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Human Performance at the Perry Nuclear Power Plant

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Abstract

Provides a description of human performance training for plant workers as implemented at the Perry Nuclear Power Plant. Practical concepts regarding the training are presented as well as a demonstration of some of the training material. Concepts are drawn from INPO, Reason and Deming. The paper encourages the use of site-wide and individual organizational unit training in human performance management techniques.

Introduction

Data shows that all human performance errors have the same root cause - HUMANS. Now what do you do about it. Ultimately the end result of human performance research is to be able to implement design and procedure changes and training and supervision changes to enable workers to be more successful. This paper presents some of the practical considerations in bringing human performance training to workers.

According to a survey presented at the 3rd Annual Utility Workshop on Corrective Action, Trending and Human Performance held in June in Chicago, 17 of 29 plants had a dedicated individual/group for human performance. Therefore roughly half of United States plants have a human performance specialist. This is rapidly increasing and there may only have been a quarter of the plants with a human performance specialist a year ago. The Institute of Nuclear Plant Operations recommended in 1992 that utilities could reduce the number of plant events by working to improve human performance. This recommendation had the first major impact on encouraging more efforts in the area of human performance. Subsequently, results at several utilities have been quite dramatic and have raised the interest level at all plants. At the Perry Nuclear Plant we currently have a three person task force which takes the lead for human performance development.

The Perry Nuclear Plant currently issues about 3500 corrective action documents per year. The primary root causes are identified below in three categories:

	%
Personnel error	48
Human performance	24
Equipment	28

All of the corrective action documents are coded, but the levels of root cause investigation vary.

People often have a hard time differentiating between Personnel Error and Human Performance, but the distinction is important. Personnel error is an individual's error. Human performance problems are when you ask a human to do a task and the person is unsuccessful in accomplishing that task. This definition includes a wide variety of things such as procedure errors, or human factor problems.

Basketball Demonstration

The following is a demonstration we have used in training. The text is taken directly from the lesson plan.

> Have an individual come up to the front and throw two or three paper wads at a wastebasket from about 25 feet away. Have a second person do the same. Discuss why they missed the basket (bad luck, poor shot, pressure to perform). Ask which of the following definitions apply.
>
> The following definitions are from PAP-1608 (the Perry procedure on corrective action):
>
> > Personnel error - A human performance problem that is specific to an individual. The appropriate depth of barriers (procedures, training, supervision, and plant design) are already in place sufficiently to preclude the error from recurring with any other individual.
> >
> > Human performance problem - An undesirable situation caused by the lack of sufficient information for the performer to complete the task or evolution successfully. It is not specific to any individual, because the same insufficient barriers to the error would exist for any other person attempting to complete the task.
>
> It is important to differentiate between these types of problems, as the means to prevent future problems are different depending on the cause of the problem.

Have one of the individuals come up again and say the following:

> If I said you could have a million dollars if you put this paper in the wastebasket, and you only get one try, what would you do?

Try to get the individual to think of some means such as getting closer to the basket, putting the basket against the wall, etc. The object is to congratulate them on doing some creative thinking on the process, e.g. sometimes the procedure writers need to figure out they can get up from their desk and get closer to the wastebasket.

As another example, the instructor should take another paper ball, take a glance at the basket and make a half-hearted throw without really looking at the basket.

> Q: Why did the instructor miss the basket?
> A: Bad attitude.
>
> Q: What is the fix in this case?
> A: Career Counseling.
> Note: This is usually not the case here at the plant. We don't come to work saying to ourselves, "I'm going to make a mistake."

The use of this demonstration is very effective. It helps supervisors to understand their role in worker errors. It helps workers understand the basic problems behind many errors. Sometimes people think that clear communication of management expectations and providing clear work instructions will solve all the problems. In the Basketball Demonstration, neither of these ensure worker success.

Fixing the Root Cause

One of the dramatic improvements that I witnessed was the exponential reduction in procedure errors over a 5 year period at the Davis-Besse Nuclear Power Station. This was the result of three efforts:

- rewrite many of the procedures
- improve the procedure revision process (ease of request and tracking)
- ownership by operators (they began to insist on having accurate procedures)

This was an effective human performance improvement effort. Just telling the operators to be sure they know their systems and to do the right actions would not have produced this improvement. It is important to fix the right cause. Cheerleading has minimal impact. When you tell a worker to watch out for rabbits, he looks for a rabbit, but then when he doesn't see one for a while he will soon forget to watch.

Latent Errors

Often when we think of human performance we tend to think of the sharp end errors of Operations and Maintenance. However, latent errors are installed by engineers and maintenance (contractors). Some training should be focused on certain sections, rather than delivered site-wide. One utility I visited had a peak in their number of corrective action documents issued to engineering which corresponded to their outage. This is to be expected. However, what was of interest to me was that a couple months later they had an additional peak that was three times as high and three times as long. This peak corresponded to the following:

- reorganization of engineering
- relocation from downtown to the site
- first time ever layoff
- largely absent manager who was working on company reorganization

Engineering errors are affected by organizational change and workload. Human performance improvement efforts should not ignore key elements in the plant staff.

Management Philosophy

Organizations often become very focused on deadlines. When management measures only results, not the methods, then errors are encouraged. One manager in a training session with his people said that one thing he had realized from the training is that managers are a lot more responsible for worker error than he had thought. My thought was that this manager had a good start on human performance improvement in his group.

The following are concepts that are key for management:

- People make mistakes, this is to be expected.
- Management is primarily responsible for the majority of workers mistakes.
- Management communication of expectations of efficiency versus safety.
- Management assignment of resources.
- Punishing people for making mistakes is punishment for being human.
- Punishing people does not prevent errors.
- Management is interested in preventing events rather than punishing people.
- Errors are usually the result of common causes rather than special causes.
- Human Performance improvement must be a part of the Business Plan.

Human Performance Day

Many United States utilities have instituted a Human Performance Day. This goes by different names, but is human performance training given to all employees on the same day. Such general training helps set a new environment and terminology. This is an important supplement to individual human performance improvement efforts. Everyone on site is taught on the same day. At the Perry Plant this was about 800 people. Training was about two and a half hours in length and was taught by organizational section, so there were about 35 sessions. Sessions are taught by section personnel who have been trained to present the lesson to their own section. All organizational units are included. Contractors are included.

The instruction is intended to teach concepts. Some plant examples are used, but the intent is to teach a concept rather than just explain an incident. Games are good. Games are very good. They are remembered much longer than just a lecture. Videos are also used. The examples used are not limited to plant operations, but also draw on other industries and everyday human experience.

The handout from our last human performance day is attached for your information. The material is drawn primarily from INPO and James Reason.

Our student questionnaire analysis shows that:

	Results
Principles are important.	heavily skewed agreement
The training is worthwhile.	skewed agreement
The site has implemented these principles.	normal bell curve

This shows that the training concepts were received very well by the workers, and that they feel we have additional work to do in this area in incorporating the principles into daily activities.

Future of Human Performance Day

At the Perry Power Plant our look to the future is to emphasize more detailed training at the section level. Our corrective action program requires quarterly trend analysis by each section. Because most of these problems were caused by human error, the sections are essentially analyzing their human performance improvement needs on a quarterly basis. Our plans are to couple this analysis with human performance training needs.

We have also found that shorter sessions (1-2 hours) are preferable than all day sessions. Our intent is to review and enlarge human performance concepts with management and staff on a regular basis. Training of managers is often done in a 15 minute session added to an established managers meeting. Workers are trained in section meetings. Occasional Human Performance Days may also be utilized to encourage the site-wide environment.

The Perry Plant has also redesigned leadership training for supervisors. This nine day training course now also includes human performance fundamentals.

Conclusion

Human performance training for plant workers has been implemented at the Perry Nuclear Power Plant. It is important that the training effectively teach practical tools that workers can use. The training concepts are drawn from INPO, Reason and Deming. Perry has found that these tools are effective in aiding workers and management to find ways to address human performance issues.

References

1. Out of the Crisis by Edward Deming

2. Human Error by James Reason

PERRY NUCLEAR POWER PLANT

HUMAN PERFORMANCE ENHANCEMENT DAY

AUGUST 28, 1997

I. INTRODUCTION		15 min.
II. TOOL BAG A. Attitudes B. Brain Strain. C. Team Effort		50 min.
III. BREAK		10 min.
IV. APPLICATION WORKSHOP		40 min.
V. PLANT MANAGER (DIRECTORS)		5 min.
	TOTAL	120 min.

Lesson Plan Objectives

1. Provide human performance improvement tools.
2. Prepare for a successful outage.

"TOOLBAG"

Tools for improving human performance:

- Correct Documentation
- Physical and Administrative Barriers (Defenses)
- Pre-Job Briefings (Error-Likely Situations)
- Post-Job Briefings (Continuous Improvement)
- Communication (3-way)
- Teamwork (questioning attitude)
- STAR and Peer-Checking
- Lessons Learned (Operating Experience)
- Continuous Improvement Culture

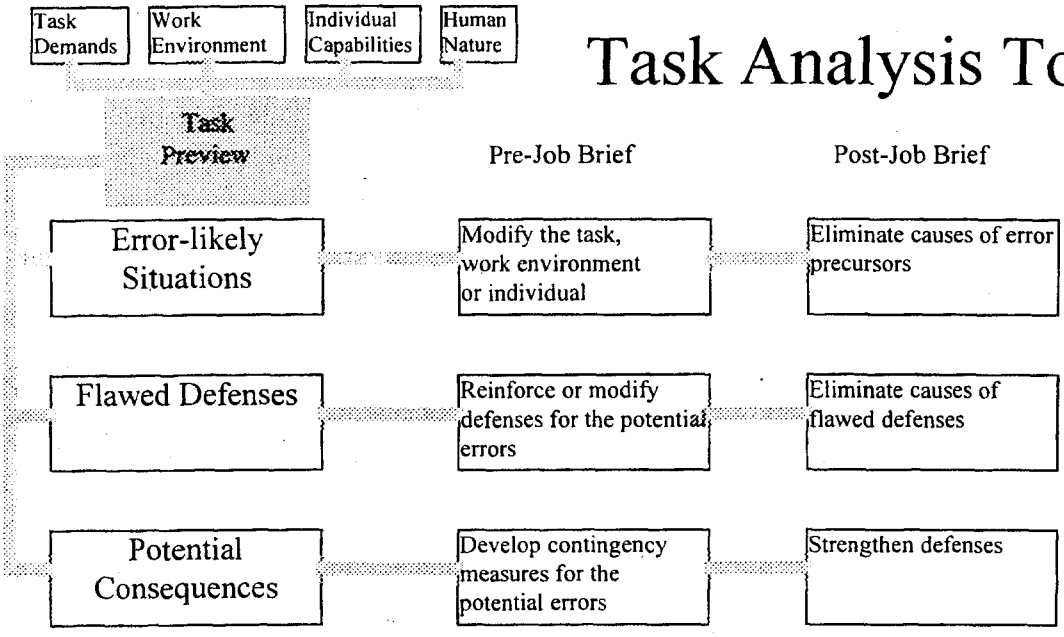
Other ways to "THINK" when using "STAR"

A. Attitudes
1. Remember to be afraid
2. Expectations and violations (shortcuts)

B. Brain Strain.
1. Unfamiliarity - walking the first time
2. Strong but Wrong

C. Team Effort
1. Team player vs. Group think (Can do vs. Can't do)
2. Identify and eliminate error-likely situations

Task Analysis Tool



Common Error Precursors	
Task Demands	**Individual Capabilites**
Time pressures or high workload	Unfamiliarity with task or lack of knowledge
Simultaneous tasks or multiple task assignments	New task or a new technique being used
Unclear expectations or standards of performance	Inexperience or lack of task proficiency
Unclear goals, roles or responsibilities	Fatigue, illness or mental stress
Repetitive or monotonous task	Imprecise communications habits/techniques
Complexity of task or communications	"Can-do" attitude or "not afraid" of failure
Long-term monitoring, delays or idle time	Inappropriate values or ethics
Work Environment	**Human Nature**
Distractions or interruptions	Stress or mental strain - limited short-term memory
Changes or departures from expected routines	Habits - pattern matching bias
Confusing instruction or vague task guidance	Complacency or overconfidence with a task
Unexpected initial equipment/task conditions	Inaccurate risk perception - "not afraid to fail"
Production pressures or conflicting priorities	Mental short-cuts or biases - simplification bias
Work-arounds or hidden system responses	Tunnel vision - overload bias
Back shift or recent shift change	Limited attention span - easily bored
Fear of consequences	Mind-set - assumptions and intentions

"SCRATCH"

- **Summarize** significant task steps to ensure everyone understands the evolution
- **Characterize** the task performance mode (skill-, rule-, or knowledge-based)
- **Review** the Error Precursor factors associated with this task, this performer and the current circumstances (Task Demands, Work Environment, Individual Capabilities and Human Nature) to determine if they are in balance
- **Acknowledge** task assumptions, weak or missing defenses, and any task imbalances
- **Target** the Error-Likely Situation(s) and Flawed Defense(s) and compensate for the potential Consequences of task failure
- **Create** contingency plans for
- **Handling** task hazards

Human Performance Cause Codes 7/1/95-6/30/96

		%
2686	Human Performance	72
1024	Equipment	28
3710	Total PIFs	

Number	Code	Description	%
102	A	Verbal communication	3.8
415	B	Procedure and documents	15.5
14	C	Man-machine interface	0.5
11	D	environment	0.4
3	E	work schedule	0.1
1287	F	work practices	47.9
124	G	planning	4.6
82	H	supervision	3.1
41	I	training	1.5
27	J	change management	1.0
47	K	resource management	1.7
40	L	managerial methods	1.5
96	M	design	3.6
99	N	equip/construction	3.7
50	O	maintenance/testing	1.9
39	P	operation	1.5
10	Q	external hazards	0.4
140	NA	N/A	5.2
59	U	unknown	2.2
2686		TOTAL	100

Work Practices Breakdown (Personnel Error)

%		
45.5	F3	Error detection (STAR)
36.7	F4	Document use practices
5.7	F5	Equipment/material practices

4.2	F6	Worker's preparation
7.9	F7	Other
100		TOTAL

Human Error Types

Error Base	Description	Example
Knowledge	Information deficiency	Unfamiliar with reactor theory
Rule	Experience pattern	All work packages are to be reviewed for confined space hazards
Skill	Performance pattern	Have used torque wrenches more than a 100 times

Error Producing Conditions

Probability

.75	Totally novel task with no clear idea of the likely consequences
.0005	Highly familiar, routine task performed by a well-motivated and competent worker

Factor

17	Unfamiliarity with the task (e.g. driving in a new city)
11	Time shortage
8	Poor human-system interface
8	Information overload
4	Inadequate feedback from system
3	Inexperience (not lack of training)
3	Poor procedure
3	Inadequate checking
1.6	Disturbed sleep patterns
1.2	Hostile environment
1.1	Monotony and boredom

CRITIQUE

1. Course overall rating Very Good Good OK Poor Very Poor

2. Course Comments (content, presentation, time, location)

3. Misc. Comment (Complaint)

4. Human Performance factors are being considered by management in job assignments:

Always Almost always Usually Sometimes Rarely

Comments (particularly if rating is "Usually" or below):

5. Suggestions for Section Process Improvements

SECTION_____