



# NSRP Projects to Support Regulatory Compliance with Welding Emissions

## Environmental Panel

NSRP All Panel Meeting  
Joe Jackens – CTC  
Pat Killeen – Chair  
Environmental Panel

# Objective and Outline

## Objective:

- Highlight the Environmental Panel's success in working with the U.S. EPA to improve shipyard welding data

## Outline:

- Introduction to the Environmental Panel
- NSRP Welding Emissions Projects (Environmental)
- Proposed Rule (Released December, 2010)
- Looking Forward

# Introduction

- Environmental Panel
  - Defining environmental compliance issues as they relate to the shipbuilding/repair industry and its customers.
- Panel Chair - Pat Killeen
  - Corporate Director of Environmental Health and Safety for Signal International located in Pascagoula, Mississippi

# NSRP Welding Emissions Projects (Environmental)

- 2007 - NSRP Research Announcement: *Shipbuilding and Ship Repair Industry Initiative to Prepare for and Comply with the Residual Risk Ruling*
- 2009 – NSRP Environmental Panel: *Developing Emissions Factors for Electrodes Commonly used within the Shipbuilding Industry for use in Regulatory Reporting Procedures*
- 2010 - NSRP Environmental Panel: *Supporting National Shipbuilding Research Program (NSRP) Shipyards in the Implementation of Recently-Generated Emissions Factors at the Federal, State, and Local Level*

# Starting Point

- U.S. EPA published Advance Notice of Proposed Rulemaking (ANPRM), entitled “Risk and Technology Review, Phase II, Group 2” in the *Federal Register* on March 29, 2007 (72 Fed. Reg. 14734).
  - Outlined a plan to assess the level of residual risk that hazardous air pollutant (HAP) emissions from Shipbuilding and Ship Repair surface coating operations presented to public health and the environment
- NSRP Funded Research Announcement: *Shipbuilding and Ship Repair Industry Initiative to Prepare for and Comply with the Residual Risk Ruling*
  - The Environmental Panel recognized the potential impact of regulation, and took a lead role in the project to define appropriate courses of action
  - Initiated a proactive approach to collaborate with the U.S. EPA in an effort to support the development of a final rule

# NSRP Research Announcement Project

## *Shipbuilding and Ship Repair Industry Initiative to Prepare for and Comply with the Residual Risk Ruling*

- Three main objectives
  - Prepare Comments for the NSRP to submit in response to the ANPRM
  - Complete onsite shipyard demonstrations to evaluate commercially available welding emissions control technologies
  - Collect data in support of developing revised emissions factors
    - Determine the % composition of Hexavalent Chromium (or Cr(VI)) (a known human carcinogen) and Trivalent Chromium (or Cr(III)) in welding emissions, and determine at what rate Hexavalent Chromium will transform into the less hazardous form of Trivalent Chromium.

# Preparation and Submittal of Comments

- Prepared and submitted comments in response to the ANPRM on June 28, 2007
  - Defined inaccuracies in the U.S. EPA air quality data set being used for transport and health risk assessments
    - Overestimates the # of “Major Sources” (potential to emit 10 tons per year [tpy] or more of any one HAP or 25 tpy or more of any combination of HAPs)
    - Included emissions not associated with regulated processes not shipbuilding and ship repair activities
    - Questionable emissions for welding and blasting, sources of data not listed
  - Inaccurate/inconsistent use of emissions factors
    - Default values used broadly across the industry
    - Chromium compounds speciated - 34% Hexavalent Chromium/66% Trivalent
  - Inaccuracies in the transport and health modeling
    - Extrapolation of emissions data (new construction to repair / large to small)
    - Defining non-point sources as “point sources” for transport and fate modeling
    - Emissions coordinates (listing single emissions points/incorrect locations)
    - Rural source classification as opposed to Urban

# Control Technologies Demonstrations

- Identified and selected the most commonly used shipyard process/electrode combinations
- Developed a Sampling and Analysis Plan to characterize Hazardous Air Pollutants in welding emissions
  - Reviewed and commented on by the U.S. EPA
- Completed demonstrations at two shipyards (AMA and BIW)
- Compared emissions results against U.S. EPA developed emissions factors
- Demonstrated/evaluated two commercially available portable welding emissions control technologies.
  - Determined the capture (fume at the source) and control (filters' ability to remove the contaminant) efficiency of both units
  - Collected shipyard welder feedback on use and applicability

# Weld Fume Chamber for Emissions Capture and Analysis



# FCAW, 71T1/0.052", AH36 carbon steel base plate, CO<sub>2</sub> shielding gas

100% suction  
0% draft



100% draft

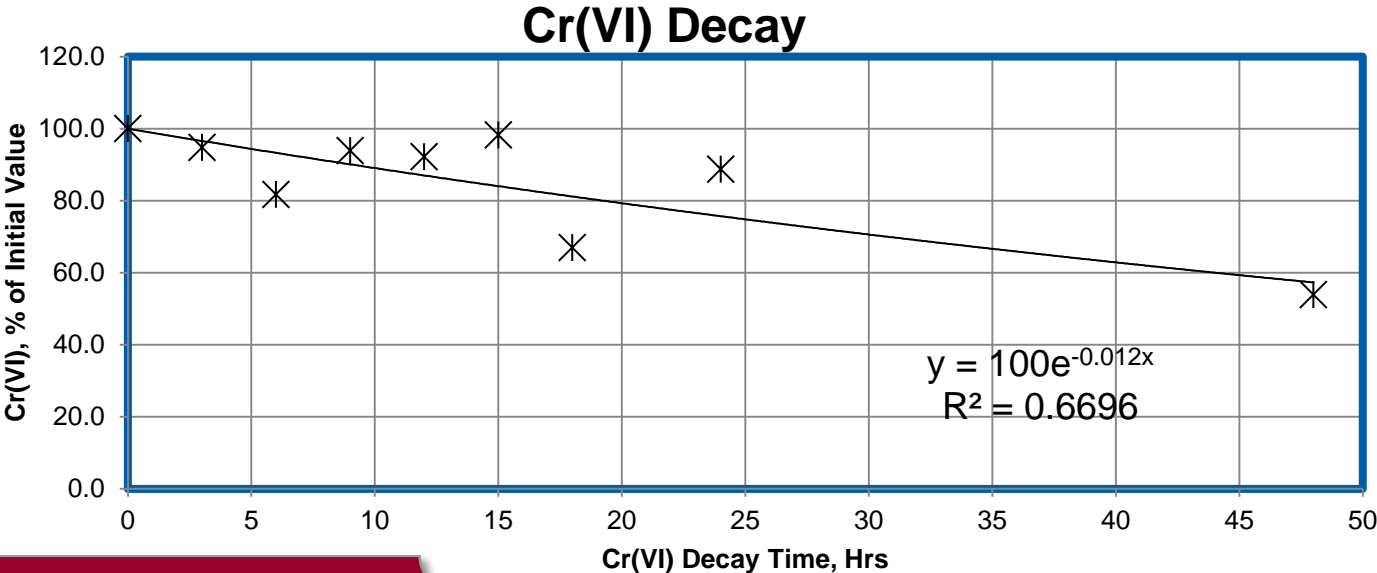
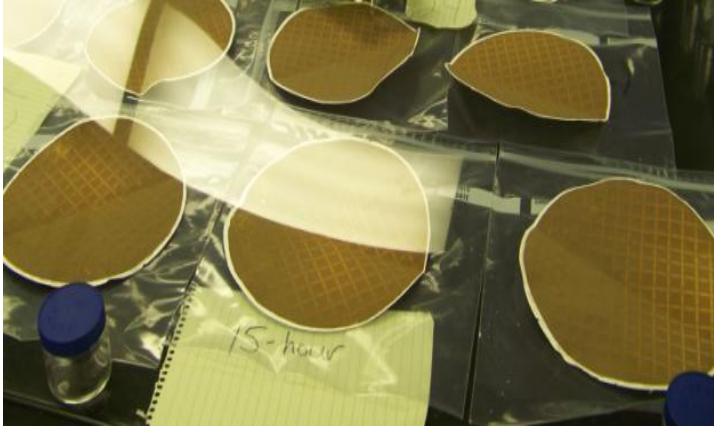


Miniflex with extraction attachments



Mobiflex 200-M  
Low Vac/High Vol

# Hexavalent Chromium Study

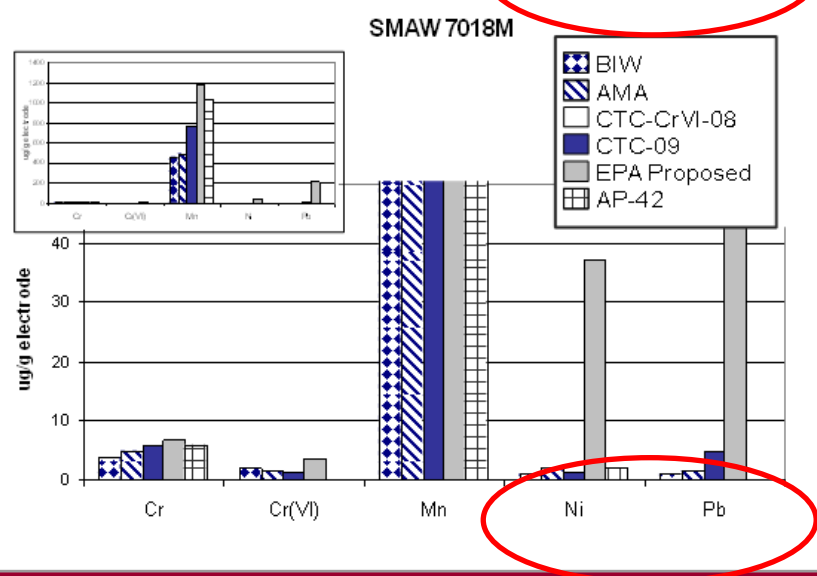
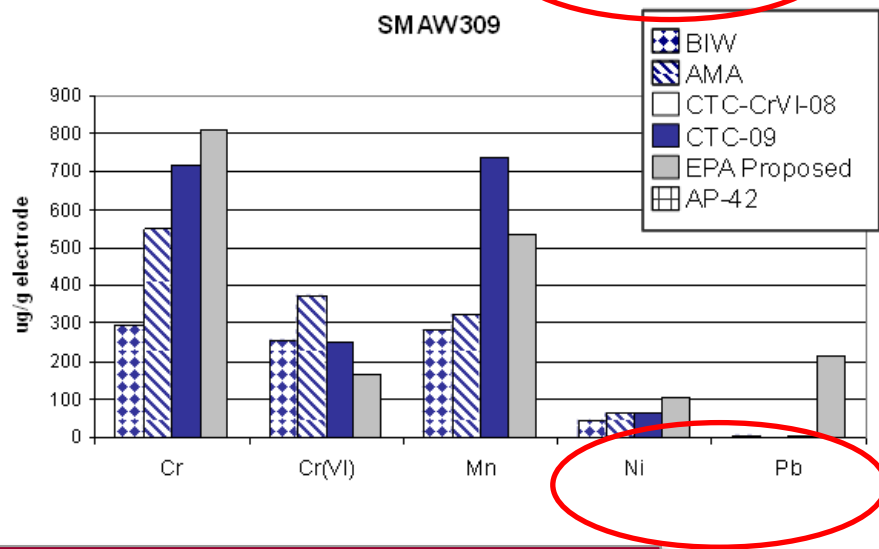
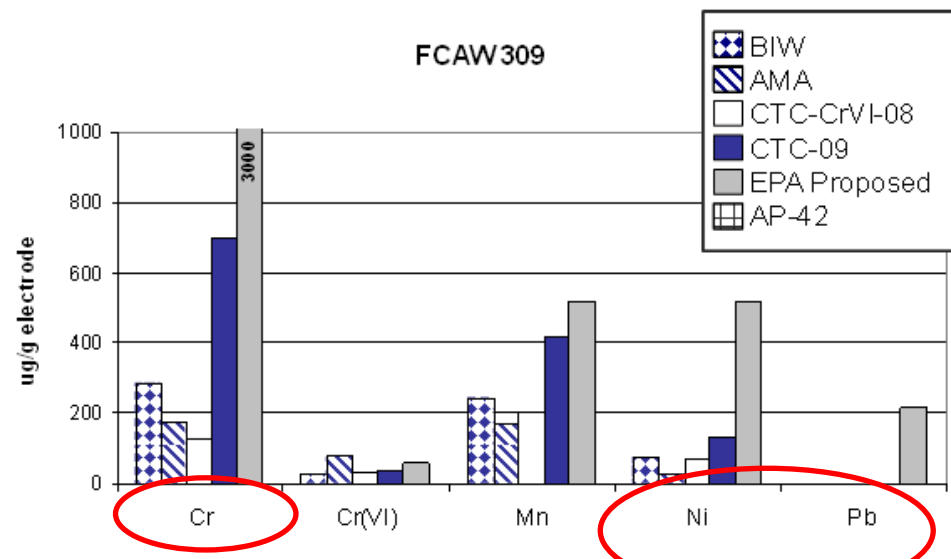
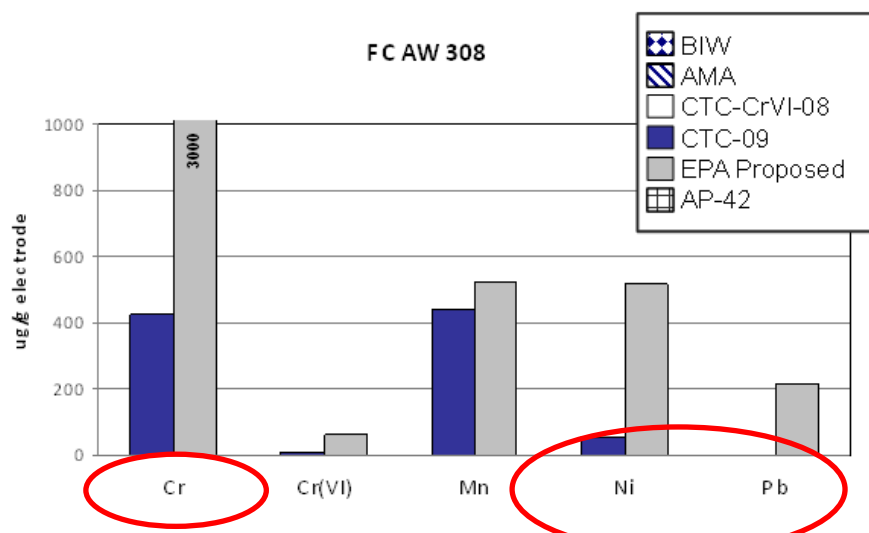


# NSRP Whitepaper Project (2009)

*Developing Emissions Factors for Electrodes Commonly used within the Shipbuilding Industry for use in Regulatory Reporting Procedures*

- Expanded on the work completed under the Research Announcement Project, but focused efforts on establishing realistic emissions factors
- Approach used to select five (5) welding process/electrode combinations for evaluation. The selection was based on:
  - Overall volume of use in the shipyards
  - Lack of current high quality emissions factors listed in the AP-42
  - Composition of Cr(VI) and Manganese (Mn) (hazardous to individuals overexposed) as the primary constituents that drive the estimation of shipyard offsite public health risks
- Same procedure was used to collect and analyze the weld fumes while simulating typical shipyard processes, but the number of samples was increased to 6 as opposed to three 3, to increase the scientific defensibility of the results

# NSRP Whitepaper Project (2009)



# NSRP Whitepaper Project (2010)

*Supporting National Shipbuilding Research Program (NSRP) Shipyards in the Implementation of Recently-Generated Emissions Factors at the Federal, State, and Local Level*

- Prepare industry for upcoming changes in Federal Emissions Factors Program (AP-42 to WebFIRE)
- Determine the necessary steps to submit data generated from past projects to U.S. EPA and hold open discussions with U.S. EPA to influence how data will be utilized to support upcoming changes in Federal Emissions Factors Program
- Determine current practices used by shipyards to report welding emissions to Federal, state, and local regulatory agencies, and identify requirements for updating/revising emissions factors
- Support up to two shipyards in submitting data generated from past NSRP SP-1 Panel Project to local and/or state regulators for use in reporting welding emissions

# NSRP Whitepaper Project (2010) – Progress

- Evaluated 5 states (CA, CT, FL, ME, TX)
- Selected 2 states to support emissions factor implementation:
  - State One: California (BAE San Diego Ship Repair)
    - Limitations exist with the information and methodology provided by California ARB and the SDAPCD
    - Extensive regulatory reporting requirements
    - Ongoing regulatory activities at the state level
  - State Two: Maine (BIW)
    - Currently using emissions factors that were proposed as part of the U.S. EPA's Residual Risk Ruling, as well as unidentified Pb emissions factors
    - BIW reports welding emissions at the federal level to the U.S. EPA under SARA, and at the state level to MEDEP
    - MEDEP provides Method E, which allows the use of emissions factors from other industry and trade groups that are developed based on sound science

# Proposed Rule (Release December, 2010)

- National Emission Standards for Shipbuilding and Ship Repair (Surface Coating); National Emission Standards for Wood Furniture Manufacturing Operations Proposed Rule
  - Published in *Federal Register* on December 21, 2010 (75 Fed. Reg. 80220)
  - Source category covered by MACT standard includes only surface coating operations that occur at these facilities during shipbuilding and ship repair
- Referenced comments from the March 29, 2007 ANPRM (72 FR 29287)
  - Approximately 20 comments received in response to ANPRM were reviewed and considered; adjustments to dataset were completed where U.S. EPA concluded comments supported such adjustment
- Proposes that risks from Shipbuilding and Ship Repair (Surface Coating) source category are acceptable; no MACT changes or additional risk regulation necessary

*National Emission Standards for Shipbuilding and Ship Repair (Surface Coating): National Emission Standards for Wood Furniture Manufacturing Operations, published in the Federal Register on December 21, 2010 (75 Fed. Reg. 80237)*

# Proposed Rule: What About Welding?

- Risk Analysis Results (85 facilities)
  - 4 found to have maximum individual risk (MIR) of cancer of **100-in-1 million or greater (the U.S. EPA established limit for acceptable risk)**
    - Surface coating accounted for ~1% of the total risk
  - 41 facilities with MIR for cancer risks of **1- in-1 million or greater (Ample margin of safety)**
    - 15 have surface coating operations that contribute greater than 50 percent to the facility-wide risks
  - 6 found to have maximum chronic non-cancer Target Organ-Specific Hazard Index (TOSHI) values greater than **1**
    - None had surface coating operations that contributed greater than 50 percent to these facility wide risks
- “The facility-wide **cancer risks** at these 41 facilities, and at the four facilities with risks of 100-in a million or more, are **primarily driven** by emissions of Cr(VI) from **welding and abrasive blasting operations**”
- “The **chronic non-cancer risks** at these 6 facilities are **primarily driven** by manganese (Mn) emissions from **welding and abrasive blasting operations**”

*National Emission Standards for Shipbuilding and Ship Repair (Surface Coating): National Emission Standards for Wood Furniture Manufacturing Operations, published in the Federal Register on December 21, 2010 (75 Fed. Reg. 80237)*

# Proposed Rule: Opportunity

- Noted uncertainties in amount and form of chromium emitted from facilities
  - Many facilities' emissions inventories included estimates for Cr(VI) and Cr(III)
  - Where only estimates of total Cr emitted were provided, a default assumption of 34 percent Cr(VI) and 66 percent Cr(III) was applied
- **“We request comment on the distribution of the default emissions assumptions for chromium emissions applied to the Shipbuilding and Ship Repair (Surface Coating) source category”**
- Identified welding and abrasive blasting operations as sources of HAP at these major source facilities
  - Recognizes that different types of metals (welding) and minerals (abrasive blasting and welding) could be involved
  - Intends to list welding and blasting operations that occur at shipbuilding and ship repair facilities as a major source category under Section 112(c)(5) of the CAA
- **“We request additional information on the HAP emitted by these activities. Once we have this information, we will be in a better position to identify the appropriate scope of the major source category to be listed”**

*National Emission Standards for Shipbuilding and Ship Repair (Surface Coating):  
National Emission Standards for Wood Furniture Manufacturing Operations,  
published in the Federal Register on December 21, 2010 (75 Fed. Reg. 80237).*

# NSRP Whitepaper Project (2010) – Progress

Participated in a meeting with the U.S. EPA (January, 2011)

- Discussed potential of a welding and blasting **major source category** under CAA Section 112 (c)(5)
  - No decision has been made regarding scope, regulatory approach, timeframe, or U.S. EPA point of contact
- Discussed ANPRM Emissions Factors Program Improvements, published in *Federal Register* on October 14, 2009 (74 Fed. Reg. 52723)
  - Projected date for Proposed Rule was July, 2011
  - Outline three primary items:
    1. *Requirement to submit performance test data through Electronic Reporting Tool (ERT)*
    2. *Transition from AP-42 to U.S. EPA's new WebFIRE*
    3. *Revision of current Source Classification Codes (SCCs) assigned to emitting process, such as welding*
- Discovered that NSRP Environmental Panel welding data will need to be entered into U.S. EPA's WebFIRE database (U.S. EPA's New Emissions Factor Data Collection and Retrieval System)

# U.S. EPA Proposed Opportunity/Path Forward

- Act as first source category to implement revised emissions factors into U.S. EPA's new WebFIRE system
  - WebFIRE will become U.S. EPA's primary collection of emissions factors (anticipated to become active in late 2011 or early 2012)
  - U.S. EPA proposed cooperative project in which NSRP EP team would beta test ERT to incorporate data not directly produced as a result of performance testing
- Update process information in AP-42
  - Welding descriptions
  - SCC
- Submit method used to develop these emissions factors for consideration as "Other Test Method" (OTM), and consideration for development of future authoritative U.S. EPA Reference Method

**ALL** actions are critical to the potential development of new welding regulations



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**[www.ctc.com](http://www.ctc.com)**

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# Back-up Slides

# Control Technologies Demonstration - Conclusions

- Identified primary welding process FCAW, followed by SMAW and GMAW.
  - FCAW and GMAW generally produce fewer emissions as compared to SMAW
- Majority (~85 to 99%) of shipyard welding is on mild steel as opposed to stainless steel.
  - Mild steel generally produces fewer Cr(VI) emissions as compared to stainless steel. This is an important fact, considering the Cr(VI) is a known human carcinogen and the primary risk driver for estimated offsite cancer risks
- Identified discrepancies between emissions factors generated under this project, and the Proposed Residual Risk emissions factors; most notably for Pb, Cr, Mn.
  - Provides analytical data that can be used to develop factors which will enhance the ability to accurately characterize emissions for any potential welding rulemakings
- Demonstrated the ability of fume capture/control technologies
  - Larger Unit
    - Capture efficiency (~73% to ~100%) average of 95%.
    - Observed some breakthrough with Mn and Ni
    - No detectable amounts observed for Cr, Cr(VI), and Pb
  - Smaller, more portable unit
    - Capture efficiency (~42% to ~89%) average of 60%
    - Fume gun was determined to be ineffective for use in a shipyard environment
    - Observed some breakthrough with Mn and Ni,
    - No detectable amounts observed for Cr, Cr(VI), and Pb.

# Hexavalent Chromium Study

- Identified 3 commonly used welding process/electrode combinations
  - SMAW 310-16
  - FCAW 309
  - FCAW 71T-1
- Evaluated each process/electrode combination for fume generation rates and concentrations of hazardous air pollutants
  - Focus on Cr(VI) / Cr(III) speciation and natural transformation of Cr(VI) to Cr(III)

# Hexavalent Chromium Study – Conclusions

- Mild steel (primarily used in shipbuilding welding processes) emits fewer Cr(VI) emissions as compared to stainless steel
  - This is an important fact, considering the Cr(VI), as a human carcinogen, is the primary risk driver for estimating offsite cancer risks using current policy rules and guidance
- FCAW emits fewer Cr(VI) emissions (0.08 and 31.4  $\mu\text{g/g}$ ) as compared to SMAW (388  $\mu\text{g/g}$ )
  - This is significant considering that FCAW is used to a greater extent as compared to SMAW
- Discrepancies were found between the emissions factors generated under this project, and the Proposed Residual Risk emissions factors, and those published in the AP-42
  - Most notably for SMAW 310-16, and FCAW 309
- Provided evidence that the concentration of Cr(VI) reduces over time as it transforms into Cr(III)
  - This is significant because it demonstrates that not all of the Cr(VI) generated during shipyard welding will reach the fence line due to its natural conversion to Cr(III).
  - Based on this, the risk to public health will decrease as the distance from the point of origin increases, based on the fact that the amount of time that the Cr(VI) is present in the environment increases as well.

# NSRP Whitepaper Project (2009) – Conclusions

- Emission factors established were found to be consistent from study to study (within the same order of magnitude) for all metals
  - ESAB completed independent testing which produced results consistent with NSRP
- Confirmed previous results that mild steel generally produces fewer Cr(VI) emissions as compared to stainless steel
- Confirmed previous results that FCAW generally produces fewer Cr(VI) emissions (0.08 and 31.4  $\mu\text{g/g}$ ) as compared to SMAW (388  $\mu\text{g/g}$ ).
- Confirmed previous discrepancies found between the newly generated emissions factors, and the Proposed Residual Risk emissions factors, and those published in the AP-42
  - Most notably for Cr, Nickel (Ni), and Lead (Pb) emissions factors
- Developed emissions factors for electrodes that currently did not have published high quality emissions factors
  - Recommended that these emissions factors be considered for use in filling these data gaps