Noise Level Hazard Testing

INTRODUCTION

Over the past several years, personal protective equipment (PPE) has been developed to protect workers from the intense radiant heat energy of an electric arc flash event. Oberon arc flash suits, including hoods and hood shield windows, are available with heat protection levels up to 100 cal/cm^2. However, there is increasing concern among some members of the NFPA 70E Technical Committee regarding potential hazards other than heat exposure that are also part of an electric arc event, e.g. shrapnel, pressure waves and high sound levels. The NFPA 70E Technical Committee elected to limit its Hazard/Risk Category exposure levels to 40 cal/cm^2 in the proposed 2004 edition until a better understanding of these additional arc flash hazards is achieved.

DuPont conducted tests in the late 1990s on sound levels produced by an arc flash event. Oberon has conducted limited testing in the area arc flash sound reduction due to Oberon's existing PPE product line. This report provides a summary of this testing.

DESCRIPTION OF THE ARC FLASH EVENT

An electric arc flash event consists of a complicated series of hazards primarily originating from the nearly instantaneous generation of an atmospheric plasma. These hazards include a radiant heat exposure, a pressure or "shock" wave, an excessive noise exposure, molten metal splatter (from the plasma erosion of the conductors and nearby materials), and ejection of projectiles or bits of "shrapnel" accelerated by the explosive force of the plasma formation.

SOUND LEVEL IN AN ARC FLASH EVENT

Measurements of multiple three-phase arc events show noise levels increase with increasing arc fault current. This effect would be expected since the noise hazard most likely results from the initial explosive expansion of air and formation of a plasma region between conductors. The first half cycle of the arc tends to produce the "big bang". Subsequent cycles serve to maintain the plasma, due to continuous current flow during a threephase arc, and would not be expected to prolong the initial noise level. The sound level measured at a distance of six feet from the source of the arc flash with fault currents from 5 to 30kA were observed to be extremely high ranging from 140 to 165 dB. This noise level is sufficient to cause damage to hearing in a single event.

SOUND LEVEL HAZARD VS. HEAT EXPOSURE

Because the sound level is related to the fault current on the first half cycle of the arc flash and heat exposure is related to both fault current and the duration of the arc flash, the hazard analysis used for heat exposure cannot be used for the sound level hazard. For instance, it is possible to have a very short arc flash duration of a half cycle but with a high fault current of 100kA that would have a very high sound level but a relatively low heat exposure. Conversely, we could have a long duration arc flash event of 60 cycles (1 second) with a low fault current of 8kA that would have a low sound level but a very high heat exposure.

The importance of this is that until we have an independent method of sound level hazard analysis, the worker needs to use hearing protection at all heat exposure levels.

OBERON PPE ACOUSTICAL TESTING RESULTS

Oberon has conducted Acoustical testing on its products in February of 2004. The results shown in Table 1 indicate that PPE can significantly attenuate the sound hazard, but since the sound level for and arc flash event is so high, the worker still needs to use hearing protection. The results show that the sound protection provided by PPE generally increases as the Arc Rating of the PPE increases. Since a 6 dB reduction represents a 50% reduction in sound level, this testing indicates that with the sound projected directly into the ear through the hood fabric an ARC100 hood would reduce the sound level by approximately 75%. If the sound is projected directly at the hood shield window, i.e. at 90° to the ear canal, the sound reduction would be approximately 90%. Earmuff type hearing protection alone reduces sound by 97%.