Beyond Assessment:

Helmet-CAM Technology Influencing Dust Exposure Awareness and Response.

By Emily J. Haas and Andrew B. Cecala

Exposure to respirable dust, and especially dust containing crystalline silica, continues to be a serious health concern for our nation's miners. Despite constant advances to lower respirable dust exposures, miners still experience periods of elevated exposure while performing their jobs.

A joint venture several years ago by Unimin Corp. and the National Institute for Occupational Safety and Health (NIOSH) developed an assessment technology now known as "Helmet-CAM" (see Cecala & O'Brien, 2014; Cecala et al., 2013). This technology is making great strides to help identify how, when and where miners are being exposed to respirable silica dust, allowing for a finely tunable focus on the subtleties of tasks and activities that can significantly increase exposures.

As NIOSH research continues to educate and broaden the use of the Helmet-CAM exposure assessment technology for the mining industry, industrial minerals mining companies are increasingly using the technology not only to efficiently detect work areas and practices that contribute to respirable dust exposures, but also to investigate the effectiveness of various engineering control technologies and interventions to lower miners' respirable dust exposures.

Building on this trending practice, NIOSH recently began the integration of a behavioral component via collaborative efforts with cooperating mining partners in which the Helmet-CAM also is being applied as a risk communication tool in a series of interventions. The initial study, performed with Badger Mining Corp., has been overwhelmingly positive in many aspects. This article highlights this preliminary behavioral/engineering cooperative study in an effort to encourage the use of Helmet-CAM technology as a risk management tool to improve site-wide awareness and communication between workers and management.

Description of Helmet-CAM Technology Intervention

NIOSH researchers designed an intervention using the Helmet-CAM to help initiate and enhance mine site conversations about the risks and potential occurrences of respirable silica dust exposures on the job. The study design involves a small sample of miners at a mine site who agree to participate, and who wear the Helmet-CAM while completing several routine work tasks, during two separate visits, approximately four weeks apart.

NIOSH setting up the Helmet-CAM on Badger Mining Corp. associates.

A significant component of the Helmet-CAM technology is the "Enhanced Video Analysis of Dust Exposure" (EVADE) software, which synchronizes the video footage and respirable dust exposure data to allow for quick and easy review by the participating miners and health and safety personnel (NIOSH, 2014). This information reveals specific information points for miners and site-level management to discuss and mitigate exposure hazards over time using a variety of resources including possible *engineering controls* and *changing work practices* that could reduce future dust liberations. The intervention requires a series of simple steps involving both miners and management, as described below.

Pre/Post Health & Safety Survey and Interview with Miners

In order to understand potential impacts of the Helmet-CAM intervention on miners' personal levels of health and safety proactivity, compliance, knowledge, motivation and risk perceptions, a subjective pre- and post-assessment are completed with each miner. First, miners complete a short health and safety survey using a six-point (strongly disagree to strongly agree) scale format.

After the survey, miners are prompted to share their personal susceptibility to respirable silica dust exposure and potential consequences of their exposure. Miners also discuss var-

ious messages they hear that impact their health/safety decisions. This same survey and interview occur during the initial part of the first visit and before concluding the second visit, four weeks later.

Helmet-CAM Use and Results Debrief with Miners

After completing the survey and interview, individual miners wear the Helmet-CAM, equipped with a personal real-time data-logging respirable dust monitor, during part of their normal work shift. After wearing the Helmet-CAM, the footage is downloaded into EVADE and reviewed with the miner in an effort to initiate discussions about:

(1) Personal health/safety behaviors that can reduce exposure to dust.

(2) Potential engineering controls that can be explored by miners and management to improve current dust control methods.

Helmet-CAM Results Debrief with Site Management

Throughout the duration of the intervention, feedback is provided to participating members of mine health and safety personnel via e-mail, phone, and/or in person about elevated exposure areas, issues associated with elevated exposures, and considerations to possibly reduce exposures. During this process, site-level management can explore new engineering controls and communicate with miners about possible behaviors that may help reduce respirable dust exposure.

Also, site-level management is encouraged to share ways that they manage, support and sustain the health and safety of their organization and respective employees within a management systems framework. This information provides an organizational context that is helpful when reviewing the Helmet-CAM footage with miners and brainstorming possible solutions.

Pilot Case Study with Badger Mining Corp. Recently, this intervention design was piloted at two Badger Mining Corp. plant facilities. Between the two plant facilities, seven workers (referred to as "associates") opted and were available to participate in both the pre- and post-assessment in April and May 2015.

After completing the survey and initial interview, associates wore the Helmet-CAM for part of their shift while completing work tasks. The Helmet-CAM footage was reviewed with these associates and in some instances, members of mine leadership (referred to as "coaches" or "mentors") were present as well. Additionally, these participating members of leadership shared ways they engage associates to be accountable and proactive in protecting their personal health and safety.

Visit 1: Associates' Reported Respirable Silica Dust Exposure Awareness

Initial Awareness and Knowledge: Associates were asked to share potential risks and hazards related to respirable silica dust exposure prior to and after wearing the Helmet-CAM. During the first visit, several associates had few concerns about elevated silica exposures and potential long-term consequences of such exposures. Particularly, younger associates often said that they think about dust exposure but not necessarily overexposure because dust is well-controlled on their respective sites and they complete routine respirator fit tests. The following excerpts illustrate some of these attitudes:

"I think about dust exposure and trying to reduce it but I generally don't worry about it being a problem in the future in terms of my health. I don't think that because people have worked here for 35+ years and they're fine."

"I know that I'm exposed but I don't think I'm overexposed. So, I tend to not worry about it, plus it's just routine to wear my respirator so really our exposures are avoided since we're protected."

"I think it's [the dust] in the back of everyone's mind. The dust is definitely there. But the exposure time is limited, so maybe you're in a dusty situation for a few hours but not your whole shift."

Alternatively, the few associates with more experience mentioned varying levels of concern about their personal exposure based on the number of years they have been working in the mining industry, not the fault of any particular plant site. Associates with more experience were well aware of the long-term health consequences associated with respirable dust exposures and acknowledged that they and their co-workers need to be attentive to these exposures throughout their mining careers.

Initial Behaviors: After gaining associates' initial perspectives and them wearing the Helmet-CAM, we proceeded to go over their individual Helmet-CAM footage with them. This first debrief ended up being a knowledge-building activity with associates. After showing them how the EVADE software works, we encouraged associates to maneuver the software and scroll to their highest sources of elevated dust exposures. While going over the personalized data, associates had the opportunity to ask questions about their exposures and associated tasks. Generally, they were surprised at the magnitude of very brief dust exposures they experienced just walking through a certain area of the facility, or the significant effects of something they did personally to raise their exposure. Examples of instances that resulted in brief dust elevations included the following:

- Rubbing/clapping hands together and on clothes; dust being liberated from dusty/dirty clothes.

- Forgetting to use ventilation measures already in place (i.e. fans) to circulate air.
- Work processes for obtaining a sample for lab analysis.
- Using cloth seats in mobile equipment.

Upon reviewing the data with associates, we determined possible methods to mitigate some of the brief elevated respirable dust exposures and eventually discussed similar potential mitigation strategies with site-level coaches and mentors. In general, associates learned about minor elevated exposures and activities that may help reduce those exposures.

Visit 2: Associates' Observed Changes in Respirable Dust Exposure Awareness and Behavior

Changes in Awareness and Motivation: During the second visit, associates completed the same survey and interview, wore the Helmet-CAM again, and we reviewed the information together. Contrary to the first visit, where knowledge building tended to take place during our discussions, associates' motivation to learn about silica dust exposure and its consequences was much more evident through their eagerness in asking specific questions about silica dust. The following excerpts illustrate these changes in health and safety awareness:

> *"So what is the silica standard? Is that exposure over time negative? How much is too much before it affects you?"*
>
> *"If you're exposed to 100 mg/m³ your whole life will you get silicosis? Why is the [OSHA] standard being lowered?"*
>
> *"I'd like to wear the Helmet-CAM again, during certain times, to identify tasks that have higher dust elevations."*

This observation of associates' increased interest indicates that perhaps "seeing," by means of the Helmet-CAM technology, what can't visibly be detected during the workday, is critical to establishing a sense of personal accountability to reduce sources of silica dust when possible.

Changes in Behavior: Based on initial and follow-up discussions with associates as well as practices captured in the actual Helmet-CAM footage, several associates modified certain work tasks and behaviors in an effort to reduce personal exposures. Examples include:

- Using the clothes-cleaning booth to remove dust from dirty/soiled clothes.
- Installing a switch to easily turn on a fan when entering the sampling splitter room to better ventilate the area.
- Changing pre-established processes for gathering samples for lab analysis so that less fugitive dust is emitted near personal breathing zones.

Changes in Perceptions and Attitudes: Finally, although significance cannot be statistically determined due to the small sample, the survey results show a slight increase in averages, indicating an encouraging intervention effect on associates' health and safety outcomes.

Table 1 lists scale averages that were measured within the pre and post survey items. A higher score is associated with positive health/safety behaviors and/or perceptions of organizational support and leadership.

As the pre-assessment results indicate, associates already held their own behaviors as well as their organizations' values and support for safety to be extremely high; so even minor increases during the post-assessment are promising for future Helmet-CAM technology application.

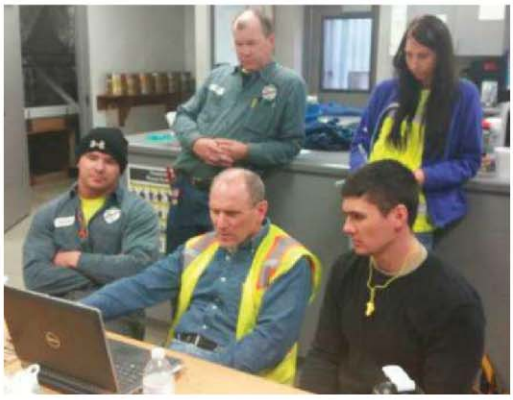
Summary and Future Helmet-CAM Interventions

Additional interventions with the Helmet-CAM as a risk management tool are necessary to help provide more substantial, generalized guidance to the industry. It is hoped that with continued support, NIOSH can provide mine operators with a summary of common procedural and environmental situations where respirable silica dust exposure is the highest, along with common mitigation strategies (to include engineering controls/interventions and corrective actions workers may take) to reduce exposures.

Initial results and observations from this pilot case study with Badger Mining Corp. suggest positive outcomes for not only improved health via personal accountability, but

Table 1. Associates' Health and Safety Perceptions Pre and Post Helmet-CAM Intervention

Workers' Self-Reported Attitudes and Behaviors	Pre Helmet-CAM Assessment *(Average on 6-point scale)*	4-Week Post Helmet-CAM Assessment *(Average on 6-point scale)*
H&S Proactivity	4.6	4.7
H&S Compliance	4.8	5.6
Supervisor's Safety Support	3.9	4.3
Organization's Safety Support	5.5	5.5
Personal Risk Tendency	4.8	5.7
Personal H&S Knowledge	5.7	5.7
Personal H&S Motivation	5.8	6.0



NIOSH reviewing Helmet-CAM footage with Badger Mining Corp. associates.

improved communication and engagement about health between miners and managers.

Importantly, the pilot case study results indicate that after miners wear the Helmet-CAM and review their personal footage, they are likely to better see and recognize instances in which they experience elevations in respirable silica dust exposure. More specifically, reviewing the footage with miners seemed to positively impact their level of awareness while on the job, including but not limited to potential hazards that may be a source of respirable silica dust. Subsequently to reviewing the footage, upon modifying certain decisions or controls, miners were able to quickly see if these changes effectively lowered their risks, helping to develop internal knowledge and personal motivation.

Finally, engaging both miners and site-level leadership by way of Helmet-CAM may showcase managements' interest in maintaining and even improving their employees' personal health. By allowing miners to wear the Helmet-CAM and subsequently discuss the feedback in a non-critical or judgmental way, management helps foster a supportive environment that may enable miners' health and safety decision making in the future. With active participation from management – meaning that they encourage using the Helmet-CAM, discuss the footage with miners, and work to mitigate potential risks – the Helmet-CAM may be used as a tool to bridge actionable communication efforts with miners.

In the near future as the Helmet-CAM assessment technology is expanded, mine health and safety management are invited to take advantage of opportunities to address a variety of health and safety issues including noise, diesel and other contaminant exposures in an effort to more accurately identify and communicate with miners to help reduce workplace risks. ▲

Emily J. Haas and Andrew B. Cecala are with NIOSH, and based in Pittsburgh.

Acknowledgments

NIOSH would like to thank the associates at Badger Mining Corp. including Marty Lehman, Linda Arzt, Brian Beaman and Curtis Hoag, who organized the site-wide participation in this pilot effort.

Disclaimer

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

References

Cecala, A.B., and O'Brien, A.D. (2014). Here comes th Helmet-CAM. *Rock Products*, October Issue, 26-30. Cecala, A.B., Reed, W.R., Joy, G.J., Westmoreland S.C., and O'Brien, A.B. (2013). Helmet-Cam: Tool for Assessing Miners' Respirable Dust Exposure. *Mining Engineering, 65*(9): 78-84. NIOSH (2014). Report of Investigations 9696: Guidelines for Performing a Helmet-CAM Respirable Dust Survey and Conducting Subsequent Analysis with the Enhanced Video Analysis of Dust Exposures (EVADE) Software. Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2014-133.

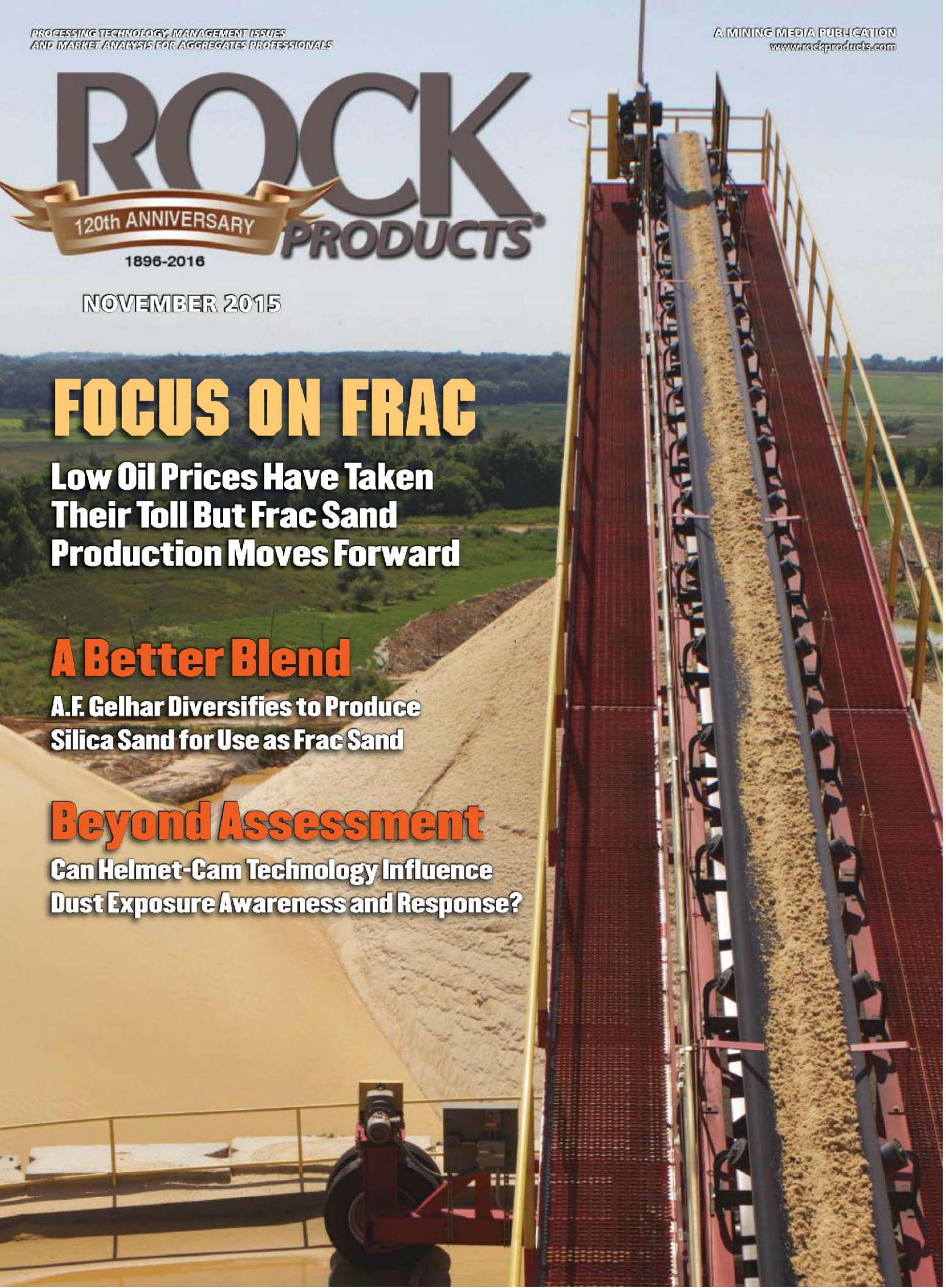
PROCESSING TECHNOLOGY, MANAGEMENT ISSUES
AND MARKET ANALYSIS FOR AGGREGATES PROFESSIONALS

A MINING MEDIA PUBLICATION
www.rockproducts.com

ROCK PRODUCTS

120th ANNIVERSARY
1896-2016

NOVEMBER 2015



FOCUS ON FRAC

Low Oil Prices Have Taken Their Toll But Frac Sand Production Moves Forward

A Better Blend

A.F. Gelhar Diversifies to Produce Silica Sand for Use as Frac Sand

Beyond Assessment

Can Helmet-Cam Technology Influence Dust Exposure Awareness and Response?

PROCESSING TECHNOLOGY, MANAGEMENT ISSUES
AND MARKET ANALYSIS FOR AGGREGATES PROFESSIONALS

ROCK PRODUCTS 120th ANNIVERSARY

Cover Photo Courtesy of McLanahan Corp.

FEATURES

EQUIPMENT & TECHNOLOGY

By Mark S. Kuhar and Josephine Smith

EDITORIAL

NEWS

KEY ISSUES

BACK PAGES