Abstract for HRO International Conference – Break-the-Chain (BTC) Model with HE Machining Event
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Most DOE organizations respond to accident prevention after an event occurs and really focus on the reactive side of events by not responding to front end indicators. The Break-the-Chain (BTC) model is a proactive and essential tool at Pantex for striving toward becoming a High Reliability Organization (HRO)).

An HRO is a low probability/high-risk business that takes a proactive approach to preventing and/or mitigating accidents. An HRO basic premise is that accidents can be prevented by applying the four main principles in managing any high risk operation.

- Manage the system not the parts – understand the system
  - System accident – an accident wherein the system fails allowing threats (human errors, equipment, facility, tooling, mother nature or others) to release the hazard and as a result many people are adversely affected (e.g. workers, enterprise, surrounding community, country, etc.) The focus and key is protecting the plant from the worker.
- Reduce the variability of the process
- Foster a culture of high reliability
- Adapt and learn as an organization

We utilize the BTC Model to incorporate the four HRO practices so that we are able to implement both effective and preventative corrective actions before an incident occurs. Our philosophy is to have “Strong Responses to Weak Signals”. This approach means we look for small near misses or information rich events before they become significant incidents. It also allows us the opportunity to investigate and take strong corrective actions to prevent/mitigate any potential threat which could result in high consequences to our organization. From these principles, logical steps in the BTC framework were developed for the workers. The HRO practices as implemented with the following BTC framework will prevent a system accident.

**Step #1 – Focus on the Consequences:** The first step focuses on the last link of the chain, the consequences of the system accident that the organization is trying to prevent. The catastrophic consequences are listed in priority order.

**Step #2 – Recognize and Minimize Hazard:** Identify and minimize the physical hazard, while maintaining production. Actions are taken to reduce the physical hazard and attempts are made to reduce the interactive complexity and tight coupling. The intent is to remove or reduce the hazard so that the consequences of an accident are minimized.

**Step #3- Recognize Threat Posed by Human Error, Equipment/Tooling/Facilities, Mother Nature, and Other:** Encouraging the organization to think about the potential Human Errors Precursors, Equipment/Tooling/Facilities, Natural Disasters, and Other threats that could indicate problems to the hazard. By recognizing the threats interacting with the hazard, we are positioned better to manage the defenses to reduce the number of error-likely situations.

**Step #4 – Manage Defenses:** The second part of the HPI portion of the BTC Framework focuses on ensuring that the defense barriers are adequate to prevent or mitigate the
consequences of a system accident. The type and number of barriers and the level of effort needed to protect them are dictated by level of consequence and type of hazard associated with the operation.

**Step #5 – Foster a Culture of Reliability:** Steps 1 through 4 require trained and experienced personnel who conscientiously follow the established safety practices by maintaining their proficiency through continuous hands-on work, by being trained so they can make decisions on the shop floor that will reflect our shared HRO values, and by having the authority to make time-critical decisions.

**Step #6 – Learn from Small Errors to Prevent Big Ones:** Gaps between work-as-imagined by the manager and work-as-done by the employee exist in every operation. The fact that these gaps exist is not the concern. The problem occurs when the organization is unaware of the gaps or does not know the magnitude or extent of the gaps across the operation. To remedy this, Pantex places emphasis on evaluating and closing the gap.

The BTC model was used in a High Explosive Machining Operation that occurred at Pantex. A high explosive part was machined incorrectly. This caused the explosive part to break free from the vacuum holding fixture stopping the machine and ultimately falling approximately 12 inches into an adiprene-padded catch pan. Fortunately, these two layers of defense worked, preventing a detonation. Instead of blaming and/or punishing the technicians, we evaluated the “system” and made significant changes in the following areas:

- Engineered Controls
- Configuration Controls
- Conduct of Operations
- Change Control
- Simulation of abnormal events

Managing the “system” and not the parts allowed us to discover latent organizational weaknesses throughout the process and make effective changes to the process.

B&W Pantex has begun this journey of becoming an HRO and has had some notable successes thus we are beginning to reap the benefits of applying the HRO principles through the Causal Factors Analysis Processes, Break-The-Chain Model and new and improved Barrier Analysis Process Mapping. We understand that it is not just a journey but a way of doing business. Therefore we would like the opportunity to share our story and successes with the leaders of your organization. We believe that being an HRO is not only the right thing from a safety point of view and a good sound business practice but that it will be the key discriminator in the deciding who wins the right to operate the NNSA sites in the future.