

## **D&D Operational Experience**

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### **ABSTRACT**

This paper describes the operational experience gained from more than 25 million man-hours of Decontamination & Decommissioning (D&D) work on both Department of Energy sites and commercial nuclear facilities in the United States. Nuclear D&D activities encompass some of the most hazardous activities imaginable – protecting workers from a huge range and endless combinations of industrial safety, radiological, nuclear safety, and industrial hygiene issues which challenges managers and safety professionals. Performing D&D activities safely is essential to project success. Managers must ensure that work is properly planned and executed, that hazards are identified and mitigated, and that operational experience is captured and utilized on future projects. Many of the lessons learned directly relate to the principles of behavioral-based safety. Our experience indicates that improved safety performance leads to improved productivity.

### **INTRODUCTION**

Over the past 7 years, BNG America has successfully completed a variety of D&D projects ranging from the Department of Energy's largest D&D project – the Three Building D&D Project at Oak Ridge's East Tennessee Technology Park to NRC license closure activities. BNG America's safety performance on these projects was outstanding as is evidenced by Day Away Case and Total Recordable Injury Rates well below industry averages and 33 awards from the National Safety Council. Achieving this level of safety performance required significant workforce and management involvement and innovative technical approaches.

This paper includes Operational Experience (best practices and lessons learned) from both DOE and commercial D&D projects, focusing on safety and operational excellence. OE from the following example projects is included:

- East Tennessee Technology Park (ETTP) Three Building D&D Project – Oak Ridge, TN
- Mound Waste Disposal (WD)/Waste Disposal Annex (WDA) D&D Project, Miamisburg, OH
- Big Rock Point Major Component Removal – Charlevoix, MI
- Westinghouse Southeast Regional Service Center License Termination, Chattanooga, TN

Specific topics to be addressed include: management alignment, union involvement, workforce engagement, training development and delivery, dose management, electrical safety, hoisting and

rigging, and material handling. While BNG America typically implements the approaches presented in this paper on all of its projects, the specific operational experience and supporting examples provided in the following sections reference specific projects.

## **MANAGEMENT ALIGNMENT**

Management Alignment is vital to ensure safe and effective operations. All too often understanding of management goals, values and intent is assumed rather than communicated and managed. All work is carried out under the company's guiding principles, policies, etc. but the workforce often carries with it previous baggage and practices that can be at odds with the project aims and values. To ensure that the values and aims are not corrupted, BNG America draws on its experience of bringing together and forming effective, focused teams with shared, well-understood values that management visibly and obviously brings into practice. Failure to articulate, communicate and monitor adherence to these aims inevitably results in a dysfunctional team. For management changes on existing projects, the team should review their existing values – both stated and implied, and develop a consensus supported by the entire team. Management needs to visibly support these common goals through their words, actions, and decisions.

### **Management Alignment – Westinghouse License Termination and Mound WD/WDA D&D Projects**

Our Mound WD/WDA project was performed with a dedicated management team and union labor. The management team had worked together on the Westinghouse License Termination project, completing it on-time without any injuries. They reviewed what contributed to their success and determined that their belief that all accidents are preventable and that safe performance was a condition of employment provided the cornerstone for this successful project. At the Mound WD/WDA project, these beliefs were clearly communicated by the management team during indoctrination training and were routinely reinforced throughout project execution. This clear and visible commitment to safe performance was well-received and embraced by the workforce, leading to a strong safety culture throughout the project. Methods of providing very visible support to these values should be implemented and all members of management and supervision should be committed to high expectations in the areas of safety, quality and operational performance. Examples of highly visible support include providing the entire workforce with a written copy of these values and consistently implementing them.

## **UNION INVOLVEMENT**

Many projects require that union labor be utilized for construction/D&D activities. Developing solid and trusting relationships between management and union representatives is essential. Working openly with Business Agents, Shop Stewards and other union representatives can result in favorable collective bargaining agreements.

### **Composite Crews – ETTP Project**

At the ETTP project, work activities were often complex, requiring multiple crafts to perform a single evolution. To avoid jurisdictional issues, we negotiated the use of composite crews. By forming work crews comprised of different crafts (laborers, ironworkers, machinists, electricians, etc.), we were able to improve productivity and eliminate worker and union concerns and potential conflicts due to jurisdictional concerns. The foreman for each crew could come from any of the trades.

### **Labor Contract – Mound WD/WDA D&D Project**

At our Mound WD/WDA D&D project, we addressed worker retention and disciplinary action during collective bargaining agreement negotiations. When a worker was brought on, they were considered on probation for 90 days during which employees could be released for any reason. Retaining top performers regardless of seniority was also viewed as critical to project success. By negotiating these provisions into the labor agreement at the beginning of the contract, management and supervisors were able to review each worker's performance, attitudes, and behaviors toward safety. Employees exhibiting at-risk behaviors, poor attitudes towards safety, and/or not performing to management's expectations were counseled to attempt to correct the unwanted condition. If the worker did not respond favorably, they were released. This immediately instilled a sense of accountability into the workforce that combined with management and supervisory reinforcement, lead to a very positive safety culture. By clearly communicating expectations to the workforce during indoctrination training, employees were focused on the expected performance. As staffing needs decreased, management and supervisors were able to identify and retain the top performers, regardless of seniority. This provided an incentive to the workforce to meet or exceed the high expectations set by management. Addressing rewards and disciplinary actions up front is essential to setting the proper tone and attitude towards safety. By agreeing on offenses and the associated disciplinary actions before they occur, the perception of management being "out to get" specific workers was eliminated.

Developing open and trusting relationships with union representatives often requires additional management attention. At our ETTP project, regular meetings were held to address issues as they arose and to keep communication channels open. Union management was very supportive of the ETTP project and its excellent safety culture.

## **WORKFORCE ENGAGEMENT**

Effective safety programs and efficient operations typically share a common attribute – a very engaged workforce. Getting workers motivated and involved and then keeping them actively engaged requires significant management commitment and a high degree of trust. The benefits of an engaged workforce easily surpasses the effort required to attain and maintain it – higher retention, improved productivity, strong safety culture, questioning attitude, worker-developed solutions, etc.

### **Gradual Ramp-up – Mound WD/WDA D&D Project**

At our Mound WD/WDA D&D project, craft workers were added in small groups throughout the early phases of the project. This permitted supervisors to interact with the workforce and ensure

that they understood the importance of safety and were working safely. When additional workers were brought on to the project, the new workers were paired with experienced workers to provide a mentoring relationship. This approach allowed more interaction between workers and supervisors and ensured that new workers benefited from the experience of workers familiar with the safety requirements and expectations. It also minimized the situation of new workers relying solely on training and supervision to perform work safely. This approach helped instill the proper safety culture from the beginning of this project, something that is especially important on a short-term project.

### **Employee Involvement – ETTP Project**

BNG America's ETTP project was one of the most complex and massive D&D projects undertaken in the United States. After the initial startup, BNG America's management determined that the ETTP project's safety performance was in need of significant improvement. The following changes were implemented:

- Increased worker involvement in identifying safety issues
- Increased worker involvement in determining and implementing safety solutions.
- Re-evaluated and revised job hazard analyses and work procedures.
- Provided safety awareness training for employees.
- Assessments by top management of incidents with the injured employees and supervisor.
- Added initial incident reporting requirements to established procedures.
- Displayed current safety performance metrics as charts prominently in the work place.
- Obtained advice and assistance from outside experienced professionals and managers.
- Added safety professionals and managers with proven safety improvement experience.
- Issued safety performance reports monthly to management and ES&H staff.
- Discussed safety at start of all meetings.

In April 1999, the project's safety record for Total Recordable Incident Rate (TRIR) was 10.62. The 2002 BLS average for the Miscellaneous Special Trade Contractors (SIC Code 179 - applicable to this project) was 6.9. Management recognized the need to improve communication between Management and Labor and seized the opportunity to empower the craft workers to become more active participants in the safety program. It was recognized that significant changes had to be made in order to achieve significant safety performance improvement. As safety performance improved, productivity also improved dramatically. After additional improvements, the Safety Program hit a plateau as evidenced by the TRIR ranging between 2.65-2.85. The project, still striving to make project activities safer, needed to further increase project-wide safety awareness. Project Management proposed that the Building and Construction Trades partner with the Project Management to launch a Behavior Based Safety (BBS) process. After a series of meetings and visits to BNG America's Savannah River project where behavior based safety had been successfully implemented, the partnership was strengthened and the following changes were made in February 2002:

- Implemented the Behavior Based Safety process
- Provided awards and special recognition for improvements in safety
- Implemented a Safety Incentive and Suggestion Program for improvements in safety.

- Strengthened the joint Labor-Management Safety Committee
- Initiated Safety/Housekeeping Walk-down Inspection Committee
- Established Incident Investigation Committee

The BBS Program improved employee morale and increased the overall sense that every employee had an impact on safety. The TRIR was reduced by an additional 25% and the Day Away Case Rate (DACR) was reduced by an additional 49%. For the third time in the past three years, the ETTP project celebrated One Million Safe Work-Hours. Also, the project has received a total of twelve (12) awards from the National Safety Council for safety improvement and for exemplary safety performance over the past seven years. Additionally, the Project's BBS and Safety Committees instituted a community outreach program, safety performance and incentives related gifts and prizes, safety luncheons, improvements in personal protection equipment and process equipment, and started a safety partnership with a local vocational technical school. These activities further enhanced the project's employees' morale. The benefits of these safety related activities can be seen not only in the improved safety of employees and associated safety performance metrics but also in the improved communication between Labor and Management.

## **TRAINING DEVELOPMENT AND DELIVERY**

Worker training is a critical component of any D&D project. Properly training and qualifying workers requires identifying the terminal objectives of training, developing the training materials, and delivering the training in a manner that your workforce can easily assimilate. Operational experience at BNG America indicates that utilizing employees in developing and deploying training improves both the quality of the training and the acceptance of the training by the workforce.

### **Employees Training Employees – ETTP Project**

The Behavior-Based Safety program at ETTP required that trained observers routinely examine work evolutions. Performing BBS observations required careful and considered communications with workers performing the evolution. This training was jointly developed by training professionals and employees on the BBS Steering committee and delivered by employees to other volunteers. The number of volunteer observers increased as a result of this training approach and the quality of observations improved.

### **Employee Involvement in Toolbox Meetings – ETTP Project**

Workers involved in incidents can provide a more personalized discussion to co-workers than managers or supervisors. They can answer questions relating to the incident and fully communicate the personal impacts of the incident. At our ETTP project, this approach has been used numerous times following injuries and near misses. Having workers provide toolbox briefings adds significant credibility to the topic and helps the workers receiving the briefing internalize the message. Workers performing these types of briefings should be instructed how to simply communicate the message. They also deserve management support as it can be difficult for workers to openly discuss the circumstances surrounding the incident. Worker involvement in toolbox meetings following an incident can help provide an easily understood message to

which other workers can relate to. It also helps foster open and detailed communications that can lead to a stronger safety culture.

### **Hands-on training facilities – ETTP Project**

D&D activities at the ETTP project involved a variety of tasks with different criticality controls. Workers routinely performed both non-fissile and fissile activities with fissile materials at various degrees of enrichment. Workers were required to distinguish between stain, thin film, and significant uranium deposits during work activities and are expected to follow the proper criticality safety controls for each type deposit. By training workers in a controlled environment that simulates actual conditions encountered during operations, the understanding of and development of proficiencies in criticality safety control and related work practices could be measured and documented prior to entering the work area. Using a mock-up facility to train personnel improved compliance with work control documents and satisfied the requirements of the ANSI standard. By providing "hands-on" training – identifying deposit types, proper packaging and spacing, etc, in a relaxed environment to workers, comprehension of criticality safety requirements was improved and workers were able to interact more effectively with Criticality Safety Subject Matter Experts. Workers had the opportunity to understand the criticality safety requirements and to practice implementing them in the dynamic setting that D&D activities create. Routinely training a wide variety of individuals in this environment also helps identify potential procedural weaknesses. D&D work often utilizes a transitory work force and this type of training ensures competency before performing fissile material activities. Beginning a project with this type of "hands-on", interactive training would eliminate the issues associated with workers understanding the intricacies of nuclear criticality safety at project startup.

## **DOSE MANAGEMENT**

D&D activities at reactors often involve the potential for high doses. BNG America's Big Rock Point Major Component Removal Project included removing the reactor vessel, other major equipment and significant amounts of activated materials. In addition, BNG America has strict administrative limits designed to eliminate all exposures in excess of 20 mSv and unplanned exposures above 15 mSv. A strong management commitment to dose control and significant pre-job planning were required to meet these stringent targets.

### **Dose Management – Big Rock Point Major Component Removal Project**

D&D activities at Big Rock Point included reactor vessel and steam drum removal and activated concrete removal. These activities presented unique challenges with contact exposure rates often exceeding 150 mSv/hour. Significant pre-job planning was utilized in conjunction with mockups to maximize efficiency and minimize exposure. Pre-job exposure estimates and dose budgets were established. Exposures were tracked and monitored on a daily basis and these results compared to estimates to improve future dose estimates. Exposure results were discussed daily in pre-evolution briefings to inform workers, review work practices, and maintain workforce awareness. A dose-sharing approach - assigning workers to activities based on exposure history and projected doses - was used to meet the administrative limits. The combination of workforce

awareness and involvement, management commitment, and stringent planning and work controls resulted in not exceeding these administrative limits.

### **Dose Extension Justification – Big Rock Point Major Component Removal Project**

The strict administrative limits established by BNG America at the Big Rock Point project led to the development of a Dose Extension Justification procedure. This procedure required a detailed justification and management approval prior to any worker exceeding the initial administrative limit of 15 mSv. By using this procedure, work planners and supervisors constantly looked for ways to reduce exposures. Due to the effectiveness of this procedure, it has been adopted as a corporate standard.

## **ELECTRICAL SAFETY**

Electrical incidents continue to plague the DOE Complex, with multiple events occurring almost weekly. Facilities slated for D&D are often mothballed, many for years with poor as-built documentation on the facility status. Entering these facilities and beginning to remove equipment and infrastructure exposes workers to significant electrical hazards. BNG America's operational experiences with electrical safety have essentially eliminated these hazards.

### **Electrical Safety Program – ETTP Project**

During the initial work activities, our ETTP project experienced several events involving cutting energized electrical cabling. Given the potential risk of serious injury, the project developed improvements to effectively eliminate this serious hazard. A successful process was developed to minimize the occurrence of electrical incidents, which included the following:

- Isolating the energy source,
- Checking to ensure power has been removed from each electrical wire,
- Cutting a gap in each electrical wire,
- Removing the electrical wiring from the conduit, and
- Cutting and removing the electrical conduit.

The process provides assurance to the employees that the cables are de-energized before removal and that conduits are empty before they are removed. This change in work practice required significant training to ensure that the entire workforce (more than 1000 people) fully understood this revised methodology. No further electrical incidents occurred from cutting conduit and wiring in 30 months after instituting the above process. Forty-four miles of wiring and conduit were removed on this project.

## **HOISTING AND RIGGING**

Hoisting and rigging activities typically play a large role in D&D programs. The very nature of D&D activities – torch cutting, equipment removal, etc. results in very heavy items, often poorly

balanced with sharp edges. These attributes quickly elevate hoisting and rigging to high hazard activities requiring special attention and focus.

### **Hoisting and Rigging Program – ETTP Project**

The ETTP D&D Project included the removal and disposition of over 150 million kilograms (330 million pounds) of hazardous and radioactively contaminated materials and equipment from three buildings comprising more than 445,000 square meters (4.8 million square feet). This project involved heavy construction dismantling, removal, and disposal of process equipment, support materials, and waste. Lifts included stacks of sharp, ragged edge, corrugated steel from dismantling. The potential risk of serious injury or death from hoisting and rigging incidents when handling heavy loads, rusted pipes, 1.2 meter (48 inch) valves and five feet wide steel ducts, etc. made it imperative that an ultra safe approach be taken. The ultra safe rigging and lifting approach consisted of the following:

- Selecting experienced personnel for their skills and knowledge as the core group of people to initially perform the work
- Establishing controlled procedures by which the work is performed
- Conducting training of all personnel
- Implementing a comprehensive, monthly inspection program for the controlled slings, harnesses and other lifting equipment
- Ensuring new personnel were added to an experienced group for initial guidance and supervision until they became safely proficient.

Approximately 800,000 lifts were made in five and one-half years, with maximum loads of 30,000 kilograms (65,000 pounds), and only one near miss occurred. Also, work was performed on night and day shifts, seven days-a-week. This is considered to be an ultra safe hoisting and rigging program for heavy, dangerous loads.

### **MATERIAL HANDLING**

Material handling is essential to every D&D operation. Contaminated and uncontaminated materials must be properly handled, packaged, transported and disposed. With disposal facilities typically charging by the cubic foot, minimizing waste volumes becomes even more critical.

### **Supercompaction – ETTP Project**

With more than 150 million kilograms (330 million pounds) of contaminated material, 3,000+ compressors and converters, and 640+ kilometers (400+ miles) of piping, BNG America's ETTP project required significant planning with respect to material handling. Many of these wastes initially contained significant void space which, if unaddressed, would have greatly increased shipping and disposal costs. Additionally, many items would have to have been cut apart using manual methods and increasing the workforce's exposure to hazards – hot work, radioactive materials, heat stress, exposure to metal fumes, etc. To reduce hazards and improve efficiency, we installed and operated the largest supercompactor in the nuclear industry. The



supercompactor unit allowed us to significantly reduce the volume of materials, thereby reducing shipping and disposal costs.

## **SUMMARY**

D&D activities involve multidiscipline teams with often short or medium-term involvement in the project. These staff and contractors are utilized because of their experience. This carries with it the problems of a team of individuals with varied experience under widely varied project value sets. To ensure effective and focused application of this expertise that is not to the detriment of the project itself, BNG America adapts a program of aligning its staff with the project policies, values, procedures aims and goals with its proven behavioral based safety process. This has been demonstrated to be effective on numerous projects with exemplary safety results.