job.

PRACTICING PERFECTION INSTITUTE

Influencing Behavior



Front Line Supervisors have the greatest ***impact*** on how work actually gets done within an organization!

PPI Key Point

Influencing Behavior

IMPACT: A tool to guide and document. Document to measure how we are doing. IMPACTS' value is in guiding personnel providing and receiving real time positive feedback.

Measuring

Rate Calculation: **# human errors** x 200,000 / **# of work hours** for the period.
Where 200,000 = 100 employees x 40 hours x 50 weeks

Human Error Resulting in an Electric Grid Event:

Year	# Event	Rate
2004	32	Ugly
2005	25	4.20
2006	33	2.95
2007	33	1.94
2008	25	1.36
2009	14	1.36
2010	16	1.64
2011	18	1.34
2012	3	
2013		
2014		

Lessons Learned

Addition of Error Elimination Tools

Declining Trend Desired!

Results

Learned of Practicing Perfection Error Elimination Tools in June 2007

Started search for Human Error Reduction Information. However, relying primarily on Lesson Learned Analysis.

Rolled out Error Elimination Tools to internal employees to include supervisors & managers starting September 2007 through 2008.

Total Work Hours	3,518,640	3,609,080	3,401,690	3,667,086	2,060,942	1,947,192	2,696,032	
Human Errors	25	33	33	25	14	16	18	
	2005	2006	2007	2008	2009	2010	2011	5 Year Avg.
	4.20	2.95	1.94	1.36	1.36	1.64	1.34	1.53

PPI & NU Developed Elimination Tools training for Vendors in July and started classes in August 2007! NU looks for Vendors with Human Error Reduction Plans starting 2009.

Goals

R	1.83 - UP
Y	1.46 -1.82
G	1.16 -1.45
B	0.00 -1.15

GOOD

Setting Goals:

Min = ≤ 1.83 (120% of our five year, '07 - '11, average of 1.53)

Target = ≤ 1.45 (95% of our five year, '07 - '11, average of 1.53)

Max = ≤ 1.15 (75% of our five year, '07 - '11, average of 1.53)

“Nothing is stronger than habit.”

Ovid, Ars Amatonia Roman Poet 17AD

Practicing Perfection Institute Precepts:

#1 Things are the way they are because they got that way.

#2 84 – 94 percent of all human error can be directly attributed to process, programmatic, or organizational issues.

#3 People come to work wanting to do a good job.

#4 The people who do the work are the ones who have the answers.