NOT MEASUREMENT SENSITIVE

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Date: ________, 2003 Draft

DOE HANDBOOK

GOOD PRACTICES FOR THE BEHAVIOR-BASED SAFETY PROCESS

U.S. Department of Energy
Washington, D.C. 20585

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Foreword

This non-mandatory technical standard is designed to assist Department of Energy (DOE) and contractor managers in providing information about the behavior-based safety process (BBSP) and its value in providing for continuous improvement with respect to the safety of DOE facilities. Contractors may use this handbook to obtain basic understanding about the BBSP and some of the results obtained from its use in the DOE complex. As a general informational source, this handbook is approved for use by all DOE components and their contractors. Because of the participatory and cooperative nature of the process, DOE does not require contractors to use a BBSP. However, because of the proven effectiveness of the process, contractors are urged to evaluate their safety programs and determine if BBSP can improve their ISMS-based safety program. Contractors may also consider using BBSP as part of or as a supplement to a Voluntary Protection Program (VPP). BBSP has proven valuable in use with both initiatives.

The best practices outlined in this technical standard are the culmination of much effort by the Department of Energy (DOE) and many of its contractors for ensuring the successful implementation of behavior-based safety. Further information may be obtained by visiting the DOE Behavior-Based Safety Web page at http://eh.doe.gov/bbs.

Comments on this technical standard should be sent to Director, DOE Office of Worker Health and Safety (EH-5), U.S. Department of Energy, Washington, D.C. 20585 by letter or by sending the self-addressed Document Improvement Proposal Form (DOE F 1300.3), available at http://www.explorer.doe.gov:1776/pdfs/forms/1300-3.pdf

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INTRODUCTION

This handbook presents a description of Behavior-Based Safety (BBS) practices as individually developed at several Department of Energy (DOE) facilities. It is intended as a resource for understanding best practices, which can assist sites in implementing or improving BBS. This handbook provides information but does not impose a requirement on DOE or DOE contractors.

The BBS Topical Committee, sponsored by DOE through the Technical Standards Program, recognized the need for a BBS handbook. A working group composed of both DOE and contractor members developed the handbook for general guidance. It is not to be interpreted as all-inclusive; rather, it is published to provide a framework as contractors consider and/or implement BBS. As in any such implementation, a site's culture will impact how and when to institutionalize new paradigms. However, certain concepts are fundamental to the behavioral approach to safety, and these should not be violated.

In implementations throughout the complex, BBS has proven effective in improving safety and reducing the number of safety incidents. Because it is a participatory process, the decision to implement should include upper-level management, first-line supervisors, workers, and their union representatives. Because of its flexibility, implementation may be considered for small shops or whole sites. Because BBS is a complex process based on behavioral principles, implementation should be done with the help of people experienced in applying behavioral techniques. This experience may be obtained within the complex (see the Topical Committee website) or from commercial sources.

More information can be obtained from the BBS Topical Committee website:

http://eh.doe.gov/bbs/

1.0 Overview of Behavior-Based Safety Process

1.1 Background of Behavior-Based Safety

Behavioral science traces its inception to a merging of different fields of science in one individual: a medical doctor who held a university chair in Philosophy in 1876. Behavior-based safety (BBS) brings together parts of behavioral science with industrial safety to create a "new" process to promote safety as an organizational value.

In the 1930's, Heinrich reported that about 90% of all accidents involving fatalities, major and minor injuries were caused by "unsafe behavior" by workers. Subsequent studies by DuPont (1956) confirmed Heinrich's contention. In the 1970's and 1980's, this was expanded to include near misses and Behavior Based Safety added "unsafe or at-risk behaviors." Traditional engineering and management approaches to counter this (such as automation, procedure compliance, administrative controls, and OSHA-type standards and rules) were successful in reducing the number of accidents significantly. However, incidents and accidents persisted, keeping rates at a level that was still disturbing to customers, managers, and workers.

Developed in the late 1970s, BBS has had an impressive record. Research has shown that, as safe behaviors increase, safety incidents decrease. Measurement of "percent safe acts" is a <u>leading</u> safety indicator. In contrast, most safety measures are <u>lagging</u> measures, which are recorded after the incident (e.g., OSHA recordable cases).

~~Ample~~ Anecdotal evidence also exists to indicate that measurement of "percentage or safe behaviors" is predictive. In other cases, the changes in the rate were acted upon, stopping the unsafe trend. In some cases the trend was not acted upon and an accident happened within a short period of time. Connelly (1997) claimed that some people he worked with felt that a change in the Safe Acts Index (% Safe Acts) was a three-week predictor of an accident.

This means that the observation and feedback techniques of BBS may be used to predict that safety problems may be growing in your facility. Intensifying the BBS observation cycle will often prevent an injury or accident.

1.2 Behavior-Based Safety in DOE

DOE sites are employing a growing number of BBS processes, each with it's own specific orientation and techniques. Despite these variations, all BBS processes have four major components: (1) investigation of the antecedents to at-risk behavior, (2) the observation process, (3) action plans to influence at-risk behaviors and conditions, and (4) feedback.

Within DOE, BBS has been instituted at sites such as the Savannah River Site (SRS), Pantex, the Strategic Petroleum Reserve (SPR), and national laboratories such as Los Alamos National Laboratory (LANL), Idaho National Engineering and Environmental Laboratory (INEEL), and Lawrence Berkley National Laboratory (LBNL). In all cases, implementing the behavioral safety process has led to an increase in safe behaviors and a decrease in overall safety incidents.

Over the years, DOE has had an excellent safety record, as compared with much of industry, but there is still concern by oversight boards such as the Defense Nuclear Facilities Safety Board and Congress about the number and nature of safety problems in the DOE complex. As shown by the incident data in DOE's Occurrence Reporting Processing System (ORPS), personnel error from all sources is present in over 77% of all occurrences. Instituting programs such as Integrated Safety Management (ISM) and the Voluntary Protection Program (VPP) has been part of the continuing responses to this persistent safety problem. Within this context, several DOE sites have looked to BBS to reduce the human error aspects of safety.

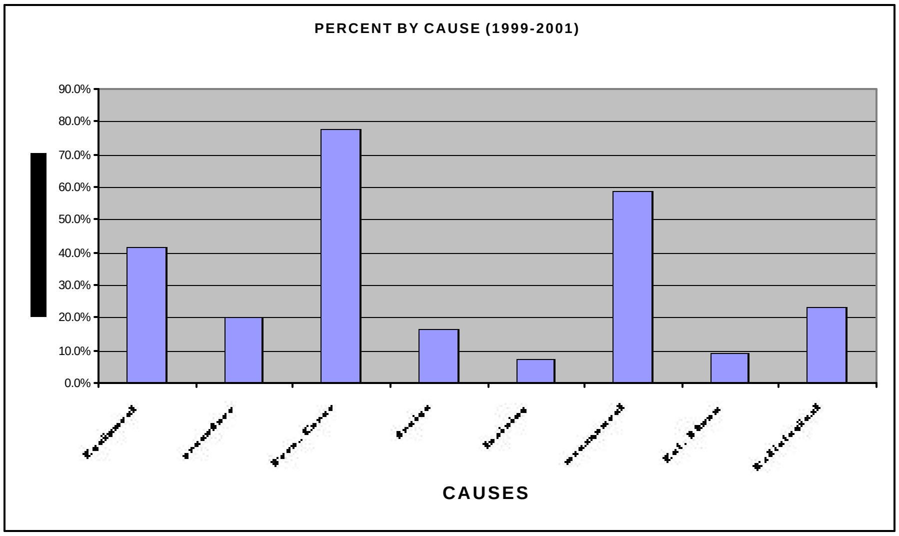

Figure 1. Causes of occurrences, as documented in DOE's Occurrence Reporting System (ORPS) reports (1999-2001)

The core philosophies of the BBS approach are complementary to those of many other programs within the DOE. For example, BBS supports VPP and ISM by giving an avenue for employee involvement and a systematic approach to identify and correct behaviors and conditions that lead to employee injuries.

BBS applies across a broad range of safety areas. BBS can be promoted on the production floor or in the office and is applicable off the job as well. BBS enhances several long-used safety tools (e.g., management tours, housekeeping audits, and safety meetings), thereby reducing the overall safety program cost. This indicates a shift in the focus of safety from programmatic to an "on the shop floor" focus. Organizations that properly implement BBS see the return on the investment ("ROI") of spending safety resources directly in the active work area, and this also leads to "reduction of injuries." This adds value to safety meetings and management tours, which customarily focus on conditions.

1.3 Benefits of Behavior-Based Safety

BBS is a process that provides organizations the opportunity to move to a higher level of safety excellence by promoting proactive response to leading indicators that are statistically valid; building ownership, trust, and unity across the team; and developing empowerment opportunities which relate to employee safety. Equally important to organizational culture, BBS provides line management the opportunity to prove and demonstrate their core values on the production floor.

BBS used in the context of ISM can impact injury rates and total reportable cases. The safety literature and DOE experience show that this occurs with consistency as shown in Figure 2, a "before-and-after" snapshot of Total Recordable Case (TRC) rate from seven different sites using BBS. In each of the cases, the TRC rate was lower following BBS implementation.

It should be noted, however, that multiple facets of an organization can influence the swings of injury rates. When a statistical process control perspective is applied, an organization realizes that specific fluctuations will occur; however, the process will remain "in control." BBS is "a key on the key ring" of safety. It is neither a quick fix nor a silver bullet. It is, however, an important process that addresses the human element of industrial safety in a scientific, logical approach with leading and predictive indicators.

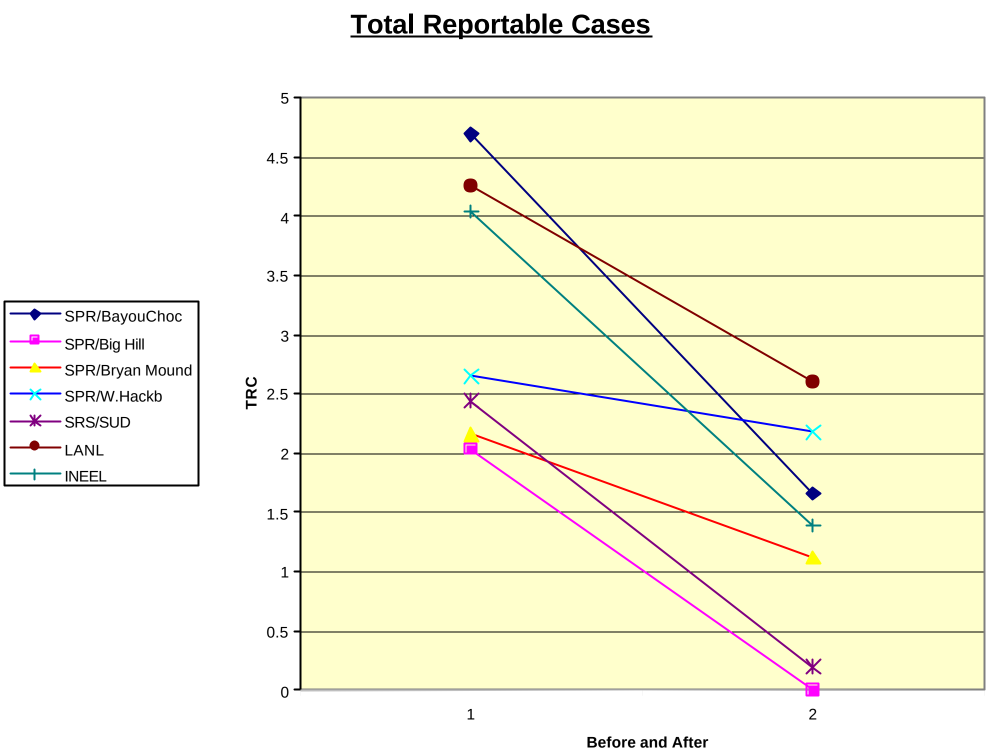

Figure 2. Total reportable case rates at several DOE facilities

before BBS implementation and after

Other safety measures also are affected by BBS. Los Alamos National Laboratory has reported that the radiological incident rates for two facilities were reduced significantly with a BBS process in place (Figure 3).

A properly designed BBS process will involve workers from every level. The atmosphere of trust that results from the non-punitive observation and feedback process leads to more worker involvement. Workers frequently start asking to be observed, and they use the feedback given to modify their activity to make themselves and their fellow workers safer. The rapport that slowly develops between the observers and the workers being observed leads to a more open workplace. As trust increases, the reporting of minor incidents increases, yet severity typically declines.

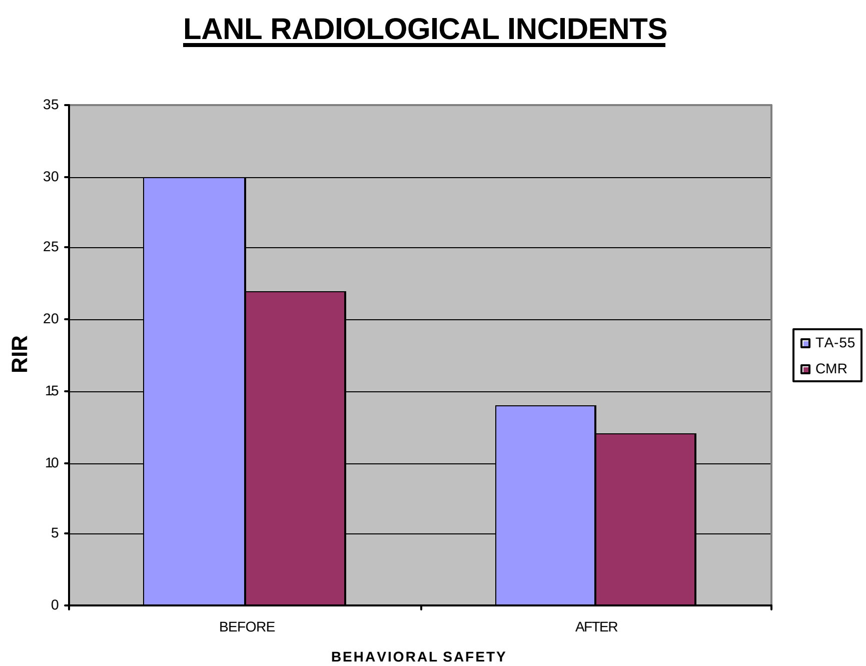

Figure 3. Changes in radiation incident rates at Los Alamos National Laboratory before BBS and after BBS implementation

BBS is good business. Safety costs money, safety programs take manager and worker time, and incidents take time to investigate. The data from LBNL, SRS and SPRO (shown in Appendix C) reflect how BBS can save money. The observation process is also transportable to improving the way work is done, which can lead to enhanced quality.

BBS values, such as building trust, sound relationships, and the use of leading indicators, are applicable in all business activity. Once an organization becomes fluent in leading the safety process through a behavioral approach, it can transfer this experience into other business priorities, such as customer service, quality and absenteeism, making the implementation a spearhead to many business improvements.

2.0 History of Behavior-Based Safety

The merging of different disciplines or sciences is not a new concept. In 1876, a medical doctor who held a university chair in Philosophy started studying behavioral processes, and the science of psychology developed. In the 1970s and 1980s, a merger of the behavioral sciences as applied to safety (Komaki et al., 1978; Krause, Hidley, and Lareau, 1984) led to the birth of a “new” process—behavior-based safety.

Linking behavior to hazardous situations is not new. As early as the 1930s, Heinrich (1951) reported that “unsafe behaviors” were linked to about 90 percent of all accidents. Subsequent studies by DuPont (1956) confirmed Heinrich’s contention. Traditional engineering and management approaches tend to center around controls focused on automation, procedure compliance, and administrative controls. These, and OSHA-type standards and rules, were successful in significantly reducing the number of accidents. ~~But,~~ despite these actions, incidents and accidents kept rates at unacceptable levels. Data in DOE’s Occurrence Reporting Processing System (ORPS) show that personnel error is still present in over 77 percent of all occurrences. DOE’s Integrated Safety Management System (ISMS) and Voluntary Protection Program (VPP) are part of the continuing responses to this persistent safety problem. However, several DOE sites are also looking to behavioral solutions to reduce the human error aspects of safety.

Formally developed in the late 1970s, behavioral safety has an impressive record. Research shows that, as safe behaviors increase, safety incidents decrease. Within DOE, production facilities such as Pantex, the Savannah River Site (SRS), and the Strategic Petroleum Reserve (SPRO), and national laboratories such as Los Alamos National Laboratory (LANL), Idaho National Engineering and

Environmental Laboratory (INEEL), and Lawrence Berkley Laboratory (LBL) have instituted behavioral safety. In all cases, implementing the behavioral safety process has led to an increase in safe behavior and a decrease in overall safety incidents.

3.0 Behavior-Based Safety and Integrated Safety Management Functions

DOE sites have embraced ISM as a philosophy for years. They have implemented ISM as it applies to specific work and tasks. A successful BBS process by default or design encompasses the Seven Guiding Principles of ISM. These principles provide the foundation on which any BBS process should be built. BBS enables organizations to apply the Five Core Functions across the entire organization on a day-to-day basis and does not restrict the process to the actual performance of work. Many workplace injuries occur when employees are involved in non-task-related activities such as walking from point A to point B. BBS processes also provide the footprints to show that ISM is at work around the clock.

3.1 Seven Guiding Principles of Integrated Safety Management

1. Line Management Responsibility for Safety
   The responsibility for safety and the BBS process is shared by management and front-line workers. All levels of the organization are involved in an effective BBS process.

2. Clear Roles and Responsibilities
   Functions within the BBS process are performed at the proper level and are integrated and adapted to fit the formal organization itself.

3. Competence Commensurate with Responsibilities
   An effective BBS process provides the skills needed to perform the tasks and functions associated with the job in a timely manner; provides the opportunity to use those skills on a regular basis; and provides for coaching and interaction with other people and organizations using the BBS process.

4. Balanced Priorities
   BBS provides the consistent stream of safety data that enables managers to balance safety priorities with production and other operational needs.

5. Identification of Safety Standards and Requirements
   Existing safety standards and requirements aid in developing the list of behaviors and definitions used in the BBS process.

6. Hazard Controls Tailored to Work Being Performed
   The observation process provides ongoing monitoring of processes so that Hazard Controls reflect the risks associated with work being performed in changing environments and conditions.

7. Operations Authorization
   The BBS process helps provide the behavior-related safety information necessary to make informed decisions prior to initiating operations.

3.2 Five Core Functions of Integrated Safety Management

- Define the Scope of Work
  Sites developing and maintaining a BBS process follow several steps to define the scope of the work:

  - Form assessment team(s)
  - Extract behaviors that were involved in past accidents/incidents
  - Develop definitions that describe the safe behavior
  - Compile datasheet using identified behaviors
  - Determine observation boundaries
  - Train observers
  - Gather data
  - Determine barrier removal process
  - Form barrier removal teams

- **Analyze the Hazards**
  Analyzing hazards is built into the BBS process. Hazards are analyzed during each observation, and the worker observed receives immediate feedback on how to minimize the risk. The assessment team and barrier removal team analyze the data gathered through observations to determine workplace hazards. The teams then develop action plans to remove barriers to safe work.

- **Develop and Implement Hazard Controls**
  Employees tasked with planning or designing work can also use the behavior assessment and data. By studying the definitions and data, barriers that could require a worker to perform at-risk behaviors can be “designed out” up front. This forethought makes the workplace a much safer environment.

- **Perform Work Within Controls**
  Although work has been designed and training conducted to help the employee know how to work safely, bad habits and shortcuts can introduce at-risk behaviors into the workplace. The ongoing observation process encourages the continued use of safe behaviors and reminds workers that one at-risk behavior could cause an accident, injury, or even fatality.

- **Provide Feedback and Continuous Improvement**
  Feedback is provided each time an observation is performed. The feedback process reinforces the use of safe behaviors and helps determine why certain at-risk behaviors were performed. Collecting information about the at-risk behaviors helps the teams determine the root cause of a behavior and develop an action plan to remove the barrier causing the behavior.

4. 0 Establishing a Behavior-Based Safety Process

Most behavioral safety processes are tailored to the work and management environment of the site. Despite these variations, all behavioral safety processes have three major components:

1. Development of a list of at-risk behaviors,
2. Observations, and
3. Feedback.

This handbook will provide a description of the basic process of setting up and running a behavioral safety program and give some variations that have worked in different sites around DOE.

The process starts with a behavioral hazard analysis to identify at-risk behaviors. These can be determined using accident/incident reports, job hazards analysis, employee interviews, and brainstorming. In some instances, a combination of all these tools could be used. Using the at-risk behaviors, a checklist is then developed to assist in the observation of work behavior. In addition, a list of corresponding behavior definitions is helpful in maintaining consistency between observers and the resulting data. Observers record safe and at-risk behaviors on the datasheet and provide feedback to workers about their performance. This feedback reinforces the necessity for safe behaviors.

The observation data are used to identify barriers to safe behavior. Removing these barriers lowers the workers' exposure to at-risk conditions and makes it easier for employees to work safely. Removing barriers and communicating successes increase employee involvement in the process. Many of these employees take these tools home, which helps decrease off-the-job injuries.

4.1 Readiness for Behavior-Based Safety

All aspects of BBS may not work in every organization. Employees will resist programs that promise big benefits but only result in more paperwork, less progress, and a mountain of wasted time for safety teams. Although it's no magic bullet for injury prevention, there are data to prove that, as observations go up, injuries go down. The question is: "Will it work for your company?" For BBS to succeed, your company has to be ready, and the conditions need to be right. Management support, effective management systems, and company culture are keys to determining whether or not a company is ready for a transition to BBS. Since implementation of these processes can be costly, how can one tell whether a company is ready for it?

There are five conditions that dramatically increase the likelihood of success:

- Safety Leadership;
- Established Integrated Safety Management System;
- Employee Empowerment and Participation in Safety;
- Organization's Safety Culture;
- Measurement and Accountability.

4.1.1 Safety Leadership

Leadership must be active, visible, and genuine in their commitment to injury and illness prevention. Senior management should articulate a clear and inspiring vision that injury-free performance is the only acceptable goal. However, caution is needed here. These “vision messages” can be interpreted as “don’t report injuries” as a means of achieving the goal. The organization must view safety as a core organizational priority equal to research, operations, productivity, and quality.

4.1.2 Established Integrated Safety Management System

For BBS to be effective, an integrated safety management system needs to be in place. This includes minimum compliance, accident investigation, self-assessments, safety and health training program, and record-keeping systems. More advanced systems enhancements (such as observation, coaching, safety involvement teams, job safety analysis, accountability, and safety by objectives) all rely on the basics being in place.

4.1.3 Employee Empowerment and Participation in Safety

Employee empowerment and involvement enhance safety innovation, ownership and results. Labor/management cooperation serves as a catalyst for success. Without employee participation and involvement, BBS won’t get off the ground. Another critical facet of involvement is buy-in. Behavioral systems are much more effective in organizations that work hard at winning buy-in from the line to the executive office before they are introduced.

4.1.4 Organization’s Safety Culture

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

4.1.5 Measurement and Accountability

What gets measured gets done. Clearly defined responsibilities at every level of the organization are the starting point for top performance. When performance evaluations include safe and at-risk behaviors, strategies can be developed to focus on real threats to worker safety.

4.2 Setting Up the Behavior-Based Safety Process

As shown in Figure 4, BBS is a multi-stage process leading to observation, feedback, and continuous safety improvement.

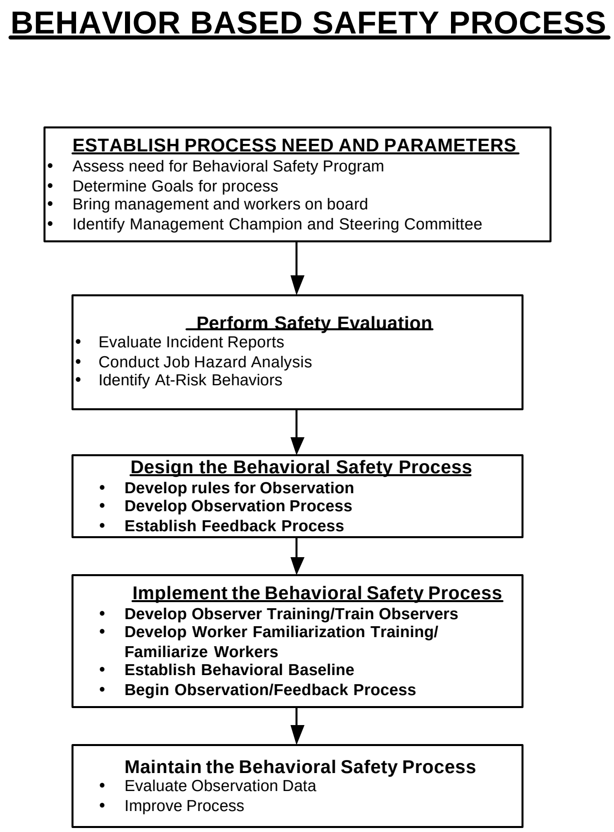

Figure 4. The Basic BBS Development Process

BBS processes should be tailored to the work and management environment where they function. Initial work in setting up a BBS process should involve management, workers, and the union at your facility. A major player is the “champion” who has the responsibility for initially driving the process forward and guiding initial training and the initial selection of the steering committee (SC).

4.2.1 Establishing a Steering Committee

The SC is the cornerstone for the implementation and growth of the BBS process in an organization, as it sets the boundaries for the process and guides the development, implementation, and process continuation. The initial SC is selected from a group of qualified employees, preferably volunteers, representing each distinct group, team, etc., of the organization. The SC should be kept to a manageable size of around 10-15 members. If the SC is larger, it may not function as well. Therefore, multiple committees may be necessary. This decision may have negative consequences if not well managed. The SC should determine how new members will join. The SC is composed of employees from the facility or organization, and should be a diverse cross-section of the organization. It is equally important that the SC members be those who command the respect of their peers, display leadership qualities, and are forward thinkers.

The organization's manager, the BBS coordinator, and the management champion may make initial assignments to the team and should establish the duration of the term, which is typically one year.

4.2.2 Steering Committee Roles and Responsibilities

The functions listed below have been shown to be key to the successful workings of the SC and to guiding the organization through implementation. The functions may be combined based on the number of members available and the capabilities of those individuals.

Management must recognize that the implementation and growth of the BBS process requires time and resources. Personnel must be afforded the opportunity not only to serve on the SC, but also to adequately perform assigned functions within that body. For each of the following functions, consider the responsibilities, desired characteristics or abilities, and the expected time factor (TF) involvement (Hi, Med, and Lo):

- Management Champion/Sponsor – The management champion or sponsor serves as an enabler and resource for the material needs of the SC. This individual must be a high-ranking member of management with a devotion to the BBS process. The individual must be willing to accept a role as an equal on the SC and avoid the temptation to manage the team. (TF=Lo to Hi)

- Facilitator – This individual should be a strong supporter of BBS, be knowledgeable of the process, and be an energetic leader comfortable with working within the organization's environment. This person leads the team through the BBS process implementation. Strong consideration should be given to selecting a deputy or assistant Facilitator, for both continuity and depth of leadership. Functions include:
  - BBS process expert
  - Have a vision of long-term process sustainability
  - Liaison with management team

- Action plan coordination
- Meeting chair
- Training and monitoring observation performance
- Other functions as identified by the SC and sponsor, such as data administrator and data input. (TF=Hi)

- Data Administrator – The data administrator will be responsible for data analysis or assist the facilitator with this function. Access to the data will be necessary by various individuals. Access to the database should be controlled. This function will require some computer experience. (TF=Lo to Hi)
  - Data Entry – In organizations using a single data entry point, this function should be associated with the SC. If a single data entry point is used, this person will input all completed observation forms into an observation database. This necessitates good typing skills and a flexible schedule. This task may be performed by committee members or clerical support. (TF=Lo to Hi)
  - Data Manager – For injuries and accidents to be predicted, the data gathered though observations must be reviewed and interpreted. The Data Manager prepares data packages for SC review, posts appropriate graphic information on organizational bulletin boards, provides necessary statistical information, etc. An additional desirable quality would be that of statistical analysis ability to help the SC interpret the data. (TF=Med to Hi)

- Recording Secretary – This function records SC meeting minutes, prepares and issues the minutes, and issues the upcoming agenda prior to the next meeting. The timely issue of the meeting minutes requires the ability to do a quick turnaround. The recording secretary needs good organizational skills. (TF=Med)

- Communicator – Experience in BBS implementation has shown that communications play a pivotal role in the involvement of the observer force and the education of the organization. This function provides for release of information from the SC to the observer force and the organization. Desirable qualities in an individual filling this function are creativity, flexibility, computer skills, and good oral and written communication abilities. (TF=Med)

One final factor for consideration is the level of involvement that the organizational safety engineer(s) will have with the SC and the BBS implementation. The SC may choose to include a safety engineer on the team. Safety engineers should be trained in the observation process along with other observers.

The SC should fill these positions as they deem necessary for the success of their process.

4.2.3 Function of the Steering Committee

Basic responsibilities of the SC are:

- Develop the at-risk behaviors inventory
- Participate in the training and coaching of observers to provide for mentoring the observer process
- Design the observation process
- Analyze the observation data
- Build action plans to respond to the leading indicators seen in the data
- Ensure that communication with observers is maintained
- Ensure that BBS is promoted and communicated to all organizational levels.

The SC may elect, as part of their team-building efforts, to create an identity for the team or for their organization's process. A unique name or acronym, logo, motto, or slogan can serve as a rallying point for the team. Depending on the scope of implementation, this identity may be site-wide, or facility-based.

4.3 Identifying At-Risk Behaviors

A very important step is the development of a list of at-risk behaviors. This inventory is supported by a list of definitions and examples of critical behaviors based on information extracted from injury reports, interviews, and observation of ongoing tasks native to a site's work environment. This inventory of behaviors, customized for your facility, is the basic tool of observation. The observation data will ultimately be used to develop plans for risk reduction. Customizing the inventory is also critical in promoting acceptance and ownership of the process by the employees.

The behavioral definitions and examples should be written so that they are "observable." Critical behaviors should be organized by risk factors, ranked in order of their potential severity.

Resources utilized for extraction of critical behaviors:

◊ Accident/Incident Reports – Information extracted from the investigations will indicate behaviors that have placed employees at risk for injury in the past. Review of these reports will often result in more than one critical behavior contributing to an injury or incident. The SC should be involved in current and future investigation groups to maintain good continuity of information from a behavioral perspective.

◊ Job Safety Analysis, Job Hazard Analysis, and PPE Assessments – Personnel who work closest to the risk should generate these documents. Information derived from these documents will assist in determining hazards on a "task to task/step by step" basis for SC members who may not be familiar with certain jobs.

◊ Task Observations – Conducting observations of typical work tasks will not only validate behaviors that have already been extracted from historical sources, but may also reveal new critical behaviors that have not yet resulted in recordable injury. Observations can also provide a means of engaging employees in the development of the site process.

◊ Employee Interviews – Interviewing employees from various work groups can provide an opportunity for workers to explain how they perform their jobs safely. Knowing what behaviors are used to perform jobs safely can aid in determining the risks of not performing a job in a behaviorally safe manner.

- ◊ Brainstorming – Group interviews can help identify critical behaviors in work teams that have historically low injury rates and low risk perception.

4.4 Review and Revision

Maintaining a valid inventory is critical to continuous improvement. The inventory should be reviewed periodically (at least annually) for applicability by the SC. Observers also review the tools during routine observations. New at-risk behaviors may be identified, especially when new equipment, facilities, and processes are introduced. Some behaviors may not be currently valid because the tasks associated with them have been changed or are no longer contributing to risk. These may need to be retired from the inventory. Inventories are modified based on a combination of data and the informed judgment of the SC.

4.5 Maintaining and Growing the Process

Keeping the momentum is an important part of a successful process. To present new challenges for the team, consider questions such as:

- How soon can you achieve an observation/feedback rate that will improve safety?
- How can you improve or maintain this observation rate?
- What is the decision process for growing BBS into new “shops” or adding different at-risk behaviors to the process?

5.0 Behavior-Based Safety with Other Safety Efforts

How do you use BBS within the structure of ISMS, VPP, or other more traditional methods? Most safety programs concentrate on “things” and have been relatively successful in reducing the safety incidents having to do with “things.” As these more traditional methods find success, what seems to remain is a residual of problems related to human error. BBS addresses many of the causes of human error; it brings worker participation into the safety arena (supporting VPP) and looks at worker tasks (ISMS at the task level). BBS supplements existing safety programs and adds another level of protection—the worker.

APPENDIX A

BEHAVIORAL CHECKSHEET EXAMPLES

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Will your next choice be the safe choice?

BREAK ROOMS

003

Behavior-Based Safety Checklist

Observer: ____________________________ Return To: Debbie Epling, 730-4B

Date: / /

Index	CRITICAL BEHAVIOR LIST			Index	CRITICAL BEHAVIOR LIST		
	Coffee Area	**Safe** *	**At Risk***		**Sink Area**	**Safe** *	**At Risk***
	Pouring water into coffee maker				Using the hot water tap		
	Using sugar, creamer, stirrers				Rinsing dishes		
	Pouring coffee into cups				Housekeeping (dirty dishes, etc)		
	Cleaning the base of coffee pot				Using the aluminum foil		
	Removing hot coffee grounds						
	Cleaning existing spills						
	Disposing of general waste						
	Disposing of glass and metal				**Preparing/Handling Food**		
					Refrigerating perishable items		
					Operating Can Opener		
					Using knives, other sharp tools		
					Using the right tool for the job		
					Storage		
					Waste Disposal		
					Housekeeping (wipe counters, etc		
					Removing food from Fridge		
	Microwave use				**General**		
	Removing food from microwave				Eyes on path (exit/enter)		
	Using microwavable containers				Eyes on surroundings (exit/enter)		
	Venting containers				Using the vending machine		
	Cleaning up spills						
	Using appropriate timing						
	Selecting the food to be microwaved				**Other**		
	Attend to cooking food				Communications		
	Heating liquid in microwave				Personal Items		
					Miscellaneous		

OBSERVED SAFE BEHAVIORS/GOOD PRACTICES

ex	

OBSERVED AT-RISK BEHAVIORS

Index	What was observed to be At-Risk?	Why was it At-Risk?

Other Comments:

Definitions for Critical Behaviors:

Will your next choice be the safe choice?

Behavior-Based Safety – ‘Self Observation”

Observer: ______________________________ Return To:

Date: ______/______/________

Index	CRITICAL BEHAVIOR LIST			Index	CRITICAL BEHAVIOR LIST		
		Safe *	At Risk*			Safe *	At Risk*
	PPE Driver seat belts						
	PPE Occupants seat belts						
	Personal health / task alignment						
	Seat adjustment						
	Mirror adjustment						
	Hands on wheel						
	Ergonomics						
	Condition of Equipment:						
	- 360^0 walkaround						
	- Headrest						
	- Brakes						
	- Windshield wipers						
	- Running/Headlights						
	Eyes on Path						
	Following distance						
	Traffic lights/signs (stop / yield)						
	Travel surface / speed						
	Distractions						
	Signaling / Changing lanes						
	Parking, refueling & securing car						
	Miscellaneous						
*							

OBSERVED SAFE BEHAVIORS/GOOD PRACTICES

ex	

OBSERVED AT-RISK BEHAVIORS

Index	What was observed to be At-Risk?	Why was it At-Risk?

Other Comments:

Definitions for Critical Behaviors:

PPE seat belts for driver / occupants: All seat belts should be fastened, and children restrained per vehicle design & state laws

Personal health / task alignment: Pre-existing health condition understood & adapted as appropriate; allergic tendencies understood; driver rested & not emotionally distracted; stretching of head/neck, applying pressure on brakes

Body position / seat & mirror adjustment: Seat properly adjusted for driver; mirrors are aligned for optimum coverage of side & rear views

Hands on wheel: Driver has both hands on steering wheel

Ergonomics: Rest periods are scheduled for extended periods of driving to avoid excessive stress on back, arms & neck; stretching of muscles

Condition of tools & equipment: Driver is aware of routine vehicle maintenance; Brakes, steering lubrication, cooling system belts & hoses, spare tire, flashlight / emergency lights, battery jumper cables; Driver familiar with operating instructions, & safety precautions;

- **Brakes**: Brakes are tested for resistance as you slowly move away from parking spot
- **Walk-around:** perform a 360^0 walk-around to check for unforeseen obstructions prior to entering vehicle;
- **Headrest:** Headrest is properly adjusted for current driver to prevent potential whip-lash from rear-end impact.
- **Windshield wipers:** periodically test wiper efficiency with washer fluid prior to rainy weather
- **Head lights:** Ensure both low & high beams are functioning properly; manually turn on any time windshield wipers are used

Eyes on Path: Proper handling of hot foods; anticipation of hot materials splattering; children’s actions accounted for;

Following distance: Maintains safe stopping distance, min. of 2 sec. for cars & vans with dry conditions, and 4 sec. for truck with payload;

Obeying traffic signs: This includes coming to a complete stop and / or yielding @ appropriate road signs / signals

Travel surface / speed: Travel within speed limits, and adjusting for poor road conditions

Distractions: Driver is not distracted by radios, telephones, or other conversations within the car while moving

Signaling / changing lanes: Driver communicates effectively with other drivers & pedestrians; checks all mirrors and signals for all turns &

APPENDIX B

REINFORCEMENT THEORY AND BEHAVIOR-BASED SAFETY

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As early as 1885, Ebbinghaus noted that performance improvement occurred in learning with feedback about answers. Thorndike (1898) 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 the correlation with the overall injury rate was r = -0.85 with a lost-time injury rate of -0.69. The negative correlation indicates that, as the percentage of safe behaviors increases, injuries decrease. A 1993 survey offers a comparison of different safety interventions as shown in Figure B-1 (Guastello, 1993).

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[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.

Guastello presented his data in terms of percentage injury reduction and reported the effect of such traditional safety interventions as engineering (29% reduction), management audits (19%), poster campaigns (14%), and near-miss reporting (0%), but reported 51.6% due to "comprehensive ergonomics" (European definition) and 59.6% due to behavior modification (behavioral safety). It appears that the behavioral safety approach is attacking a different aspect of the safety problem.

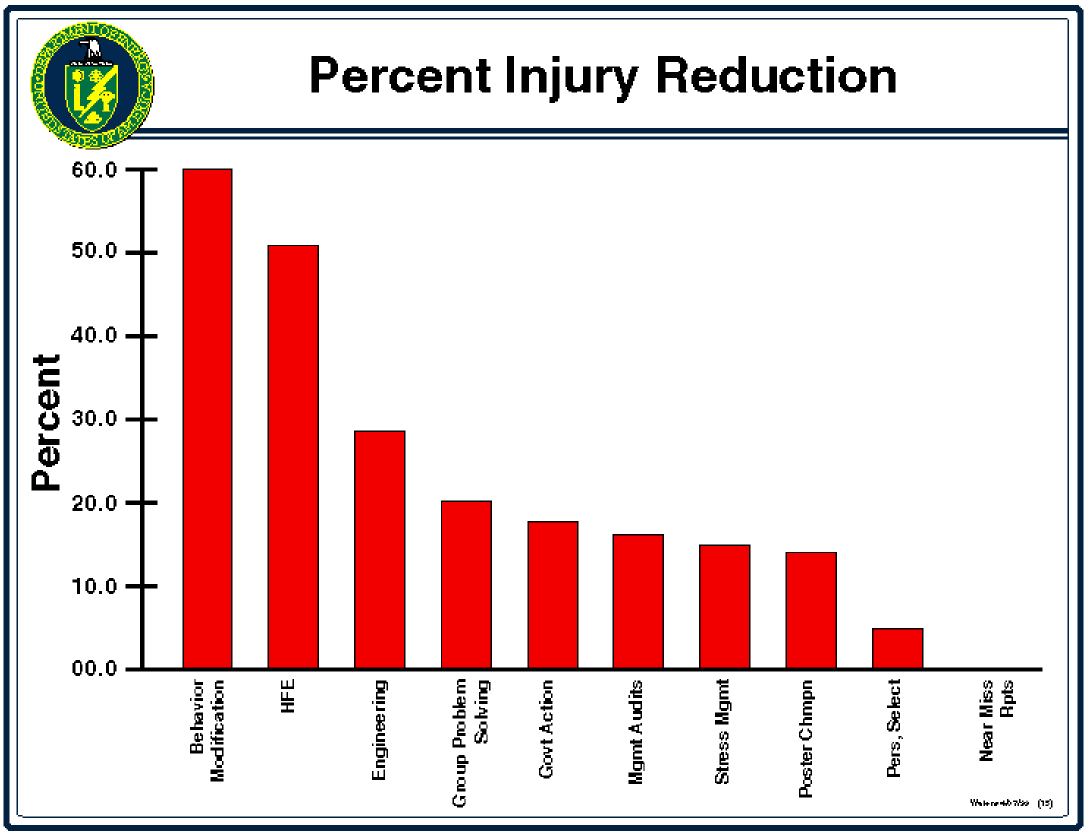

Figure B-1. Percent injury reduction due to different safety program interventions. (Guastello, 1993)

APPENDIX C

SITE EXPERIENCES

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A. Lawrence-Berkeley National Laboratory

Table C-1. Lawrence-Berkeley National Laboratory BBS amortization

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

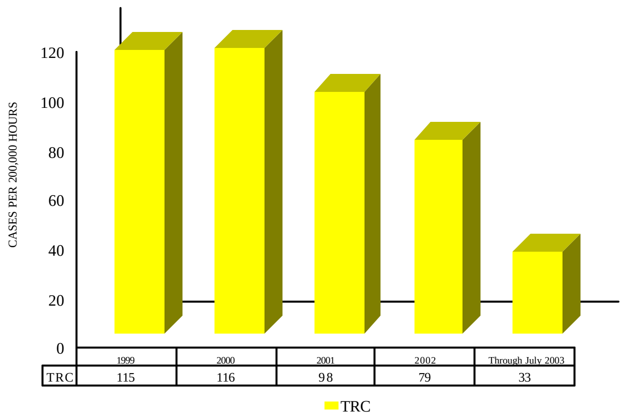
The costs in these data included:

- EH&S Division's personnel time for developing the BBAP program and investigating SAARs
- BBAP software development for tracking and trending metrics
- Retaining a consultant from Behavioral Safety Technology (BST) to certify LBNL's 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

B. Westinghouse Savannah River Company

SRS reported for the period of 1999 through July of 2003 that the whole site TRC rate went from 115 to 33, almost a fourfold decrease when BBS was implemented.

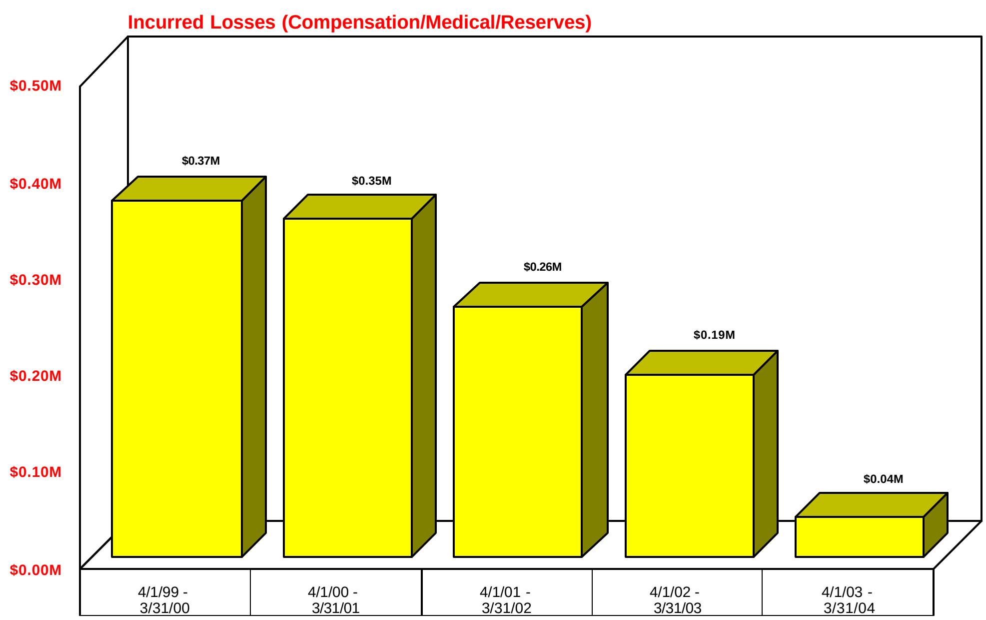
SRS OPERATIONS
Total Recordable Cases
1999 through July 2003



In addition, incurred losses due to workman's compensation and medical reserves went from $370,000 to $190,000 and the costs are projected at ony$4000 for the April 2003 to March 2004 period.

SRS OPERATIONS

WORKERS COMPENSATION INCURRED LOSSES
April 1, 1999 through June 30, 2003



C. Dyn-McDermott at the Strategic Petroleum Reserve (SPR)

The Cost Index is one of the five performance metrics from the Occupational Safety and Health Administration (OSHA) used DOE-wide in judging the effectiveness of Integrated Safety Management performance.

- This is an artificial rate used for comparison of accident costs. It is arrived at by assigning a dollar value to certain categories (death, permanent disability, etc.); it does not reflect actual insurance payments, for example.

- As shown below, the SPR's Cost Index peaked in June of 2000 at over $20.00. Since then, there have been 10 months with no injuries or illnesses, driving the rate down to less than $3.00 for the last six-month period.

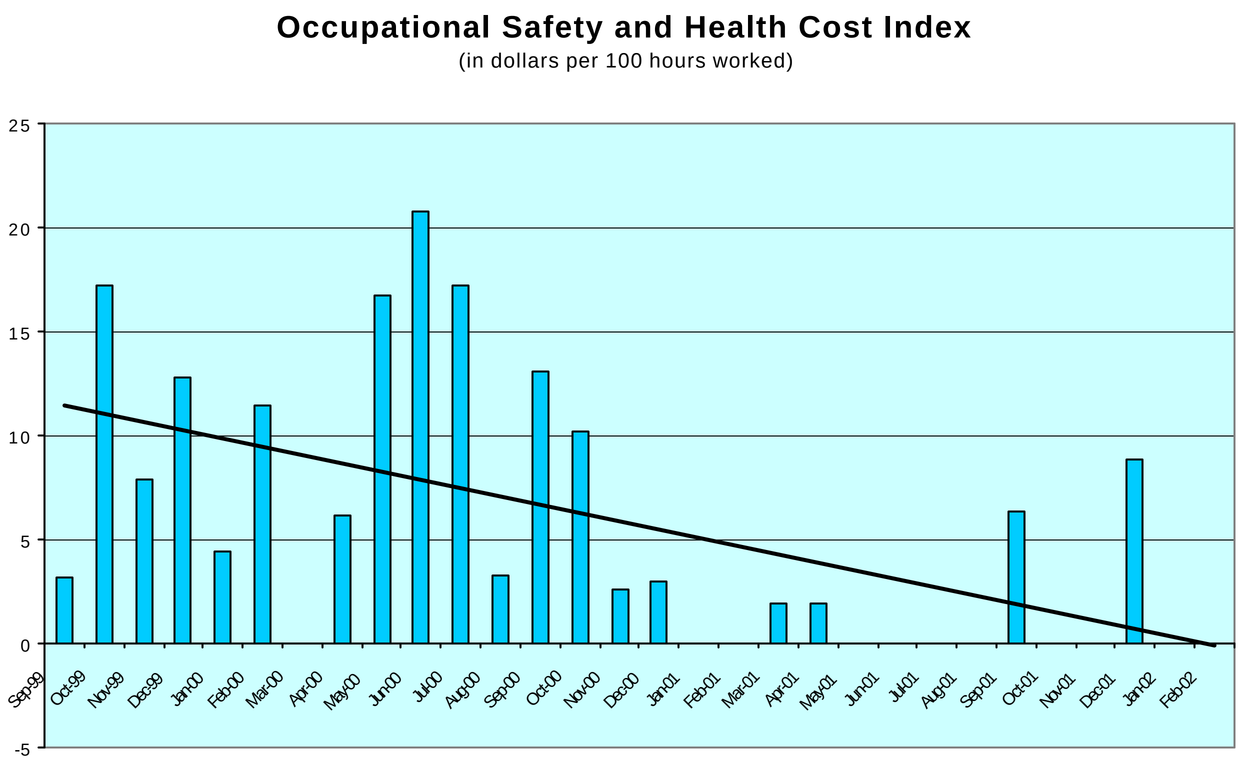


Figure G- Strategic Petroleum Reserve Results for DOE's Occupational Safety and Healtlh Cost Index.

• **Note.** These figures exclude a vehicle fatality in November 2000, when a private vehicle crossed the I-10 median and hit and killed an SPR employee driving a government vehicle in the other direction. OSHA did not investigate or assign any blame to the SPR employee. The only reason the accident was considered work-related was that he was returning from one of the sites. Including the fatality would add a factor of 1,000,000 to the initial equation.