Miller, Diane M. (CDC/NIOSH/EID)

From: Mezei, Gabor [GMezei@epri.com]

Sent: Monday, March 30, 2009 6:09 PM

To: NIOSH Docket Office (CDC)

Cc: Campleman, Sharan; Miller, Mike

Subject: 144 - NIOSH Criteria Document Update: Occupational Exposure to Hexavalent Chromium

Attachments: EPRI Comment on NIOSH Draft Hex Chrome Criteria 033009.pdf

March 30, 2009

Dear Dr. Branche:
Please see the attached letter which provides comments related to the NIOSH Criteria Document Update (External Review Draft) on Occupational Exposure to Hexavalent Chromium (DHHS, September 2008).
Sincerely,
Gabor Mezei

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ELECTRIC POWER RESEARCH INSTITUTE

March 30, 2009

Christine Branche, Ph.D.
National Institute for Occupational Safety and Health
Centers for Disease Control and Prevention

Subject: EPRI Comments on NIOSH Criteria Document Update (External Review Draft) on Occupational Exposure to Hexavalent Chromium

Dear Dr. Branche:

This letter provides comments related to the NIOSH Criteria Document Update (External Review Draft) on Occupational Exposure to Hexavalent Chromium (DHHS, September 2008) that is currently out for public comments.

Our comments are limited to general observations on the epidemiologic literature as it relates to cancer risk among welders and to information on measurement data on occupational exposure to hexavalent chromium (Cr[VI]) during welding in the electric power industry.

We would like to acknowledge the input we received from Mr. Jeffrey Hicks of Exponent while preparing these comments.

The NIOSH Draft Criteria Document Update considers – among other streams of evidence – the epidemiologic literature examining the association between occupational exposure to Cr(VI) and cancer risk with particular focus on lung cancer. The main bulk of epidemiologic evidence in support of a link between occupational exposure to Cr(VI) and lung cancer comes from studies conducted among chromium production workers. The qualitative risk assessment study (Park et al., 2004) that NIOSH referred to as their primary basis for the revised recommended exposure limit (REL) is also based on epidemiologic data of chromium production workers.

Evidence for an association between occupational exposure to Cr(VI) and lung cancer is more limited in epidemiologic studies conducted among welders. As OSHA pointed out in its final rule making document in 2006 (FR 71 (39):10099-10385), these studies were less likely to show a clear trend with exposure duration and cumulative exposure to Cr(VI). Some of these studies – including the study by Simonato et al. (1991), the only epidemiologic study of welders referred to by the NIOSH Draft Criteria Document Update – were also limited by their inability to consider the potential confounding effect of other lung carcinogens, such as cigarette smoke and asbestos, and by their potential for exposure misclassification.

Although, as both OSHA and NIOSH indicated, welders may represent the largest worker population with potential occupational exposure to Cr(VI), the available epidemiologic and exposure data continue to be limited for these workers. To characterize Cr(VI) exposure among welders, NIOSH relies on a relatively small number of welding fume Cr(VI) air sampling data, most with some degree of local exhaust ventilation, and many associated with a mixture of welding processes (e.g. various combinations of TIG, MIG, SMAW, and plasma cutting). There was almost no information given about important factors, such as the chromium content of the consumable materials being welded, the duration of the tasks, or information about environmental conditions. To better understand determinants and characteristics of occupational exposure to Cr(VI) and its potential health impact among welders, more accurate information is needed on Cr(VI) exposure among these workers.

Welding is a very common activity within the electric power industry. It is especially common at power plants where some of the metallic surfaces are various grades of stainless steel. At these plants, welding is routinely conducted by electric power company workers, as well as by contract workers during maintenance and construction activities. To provide more accurate information on occupational exposure to Cr(VI) among welders and to help understand determinants of potential exposures to Cr(VI) during common welding and metal cutting procedures, EPRI has started systematic collection and classification of Cr(VI) air sampling data from workers engaged in welding and cutting activities. Currently over 1,700 air sampling data points are available to us from 6 different electric power companies representing a wide variety of welding and cutting activities.

There are a number of factors that will affect the presence and concentration of Cr(VI) in the work environment associated with welding and cutting on chromium bearing metals. These are based on knowledge of welding activities, and the factors that will affect fume formation and possible accumulation within the work environment. These factors include the following:

- The welding or metal cutting procedures or process;
- The amount of chromium present in the consumable (also known as the welding rod, stick or wire);
- The amount of chromium in the base metal;

- The relative openness or confinement of the work area, which would affect the ability of the fume to accumulate or be dispersed;
- The degree of ventilation;
- The worker's orientation to the fume plume;
- The duration of time the welding process is conducted; and
- The duration of the arc time or the duration of time that metal fumes are generated.

Approximately 400 of the 1,700 air sampling data points have undergone preliminary analyses (the remaining data points will undergo this process in 2009). We examined the individual data points based on the following criteria:

- Were the samples collected and analyzed according to an approved method (e.g. NIOSH method 7604 or OSHA ID 215);
- Is there sufficient information to determine the chromium content of the consumable welding materials;
- Is there sufficient information to determine the type and degree of ventilation provided to the work area.

Limiting the data to those data points that had required information, a total of 295 air samples have been identified as sufficient and entered into a data base. These include air samples associated with 7 different common types of welding and metal cutting processes, namely shielded metal arc welding (SMAW, also called "stick arc welding"), gas metal arc welding (GMAW, also called MIG welding), gas tungsten arc welding (GTAW, also called TIG welding), flux-cored arc welding (FCAW), plasma torch cutting (also called plasma arc cutting or PAC), flame torch cutting, and arc gouging (also known as air carbon cutting). Table 1 presents summary statistics on the four most common types of welding processes used at electric power companies: SMAW (66%), GTAW (14%), GMAW (4%) and Arc Gouging (11%). We believe that this breakdown is representative of the relative frequency of these different welding and cutting procedures used within the electric utility industry.

Table 1. Summary Statistics for Cr(VI) Air Sampling Data (EPRI Preliminary Data, March 2009)

Welding or Cutting Process	Number of Samples	Concentration Range ($\mu g/m^3$)	Mean	Geometric Mean
SMAW	194	<0.02 – 330	11.7	0.74
GMAW	12	<0.14 – 52	10.3	1.9
GTAW	42	<0.03 – 3.2	0.476	0.196
Arc Gouging	33	0.95 – 229	74.0	27.4

As part of the data analysis, various logical categories of welding parameters were developed. For example, there are several types of chromium bearing metals routinely welded on or with that can be categorized based on the chromium content. Stainless steel grades 304 and 316 are the most common type of stainless steel and they have a chromium content of 17.5 - 20% (304) and 16-18.5% (316). Under this categorizing protocol, these would be classified as having medium chromium content. Another common chromium containing metal found in boiler tubes is P22 steel containing 2.25% chromium, which would be classified as low chromium content. To simplify the effect of chromium content, available information for each air sample was categorized into low (<5%), medium (5-20%), high (20-30%), and very high (>30%) categories.

Certain environmental conditions directly impact the presence and concentration of welding fumes in the breathing zone of welders. These include how confining the work area is and the degree of ventilation that is present. For some air samples, active forms of ventilation were in place, such as local exhaust ventilation and dilution ventilation (e.g. the use of space fans to dilute down the concentration of airborne fumes). The categories of these conditions that have been developed are as follows: Low (confining work environment, low degree of ventilation); Medium (open work areas with limited active ventilation but no obvious accumulation of airborne fumes); High (active ventilation such as dilution ventilation, and outdoor work, except in circumstances where the work area is confined); and Local Exhaust Ventilation (LEV) (highly localized ventilation to extract fume at the point of generation).

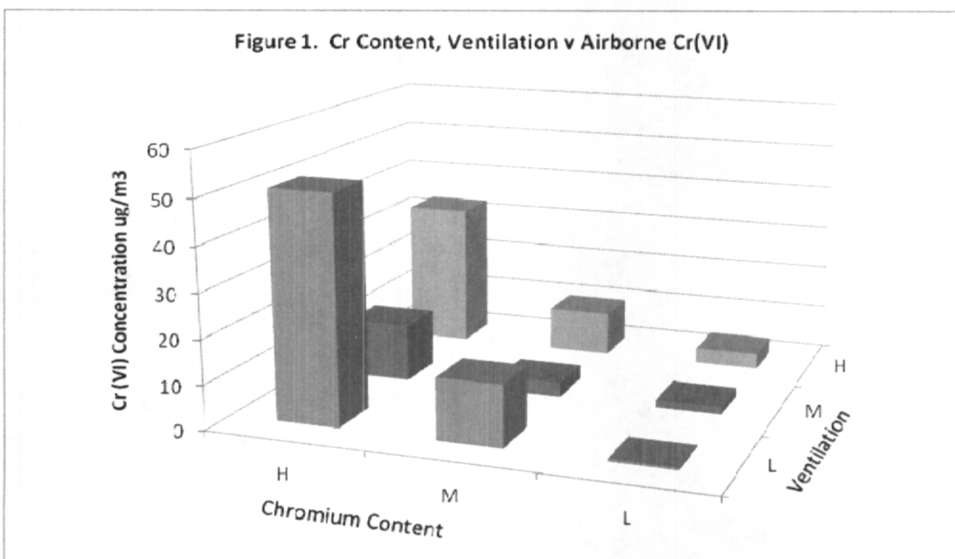
A further breakdown of the results of the SMAW personal air samples in shown in Table 2. These data were chosen for this further analysis because they represent the largest data set compared to the other welding processes. The data are broken down by the chromium content in the welding consumable material that was used, and the type of ventilation that was present.

Table 2. Analysis of SMAW Air Sampling Results (EPRI Preliminary Data, March 2009)

Cr Content in Consumable	Ventilation Conditions	Number of Samples	Range ($\mu g/m^3$)	Mean ($\mu g/m^3$)
H	H	29	0.12 – 330	33.4
H	M	30	0.061 – 174	13.1
H	L	13	<0.7 – 261	51.4
M	H	12	<0.02 – 330	11.7
M	M	7	<0.01 – 7.78	3.27
M	L	2	6.0 – 21	13.9
L	H	12	<0.37 – 17	3.64
L	M	52	<0.06 – 11.1	1.77
L	L	3	<0.05 – 0.85	0.45
None	All	24	<0.02 – 22.0	2.14

$\mu g/m^3$ = micrograms per cubic meter of air

This breakdown provides some insight to the changes in Cr(VI) fume concentrations with common consumable metal compositions and ventilation conditions. A graphical representation of these findings is shown in Figure 1.



To simplify this analysis and to determine the effect of varying the chromium content in the consumable metal, and the effect of ventilation, Figures 2 and 3 show graphical representations of the relationships between airborne Cr(VI) concentrations and chromium content in the welding consumable, and with different ventilation conditions. In addition to high, medium and low ventilation rates, the use of local exhaust ventilation is presented separately.

Figure 2. Mean Cr(VI) Concentration v Chromium Content in Consumable

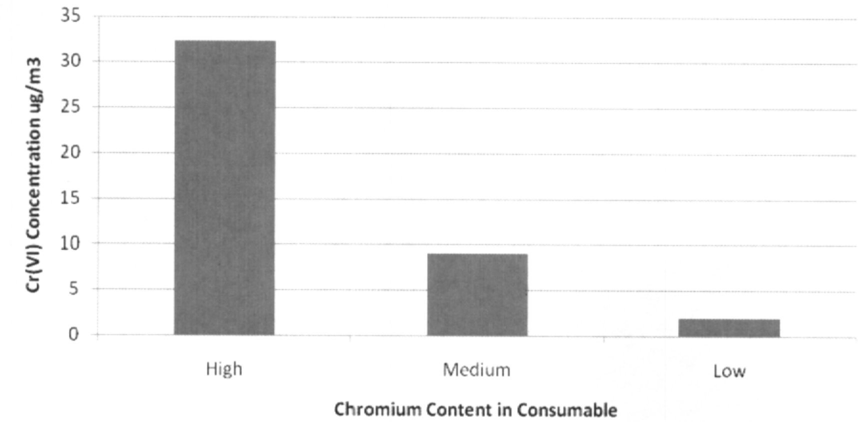
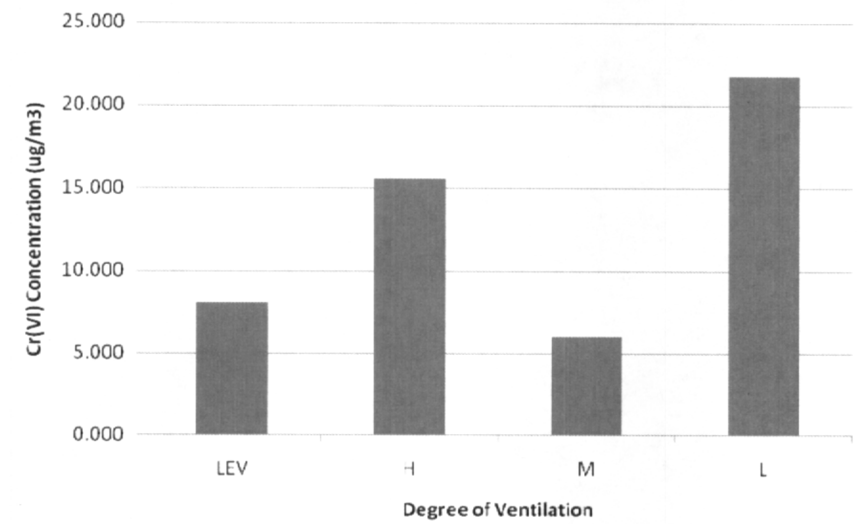


Figure 3. Cr(VI) Airborne Concentration v. Degree of Ventilation



NIOSH has proposed that the REL be lowered to 0.2 $\mu g/m^3$. Table 3 presents an analysis of the fraction of the welding fume air sampling data that EPRI has collected in comparison to a value of 0.2 μg/m^3. Included is the fraction of samples based on welding type in which local exhaust ventilation (LEV) was in use. LEV is considered to be the preferred and optimal engineering control, when the metallurgic or engineering conditions mandate the use of chromium containing metals.

Table 3. Comparison of air sampling results by welding type to the proposed REL of 0.2 μg/m^3 (EPRI Preliminary Data, March 2009)

Welding/Cutting Process	Number of Samples	Percent of air samples with concentrations > 0.2 μg/m^3 (number)	Percent of air samples with concentrations > 0.2 μg/m^3 with LEV (number)
SMAW	194	85 (165/194)	86 (12/14)
GTAW	41	41 (17/41)	87 (7/8)
GMAW	12	83 (10/12)	50 (1/2)
FCAW	11	100	100 (4/4)
Plasma Arc Cutting	4	100 (4/4)	NA
Air arc gouging	33	100 (33/33)	100 (17/17)
All welding/cutting types	295	83	90

μg/m^3 = micrograms per cubic meter of air

This analysis indicates that for most welding and cutting procedures, airborne concentrations of Cr(VI) routinely exceed the proposed REL. For all welding and cutting types considered together, 83% of personal breathing zone air samples exceed 0.2 μg/m^3. When examining the results from welding in which local exhaust ventilation controls were in use, 90% of air samples showed airborne concentrations in excess of the REL. However, in these samples its use was limited to conditions in which high fume concentrations were anticipated (e.g. work inside confining areas, welding or cutting procedures known to produce considerable fume, such as air arc gouging). If LEV had been used during all welding activities, the airborne concentrations would have been lower in all cases. This analysis indicates that in order to maintain exposures to concentrations below the proposed REL within the welding hood, respirators would always be required, even when LEV was in use. Unless there are significant technological improvements in LEV, employees engaged in welding activities will likely need to rely on other control techniques to maintain exposures below the REL. This would most likely occur by the use of respiratory protection whenever they are welding on or with any chromium bearing metals.

At EPRI, we will continue to collect and analyze the available Cr(VI) exposure data and are planning to publish the summary results in the peer-reviewed literature. We believe that more in-depth analyses of measurement-based Cr(VI) data, such as ours, will be required to fully understand the true scope of occupational Cr(VI) exposure among welders. These could be then further expanded to epidemiologic investigations to clarify and explain the observed differences in Cr(VI) exposure related lung cancer risk between chromate production workers and welders.

Sincerely,

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