

BUILDING on what we've LEARNED

HIGHLIGHTS 2014



CONTENTS

1 FOREWORD Sean McGarvey

2 MESSAGE Pete Stafford

3 ONE OF OUR CORNERSTONES – Dr. Eula Bingham

4 RESEARCH

New Projects 2014-2019

- 5** Acting to SAVE Bricklayers' Shoulders and Backs
- 5** Choosing a Safe Builder Before the First Stone is Laid
- 5** Enhancing Safety Climate through Leadership
- 6** Focus Five: Doing Safety One Better through Work Organization Research
- 6** Keeping Construction Workers Safe from Chemical Resins
- 6** Prevention Partnerships for Research to Practice
- 6** Safety at the Student Level
- 7** Sorting Technological Advances from Tiny Trouble
- 7** Testing Concrete Drilling Tools

Continuing Projects 2009-2019

- 8** Construction Solutions
- 9** Dissemination/Communications
- 10** Information at Your Fingertips: CPWR's Data Center
- 12** Research to Practice (r2p)
- 13** High ROI on Small Studies

Completed Projects 2009-2014

- 14** Assessment and Prevention of Isocyanate Exposures in the Construction Industry
- 15** Enhancing Safety through Leadership
- 15** Ergonomics and Welding Fume Exposures during Stud Welding
- 16** Evaluating the Efficacy of Safety Liaisons and Worker Training
- 17** Fall Prevention in Residential Construction
- 18** Highway and Bridge Construction Drilling
- 19** Participatory Ergonomics
- 20** Prevention of Nail Gun Injuries in Residential Construction

21 Reducing Worker Exposure to Silica, Dust and Noise in Construction and Demolition

21 Safety Culture/Safety Incentives

23 Tuckpointers and Welders Breathe Easier with Local Exhaust Ventilation

24 Products of Research

26 TRAINING

- 27** Fifteen Years of Hazardous Waste Worker Training
- 27** New Developments
- 28** 851: Training Workers at U.S. Government High-Hazard Sites
- 29** OSHA Outreach Training
- 29** America's #1 Occupational Safety Training Provider: Labor-Management Apprenticeship and Training Programs
- 29** What is OSHA-10?
- 30** Smart Mark
- 31** Emergency Response
- 31** TRU-Net: Opening New Frontiers in Research and Training
- 32** Minority Worker Training Program: Good for People, Communities and the Construction Industry
- 32** MWTP Evaluation: A Confirmation of Tremendous Results
- 33** Mike Patterson: This "Gladiator" wins a new life

34 SERVICE

- 35** Stepping Up for Our Unsung Heroes
- 36** Innovations: Early Lung Cancer Detection (ELCD)
- 36** BTMed and Research
- 37** What's Next for BTMed?
- 37** Dr. Eula Bingham

38 CPWR CONSORTIUM PARTNERS

39 OVERSIGHT AND ADVISORY BOARDS

40 CPWR STAFF



Sean McGarvey

The members of North America's Building Trades Unions take great pride in our crafts and our ability to do quality work – whatever obstacles we face. We shrug off aches and pains and hazardous chemical exposures as “just part of the job.” But it is clear that construction work takes a toll on our bodies. Being around tradesmen and women

in the field, at meetings and even here in the national office, I see evidence of bad backs, shoulders, knees, hips, and joints. I also know a lot of people with various health problems that, at least in part, are a result of working in the construction industry.

Thankfully, we have an organization investigating what causes debilitating pain and disease after years of work. That organization is CPWR – The Center for Construction Research and Training.

CPWR laid a foundation when it formed a research program in 1990. CPWR has been building on that work ever since, seeking out controls for well-known problems, such as falls and lifting heavy loads, while exploring new hazards, such as the world of “nano-enabled materials.” It started serving construction workers formerly employed on DOE nuclear sites with a free medical screening program in 1996. Two years later, CPWR took on training programs. They started with OSHA training, and soon expanded into environmental cleanup, minority worker, and disaster response training. With strong research, service, and training programs in full swing, they now have leveraged these programs, making the organization more than just the sum of its parts.

We have always found CPWR's work to be of immense benefit to our members. Its work can be counted on to provide verified evidence of health and safety threats confronting workers, as well as ways to control hazards. When OSHA announced a proposed silica rule, we sought CPWR's decades of work investigating worker exposure to crystalline silica. Since CPWR published its first research paper on silica hazards in 1993, the institutional knowledge has grown to encyclopedic levels.

This detailed, peer-reviewed and published information on silica exposures and effective controls was invaluable – and irrefutable. Not only did they publish results of research in scientific journals, they developed a website (silica-safe.org) that translates the science into information and tools that make the results of research available to all in our industry. I cannot fully describe the value of CPWR's work to the North America's Building Trades Unions and to all construction workers in the United States.

Just this one contribution would have cemented CPWR's place in providing accurate information to protect construction workers, but scanning other critical issues in our industry we found other CPWR

We have always found CPWR's work to be of immense benefit to our members. Its work can be counted on to provide verified evidence of health and safety threats confronting workers, as well as ways to control hazards.

work that provides evidence that informs federal and state policies. For instance, CPWR's extensive research into nail gun injuries – and work showing reductions in injuries among apprentices after safety training – anchored the OSHA/NIOSH guidance document on nail guns. Research into training effectiveness helps states determine if mandatory OSHA 10-hour training laws are a good idea. Seven states and numerous municipalities have enacted such laws. The CPWR Report “Deaths and Injuries Involving Elevators or Escalators” has been used by the Elevator Industry Preservation Fund to convince states and some municipalities of the need for certified workers repairing and maintaining the equipment. Thirty-one states now require licensed elevator mechanics.

These activities go unreported in the following pages, as they should. But they are evidence of the ways CPWR's work has impact on construction workers. There is no organization that even comes close to making a difference in construction safety and health in our nation, and perhaps the world. Please enjoy the contents of this report on the research, training and service work done this year for North America's building trade workers. I encourage you to visit www.cpwr.com and CPWR's many sister websites – not just to appreciate the findings but to use their products and put into practice the information that will make every jobsite safer.

SEAN MCGARVEY

Chairman of the Board and President, CPWR
President, North America's Building Trades Unions

MESSAGE FROM THE EXECUTIVE DIRECTOR

This year, CPWR completed one five-year cooperative agreement with NIOSH and began a new one. The 2014-2019 award is CPWR's sixth five-year cooperative agreement with NIOSH, dating back to the start of the NIOSH construction safety and health research initiative in 1990. In 2015 we also begin a new five-year cooperative agreement with DOE to continue our construction worker medical screening program, BTMed, and we are poised to continue our hazardous waste, disaster response and minority worker training programs for another five years in what we hope is a new cooperative agreement with NIEHS. I commend and congratulate our staff and consortium partners, both new and returning, on the tremendous work collectively done over the years to advance construction worker safety and health.

We now have 25 years of experience in managing large, national, multi-consortia research, training, and medical services programs. Over the years, CPWR has developed into a nationally and even internationally recognized leader in construction safety and health. In this year's Highlights you'll read about projects we are completing and many new ones now getting underway. Although "new," many build on the foundation of our previous work, as both our research and training programs continue to evolve as the body of knowledge continues to grow.

You'll read about one of our new projects, "Enhancing Safety Climate through Leadership," which builds on the foundation of Linda Goldenhar's work over the past two years, including a 2013 Workshop on Safety Culture and Safety Climate in the Construction Industry and a 2014 Workbook so practitioners could assess and improve their own jobsite's safety climate. In our new project, we are developing a leadership safety and health training module, targeting primarily new front-line supervisors.

You'll also read about Bruce Lipsey's investigative work into nanotechnology and "nano-enabled products." These products are now being used on construction sites, yet traditional engineering controls have not been tested to determine if they can adequately protect workers from exposure to nanoparticles. Bruce has already begun collecting data on worker exposure to some of these products, such as roof tiles. He created a "nano" website and product inventory as part of the eLCOSH.org site. It holds a database of more than 400 "nano-enabled products" that may be in use in construction.

As part of CPWR's r2p program you'll read about a masonry industry partnership now continuing on its own, and you'll see a new roofing industry partnership under Eileen Betit's guidance take shape. You'll also learn about a new r2p initiative that formalizes the connection between our researchers and our construction safety and health training community. We call it Trainers and Researchers United Network (TRU-Net).

We continue our data tracking efforts under the direction of Sue Dong, as they produce valuable statistics for both researchers and the entire construction industry. We will publish the Data Center's popular *The Construction Chart Book: The U.S. Construction Industry and Its Workers*, but in a different form. Rather than publish one book every five years, we will continuously update the book housed on CPWR's website, www.cpwr.com, as new data become available.

In training, CPWR's programs continue to grow, as we update and develop new curricula to meet construction industry demands. Our environmental, disaster response, minority worker, and OSHA

We now have 25 years of experience in managing large, national, multi-consortia research, training, and medical services programs.

training programs are going strong. In this report you will also read about the support we provide to our network of trainers through annual enhancements and other trainer opportunities.

Our medical screening program, BTMed, continues to provide medical exams to workers formerly employed at DOE nuclear weapons sites, while expanding the provision of low-dose CT scans for these construction workers.

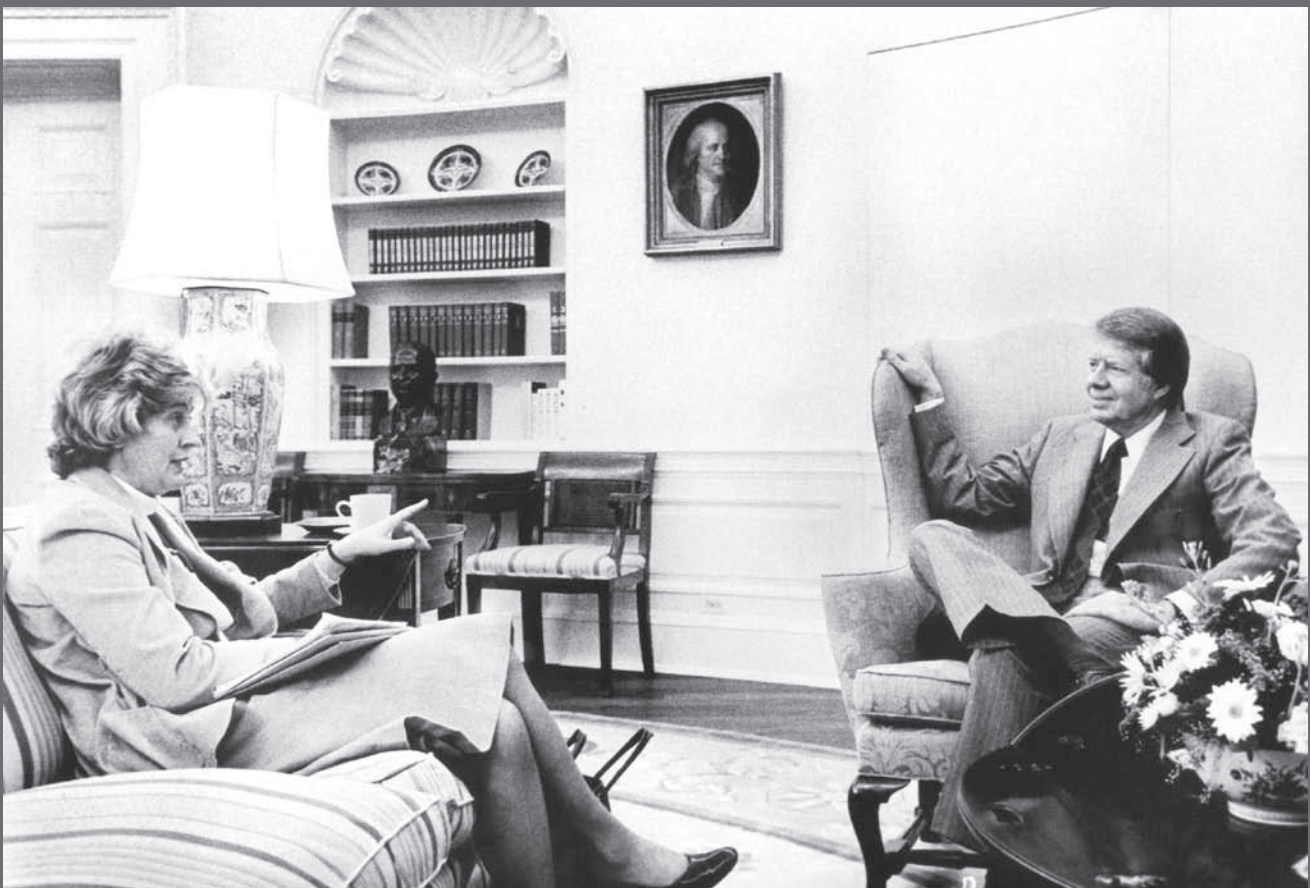
Dr. Eula Bingham, University of Cincinnati, has decided that 2015 will be her last year of work with us on the BTMed program. Eula has been with us since the beginning of not only the BTMed program, but since the inception of CPWR's construction safety and health program. She has been a co-investigator, advisor, colleague and friend. She has been a true pioneer and advocate for worker safety and health. Formerly the head of OSHA in the Carter administration, much of the training we do today builds on the foundation of worker safety and health training Eula established when she created what is now known as OSHA's Susan Harwood training grants program. I'm very pleased to report that Eula will continue to work with us as a member of CPWR's Technical Advisory Board, and I'm honored to pay tribute to the incredible contribution Dr. Bingham has made to America's workers in the following page of this report.

We look forward to a good year and hope you'll follow our work during 2015.

PETE STAFFORD
Executive Director

One of Our Cornerstones – Dr. Eula Bingham

We take great pride in the people we've assembled to carry out the mission of CPWR. Long before she partnered with us on the BTMed program and joined our Technical Advisory Board in 1992, Dr. Bingham served as the head of OSHA in the Carter administration from 1977 until 1981. She was photographed during her interview with newly elected President Jimmy Carter, as she explained what she'd witnessed and what her research found regarding workers' health and safety. Dr. Bingham retires from our BTMed program in January 2015 but remains on our advisory board.



"Rosalynn and I wish Eula Bingham all the best in the next stage of her life. I was fortunate to have many outstanding appointments in our administration, and Eula was one of the best. I always could count on her for sound and direct advice with the well-being of the American worker foremost in her mind.

She helped eliminate barriers to women in the workforce and to make our nation's workforce stronger and more productive. Eula deserves credit as one of the unsung heroes giving women an important voice and a place in our nation's history. We all should be proud of her service to our country." — Jimmy Carter, January, 2015



RESEARCH

Some nine million construction workers show up at a jobsite every day in this country. In 2013, 824* never came home, their lives cut short from a work-related incident. Around 203,000 were injured; about 82,040 injuries were severe. Illnesses and chronic health problems are much more difficult to quantify: most are never reported. Researching the hazards to our nation's construction workforce was the reason CPWR was created. That's why the above worker is being monitored for exposure while cutting roof tiles coated with an engineered nanoparticle.

*2013 preliminary data from Bureau of Labor Statistics

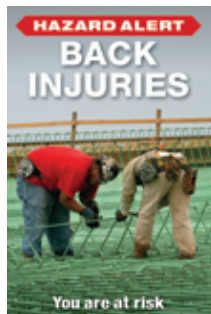
Acting to SAVE Bricklayers' Shoulders and Backs

Dan Anton, PT, PhD, Eastern Washington University
Jennifer Hess, DC, PhD, University of Oregon
Laurel Kincl, PhD, Oregon State University
Douglas Weeks, PhD, St. Luke's Rehabilitation Institute

Hheavy lifting, awkward positions, and repetitive physical tasks are common risk factors for work-related musculoskeletal disorders (MSDs) in the construction industry. Few tradeworkers are impacted more severely by MSDs than bricklayers.

Targeting apprentices with educational programs and preventive strategies may offer the best returns in MSD prevention. Apprentices, who are at the front-end of their careers, may be the ones most open to trying new, ergonomically sound approaches to traditional tasks. However, as newcomers, they are also subject to the influence of more experienced journey-level bricklayers who may be committed to traditional (and risky) work practices.

From 2004-2009, Drs. Anton, Hess and Kincl worked with CPWR to investigate ergonomic solutions in masonry. Anton's team continued to provide solutions for the Construction Solutions database project. Dr. Anton was the primary researcher behind CPWR's popular Hazard Alert Card on Back Injuries, while Dr. Hess displayed ergonomic solutions under CPWR's banners and displays at World of Concrete. Now his research team, in conjunction with the CPWR Masonry r2p Partnership, will further their work with a novel training program aimed at apprentice bricklayers: SAVE (SAfety Voice for Ergonomics). SAVE will teach apprentices about ergonomics to help them prevent MSDs, as well as teach them how to find their "safety voice" – the initiative they need to appropriately advocate for safety in the workplace. The team also will employ innovative measures by using social media, such as emails or text messages sent to apprentices, as reminders of new work practices.



Dr. Anton was the subject matter expert for this popular Hazard Alert card.

Choosing a Safe Builder Before the First Stone is Laid

Jack Dennerlein, PhD, Northeastern University

Owners want to protect the men and women of the trades who build their projects – and also their own pocketbooks and reputations. General contractors want the same from their subcon-

tractors. That's one reason both groups strive to carefully screen the firms allowed to work, often with extensive prequalification procedures that document their safety records as well as experience and financial stability.

When it comes to safety, though, they traditionally rely on "lagging indicators" like past OSHA violations, injury rates, and especially the Experience Modification Rating or EMR – a measurement of workers' compensation claims activity usually based on data that are years old. There are numerous shortcomings with this reliance on lagging indicators. As everyone with a 401(k) knows, past performance is no guarantee of future results; even worse, scores can be manipulated by suppressing accident reporting.

Dr. Dennerlein and his team are looking for a better way. An expert on "leading indicators" of safety, he has spent the past five years developing tools to audit a firm's preventive safety practices and provide timely feedback to workers and management so they can thwart injuries and illnesses before they happen (see page 21). Now Dennerlein's team is investigating how to assess the "systems of safety" employed by a firm – and to make it practical for owners and general contractors to use these assessments to prequalify contractors.

Enhancing Safety Climate through Leadership

Linda M. Goldenhar, PhD, CPWR
Stefanie Johnson, PhD, University of Colorado, Boulder

Since 2004, several CPWR research teams, often working with outside partners, have explored various aspects of safety culture, safety climate, and safety leadership in our industry. In 2013, CPWR-NIOSH held the workshop, Safety Culture and Safety Climate in Construction: Bridging the Gap between Research and Practice. The two-day event brought together a multidisciplinary group of 70 stakeholders to discuss the important issues of definition, measurement and promising interventions. One output from the workshop was a major report detailing the findings and recommendations for moving forward. Subsequently, Dr. Goldenhar developed a much-heralded workbook, based in part from workshop findings and participant feedback, to provide real-world tools to aid construction firms seeking to improve safety climate on their jobsites.

For this next grant cycle, Dr. Goldenhar from CPWR and Dr. Stefanie Johnson from the University of Colorado, Boulder, will be co-leading the project, Enhancing Safety Climate through Leadership. Dr. Johnson worked with lead researcher Dr. John Rosecrance (see page 15) on his earlier research that developed leadership skills training for apprentices to improve job site safety culture and climate. Findings from his project will provide an important foundation for Drs. Goldenhar and Johnson's project. The goal of the new project is to create a short module on Leadership Skills to be offered as an elective within the popular OSHA 30-hour Outreach Training Course. Once developed, the research team will partner with leading

RESEARCH

construction contractors to conduct controlled trials to test the effectiveness of the module and ultimately disseminate the evidence-based module to OSHA Training Institute Education Centers and OSHA 30-hour outreach trainers across the country.

Focus Five: Doing Safety One Better through Work Organization Research

Ann Marie Dale, PhD, Washington University in St. Louis

The unique organization of work in our industry – an ever-changing kaleidoscope of owners, general contractors and subcontractors – enables the efficient construction of custom building projects. But the proliferation of small specialized firms that makes the system productive also poses major challenges for occupational safety and health. Studies by CPWR and others have repeatedly shown that workers at smaller firms face higher risks on the job.

Can a general contractor with an enlightened safety culture and a sound safety program improve the safety performance of the firm's subcontractors? That's what Dr. Ann Marie Dale and her team at Washington University in St. Louis want to find out. The team is partnering with six major St. Louis-area GCs promoting improved safety practices among their subcontractors. They will survey both management and labor informants to assess how the safety culture, practices and perceptions of those subcontractors evolves in the course of their collaboration with the GCs.

The team will also work with participating contractors to address ergonomic hazards. Construction safety programs understandably focus closely on the familiar "fatal four" – falls, caught-in/caught between, struck-by, and electrocution – that claim hundreds of worker lives every year. Yet each year millions of construction workers suffer loss in work days and quality of life to preventable injuries of the back, shoulder, knee or wrist: musculoskeletal disorders deserve a prominent place in construction safety and health programs as well. Dale and her colleagues will bring their considerable experience in ergonomics training (see page 19) to bear, assisting participating contractors as they transform their "focus four" training into a "focus FIVE" with ergonomic safety included.

Keeping Construction Workers Safe from Chemical Resins

Dhimiter Bello, ScD, University of Massachusetts, Lowell

Chemical hazards aren't only found in factories. In our most recent five-year cycle, Dr. Carrie Redlich documented alarming rates of occupational asthma among spray-foam insulation workers (see page 14). Isocyanates are potent sensitizers, and workers applying this efficient insulation material in our walls and attics without extensive protection often find themselves with debilitating asthma that does not disappear when they leave the job.

Epoxies and isocyanates are used throughout the building industry in coatings, caulks and glues. There are many varieties used in a multitude of individual tasks, and a thorough examination of these exposures is long overdue. Drs. Dhimiter Bello and Susan Woskie (see page 21) will investigate the various tasks that entail use of these highly reactive chemicals, plus the efficacy of available engineering controls and personal protective equipment, to assess how best to protect workers from unhealthy exposures.



Epoxies used in terrazzo work can create health problems in workers.

Prevention Partnerships for Research to Practice

Eileen Betit, CPWR

The lessons learned and success of the partnership component of the first r2p project prompted CPWR to increase its focus during this new research cycle on ways successful stakeholder partnerships are built, sustained, and used to bridge the gap between safety and health researchers' findings and what actually happens on construction sites.

CPWR's "Prevention Partnerships for Research to Practice" project will focus on using partnerships to develop ongoing roles for contractor and workers in the promotion and adoption of research findings, create communication methods and products, and identify research priorities and gaps. The continuation of the Masonry r2p Partnership and the establishment of a new Roofing Industry r2p Partnership will expand both the research community and industry's understanding of how to establish and support industry-driven partnerships and promote use of research-based solutions. In addition, the establishment of the first National Safety and Health Partnership Network will create a mechanism for furthering the use of safety and health partnerships for r2p, as well as provide a place for researchers and industry partnerships to learn and share best practices and strategies.

Safety at the Student Level

Diane Bush, MPH, University of California, Berkeley
Kimberly Rauscher, ScD, MA, West Virginia University

Researchers know that the newest workers are most likely to experience a workplace illness or injury. Wouldn't it be great to target construction workers for safety training before they ever set foot on the job site?

RESEARCH

We can – if we work through our nation’s extensive network of Career and Technical Education (CTE) programs. Each year some 200,000 high school students take construction-focused courses in what used to be called “vocational education” programs, and nearly 100,000 more adults participate in technical construction training. In 2014-2017, Diane Bush of the Labor Occupational Health Program (U.C. Berkeley) and Dr. Kimberly Rauscher from WVU’s Department of Occupational and Environmental Health Sciences will lead a research team assessing the current state of safety training in post-secondary CTE programs across the United States in order to create and disseminate a publication of recommendations and best practices.

Sorting Technological Advances from Tiny Trouble

Bruce Lippy, PhD, CIH, CSP, CPWR

Not so long ago, nanotechnology was a mainstay of science fiction. Today it’s becoming a mainstay of the construction industry, and CPWR is working to ensure that we don’t lose sight of worker health and safety when adopting promising new techniques and materials.

Manufacturers are adding nanoparticles to construction materials like glass, concrete, insulation, paint and industrial coatings to give them strength and flexibility – but animal studies are



beginning to reveal that real health dangers might accompany exposure. Nanoparticles exist on a scale undreamed of when

conventional gloves, garments, respirators and ventilation systems were developed to protect workers from hazardous dust and chemicals. The scale: nanoparticles are from 1 to 100 nanometers in one dimension; for comparison, a human hair or a sheet of paper is approximately 100,000 nanometers thick.

Dr. Lippy began a study of nanotechnology as a pilot project when he entered CPWR in 2013 as Director of Safety Research. He and his team began conducting industrial hygiene testing of worker exposure to nanomaterials during common construction tasks, such as cutting roof tiles, to increase the extremely limited knowledge about the levels of nanoparticles released into the breathing zone of workers. In addition, they started assembling a comprehensive inventory of nano-enabled construction products. By mid-year 2014, the CPWR inventory contained more than 400 items, making it the most comprehensive inventory of nano-enabled construction products in the world.

To alert the construction industry to the prominence of nanomaterials on worksites, the CPWR team developed an easily searchable online database to hold these 400-plus construction products believed to contain nanoparticles. The “eLCOSH Nano” site within CPWR’s eLCOSH website offers workers and contractors a way to

find out if the products they use contain nanomaterials.

In the new grant cycle, his team will continue exposure testing of nano-enabled products while adding a valuable component for stakeholders: they will explore how effective commercially available local ventilation systems are in controlling exposures to these tiny airborne particles.

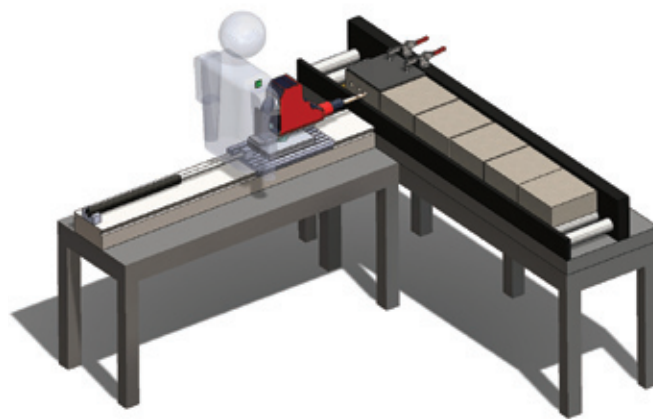
Testing Concrete Drilling Tools

David Rempel, MD, MPH, University of California, San Francisco

Drilling holes in concrete or stone to accommodate anchor bolts or rebar is a physically demanding construction task that crosses multiple trades. It might be performed in new buildings by plumbers hanging pipe, sheet metal workers hanging ductwork or electricians hanging fixtures and conduit. It’s often the job of laborers who need to insert rebar dowels while retrofitting a building or a bridge. No matter who does it, wielding the heavy hammer drills or rock hammers means fatigue, hand vibration, noise and clouds of hazardous silica dust.

To make wise choices about tool and equipment purchases, the industry desperately needs standardized testing of commercial rock drills, their peripherals and accessories. Dr. David Rempel and his team at the University of California Ergonomics Program, whose work with CPWR in the past research cycle produced two ergonomically-friendly rock drill rigs (see page 18), is now working with CPWR to develop a test-bench system to provide this information.

The test bench will enable standardized testing of commercially available rock and hammer drills. Comparison data from such tests will allow individuals and firms to select “ergonomically friendly” tools when making a purchase. The test bench will also determine how drilling methods, such as how much force is applied to the drill or type of concrete bit, will change the drill’s cutting speed, handle vibration and dust.



New system will measure rock drills’ force to a worker’s body.

Construction Solutions

Jim Platner, PhD, and Chris Le, MPH, CPWR

Occupational health researchers like to zero in on a narrowly defined research problem, thoroughly recording injury and illness rates, body parts affected, and possible controls. That's excellent scientific practice, but the information may not be easily found by practitioners in the field.

Construction Solutions, unveiled in 2008, offered something different. Associate Director for Science and Technology Dr. Jim Platner and his team built a website for construction practitioners who wanted to make their workplace safer. Rather than an encyclopedia of health issues, this would be an online database of common construction industry hazards paired with practical interventions – a tool created with construction firm owners, managers and workers in mind.

Users of Construction Solutions could begin by selecting their construction trade. A series of prompts would guide them through the offerings: first a list of construction tasks common in the user's trade, then a list of characteristic hazards encountered in that task, an analysis for the particular hazard selected, and finally a list of solutions to abate that hazard. For instance, a visitor who chose the trade "masonry" might select "mix mortar" from a list of more than a dozen tasks typical of masonry work. Construction Solutions would present a list of 10 hazards frequently encountered while mixing mortar, including "skin contact with Portland cement." A user concerned about this hazard who clicked that link would find that the hexavalent chromium contained in Portland cement could cause dermatitis and possible long-term, career-ending problems. The user would learn that providing protective gloves and a hand washing station are sound strategies to reduce this risk. The user would even find links to firms renting or selling portable outdoor sinks!

Today, Construction Solutions has grown into a comprehensive industry resource documenting 1,431 trade, task and hazard combinations, and pairing them with 214 evidence-based solutions. Some "solutions" can even address multiple hazards, such as an auto-darkening welding helmet with a powered air purifying respirator (PAPR), which reduces exposure to hazardous fumes. With its auto-shading feature, the welding helmet's unique design can reduce neck strains (no "head jerk" to flip the visor down) while it shields the eyes from foreign material and UV radiation.

Major enhancements during the 2009-2014 research cycle include:

The ROI calculator. For many in the industry, the most powerful argument for adopting sound safety practices is a solid "return on investment" (or ROI). A safety intervention that saves more money than it costs – by preventing injuries, illnesses and lost work time – is a slam-dunk. But how do you show it? Construction Solutions now includes an ROI calculator that firms can use to weigh the costs and



Find it: www.safecalc.org

keep a smartphone close at hand. Construction Solutions made the move from desktop to handheld in 2013 with a dynamic design, empowering the site to select the best display options for the device in use, whether desktop computer, tablet, or smartphone.

Improved navigation. Users can choose to maneuver through the site by line of work, by construction trade, by hazard or search for a specific product or topic. No matter which option they choose, they will see a handy "breadcrumb trail" leading them back to the search page when necessary. They will also find links to other appropriate CPWR resources, like links to useful entries in the eLCOSH database (page 9) and the website Work Safely with Silica (page 12).

In the next grant cycle, the Solutions Program will add an Exposure & Control database. This will allow contractors to implement effective engineering controls to reduce airborne hazards and noise at the source with added confidence that exposure will be kept low. This new research work will be conducted in cooperation with NIOSH's Division of Applied Research and Technology (DART). The Solutions Database will be populated with more information on "ready for impact" research to prevent falls, struck-by injuries and new developments to improve worksite conditions: *Prevention through Design* or *PtD*, as well as other new, evidence-based solutions as they come on the market. The Return-on-Investment calculator (ROI calculator at www.safecalc.org) will continue to be populated with more examples of the ROI value of tools and equipment with safety benefits to workers, contractors and owners. Site promotion will increase with CPWR-produced webinars and outreach.

benefits of different controls under consideration.

Mobile interface. Virtually every construction superintendent and safety director today – and many foremen and trades employees –

Photo courtesy © The 3M Company, 2015.



This 3M 9100 FX Air helmet protects workers from hazardous welding fumes with a built-in respirator (PAPR). Its auto-darkening visor can reduce neck strain from flipping visors down.

Other accomplishments include:

- Several solutions investigated by Eastern Washington University have spun off into separate studies. Graduate assistants pursued further evaluation of sub-compact band saws, and they will present their findings at the 2015 Applied Ergonomics Conference. EWU students also created two videos based on their research of solutions to hand-arm vibration and whole-body vibration.
- Construction Solutions has been featured in three safety topic presentations at conferences, including one webinar.
- Construction Solutions has drawn 5,000+ visitors a month, amassing more than 300,000 visits over the past five years. The 2013 redesign increased the number of users who accessed underlying, detailed descriptions by 40%. In a recent survey of users, 85% said they found the information they sought.

Dissemination/Communications

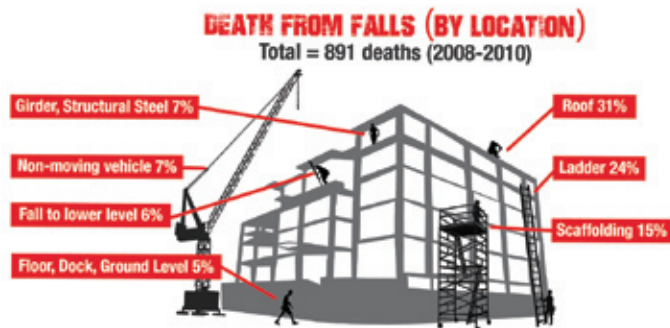
Mary Watters, MFA, CPWR
Clayton Sinyai, PhD, CPWR

Research breakthroughs don't mean much for construction practice if they aren't shared with the world. That's why CPWR's Communications Department has been disseminating the findings, tools and products developed by CPWR researchers, as well as creating new products for industry that are built to match the needs (and visual demands) of different users.

The last year of this grant cycle was a whirlwind of creativity and production. In 2014, the department produced nearly 30 pieces, working directly with researchers Susi, Rempel/Barr, Goldenhar, Ochsner, and Woskie/Bello to strengthen the message and professionalize the look and functionality of a piece. The staff packaged an entire Latino Safety and Health Training program with 13 different documents, working with Dr. Michele Ochsner and her Rutgers/New Labor team. The department also created original materials on topics needing communications support and messaging. When the r2p Working Group voiced a need to educate workers on CO poisoning, the department responded. Working with NIOSH and CPWR researchers, they produced a new Hazard Alert card – Carbon Monoxide Poisoning (see page 25). To support the National Campaign to Prevent Falls in Construction, the department developed "infographics" that illustrate facts on fatal construction falls based on CPWR Data Center research.

Moving images also played a role. The department created a new short video showing the benefits of water suppression as a silica control when cutting concrete pipe. The footage drew from Dr. Susan Woskie's research (page 21). The three popular short videos based on NIOSH Fatality Reports, "Lessons to Go Home Safe," were translated into Spanish.

Communications staff produced 12 issues of the monthly e-news, CPWR UPDATE, posted 52 new CPWR Key Findings from Research, produced two Data Briefs for the Data Center, and wrote articles for trade journals.



One of five new infographics using research on fall fatalities in construction from the CPWR Data Center; all are available on www.elcosh.org.

The department's dissemination efforts continued to pay off. In the last grant year, 1,970 print copies of *The Construction Chart Book* were distributed, 40,115 Hazard Alert cards went to users, and 3,952 (nearly the entire printing) of CPWR's *Highlights 2013: Why We Do This Work* were put in the hands of construction stakeholders. CPWR's website had 81,439 visits last year, more than double 2013. *The Construction Chart Book* pageviews totaled 6,073 for the year, with 2,574 downloads and 344 downloads of the entire book.

The past research cycle has seen several innovations on the communications front that have vastly expanded CPWR's reach:

A superior search system for eLCOSH. A prime charge of the department is maintenance of the electronic Library of Construction Occupational Safety and Health, an online collection of leaflets, tools, studies, training materials, and images made freely available to construction professionals and the general public. During the 2009-2014 research cycle, the department directed a major retooling of the site, relying on extensive user testing. Before restructuring, fewer than 1,200 visitors per month began their search from the eLCOSH homepage; today more than 1,600 per month do. Users will find 858 new pages of content added just in 2014.

A remodeled Hazard Alert card collection. A CPWR mainstay, these pocket-sized cards describing major industry hazards were created as handouts for workers. In a major update reflecting contemporary design ideas and recent research on health communications, the department replaced the text-heavy blue cardstock with image-driven cards focusing on key messages expressed in simple, clear language. The overhaul drove an explosion of interest in the program: requests for the cards jumped from a few hundred per year before the renovation to tens of thousands per year today.

CONDOR. Targeted outreach is a must. Inspired by discussions generated in the r2p Working Group (see page 12), the Communications Department created the CPWR, OSHA and NIOSH Database Outreach Resource – CONDOR – in 2011. The department steadily gathered information, amassing more than 4,400 stakeholder contacts in labor, management, government agencies, the university world and trade press, among others, by 2014. CONDOR has made it possible to do targeted outreach to promote appropriate products, from sending trenching safety messages to contractors and labor

organizations working on buried utilities to sharing CPWR's Safety Climate Workbook with safety directors from ENR 400 firms.

An UPDATE to keep you current. Launched in Fall 2011, the CPWR UPDATE briefs users on innovative research and promotes newly available CPWR products and tools with an exploding roster of industry opinion leaders. Its subscriber list has more than doubled, last year increasing by 19%. "Business & Industry" subscribers rose by 37%. It delivers news the industry can use.

A Higher Profile in the Trade Press. Aggressive outreach to construction trade publications, collaboration with CPWR researchers to draft articles aimed at general readers, and the regular publication of compelling stories in the UPDATE added up to a major increase in CPWR media coverage. Thirty stories covering CPWR appeared in major publications in 2011; 44 in 2012; 59 in 2013, and 64 in 2014. That doesn't include our appearance in countless blogs and electronic newsletters!

CPWR YouTube Channel. With three short, original animated videos – each based on the true story of a fatal construction accident investigated by the NIOSH FACE (Fatality Assessment and Control Evaluation) program – CPWR launched its YouTube channel in



"A Simple Task," a 2-min. video telling the story of a worker who died in a fall from a stepladder, logged more than 14,000 views one year after its posting.

January 2014. By year's end, the videos had been viewed more than 22,000 times. "A Simple Task," a 2-min. video telling the story of a worker who died in a fall from a stepladder, had clocked just over 14,000 views one year after its posting. CPWR's popular ladder safety training video,

"Don't Fall For It!" is gaining new converts after its YouTube posting. Two videos were added recently: "Construction Work That's Out of Control," a 2-min. piece based on research from Dr. Susan Woskie (see page 21) and "Drill Rig Safety and Health Outreach Video" created by students working with Dr. Rempel (see page 18).

Other accomplishments include:

- 363,014 unique visitors went to the eLCOSH site and viewed 658,506 pages during the last year of the grant cycle. Since its launch in August 2000, the site has received 6,421,593 visitors and 15,659,743 pageviews.
- Communications staff published in two peer-reviewed journals in 2014. But much more important, CPWR research was covered in 64 trade publications.
- The newly conceived Toolbox Talks, developed with CPWR Director of Safety Research Bruce Lippy and promoted through the CPWR UPDATE, were downloaded more than 90,000 times from www.cpwrr.com, accounting for 78% of site downloads.

Information at Your Fingertips: CPWR's Data Center

Xiuwen (Sue) Dong, ScD, CPWR

The CPWR Data Center continues to provide timely updated data and research findings on construction safety and health to all construction stakeholders through a wide variety of products.

The Construction Chart Book. The chart book, now in its fifth edition (published in 2013), continues to be a go-to reference on construction safety and health. The contents of this book have been cited in many forms – news articles, peer-reviewed journal papers, training and teaching materials, books, trade magazines, conference presentations, and podcasts. It is collected by the U.S. Department of Labor's Wirtz Labor Library and has been recognized as a major data source for the U.S. construction industry by many university and Internet libraries. The chart book has been translated into French, Spanish, Japanese, and other foreign languages. Users are from all walks of life, both domestic and international. A Google search yielded more than 22,000 results for "Construction Chart Book" as of Nov. 3, 2014. In addition, more than 55,000 pageviews were counted through www.cpwrr.com and www.elcosh.org.

Chart Book users no longer have to wait five years for new data; topic pages of the newly designed Construction eChart Book will be posted online as soon as the data are available.

Fall Injuries. Falls remain the leading cause of injuries in construction. To provide insight into fall prevention, the Data Center conducted a series of targeted studies on fatal falls in construction, including: 1) Hispanic workers (*Accident Analysis and Prevention*, 2009), 2) older workers (*Human Factors*, 2012), 3) falls from roofs (*Journal of Safety Research*, 2013), and 4) residential construction (*American Journal of Industrial Medicine*, 2014). These findings received extensive attention and were quoted by OSHA, NIOSH, BNA reports, trade magazines, and the media.

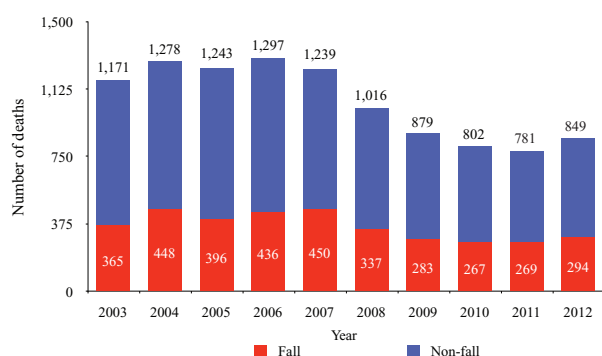
The Data Center also created a web-based map of construction fatalities derived from news reports and OSHA investigation. This map, hosted at StopConstructionFalls.com, has increased public awareness of fall hazards in construction by indicating the location and circumstances of those fatalities, which directly supports the National Fall Prevention Campaign.

In addition, the Data Center's study, "Fall Injuries in the U.S. Construction Industry," is included as a chapter in NIOSH's new cross-industry book, *Fall Prevention and Protection: Principles, Guidelines and Practices* (in press). Many of the Data Center's studies and links to peer-reviewed journal articles can be accessed through www.cpwrr.com in CPWR Key Findings from Research.

New Trends in Fatalities. The Data Center closely monitored injury trends in the construction industry. By analyzing the newly released CFI data, the researchers found that in 2012, the number of fatalities in construction increased for the first time since the

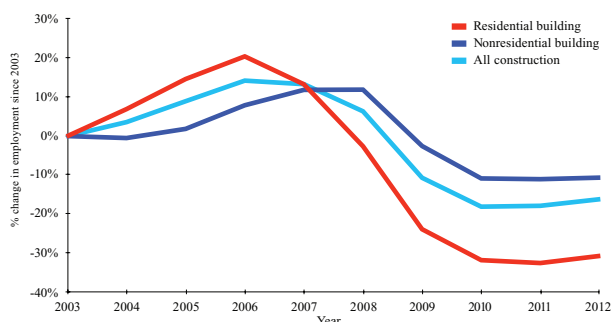
RESEARCH

Number of fatalities in construction, falls and non-falls, 2003-2012



Source: The chart was included in CPWR Data Brief June 2014 Vol. 3 No.2. The numbers were based on the BLS' online CFOI database.

Percent change in construction employment since 2003, 2003-2012
(Private wage-and-salary workers)



Source: The chart was included in CPWR Data Brief June 2014 Vol. 3 No.2. The numbers were from U.S. Bureau of Labor Statistics, 2003-2012 Current Employment Statistics.

These and many others charts can be found in the "New Trends in Fatalities Among Construction Workers," June 2014, CPWR Data Brief.

recent economic downturn, particularly in residential construction. The findings were published in a CPWR Data Brief, which has been widely quoted and reprinted since it was posted to CPWR's website in Summer 2014.

To meet the needs of construction stakeholders, the Data Center will produce the CPWR Quarterly Data Reports starting in 2015.

Lifetime Risks in the Construction Industry. This study estimated the lifetime risk among construction workers over a 45-year exposure period by analyzing data from multiple sources. The initial findings, presented at the 139th APHA Annual Meeting, attracted a wide range of attention from the media and general public, and were reported in the APHA News Release, *U.S. News*, *Medical News*, *ISHN*, *Central Coast Industrial Care News*, and many other outlets. A Google search yielded 17,500 related linkages after the findings were released. Two papers based on this study were published in 2014 in the *American Journal of Industrial Medicine* (Risks of a lifetime in construction, part I:

Traumatic injuries; Risks of a lifetime in construction, part II: Chronic occupational diseases).

Safety and Health Disparities. The persistence of ethnic and racial disparities impacts virtually every segment of our society. To understand safety and health disparities in construction, the Data Center has conducted a group of studies focusing on Hispanic construction workers. The research covers multiple topics including employment, demographics, immigration, fatal and nonfatal injuries and illnesses, injury underreporting, language spoken and related barriers, health insurance and healthcare utilization. The findings generated dozens of publications and presentations, and have been widely cited by construction stakeholders and the general public. The research has also been used for NIOSH program development and published in books in the general public health domain: Chapter 16 in *Expanding Access to Health Care: A Management Approach*, 2009; Chapter VII in *Health Disparities: Epidemiology, Racial/Ethnic and Socioeconomic Risk Factors and Strategies for Elimination*, 2013.



These short, one-topic publications provide a concise overview of an issue.

Aging Workforce. The Data Center examined many implications of the aging workforce using cross-sectional studies to watch today's new and emerging trends, and longitudinal studies to capture construction worker health and safety across the lifespan. In addition to frequent data requests, the findings appeared at conferences and peer-reviewed journal papers (Chronic back pain among older construction workers, *International Journal of Occupational and Environmental Health*, 2012; Chronic diseases and functional limitations among older construction workers, *Journal of Occupational and Environmental Medicine*, 2011).

The researchers have also conducted longitudinal studies on younger construction workers, including 1) Factors associated with work-related injuries; 2) Health behaviors and long-term health outcomes, and 3) Work-related injuries and workers' compensation. These findings were published by the *Journal of Occupational and Environmental Medicine* in 2014 and presented at the 2014 International Epidemiology in Occupational Health Conference, the 2014 APHA annual meeting, and the first International Symposium to Advance Total Worker Health™ sponsored by NIOSH.

Green Construction. Green construction has exploded in recent years. Using public and private data sources, Data Center researchers analyzed development of green construction projects, workforce involvement, as well as safety and health training related to green activities and technologies. The findings were reported in *The Construction Chart Book* and a CPWR Data Brief, and were distributed in training classes and conferences. The results suggest that safety and health training on green technologies is far behind the growth of green construction.

RESEARCH

Improving Safety and Health Surveillance. The Data Center has worked steadily to improve surveillance in construction safety and health. Their research was presented in peer-reviewed journal papers (Injury underreporting among small establishments in the construction industry, *American Journal of Industrial Medicine*, 2011; Work-related injuries among Hispanic construction workers—evidence from the Medical Expenditure Panel Survey. *American Journal of Industrial Medicine*, 2010) and conferences, and is widely referenced. In addition, the Data Center has collaborated with government agencies and external researchers. For example, they assisted in the OSHA data system revision, NIOSH questionnaire development (injury underreporting and the NHIS supplement), and BLS coding revision. The Data Center's suggestions have been reflected in the BLS updated occupational injury and illness classification system (v2.01). A paper co-authored with BLS researchers on applying the new coding system was published in the BLS' *Monthly Labor Review* (June 2014).

Other accomplishments include:

- Data Center findings have appeared in many academic journal papers, books, and trade publications. In 2014 alone, Data Center staff co-authored seven peer-reviewed journal papers.
- The CPWR Data Briefs bring today's relevant construction statistics to the public in a timely and concise manner, and they draw a big audience.
- A wide variety of products allow access to Data Center findings for all construction stakeholders and interested parties. For example, the fatality map and articles on falls are used as materials for the National Fall Prevention Campaign; the Data Brief was distributed by OSHA to all OSHA Training Institute (OTI) Education Centers across the nation, and translated into Spanish. Data Center statistics were used by the NIOSH Construction Snapshot series and injury projection estimates for future NORA goals.

Research to Practice (r2p)

Robin Baker, MPH, CPWR

In 2010, CPWR was charged with addressing the National Academies' finding that more needs to be done to increase use of research-based interventions by workers "in the trench" or "on the steel."

Under the direction of Robin Baker, CPWR's r2p Director, a team with expertise in construction, research to practice (r2p), and evaluation came together to focus on three inter-related priorities: 1) develop a systematic approach for research dissemination using a triage process for completed projects and a roadmap for guiding r2p initiatives in new research; 2) formalize the process for dissemination efforts with NIOSH and OSHA through the establishment of an interagency r2p Working Group; and 3) explore the role of stakeholder partnerships.

During the four-year project, the r2p team designed, tested and used the Roadmap with 11 new projects and the Triage Tool with 17 completed projects, and conducted a roadmap training session for NIOSH researchers. Based on the triage results, the r2p Working Group identified six follow-up dissemination projects that led to some of CPWR's most important achievements during this research cycle, including the widely consulted OSHA-NIOSH Nail Gun Safety guidance document based on CPWR research, and the Campaign to Prevent Falls in Construction, a high-profile joint OSHA-NIOSH-CPWR campaign to address the leading cause of industry fatalities. In its third year, a nationwide Safety Stand-Down was held, which resulted in more than 1.5 million workers participating in fall prevention activities.

Two major meetings were held with representatives from academia, business, labor, and government to tackle major issues in construction safety. A technology transfer symposium focused on how to commercialize research-based interventions and resulted in a detailed report and an *Intellectual Property Patent and Licensing Guide*. A CPWR workshop on Safety Culture and Safety Climate, held in conjunction with NIEHS and the NORA Sector Council, generated new tools and strong interest and demand from the industry as they seek to understand and improve their organizational safety culture and jobsite safety climate.

Developing industry partnerships of key stakeholders to take action on safety and health issues was an r2p priority from the start. The r2p team examined existing safety and health partnerships, developed related case studies, including one on the highly successful Asphalt Paving Partnership, and established a model national industry partnership – the Masonry r2p Partnership, whose core members include the International Union of Bricklayers and Allied Craftworkers, the International Council of Employers, and the International Masonry Institute. This safety and health partnership allowed CPWR to track and evaluate a partnership from its infancy and the partners to advance their safety and health priorities and develop related dissemination products. One such product, the *ChooseHandSafety.org* website, combines research findings and interventions to prevent hand injuries, a serious risk for all construction workers.



The StopConstructionFalls.com website provided training materials and advice to contractors and organizations wishing to participate in 2014's nationwide Safety Stand-Down.

In the coming research cycle, the r2p team will foster new partnerships in additional high-hazard construction sectors (see Prevention Partnerships, page 6), continue to work closely with CPWR researchers to include dissemination strategies in their projects, build on the team's earlier research on reaching Latino workers and small contractors, promote the use and development of the new Trainers and Researchers United Network (TRU-Net), further efforts to create a community of practice among partnerships, and continue to work with the r2p Working Group to establish and implement dissemination priorities.



The **ChooseHandSafety.org** website, a product of the Masonry r2p Partnership, combines research findings and interventions to prevent hand injuries, a serious risk for all construction workers.

Other accomplishments include:

- The 10-page workbook *Strengthening Jobsite Safety Climate: Eight Worksheets to Help You Use and Improve Leading Indicators* provides practical information and tools that employers and other stakeholders can use to improve safety climate on their jobsites. The workbook is based in part on findings from the Safety Culture/Climate workshop.
- The r2p Partnership Toolkit, developed from the partnership case study research and the model Masonry r2p Partnership evaluation, brings together the lessons learned from these projects: how to establish, strengthen, and sustain partnerships focused on advancing the use of research-based interventions.
- The Work Safely with Silica website (www.silica-safe.org), one of the first joint projects undertaken by the Working Group, is increasingly being used by workers, contractors, manufacturers and government agencies to raise awareness of the hazard and advance the use of available engineering and work practice controls. This website was one of only six technical resources identified on OSHA's silica rulemaking website.

High ROI on Small Studies

Research initiatives with promising ideas and a budget under \$30,000 can find a home in the CPWR Small Studies program. Some major research projects – like Dr. Nate Fethke's search for ergonomic interventions for stud welders (see pages 15-16) – have begun with a small study to demonstrate their viability or test their approach. But others represent important stand-alone projects: a survey of 2004-2009 Small Study authors found that more than 60% had published their findings in peer-reviewed journals. And some of

the most influential and widely discussed CPWR studies of recent years were supported by Small Studies grants.

Highlights included:

Is green building good for workers? In a much-discussed cycle of studies published in the *Journal of Construction Engineering and Management* and *Construction Management and Economics*, Dr. Matthew Hallowell of the University of Colorado asked construction professionals to compare certain green building techniques associated with U.S. Green Building Council LEED (*Leadership in Energy and Environmental Design*) credits with conventional counterparts. Respondents indicated how, for instance, green roof installation and materials recycling requirements can create additional hazard exposures for workers on LEED projects.

"If you get hurt and report it, you will be replaced." In an important addition to CPWR's already extensive literature on injury underreporting (see Data Center, page 11), Dr. Hester Lipscomb of Duke University surveyed 1,020 carpenter apprentices in the Midwest. Nearly one-third of the respondents indicated work-related injuries on their jobsites were rarely or never officially reported, offering explanations like, "I got the impression if I got hurt I was no longer employed," and "The term 'fired before you hit the ground' is used too much in our industry."

Injury and Compensation Claims for an Aging Construction Workforce. Dr. Natalie Schwatka, a member of Dr. John Rosecrance's research team at Colorado State University (see page 15), took the lead in an important analysis of worker's compensation insurance

claims. The study, appearing in the *American Journal of Industrial Medicine*, found that medical costs increased by 1.1% for every year over age 18, and indemnity costs – largely, lost wages and benefits – increased by 3.5% for each year. A literature review that accompanied the original research was published in the highly respected *Epidemiologic Reviews*.



Photo: Earl Dotter/www.earldotter.com

The study found medical costs increased 1.1% for every year after age 18. Indemnity costs (mostly lost wages and benefits) increased 3.5% each year.

The Cost of Interpersonal Conflict in Construction. How much time and money is wasted in arguments on a construction job site? Estimating software generally doesn't include a line for "fights and arguments," but they can carry a real price tag. Michigan State



If an “interpersonal conflict” averaged \$11K, as was found in Dr. Brockman’s study, then teamwork and a good safety climate is positive for both the work environment and the bank account.

University’s Dr. Julie Brockman investigated, costing out 41 episodes of “interpersonal conflict” on the job and found they averaged a steep \$11,000 apiece. Too often, the disputes between two people or two subcontractors escalated, creating delays not just for the parties involved but for other members of the project team as well. Brockman’s analysis of this often-overlooked cost attracted significant notice in the trade press, including *Engineering News-Record (ENR)*.

Building a Better Texas. CPWR supported the Workers’ Defense Project in a pilot study of working conditions in the Lone Star state’s residential construction industry. The community group eventually visited nearly 1,200 of these mostly Latino and immigrant workers on the job. Sixty percent of the workers reported that they had never received basic safety training; 41% were misclassified as independent contractors or paid in cash, enabling employers to evade both payroll taxes and workers compensation insurance requirements; 22% reported being victims of wage theft, left unpaid for work performed. The final report, *Build a Better Texas: Construction Working Conditions in the Lone Star State*, earned newspaper headlines around the state and nation.

Safety Management Survey. Teaming up with industry giant McGraw-Hill – publisher of the *Engineering News-Record* and the *Dodge Reports* – CPWR co-sponsored a survey of hundreds of construction contractors about their safety practices. Contractors identified developing a site-specific health and safety plan, analyzing potential site safety hazards before construction begins, and assigning project safety personnel before construction begins as especially effective methods to increase project safety.

Findings from recent small studies have appeared in journals such as the *American Journal of Industrial Medicine*, the *Journal of Construction Engineering and Management*, the *Journal of Occupational and Environmental Medicine*, and *Epidemiologic Reviews*, among others. They have also been covered in popular and trade publications from *ENR*, *Architectural Digest*, and *Plumbing and Mechanical* to *EHS Today*, *ISHN*, and the *Dallas Morning News*.

Completed Projects 2009 – 2014

Assessment and Prevention of Isocyanate Exposures in the Construction Industry

Carrie Redlich, MD, MPH, Yale University

In the new millennium the market for spray-foam insulation exploded. However, Dr. Carrie Redlich knew that the isocyanates that enabled the foam to cure were far from harmless. The Yale University scholar had already shown how auto body-shop painters had suffered occupational asthma from exposure to such isocyanates. Were they equally dangerous for the workers applying SPF in homes?

With CPWR support, Dr. Redlich explored this question, and her team quickly uncovered high rates of work-related asthma among spray-foam insulation applicators. A quarter of the insulators exhibited work-related asthma symptoms – a frequency several times greater than the general construction labor population. Worse, workers who contracted asthma from this exposure did not always fully recover. While their symptoms may recede after they leave insulation work, exposures such as dusts, particulates, fumes, and



Dr. Redlich’s work uncovered high rates of asthma among spray-foam insulation applicators.

cold weather can trigger their asthma symptoms, making employment in other segments of the construction industry difficult.

Dr. Redlich and her team shared their findings with the industry and have partnered with spray-foam insulation contractors and trade groups to develop and implement protocols to protect workers. Her team’s research findings have appeared in journals such as *Chemico-Biological Interactions* and presentations to trade industry groups.

Enhancing Safety through Leadership

John Rosecrance, PhD, Colorado State University

Leadership is a basic element of a positive safety culture. All too often in the wake of a workplace injury we learn that many workers and supervisors observed the hazardous conditions, but no one acted to change them. The apprentice was afraid to speak up because he was new on the job. The journeyman said nothing because it was a different trade's equipment and she didn't want to get involved. The foreman thought the superintendent was more concerned about making production than abating hazards. The superintendent knew that the project was running behind schedule and his firm was liable for liquidated damages under the contract.

In short, apprentices don't just need knowledge about safe practices. Like journeymen, they need the leadership skills necessary to take the initiative for occupational safety and health. That's what Project LeAD – Leadership Apprentice Development – was all about.

Dr. John Rosecrance and his team at Colorado State University have investigated safety leadership and communication in multiple industries. Project LeAD built on the team's previous work (CPWR research cycle, 2004-2009) with union plumbers and pipefitters, and the contractors employing them.

Their program began with research to identify the most vital leadership skills in the construction industry. Having done so, they created and tested a safety leadership education program based largely on active learning concepts. Rather than relying on lectures, the program used role playing exercises and short video scenarios, followed by group discussions aimed at solving the safety problems presented. The programs were presented to a variety of audiences from construction apprentices to construction management students.

One of the team's key observations was that "Leaders Create Culture." A foreman who is highly respected for his skills and work ethic, and who shows not just by words but by actions that he values occupational safety, can seed positive safety attitudes in the workers

around him. Such "transformational leaders" are the building blocks of a positive safety culture (see page 12). Since these foremen are not just the grassroots leaders of today but the safety directors and superintendents of tomorrow, they quickly became a primary focus of Project LeAD. Dr. Stephanie Johnson, who worked with Rosecrance on the 2004-2009 project, and CPWR's Dr. Linda Goldenhar will build on this work of creating safety leaders in the new research cycle (see page 5).

Some of the Rosecrance team's related projects – in particular, a survey of construction workers explaining why they don't always report injuries to their supervisors or workers' compensation providers – attracted considerable attention on their own. The team's work has appeared in journals such as the *American Journal of Industrial Medicine*, *Epidemiologic Reviews*, *Safety Science*, the *International Journal of Occupational Safety and Ergonomics*, *Leadership and Organization Development Journal*, and *Accident Analysis and Prevention*, as well as trade publications like *ENR*, *EHS Today*, and *OH&S*.

Other accomplishments include:

- Several publications on the importance of developing and sustaining a strong safety culture in the construction industry will be available soon from the research team.
- Project LeAD resulted in a video-based curriculum on safety leadership for apprentices.
- Apprentice trainers have indicated that the information presented in Project LeAD is unique and expressed interest in using the video program in their apprentice program.

Ergonomics and Welding Fume Exposures during Stud Welding

Nate Fethke, PhD, University of Iowa

When ergonomics researcher Dr. Nate Fethke at the University of Iowa looked at ironworkers welding floor-level studs – for instance, while securing floor decks to a new skyscraper's steel frame – he cringed. These workers spent much of their workday bearing heavy tools, hunched over at a right angle for 20 minutes at a time, dangerously near a source of toxic fumes.

Every year thousands of workers toil at this task while erecting bridges or commercial buildings. Fethke's team of scholars partnered with locally-based steel contractors, Ironworkers Union leaders and equipment manufacturers to assess the problem and explore solutions.

Tests confirmed what both workers and researchers already suspected: conventional stud welding put unhealthy strain on workers' lower backs for long periods and brought workers' breathing zones perilously close to hazardous fumes. If the team could engineer a way for workers to perform floor-level stud welding while standing upright, they could address two occupational hazards at once.



Dr. Krista Hoffmeister, pictured with ergonomics engineer Dan Wisner, authored a paper on the effects of transformational leadership on employee safety, which gained the attention of the construction industry and its press.

RESEARCH

An innovative local tool manufacturer and supplier – himself a former ironworker committed to the health and safety of workers in the industry – proposed a promising concept. His device was a wheeled cart with an articulated arm that would support the welding gun; a worker using the device could stand upright while arc welding floor level studs. Using a prototype designed by the manufacturer and another they fabricated themselves, Fethke's team measured workers' posture and muscle effort using both the conventional approach and the alternative.

The research program has been an object lesson in the barriers to efficient technology transfer. Building a device that can meet workers' demand for safety and contractors' demand for productivity has been a daunting challenge. The prototypes reduced fume exposure and relieved strains on workers' backs. But they also increased demands on workers' shoulder muscles, and a wheeled cart effective on a flat surface encountered in bridge construction can be thwarted by waffle decking on a building job. The local equipment manufacturer made considerable strides in refining the device to meet these complex task demands but, with limited resources, has not yet commercialized the product.

The team hopes to continue development of its prototype and to use the relationships and methods it has developed to test other interventions, such as fume extraction guns and powered air-purifying respirator systems. Their work has appeared in academic journals such as *Applied Ergonomics* and the *Journal of Occupational and Environmental Hygiene*.

Other accomplishments include:

- Real time, continuous measurement of the concentration of welding fume nanoparticles in a worker's breathing zone was a unique aspect of the research project. The team validated a relatively new portable diffusion size classifier – the DiSCmini (Matter Aerosol, Wholen, Switzerland) – in the laboratory prior to

using it to evaluate the effectiveness of the prototype stud welding equipment. The results of the laboratory testing, published in the *Journal of Occupational and Environmental Hygiene*, suggested that the DiSCmini was well-suited to real-time measurement of nanoparticles similar to those present in welding fumes.

- Data collection for the project ended not long ago, and while the team works to finalize its analyses for publication, preliminary results have been shared with key leadership of the Ironworkers Union.

Evaluating the Efficacy of Safety Liaisons and Worker Training

Michele Ochsner, PhD, Rutgers University

Latin American immigrants are transforming the building industry's labor force, especially in residential construction. CPWR Data Center researchers, as well as others, have carefully documented elevated occupational injury and illness risks suffered by Hispanic workers, foreign-born workers and residential construction workers (see Data Center, page 11). Rutgers University and New Labor teamed up to test interventions designed to protect perhaps the most at-risk segment of the construction workforce: Latino day laborers employed in residential construction.

In the 2004-2009 research cycle, New Labor and the Rutgers OTEC (Occupational Training and Education Consortium) drew on the Smart Mark curriculum (created by the Building and Construction Trades Department, AFL-CIO) to develop a bilingual, hands-on health and safety curriculum designed around the needs of immigrant workers. "Peer leaders," or day laborers with demonstrated initiative and interest in occupational safety, guided colleagues through active, problem-solving exercises. The team disseminated the curriculum and teaching model to worker centers across the United States.

For the 2009-2014 research cycle, the team proposed training "safety liaisons" who would monitor potentially hazardous conditions on worksites and encourage safer practices, more training and a safer work culture. Safety knowledge is necessary for "safety liaisons," but it is not alone sufficient – they also need initiative, diligence and good leadership skills. Safety liaisons must be meticulous in documenting hazards using safety audits to characterize working conditions in the poorly regulated residential construction sector, but also persuasive in recruiting workers to attend basic safety training classes. And they need the right combination of diplomacy and forcefulness in order to seek remedies – first to petition the employer to abate the hazard, but if necessary to escalate the issue by leading a jobsite action or even filing an OSHA complaint.

The team successfully maintained a core group of eight to 12 safety liaisons. The liaisons have audited more than 200 residential construction sites – demonstrating, for example, a startling absence of fall protection, rare personal protective equipment, and many



Dr. Fethke operates a prototype that enables workers to stand while stud welding. The tool's developer, a former ironworker, is in the background.

RESEARCH



Training classes are interactive and involve demonstrations. Three of four OSHA-authorized instructors, all immigrant Latinos who worked construction: (L-R) Selvin Trejo, Edison Flores, and Jonass Mendoza. Safety liaisons approach a dangerous worksite and engage workers.

poorly constructed scaffolds. They have intervened to discuss changes and abate hazards at more than 70 New Jersey construction sites. The liaisons and New Labor developed a level of trust and cooperation with area OSHA offices and successfully reported dangerous conditions, particularly fall hazards. For example, they pursued a formal OSHA complaint in the case of one recalcitrant contractor who placed workers in peril on a poorly built scaffold with

no fall prevention. The safety liaisons meet regularly in a “consejo” or council to discuss problems and develop solutions. The team has recently debuted a new mobile tool for safety audits, and liaisons and New Labor staff have recorded information on more than 50 job sites directly to their smartphones instead of via paper and pencil.

OTEC and New Labor have enhanced their worker training efforts as well. In 2014, four safety liaisons completed the OSHA 500 level construction training. Using a curriculum developed during the 2004-2009 grant cycle, 550 workers have completed the Spanish language “OSHA-10 for construction” class. Results from the team’s research have appeared in the *American Journal of Industrial Medicine*, the *Journal of Safety Research*, and *New Solutions*.

Other accomplishments include:

- The project’s health and safety leadership-building components are explored in *Beyond the Classroom – A Case Study of Immigrant Safety Liaisons in Residential Construction*, found in *New Solutions*, 2012.
- *Bending Toward Justice: How Latino immigrants became community and safety leaders*. CPWR-The Center for Construction Research and Training, 2014.
- Through a training partnership with New Labor, seven members of the Brooklyn-based Workers Justice Project have become safety liaisons and gained the capacity to offer OSHA-10 classes using the Spanish language curriculum developed through this project.

Fall Prevention in Residential Construction

Bradley Evanoff, MD, MPH, and Vicki Kaskutas, OTR/L, OTD, FAOTA, Washington University in St. Louis

Falls remain the No.1 killer of construction workers on the job. Nowhere is this more true than in residential construction.

In an effort to put a stop to these preventable tragedies, the Washington University research team has spent the past decade working with St. Louis-area residential contractors and the Carpenters’ District Council of Greater St. Louis and Vicinity to create innovative initiatives targeting apprentices, foremen and contractors. The foundation of the team’s program is a pair of tailored fall prevention curricula aimed at apprentices and residential crew foremen. The team’s safety audit tool – the St. Louis Audit of Fall Risks or “SAFR” – represents an important achievement in training program evaluation. The SAFR instrument for jobsite audits enabled the team to objectively document changes in workers’ safety behavior after the training.

In another novel experiment to lower the barriers to adopting improved safety practices, the group operated a lending program allowing contractors to borrow and test unfamiliar fall prevention devices, such as a hanging scaffold system. The group also

RESEARCH



John Moremann, instructor at the Southern Illinois Carpenters Joint Apprenticeship Program, demonstrates various anchors that can be used with personal fall arrest systems on roof trusses to a group of foremen, safety directors and owners participating in the study's residential foremen's fall prevention and safety communication training.

designed a web-based inventory of fall prevention devices suitable for residential construction.

The team's work played a prominent role in the National Campaign to Prevent Falls in Construction, a group effort of CPWR, OSHA, NIOSH and the NORA Construction Sector Council, www.stopconstructionfalls.com (see page 12.) The Washington University team wrote a campaign case study highlighting the steps taken by the St. Louis Habitat for Humanity to ensure that their "volunteer" builders are not exposed to fall hazards. The team also developed a Facebook page for the campaign and assisted with development of many campaign materials and methods. Results from the team's work have appeared in journals such as the *American Journal of Industrial Medicine*, the *Scandinavian Journal of Work, Environment and Health*, and *Professional Safety*. The group's findings have also been discussed in the *Rental Equipment Register*, *Safety+Health*, and *OH&S* magazine.

Other accomplishments include:

- The team is currently preparing a final manuscript describing the outcomes of the foremen's intervention. Design and pilot testing were reported in the article, Fall prevention and safety communication training for foremen: Report of a pilot project designed to improve residential construction safety, in the *Journal of Safety Research*, 2013.
- This research resulted in an 8-hour foremen's fall prevention training and safety communication training program.
- The team also developed a website cataloging 150 devices to protect workers from falls during residential construction: www.ot.wustl.edu/fptech/homepage.htm. This site provides detailed information about each device and links to manufacturer websites, videos and installation manuals. The website expands on

OSHA's Guidance Document for Residential Construction, which was developed in response to revised fall protection standards for residential construction.

- More than 2,000 carpenters have participated in the revised fall prevention apprenticeship training; the team anticipates 3,000 views of the fall protection device website this year.
- The foremen's training resulted in improved safety behaviors when working at heights, increased use of fall prevention equipment, increased knowledge, and more frequent toolbox talks. Improvements reported by the 84 participants were corroborated by their crewmembers, and most effects were maintained six months after the training.

Highway and Bridge Construction Drilling

David Rempel, MD, MPH, University of California, San Francisco

In the eyes of a worker wielding a heavy hammer drill, or of an ergonomics expert like Dr. David Rempel, concrete and rock drilling is one of the most punishing of construction tasks. Rempel and development engineer Alan Barr have spent a significant portion of their research careers seeking ways to relieve construction workers from the extreme physical stresses endured during concrete and rock drilling.

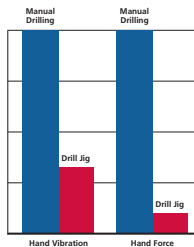
In an earlier research cycle, Rempel and his team at the University of California, San Francisco tackled overhead drilling. The inverted drill press they designed for workers installing anchor bolts in concrete ceilings (to support lighting, pipes and air ducts) saved countless workers from a painful task when it was adapted for



As seen in **TOOLS OF THE TRADE**

RESEARCH

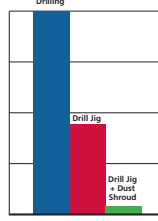
LESS FORCE AND VIBRATION



The jig reduced hand vibration by two-thirds and hand force need by 90%.

Source: UC Ergonomics

LESS AIRBORNE SILICA



The jig reduced airborne silica by 55% when used alone, and by 96% when used with optional dust shroud.

Source: Cooper et al., 2012, *Journal of Occupational and Environmental Hygiene*

MORE PRODUCTION

"Amazing for productivity — ballpark 3-4 x faster hole drilling."

— Thomas Burkland, Engineer, Warm Springs Constructors, Fremont, CA

"We saved a lot of time because the drill jig is so easy and convenient to use."

— Charles Colley, Electrical Superintendent, Shimmick Construction, Oakland, CA

Research findings on the Universal Drill Rig.

commercial production by a major tool manufacturer. Rempel was named one of *ENR* magazine's "Top 25 Newsmakers of 2010."

Building on this achievement, the team turned their attention to a new challenge: creating a universal drill rig suitable for workers who use very heavy drills when engaged in bridge and highway construction. The laborers drilling holes for rebar dowels drill horizontally or vertically, at varying heights, and even operate heavier pneumatic drills. They are plagued by tool vibration and high hand forces that can cause soft tissue damage, turning a short-term job into long-term pain.

The resulting universal drill rig is the product of several years of testing by industry partners: workers at union training centers and contractors on the job. The rig has not simply proven useful in protecting workers from musculoskeletal injuries – it has helped reduce worker exposure to dangerous airborne silica (see page 23). And, in a bonus that should reduce barriers to adoption, drilling using the rig is also faster than manual drilling. Firms involved in the testing clamored to buy the tool, and Barr has launched a firm – Ergomek – to manufacture it for them.

Dr. Rempel is continuing his concrete drilling research in the next grant cycle with a novel test bench system (see page 7).

Rempel's group's work has appeared in journals such as the *Journal of Occupational and Environmental Hygiene* and *Ergonomics*, and has been covered in trade magazines from *ENR* and *Concrete Contractor* to *Safety + Health* and *OH&S*. The Universal Drill Rig was featured at the 2014 "World of Concrete" expo.

Other accomplishments include:

- The Universal Drill Rig reduces hand and arm forces, handle vibration, and respirable silica dust during concrete drilling.
- The group's work has been published in academic journals and has been covered by *ENR* and trade publications, including a video and feature in a "Tools of the Trade" blog during World of Concrete. Months after the WOC, the tool was No. 13 in the "50 Cool Things You Should Have Seen at the World of Concrete."
- The rig is now commercially available under the name DrillBoss

and is sold by Ergomek. It is currently being used by large general contractors and electrical contractors across the country. The user base continues to grow.

- The current rig manufacturer is actively marketing the rig using the research findings as evidence of the benefits of using the device.

Participatory Ergonomics

No one's job should be a chronic pain

Laura Welch, MD, CPWR

Few occupational hazards touch more construction workers than work-related musculoskeletal disorders (WMSDs). Sprains, strains, repetitive motion injuries and all manner of soft tissue damage steal quality of life from tens of thousands of construction workers. CPWR Medical Director Laura Welch, MD, and a team of colleagues at Washington University in St. Louis headed by Brad Evanoff, MD, set out to design and test an intervention program that would promote safer work postures, techniques and tools in ever-changing construction worksites.

The researchers began their investigation with a review of workers' compensation and health insurance claims data for some 17,000 Missouri carpenters and sheet metal workers to assess the prevalence of WMSDs. Health insurance claims records confirmed what scholars have long suspected – workers' compensation data greatly understate the frequency of these injuries because so many workers take their complaints to the family doctor rather than enduring the cumbersome comps claim process.

The results also helped identify characteristic tasks of each trade that are especially punishing for the human body. But finding alternatives can't be done in the lab alone: it's best achieved through participatory methods, where the insights of workers and contractors in the field can identify problems and seek practical solutions.

The research team did just that. With assistance from partners in both labor and management, they took to the field with carpet layers, drywall carpenters and sheet metal workers to gather insights, evaluate tools and create tailored curricula on the prevention of musculoskeletal disorders.

The team's work has appeared in the journals *Work*, *Applied Ergonomics*, *Occupational and Environmental Medicine*, and the *American Journal of Industrial Medicine*.

Other accomplishments include:

- Through video analysis, the team identified specific tasks that required high force or prolonged awkward postures among floor layers.
- The team tested the usability of an overhead drilling system and shared the limitations with the manufacturer. This led to design modifications for future production of the device, including a column extension, a smaller model for use on scissor lift platforms, and a T-bar accessory that allows the operator to use two drills at once.

Photo courtesy Washington University in St. Louis



Workers discuss how best to move one section of a 28,000 cfm air handling unit, while Drs. Lisa Jaegers and Ann Marie Dale observe their decision-making. This section (over 11' x 7' and 30' in length) was one of five, ranging from 1.5 to 5.8 tons. Workers had approximately 1" clearance between the walls of the air handler sections and the opening in the basement wall when moved into the mechanical room. The "Roll-a-Lift" tool is a hydraulic jack mounted on casters that allows the piece to be raised off the floor and easily maneuvered into place.

- The ergonomic benefits of a variety of tools were tested and the team developed examples of "return-on-investment" for some, including an overhead drill press for drilling into concrete and power shears for prepping metal duct materials that are available as examples on the ROI calculator website, www.safecalc.org (see page 8).

Prevention of Nail Gun Injuries in Residential Construction

Hester Lipscomb, PhD, Duke University

Pneumatic nail guns with "contact-trip" triggers are veritable automatic weapons of the construction world: they permit the user to fire the gun repeatedly by holding down the trigger and bumping it up against the work. They are widely used by the carpenters who frame single family homes and other "stick-built" structures – but the combination of powerful pneumatic nailers, heavy framing nails, and "contact-trip" triggers adds up to severe injury for thousands of workers every year.

Dr. Hester Lipscomb of Duke University has been working on this issue for more than a decade, even before joining the CPWR consortium in 2004. In earlier stages of her work, Lipscomb examined workers' compensation and ER admissions data to gauge the scope of the problem. Then, in cooperation with the Carpenters' District Council and St. Louis-area framing contractors, she demonstrated that proper apprentice training and substitution of a safer nailer with a sequential trigger could cut nail gun injuries by 31% – at least in the short term.



Lipscomb's work made a significant policy impact with this OSHA-NIOSH employer guide.

During the past five years, Dr. Lipscomb and her team broadened and deepened their research on nail gun injuries and hazards. They followed the St. Louis apprentices who had considerable exposure to tools with sequential triggers, as well as training in safe tool use, to assess musculoskeletal injury risk and to monitor acute injury patterns. Injury rates have declined 56% since 2005. No differences were seen in the rate of musculoskeletal problems based on the type

of trigger on the nailgun of users. Furthermore, acute injuries occurred at rates 13 times higher than musculoskeletal disorders even after the marked reduction in injuries over the last decade.

The team also pursued many avenues to increase dissemination of their findings, meeting with tool manufacturers, government regulatory agencies, and occupational health experts, as well as construction labor and management figures, to discourage use of the dangerous, hair-trigger "bump gun." They have created handouts, videos and a website – www.nailgunfacts.org – to amplify the message. The team's work achieved a significant policy impact when NIOSH and OSHA partnered in 2011 to issue a guidance document regarding nail gun safety based largely on the team's research. On OSHA's website, *Nail Gun Safety: A Guide for Construction Contractors* drew 178,334 views in the first month.

The team's research has appeared in journals such as the *American Journal of Industrial Medicine* and the *Journal of Safety Research*, as well as trade magazines like *Safety+Health*, *OH&S*, *ISHN*, *EHS Today*, *Tools of the Trade* blog, and a variety of union publications.



Nailgunfacts.org offers visitors research, news and literature on nail guns, as well as training materials and videos.



RESEARCH

Other accomplishments include:

- Research from this project was used in developing the OSHA-NIOSH guidance document for employers on nail guns.
- A manuscript will appear in the *American Journal of Industrial Medicine*, Musculoskeletal concerns do not justify failure to use safer sequential trigger to prevent acute nail gun injuries.
- The website www.nailgunfacts.org was created as the team's repository for information on nail gun injuries. It receives more than 2,000 visits per day and offers visitors resources for training (including videos), quick answers to user questions, links to research, policy debates and news items.

Reducing Worker Exposure to Silica, Dust and Noise in Construction and Demolition

Susan Woskie, PhD, University of Massachusetts, Lowell

Jackhammers and pavement breakers, concrete saws and backhoes: the work of the equipment operator and the laborer who build bridges, pave roads and knock down old buildings is synonymous with dust and noise. When workers aren't protected from these hazards, development of respiratory disorders and hearing loss are just a matter of time.

In the 2004-2009 research cycle, researchers at the University of Massachusetts, Lowell, Department of Work Environment investigated how construction worker health is threatened by exposure to dust and noise with a focus on cutting concrete pipe. Since 2009, Dr. Susan Woskie and her research team have partnered with New England-area construction contractors and labor unions to assess the effectiveness and viability of a variety of controls meant to keep these dangers in check.

Some concepts already familiar to industry contractors proved less effective than hoped in practice. A noise-reducing concrete saw blade may have been a product of marvelous engineering – but noise pollution from portable gas-powered saws is largely a product of internal combustion, something that can't be fixed with a new blade. Noise perimeter strategies – demarcated no-go zones around loud work operations – are effective in many industries where work locations are fixed, but less practical in construction where the heavy equipment generating the noise is constantly in motion. Preliminary work suggests that adding noise dampening “mats” in the engine compartment of heavy equipment reduces noise levels both inside the cab and the area just outside the cab.

Other interventions, however, proved their worth. The team found that workers in “knock-down” or structural demolition projects that use water hoses, commercially available misters, and roadway watering trucks have low exposures to harmful silica dust. Without controls, workers on rock and concrete demolition equipment are exposed to high levels of silica dust. The team found that water



Rock crushing (above) creates high levels of silica exposure, but researchers found misting equipment provided valuable protection to workers.

misting of the crushers at transfer points provided valuable protection against silica dust. And at a time where a controversial silica rulemaking at OSHA was creating demand for practical solutions, the team demonstrated that it was feasible for a concrete-cutting saw with a water hose attachment to bring airborne respirable silica levels below the NIOSH recommended exposure limit of 50 µg/m³, when cutting is done for less than two hours per day.

The team's work has appeared in academic journals such as the *Journal of Occupational and Environmental Hygiene* and the *Journal of Construction Engineering and Management*, plus the trade publication *Equipment Today*. In the new research cycle, Dr. Woskie and her team will turn their attention to other construction respiratory and dermal exposure hazards: isocyanates and epoxies used in spray-on foams, paints and coatings, caulks and adhesives (see page 6).

Other accomplishments include:

- The results from a paper describing water suppression with portable masonry cutoff saws were also highlighted in *Equipment Today*.
- Presentations delivered to the OSHA Roundtable on Construction and to local contractors about the results from sampling have influenced the use of dust controls in the New England region.
- A presentation to about 25 workers during a research partner's annual safety training helped raise workers' awareness on silica health effects and exposures. The highlight of the event: one of the workers said, “Where have you been? I have been chipping for 19 years and I never knew how dangerous silica exposures were.”

Safety Culture/Safety Incentives

Jack Dennerlein, PhD, Northeastern University

It would be hard to find a research project more of the moment than that of Dr. Jack Dennerlein and his team at Northeastern University and Harvard University. Safety culture – the beliefs, attitudes and values that inspire team members to prioritize or

RESEARCH

neglect safe work practices – has become an industry buzzword in the course of the project (see page 5). Dennerlein's group set out to explore how incentive programs can cultivate or corrode safety culture, depending on how they are structured.

Incentive programs rewarding worker teams for long strings of “accident-free” days are cheap and popular with management, but many occupational safety experts fear that they may aggravate the problem of underreporting workplace injuries (see Data Center, page 12 and Small Studies, page 13). Work teams learn to hide injuries and illnesses in order to qualify for a prize; management gains a false confidence in safety conditions on the worksite and misses real opportunities to identify and abate hazards.

But what if an incentive program awarded workers based on the creation and maintenance of safe working conditions and practices? And workers were scored not by counting reported injuries but by tallying best practices in worksite audits? That would remove the incentive to leave injuries underreported and allow safety representatives to identify and correct problem areas based on their audits. It might even enhance safety culture as workers and managers work together to recognize and control hazards through safe working conditions and root out unsafe conditions.

The group designed a safety incentive program – Building Safety for Everyone – around this concept. They developed a scoring system based on best practices in construction occupational safety, and had trained safety professionals to inspect and score work practices and conditions of the worksite on a regular basis (a minimum of once a week). Feedback was delivered weekly to workers and foremen in various forms: posters located in central locations tracked the overall worksite safety score each week; safety scores of individual subcontractors were also posted and tracked over time; and, foremen received detailed reports of all observations (including both safe and unsafe) from their company and were encouraged to share the information with their crews. If and when the overall site score (combination of all subcontractors' scores on a given project) at the



A small, organized space for Building Safety for Everyone made a big difference. A participant said, “Building Safety for Everyone increased the level of awareness around safety conditions on-site.... Instead of cutting corners, we'd do it right.”



Housekeeping issues bedevil many jobsites; Building Safety for Everyone helped prevent slips, trips and falls. “The trades were working together with the Building Safety for Everyone program, and other trades were watching out for everyone else. Normally they would never do that, but now I see talking amongst the trades – this came from the program.” (Building Safety for Everyone site employee)

end of a month met a pre-determined threshold score, workers, site managers and research staff would gather to recognize the achievement. Working with five general contractors on eight large Boston-area construction projects, the group implemented Building Safety for Everyone – and collected more than 1,200 surveys from both craft labor and supervisors demonstrating improved teamwork, safety awareness and communication in the course of the program.

The team's research results have appeared in the peer-reviewed journal *Safety Science* and reached an industry audience in *Occupational Health & Safety Magazine*.

Other accomplishments include:

- The team received a CPWR Small Study grant to perform a deep analysis of the safety scores and site safety climate. The results were published in the *American Journal of Industrial Medicine*.
- The team has one journal article on the intervention's development in press at *New Solutions*, another article under review that examines patterns of employment and their relationship with musculoskeletal pain among construction workers, and others in progress on the impact of the Building Safety for Everyone program on safety climate and communication, MSD pain, and injury.
- As part of the Research to Practice component of the study, the team developed an extensive program website (<https://www.northeastern.edu/buildingsafetyforeveryone/>) describing how to adapt and implement Building Safety for Everyone on worksites of varying sizes and management structures. This website was revised after an extensive vetting process with program partners and industry experts.
- For the duration of the evaluation period, the team's industry partners incorporated the program into their own health and safety program. They have also expressed interest in continuing the program on their own.

Tuckpointers and Welders Breathe Easier with Local Exhaust Ventilation

Pam Susi, MSPH, CIH, CPWR

Dusts and fumes are pervasive on construction sites, and many pose severe health hazards. Health effects are usually insidious, causing irreparable harm often not apparent until years or decades after exposure. Airborne crystalline silica can damage lung tissue and cause other disorders – some fatal but all totally preventable. Meanwhile, trades who routinely engage in welding are commonly exposed to hazardous levels of fumes from disease-causing metals.

For two decades, Pam Susi and her colleagues have documented these dangers through their pioneering research measuring hazardous exposures encountered by various trades. The published results have become required reading in the field; small wonder that two of their publications were cited in the preamble to OSHA's proposed silica rule.

But documenting the danger is just the first step. Over the past five years, Susi's team has enlisted industry participation in a project to evaluate solutions for both welding fumes and silica dust generated during a masonry restoration.

Occupational health experts prefer Local Exhaust Ventilation or LEV that captures dusts and fumes at the source; LEV protects not just the worker who welds or grinds but everyone in the vicinity. To find out which LEV systems are practical and effective, Susi's group recruited knowledgeable contractors, labor union representatives, hygienists and tool and equipment manufacturers in Partnerships for Advancing Control Technologies (PACTs) focused on each hazard. The PACTs selected commercially available LEV systems for performance testing.

Tuckpointers, who grind out old mortar when repairing aging masonry structures, face some of the highest silica exposures in the construction industry. Researchers identified a number of commercially available LEV systems, which were rated by labor and contractor group members of the Silica PACT. Four of the most highly rated systems were subjected to an extensive evaluation for dust capture effectiveness. Each reduced silica exposure by more than 95%.

The Welding PACT, with mechanical contractors, pipefitters, and boilermakers in the fore, identified and rated a number of LEV systems for capture of welding fumes. Susi's team tested three of the most highly rated systems at union apprenticeship and training centers. Manganese and hexavalent chromium exposures were reduced between 56% and 94%.

However, apprentices need instruction in proper LEV use for these systems to be effective. So the team also designed and piloted a short training curriculum on proper LEV use while welding. Pilot test results showed that not only did knowledge increase after training, but welding fume exposures decreased.

In the new five-year grant cycle, Susi will continue working in the area of exposure assessment and controls as part of CPWR's Construction Solutions team (page 8). She will be concentrating on the development of a publicly accessible and searchable exposure

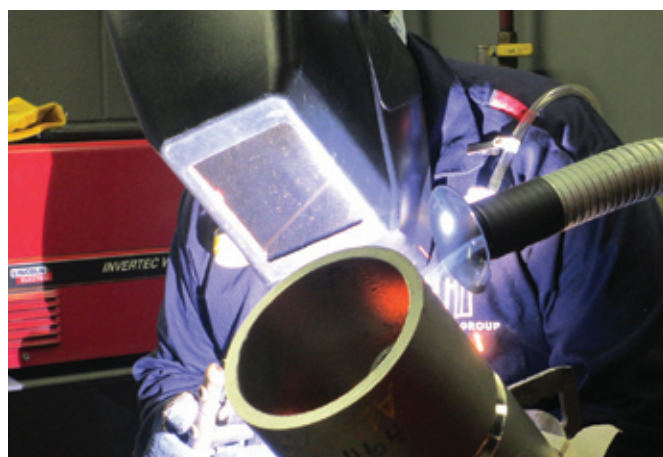
and control database for noise, silica, welding fumes and lead. The goal is to gather exposure data for specific construction tasks and trades, especially with use of engineering controls, so that high exposure tasks can be identified before work starts and effective engineering controls can be built into the job.

Since 2010, the team has published five papers in the *Journal of Occupational and Environmental Hygiene* and the *Annals of Occupational Hygiene*. The research has also been published in popular news outlets.

Other accomplishments include:

- Susi's team has published some of the most frequently cited papers in the occupational health field.
- Unions and contractor associations (UA, Boilermakers and the MCAA) published news about the project in outlets reaching hundreds of locals, training centers and contractors.
- Her team produced "LEV Works," an evaluation of three systems for controlling manganese and hexavalent chromium exposure while welding.
- Investigative journalists from the Center for Public Integrity used information gleaned from Susi's research team in their award-winning news series, "Hard Labor."
- A major dust control manufacturer (Ermator) designed a new dust shroud based on her team's LEV evaluations conducted in 2013.
- *Model Silica Specifications*, developed by the CPWR/NIOSH Engineering Controls Work Group with support from this project, were adopted by the Philadelphia School District for use on all capital improvement projects.

In 2014, the City of Philadelphia developed and posted guidelines for dust control during construction, renovation and demolition using research results and input from the research team. The city is currently drafting new regulations, which will require use of engineering controls for construction, renovation and demolition operations that may potentially expose the public to elevated dust levels.



Controlled tests when welding showed manganese reductions from 59% to 94% and hexchrome between 56% and 94%.

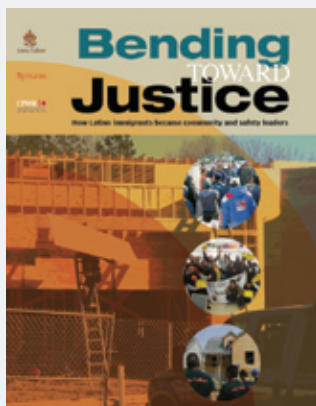
PRODUCTS OF RESEARCH

All documents displayed here were produced in 2014. Websites on nano-enabled products, fall protection devices, the Building Safety for Everyone safety management program, Choose Hand Safety, and our CPWR YouTube channel came to fruition in 2014. All have the same purpose: provide industry with user friendly research findings to inform decision-making.



Research results spurred changes in equipment design and city guidelines.

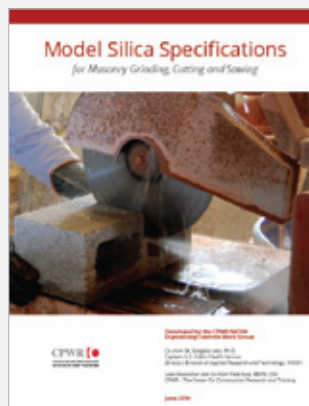
This workbook of eight worksheets helps you evaluate your site's safety climate and take steps to improve it.



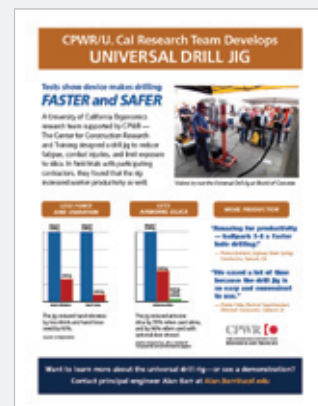
Latino immigrants became safety and community leaders thanks to research and training.



Hand-held safety audits in English and Spanish.



Developed by contractors, labor, government representatives, and researchers.



New product explained on one page.



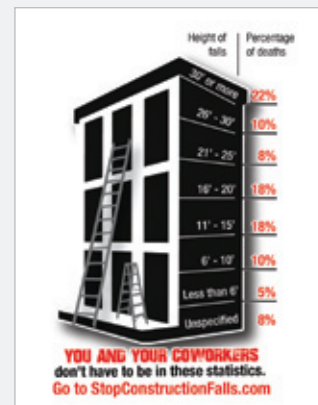
A one-topic analysis of construction data distilled into charts with accompanying text.



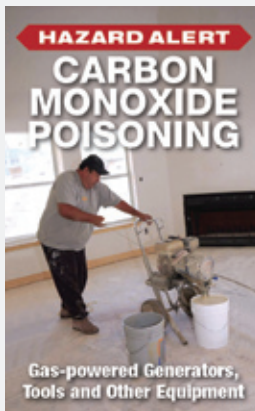
One of many Success Stories posted on StopConstructionFalls.com



Flier developed and disseminated at the World of Concrete exhibit.



One of five infographics on construction fall fatalities.



Risks of using gas-powered equipment indoors exposed.



How you can protect your idea or new tool.



One of 52 new Key Findings on www.cpwr.com.



A guide for creating and managing successful partnerships.



Test results of three systems that capture hazardous welding fumes.



CPWR's monthly e-news: brief and informative.



A CPWR Small Study's internal report that's applicable to other projects.



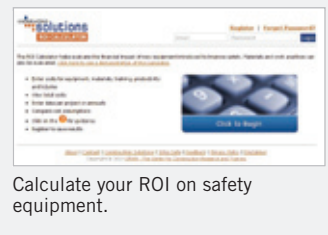
CPWR's website offers reports, toolbox talks, handouts and more.



Find ways to control jobsite hazards at Construction Solutions.



Are you working with products containing nanoparticles? Search the database.



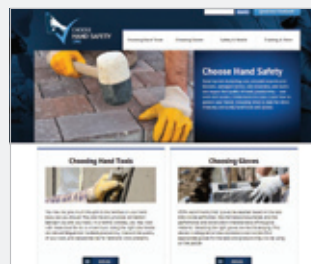
Calculate your ROI on safety equipment.



Find fall protection equipment quickly and easily.



Building Safety for Everyone program for a safer worksite.



Choose Hand Safety protects hands and livelihoods.



CPWR's YouTube Channel of safety and health videos.

BUILDING on what we've LEARNED



TRAINING

Since the 1800s, North America's Building Trades Unions have employed a training method begun more than 500 years ago among European trade guilds: master craftsmen guiding apprentices. CPWR Training continues that tradition: master trainers in safety and health pass along knowledge and skills that workers need to protect themselves and their co-workers on the job. Peer-led training is key, as people who have "been there, done that" share real-world experience while incorporating research-based methods to prevent injuries, illnesses and deaths.

Fifteen Years of Hazardous Waste Worker Training

The early 20th century was a time of technological breakthroughs: our nation's young industries enjoyed impressive growth, employing unfamiliar new chemicals or just using old ones on a mass-production scale. After the Second World War, we explored another new scientific frontier by taming the atom. Both yielded countless benefits – but the ventures left behind an environment pockmarked with hazardous waste sites. These zones, no longer safe for human habitation, were fouled by contaminants such as asbestos, cyanide, benzene, lead, dioxins, and nuclear waste.



Workers engage during hazardous waste training conducted at the HAMMER Training Center near the Hanford DOE nuclear site.

That's why the federal government, through the National Institute of Environmental Health Sciences (NIEHS), sponsors the Worker Education and Training Program (WETP). WETP supports training programs across the United States preparing workers for the safe handling of hazardous wastes as they remediate and restore these poisoned properties.

For 15 years, CPWR and its partners in the building trades unions have participated in WETP, training the construction workers who are cleaning up this toxic legacy. CPWR's efforts create a pool of trained and qualified workers who can clean up Department of Energy atomic sites contaminated during 50 years of processing material for atomic weapons. CPWR's programs prepare workers to restore hazardous waste sites and brownfields marred by industrial pollution, an initiative established by the EPA.

CPWR's Hazardous Waste Worker Training Program trained 6,103 workers in the past program year – 4,075 for the DOE

program and 2,028 for the EPA program, thanks to NIEHS funding. Since joining the program in 1999, CPWR and our building trades partners have trained more than 130,000 construction workers to safely handle hazardous waste.

How do we do it? By leveraging the power of North America's Building Trades Unions and their extensive infrastructure for recruiting, training and dispatching skilled construction workers. These unions administer – together with their signatory contractors – a training apparatus with tens of thousands of experienced tradesmen on the roster as full- or part-time instructors. The instructors bring to bear a collective knowledge base in real-world construction that can't be beat. Local unions can effectively register trainees' credentials and certifications and then refer them for hazardous waste work as needed.

NEW DEVELOPMENTS

This five-year cycle saw some important additions to CPWR's offerings on Hazardous Waste Training...

Getting the Lead Out. Lead has accumulated an alarming record as a public health concern, and a large part of that record concerns brain damage to small children ingesting chips of lead-based paint. Such paints have long been banned from residential use, but they remain as an unhappy legacy in many older homes, schools and daycare centers. Renovations that scatter chips and dust can increase the danger. That's why the EPA issued a "Lead Renovation, Repair, and Painting" rule in 2010, requiring construction workers disturbing lead paint in such facilities to obtain training in lead-safe work practices. CPWR responded to the challenge, adopting the EPA "RRP" curriculum and supplementing it with dynamic hands-on activities. Today CPWR is an EPA-accredited Lead RRP Training provider.

Safer in Any Language. Where did they make that caulk you are using? Is it safe? How do you know? Until recently, every nation followed its own laws and regulations about the labeling of hazardous materials. But in a globalized world that won't work: the solvent in your canister might come from Montana, Mexico, Malaysia, Montenegro or Mozambique. So occupational health experts from around the world created a set of basic, uniform guidelines for warning workers about chemical hazards in the workplace, including a set of interna-

Why should you care about this?

More than 50,000 U.S. workers die every year from work-related diseases due to chemical exposures.



TRAINING

tionally standardized pictograms and consistent labeling requirements. OSHA mandated that by December 2013, U.S. employers must train workers to understand the pictograms and the updated “Safety Data Sheets” (SDSs) that will replace the familiar Material Safety Data Sheets (MSDSs) of the past. CPWR Hazardous Waste Training Director Don Ellenberger and Director of Safety Research Bruce Lippy, PhD, pooled their efforts to design and test a four-hour Hazard Communication training curriculum, available in both English and Spanish. The course manuals have been downloaded more than 1,000 times by visitors to www.cpwr.com. An abbreviated one-hour version is available for use as part of the Smart Mark OSHA-10 Curriculum.

851: Training Workers at U.S. Government High-Hazard Sites

The Department of Energy (DOE) developed requirements for a worker safety and health program to ensure that DOE contractors and their workers operate a safe workplace. The rule, adopted in 2006, provided for a worker protection program that “will reduce or prevent occupational injuries, illnesses, and accidental losses by requiring DOE contractors provide their employees’ with safe and healthful workplaces.” DOE contractors also must “inform workers of their rights and establish procedures to report job-related injuries,

illness, and hazards ... and ensure a deliberate and expedient response to reports of job-related injuries.”

The Department of Defense has adopted a similar program of illness and injury prevention covering workers employed by DOD contractors.

Yet when CPWR’s trainers delivered environmental hazard training to construction workers on DOE sites who are protected through these guidelines, none of them had heard of 851 and the new rights workers are guaranteed. Although the regulations required posters and informational literature, workers couldn’t recall any notice of the changes – and its far-reaching protections.

So CPWR’s Don Ellenberger and several of his staff developed a three-hour program to train workers in the specifics of the new 851 regulation and how it affects their work on DOE sites. The team added an additional hour of training for union business agents and stewards so they can learn their role in advocating for the workers they represent, as the changes are profound. OSHA standards are now enforceable on DOE sites. The 851 rules can inflict more severe penalties on employers who do not comply than are allowable under OSHA.

For workers, this new regulation allows them to either refuse an assignment, or to stop work, when they believe an immediate threat/hazard is present, *without fear of retaliation* from their employer. “At least that’s the theory,” says Ellenberger, “but reality hasn’t caught up to it yet. Workers can still feel threatened.”

This level of workers’ authority is not to be found on all other



Instructor Ted Olsen, second from left, stands with students who have just completed the second 851 class delivered at the HAMMER Training Facility near the Hanford Nuclear site in Washington state. The training informed workers of their worker protections and rights under the 851 regulation covering DOE contractors.

TRAINING

U.S. construction sites, where only the designated competent person can shut down work based on a possible and immediate threat.

CPWR began 851 training in Spring of 2014 and continued into the second half of the year. Trainers expect to see more students seeking training as word gets out to the members – and to union leadership.

OSHA Outreach Training

Meeting a Growing Demand for Construction Safety “Boot Camp”

Although best known for its enforcement activities, OSHA does much more than inspect jobsites for dangerous conditions and practices. The OSHA Outreach Training Program is an OSHA initiative that’s quite popular with employers – especially in construction. In the program description, OSHA defines the basics of a 10-hour standard safety curriculum (see “What is OSHA-10?” below) and authorizes trainers to issue “OSHA-10” cards to students taking the course. OSHA-10 is not required by any federal law, but construction companies and owners consider it the equivalent of basic training. A growing number of state and local governments, construction owners, project managers, general contractors, and subcontractors require employees to obtain an OSHA-10 card prior to work.

For many men and women in our industry, getting that training means scrambling to find a vendor and paying upwards of \$100 out of pocket for the needed instruction. Once the payment is made, the training is too often delivered as a mind-numbing series of canned lectures delivered by an instructor with little or no experience on construction sites (or even through an automated website). For union members, it’s a different story. Last year, on job sites, in union halls and in union training centers, nearly 70,000 construction workers earned their OSHA-10 cards from experienced instructors in their trade – without digging into their wallets. More than 20,000 workers received an OSHA-30 card by attending the even more rigorous 30-hour training class.

How does it happen? It begins with collaboration between CPWR and an all-star team of 50 “master trainers” from the national construction trades unions. Working together under the auspices of North America’s Building Trades Unions, the technical experts of CPWR and the union apprenticeship and training leaders forged a rigorous curriculum based on the latest research and experience from the field, plus attention to detailed federal and state regulations. These master trainers fan out to “train the trainers.” That is, they deliver OSHA 500-level training and authorize hundreds of OSHA Outreach Program Instructors from their colleagues in the trade to deliver the OSHA-10 and OSHA-30 to construction workers in the field.

These local trainers in turn teach hazard recognition to tens of thousands of their peers in every corner of the nation and industry. At any given time, approximately 5,000 authorized outreach trainers are part of this building trades’ network. Continuing education is a

America’s #1 Occupational Safety Training Provider:

Labor-Management Apprenticeship and Training Programs

Did you know that North America’s Building Trades Unions – with support from CPWR – operate the nation’s largest occupational safety and health training network? That’s right, the construction unions and their signatory contractors spend nearly a billion dollars per year providing basic skills training for new trade apprentices and periodic upgrades for journeymen, to keep them at the cutting edge of new technologies and techniques. But they don’t stop there. In the past eight years, they also put about 560,000 workers through an OSHA-authorized, but voluntary, 10-hour hazard awareness training boot camp. Another 166,000 workers sought out the extended 30-hour version.



must: every four years they must return for refresher training with the master instructors to improve their skills and learn about new regulations and research in the field. And since it’s not uncommon for construction firms to promote these skilled outreach trainers to management duties, there’s a constant need to train replacements! In the past program year, master trainers led 90 of the 500-level “train the trainer” classes for new or returning outreach trainers. Our outreach trainers in turn taught 6,914 OSHA-10 and OSHA-30 classes, bringing hazard recognition skills to 91,110 men and women of the trades.

What is OSHA-10?

The “OSHA-10” is a 10-hour basic hazard awareness course delivered under the OSHA Outreach Training Program. OSHA authorizes a limited number of nonprofit organizations and consortia to recruit and train local “outreach trainers.” These consortia are known as OSHA Training Institute Education Centers (OTIEC); in 1994, CPWR joined with West Virginia University to create the OTIEC known as the National Resource Center (NRC).

OTIECs like the NRC administer all the OSHA classes including the intensive “train-the-trainer” courses (OSHA 500 and 502) and the Construction Standards class, the OSHA 510. These classes prepare the outreach trainers to teach occupational health and safety to workers. The outreach instructors in turn deliver the OSHA-10 hazard recognition course to the men and women of the

TRAINING

CPWR OSHA Training

Conducted 2007 – 2014

540 authorized **8,735** who taught
OSHA 500, 502
and 510 courses **trainers**

39,568 that trained **558,951**
OSHA-10 courses **workers**

12,223 that trained **166,683**
OSHA-30 courses **workers**

trades in every corner of the country. What's the curriculum? Trainers have a little flexibility in designing the course, but OSHA prescribes 10 hours of instruction that include a minimum of:

- two hours on OSHA and the rights of workers to a safe workplace;
- four hours on the “focus four” hazards that cause the most construction fatalities – falls, electrocutions, “struck-by” (vehicles or objects), and “caught-in or caught-between” (such as a trench collapse);
- 30 minutes each on personal protective equipment and on health hazards (e.g. inhaling airborne contaminants); and
- three hours of appropriate specialized training.

When the outreach instructor reports that a worker has satisfactorily completed the training, the OTIEC issues that worker an OSHA-10 card. “OSHA-10 for construction” has proven wildly popular in the building industry. Although no federal regulation requires OSHA-10 training, many owners and firms have made the OSHA-10 card a requirement for hiring, and several states require a valid OSHA-10 card to work on publicly-financed construction projects like roads, schools and government buildings.

Outreach trainers also offer a more intensive 30-hour occupational safety class. Demand for the OSHA-30 card is increasing as well, with many firms requiring supervisors, including foremen, to hold one.

SmartMark

Two decades ago, North America's Building Trades Unions and CPWR convened a team of safety leaders from business, labor and academia to craft a curriculum for OSHA-10 instruction – and Smart Mark was born. The curriculum was an instant hit, combining technically accurate construction safety elements with good graphics and the flexibility of a modular menu of topics, enabling individual trades to teach about special dangers characteristic of their craft. Rather than relying on a monotonous lecture format, Smart Mark incorporated interactive presentations with Q & A and recommended activities.

Since that time, as regulations evolved and new challenges emerged, Smart Mark has been continually revised to keep up with the times. New training modules were added to provide training materials for the Focus Four and the Safety Management requirements for the 10- and 30-hour programs. Other recent Smart Mark landmarks include:

Smart Mark goes Digital. Today people get books, software, movies and music by downloading them. Starting in 2012, they could get SmartMark that way, too. eSmartMark, an electronic distribution system for the popular curriculum, is easy to use and enhanced



TRAINING

with traumatic injury statistics and important new research findings. Small wonder it was downloaded 1,000 times in its first month!

Smart Mark visits the Workers' Centers. Immigrant workers, often engaged in residential construction work, face especially high workplace injury risks (see page 11—Data Center). CPWR consortium researcher Dr. Michele Ochsner and her research team (see page 16) brought together Smart Mark's fundamentals and community organization New Labor's experience in participatory training models to create something entirely new: a bilingual, peer-led OSHA-10 curriculum designed with residential construction workers in mind. Cooperating with a network of workers' centers around the nation known to serve this population, the group successfully delivered the OSHA-10 to nearly 500 people in this especially high-risk group over three years. You can find the complete OSHA-10 curriculum for Spanish-speaking construction workers on CPWR's website, www.cpwrr.com.

Emergency Response

In 2011, we saw a tornado in southwest Missouri that shattered the town of Joplin. In 2012, Superstorm Sandy devastated New York City with flooding and blackouts. In 2013, a "hundred-year flood" struck Colorado, and in 2014 images of earthquake damage in Napa filled our TV screens.

Every year such catastrophes engulf cities and towns across America, downing power lines and toppling buildings. Construction workers can provide invaluable aid to first responders at a disaster site, but first they must know how to work safely in this unique environment and how to integrate into the Incident Command System used by the first responders.

CPWR's OSHA 7600 Disaster Response training fills this need. The program has enabled thousands of building tradesmen and tradeswomen to become "Skilled Support Personnel" during a disaster. Through this program, our nation has developed a "reserve

army" of trained construction personnel in every state and metropolitan area of the United States. CPWR continues to expand this network of trainers and trained workers to more and more communities where our people can become important resources for first responders in difficult times.

TRU-Net: Opening New Frontiers in Research and Training

The interaction between CPWR's training and research programs has always been one of our strengths, and both researchers and trainers have benefited from this interaction. Trainers' knowledge and skills enhance researchers' understanding of worksite practices and contribute to research outcomes that improve worker safety. In the past these connections have been made on a project-by-project basis, but beginning in 2014 our r2p and training programs took steps to formalize the link between these two groups through the establishment of the Trainers and Researchers United Network, or TRU-Net.

Launched at the October 2014 Trainer Enhancement program, TRU-Net has both an informal and formal component. The informal online forum was developed as a place where union trainers and CPWR researchers can talk with each other about what's going on in the industry, ask questions, suggest research ideas, and find out about new research initiatives and ways to become involved. The formal component involves trainers and their trainees directly in new research studies. "Safety and health trainers can play an important role in shaping and guiding the studies our researchers undertake," said CPWR's deputy director, Chris Trahan, "as well as helping us test and refine the TRU-Net concept."



A dramatic search-and-rescue operation plays out in CPWR's Disaster Response Training DVD, which teaches the Incident Command structure.



Finishing Trades Institute Director Dan Penski (right) talks about hands-on training with participants of CPWR's Trainer Enhancement during a visit to the FTI's Hanover, Md., facility.

MWTP Evaluation: A Confirmation of Tremendous Results

The funding agency NIEHS commissioned the National Clearinghouse to conduct an evaluation of the Minority Worker Training Program, seeking an evaluation of the financial and non-monetary benefits of the program. The report, issued in 2014, concluded that the MWTP profoundly affected the individuals and communities at-large and presented a compelling statement for continued funding, perhaps even at higher levels.



“Many MWTP trainees enter the program with little to no job experience or training, and in some cases, legal issues and difficult home situations. For many graduates, the MWTP provides them with their first marketable job skill, and **we estimate the MWTP increases the probability of employment by approximately 59 percent.**”

“We identify and discuss seven pecuniary benefits from the MWTP: higher earnings for its graduates, fewer workplace injuries and related costs, lower hiring costs, reduced crime related costs, an improved government fiscal budget, environmental benefits, and donations from local firms, non-profit organizations, and individuals.”

“The **cumulative total value added of the MWTP is estimated to be \$1.82 billion** from 1995 through 2013, or roughly \$100 million annually.”

“The **cumulative reduction of government expenditures as a result of the MWTP is estimated to be \$711.6 million** from 1995 through 2013, or roughly \$39 million annually.”

“There are substantial non-monetary benefits to participants. Student interviews done **after completing the program discuss the MWTP’s transformative effect on their lives.** A common theme in these stories is a weak attachment to the labor force prior to training, and an increase in self-worth from having regular employment.”

Minority Worker Training Program:

Good for People, Communities and the Construction Industry

The need for trained construction workers to build this new century is never too far from the minds of many construction managers. With baby boomers nearing retirement and a smaller field of skilled journey workers to replace them, managers are eager to find skilled replacement trade workers.

North America’s Building Trades Unions are turning out quality workers through trade-specific apprenticeship programs. But what about the untapped human potential in blighted sections of our cities – the people who want to find steady employment but don’t have the skills needed for a solid career?

That’s where CPWR’s Minority Worker Training Program (MWTP) steps in. It has been serving residents of economically disadvantaged communities since 1995, providing them with a pre-apprenticeship training program as a “leg up” into the construction industry and employment opportunities, and a full measure of support from local community agencies. Funding for the program is provided by the National Institute of Environmental Health Sciences (NIEHS).

The program year 2013-2014 achieved a 100% graduation rate, a few surprising changes in the student population, and a welcome report on the program’s operations delivered by a third-party reviewing organization.

Program training centers in St. Paul, Minn., East Palo Alto, Calif., and New Orleans, La., recruited a total of 296 applicants for only 60 available training slots. Sixty (60) applicants were admitted for training, and every one of them graduated. (In contrast, only 50% of U.S. students who enroll in college complete their degrees!) Despite the challenges of the economic downturn, 80% of students were placed in jobs averaging a respectable \$15.29/hour wage.

MWTP Director Kizetta Vaughn saw shifts in the student population they were serving, although overall student demographics did not change markedly. As in previous years, just over half of the students were African-American, and about one-third were Hispanic. The remainder were Asian with a Pacific Islander and an Alaskan Inuit rounding out the very American profile. However, six non-minority, dislocated workers joined the MWTP, an increase over previous years. Vaughn believed the rise may be attributed to the number of non-minorities looking to enter apprenticeships and see this program as a means to prepare them. She also saw a greater influx of Hispanics into the East Palo Alto and St. Paul programs than in previous years.

Students get state-of-the-art training in remediating hazardous materials, as well as basic construction skills and training to identify and safely use trade-related tools. They also receive specialized scaffold erection training, confined space training, and OSHA 10- and 30-hr classes. The program also delivers adult literacy and life skills, such as developing work ethics, teamwork, effectively communicating, building working relationships, problem solving, conflict resolution, budgeting, managing their paychecks, and ride-sharing.

TRAINING



MWTP trainees get state-of-the-art training, like this simulation of being lowered into a confined space.

Many of these essential learning opportunities are accessed through community-based agencies that have worked with MWTP for many years. GED training and testing is often provided by another community service agency, as are reading comprehension and English-as-a-second-language classes.

Graduates of the programs leave better prepared for the testing processes of the unions. According to an analysis of union apprenticeship outlined in the Apprentice Benchmark Survey 2013-14 by Breslin Strategies, Inc., math skills, reading comprehension skills, spatial mechanical skills, physical dexterity, and problem solving are assessed during candidate evaluation and screening at apprenticeship centers. As well as practical skills training, MWTP offers 120 hours of Life Skills training and up to 180 hours of mentoring and career guidance.

For the four years 2010-2014, CPWR's Minority Worker Training consortium:

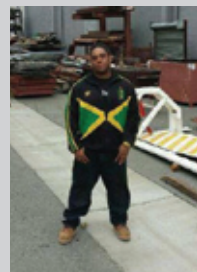
- Recruited **1,333** applicants for **240** training slots.
- Provided **184,919** contact hours of training.
- Trained **244** students, graduating **98%** and placing **82%** in employment.

MIKE PATTERSON:

This “Gladiator” wins a new life

Just being accepted into the Iron Workers’ Gladiator program was an accomplishment. But Mike Patterson was one of 10 people in his class of 45 students to successfully complete the program and become a union apprentice.

He’s now employed with signatory contractor Camblin Steel.



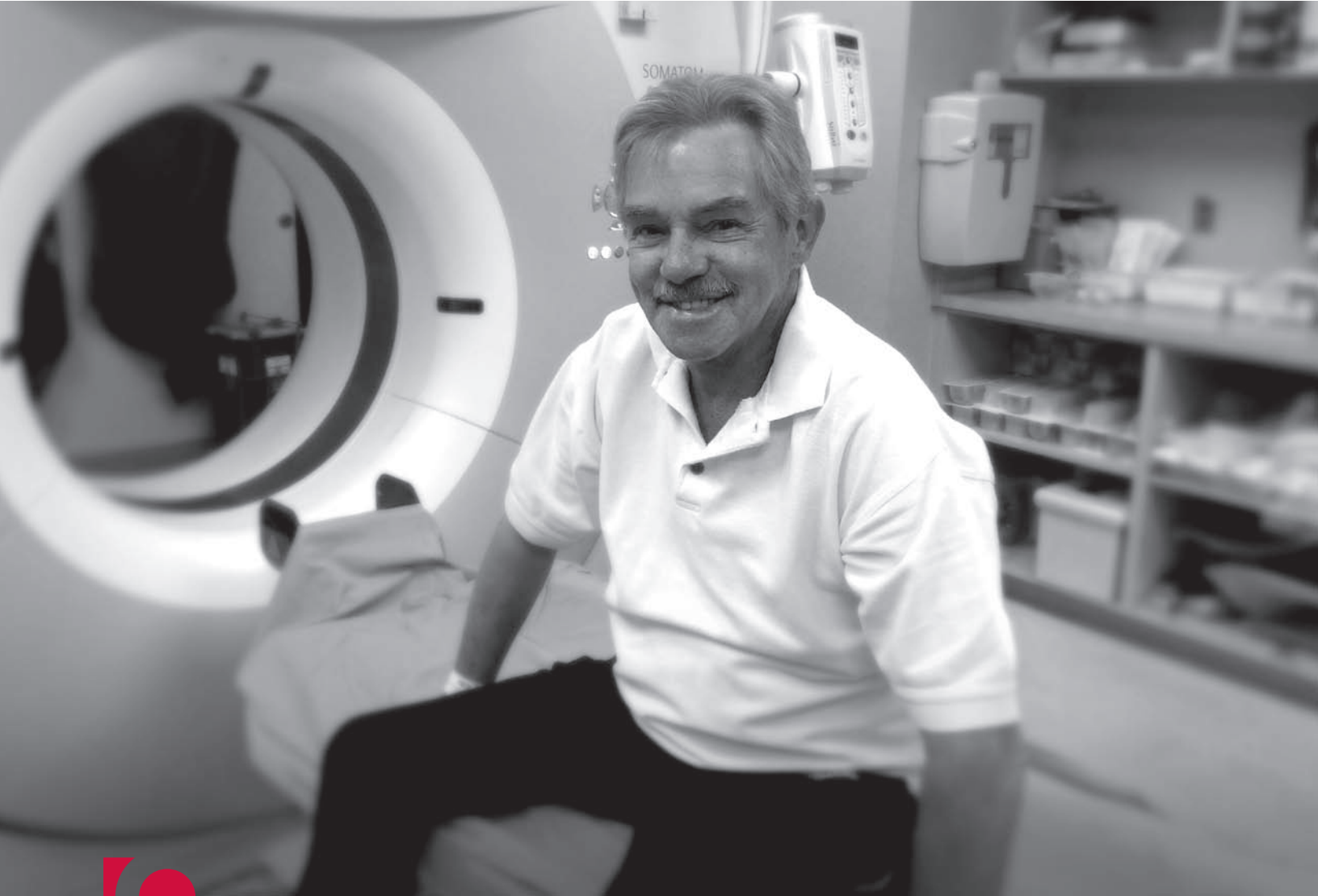
Mike Patterson

Mike Patterson, a 2013 Minority Worker Training Program graduate, came to the program through the California State “Achieve 180” – the San Mateo County Re-entry Program for formerly incarcerated individuals. He was initially referred to a program where he worked several months, learning landscaping maintenance and use of power tools.

But Patterson had higher ambitions and shared his desire to train for a different career with his counselor. He chose Project Build, the East Palo Alto MWT program administered through Job Train. Mike excelled in class, had the highest academic scores, perfect attendance and a passion for the industry. He was offered the opportunity to apply for the Iron Workers Union, a Project Build partner, and was accepted into their four-week Gladiator program. Of the 45 people accepted, Patterson was one of only 10 who successfully completed the rigorous program. Upon completion of his union apprenticeship, he was placed in a job immediately with Camblin Steel, a signatory contractor with Local 377. Mike’s starting wage was \$20.42. He has been with the Ironworkers Union for one year.



BUILDING on what we've LEARNED



SERVICE

Bob Irwin worked more than 42 years on the Hanford DOE site where nuclear weapons were produced. He's about to undergo a low-dose CT scan to determine if he has undiagnosed health issues related to his years of service to our nation. The Building Trades Medical Screening Program (BTMed) offers free medical screenings to tradeworkers employed on one of 27 sites. As one participant said, "There was all kinds of stuff out there ... and you don't how much your life's been cut short because of it."

Stepping Up for our Unsung Heroes

BTMed protects the workers who protected us

The atom bomb brought World War II to an end in 1945, and a vast nuclear deterrent secured our nation's defense through five decades of Cold War with the Soviet Union. What did that mean for the men and women who built and maintained the facilities where nuclear fuel was processed? Too often, it meant fatal cancers or chronic illness after a lifetime of exposure to radiation and hazardous materials.

We owe these workers a debt we can hardly repay. There are no Veterans Administration hospitals for these unsung heroes of the Cold War, but the Building Trades Medical Screening Program (BTMed) provides an important service to these men and women of the trades.

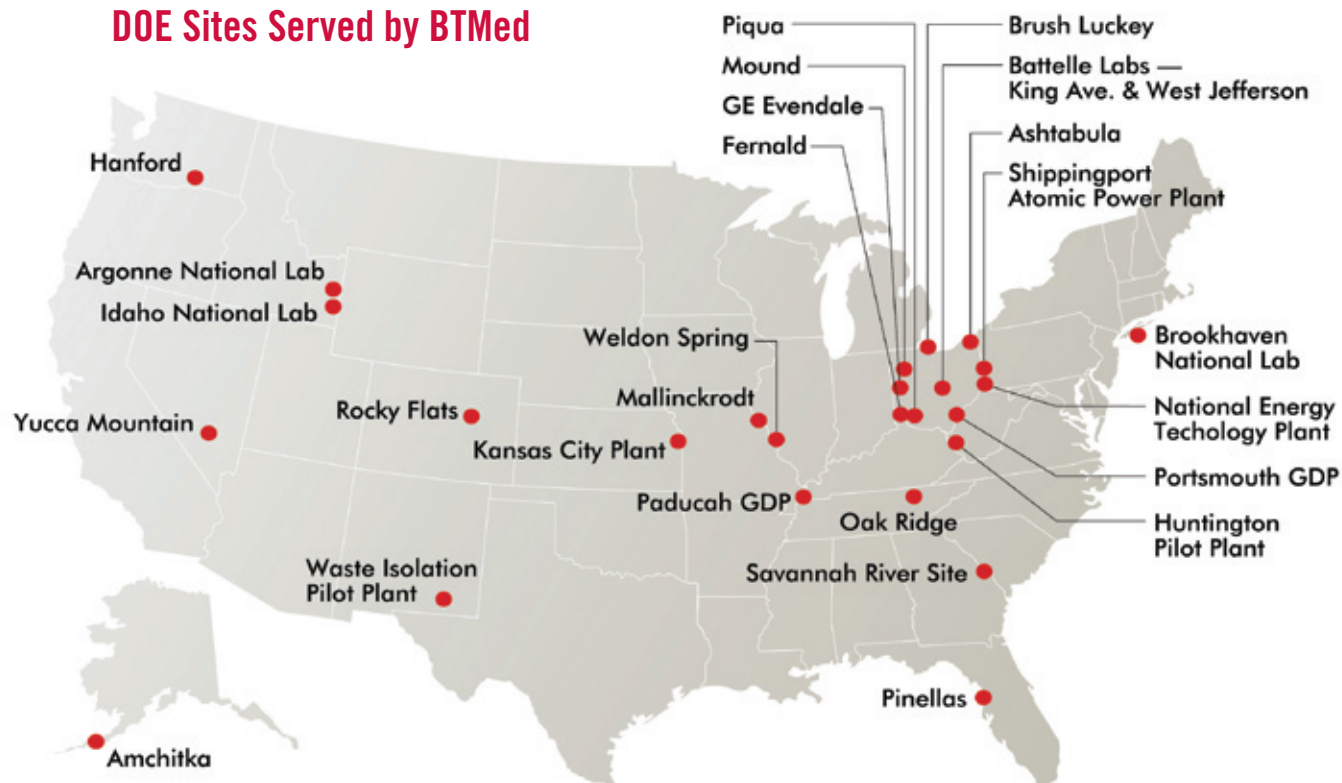
BTMed identifies construction workers who have been employed on DOE sites and screens them for occupational illnesses. The program began offering medical screenings at two sites in 1996; today, as we approach the conclusion of the program's fourth grant cycle for this DOE cooperative agreement (2010-2015), BTMed serves workers in need from 27 locations. BTMed has delivered nearly 30,500 medical screenings to more than 22,000 workers, through its network of more than 200 specially credentialed clinics across the country. After an initial review, workers are invited for an



There are no Veterans Administration hospitals for these unsung heroes of the Cold War, but the Building Trades Medical Screening Program (BTMed) provides an important service to these men and women of the trades.

additional screening every three years to identify any newly developed health impairments. The program has found abnormal chest x-rays in 18% of these workers, abnormal pulmonary function in 40%, and evidence of hearing loss in a striking 64% of former DOE construction workers. Those workers presenting abnormal test results are referred for additional testing and care. BTMed is proud to report a 97% satisfaction rate among participants in the program.

DOE Sites Served by BTMed



Innovations: Early Lung Cancer Detection (ELCD)

An alarming 160,000 Americans die from lung cancer each year, and the combination of smoking with exposure to workplace dusts and toxins can put construction workers at an elevated risk. To respond, BTMed has stepped up in recent years by introducing a program of ultra-low dose CT scans. The scans are capable of detecting early stage cancers for more effective intervention.

The Early Lung Cancer Detection (ELCD) program began with at-risk workers at Oak Ridge, Tenn., in 2011. Today BTMed offers low-dose CT scans in Augusta, Ga., Knoxville, Tenn., Richland, Wash., as well as Cincinnati and Seattle. The test results can identify small nodules on the worker's lungs. Workers found to have these nodules are referred to specialists for further testing and, if the nodules prove to be cancerous, for treatment.

Workers who receive early screenings are afforded a unique opportunity – and a vital health benefit. Lung cancer has a 16% survival rate when detected using conventional methods; early detection, like that promised by low-dose CT screening, can boost this rate as high as 80%.

ELCD is already saving lives. The scans have already identified early-stage lung cancers in seven workers.



An early CT screening can boost the lung cancer survival rate to 80%, far greater than the 16% rate for conventional methods.

BTMed and Research

While providing critical health services to past generations of construction workers, BTMed benefits future generations of men and women working in the trades – with a rich vein of medical surveillance data informing cutting-edge health and safety research.

Medical screenings offered by BTMed are completely confidential. But the aggregate results, once stripped of names and personal information, permit leading occupational health scientists to identify outstanding threats to worker health and safety.



Be on the lookout in 2015 for a BTMed video revealing the history and impact of the program. You'll meet this plumber/pipfitter who worked 30 years at Hanford and was a "vision of health," when he went in for his CT scan. But doctors detected an aggressive form of lung cancer that "would not have been noticed until it was too late."

Take beryllium: workers engaged in abrasive blasting using certain coal slag products, or in particular types of welding and brazing, are at risk of exposure to the toxic metal. The ominous-sounding element was widely used in nuclear weapons facilities. For more than a decade, BTMed has tested former workers from DOE nuclear sites for beryllium sensitivity. CPWR researchers reviewed data from nearly 14,000 BTMed blood tests, finding that 1.4% of the workers had tested positive for beryllium sensitivity – and 15% of those with sensitivity in time developed Chronic Beryllium Disease. (CBD is a lung disorder that can present as coughing, shortness of breath with activity, fatigue, loss of appetite and weight loss.) The results of the study were published in the *American Journal of Industrial Medicine*.

Researchers analyzing surveillance data from BTMed have also discovered that:

- The risk for occupationally related disease over a lifetime in a construction trade was two-to-six times greater than the risk among non-construction workers.
- Construction workers are significantly more likely to suffer noise-induced hearing loss than workers in general industry. Nearly 60% of construction workers in the group were found to have material hearing impairment.
- Construction workers are at an elevated risk of COPD. Non-smoking construction workers in the sample were significantly more likely to suffer Chronic Obstructive Pulmonary Disease (COPD) than non-smokers working in other industries.

For the complete reports, visit www.btmed.org.

“The survival rate for lung cancer is about 15% but, found in the early stages, that number increases to 85%,” says Laura Welch, MD, medical director for CPWR. “We only partner with programs that follow a strict protocol, like the one at the UC Cancer Institute. It’s also important to get at-risk participants who are still smoking to stop, and the UC Comprehensive Lung Cancer Center has a necessary smoking cessation component to it.”



Researchers and physicians from the University of Washington, Seattle Cancer Care Alliance and CPWR are instrumental in reading CT scans and providing follow-up care to workers. CPWR’s Dr. Laura Welch is second from right.

IMPLEMENTING ORGANIZATIONS:

- CPWR – The Center for Construction Research and Training
- Duke University
- University of Cincinnati
- Zenith American Solutions

PARTNERS:

North America’s Building Trades Unions, with support from various state and local councils including:

- Alaska State BCTC
- Augusta BCTC
- Central Washington BCTC
- Colorado State BCTC
- Dayton BCTC
- Florida Gulf Coast BCTC
- Greater Cincinnati BCTC
- Greater Kansas City BCTC
- Idaho BCTC
- Knoxville BCTC
- Nassau and Suffolk Counties BCTC
- New Mexico BCTC
- Tri-State (Kentucky, Ohio, West Virginia) BCTC
- West Kentucky BCTC
- St Louis BCTC

What’s Next for BTMed?

Thousands of former DOE site construction workers have not yet been screened. Over the next five years, BTMed anticipates reaching 4,500 of these workers. In addition, BTMed will rescreen 5,700 eligible workers and administer CT scans for Early Lung Cancer Detection to nearly 4,600 more.

Dr. Eula Bingham



Dr. Eula Bingham’s accomplishments to protect America’s workers are substantial and lasting, yet her work is unknown to those outside a small circle.

Long before CPWR’s mission began, Dr. Bingham was blazing a trail as an accomplished scientist and advocate for workers’ health and safety. After receiving her PhD from the University of Cincinnati, she joined its School of Medicine in 1961 as a researcher who did pioneering work on chemical carcinogens.

She began her public service to workers in the early 1970s as a scientific and policy advisor for many federal agencies including NIOSH, OSHA, FDA, and EPA, as well as the National Academy of Sciences. Her research and policy work led President Carter to appoint her as OSHA’s head, and she served throughout his administration, 1977-1981.

Dr. Bingham was one of the leading scientists working in America who identified the risks to workers at DOE sites. Her research, scientific reputation and personal commitment to ending hazardous workplaces pushed the DOE to establish the program to screen workers on its nuclear sites.

She has contributed more than 100 peer-reviewed articles on occupational and environmental respiratory hazards, chemical carcinogenesis, and occupational and environmental health policy.

Although she retires from her current role with the BTMed program in January 2015, she stays on as a Special Advisor and will continue as a member of CPWR’s TAB, a group she joined in 1992.



In 1977, then Secretary of Labor Ray Marshall administers the oath of office to Dr. Bingham, making her the head of OSHA.

CPWR CONSORTIUM PARTNERS & LEAD COLLABORATORS

Daniel C. Anton, PhD
Eastern Washington University

Dhimiter Bello, ScD
University of Massachusetts, Lowell

Eula Bingham, PhD
University of Cincinnati

Diane Bush, MPH
University of California, Berkeley

Ann Marie Dale, PhD
Washington University in St. Louis

John M. Dement, PhD, CIH
Duke University

Jack Dennerlein, PhD
Northeastern University

Bradley A. Evanoff, MD, MPH
Washington University in St. Louis

Nathan Fethke, PhD, CPE
University of Iowa

Sergio Caporali Filho, PhD
University of Puerto Rico

Mark Fullen, EdD, CSP
West Virginia University

Robert F. Herrick, SD
Harvard School of Public Health

Hester J. Lipscomb, PhD
Duke University School of Medicine

Jeffrey Nelson, MS, MBA
Conceptual Arts Inc.

Michele Ochsner, PhD
Rutgers, The State University
of New Jersey

Carrie Redlich, MD, MPH
Yale School of Medicine

David Rempel, MD, MPH
University of California
San Francisco

John Rosecrance, PhD
Colorado State University

Susan Woskie, PhD
University of Massachusetts, Lowell

SMALL STUDY GRANTEES

John M. Dement, PhD, CIH
Duke University

Sergio Caporali Filho, PhD
University of Puerto Rico

John Gambatese, PhD
Oregon State University

Javier Garcia Hernandez, BA
PhilaPOSH

Vicki Kaskutas, OTD, MHS, OT/L
Washington University in St. Louis

Melissa Perry, ScD
George Washington University

Peter Philips, PhD
University of Utah

Edward Taylor, PE
University of Tennessee

PARTNERSHIPS

LABOR ORGANIZATIONS

North America's Building Trades
Unions, and Affiliated Councils

International Construction
Unions and Affiliates

CONTRACTOR ASSOCIATIONS

The Association of Union Constructors

International Council of Employers of
Bricklayers and Allied Craftworkers

Mechanical Contractors Association

National Association of Construction
Boilermaker Employers

National Electrical Contractors Association

National Roofing Contractors Association

North American Contractors Association

Sheet Metal and Air Conditioning
Contractors National Association

U.S. GOVERNMENT AGENCIES

U.S. Department of Energy

U.S. Department of Labor

Environmental Protection Agency

National Institute for Occupational Safety
and Health (NIOSH), CDC

National Institute of Environmental Health
Sciences (NIEHS)

STATE AGENCIES

State Departments of Health

BUSINESS

Zenith American Solutions

OVERSIGHT AND ADVISORY BOARDS

BOARD OF DIRECTORS

Sean McGarvey

Chairman of the Board and President
President, North America's Building
Trades Unions
Washington, DC

Brent Booker

Secretary-Treasurer
Secretary-Treasurer, North America's
Building Trades Unions
Washington, DC

Richard Resnick

Vice President/General Counsel
Sherman Dunn, Cohen, Leifer
& Yellig, PC
Washington, DC

Erich J. (Pete) Stafford

Executive Director
CPWR – The Center for Construction
Research and Training
Silver Spring, MD

Noel C. Borck

Employer Representative

Iz Cakrane

Vice President of Labor Relations
Washington Division of
URS Corporation
Princeton, NJ

Reverend James Cletus Kiley

Director of Immigration Policy
UNITE HERE
Washington, DC

Morris M. Kleiner

AFL-CIO Professor of Labor Policy
Director, Center for Labor Policy
Hubert H. Humphrey
School of Public Affairs
University of Minnesota
Minneapolis, MN

TECHNICAL ADVISORY BOARD

Ralph Frankowski, PhD

Chair
Professor of Biometry
University of Texas
Health Science Center at Houston
School of Public Health

Eula Bingham, PhD

Department of Environmental Health
University of Cincinnati

Letitia Davis, ScD

Director, Occupational Health
Surveillance Program
Massachusetts Dept. of Public Health

Denny Dobbin, MSc, CIH (Ret.)

Environmental Advisor
Chapel Hill, NC

Steven Hecker, MSPH

Senior Lecturer Emeritus
Department of Environmental
and Occupational Health Sciences
University of Washington

James M. Melius, MD, DrPH

Administrator
New York State Laborers' Health
and Safety Fund

Melvin L. Myers, MPA

Associate Professor
University of Kentucky
Emory University (adjunct)

Melissa Perry, ScD

Professor and Chair,
Department of Environmental
and Occupational Health Sciences
George Washington University

Harry Shannon, PhD

Professor, Department of Clinical
Epidemiology & Biostatistics
McMaster University

CPWR STAFF

SENIOR STAFF

Pete Stafford

Executive Director
pstafford@cpwr.com

Chris Trahan, CIH

Deputy Director
ctrahan@cpwr.com

ASSOCIATE DIRECTOR

Mary Tarbrake, MBA

Associate Director
Finance and Administration
mtarbrake@cpwr.com

DIRECTORS

Robin Baker, MPH

Director, Research to Practice (r2p)
rbaker@cpwr.com

Eileen Betit

Director, Special Projects
ebetit@cpwr.com

Xiuwen (Sue) Dong, DrPh

Data Center Director
sdong@cpwr.com

Don Ellenberger, MA

Director, Environmental Hazard Training
donellenberger@cpwr.com

Linda Goldenhar, PhD

Director, Evaluation and Research
lgoldenhar@cpwr.com

Bruce Lippy, PhD, CIH, CSP

Director of Safety Research
blippy@cpwr.com

Patricia Quinn

Director
Energy Employees Department
and Small Studies Coordinator
pquinn@cpwr.com

Spencer Schwegler

Director, OSHA and
Disaster Response Training
sschwegler@frontier.com

Pam Susi, MSPH, CIH

Director, Exposure Assessment
pam_susi@comcast.net

Megan Tindoll, MA, CPA

Director of Accounting
mdecker@cpwr.com

Kizetta Vaughn

Director, Minority Worker
Training Program
kizettavaughn@gmail.com

Mary Watters, MFA

Communications Director
mwatters@cpwr.com

Laura Welch, MD

Medical Director
lwelch@cpwr.com

Janice Wheeler

National Resource Center
Program Director
jwheeler@cpwr.com

TRAINERS/COORDINATORS

Gene Daniels, MA

Master Instructor & Lead
and Asbestos Training
Program Manager
homerblue@aol.com

Kelly Dykes

Equipment Manager and Instructor
kellydykes@frontiernet.net

George Newman

Master Instructor
sirdashGCN@aol.com

Steve Surtees

Coordinator, Training
ssurtees@cpwr.com

Alexandra Szymczak

Lead and Asbestos
Program Coordinator
Grants Data Manager
aszymczak@cpwr.com

FIELD SERVICES

Mike Dorsey

Field Representative
mdorsey@cpwr.com

Art Lujan

Field Representative
alujan@bctd.org

ADVISORS

Donald Elisburg, JD

Senior Environmental Advisor
delisbur@infionline.net

Knut Ringen, DrPH

Senior Scientific Advisor
knutringen@msn.com

Rosemary Sokas, MD

Senior Research Advisor
sokas@georgetown.edu



FIND MORE AT WWW.CPWR.COM

Photos courtesy Eula Bingham, David Rempel/Alan Barr, The 3M Company, Chicagoland Spray Foam/<http://www.stevebeckerphotography.com>, John Rosecrance/Natalie Schwatka, Nate Fethke, Louis Kimmel, Vicki Kaskutas, David Frane/editor Tools of the Trade blog, Ann Marie Dale/Washington University in St. Louis, Anila Bello/Susan Woskie, Jack Dennerlein/Emily Sparer, Pam Susi, Don Ellenberger, Spencer Schwegler, Kizetta Vaughn, Bob Irwin, U.S. Department of Energy, Kim Cranford, RN – Nurse Manager, BTMed, Knut Ringen. Other photos from CPWR research photographer Neil Lippy and Earl Dotter/www.earldotter.com.

© 2015, CPWR – The Center for Construction Research and Training. All rights reserved. CPWR is the research and training arm of North America's Building Trades Unions and serves the construction industry and its workers. CPWR, 8484 Georgia Ave., Suite 1000, Silver Spring, MD 20910. (Sean McGarvey is president of North America's Building Trades Unions and of CPWR; Brent Booker is secretary-treasurer of North America's Building Trades Unions and of CPWR.)

Production of this publication was supported by NIOSH cooperative agreement OH009762, DOE cooperative agreement DE-FC-01-06EH06004, NIEHS cooperative agreements ES009764 and ES006185, and DOL contract DOLJ119E32607. The contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH, DOE, NIEHS, or DOL.

Find more information about our research, training and service work. Visit www.cpwr.com.

BUILDING on what we've LEARNED



8484 Georgia Ave.
Suite 1000
Silver Spring, MD
20910
www.cpwr.com
www.elcosh.org



Celebrating 25 years of service to the
construction industry and its workers