Behavioral Interventions at DOE Sites in 2004

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1.0 Overview of Workplace Safety Interventions

A. Safety and Health Interventions and safety culture

Safety is a line management function and an integral part of doing business. Safety should be seen as a core value not a priority, because whereas priorities change, values remain relatively constant. Ultimately, line management is responsible for the safety of the workers. Safety culture and management accountability go beyond traditional safety and health management.

Traditional safety and health management systems rely on informal feedback, on compliance with safety procedures, safety audits, safety awards, safety meetings, management support, hiring practices, rewards, training, employee participation training and special activities (posters, etc).

Excellence (or substantial progress in safety and health performance) requires more. It requires deliberate safety and health intervention beyond an effective safety and health management system and effective engineering controls. This includes the incorporation of a safety culture and the maintenance of a behavioral process. Safety culture, a part of the overall corporate culture, is an attitude and effort by which all organizational members direct their actions toward improving safety. Elements of a strong safety culture include the optimization of the surroundings/environment, people and behavior. Employees' perceptions of management's attitudes and behaviors toward safety, production and issues, such as planning, etc. are one of the most useful measurements of an organization's safety culture.

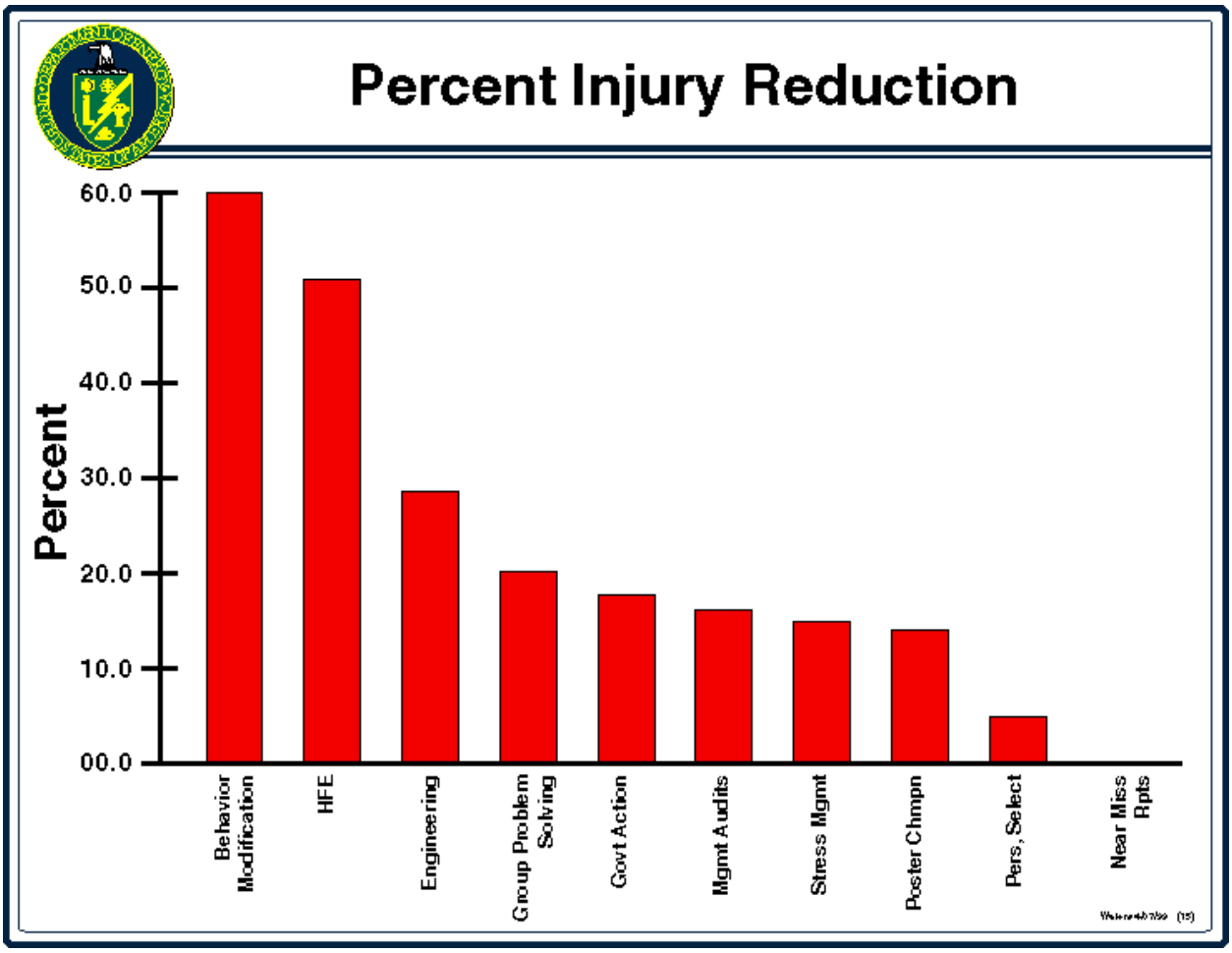
Those recognized as having both an excellent safety culture and safety performance are certified in the OSHA and DOE Voluntary Protection Programs (VPP). This certification highlights those worksites that have achieved and are maintaining excellence in worker safety and health protection through cooperation among government, industry and labor. A site that applies for participation in the VPP must submit a written application that addresses the major elements of the program: management leadership, employee involvement; worksite analysis; hazard prevention and control; and safety and health training. An onsite review by DOE or OSHA officials to evaluate the workplace safety and health program and to interview employees at the facility is the final stage of the application process.

B. Behavioral Programs

Behavior modification is a very effective intervention technique (See figure). Developed in the late 1970s, behavioral safety has had an impressive record. Research has shown that as safe behaviors increase, safety incidents decrease. Behavior-Based Safety (BBS) and it's measurement of percent Safe Behaviors is a leading safety indicator.

BBS concentrates on the at-risk behaviors and not at-risk conditions. At-risk behavior is usually a result of poor communication, imperfect memories, no supervision, peer pressure, bad habit,

inadequate training, time/pressure, etc. It depends on identification of critical behaviors, routine observation of those behaviors, review of those behaviors and feedback to those observed.



Effectiveness of various safety and health interventions
(Derived from Guastello, 1993, HFE= Human Factors Engineering)

Elements of BBS processes include training, specifying critical behaviors and goals, conducting observations, providing feedback and analyzing data (from which to modify the environment, equipment or systems) and monitoring the performance. BBS does not work when there is: distrust between management and workers; management abandonment of it responsibilities for safety; a perception by employees of increased employee accountability; and adversarial employee-management relationships.

C. Benefits of Behavioral Programs

1. BBS and its measurement of percent Safe Behaviors is an upstream (leading) indicator of safety. Most safety measures are downstream (lagging) measures that are recorded after the incident. Although no formal studies have been done, there is anecdotal evidence of per cent Safe Behaviors as being predictive. For example, Dupont felt that a change in the Safe Acts

Index (%Safe Behaviors) was a three week predictor of an accident. This means that using the observation techniques of BBS, the changes in the measurement may be used to predict that safety problems may be growing in your facility and that action (often by intensifying BBS activity of observation and feedback) can be taken to stop the incident from occurring.

2. BBS gets workers involved. The atmosphere of trust that results from the non-punitive observation and feedback process leads to more worker involvement. Workers start asking to be observed and use the feedback given to modify their activity to make it safer. The rapport that slowly develops between the observers and the workers being observed leads to a more open workplace. This has the consequence of frequently leading to more reported minor incidents, but the more serious incidents invariably decline.

3. BBS is good business. The direct and indirect costs associated with investigation and follow-up of incidents, accidents, and injuries far outweigh the cost of implementing an effective safety program with a focus on employee involvement. BBS saves money.

2.0 DOE EXPERIENCES

A. GENERAL

From 1990 to present, 14 DOE sites have implemented a BBS process and several sites have shared their successful results (lower TRC, high Return On Investment, Cost Index reductions, etc.). A DOE BBS Topical Committee was formed in 1997 as a resource to encourage BBS growth within DOE.

The core philosophies of a behavioral approach, such as BBS, are complementary to many of the existing programs within the DOE. As an example, BBS supports VPP and ISM by giving an avenue for employee involvement and a systematic approach to identify and correct behaviors / conditions that lead to employee injuries. BBS also applies to a broad range of safety areas. BBS can be promoted on the production floor and in the office environment and can address DOE systems, identify barriers and is applicable to off-the-job activities as well.

1) Management Commitment

Leadership must be active, visible and genuine in its commitment to injury and illness prevention. It is helpful for senior management to articulate a clear and inspiring vision that continuous improvement towards an injury-free performance is the only acceptable goal. The organization must also view safety as a line management responsibility rather than the job of the safety manager or committee. Ideally, the Department head should include safety as a core organizational value equal to research, operations, productivity and quality. Top levels of management must participate actively to ensure BBS reaches its full potential.

2) ISM and BBS

In order for BBS to be effective, a safety management system, such as the DOE Integrated Safety Management System, needs to be in place. This includes minimum compliance, accident investigation, self-assessments, safety and health training program and recordkeeping systems, etc. More advanced systems enhancements in BBS like observation, coaching, safety involvement teams, job safety analysis, accountability, safety by objectives, etc. all rely on the basic safety and health management system being in place.

3) Culture and BBS

Employee empowerment and involvement enhance safety innovation, ownership and results. Labor/management cooperation serves as a catalyst for success. Without employee participation and involvement, behavior-based systems rarely get off the ground. Another critical facet of involvement is buy-in. Behavioral systems are much more effective in organizations who work hard at winning buy-in from the line to the executive office before they are introduced.

A positive social climate of trust, openness, respect for individuals, positive reinforcement, etc. is an intangible benefit of organizational life that dramatically affects worker performance. With a more negative organizational style, involvement is low, complaining replaces problem solving and coaching seems like scolding. In companies low on trust, behavior-based safety is resisted because it symbolizes another way to oppress the worker.

4) VPP Certification and BBS

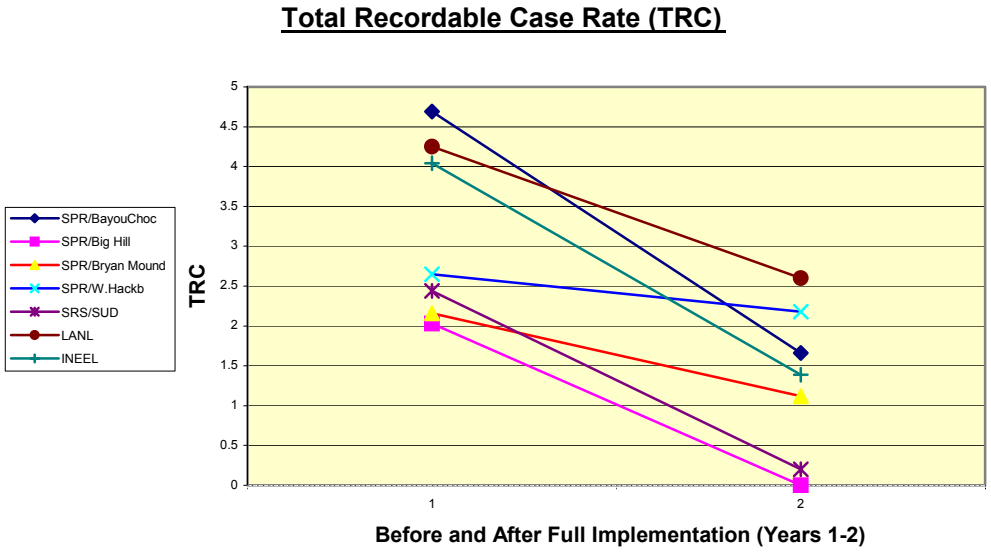
BBS can be an important tool to establish and increase worker involvement and overall communication. It is one of the most useful tools for employee involvement and contributes greatly to the continuous safety improvement process. Many STAR sites within DOE's and OSHA's VPP began their effort by using a BBS program.

5) Performance metrics and accountability

Clearly defined responsibilities at every level of the organization are key for top performance. The process or activities that create a safe work environment are far more important than injury rates when trying to create a safety culture.

6) BBS Benefits at DOE

BBS is a tool that when used in the context of the DOE's Integrated Safety Management System impacts injury rates and total reportable cases. The DOE experience shows that this occurs with consistency as shown in the following figure, which shows reductions in the Total Recordable Case (TRC) rate from seven different sites using Behavior Based Safety Management. In each of the cases, the TRC was lower following BBS implementation.



B. SITE EXPERIENCES (See Appendix C for Acronym List)

Advanced Photon Source at ANL (East) (as of 2003)

History

The Advanced Photon Source (APS) facility at Argonne National Laboratory (ANL) outside Chicago Illinois is a synchrotron light source funded by the U.S. Department of Energy, (DOE) Energy Research Division and Office of Basic Energy Sciences. APS is a national user facility serving the international x-ray research community from industry, universities, medical schools, federal and international research laboratories. The APS is a source of high-brilliance x-ray beams for basic and applied research in: materials science, biology, medicine, chemistry, physics, & geosciences. APS has a staff of nearly 500 scientists, engineers, technicians and support personnel and hosts over 1500 visiting experimenters annually.

The APS proposed in 1997 to augment the Argonne safety program with a BBS system tailored specifically to the needs of the APS and its staff. Throughout 1997 APS researched existing commercially available BBS systems finally selecting a program based on supervisor observations.

The program was initially integrated into one of the major divisions of APS in 1998.
As a result of this preliminary implementation, APS began receiving safety feedback on at-risk behaviors, conditions, inadequate procedures, as well as noteworthy practices and exemplary behavior and processes. This influx of information led to the creation of a web based corrective action tracking system (named COATS) to track the progress of identified deficiencies through any final remedial action. This system was open to all employees.

The APS safety program at that point consisted of the well defined ANL safety program of policies and procedures and its associated infrastructure of programs, training and subject matter

experts, and the APS supervisor behavioral observation process and a corrective action tracking system. Although APS was identifying at-risk behavior and conditions, several integral components of a holistic safety system were missing. Initial feedback concerning this deficiency was voiced during follow-up BBS training. First line supervisors and foreman felt ill prepared to manage safety. They felt that the BBS training while instructing them on observational skills did not address their need for clarification of their safety role as supervisors.

From this feedback APS created the third and fourth facets of their BBS system. These were: First Line Supervisor Safety Training and the Employee Safety Envelope. These systems were created to clarify what was expected of a group leader, supervisor, foreman and general employee in managing safety and performing work in a safe manner.

The technicians at APS who are charged with installing and maintaining the accelerator systems envisioned the fifth and final facet of the APS BBS program. The technicians proposed a complete facility hazard analysis. (Not to be confused with a safety assessment document or SAD) This final process required over 500 man hours to complete and resulted in a web based library of the equipment, systems and associated safety documentation required to operate and maintain the accelerator systems at APS.

The BBS system at APS is called: Safety Management Reporting Tool or S.M.A.R.T.

SMART was built on a behavioral observation process. When properly administered and maintained, these processes create feedback that must be addressed. In fact BBS systems are driven by feedback. A BBS system integrates safety into the way work is conceived, performed and evaluated.

Present Implementation

Walkthroughs and talks with technicians reinforce commitment to the process.

Success Indicators

Though APS is 25% of ANL population and 33% of square footage, they had only 22 findings in a summer 2003 OSHA oversight inspection. This compares to over 1000 findings for the ANL as a whole.

LANL (as of 2002)

History

Behavior Based Safety (BBS) at the Los Alamos National Laboratory began in August 1996 with an introduction to BBS by Chemical Sciences and Technology (CST) Division Director Alex Gancarz. CST Division contracted Behavioral Science Technology, Inc. (BST®) to provide an overview to the Chemistry Metallurgy Research (CMR) facilities Safety Committee later that

month. An assessment was performed by BST® in October of 1996 and the BOMBS (Behavioral Observations Mean Better Safety) squad was formed and began training in behavioral safety.

In February 1997 the BOMBS Critical Behaviors Inventory (CBI®) was formed and in March 1997 formal behavioral observations began. Over the next two years the BOMBS squad trained 159 observers and made 987 behavioral observations. The overall % safe behaviors for all residents increased from 87% in CY-97 to 91% in CY-98.

In January 1998 Nuclear Materials and Technology Division (NMTD) began the integration of the CMR facility from CST Division. In January 1999 the NMTD Director, Bruce Mathews, contracted Behavior Science Technology, Inc. (known as BST®) to perform an assessment of the safety culture for NMTD Technical Area 55 (TA-55) facility. The decision was made to implement a division wide process. An Implementation Design Team (IDT) was formed for the purpose of identifying the unique challenges faced in integrating the efforts of the CMR facility and TA-55 facility and charting a path forward. The IDT included managers and employees from both facilities as well as steering committee members from the BOMBS squad. The IDT, working with BST® consultants, planned for an implementation that would serve a division of approximately 1000 employees.

In October 1999 NMTD again contracted BST® to provide consultation for the division wide implementation of BBS. The current NMTD Director, Tim George, serves as the management sponsor for the expanded process known as the ATOMICS. (Allowing Timely Observations Measures Increased Commitment to Safety) The ATOMICS were formed in December 1999. The ATOMICS process chose to review the successes of the BOMBS and build a process using the lessons learned. The ATOMICS steering team began formal observations in January 2000 and began observer training in August 2000.

Present Implementation

LANL's Nuclear Materials and Technology Division's ATOMICS program (Allowing Timely Observations Measures Increased Commitment to Safety) was developed to sustain ISM through a worker-based safety system by using the BST® Behavioral Accident Prevention process®. All NMTD employees are involved. Management encourages observations as part of the daily work routine, as well as attends additional training on how to utilize the data.

Success Indicators

Another major success of the ATOMICS program at this stage is the fact that 200 employee observers have made behavior-based observations of over 1,250 individuals who were given positive feedback on the safe behaviors demonstrated. At this writing, roughly 2,600 individuals have made the choice to participate in an informal one-on-one discussion of safety as it relates to their work.

The NMTD Total Recordable Case Rate (TRC) began at 4.25 worked in March of 2000 and has dropped to a TRC of 2.60 in February of 2001. In one year's time the TRC has shown a significant 38% drop. This downward trend includes an approximate10 percent drop in man-

hours worked. In the same period, the Lost Workday Cases (LWC) rate has dropped from 3.57 to 0.76.

OAK RIDGE Y-12

History

Since being awarded the contract to operate the Y-12 National Security Complex in Oak Ridge, Tennessee in November 2000, BWXT - Y12 has demonstrated a commitment to safety. The lost-workday case rate is as low as it has been in 10 years. Even with these improved statistics, more than 100 people were injured last year. Based upon experience, the BWXT - Y12 management team feels that the Behavior-Based Safety is a process that can make Y-12 a safer place to work.

Present Implementation

From observations, individuals serving on subcommittees will be taught to use data sheets to observe behaviors and provide feedback. Items such as body positions (e.g., line of fire, pinch points, eyes on path); body use/ergonomics (e.g., lifting, twisting, overextended/cramped); tools/equipment (e.g., use, vehicle selection/condition/use); procedures (e.g., lockout/tagout, hot work); personal protective equipment (e.g., head, eyes and face, hearing); work environment (e.g., walking/working surface, housekeeping); chemicals/materials (e.g., mixing chemicals); and any other safety-related observations will be studied.

For this process, BWXT - Y12 has been grouped into 16 areas. Each area has a steering committee to assist with the implementation of the process. Steering committees are engaged with developing their groups' Critical Behavior Inventory, writing clear and concise definitions, planning their presentations for the ownership meetings or in some organizations the committee members are actually conducting these meetings.

There are four groups of BBS InCons (Internal Consultants), each consisting of a salaried and union representative, that are teaching observer/feedback fundamentals. Each of these groups met with the site's 16 steering committees in two-day training sessions to teach individuals from these committees how to extract behaviors from data sheets, build critical behavior inventories, and observe behaviors in the workplace. Every BWXT Y-12 employee is represented by a steering committee. The steering committees returned to their workgroups and began training their peers. This will continue until the entire Y-12 population is trained in BBS. No name, no blame is the theme for BBS at Y-12. Eventually everyone will be observing each other in our own work environments, looking for barriers to safety without blame.

The Y-12 behavior-based safety process has been named BEST, an acronym better suited to reflect the message we hope will prevail…Building Everyone Safe Tomorrows. Since February 2004, 450 observers have been trained. To date, over 2200 observations have been conducted across the site. In doing those observations, over 13,000 safe behaviors have been identified. These observations show we're working safely about 89% of the time. The value of these

observations is that two employees got together to have a conversation about safety, reinforcing safe behaviors and discussing how to eliminate any at-risk behaviors through a meaningful discussion about barrier removal.

Success Indicators

Full implementation is some months away.

SRS

History

Behavior Based Safety (BBS) was originally implemented in the Site Utilities Department (SUD) at Westinghouse Savannah River Company (WSRC) in early 1994. The department purchased consultation support from Behavioral Science Technology, Inc.

The process remains strong within the SUD as indicated by over 12,000 observations and the positive trend of leading indicators to injuries, such as number of observers trained, observation contract rate, and action plans implemented.

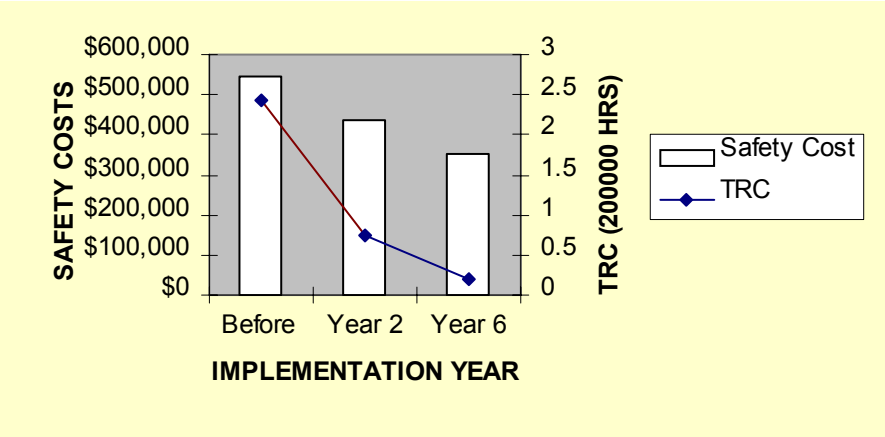
In 1999, the WSRC Management Council approved the formation of a Site Safety Steering Committee (S3C) to guide the site in the implementation of behavior-based safety at Savannah River Site. The committee developed a strategic plan and is working on key issues to ensure effective implementation.

The site Occupational Safety and Health Technology Department (OSHT), in concert with BNFL-Solid Waste Division, who have had prior experience implementing BBS in the United Kingdom, developed workshop modules for Managers, Teams, and Observers.

Present Implementation

To date, over 4,000 WSRC employees have become trained BBS observers. The site now has 34 Local Safety Improvement Teams (LSITs) and preformed over 15, 000 observations during 2003.

Success Indicators



SRS (Site Utility Dept) COSTS & TRC

SRS/SUD shows a significant decrease in TRC while at the same time, reduced costs for safety. These safety costs include safety program costs, such as meetings, audits and awareness programs; incident investigation costs; and BBS associated costs, such as meetings, observer training, and administrative oversight. Some of the categories considered in costing include: Safety meetings; awareness programs; Safety Observer Audits/Safety stand-down; accident investigation; division safety committee; and workers' compensation costs.

INEEL

History

In the early 1990s, several organizations at the Idaho National Engineering and Environmental Laboratory (INEEL) were incorporating the "safety excellence criteria" presented by safety pioneer Dan Petersen. Petersen identified behavioral-based observations as a critical element of any successful safety program. In response, several safety professionals at the INEEL began to benchmark the implementation of behavioral-based safety (BBS) at various companies. A conclusion of the investigation was that BBS was fairly new in general industry and particularly unknown among the contractors of the Department of Energy (DOE). One of the primary literature resources on BBS at that time was a book by Dr. Thomas Krause, "The Behavior-Based Safety Process." The book contains the basic elements of a BBS process and was used as the basis for the INEEL's development of its own pilot process of BBS, the Employee Safety Assurance Process (ESAP). The Transportation Complex-Fleet Management was selected for the pilot process because of the organization's management and employee support for BBS. The pilot process functioned successfully for approximately one year.

In 1993, the INEEL expanded its safety program to include the Total Safety Culture (TSC) as espoused by Dr. E. Scott Geller. The INEEL quickly incorporated the cultural philosophy of "actively caring" and the precept that safety must be a value and not a priority. To enhance its safety culture, the INEEL entered into an agreement with Dr. Geller for implementation of his TSC methodology.

One of the first changes at the INEEL based on Dr. Geller's recommendations was the successful completion of the "basic implementation steps" of TSC:

- Achieve management consensus to implement the TSC
- Organize a volunteer facilitator group
- Develop a written plan
- Conduct a facilitator "train-the-trainer" workshop
- Develop all-employee awareness training
- Assign facilitators and instruct them to conduct TSC area workshops
- Instruct the facilitators to interface with work groups to implement safety principles, interventions, and "DO ITs" (Define, Observe, Intervene, and Test).

In 1994, the INEEL hosted in Idaho Falls a one-day roundtable workshop on BBS. Participants included a broad spectrum of INEEL management and employees and numerous representatives from across the DOE complex. Later that year, the INEEL presented "Developing a Total Safety Culture" at the first DOE Headquarters workshop on behavioral-based safety held in Washington, D.C. During the next three years, Dr. Geller presented several BBS seminars for management at the INEEL on BBS. In tandem, personnel assigned as facilitators were able to present a half-day workshop on TSC to approximately 5,000 INEEL employees.

Present Implementation

The philosophy and principles of the TSC have carried through over the years and through changes in mission and leadership at the INEEL. In 1999, a group of INEEL union employees decided to organize a formal observation and feedback process. These workers applying the TSC organized the Worker Applied Safety Program (WASP) to encourage workers to observe at-risk behaviors so that work conditions can be improved on a continual basis. Today, the program remains a key BBS process at the INEEL and now relies on an in house WASP database to track and trend observation data. The WASP committee administers the program and has developed several avenues through WASP to promote the TSC at the INEEL:

- Employee awareness overviews
- Review of injury and illness data and identifying target behaviors
- Development of companywide observation checklists
- Maintaining a database to collect information from observations and prepare reports
- Maintaining an intranet WASP homepage (at http://home.inel.gov/safety-health/vpp/wasp/mainpage.htm)
- Promoting employee recognition for participating in WASP
- Conducting annual training retreats
- Conducting monthly committee meetings with minutes.

Since the beginning of WASP through 2002, the WASP committee developed several standard companywide observation checklists to encourage all employees to observe at-risk behaviors:

- Computer workstation

- Slips and falls
- Sprains and strains
- Lifting
- Ergonomics
- General purpose.

During the past year, the WASP committee heightened its focus on worker protection through creating several job- or task-specific checklists to target specific worker populations as well as other checklists to address specific at-risk behaviors (see Figure 1):

- Welding
- Pipe fitters
- Painters
- Carpenters
- Laboratory observations
- Vehicle safety
- Surge protectors and extension cords
- Error precursors.

The WASP database compiles worker observation data. This information can show in various report formats, for example, at-risk behaviors at a facility such as over a specific time period, the number of employees at-risk, or the specific types of risk behaviors observed:

- Percent-safe bar chart (see example of a monthly percent-safe bar chart for the INEEL Central Facilities Area in Figure 2)

- Facility at-risk summary (see example for the Central Facilities Area in Figure 3)

- Summary of observed-behavior comments (see example for the Central Facilities Area in Figure 4).

Success Indicators

The impact of employee involvement in safety, including behavioral-based safety, is monitored systematically at the INEEL. As shown in Figure 5, the number of recordable injuries has declined by a factor of nearly three from the rate in 1995. In addition to WASP, the methods responsible for the success include the Integrated Safety Management System, the Voluntary Protection Program, the International Organization for Standardization (ISO) 14000 certification, and implementation of human performance principles and techniques. The degree of employee involvement in safety is reflected in the number of WASP observation checklists for the calendar year 2003: 5,990 from a workforce of 5,055 employees.

Even though the INEEL collects and analyzes observation data, we must continually remind ourselves of the primary purpose of conducting worker observations:

- To promote employee-to-employee feedback, constructive or corrective.

The importance of worker involvement in safety is expressed succinctly in the INEEL's personal safety value statement, which applies to every employee:

"I will actively care for my safety and the safety of others."

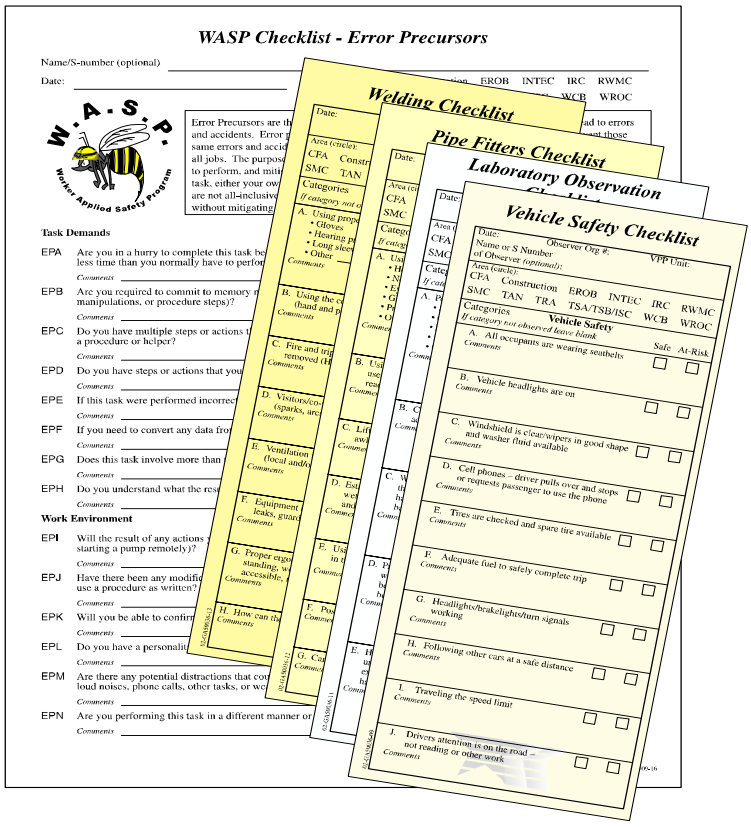


Figure 1. Examples of Worker Applied Safety Program checklists developed in 2003.

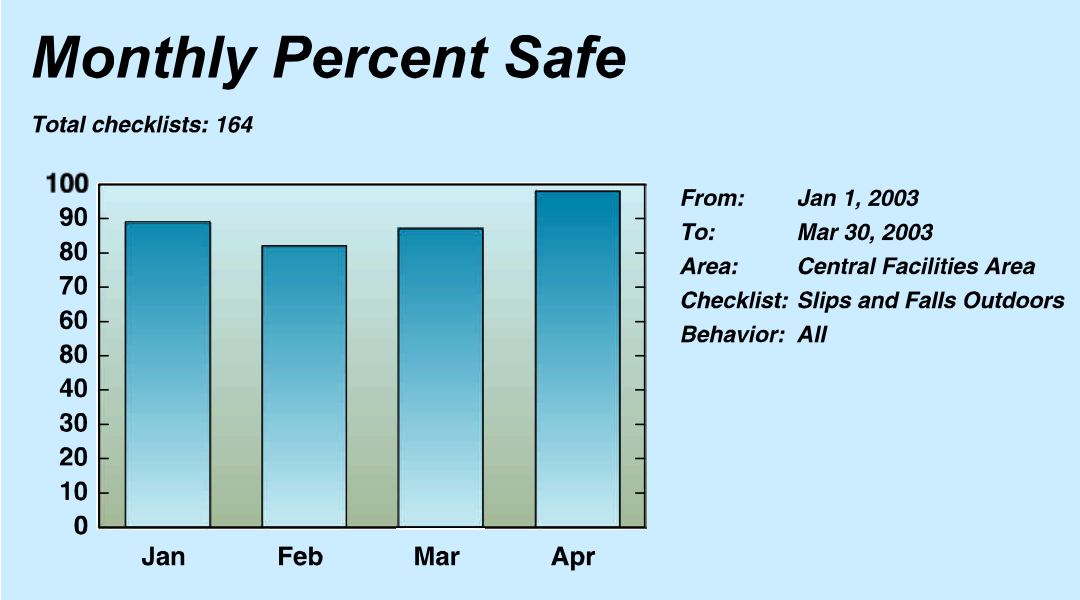


Figure 2. Example of a percent-safe bar chart for slips and falls at a facility

At-Risk Summary

Central Facilities Area
Slips and Falls Outdoors

Description	*Total at-risk Employees*
Walking with proper balance when carrying objects	*37*
Uses crosswalk and sidewalks	*32*
Proper footwear	*29*
Uses clear and appropriate parking areas	*25*
Pathway free of obstruction and hazard	*25*
Walking at appropriate speed	*23*
Unobstructed view of pathway	*23*
Uses well illuminated pathways	*8*

Figure 3. Example of an at-risk summary report for slips and falls at a facility.

Comments by Area and Month

Area: **Central Facilities Area** Observation Checklist: **Slips and Falls Outdoors**

Date	Description	Value	Comments
February			
02/01	Walking with proper balance when carrying objects	At-risk	Hands in pockets
02/01	Walking with proper balance when carrying objects	At-risk	Arms loaded
02/01	Uses crosswalk and sidewalks	At-risk	Feedback on crosswalk usage
02/06	Uses crosswalk and sidewalks	At-risk	Not using the crosswalk
02/07	Uses crosswalk and sidewalks	At-risk	Not using sidewalk
02/08	Uses clear and appropriate parking areas	At-risk	Bus
02/12	Proper footwear	At-risk	Getting new shoes
02/12	Uses crosswalk and sidewalks	At-risk	Snow covered
02/14	Uses clear and appropriate parking areas	At-risk	Parking lot snow covered
02/14	Walking with proper balance when carrying objects	At-risk	Gave feedback
02/14	Uses clear and appropriate parking areas	At-risk	It was snowing
02/19	Uses well illuminated pathways	At-risk	Lights not working
02/19	Walking with proper balance when carrying objects	At-risk	Hands in pockets
02/19	Walking with proper balance when carrying objects	At-risk	No gloves
02/21	Walking at appropriate speed	At-risk	Running
02/26	Pathway free of obstruction and hazard	At-risk	Ice & snow
02/28	Uses crosswalk and sidewalks	At-risk	Running down road

Figure 4. Example of a summary report of observed-behavior comments for slips and falls at a facility.

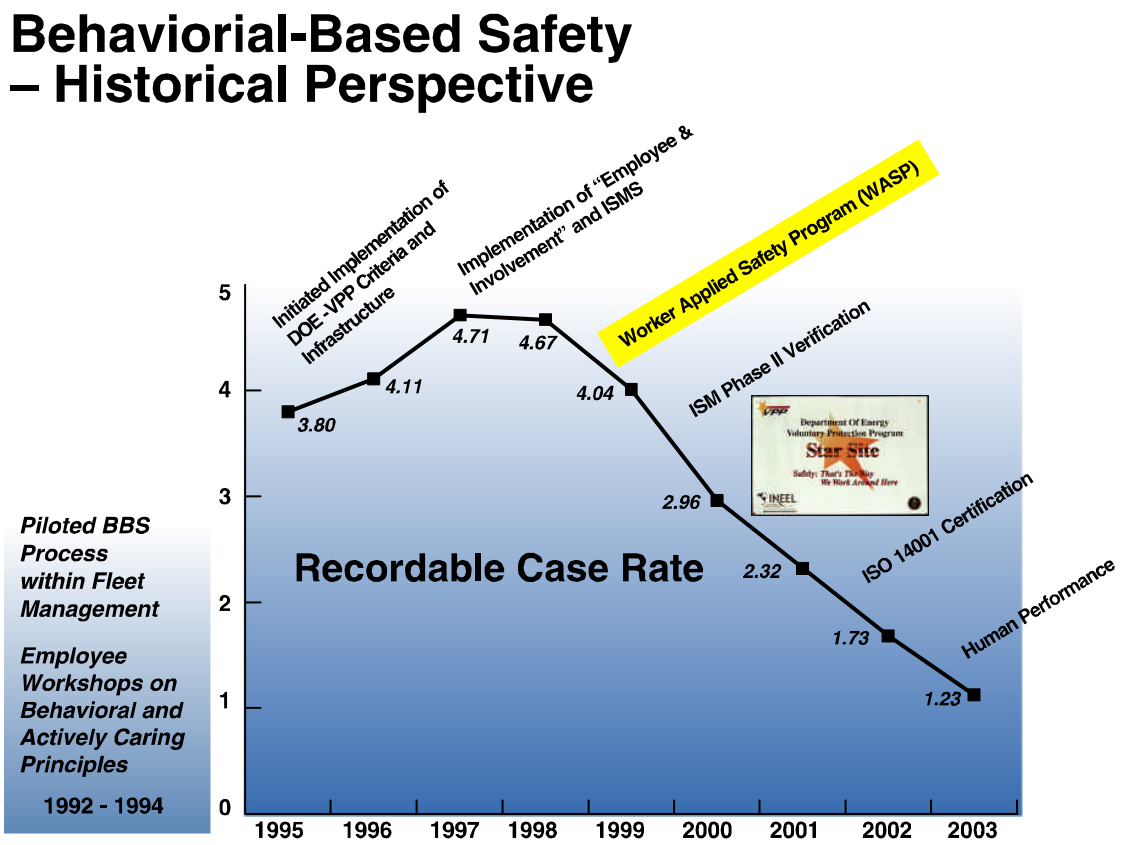


Figure 5. Line graph showing the decline of the recordable case rate from 1997 to 2003 at the Idaho National Engineering and Environmental Laboratory.

SPR

History

The road began in 1994 after a series of near misses. Rather than reinventing the wheel, Dyn McDermott (DM) uses the model developed by Behavioral Science Technology, Inc. (BST®) to gather behavioral risk data (at the employee level) and to provide employee feedback, which in turn allows continuous reduction of risk. The use of in-house licensed consultants resulted in a 53% cost reduction. The first joint facilitators meeting and user conference took place in 1996 after a full year of observations. Since that time, this behavioral approach evolved into other areas, (such as environmental pollution and waste reduction behaviors), as workforce and tasks changed.

Present Implementation

Because different processes, systems, and workers characterize each DynMcDermott (DM) site, each one having a unique set of issues contributing to its safety culture, identifying the right issues is essential to successfully tracking and documenting efforts to manage safety-related behavior. Because of this, DynMcDermott's Behavioral Safety Steering Committees (one for

each site) have written site-specific safety definitions that were derived from a number of actual incidents/accidents that occurred within the areas respectively. Additionally, Steering Committees are provided with training and oversight by New Orleans Safety through internal consultants, sponsored by site managers, and advised by key site personnel such as from ES&H. The committees are responsible for using the data gathered to continuously reduce at-risk behaviors, and for conducting those activities necessary to administer the process, including:

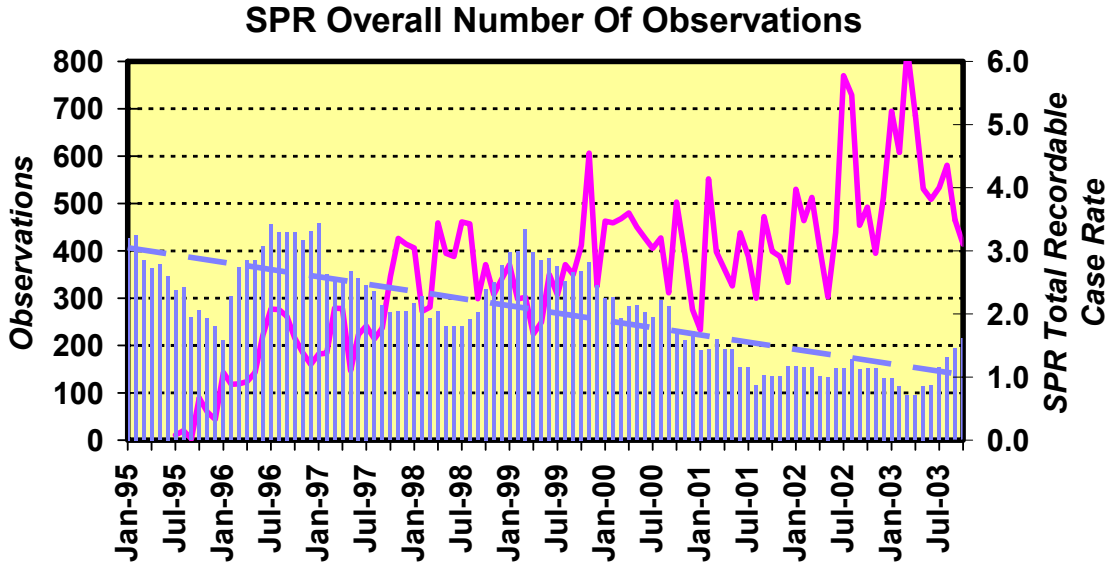
- regular meetings
- ongoing observations, and
- coaching of observers.

Progress is reported at the monthly Site Safety Council meetings. The growth of the process is shown by the contact rate, which is once again on the upswing thanks to the efforts of the newly trained committee members and Observers. In addition to reducing the risk of injury, the Employee Behavioral Safety Process is the employee participation portion of the DOE Integrated Safety Management Program, the new DM Ergonomics Program, and satisfies several OSHA requirements for documented employee involvement. This is good business because it saves DM from having to establish separate committees and teams for each of these requirements.

In 2002, DM began designing an upgrade to their Behavioral Process to take advantage of process methodology improvements made over the years and to create a barrier removal team, (Resource Team). This team analyzes Site data, on a quarterly basis and supports the sites with enhanced analysis and by identifying systemic barriers, beyond Site control. The resource team then presents this analysis to DM Senior Staff for possible resolution. Other changes were made, as well. Over the years through continuous improvement, the behaviors being observed at each site began to look very similar. The Resource Team worked with Site representatives to develop a unified Critical Behavior Index (CBI®) to be used by all sites and entered into a newly developed database. This allowed for greater Site trending and comparison to help identify cultural differences that may allow some safe behaviors to be less enabled. This upgrade is being rolled out in January 2003. The data analysis being done by the resource team allows the site committees to focus more time on process issues, such as Observer calibration and coaching.

Success Indicators

Savings were realized in reduced workers compensation costs. The Total Recordable Case Rate has also declined. See the following chart.



LBNL

History

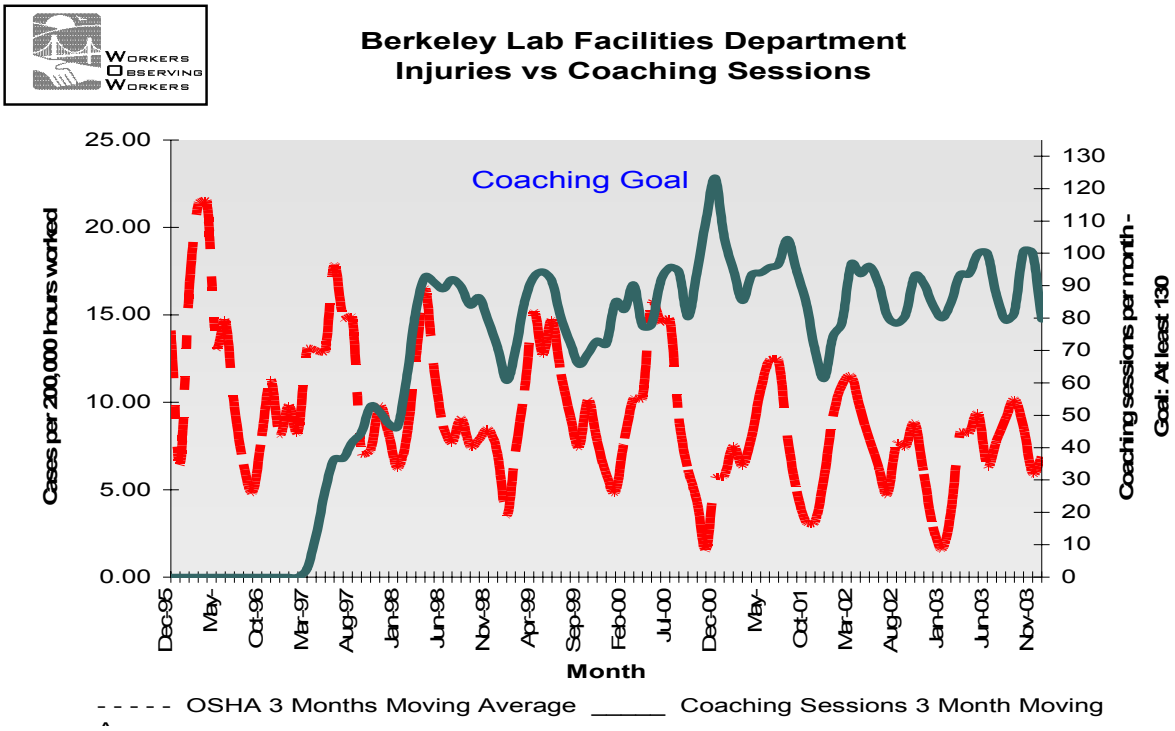
Safety remains one of the most prominent core values for the Facilities Division at Berkeley Lab. The creation and maintenance of a safe working environment for Facilities staff, contractors and the Laboratory community continue to be of utmost importance. The desire to get people to think about safety, or think about themselves in relation to safe work activities, was the impetus in the creation and implementation of a Behavior-Based Accident Prevention Program (BBAP). Facilities' BBAP, known as Workers Observing Workers (WOW), was launched in February 1997. Management support and employee involvement have been instrumental in sustaining this program into its eighth year.

The goal of WOW is to reduce accidents and injuries through peer observation and positive feedback, creating a work culture committed to an accident-free workplace. Every month, each employee is observed on the job for 15 to 20 minutes by another employee, or "coach," who has already been observed and trained in proper safety behavior. The employee (who is not identified by name) receives a score and constructive feedback from the coach. The score goes toward a group score for an entire craft or discipline. The goal is to chart and see safety improvement from month to month.

Present Implementation

WOW has expanded to include more management participation, a strategy of continuous improvement to fully engage all Facilities staff in an expanded safety effort and ensure that managers share equally with staff in the success and advancement of the WOW program. Supervisors and line managers are being trained and will participate in the worker observations as peers.

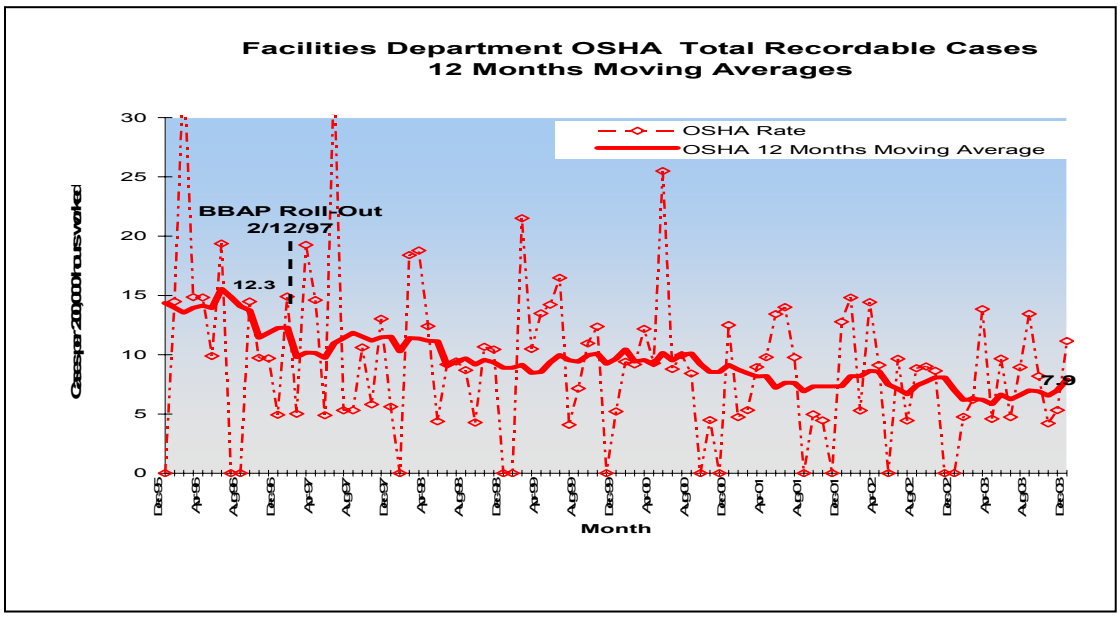
There is a distinct injury rate pattern that can be observed graphically. As the number of observations increase, the frequency of DOE-recordable cases declined over that observation period. The opposite pattern also occurred; when the number of observations declined, DOE-recordable cases began to rise. The lessons learned here is that engaging employees through behavioral safety observations must be sustained at an established interval and frequency to achieve a downward trend in DOE-recordable cases. The graph below illustrates the variability of employee injury cases when observation frequency fluctuates.



In 2002, a pilot project, known as the Office Behavior-Based Accident Prevention Program (OBAP), has also been developed for the office computing environment, with a special emphasis on ergonomics. It is being tested in the Computing Science Directorate.

Success Indicators

Since the inception of the WOW program, there has been a 36 percent reduction in the Total Recordable Case rate (TRC) in the Facilities Division (12.2 down to 7.9):



For the WOW coaches, the big payoff is seeing their co-workers go home healthy at the end of the day.

A performance measure that provides feedback to management is the analysis of the return on occupational safety and health investment (ROSHI). The initial and continuing investment by Facilities' management has yielded a positive return.

Metric	Result	Comments
Payback Period	0.6 years	Recovered $230,000 in BBAP program costs within 7.2 months.
Net Present Value	$648k	Generated $648,000 in lost prevention savings from BBAP implementation (50% from workers compensation program)
Annual Return on Investment	281%	Created an investment return from BBAP that nearly triples the program outlay of $230,000

The cost data included in this algorithm included:

- *EH&S Division's personnel time for developing the BBAP(Behavior-Based Accident Prevention) program and investigating Supervisor Accident Analysis Reports (SAARs)*
- *BBAP software development for tracking and trending metrics*
- *Use of technical consultants to certify LBNL's WOW-BBAP program*

- *Purchase of BBAP videos for training coaches*
- *Creation of BBAP critical behavior checklists/field booklets*
- *Sending LBNL employees to BST Users Conference*
- *Coaches Training*
- *BBAP Committee Meetings*
- *Field Observations by Coaches*
- *BBAP Coaches' meetings*

Another metric of the WOW program's success is its net savings for Berkeley Lab in workers compensation costs.

In addition, the WOW process has also identified and corrected root causes to inconsistent use of eye protection. The coaches noticed in their observations that people were often not wearing safety glasses when performing activities that required them. When the employees were asked about this, they shared a number of reasons: the glasses were too heavy, too ugly, didn't fit. People also legitimately didn't want to keep them on when they were doing activities that didn't require them, but they still needed to have them around for when they resumed work that called for eye protection. Given this feedback, the WOW Steering Committee pushed for new safety glasses. Their research identified a brand that offered different sizes, were lighter, more attractive and less expensive than the old ones. Use of safety glasses has gone up dramatically since the new ones have been issued to the employees.

BNFL (Oak Ridge, INEEL, and SRS)

History

The BBS program was developed based on programs used by the parent organization BNFL in the United Kingdom. At the ETTP Project in Oak Ridge, TN, a BBS steering committee was formed with craft personnel and supported by ES&H staff. After initial training, this committee developed and implemented the program. By allowing the workforce to design "their" program, significant program ownership was achieved.

Present Implementation

Employees at field and office locations receive awareness training that explains the concept and theory of BBS. This training also explains the observation process. A percentage of each site's employees are trained to perform BBS observations. This training focuses on the technical aspects of making an observation and the "soft" skills such as effective communication and coaching.

BNFL Inc. utilizes a multi-faceted approach that addresses project duration and maturity. Long-term projects can evolve the basic concepts to continually enhance safety performance while short-term projects can implement BBS in its simplest form – observations and feedback. Facilitating this evolution to meet project needs ensures that employees and management stay engaged in the BBS program and allows each program to establish its own identity.

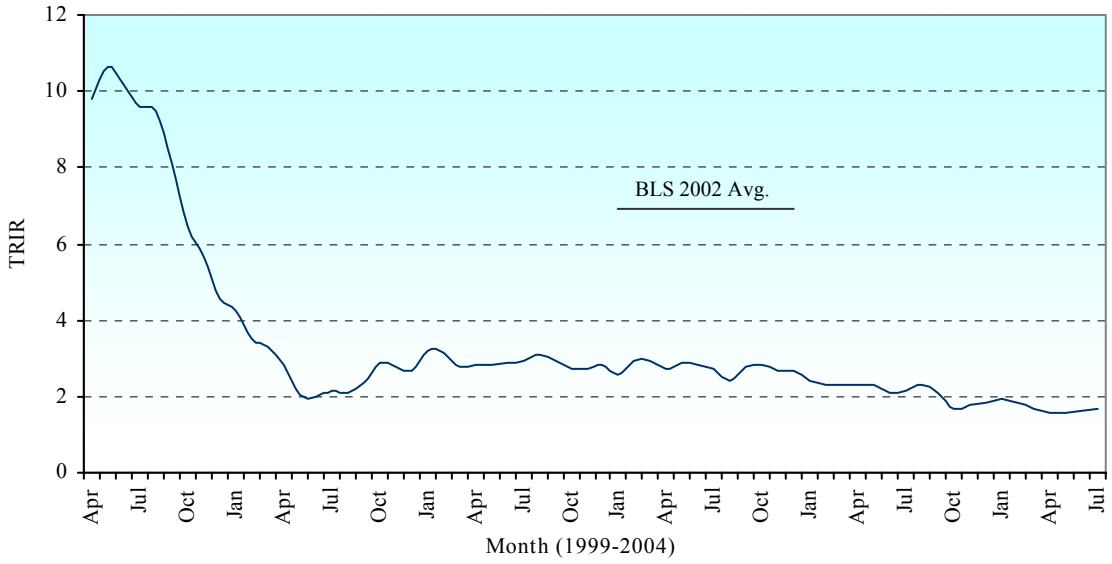
Success Indicators

In 2003 ETTP received 8 NSC Awards in recognition of outstanding achievements in ES&H performance. At our Advanced Mixed Waste Treatment Project in Idaho, we have also been recognized by the National Safety Council for our ES&H performance during the hazardous activities of construction and commissioning with an additional 4 awards.

In a ceremony slated for November 5, BNFL Inc. at Oak Ridge will receive special recognition from the Tennessee Center for Labor-Management Relations for its outstanding accomplishment in designing and implementing a Behavioral-Based Safety (BBS) program.

BNFL Inc. at Oak Ridge recorded the lowest Total Recordable Case Rate (TRC) during the six years of the project's history. The January – October 2003 year-to-date rate of 1.61 was accomplished during the largest production period since the inception of the project.

The overall Total Recordable Injury Rate (TRIR) safety performance of BNFL Inc. has improved considerably and is approximately 81% better than the national average for the type work performed by BNFL Inc., as shown in the Figure below.



Pantex

History

BWXT Pantex began implementation of its PATRIOTS (Pantexan Actions Toward Reducing Injuries Offers True Safety) Behavior-Based Safety (BBS) process in August 2001 with BBS observations starting the following November. Notable improvements in the site's overall Total Recordable Case Rates (down 47% from FY01 to FY02 and down an additional 24% from FY02 to FY03) with similar improvements in Lost Workday Case Rates that correspond directly with

the implementation and sustainability of the BBS process at Pantex over the past two and half years.

Present Implementation

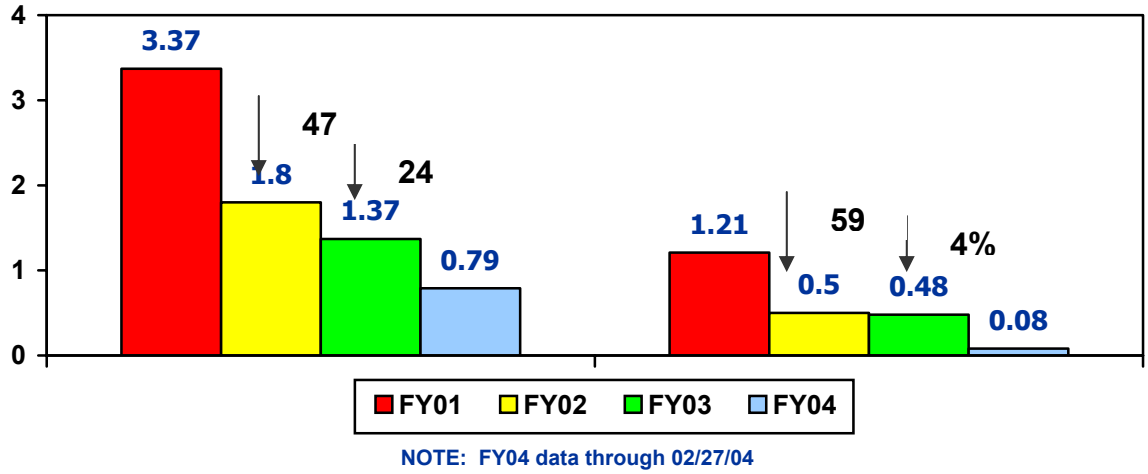
Other specific BWXT Pantex BBS accomplishments include:

- Over 2,700 employees trained as BBS Observers as of February 2004
- Reached a high of 2,700+ observations with feedback per month in December 2002 (each observation is a "mini" safety meeting)
- Regularly conduct mass and/or focused observations (e.g., traffic safety, ramp traffic safety, icy weather, truck load/unloading, etc.)
- At-risk barrier removal through data analysis and action planning
- Implemented the PATRIOTS Can Do Process to identify hazards in the plant work areas and ensure corrective action is implemented
- Improved the accident investigation process using behavioral analysis techniques
- Integrated communications activities (e.g., weekly news articles, newsletters/bulletins, plant intranet, observer networking meetings) to publicize process news, accomplishments and data results
- Plant-wide BAPPTrack® database implemented to improve observation data communication to employees
- Shared BBS implementation strategies with other NNSA/DOE sites

Success Indicators

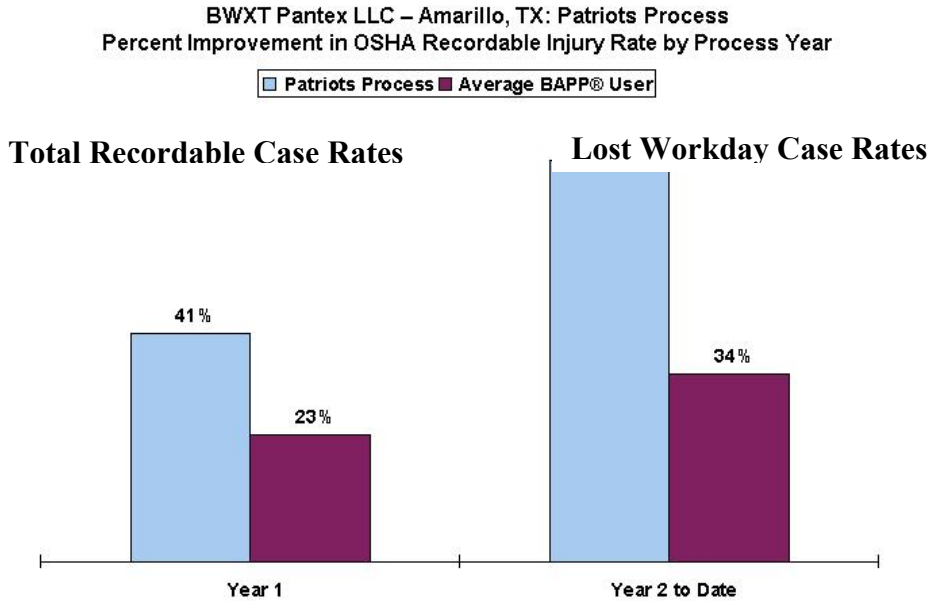
It is also noteworthy plant employees did not experience a lost time injury/illness through the first four months of FY04 in striving to attain our corporate goal of "Target Zero" in connection with accidents and injuries. (See chart below.)

BWXT Pantex
Total Recordable Case Rates & Lost Workday Case Rates



NOTE: FY04 data through 02/27/04

BWXT Pantex's BBS "PATRIOTS" process implementation results are better than industry averages according to Behavioral Science Technology's (BST®) benchmarking data. The chart below shows the percent improvement in the recordable rate in each of the last 1+ years since the BWXT Pantex BBS process began. The light blue bars represent the percentage improvement for Pantex for that year. The dark red bars represent the average Behavioral Accident Prevention Process users percent improvement.



Additionally, BST®'s average BBS Steering Committee implementation time is 10 months. BWXT Pantex's average for accomplishing the same task, for 10 Steering Committees, was 5 months.

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Web Sites (non-commercial)

www.behavioral-safety.com

Appendix A
Safety and Health Intervention Notes

- Information provided by others on BBS is sometimes distorted because the consultant is trying to sell HIS /HER services. Accuracy is sacrificed to timeliness or marketability, or information is intentionally distorted by critics out to make a name for themselves. It is only through a thorough discussion of the issues surrounding BBS that accurate and tailor- made information can be conveyed.
- The most cost-effective application of BBS is an Integrated Human Factors Approach, such as that at EXXONMobil.
- A 2003 analysis of incidents in the Office of Science suggests that the application of BBS to the non-professional force (where the highest TRCs are) there would be the best use of resources. This may be applicable to other Offices within DOE.
- Sites must determine whether to go with an observation-based in-house process or modify a commercial BBS process.
- The collection of data from the BBS process may be of little value in certain environments, such as construction. The use of leading indicators such as participation in the BBS program may be more beneficial than analysis of data.
- Behavioral programs rely on attention to the individual worker, reinforcement, feedback and peer communication. Most are not fully successful unless they involve reinforcement by the first line supervisor.
- The Conference Board creates and disseminates knowledge about management and the marketplace to help businesses strengthen their performance and better serve society. Working as a global, independent membership organization in the public interest, they conduct research, convene conferences, make forecasts, assess trends, publish information and analysis, and bring executives together to learn from one another. Its November 2003 study titled “Driving Toward 0”, based on a list of 23 best management practices and a survey of 68 safety executives, is a benchmark on corporate safety culture and a rating of the policies and best practices that affect corporate safety performance. It found:

  From 1999 to 2002, the number of lost-time cases per 100 full-time employees (similar to Lost Workday Cases) in firms surveyed by The Conference Board declined by an average of more than 40 percent. OSHA- recordable incidents declined an average of more than 23 percent.

  Executives view accidents and injuries as both unacceptable and costly. They believe business strongly benefits from workplace safety programs - through reduced costs, improved morale and increased productivity.

  "Operational integration" - building safety into all facility operations and processes - is the most highly rated practice driving performance improvements, according to the survey. It's been adopted by 90 percent of the survey participants. Ratings for more traditional programs, such as safety committees and training,

were less positive. The Conference Board suggests that surveyed companies view these programs more as necessary obligations than best practices.

Core elements of successful safety and health strategies, according to The Conference Board survey:

- leadership at the top (translated into management commitment);
- confidence on the part of all employees (translated into employee involvement);
- creating and implementing a safety and health management system that works for the individual company (translated into workplace evaluation and control and safety training);
- monitoring performance regularly (translated into program evaluation).

- Alison Vrendenburg – NIOSH Symposia –

The most effective safety intervention in hospitals was the "Front-end hiring of new personnel and verifying that skills gained through training are being employed in the work areas." In other words, personnel screening and verified training provided the best results for safety in hospitals. Certain environments or business sectors may not gain as much from BBS, as others might. (Occupational Hazards, Nov 2003, p. 7)

- Dan Petersen (private consultant) - "In most cases, unsafe behavior is normal human behavior; it is the result of normal people reacting to their environment. Management's job is to change the environment that leads to the unsafe behavior." (Safety Management, 2nd edition, 1998, ASSE, p. 15)

APPENDIX B

Reinforcement Theory and Behavior-based Safety – a History

As early as 1885, Ebbinghaus noted that performance improvement occurred in learning when feedback provided answers. Thorndike (1898) also noted that learning, a positive change of behavior, proceeded with reinforcement. In the following decades, these findings were amplified and refined by research by Pavlov (1927[1]) and Skinner (1930[2], 1938[3]). It was not until 1950 that Dollard and Miller[4] first suggested that this reinforcement process be used in a clinical psychology setting to change behavior of people. Skinner suggested (1955) in his novel Walden II that this process could be used to shape society. Within a decade, "behavior modification" was being used by psychotherapists all over the country. In 1971, Skinner published *Beyond Freedom and Dignity*, in which he suggested that a "technology of behavior" could be used to correct many problems caused by "poor" human behavior in society. The technology of behavior was first applied to the problem of correcting "unsafe behavior" by Komaki and her associates in 1978.

In 1978, Komaki, Barwick and Scott first applied reinforcement theory to the problem of safety. They showed that behavioral observation and feedback could affect behavior; an increase in safe behaviors from 75-80% to 95-99% was found. The feedback given was positive, which elicited positive reactions from the employees as well as their supervisors. Komaki et al. demonstrated a positive impact on safe behaviors, but the initial study did not link this increase in safe behaviors to actual safety measures. Sulzer-Azaroff (1978) and Sulzer-Azaroff and Santamaria (1980) demonstrated that, when safety hazards are identified and positive feedback is used following hazard inspections, the number of hazards is reduced. The implication is that the fewer the hazards, the safer the workplace. It was left to Reber and associates (Reber, Wallin, & Chhokar, 1983; Reber & Wallin, 1984) to relate safe behaviors to different safety measures. They found that, as the percentage of safe behaviors increases, injuries decrease.

[1] Pavlov, I. P. *Conditioned Reflexes: An investigation of physiological activity of the Cerebral Cortex,* Oxford University Press, London, 1927.
[2] Skinner, B. F. On the conditions of elicitation of certain eating reflexes. *Proc. Nat. Acad. Sci,* 1930, 16, 433-438.
[3] Skinner, B. F. *The Behavior of Organisms,* Appleton-Century-Croft, New York, 1938.
[4] Dollard, J., and Miller, N. E., *Personality and Psychotherapy,* McGraw-Hill, New York, 1950.

APPENDIX C
ACRONYMS

ANL	Argonne National Laboratory (near Chicago)
APS	Advanced Photon Source at ANL
BBAP	Behavior-Based Accident Prevention (at LBNL)
BNFL	British Nuclear Fuels Limited
BST	Behavior Sciences Technology (California)
BWXT	Babcock Wilcox
COATS	Corrective Action Tracking System
CCBS	Cambridge Center for Behavioral Studies
DM	Dyn McDermott, Operating Contractor for several Strategic Petroleum Reserve (SPR) sites in Wyoming and Texas
ETTP	East Tennessee Technology Park (former K-25 site)
InCons	Internal Consultants (BST term)
INEEL	Idaho National Engineering and Environment Laboratory
LANL	Los Alamos National Laboratory, Los Alamos, New Mexico (run by U. of California)
LBNL	Lawrence Berkeley National Laboratory, Berkeley, California (run by U. of California)
LLNL	Lawrence Livermore National Laboratory, Livermore, California (run by U. of California)
NSC	National Safety Council
NV	Nevada Site
OBAP	Office-Based Accident Prevention (at LBNL)
PATRIOTS	Pantexan Actions Toward Reducing Injuries Offers True Safety (at Pantex)
PAWS	Prevent Accidents, Work Safe (at SLAC)
QSE	Quality Safety Edge (Houston, Texas)
SLAC	Stanford Linear Accelerator Complex
SMART	Safety Management Reporting Tool
SNL	Sandia National Laboratory
SPR	Strategic Petroleum Reserve sites (Wyoming and Texas)
SPS	Safety Performance Solutions (Virginia)
SRS	Savannah River Site
START	Safety Towards Avoiding Risk-Taking (at SLAC)
TRC	Total Recordable Case rate
TSC	Total Safety Culture (at INEEL)
WASP	Worker Applied Safety Program (at INEEL)
WOW	Workers Observing Workers (at LBNL)
WSRC	Westinghouse Savannah River Corporation

(Mention of a private entity or corporation does not imply endorsement or support of that corporation or its work)

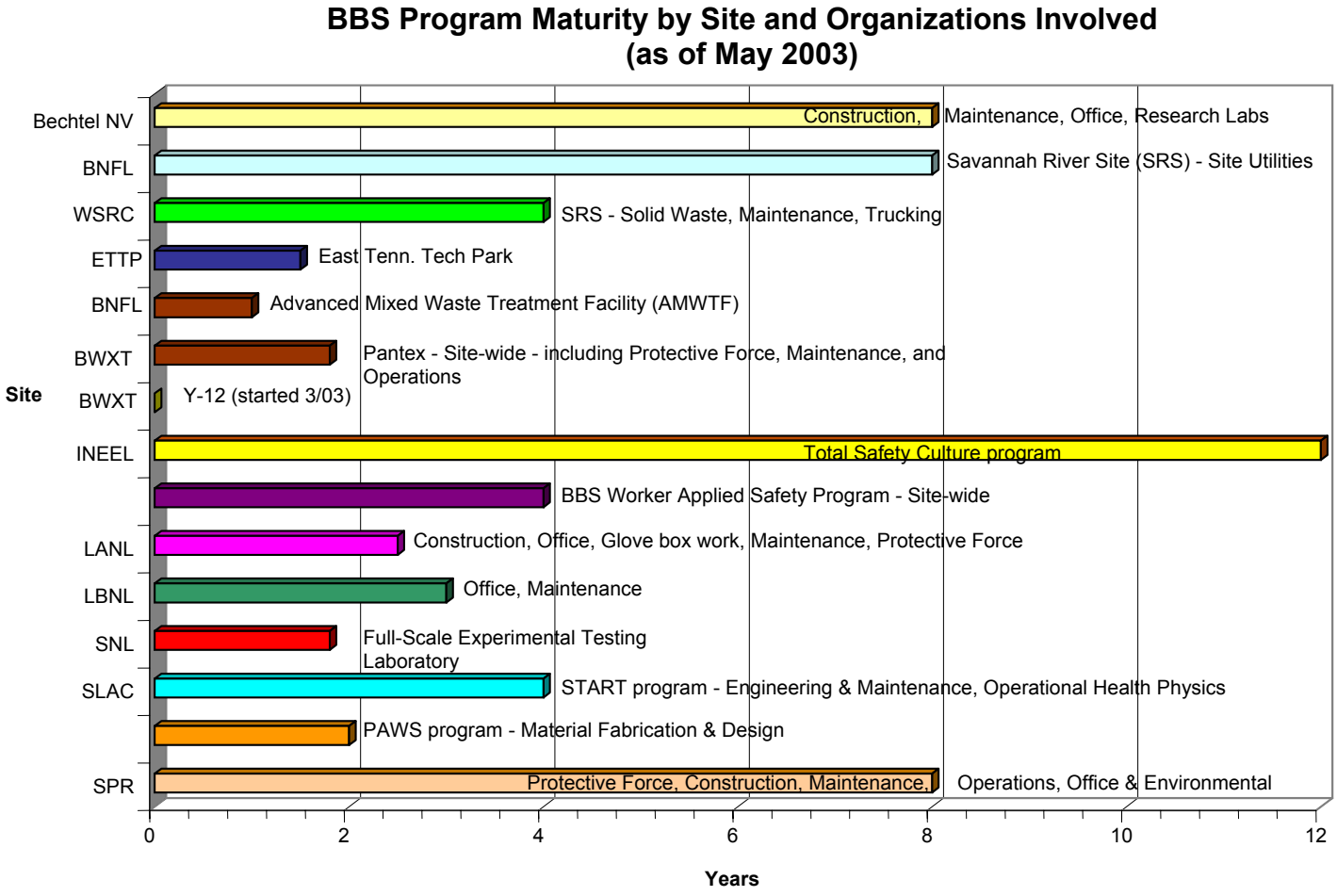
Appendix D – Site Survey

Summary of BBS by DOE site as of 5/28/03

Table I summarizes information that was collected from a survey that was conducted of Behavior Based Safety (BBS) programs at DOE sites. The following figure is a graph depicting the age of the programs by site and the involved organizations.

Site	Approximate # of People		Program Development Source	# People involved in management of program
	Union	Non-Union		
Bechtel NV	766	2182	Cambridge Ctr for Behavioral Studies, SPS, Internal	?
AMWTP - BNFL	0	200	Internal	1
BNFL (SRS)	0	1300+	BST, Internal	30
BWXT – Pantex	1000	2000	BST	20
ETTP - BNFL	800	150	Internal	3
INEEL	1200	4100	SPS	13
LANL	200	800	BST	3
LBNL	0	70	Internal	?
SLAC	185	25	BST	13
SNL	0	50	BST	4
SPR	0	734	BST INCON	1

Note: BST = Behavior Science Technologies, SPS = Safety Performance Solutions


BBS Program Maturity by Site and Organizations Involved
(as of May 2003)
Site
Bechtel NV
BNFL
WSRC
ETTP
BNFL
BWXT
BWXT
INEEL
LANL
LBNL
SNL
SLAC
SPR
Construction,
Maintenance, Office, Research Labs
Savannah River Site (SRS) - Site Utilities
SRS - Solid Waste, Maintenance, Trucking
East Tenn. Tech Park
Advanced Mixed Waste Treatment Facility (AMWTF)
Pantex - Site-wide - including Protective Force, Maintenance, and Operations
Y-12 (started 3/03)
Total Safety Culture program
BBS Worker Applied Safety Program - Site-wide
Construction, Office, Glove box work, Maintenance, Protective Force
Office, Maintenance
Full-Scale Experimental Testing Laboratory
START program - Engineering & Maintenance, Operational Health Physics
PAWS program - Material Fabrication & Design
Protective Force, Construction, Maintenance,
Operations, Office & Environmental
0
2
4
6
8
10
12
Years

Appendix E
Behavioral Program Contractors
Used at DOE Sites

Contractor	Role	Sites	Principal	Products
Behavior Sciences Technology	Consultant	Y-12, Pantex, LANL, SNL, SLAC, SPR, SRS	Thomas Kraus	**Perspectives**, data management, Books
Safety Performance Solutions	Consultant	INEEL, NV, SRS	E. Scott Geller	Books, online training, data management
Cambridge Center for Behavioral Studies	Non-profit Consultant	NV	Ted Boyce U. of Nevada	
Quality Safety Edge	Author	EH at Headquarters	Terry McSween	Books

Other known behavioral program contractors (not at DOE sites) include: Aubrey Daniels (Aubrey Daniels International); Michael Topf (The Topf Organization) and the SAFESTART program.