Bechtel National Incorporated Waste Treatment and Immobilization Plant Construction Site

Report from the Department of Energy
Voluntary Protection Program
Onsite Review
October 25-November 3, 2016

U.S. Department of Energy
Office of Environment, Health, Safety and Security
Office of Health and Safety
Office of Worker Safety and Health Assistance
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Foreword

The Department of Energy (DOE) recognizes that true excellence can be encouraged and guided, but not standardized. For this reason, on January 26, 1994, the Department initiated the DOE Voluntary Protection Program (VPP) to encourage and recognize excellence in occupational safety and health protection. This program closely parallels the Occupational Safety and Health Administration's (OSHA) VPP. Since its creation by OSHA in 1982 and implementation by DOE in 1994, VPP has demonstrated that cooperative action among Government, industry, and labor can achieve excellence in worker safety and health.

DOE-VPP outlines areas where DOE contractors and subcontractors can surpass compliance with DOE Orders and OSHA standards. The program encourages a *stretch for excellence* through systematic approaches, which emphasize creative solutions through cooperative efforts by managers, employees and DOE.

Requirements for DOE-VPP participation are based on comprehensive management systems with employees actively involved in assessing, preventing and controlling the potential health and safety hazards at their sites. DOE-VPP is available to all contractors in the DOE complex and encompasses production facilities, laboratories, and various subcontractors and support organizations.

DOE contractors are not required to apply for participation in DOE-VPP. In keeping with OSHA and DOE-VPP philosophy, *participation is strictly voluntary*. Additionally, any participant may withdraw from the program at any time. DOE-VPP consists of three programs with names and functions similar to those in OSHA's VPP: Star, Merit, and Demonstration. The Star program is the core of DOE-VPP. This program is aimed at truly outstanding protectors of employee safety and health. The Merit program is a steppingstone for participants that have good safety and health programs, but need time and DOE guidance to achieve true Star status. The Demonstration program, expected to be used rarely, allows DOE to recognize achievements in unusual situations about which DOE needs to learn more before determining approval requirements for the Merit or Star program.

By approving an applicant for participation in DOE-VPP, DOE recognizes that the applicant exceeds the basic elements of ongoing, systematic protection of employees at the site. The symbols of this recognition provided by DOE are certificates of approval and the right to use flags showing the program in which the site is participating. The participant may also choose to use the DOE-VPP logo on letterhead or on award items for employee incentive programs.

This report summarizes the results from the evaluation of the Bechtel National Incorporated (BNI), Waste Treatment Plant construction site during the period of October 25-November 3, 2016, and provides the Associate Under Secretary for Environment, Health, Safety and Security (AU) with the necessary information to make the final decision regarding BNI's continued participation in DOE-VPP as a Star site.

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ABBREVIATIONS AND ACRONYMS

AJHA	Automated Job Hazard Analysis
AU	Office of Environment, Health, Safety and Security
BLS	Bureau of Labor Statistics
BNI	Bechtel National Incorporated
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
Craft	Craft Worker
CSR	Craft Safety Representative
CSA	Construction Safety Alliance
CSW	Craft Safety Watch
CY	Calendar Year
DART	Days Away, Restricted or Transferred
Distribs	Distributed Support Group
DRIVES	Developing Responsibility in Vehicle and Equipment Safety
DOE	Department of Energy
ECP	Exposure Control Plan
EJTA	Employee Job Task Analysis
ESC	Electrical Safety Committee
HCD	Hazard Control Document
HLW	High-Level Waste
IH	Industrial Hygiene
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
LAW	Low-Activity Waste
LMS	Learning Management System
LOTO	Lock-Out/Tag-Out
NAICS	North American Industry Classification System
OBT	On Board Training
OEL	Occupational Exposure Limit
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PAPR	Powered-Air Purifying Respirator
POD	Plan-of-the-Day
PPE	Personal Protective Equipment
PT	Pretreatment
SETO	Safety Education Through Observation
SDS	Safety Data Sheet
SIP	Safety Impact Plan
SME	Subject Matter Expert
STARRT	Safety Task Analysis Risk Reduction Talk
Team	Office of Environment, Health, Safety and Security DOE-VPP Team
TRC	Total Recordable Case
VPP	Voluntary Protection Program
VR	Virtual Reality
WBGT	Wet-Bulb Globe Temperature
WTP	Hanford Tank Waste Treatment and Immobilization Plant
ZAC	Zero Accident Council

EXECUTIVE SUMMARY

The Department of Energy's (DOE) Voluntary Protection Program (VPP) Team (Team) from the Office of Environment, Health, Safety and Security (AU) is recommending that the Bechtel National Incorporated (BNI) construction project at the Hanford Tank Waste Treatment and Immobilization Plant (WTP) continue participating in DOE-VPP *conditionally* as a Star site as it addresses the current limited employee involvement in safety programs. This report provides the results of the triennial onsite assessment conducted by the Team from October 25-November 3, 2016, and supports that recommendation.

Although BNI meets four of the five DOE-VPP tenets, Employee Involvement has substantially dropped since the 2013 assessment. The limited Employee Involvement is leading to other cultural and communication difficulties, and does not currently demonstrate the level of excellence expected of a DOE-VPP Star site. BNI has the resources and talent necessary to encourage broader employee involvement, but needs time to implement improvements. In accordance with DOE-VPP policies and procedures, the Team will schedule a reassessment per DOE-VPP procedures, and make a final recommendation regarding BNI's continued participation.

The WTP is the largest construction project for DOE. BNI is engaged in designing, building, and commissioning the vast plant complex, which will cover 65 acres. AECOM (formerly URS) is a partner with BNI. Together, these two companies comprise the WTP construction project. The scope of this DOE-VPP review does not cover the entire project organization, but only covers the physical construction site and the material receipt and warehousing areas in Richland, Washington, and activities directly related to construction. The work performed by this construction organization is typical of any large-scale site within the construction industry.

BNI began the VPP process as a Merit participant in 2008, and achieved Star recognition in 2010, with a recertification in 2013.

The BNI 3-year total recordable case (TRC) rate dropped 63 percent since the 2013 VPP assessment, and the BNI days away, restricted or transferred (DART) case rate dropped 40 percent for the same period. However, at the time of this assessment, BNI is experiencing a TRC rate of 1.18 for 2016, which is a significant increase from a record low rate in 2015.

BNI managers are committed to achieving and maintaining a world-class safety program at WTP, but have not successfully convinced the workforce of that commitment, fully earned workers' trust, and motivated the workforce to help them achieve that goal. Managers appreciate the efforts by a small segment of the workforce trying to accomplish this goal, but need to encourage broader segments of the worker population to become engaged in the safety program. Some workers are apprehensive about voicing their concerns. Worker ambivalence towards safety rules, lack of involvement and engagement with fellow workers relating to observed safety conditions, and a minimal presence in the work areas by senior managers is contributing to a decline in Employee Involvement at the WTP. BNI needs to find methods to establish personal acceptance and ownership of safety by every worker, supervisor and manager to develop the Employee Involvement expected of a DOE-VPP participant.

BNI has a consistent approach to identify and analyze hazards to recommend controls for worker protection. Craft workers and safety and health professionals are involved in the development of the Automated Job Hazard Analysis (AJHA), which captures the hazards and controls, and

references the hazard analysis in support documents. Workers rely on Safety Task Analysis Risk Reduction Talk (STARRT) cards to help them analyze their daily work environment and focus on the hazards they may encounter. BNI has several teams that conduct facility inspections and uses that opportunity to observe work and the conditions of work areas. BNI tracks several lagging indicators and has implemented corrective action plans based on identified trends, but should adopt more leading indicators to improve Employee Involvement.

BNI uses the hierarchy of controls to eliminate or minimize hazards. Most hazards to workers are controlled, and workers have the ability to implement those controls. As noted in Employee Involvement, workers do not always comply with identified controls. Additional enhancements to existing programs, such as adding a marking on hand tools that show noise hazard boundary marking expectations would improve the implementation of hazard controls for noise.

Safety and Health Training is effective in ensuring workers are trained and qualified to address the hazards associated with working at the WTP construction site. BNI has developed several new training initiatives since the 2013 review in an effort to enhance hazard identification to ensure continued improvement. BNI identified weaknesses in its approach to training engineers and it has developed a response to correct those deficiencies.

TABLE 1
OPPORTUNITIES FOR IMPROVEMENT

Opportunity for Improvement	Page
BNI managers need to broaden their personal expectations for Employee Involvement, provide resources to the various safety committees to operate relevant campaigns to stimulate employee involvement, and find more effective, objective measures of employee participation in those activities.	**7**
BNI should allow the CSW to work with other VPP participants, both on and off the Hanford site, to incorporate best practices and lessons learned in behavioral observation programs that will improve the effectiveness of its observations, encourage more workers to participate in the program, and revitalize workers' acceptance of observations.	**9**
BNI needs to provide foremen, superintendents, managers, and committee members with tools and training to (1) recognize and encourage employee involvement in safety programs, (2) increase managers' visibility in the work areas, (3) ensure supervisors are leading by example, and (4) assure workers' concerns are addressed without fear of retaliation or apprehension due to their rank or position (apprentice, journeyman).	**12**
BNI should review the procedures and postings for PPE usage, ensure they are consistent, and reinforce those requirements to workers.	**12**
BNI needs to develop broader opportunities and activities that workers can participate in that reinforce and encourage safety awareness and safe behaviors and result in assured rewards for employees consistent with the level of effort and expected value of participation rather than cash awards from random drawings.	**12**
BNI should identify and track leading indicators that are meaningful to the understanding of its safety culture, particularly indicators of employee involvement.	**17**
BNI should ensure superintendents and foremen review AJHAs more frequently when reviewing STARRT cards and ensure controls identified on the STARRT card are consistent with controls identified in the AJHA.	**20**
BNI should consider tagging or color- coding each noise-producing hand tool as a secondary way to ensure workers properly post noise boundaries.	**21**
BNI should consider the use of modern physiological monitoring technology to enhance or augment the existing heat stress program.	**22**
The BNI training group should consider identifying a review team of onsite personnel (i.e., SMEs, safety professionals, or VPP safety committee members) to provide more	**23**

Opportunity for Improvement	Page
frequent reviews of the orientation packet information to ensure the content remains current and applicable.	

I. INTRODUCTION

The WTP is the largest construction project for DOE. BNI is engaged in designing, building, and commissioning the vast plant complex, which will cover 65 acres. AECOM (formerly URS) is a partner with BNI. Together, these two companies comprise the WTP construction project. The scope of this DOE-VPP review does not cover the entire project organization, but only covers the physical construction site and the material receipt and warehousing areas in Richland, Washington, and activities directly related to construction. It does not include the engineering, design and operations activities. The Central Washington Building and Construction Trades Council (Building Trades Council) represents workers at the site collectively. Incorporating technology successfully employed in France and England, the West Valley Demonstration Project in New York, and the Savannah River Site in South Carolina, the WTP construction project will consist of three main facilities: Pretreatment (PT), Low-Activity Waste (LAW) Vitrification, and High-Level Waste (HLW) Vitrification, as well as a large Analytical Laboratory, and 20 support facilities. These facilities will treat more than 56 million gallons of radioactive and chemical wastes stored in 177 underground tanks and vitrify the waste for safe and secure disposal, thereby reducing the risks and exposure to the adjacent Columbia Valley region and the Columbia River. Started in 2001, DOE originally expected WTP to be operational in 2019. The current target dates for Hot Commissioning have shifted out as funding profiles have changed, and DOE is negotiating with Washington State and the Environmental Protection Agency.

The organization for the WTP construction site located on the Hanford Site is comprised primarily of manual workers, foremen, supervisors, subcontractors and their managers, administrative support, and field engineering personnel (collectively known as "nonmanual" employees at the project). The work performed by this construction organization is typical of any large-scale project within the construction industry. This work includes developing construction strategies, identifying apparent hazards within all work activities, performing constructability reviews, developing construction schedules, managing material receipt, installing and maintaining permanent plant equipment, and executing complex civil, electrical, and mechanical construction activities.

BNI began the VPP process as a Merit participant in 2008 and achieved Star recognition in 2010. Since then, technical design issues and budget constraints have slowed construction progress. Work on the Pretreatment facility, the largest of the four main buildings on the project, has paused. Work on the HLW building has slowed significantly. Construction emphasis is on the LAW building (about 80 percent complete) and a revised treatment strategy to feed some tank waste directly to LAW, bypassing the PT facility. The Analytical Laboratory building, the fourth of the major buildings, is substantially complete. The current construction workforce consists of approximately 600 skilled craft workers (crafts) and laborers. Trades employed at the construction site include insulators, boilermakers, carpenters, cement finishers, electricians, ironworkers, laborers, millwrights, operating engineers, painters, pipefitters, sheet metal workers, sprinkler fitters and Teamsters.

The standard for DOE-VPP is not perfection, but continuous improvement. As such, this report identifies additional opportunities for improvement. Some opportunities use the term "need," indicating this is an improvement necessary for BNI to meet the conditions for continued participation. BNI should evaluate these opportunities, address them, as it deems appropriate, through its safety improvement processes and include them in its annual self-assessment.

II. INJURY INCIDENCE CASE RATE

Injury Incidence/Lost Workdays Case Rate (BNI and staff augmentees at the construction site)					
Calendar Year	Hours Worked	Total Recordable Cases (TRC)	TRC Incidence Rate	DART* Cases	DART* Case Rate
2013	2,140,000	11	1.03	8	0.75
2014	2,415,000	8	0.66	3	0.25
2015	2,450,545	7	0.57	3	0.24
3-Year Total	7,005,545	26	.74	14	0.40
Bureau of Labor Statistics (BLS-2015) composite for NAICS** Code 237, heavy and civil engineering construction			2.8		1.7
Injury Incidence/Lost Workdays Case Rate (BNI Subcontractors at the construction site)					
Calendar Year	Hours Worked	TRC	TRC Incidence Rate	DART* Cases	DART* Case Rate
2013	251,000	1	0.8	0	0
2014	341,000	0	0	0	0
2015	291,116	0	0	0	0
3-Year Total	883,116	1	0.23	0	0
Bureau of Labor Statistics (BLS-2015) composite for NAICS** Code 237, heavy and civil engineering construction			2.8		1.7

* Days Away, Restricted or Transferred
** North American Industry Classification System

3-year TRC Incidence Rate, including subcontractors: 0.68
3-year DART Case Rate, including subcontractors: 0.35

Conclusion

The BNI 3-year total TRC rate dropped 63 percent since the 2013 VPP assessment, and the BNI DART rate dropped 40 percent for the same period, reaching a record low for the project in 2015. However, at the time of this assessment, BNI is experiencing a TRC rate of 1.18 for 2016, a significant increase from 2015. This rise in TRC and DART case rates may be attributable to reduced employee commitment and involvement as well as an increased willingness to report injuries. The Team reviewed several first-aid cases and found no discrepancies. The Team did not find any incentives to discourage the reporting of injuries, illnesses, or safety concerns by workers although some newer workers expressed an unwillingness to report minor injuries to

avoid the investigation process. The BNI injury/illness and DART rates meet the expectations for continued participation in DOE-VPP.

III. MANAGEMENT LEADERSHIP

Management leadership is a key element of obtaining and sustaining an effective safety culture. The contractor must demonstrate senior level management commitment to occupational safety and health, in general, and to meeting the requirements of DOE-VPP. Management systems for comprehensive planning must address health and safety requirements and initiatives. Elements of that management system must include: (1) clearly communicated policies and goals; (2) clear definition and appropriate assignment of responsibility and authority; (3) adequate resources; (4) accountability for both managers and workers; and (5) managers must be visible, accessible, and credible to employees. Authority and responsibility for employee health and safety must be integrated with the management system of the organization and must involve employees at all levels of the organization.

In 2013, BNI managers at the WTP construction site demonstrated effective leadership and commitment to workers' safety and health. Improvements in supervisor training, additional emphasis on safety and quality as a means to achieve cost and schedule performance, and a willingness to accept and encourage workers' suggestions were evident across the site. Managers were building trust with most of the workforce, but needed to address continuing worker distrust of the injury case management process.

BNI has an experienced management team at the WTP construction site. In some cases, managers have been at the site since the beginning of construction. In other cases, BNI has assigned new managers since the last assessment that bring a wealth of experience from other BNI construction projects. Many of the managers have backgrounds that include construction craft experience and understand the workers' perspectives. Overall, the management team understands the complex problems associated with this project and is working to achieve optimal results despite the myriad of challenges presented.

All the managers interviewed genuinely demonstrated their belief that safety is a core value and consider safety as an essential prerequisite to successful, quality, project completion. They each expressed an understanding that although priorities may change, the values of safety and quality would not. To reinforce these values, WTP developed leadership covenants that establish expectations for managers and supervisors to help treat each other with respect, provide open and clear communication and to earn trust based on the Institute for Nuclear Power Operations attributes for a nuclear safety and quality culture. Although this belief has permeated the senior management team, as described later in Employee Involvement, they have not succeeded in convincing a broad segment of the workforce of that belief.

BNI continues to maintain an extensive set of policies and procedures that establish the roles, responsibilities, authority and accountability for the safety of all personnel. These policies and procedures incorporate the requirements of title 10, Code of Federal Regulations, part 851, *Worker Safety and Health Program* (10 CFR 851), and Integrated Safety Management (ISM). These policies include the right of workers to pause or stop work, raise safety questions and issues, and observe testing and monitoring in the work place. BNI managers signed and committed to a "Zero Tolerance for Retaliation" policy that reinforce those rights.

BNI is providing resources to conduct work safely. There are both field safety and field industrial hygiene (IH) organizations at the construction site that are available to conduct field inspections, perform monitoring for hazards, and provide subject matter expertise if safety

questions arise. Tools and equipment are readily available as is personal protective equipment (PPE). Workers are free to obtain replacement PPE, such as safety glasses and hearing protection, from tool issue points.

Corporately, BNI has set aside considerable resources to invest in new technology to improve the efficiency, productivity and safety of its construction workers. BNI has used these resources at WTP to support innovations discussed later in this report, such as the development of training simulations for worksite inspections, the use of 360-degree view wireless cameras, and virtual reality (VR) simulations developed from actual plant configuration and equipment. The investment in these technologies further demonstrate the BNI core value that quality and safety result in improved production and efficiency.

In 2013, managers had lost the trust of a significant portion of the workforce, primarily related to reporting of injuries and accidents. Since that assessment, BNI has modified the way it conducts injury investigations. Personnel investigating injuries no longer begin the interviews in the medical facility treatment areas. Instead, they have separate, private areas where they can investigate relevant details. BNI continues to pursue the investigations quickly, and workers still perceive the process for reporting an injury as cumbersome at best. Some workers continue to state they will not report minor injuries rather than face the investigation process. Managers want to gain and retain workers' trust and help workers successfully perform work. While most workers interviewed by the Team trusted their managers, some remained neutral or unsure of the managers' commitment to safety, citing the lack of senior managers' visibility in the work areas as the primary reason. Most managers interviewed by the Team agreed that they do not get into work areas as much as they want to, but few managers were making a deliberate attempt to spend more time walking the spaces.

BNI is creating more opportunities for managers to conduct field visits by reducing the number of meetings and ensuring meetings are efficient by implementing a quality meeting procedure. This process requires that a meeting have a specified agenda, identify required attendees to fulfill that agenda, and include a short discussion at the end of the meeting to rate the meeting and determine if the meeting met the objectives. Meetings observed by the Team followed this template.

Managers, like workers, are frustrated with slow progress, changing priorities, extensive rework, uncertain funding and the lack of reliable project milestones. These conditions arise from the processes put in place by DOE to manage the project, ensure sufficient credibility in the design process, incorporate concerns by the varied stakeholders and meet milestones agreed to between DOE, the Environmental Protection Agency and the State of Washington. Managers are hopeful that all stakeholders will agree to final decisions in the coming months, and that DOE will be able to provide the necessary funding to implement fixed project milestones. This will allow BNI to stabilize and plan the workforce structure, smoothly transition from construction to commissioning and operation of the LAW and Laboratory, and resume construction activities in PT and HLW without losing its currently trained and qualified workers.

Managers have been unsuccessful motivating the workforce to contribute to workplace safety improvements. They did not have effective tools to personally recognize workers for their contributions to a safe work environment, and relied primarily on discipline for workers that did not follow safety rules. During interviews, managers expressed that they appreciated the efforts of the small portion of the population that were engaged in the safety program, but had few tools

to demonstrate that appreciation. Most rewards identified during this assessment consisted of cash incentives. Rewards for safety were primarily "drawings" where workers were not certain of recognition for their efforts, and participation in the drawings required only token efforts by workers, such as completing a simple puzzle and submitting it. The result was that workers had little or no incentive to participate in safety improvement programs, and reacted negatively to personnel pointing out at-risk or unsafe work practices.

In some cases, managers have not effectively demonstrated the desired safe behaviors they expect from workers. The Team observed supervisors (foremen and superintendents) not following proper safety practices in construction areas, such as not wearing hearing protection, not wearing safety glasses, crossing under barriers, or ignoring similar conditions in work areas. Foremen and superintendents did not identify missing safety barriers, poor housekeeping practices, or other at-risk conditions and behaviors in the work areas, by default accepting those conditions. This acceptance of deviations from the stated BNI standards has led to normalization of these deviations within the workforce. Many workers, when asked about these conditions, stated "it isn't a problem" or "it doesn't bother me."

Managers are not taking enough time to interact with workers in the workplace. A significant number of workers interviewed were either ambivalent or negative in their opinions of managers' motives regarding safety. Many workers still do not trust managers that have been onsite for 2 years or more.

Managers are relying on behavioral observations from the Craft Safety Watch (CSW) program and focused observations by supervisors to identify and correct unsafe behavioral trends or conditions, but these programs are not fulfilling that objective. Despite efforts to publicize these programs as anonymous or "no fault," many workers consider the observations as attempts to get them in trouble. The culture of the manual workforce has not advanced to a level of self-accountability where behavior-based safety is an effective tool. The number of at-risk behaviors observed by the Team is not consistent with the number of at-risk behaviors reported by CSW (see Employee Involvement).

BNI performs an annual self-assessment that focuses on a survey of the current plant population. Workers on the various safety committees perform the survey, asking specific questions, and recording the answers. The results are tallied and analyzed, then compiled into a report structured around the five tenets of DOE-VPP. The 2015 report ranked four of five tenets as "Excellent," with Employee Involvement receiving 8.11 out of 10, a significant increase from 2014. That score stands in stark contrast to conditions observed by the Team during this assessment. As discussed in Employee Involvement, only a limited portion of the workforce is fundamentally involved in the structure and function of the safety program, and BNI focused its evaluation primarily on workers' ability and willingness to raise safety questions or issues, and workers' perceptions that "this is the safest place I've ever worked." This does not adequately reflect the DOE-VPP expectation that "Employee participation is in addition to each employee's individual right to notify appropriate managers of hazardous conditions and practices." BNI managers need to broaden their personal expectations for Employee Involvement, provide resources to the various safety committees to operate relevant campaigns to stimulate employee involvement, and find more effective, objective measures of employee participation in those activities.

Opportunity for Improvement: BNI managers need to broaden their personal expectations for Employee Involvement, provide resources to the various safety committees to operate relevant campaigns to stimulate employee involvement, and find more effective, objective measures of employee participation in those activities.

Conclusion

BNI managers are committed to achieving and maintaining a world-class safety program at WTP, but have not successfully convinced the workforce of that commitment, fully earned workers' trust, and motivated the workforce to help them achieve that goal. Managers appreciate the efforts by a small segment of the workforce that are trying to accomplish this goal, but need to provide resources to encourage broader segments of the worker population to become engaged in the safety program, and to demonstrate the Management Leadership expected of a DOE-VPP participant.

IV. EMPLOYEE INVOLVEMENT

Employees at all levels must continue to be involved in the structure and operation of the safety and health program and in decisions that affect employee health and safety. Employee involvement is a major pillar of a strong safety culture. Employee participation is in addition to the individual right to notify appropriate managers of hazardous conditions and practices. Managers and employees must work together to establish an environment of trust where employees understand that their participation adds value, is crucial, and welcome. Managers must be proactive in recognizing, encouraging, facilitating and rewarding workers for their participation and contributions. Both employees and managers must communicate and collaboratively participate in open forums to discuss continuing improvements, recognize and resolve issues, and learn from their experiences.

In 2013, the Team found that employee involvement at BNI had matured significantly since 2010. Most of the construction workers exhibited ownership of their coworkers' safety through the *My Brother's Keeper* concept. Workers freely and without prompting identified and reported issues, process improvements, work package issues, and participated in safety committees and programs.

BNI provides opportunities for employee engagement and participation to help improve site processes, procedures, and identification of and suggested solutions to issues. Those opportunities include possible participation on numerous standing safety committees. Committees include specific areas of concern, such as the Electrical Safety Committee (ESC), employee-driven committees focused on employee concerns and actions, and the Zero Accident Council (ZAC) that coordinates the inputs from various committees described below.

The ESC supports BNI's goal of achieving zero accidents and errors, specifically focused on electrical safety. Electrical safety has become more of a concern over the past several months as normal power replaces temporary power supplies used for construction, and utilities become energized. The committee promotes safe electrical work practices and communicates those work practices to employees to prevent injuries from electrical hazards.

The Developing Responsibility in Vehicle and Equipment Safety (DRIVES) team focuses on vehicle safety and suggestions on how to improve vehicle safety onsite. This committee grew from the former Lift Safety Committee when committee members recognized that similar hazards experienced with cranes and forklifts applied to other rolling equipment around the construction site. They respond to low-level vehicle incidents (minor events), communicate lessons learned involving mobile equipment and provide input for mobile equipment safety.

The CSW, formerly the Safety Education Through Observation or SETO, focuses on creating a safer work environment through behavioral observations, education, and increasing worker awareness. BNI is revising the charter due to the rebranding this year. BNI expects the revisions and rebranding will encourage increased participation.

The Construction Safety Alliance (CSA) is the joint labor management safety committee, chartered by the ZAC to promote site alignment and communication for VPP and encourage employee involvement and ownership in achieving the project's goal of zero accidents. The CSA gathers safety feedback from craft and nonmanuals about opportunities for improvement, safety logbook issues, and communicates safety information.

BNI created craft safety representatives (CSR) as safety advocates for workers. The CSRs share and seek solutions from workers, solve safety and health concerns, and convey ideas to safety assurance and construction management in a professional and direct manner. The CSRs provide an avenue for workers to bring up health and safety concerns without fear of retribution. The CSRs work closely with the ZAC and those committees that make up the ZAC.

The ZAC guides and manages safety improvements at the construction site by coordinating the efforts of safety committees, organizations and individuals. Championed by the construction manager, the ZAC uses available resources to promote this objective. Representatives from the other committees and safety teams attend the ZAC meetings and communicate accomplishments and issues for the committee's consideration.

In 2013, BNI's behavior-based safety program SETO had made significant improvements by documenting a charter, training most employees and continuing to encourage observations. Since that time, support and participation in SETO waned. BNI is trying to regenerate interest in behavioral observations, so it rebranded SETO as CSW. Previously, BNI trained most of the construction workforce to conduct observations using SETO, but participation rates were low. Now CSW uses a smaller group of trained members to perform longer observations and identify both safe and at-risk behaviors using a tally sheet. Initially a full-time, 10-week assignment, CSW now assigns members on a rotational 20-hour observation week. Each observer must perform four observations each week. The observers also interact with the personnel they are observing. The Team attended its committee meeting. They discussed ongoing challenges and reviewed examples of behavior-based safety observations and employee responses. There were 93 safety observations performed in October 2016. While most employees responded to observations with positive dialogue with the observer, the committee also discussed the challenges posed by individuals who are not comfortable with observations, and several who responded in a negative fashion. The CSW is exploring ways to encourage and revitalize the interest and benefit of these observations with craft. BNI should allow the CSW to work with other VPP participants, both on and off the Hanford site, to incorporate best practices and lessons learned in behavioral observation programs that will improve the effectiveness of its observations, encourage more workers to participate in the program, and revitalize workers' acceptance of observations.

Opportunity for Improvement: BNI should allow the CSW to work with other VPP participants, both on and off the Hanford site, to incorporate best practices and lessons learned in behavioral observation programs that will improve the effectiveness of its observations, encourage more workers to participate in the program, and revitalize workers' acceptance of observations.

Safely Speaking continues as a forum where managers and employees present safety topics and other useful information to the workforce. Topics may include winter driving, recent event investigation results and new processes. The *Safely Speaking* safety meetings occur such that every employee attends weekly. The Team attended both day shift and night shift meetings and the forum and presentations were consistent. The managers were present, but not intimidating. Employees presented safety topics and managers provided opportunities for the craft to ask questions or solicit clarification from presenters. Several craft asked questions for clarification and the exchanges between workers, managers and subject matter experts (SME) were very professional. During the day shift meeting, one of the CSRs was asked if he had any input. He provided an excellent explanation of why spotters are vital to safe operation of vehicles.

The CSRs continue to be a bridge between managers and workers to promote safety. The Team observed CSRs openly and effectively communicating with craft and supervisors. For example, a vehicle operator conferred with a CSR about workers walking in the road, and the CSR told the vehicle operator about proposed actions by management to prevent that situation. CSRs are now an integral part of committee meetings with their input solicited by individual committee chairs, including ZAC. The Team observed managers asking CSRs for employee suggestions and recommendations, such as getting involved in correcting some observed safety deviations in the LAW building.

BNI continues to use "Operation Zero" as an employee involvement tool. Employees can complete safety-related activities on a monthly basis. Employees are encouraged to participate in up to three activities per quarter to be eligible for the random $500 drawing awarded to several employees each quarter. Managers and superintendents can also award employees with on-the-spot awards for safety or quality contributions. As discussed in Management Leadership, these awards are not creating any significant desire within the workforce to participate in safety programs.

Plan-of-the-day (POD) and prejob meetings continue to provide workers an opportunity to ask questions, raise issues or recommend alternative approaches. The Team attended POD meetings and prejob meetings that included discussion of the upcoming day's work and job-specific tasks respectively. At the worker level, the Team observed good interaction and engagement at prejob briefings by workers. Several workers asked questions for clarification. Prejob meetings also offered an opportunity for workers to provide input to sequencing and installation of equipment to field engineers.

Employees generally stated that they feel empowered to correct another's unsafe actions or stop work, and acknowledge that stopping or pausing work is BNI's expectation when questions or issues arise. Despite this stated understanding, observed workers were not acting as *My Brother's Keeper*. The Team observed numerous conditions that demonstrated workers' ambivalence towards BNI's safety rules and safety expectations. For example, the Team observed partially empty water bottles on energized spider boxes and employees allowing those bottles to remain there. Several times the Team observed employees traversing or working in areas posted as "hearing protection required" areas without using hearing protection, again without other workers intervening. The Team also observed equipment operators and drivers not stopping for stop signs and or exceeding the posted 10 miles per hour zones on the construction site. In some cases, the Team saw supervisors smoking while walking past no smoking signs and smoking between buildings. In a few cases, high-pressure gas bottles were incorrectly stored, and workers ignored the condition. The general willingness of workers to accept deficient conditions or practices without intervening is in direct contrast to the efforts BNI has spent training them to identify these conditions and take corrective actions.

Employee-driven safety committees, such as CSW and DRIVES, are struggling to get craft volunteers to serve on committees. Interviews with workers found a reluctance to participate in these activities because of the perception that their supervisors would reduce their overall employee rating. Some current safety committee members believed that supervisors reduced the safety rating piece of their three-part rating because they volunteered to serve on these committees. Another similar comment about the rating system received by the Team involved instances where supervisors down-rated employees that did not participate in the morning stretches even though the stretching program is voluntary. Other workers commented they questioned management commitment to safety because they had established a policy that

prohibited the use of overtime for behavior-based observations. Although the Team could not investigate each of these concerns, the existence of these perceptions demonstrates the challenge BNI faces in employee involvement and ensuring the entire supervisory and management chain of command supports and encourages effective worker participation in the safety program, not just compliance with safety rules.

Numerous influences onsite may be contributing to the observed attitudes regarding safety. Although intended to be a conduit between workers and managers, some workers may distrust CSRs. BNI has hired previous CSRs out of the craft into nonmanual positions, and some workers perceive CSRs as "company" men rather than union safety advocates. One CSR believed that employees were less vigilant and satisfied with the status quo because there have not been any serious injuries recently. Other influences included a lack of management visibility in the work areas, supervisors not leading by example, and an overemphasis on discipline for not following the rules rather than recognition for following the rules.

In some cases, supervisors have ignored or responded improperly when employees raised a safety concern, discouraging employees from raising future concerns. For example, the BNI *Stop the Drop,* using lanyards, reduced falling objects from elevated work areas. However, some lanyards consist of a bungee cord with an attached "D ring." A concerned employee identified that the D-ring could catch on equipment and then spring toward the user. The employee brought this to the attention of a foreman and requested a different lanyard that was not a bungee. The foreman (incorrectly) told the employee that those lanyards were only for journeymen. The employee later suffered an injury later when the "D ring" caught on a tool bag and sprang toward the employee when it dislodged.

Another employee related a situation where the employee questioned the manufacturer's information and current training information relating to issuing a powered-air purifying respirator (PAPR). The employee was concerned that the loose fitting drape over his shoulders presented a hazard when using a grinder for the work he was assigned. He requested a different type of PAPR that did not have the loose fitting drape, but the worker at the respirator issue point would not issue the desired PAPR because of facial hair. The concerned employee disagreed that his facial hair would interfere with the respirator fit and decided to confer with an SME. According to the employee and others that were present, the individual conferred with the SME in a constructive, questioning attitude. The employee later had a conversation with his superintendent, who was required to follow up on the concern, which the employee perceived as a verbal reprimand for exhibiting a questioning attitude. BNI is reviewing the training material for respirator use, clarifying respirator issue requirements, and trying to avoid future confusion for respirator users. BNI needs to assure worker concerns are addressed without fear of retaliation or apprehensiveness due to their level of experience or position in the organization.

Finally, the CSW meeting discussed two instances of negative interaction between observers and workers. These instances centered on a worker responding with "I don't have a problem with it, why should you?" Whether or not the negative worker response was the result of other influences was never discussed, nor was there a conclusion or solution offered on how to avoid these negative events.

BNI needs to provide foremen, superintendents, and managers with tools and training on recognizing and encouraging employee involvement in safety programs in order to achieve the level of employee ownership and involvement expected at a DOE-VPP site.

Opportunity for Improvement: BNI needs to provide foremen, superintendents, managers, and committee members with tools and training to (1) recognize and encourage employee involvement in safety programs, (2) increase managers' visibility in the work areas, (3) ensure supervisors are leading by example, and (4) assure workers' concerns are addressed without fear of retaliation or apprehension due to their rank or position (apprentice, journeyman).

Another contributor to the aforementioned ambivalence could be inconsistency between requirements and practices for PPE onsite. Procedure 24590-WTP-GPP-SIND-025-Rev 7, *Personal Protective Equipment,* paragraph 5.1.3, states, "hardhats should be worn at all times while on the WTP construction site except when employees are inside vehicles, in offices or trailers, taking lunch breaks, provided that no work is in progress in the immediate area and walking to or from office building to parking lot on designated pathways." In paragraph 5.1.4, *Eye and Face Protection,* the procedure states, "safety glasses that meet the specifications of ANSI Z87 shall be worn at all times on the WTP site, except when in office trailers and when goggles are worn (unless the activity calls for double eye protection)." The employee handbook echoes these requirements. BNI has marked certain walkways onsite with signs indicating that PPE is not required within these walkways when arriving late to work, or leaving early from work to allow workers to get to and from their lockers without having to take PPE home. Most workers traversing the site were observed wearing their hardhats and safety glasses. However, some workers are developing a habit of not wearing PPE whenever they are in those walkways, and sometimes failing to don their PPE when they exit those walkways. In other cases, the Team observed some workers not wearing PPE outside those walkways at the beginning or end of their shift. BNI should review the procedures and postings for PPE usage, ensure they are consistent, and reinforce those requirements to workers.

Opportunity for Improvement: BNI should review the procedures and postings for PPE usage, ensure they are consistent, and reinforce those requirements to workers.

The Employee Involvement tenet of DOE-VPP focuses on opportunities beyond the right to stop work, raise safety issues without fear of retaliation, and receive support from the management and leadership of the company to address safety concerns. Outside of safety committee membership, safety logbooks, and communicating with CSRs, supervisors, or professionals, there are few opportunities for workers to become involved in safety activities. Apprentices are restricted from committee membership until they reach the journeyman status. BNI limits participation at the Regional or National-level Voluntary Protection Programs Participants' Association conferences to those individuals who are safety professionals, CSRs, or safety committee members. BNI needs to develop broader opportunities and activities which workers can participate in that reinforce and encourage safety awareness and safe behaviors and result in assured rewards for employees consistent with the level of effort and expected value of participation rather than cash awards from random drawings.

Opportunity for Improvement: BNI needs to develop broader opportunities and activities which workers can participate in that reinforce and encourage safety awareness and safe behaviors and result in assured rewards for employees consistent with the level of effort and expected value of participation rather than cash awards from random drawings.

Conclusion

The Team observations indicate BNI has not adequately involved a significant portion of the workforce in a sustainable culture seeking continuous improvement. Some workers do not feel free to voice their concerns without being apprehensive about the outcome. Worker ambivalence toward safety rules, lack of involvement and engagement with fellow workers relating to observed safety conditions, and minimal presence in the work areas by management are contributing to a decline in Employee Involvement at the WTP. BNI needs to find methods to establish personal acceptance and ownership of safety by every worker, supervisor, and manager to develop the Employee Involvement expected of a DOE-VPP participant.

V. WORKSITE ANALYSIS

Management of health and safety programs must begin with a thorough understanding of all hazards that might be encountered during the course of work and the ability to recognize and correct new hazards. Implementation of the first two core functions of the integrated safety management system (ISMS), defining the scope of work and identifying and analyzing hazards, form the basis for a systematic approach to identifying and analyzing all hazards encountered during the course of work. The results of the analysis must be used in subsequent work planning efforts. Effective safety programs also integrate feedback from workers regarding additional hazards that are encountered and include a system to ensure that new or newly recognized hazards are properly addressed. Successful worksite analysis also involves implementing preventive and/or mitigating measures during work planning to anticipate and minimize the impact of such hazards.

In 2013, the Team determined that BNI has processes in place to identify and analyze hazards associated with work performed at the WTP construction site. The hazard baseline was current and industrial hygienists regularly sampled for hazardous material. BNI built upon previous VPP opportunities for improvement by enhancing the STARRT cards' role in hazard analysis, enhanced employee involvement in prejob and hazard walkdowns, continued focus on behavioral-based safety, and leading indicators.

BNI field engineers use 24590-WTP-GPP-WPHA-001, Rev7, (2016), *Work Control and Work Packaging*, to develop the work packages for the construction of the WTP. The work package incorporates the automated job hazard analysis (AJHA), a computer-based tool that assists the hazard analysis process for work. Engineers can develop entirely new work packages or modify existing work packages to accomplish the work by following the work package cover sheet and instructions. The engineers initially walk down the work to understand the scope and potential hazards and then work closely with superintendents to discuss the project needs and workscope. The engineer then involves craft workers, superintendents, safety assurance and other functional area SMEs by walking down the work together using a hazard identification checklist to identify and analyze the hazards of the project and discussing potential controls and permits. Afterwards, the engineer populates the AJHA with the hazards and controls. Superintendents, safety, IH, and other functional area SMEs review and update the work package and AJHA content until they agree with the selected hazards and controls. Upon final approval, workers are required to read and understand the hazards and controls outlined in the AJHA and subsequently read and review on an annual basis.

BNI maintains a suite of Safety Analysis Technical Basis documents that document the analysis of many common hazards found on the construction site. These documents capture the justification for the controls selected for a variety of activities common to construction activities, such as working from elevated platforms, selection of footwear, falling object protection from scaffolds, lasers, and welding. These documents can be referenced within an AJHA rather than having to perform additional analysis during work planning.

BNI maintains, updates, and samples for exposures that occur on the construction project. 24590-WTP-GPP-SAIH-001, Rev 5, (2016), *Chemical and Biological Exposure Assessments Strategies*, along with IH knowledge, guides the analysis of potential exposures onto exposure assessment estimate worksheets. The estimates include the safety data sheets (SDS) of the chemical or substance, exposure data from similar processes, applicable exposure standards, and

an IH analysis of the activity and relevant potential exposures from other sources. This information helps develop the exposure control plan (ECP), which describes the activities and recommends hazard controls based on the exposure assessment worksheet. The AJHA references the ECP document. For example, the work package 24590-CWP-WMS0005-00, *Mechanical Skill of the Craft Tasks and Activities*, references the ECP document number and the particular respirator for the hazard on the AJHA. Other work packages had the same level of respiratory protection detail included in the AJHA. In addition, if workers require respiratory protection qualifications for a work package, that requirement is included in their employee job task analysis (EJTA). The EJTA is an analysis for a specific worker that includes anticipated PPE, physical demands of the job, and anticipated exposure hazards. BNI then provides medical exams based on the EJTA. Potential exposures may require medical surveillance for biological exposure indices. In general, BNI provides controls in the AJHA to prevent workers from making wrong decisions or using improper controls.

To complete the analysis of an exposure hazard, IH conducts air sampling based on a developed exposure surveillance plan. Sampling ensures the estimates for the hazards are accurate and the controls are adequate. The current highest hazards for BNI are crystalline silica and hexavalent chromium, primarily from grinding on coated stainless steel piping and vessels. BNI has sampled these exposures and demonstrated that controls adequately protect the worker. BNI has over 3,700 sampling events for a multitude of processes and associated activities. To organize and analyze this data, BNI hired a certified industrial hygienist (CIH) with a certification in exposure decision analysis. The IH team is working to bundle similar work operations that produce similar exposures to improve data management. The IH team is in the process of developing this method. Discussions with the CIH indicate that BNI did not adjust occupational exposure limits (OEL) to reflect the 4-day, 10-hour workweek change since the last VPP assessment. The CIH based that decision on measurement data that indicated typical worker exposures were less than the longest measured exposure of 6 hours. The CIH realizes that if exposures longer than 8 hours occur, he needs to adjust the OEL accordingly. The IH staff conducts exposure baselines and strongly support worker requests for information and monitoring.

Superintendents provide a work package prejob briefing with all craft assigned to the work package prior to its release. As the superintendent discusses the work package, craft have the opportunity to raise issues to ensure understanding of the work package items, such as hold points, permits, PPE requirements or AJHA. The prejob worksheet documents issues identified that need resolution prior to the start of the project. Safety professionals, facility safety and other functional areas attend the prejob briefing to provide expertise as needed. After the start of work, superintendents and craft review the work package annually to provide revisions or verify the conditions of the work package. The field engineer coordinates any changes to the work package with safety and health to complete the update. The Team reviewed several work packages and the date of review did not exceed the 1-year period.

Craft commonly work from several work packages as work shifts to different areas within the construction project. The electrical craft in the LAW facility work to 12 work packages, with 3 separate work packages tailored for each of the four levels of the LAW. The hazards can vary on each floor during the construction, justifying a hazard analysis for each floor. AJHAs may be lengthy, and take several hours to review before starting work. To focus workers from the abundance of information available to them in the work packages, BNI uses the STARRT card. 24590-WTP-GPP-WPHA-002, Rev4, (2015), *Hazard Analysis and Contro*l, outlines the process

to complete the STARRT card with specific tasks to be performed, proper controls from the AJHA, likely error precursors, actions to prevent those errors, and a review of other activities in the area that may affect their work. The card also identifies the types of hazards, PPE, weather, and feedback for improvement. The Team found that workers rely on the STARRT cards and the information it provides. One foreman stated that he emphasized the Talk (in STARRT) between his workers to identify the daily hazards encountered as they installed cathodic protection throughout the site. The cards helped identify other hazards in the area and focused his craft to finish the project earlier than planned. In most situations, the craft workers and foremen had a solid understanding of the jobsite/work-related hazards for the specific task and the immediate worksite conditions. In some limited cases, workers and foreman were not attentive to the hazards and controls identified in the AJHA when using the STARRT cards (see Hazard Prevention and Control).

BNI conducts weekly facility safety walkdowns at the HLW, Laboratory, LAW, the equipment maintenance facility and some other direct support facilities on the construction site. A superintendent leads a team of craft to inspect the facilities for safety issues. The team prepares a report of findings and open items are logged into the integrated safety observation database. Findings roll up to the POD for management action until they are closed. BNI also posts supervisory safety watches on Tuesday, Wednesday and Thursday. Observers rotate from a pool of managers, foremen, general foremen, superintendents and field engineers. They can use checklists from the software database, as well as their own knowledge and experience to record observations they make throughout the day. In one report, the observer noted a worker entering into the crane swing radius red tape barrier to conduct work. The observer raised the issue to safety assurance to investigate. The distributed support group (Distribs), which includes a variety of distributed services, such as warehousing and rigging, conducts its own facility safety walkdowns so that each facility receives a review approximately three times a year. They walkdown a facility weekly with a group of up to nine workers. Open items from the walkdown roll up into their weekly staff meeting until closed. Although the Distribs facilities receive formal reviews less frequently, managers, safety, superintendents, and others constantly walk through the facilities and raise issues that need attention.

BNI tracks several metrics. The WTP project health dashboard tracks safety metrics like TRC, DART, Occurrence Reporting and Processing System (ORPS) events and worker exposures above the OEL. BNI reviews indicators and identifies trends and improvement actions via the *Safety Impact Plan (SIP)*, 24590-WTP-PL-SA-16-002. This plan reviews the previous calendar year (CY) trends, areas for improvement, and initiatives. Actions are tracked through the SIP line items that identifies the responsible organization, manager, and status of the action. Included for CY 16 are improvements in hand safety, hazard recognition, STARRT card improvements, supervisor engagement in safety, improvements for slips, trips, and falls, and the phase I implementation of ISMS for Commissioning and Operations. The weekly "Safety Body" is a visual display that represents TRC, DART and first-aid statistics for the construction site and material handling facility, using a diagram of a human body. Half of the first aids and injuries occur in the arm area. BNI reports a quarterly performance and recurring events analysis report to DOE Office of River Protection. The report includes mostly the ORPS cases that occurred in the reporting period and some special projects like the training of supervision and craft on the phase I and II of the WTP Project Hazard Analysis Simulator. The report also includes the tracking of injuries by body part similar to the "Safety Body." BNI primarily tracks lagging indicators and could benefit by identifying, tracking and reporting on more leading indicators. Examples of leading indicators might include the amount of time managers spend in workspaces,

the number of safety issues raised by workers, time since last work pause or stop work (by area, work group, or plant location), the number of personnel being observed by CSW, the number of personnel participating in identifiable safety improvement or awareness activities, and others. BNI should identify and track leading indicators that are relevant to its safety culture, particularly indicators of employee involvement.

Opportunity for Improvement: BNI should identify and track leading indicators that are meaningful to the understanding of its safety culture, particularly indicators of employee involvement.

Workers anonymously raise safety issues by using the safety logbooks located across the construction site. The Team reviewed the logbook in the Safety Speaking facility and almost all the issues are anonymous. Craft safety team members investigate the issues and document the results in the same logbook and brief workers on the results at the Safety Speaking meetings.

Workers understand the work rules infractions and progressive discipline as described in the Employee Handbook. Safety assurance reviews all accidents and presents a fair representation of the events. The investigation team includes the superintendent, union steward, employee concerns, human resources, labor relations and safety assurance. Currently, BNI has one union steward trained in accident investigations. The craft presents its observations of the accident in a nonthreatening environment. The Team interviewed a worker who was involved in an accident moving ecology blocks from a flatbed to the ground. The craft discussed details of the accident with their superintendent, including how the accident occurred, and what procedures for equipment operation were required. The craft stated the BNI conducted the investigation in a fair manner.

Conclusion

BNI has a consistent approach to identify hazards and analyze those hazards to recommend controls to protect workers. Craft and safety and health professionals are involved in the development of the AJHA, which captures the hazards and controls, and references the hazard analysis in support documents. Workers rely on STARRT cards to help them analyze their daily work environment and focus on the hazards they may encounter during their work shift. BNI has several teams that conduct facility inspections and uses that opportunity to observe work and the conditions of work areas. BNI tracks several lagging indicators, and should adopt leading indicators to improve employee involvement. BNI meets the overall DOE-VPP expectations for Worksite Analysis.

VI. HAZARD PREVENTION AND CONTROL

The second and third core functions of ISMS, identify and implement controls and perform work in accordance with controls, ensure that once hazards have been identified and analyzed, they are eliminated (by substitution or changing work methods) or addressed by the implementation of effective controls (engineered controls, administrative controls, or PPE). Equipment maintenance processes to ensure compliance with requirements and emergency preparedness must also be implemented where necessary. Safety rules and work procedures must be developed, communicated, and understood by supervisors and employees. These rules and procedures must also be followed by everyone in the workplace to prevent, control the frequency of, and reduce the severity of mishaps.

In 2013, the Team concluded that BNI effectively used engineering, administrative, and PPE, while also identifying materials, methods and products that eliminated or minimized hazards. Engineering controls were available for use during welding, cutting, grinding and confined space entry. The improvement to the flying loads/hoisting and rigging administrative controls was evident. In addition, continuous improvement of controls was observed during the assessment with the color-coded, confined space ducting and providing workers individual water bottles that were available throughout the construction site. Craft workers were vigilant in performing safety inspections of various tools and systems.

BNI uses the hierarchy of controls in a variety of ways across many crafts. It mitigates hazards using engineering and/or administrative controls, as well as PPE. One example includes a situation where electricians recognized they could adapt a pipefitters' tool known as a "Grasshopper" to move and position heavy electrical equipment. The Grasshopper, a manual, nonmotorized, two-wheeled lever, mitigates the hazards associated with lifting heavy equipment.

BNI has continued its campaign to prevent items from falling from elevated work areas. The campaign called *Stop the Drop* focuses on preventing injuries caused by falling objects. The actions included focused prejob discussions on elevated work, not taking material up to work platforms if not needed, tying off (lanyard) tools when working on elevated platforms, and ensuring spotters and other personnel were not near areas where falling objects are possible. Because of the continued efforts, BNI has significantly reduced near-misses from falling objects.

Construction work presents a wide variety of hazards to workers. To protect workers, BNI uses PPE extensively at the WTP, and describes PPE requirements in BNI Procedure 24590-WTP-GPP-SIND-025, Rev 7, *Personal Protective Equipment*. BNI maintains the PPE and involves the workers in the selection and implementation of PPE. BNI has a strong emphasis on glove use, and BNI has a dedicated safety professional who seeks out new gloves for evaluation, distributes gloves to various craft workers for evaluation and requests glove performance feedback. The implementation of a wide variety of gloves evolved from worker feedback and management acknowledgement of protection needed for the hazards that workers encounter at the site. These efforts of identifying and using gloves appropriate for the type of work has resulted in a decrease in hand injuries.

BNI requires all personnel wear hardhats, safety glasses, and sturdy work boots while on the construction site with some exceptions. Any worker handing material or performing work must wear work gloves. Other gloves, respirators, hearing protection and fall protection are also commonly required dependent on work tasks. During site walkdowns, Team members reported many instances where workers were not wearing required PPE, typically safety glasses or

hearing protection, in work areas, such as craft shops and the LAW. In the carpenter shop, signs specifically prohibit safety glasses with dark lenses, yet the Team observed workers transiting the shop with dark lenses in their safety glasses. Although the CSW is conducting workplace observations and BNI has the *My Brother's Keeper* program to minimize these behaviors, the programs have not effectively changed workers' behaviors or attitudes.

Most areas observed at the WTP are free from clutter, loose tools, trash and debris; however, the Team observed some areas where housekeeping needed improvement. Poor housekeeping examples included abandoned gloves, discarded wire ties, food wrappers, empty water bottles, abandoned rigging equipment, tool carts piled high with equipment, and flammable cabinets with containers leaking because they were laying on their side. In a few cases, workers had tied compressed gas cylinders with ropes, contrary to site policy that required chains.

The Team visited the Material Handling Facility during this assessment. The facility stores components for installation at the WTP. Some storage areas are climate-controlled, such as the area storing glass for the laboratory hot cells. Other storage areas include outside storage for piping and large components, such as tanks. The facility was neat, clean and well organized. Efforts to reduce potential injuries from lifting and moving material include, procurement of jack stands for staging material, material movers (dollies, pallet jacks), wrapping stations, and various forklifts (electric, gas, and propane). Charging stations inside the facility included eyewash stations (required by OSHA) nearby with no obstacles to impede employees from using the stations. Workers interviewed were proud of their efforts to keep the facility neat and clean with emphasis on assuring a safe workspace.

For the past several months, BNI has been changing cathodic protection for buried utilities and installing utilities associated with the direct feed LAW project. This work resulted in a large number of open excavations that remained open for extended periods. To ensure workers properly inspected these excavations before other workers entered, craft workers suggested an administrative control adapting the scaffolding tagging system for use with excavations. BNI uses a tag on all scaffolds that indicate the scaffold owner, its status (i.e., ready for use), and the date of the last inspection. Based on the workers' suggestion, BNI adopted a similar tag for open excavations. The tags show contact information for the excavation owner, and job status for workers, which allows for coordination of work near existing excavations.

Ladders are a leading cause of injuries in construction. BNI has established worksite policies that limit work from ladders. Scaffolding, scissor lifts and man-lifts are the preferred option to reduce these risks. Scaffold use at the WTP is extensive. While well-constructed scaffolding increases worker safety compared to ladders, it can pose its own risks. Scaffolding erected in tight quarters often presents hazards due to overhead obstructions above access ladders. The Team observed many instances of good practice where administrative controls in the form of caution signs posted on access ladders forewarn users of these situations. In addition to using the manufacturer's recommended scaffolding assembly/training programs, BNI hired a person from a scaffolding manufacturer with extensive scaffolding knowledge. This has helped BNI ensure proper use of scaffolding and provide stable and compliant working surfaces that increase safety for workers. BNI conducts frequent and periodic inspections per OSHA standards. A color-coded tagging system signifies the status of inspected scaffolding.

To help workers focus on important information from work packages, BNI uses the STARRT card. Procedure 24590-WTP-GPP-WPHA-002, Rev 4, *Hazard Analysis and Control*, describes

how to complete the card on a daily basis. In 2013, the Team found that craft relied heavily on their STARRT cards to conduct the daily prejob, which included identifying the work packages, specific tasks, proper controls from the AJHA, error likely precursors, actions to prevent those errors, and a review of other activities in the area that may affect their work. The card also specifies the types of hazards, PPE, weather and feedback for improvement. In 2016, the Team found that workers continue to rely on STARRT cards.

The procedure 24590-WTP-GPP-WPHA-002, Rev 4, *Hazard Analysis and Control*, paragraph 4.3 states in Note 1, "The results of the Activity Hazard Analysis process (identified hazards and controls) may be documented directly in the job instruction/startup instruction or the AJHA output report and are considered the Hazard Control Document (HCD)." In paragraph 4.4, of the *Safety Task Analysis & Risk Reduction Talk* (STARRT) procedure it states, "…the STARRT card augments the hazard analysis process, as such, the STARRT card cannot be used as the sole hazard control document." The procedure also states, "The STARRT card is used to accomplish the following:

> *Represents the most current review/discussion of hazards, environmental aspects, and their controls based on the HCD before work execution is initiated ensuring the controls are in place.*"

In most STARRT card preparation/discussions, the applicable HCD is the AJHA in the work package. Workers review the AJHA annually or when the AJHA changes. The Team reviewed multiple STARRT cards and observed the STARRT card briefing at the start of a work activity. In most situations, the craft workers and foreman understood, noted, and discussed the jobsite/work-related hazards related to the specific task and the immediate worksite conditions. However, in one case the Team observed that the workers did not properly implement controls for noise hazards. Workers were performing work package BMS-0005-01, *Condenser Tube Cleaning at Chiller Building*. The STARRT card section "Personal Protective Equipment," identified the need for "Single Hearing Protection." In the "What controls are you taking to eliminate/mitigate the hazards?" section, identified controls were hearing protection, and posting of hearing protection boundary. The superintendent and foreman present on the job were unfamiliar with the BNI process for identifying and posting hearing protection requirements and boundaries. The AJHA (CONST-7467, Rev 0) included a reference to a *Hearing Protection Matrix* (24590-WTP-LIST-SA-002), and a list of *Sound Levels of Common Construction Tools* (24590-WTP-LIST-SA-0001), for determining the correct level of hearing protection and safe distance for hearing protection boundaries. The superintendent and foreman were surprised to know that such lists existed. The superintendent and foreman had not referenced the AJHA to identify the correct controls, but had used their own experience and judgement. In this case, the foremen and superintendent were not sufficiently aware of the contents of the AJHA and the hazard controls related to the work. BNI should ensure superintendents and foremen review AJHAs more frequently when reviewing STARRT cards, and ensure controls identified on the STARRT card are consistent with controls identified in the AJHA.

Opportunity for Improvement: BNI should ensure superintendents and foremen review AJHAs more frequently when reviewing STARRT cards, and ensure controls identified on the STARRT card are consistent with controls identified in the AJHA.

During the 2013 VPP onsite assessment, the Team identified an Opportunity for Improvement that involved labeling of equipment that was important to worker safety, specifically local

exhaust ventilation equipment. During this visit, the Team found that BNI has improved its equipment inspection program for not only the local exhaust but for other cord-connected tools. The Team also found effective inspection and color-coding (for inspection frequency) of equipment.

WTP also inspects and labels or tags ladders, electrical handtools, and fall protection equipment. Carpenters inspect all ladders on a quarterly basis. They mark ladders that pass inspection with colored tape that indicates the current quarter, and permanently remove ladders that fail inspection. Qualified electricians inspect power cords and spider boxes to identify and eliminate shock hazards. BNI continues to control electrical hazards on the construction site through regular inspections by qualified electricians. The quarterly inspection program and the color-coded tape on electrical cords continues to be effective. BNI maintains and inspects all hoisting and rigging equipment, fixtures, and slings as required by OSHA.

BNI has evaluated handtools' potential to produce noise. As a best practice, BNI has compiled a list [*List of Sound Levels of Common Construction Tools* (24590-WTP-LIST-SA-10-0001)], indicating the noise level for each tool. Work planners, field engineers, foremen and superintendents can use that list in conjunction with work planning and the STARRT card. To control the hazard, the list stipulates boundary distances required for area postings due to high noise related to each tool. The Team found several instances where the high noise ribbons and signs were not consistent with the required posting distances in the list because they were not included on the STARRT card from the work package and associated *List of Sound Levels of Common Construction Tools*. BNI should consider tagging or color-coding each noise-producing hand tool as a secondary way to ensure workers properly post noise boundaries.

Opportunity for Improvement: BNI should consider tagging or color-coding each noise-producing hand tool as a secondary way to ensure workers properly post noise boundaries.

The previous report in 2013 listed lock-out/tag-out (LOTO) compliance as problematic. BNI rewrote the 24590-WTP-GPP-MGT-073, *System and Equipment Lockout/Tag-out* in April 2014. The revision made the procedure more user friendly. Since the revision, LOTO incidents have decreased and discussions with workers involved with LOTO indicate the process has improved.

BNI conducts confined space work in WTP in accordance with Procedures 24590-WTP-GPP-SAIH-106, *Evaluating Confined Spaces,* and 24590-WTP-GPP-SINS-107, *Confined Spaces.* These procedures ensure compliance with 10 CFR 851, *Worker Safety and Health Program,* 29 CFR 1910.146, *Confined Spaces,* and 29 CFR 1926.1200, *Confined Spaces in Construction.* Using 24590-WTP-GPP-SAIH-106, *Evaluating Confined Spaces,* BNI evaluates each potential confined space to determine and classify it as: (1) not a confined space; (2) a nonpermit confined space; or (3) a permit-required confined space. Based on this classification, BNI establishes controls to mitigate hazards associated with entry into the confined space. Typical controls usually include mechanical ventilation (engineered controls), respiratory protection (PPE) and signs (administrative controls). The robust confined space program discussed in the 2013 VPP onsite evaluation report and detailed in BNI Confined Space procedures continues to control the hazards presented from work in these locations.

BNI uses heat stress predictive modeling to control the hazards from heat exposure at WTP. 24590-WTP-GPP-SIND-068, *Heat and Cold Stress Prevention,* defines the program. This

predictive modelling uses historical weather data for the Eastern Washington high plains desert area. The program takes into account consistent levels of summer relative humidity, summer temperature fluctuation (cooler nights, hotter days), historical meteorological data for the area, and extensive site wet-bulb globe temperature (WBGT) measurements. It incorporates daily breaks and the lunch period into appropriate work/rest regimens. This technique utilizes the next day's weather forecast and the model to predict the next day's work/rest schedule. As the next level of performance improvement, BNI should consider the use of modern physiological monitoring technology, such as that used at the Hanford Chemical Tank Operations and at the Savannah River Site, to enhance or augment the existing program. Remote physiological monitoring has proven to be an effective method to monitor an individual's response to heat stress conditions. This includes, but is not limited to, heart rate monitoring and body temperature measurement. It does not include medical monitoring parameters (measuring blood pressure, oxygen saturation, urine testing or cardiac rhythm). Remote monitoring of workers' heart rate, recovery heart rate, oral temperature, or extent of body water loss when used in conjunction with common industry practices, such as WBGT, physiological monitoring can provide a higher level of worker protection and improve worker efficiency.

Opportunity for Improvement: BNI should consider the use of modern physiological monitoring technology to enhance or augment the existing heat stress program.

DOE/RL094-02, *Hanford Emergency Management Plan,* and the guidance document *Technical Planning Basis, Emergency Management Guide,* DOE G 151.1-2, establish the overarching emergency management requirements and guidance for the Hanford site. WTP is currently a general-purpose facility for emergency planning based on the Hazards Survey, *24590-WTP-RPT-CON-03-001, Rev 4*. BNI developed the hazards survey using the *Hanford Emergency Management Plan*, DOE/RL-94-02 as well as guidance in *Technical Planning Basis, Emergency Management Guide*, DOE G 151.1-2. BNI maintains emergency preparedness consistent with DOE/RL094-02, *Hanford Emergency Management Plan*. Mission Support Alliance, LLC, the Hanford site infrastructure contractor makes site-wide emergency announcements over public address speakers installed on the construction site. BNI supplements these communications using its site hand-held radio system. BNI conducts periodic drills to ensure effectiveness of the program. BNI has contracted with Medcor® to maintain a medical clinic at the WTP. The onsite clinic medical staff and BNI safety assurance staff immediately respond to emergencies at the WTP. The Hanford Fire Department provides emergency response, fire and ambulance service, and response times that have never exceeded 10 minutes. The onsite clinic also provides first aid, as well as periodic physicals and return-to-work evaluations. Medcor® employs trained and qualified staff that includes physicians' assistants, licensed practical nurses, and a licensed physician. Medcor® can provide advanced medical treatment if necessary to save a life or stabilize a critically injured patient.

Conclusion

BNI uses the hierarchy of controls to eliminate or minimize hazards. Most hazards to workers are controlled, and workers have the ability to implement identified controls. As noted in Employee Involvement, workers do not always comply with identified controls. Adding markings of inspected hand tools that correlate to required noise hazard boundary markings, would improve the implementation of hazard controls. Overall, BNI meets the DOE-VPP expectations for Hazard Prevention and Control.

VII. SAFETY AND HEALTH TRAINING

Managers, supervisors, and employees must know and understand the policies, rules, and procedures established to prevent exposure to hazards. Training for health and safety must ensure that responsibilities are understood, personnel recognize hazards they may encounter, and they are capable of acting in accordance with managers' expectations and approved procedures.

In 2013, BNI safety and health training was effective in ensuring workers were trained and qualified to address the hazards associated with working at the WTP construction site. BNI had developed several new training initiatives since the 2010 review in an effort to improve communication between supervisors and foremen to ensure continued improvement and to broaden their experience.

BNI continues to require that all employees, managers and supervisors hired to work onsite attend the On Board Training (OBT) session at the Project Office North Annex (PONA) located in Richland. The OBT includes several modules over a 2 1/2-day period required for "Brown Badge" issuance. The "Brown Badge" certifies that the employee is qualified to access and perform work onsite. The OBT modules include two, 4-hour modules related to construction and project-specific safety orientation. New personnel also complete medical and drug screening tests in addition to a preselected set of computer-based training and instruction related to equipment/spotter requirements, aerial/scissor lift safety, and fall protection and prevention.

The OBT only satisfies the requirements for site access. Upon completion of OBT, the workers report to the construction site and must complete any additional training based on their job description. The BNI training group prepares "orientation" packages for new hires that detail the company's expectations for workers onsite. The package contents include many informative booklets, such as rules of conduct, employee concerns program information, and Right to Know. The Team identified three items included in the packet that no longer apply. Those items included an 8-page booklet describing the "PIER" issue resolution process that was replaced with the Condition Report process in 2014, references to material safety data sheets (now the SDS per the global harmonization system for hazardous materials), and an informational tri-fold describing the obsolete SETO process. BNI should take steps to ensure the information contained in the packet is up to date. The BNI training group should consider identifying a review team of onsite personnel (i.e., SMEs, safety professionals, or VPP safety committee members) to provide more frequent reviews of the orientation packet information to ensure the content remains current and applicable.

Opportunity for Improvement: The BNI training group should consider identifying a review team of onsite personnel (i.e., SMEs, safety professionals, or VPP safety committee members) to provide more frequent reviews of the orientation packet information to ensure the content remains current and applicable.

The BNI training group, in conjunction with the workers' supervisors, developed job-specific training "bundle" requirements for each job position. The training group continuously updates the job position training based on requirements or policy changes, best practices, or even lessons learned over the years to ensure workers receive adequate training to perform job tasks.

In many cases, site workers' training includes workers reading and reviewing BNI procedures on an annual basis to ensure they comprehend site-specific requirements associated with their work.

BNI requires line managers and SMEs review any changes to procedures to determine if craft employees will need to have their training requirements modified to include the new requirements of the modified procedures or if a re-read of the changes will be sufficient. Typically, during a procedure review the worker is required to read and sign a form indicating they reviewed that document, and their manager forwards that form to the training department for assurance and recordkeeping.

A recent BNI internal review titled, *Common Cause Analysis of Calculation Issues Identified during the Reliability Validation Process*, identified a lack of adequate and sustainable technical training and qualification programs related to the engineering group. Specifically, the review found that the current approach of procedure review and supervisor approval did not provide adequate training for the engineering group staff. The review determined that while the engineers were well educated in their fields of expertise, training and experience with regards to configuration management, technical baseline management, design basis, etc., was inadequate. In addition, the training content did not adequately address WTP-specific tailoring of processes or implementing codes and standards. In response to that review, BNI developed a Management Improvement Plan (MIP-33, *Engineering Training and Calculations*), that required the BNI training group to develop a new "Engineering Training and Qualification Improvement Plan" in October 2015. That plan, developed by the training group, specifically focused on restructuring qualifications, requiring engineering mentoring through performance demonstrations, and an increased emphasis on engineering processes, configuration management, and technical basis and design basis fundamentals.

In support of this effort, BNI developed approximately 35 classroom and computer-based engineering-related training modules. The new training requires that employees pass a test demonstrating their understanding of the course content. The Team believes the BNI response will be effective in resolving the identified issues; however, BNI should monitor the effectiveness of the new process to ensure its effectiveness over the next few years.

BNI records training for the crafts in the Learning Management System (LMS), and supervisors verify training and qualification prior to assigning work. The training group ensures that all workers' training is current through LMS. LMS automatically sends 30-day notices to the responsible line manager of workers with expiring training requirements. The line manager ensures the workers schedule refresher training within the 30-day period to avoid delinquency.

BNI continues to permit its foremen to participate in Bechtel University training courses. Bechtel corporate policy normally prevents foremen from participating in the Bechtel University training programs, but BNI allows its foremen to complete Bechtel supervisory training and credits those foremen with the course completion in LMS. If the foremen advance to management positions, BNI retroactively credits them with the previously completed Bechtel University training. This exemption provides incentives for supervisors to participate in managerial training. In addition, it provides them with better operational insight and awareness.

BNI developed simulation training to provide workers with practical experience in hazard identification and control. BNI safety assurance provides a hands-on training course to assist in improving employees' abilities to identify hazards in the work environment. This type of on-the-job training and execution mirrors the work environment and demonstrates in real time the types of hazards an employee may encounter. This hands-on training increases the retention of the material. The first phase of the training began in October 2014 with emphasis on hazard

identification. BNI expanded the second phase to include the control mechanisms associated with the identified hazards to help employees identify and correct hazards in the work environment and supplement classroom and computer-based training. The hazard analysis and control simulator provides employees with the opportunity and training to identify site hazards and appropriate controls. Staff and management were included in this training to assist in the hazard reduction and controls used during the course of work.

The Safety Assurance Group established several hazard simulation stations in the PT Facility canyon area. The simulations provide many workplace hazards and associated errors that require the student to think and observe critically, to identify all the hazards, and look beyond just the obvious hazards. Each station includes a scenario similar to what workers might encounter in work areas on the construction site. Each station has a number of issues to identify related to safety, training, environmental, IH, STARRT card signoff, etc. In addition to sharpening employees' hazard recognition skills, the simulations establish and reinforce BNI's expectation that all employees are responsible for preventing or correcting workplaces hazards. Employees record all the hazards they identify. BNI plans to develop 12-14 scenarios that change periodically and encompass 16 different procedures.

Managers, foremen, general foremen, and supervisors have participated in the hazard simulation with the intent to sharpen employee skills when it comes to identifying and correcting adverse behavior when performing their oversight function of the manual crafts. The training emphasizes the hazards present and the complexity of the requirements to perform work at WTP.

In one scenario, an employee is required to review a permit-required, confined space. The simulation includes staged reportable issues in the space and along the route to the space. The employee must assess all situations and list the hazards and appropriate controls. Each scenario also includes an item that would cause an employee to pause or stop the work activity. BNI developed these scenarios from lessons learned and site incidents. All craft employees at the construction site participated in the training, beginning with superintendents. BNI has trained more than 800 people during the first phase.

In early 2016, BNI was performing numerous confined space entries every day at the WTP project. Analysis of the permit identified that supervisors were making errors on the permits because the dropdown menus associated with the process were confusing. In support of continuous improvement, the WTP safety team completed and rolled out a revamped version of its Confined Space training. BNI now divides the training into three parts:

1) Classroom review of the procedure;

2) Computer laboratory, hands-on practice of the how/why of filling out the permit; and

3) Complete hands-on simulated confined space entry. The computer laboratory has significantly reduced the frequency of errors on permits.

Building on the success of hands on simulation, BNI plans to digitize the simulations into a VR context. Used in concert with the physical simulator, the VR simulation will create a true competence-based training experience and will assess the individual's observation and assessment abilities. In this scenario, employees will be required to demonstrate their ability to properly complete the confined space entry evaluation and inspect the virtual site. Trainees will

also be required to assess whether the confined space meets the requirements of the permit by moving around the virtual environment and assessing each piece of equipment.

While BNI will deliver the majority of training using personal computers, the simulations will eventually be delivered on a wide variety of devices ranging from tablet computers to fully immersive VR headsets that have the potential to offer an unparalleled training experience. Viewing the presentation on a tablet has the potential to integrate daily activities while keeping requirements fresh in the minds of the workers. The benefit of utilizing a tool that replaces the static classroom environment with a real-time evaluation experience without the actual exposure to hazards represents a breakthrough in new training opportunities and continuous improvement.

Conclusion

The Safety and Health Training is effective in ensuring workers are trained and qualified to address the hazards associated with working at the WTP construction site. BNI has developed several new training initiatives since the 2013 review in an effort to improve hazard identification to ensure continued improvement. BNI self-identified weaknesses in its approach to training engineers and has developed a response to correct those deficiencies. BNI continues to meet the expectations for the Safety and Health Training tenet.

VIII. CONCLUSIONS

Although BNI meets four of the five DOE-VPP tenets, Employee Involvement has substantially dropped since the 2013 assessment. The limited employee involvement is leading to other cultural and communications difficulties and does not currently demonstrate the level of excellence expected of a DOE-VPP Star site. This decline stems from several factors, including uncertainty over project funding and schedules, that is creating frequent layoffs, only to be followed by rehiring, reductions in manager visibility, an overreliance on larger cash awards from drawings, limited employee participation opportunities, and managers' and supervisors' focus on the disciplinary process as a primary means of correcting at-risk behaviors. The result is a workforce that generally focuses on compliance with safety rules, but does not hold themselves or their coworkers to a higher standard reflective of the DOE-VPP expectations. BNI has policies and procedures in place to implement a compliant safety and health program, but needs to expand its efforts to demonstrate excellence through Employee Involvement. BNI has the resources and talent necessary to encourage broader employee involvement, but needs time to implement improvements. The DOE-VPP procedures establish that if a Star participant is deficient in one or more requirements that the participant cannot correct during a 90-day deferral of decision, but the participant agrees to correct deficiencies within 1 year, the Team can recommend *conditional* Star participation for 1 year with a formal reevaluation scheduled at the end of the year. The Team believes BNI can correct the deficiencies in Employee Involvement by implementing the opportunities for improvement identified in this report as "BNI needs." Therefore the Team recommends that the Bechtel National Incorporated (BNI) construction project at the Hanford Tank Waste Treatment and Immobilization Plant (WTP) continue participating in DOE-VPP *conditionally* as a Star site as it addresses the current limited employee involvement in safety programs.

APPENDIX A

Management

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