

circuit SCUBA provides the nitrox breathing-gas mixture, the proposal would permit employers to use the emergency-egress procedure (*i.e.*, a reserve breathing-gas supply) specified for open-circuit SCUBA by paragraph (c)(4)(i) of § 1910.424 instead of a separate bail-out breathing-gas system.

Paragraph (c)(4)(i) of § 1910.424 is an emergency-escape provision in OSHA's existing CDO standards that applies to divers who use air-supplied open-circuit SCUBA. Under this provision, employers can maintain a reserve supply of breathing-gas in the breathing-gas cylinders carried by the diver, and that the diver can access in an emergency by manually activating a J valve located on the supply manifold. Having already recognized the safety afforded to divers by this system in the context of air-supplied, open-circuit SCUBA diving, the Agency believes that it would provide a similar level of protection to divers who use open-circuit SCUBA supplied with nitrox breathing-gas mixtures.

(c) *Safety requirements.* This proposed condition requires employers to provide their divers with a system that performs reliably and supplies sufficient emergency breathing gas to enable the diver to terminate the dive and return safely to the surface. Accordingly, this proposed requirement would ensure that the bail-out system used by employees, whether it is an independent or integrated bail-out system, will function appropriately when needed by the diver for emergency egress. The bail-out system must enable the diver to terminate the dive and make a safe and orderly ascent to the surface under "worst-case" conditions, thereby preventing over-pressurization of the lungs associated with AGE. However, OSHA is not proposing a specific capacity for bail-out systems because it believes that the SCUBA manufacturers are in the best position to make this determination. In this regard, a rebreather manufacturer could determine the capacity that is needed for the bail-out system based on critical diving parameters (*e.g.*, depth of dive and breathing rate) provided by the employer.

8. Treating Diving-Related Medical Emergencies

(a) *Availability of medical resources.* This proposed condition requires that employers, prior to beginning diving operations each day, ensure that: (i) A hospital, qualified health-care professionals, and the nearest Coast Guard Coordination Center (or an equivalent rescue service operated by a State, county, or municipal agency) are

available for diving-related medical emergencies; (ii) each dive site has a means to alert these treatment resources in a timely manner when a diving-related medical emergency occurs; and (iii) transportation to a suitable decompression chamber is readily available when no decompression chamber is at the dive site, and that this transportation can deliver the injured diver to the decompression chamber within two hours travel time from the dive site. Overall, the proposed provisions would avoid unnecessary delay in treating diving-related injuries by confirming that resources are on call and available to render appropriate treatment, by alerting them to the occurrence of a diving-related medical injury so they can initiate treatment action (*e.g.*, using a pre-programmed electronic system, list of telephone numbers), and by providing timely transportation for the injured diver to the treatment facility. OSHA believes that reducing treatment delay will improve the likelihood that an injured diver will recuperate fully from any diving-related injury.

Prior to granting the permanent variance to Dixie, OSHA requested Dr. Edward D. Thalmann to render an opinion on the likely incidence of AGE and DCS under the proposed variance conditions. In doing so, Dr. Thalmann reviewed available research studies, as well as data from the Diver Alert Network ("DAN") (Ex. 2-7). With regard to AGE, Dr. Thalmann stated, "[AGE] is a rare occurrence and can be avoided with proper training and experience," that it "is essentially independent of the time at depth," and that "there is no evidence * * * [to] suggest that the occurrence and outcome of [AGE] would be any different breathing a [n]itrox mixture [other] than air." In addressing DCS, Dr. Thalmann noted that DCS associated with breathing a nitrox gas mixture "should not be substantially different in incidence and severity compared to diving on air[,] provided the [n]itrox no-decompression times are computed from accepted air no-decompression limits using the [NOAA] EAD [formula]."

Dr. Thalmann then discussed the two-hour transportation limit proposed for the Dixie variance by reviewing the available DAN data; he cautioned that these data "apply to recreational diving only where the vast majority of diving is within no-decompression limits." Under these conditions, he found that for both pain-only DCS and DCS with severe neurological symptoms, a treatment delay of four hours can occur without diminishing treatment success (*i.e.*, complete relief of symptoms). In

summary, Dr. Thalmann stated, "There is no significant body of evidence to suggest that, so long as one is diving within accepted no-decompression limits breathing air or [n]itrox, having access to a recompression facility within 4 hours is inadequate." For the reasons set forth in Dr. Thalmann's expert opinion, OSHA believes that the proposed condition for availability of medical treatment would provide adequate employee safety.

(b) *O₂ treatment.* Oxygen treatment is the preferred means of initially treating AGE and DCS (see Section III below, Reference (1), pp. 3-19 and 3-28). This proposed condition would require the employer to ensure that portable O₂ equipment is available at the dive site to treat an injured diver. This equipment must deliver pure O₂ to a transparent mask that covers the injured diver's nose and mouth. To provide assurance that the O₂ is suitable for treatment purposes, this proposed condition also requires employers to use only O₂ that meets the criteria for Medical USP oxygen (Type I, Quality Verification Level A) of CGA G-4.3-2000 ("Commodity Specification for Oxygen"). Additionally, sufficient O₂ must be available to administer to the injured diver from the time the employer recognizes the symptoms of a diving-related medical emergency until the injured diver reaches a decompression chamber for treatment. This proposed condition would require that the O₂ supplied for this purpose be pure O₂, and that the injured diver receive the O₂ continuously from the time an employer detects the diving-related medical emergency until the diver begins treatment in a decompression chamber. These provisions would ensure that injured divers receive the maximum dose of O₂ possible to enhance treatment effectiveness. The transparent mask covering the diver's nose and mouth allows attendants to monitor the diver's breathing and provides an effective seal against O₂ loss.

(c) *Treatment personnel.* This proposed condition requires the employer to ensure that at least two attendants (either employees or non-employees) qualified in first-aid and administering O₂ treatment are available at the dive site to treat diving-related medical emergencies before starting each day's diving operations, and to verify their qualifications before using them for this purpose. Under these proposed requirements, only qualified personnel would administer initial treatment to injured divers. OSHA believes that personnel qualified in first aid and O₂ treatment would stabilize the