Advisory Committee on
Decompression Procedures for Non-diving Pressurized Worksites
Proposed Revisions to Title 8, GISO, Article 154
June 30, 2008

MINUTES

AGENDA

- Introduction
- Decompression practices – experiences – issues
- Decompression procedures / tables
- Select decompression procedures / tables for proposed amendment to Article 154
- Develop proposed text of revised decompression procedures/tables
- Proposed revisions incidental to decompression procedures/tables
- Adjourn

ATTENDANCE

- Tony Serpas, Senior Safety Engineer, CALOSHA Mining and Tunneling
- Andy Nordquist, Safety Mgr., Traylor Brothers Construction
- Kevan Corson, OxyHeal Health Group
- Karen Van Hoesen, M.D., UCSD Hyperbaric Medicine Center
- Marvin Underwood, Corporate Risk and Safety Mgr., Obayashi Construction
- Ron Meyers, Laborers International Union
- Guy Prescott, Director, Operating Engineers Local 3
- Ed Flynn, M.D. Naval Sea Systems Command (on speaker phone)
- Tom Mitchell, Senior Safety Engineer, OSHSB
- Leslie Matsuoka, AGPA, OSHSB

SUMMARY

- There was agreement to replace the OSHA decompression tables with the Revision 6 Navy tables and to keep the tables in “feet of sea water” (FSW) but also indicate the equivalent “pounds per square inch gauge” (psig). Kevan Corson will use a conversion factor with four decimal places to calculate the equivalent psig then round to two decimal places since some digital psi gauges readout to two decimal places.
- It was agreed that the proposal would require the use of the Navy tables except when alternative tables are recommended by the supervising physician and approved by the Division. These alternative tables could include work at pressures greater than 50 psi and bottom times longer than those in the Navy tables, if approved by the Division.
- It was agreed to amend Section 6080(b) to allow work >50 psi if approved by the Division, and that the incorporated Navy tables not go beyond 50 psi, even though it is anticipated that there will be a need in the future to go deeper than 50 psi.
- There was a proposal to limit the use of the Navy table to a maximum of 190 feet as recommended by the Navy to prevent nitrogen narcosis.

- There was agreement to remove subsection (a)(3) of Section 6120, Medical Control, which requires "An oxygen tolerance test shall be passed by all persons engaged in compressed air work." because the test is not reliable and it is no longer used.
- Other than fire safety, the group did not identify any critical issues that must be addressed concurrent with the proposed revision which would require oxygen decompression for some compressed air work.
- Kevan Corson will mail CDs to committee members with standards relevant to fire safety.
- Tom Mitchell will look at the information Kevan Corson is sending and work with the Division to develop proposed oxygen safety provisions. Another advisory meeting may be necessary on fire safety.
- It may be necessary to add a section that applies specifically to tunnels to address situations such as 14 foot diameter tunnels where it is difficult to comply with the size requirements for a chamber when the chamber has to be 3 feet above the tunnel bottom.
- There was general agreement to consider adding employee training requirements in Article 154. The Division currently relies on general training requirements in other sections.
- Unless information is presented otherwise, it may be reasonable to estimate that employer costs incurred as a result of replacing the OSHA tables with Revision 6 Navy tables, which may require special oxygen safety procedures and equipment, will be offset by savings from reduced decompression times and less need for hyperbaric medical treatment.
- Tom Mitchell will develop a draft proposal that replaces the OSHA table with the Revision 6 Navy tables and distribute it to the committee along with the meeting minutes.

MINUTES

Tom Mitchell noted that handouts are available. These were previously emailed to the committee and/or posted on the OSHSB website. The group introduced themselves. Tom Mitchell described the advisory process and the rulemaking process. Tom Mitchell asked for any corrections to roster contact information. Tom Mitchell stated that this proposal was initiated at the request of CalOSHA Mining and Tunneling (M&T) unit, which requested the decompression tables be revised because they are outdated and generally considered to be inadequate. Mining and Tunneling has permitted modifications of the dive tables to permit longer decompression times or oxygen breathing during decompression because these modifications were considered to be more stringent than the tables in the standard. Tom Mitchell noted that the following handouts have been provided for discussion: rulemaking process, agenda, roster, initial proposal to use Revision 6 of the US Navy dive tables, also alternative proposal to use French dive tables that have been used for tunneling, Kindwall tables, and Article 154. Tom Mitchell said he has copies of other tables that were not distributed previously but are available if needed. Tom Mitchell noted sections in Article 154 that refer to tables and language which permits the Division to approve alternative tables. Tom Mitchell distributed a handout that was provided by Dr. Flynn which compares US Navy decompression times to those in the French table.

Each member introduced him/herself as follows:

- Guy Prescott, Operating Engneers Rep, his only personal experience with the issue is as a recreational diver.
- Ron Meyers has 25 years work experience including work with Mike Shanks on NUMI tunnel job. He mentioned that Hetch Hetchy project is coming up.
- Marvin Underwood; he is working on a project in Pittsburgh now with a slurry shield machine at 1.2 bar. They are using Canadian dive tables to do intervention into the head of the TBM because they felt the Canadian tables were better than OSHA tables.
- Dr. Karen Van Hoesen has experience with commercial diving medicine, diver medical exams, hyperbaric chambers, fitness to dive exams, treatment of embolisms at hyperbaric chamber. She worked with a company a couple years ago that had problems with DCI at 40-50 foot level using the old US Navy tables and had to extend times a bit, so she is glad to see new US Navy tables has revised those times to improve safety.
- Kevan Corson, Oxyhealth, has experience with saturation diving and egress of these divers in an emergency situation. He has worked on projects from 4 bar to 30 bar. Worked in commercial diving related to off shore oil rigs. He assisted Andy Nordquist with the UCLA project. He commented that the use of several different tables on different projects causes a problem. Also he did not think the Canadian dive tables had been updated since 1957. He also noted that the strenuous physical work that miners do would be considered an "arduous dive" which effects decompression time.
- Andy Nordquist, Traylor Bros., has experience with work in compressed air to provide protection against water and flammable gas. He worked with Tony Serpas, Kevin Corson and Ron Meyers on the NEIS (LA Northeast interceptor sewer) tunnel project where they had 117 entries and only 2 suspected DCI cases that were questionable. He is on a presentation committee with Jean Claude LePechon regarding the Lake Mead tunnel project. He wants to apply the best science in response to anticipated increase in Earth Pressure Balanced (EPB) projects that will require entry at increasingly higher pressures. He believes the employer needs to have as much flexibility as possible to allow employer to provide the highest level of safety.
- Tony Serpas, CalOSHA; when the NEIS project began OSHA recognized that the present tables did not provide adequate safety and that is why the Mining and Tunneling Unit requested this advisory committee.

Tom Mitchell noted that one way the standard could provide employers with the flexibility is to include language such as that used with the repetitive dive tables which states that an alternative to the required tables can be used if approved by the Division. He noted that this advisory committee meeting will help provide the Division with information on which to base their approval if the standard allows that flexibility. If the standard did not allow the use of alternative decompression procedures that are approved by the Division the employer would have the option of requesting a variance. Tom Mitchell described the variance process and the amount of time it takes to receive a variance from the OSHSB, which varies from a couple months to six months or more depending on the complexity of the issue and the variance workload. It is generally preferable to avoid the need for a variance if possible. A permanent variance applies to a particular worksite/operation. The employer must demonstrate that the alternative provides safety that is equivalent to compliance with the standard. Tom Mitchell asked for comments regarding how to provide flexibility. Andy Nordquist supported using text like "if approved by

the Division" because the variance process is too long. Tom Mitchell said that similar language is used in other standards and it does not require a variance. He thought that there should be adequate lead time on tunnel projects which would allow time to get approval by the Division. Tony Serpas agreed and stated that as long as the minimum requirement of the existing tables is met they would not have a problem with it. There was a question about federal requirements. Tom Mitchell believed the federal tables were the same as those in Article 154. Tony Serpas noted that by law CalOSHA has to be at least as effective as federal OSHA so he presumes that they are the same. There was some agreement that Rev 6 of the US Navy tables represents the most recent national standard.

Dr. Flynn said that the current OSHA tables are constant rate of assent tables rather than tables that specify stops; they were designed for tunneling work and are not the 1957 US Navy tables. The new Revision 6 tables are designed to replace the 1957 tables, and emphasis is on oxygen decompression in the water to reduce decompression times. New oxygen times are roughly the same as the old air times, so the Navy feels they are safer. The tables are designed for in the water stops at 20 and 30 feet to avoid CNS oxygen toxicity. In a dry operation, oxygen can be breathed at about 60 feet without oxygen toxicity problems, so the depth of oxygen breathing may not be optimal for dry work. Canadian tables developed in 1984 have nearly identical oxygen breathing times as the new Navy tables. The French tables were developed for tunneling and caisson work by Jean-Pierre Imbert for Comex and were adopted by the French ministry of labor. These tables breathe oxygen at 30, 20 and 10 feet. He noted that the handout he provided shows that the oxygen breathing times of the French and Navy tables are also very similar. He recommended considering the use of any one of the 3 tables. He acknowledged that oxygen has fire safety concerns but it is recommended because it provides practical decompression times and improves safety. He noted that French tables only go to 60 minutes bottom time whereas the OSHA tables go out to 6-8 hours. So the Navy tables would need to be customized for bottom times > 60 min. The OSHA repetitive diving tables are similar to the 1957 Navy tables, but they are less accurate because they do not account for the gain or loss of residual nitrogen during the actual decompression time, only bottom time. The new Navy procedures are technically correct in this regard. The Canadian and French tables do not use repetitive groups; they have a different method for repetitive dives.

Tom Mitchell asked if there was a need for repetitive work and tables. Andy Nordquist said there could be, such as in an emergency or when using a limited number of trained employees which can be safer than a larger group. Dr. Flynn agreed with Tom Mitchell that the French repetitive tables are simpler to understand than the Navy tables but he said that they don't provide the flexibility that the Navy needs. He has not done a quantitative comparison of the French and Navy repetitive dive tables. The new Navy tables also include an altitude correction table as do the Canadian tables but not the French. Kevan Corson said repetitive tables are needed for medical emergencies. He and Dr. Flynn agreed that the Navy tables are not that hard to use.

Dr. Van Hoesen asked what percentage of work is done using oxygen vs. air. Andy Nordquist said he thought nearly every hyperbaric medical consultant like Dr. Bayne and Dr Kindwall recommends oxygen to improve purging nitrogen from the body. He was not aware of anybody presently using air in CA. Seattle is using oxygen. Ron Meyers said oxygen is proposed for the Impregelio job in Las Vegas. Tom Mitchell noted that LePechon advised that oxygen should not

be required for all jobs but air should also be allowed. Dr. Flynn said that air would work for shallow jobs with short decompression times. He said new tables are flexible and allow substituting some air for oxygen at some stops. Andy Nordquist asked about mixed gas operations. Dr. Flynn thought you would always want to use oxygen. He also said the Netherlands use saturation for really deep work. They use a trimix and work on bottom with mixture of helium, oxygen and nitrogen. This provides advantage over "bounce dive" in work efficiency and less risk of gas emboli. Kevan Corson said saturation is used widely in commercial diving both shallow and deep. Dr. Flynn thought tunnel work would be compatible with saturation procedures. Marvin Underwood said their Pittsburgh job is only 1.2 bar but uses oxygen.

Tom Mitchell asked Kevan Corson about his concerns regarding work with multiple tables and how that relates to the need for flexibility. Kevan Corson said that the use of multiple tables presents a challenge for hyperbaric physicians in emergency situations. He said using both air-only and air/oxygen tables creates a similar problem. He thinks oxygen is the way to go. Dr Flynn thought that different jobs could use different tables that provide equivalent safety, but a single job should only use one table. Kevan Corson agreed. Andy Nordquist added that the emergency hyperbaric chambers used for a job should have copies of the tables used at the job to avoid confusion.

Kevan Corson said the hardest thing about the NEIS job was impressing on employees the importance of decompression. There were only 2 potential cases and these could not be confirmed. Both he and Andy Nordquist agreed that having employees remain on job after decompression to post-breath oxygen helped medical evaluation/control. Marvin Underwood said they have EMT with diving experience in the chamber when employees work at head. Kevan Corson said CFR 46 for commercial diving requires medical personal on site for certain depths. Dr. Van Hoesen said Article 154 only requires physician be available at all time during compressed air work but not actually on site. And the chamber is required to be adjacent to medical facility, not necessarily on site. Andy Nordquist agreed. Kevan Corson said that it is important that the doctor be able to speak to an on-site EMT in the chamber that is knowledgeable about decompression (i.e. diving). Marvin Underwood said on Pittsburgh job they had chamber on site and access to offsite emergency chamber. Andy Nordquist said at NEIS job they wanted an ICU capable chamber and fortunately one was close by at UCLA but the admission process was somewhat problematic.

Tom Mitchell asked whether the airlock typically meets the Article 154 requirement for a special decompression chamber for decompression times > 75 minutes. Andy Nordquist said yes, and Tony Serpas said the lock is acceptable if it meets all of the requirements. Ron Meyers said all Earth Pressure Balanced – Tunnel Boring Machine (EPB-TBM) need a chamber; and therefore they should be required to have a chamber when the job is bid. Andy Nordquist said that it is not always the case that employees enter a pressurized space. Tom Mitchell asked if EPB-TBM have chamber that meets requirement of Section 6095. Andy Nordquist said they do but the chamber size will depend on size of tunnel and machine and that is where Jean Claude LePechon shuttle can bring saturation workers out to a larger chamber. Ron Meyers said that the State should require a chamber be on an EPB – TBM and it should be spelled out in the construction job contract. Kevan Corson said that commercial diving operations are similar in that the type of

chamber depends on the depth. Andy Nordquist said the quality of the chamber provided also depends on which company does the work. Kevan Corson commented about chambers for saturation work vs. air locks for shallow work and decompression decisions that have to be made if employee is injured.

Tom Mitchell asked what commercial diving operations use for diving tables since no table is referenced in the standard. Kevan Corson said they use Association of Diving Contractors (ADC) tables in the US and other countries us International Marine Contractors Association (IMCA) tables. Kevan Corson said that the tables are modified to fit the situation such as the need to get employees out of cold conditions. Each company selects the tables to be used from a book of tables. Kevan Corson said that CFR provides that tables must be approved by qualified persons.

There was some discussion about the similarities and differences between compressed tunneling and compressed mining work. Ron Meyers said that in 3 months there would be a job bid for a tunnel under SF Bay for the SF Utilities commission. He repeated that the State should require that chambers be on EPB TBM. Tony Serpas said OSHA policy has been not to tell the employer what machine they have to have. There are alternatives such as grouting that avoid compressed air work. Guy Prescott and Tony Serpas explained that OSHA requirements apply to employers, not owners.

Guy Prescott suggested that the proposal specify which dive tables to use but allow alternatives upon approval by the division. Kevan Corson said that the Rev. 6 Navy manual includes tables for many different types of gasses and situations.

Andy Nordquist asked how we prevent risk of fire and oxygen toxicity. Kevan Corson said that commercial diving is governed by ASME for pressurized chambers, and NFPA book 99, Chapter 20 for safe operation of hyperbaric oxygen chambers in a medical environment. If oxygen > 23.5 % fire spreads 33% faster. The maximum allowed is 25%. Hydrocarbons are potential hazards. ADC standards may help.

Tony Serpas said oxygen fire safety addressed in Mining and Tunneling Safety Orders (MTSO) in relation to gassy and hazardous environments. Tony Serpas said the proposal should require chambers be vented directly to tunnel air ventilation inlet so any oxygen is vented outside. He said the MTSO set 22% oxygen as maximum and in gassy potentially explosive environment all electrical equipment must be Class I, Division II. Also neede is continuous monitoring for LEL/O2 and no hot work. These are addressed in MTSO but need to be added to Article 154 specifically for tunneling operations.

Kevan Corson said it is similar to dry habitat welding. Kevan Corson said 40 LPM of 100% oxygen is supplied to employees in chamber. There was general agreement that the committee will need to spend more time developing fire safety requirements regarding oxygen. Guy Prescott was concerned with mixing methane and oxygen. Tony Serpas said generally no other work being done during decompression because the head is sealed off and repressurized. Guy Prescott and Tony Serpas agreed that this might have to be included in the standard. Tony Serpas said that for the NEIS project that everone reached an agreement as to safety procedures before

work was done. Kevan Corson said that training was necessary for hyperbaric medical personnel because they were not familiar with tunnel work.

Kevan Corson noted that there are not many ICU hyperbaric chambers available in CA or the US. Most chambers are for medical treatment and not decompression emergencies. The committee should consider a requirement for an onsite chamber when no medical chamber is available within a certain distance/time/altitude. This could be an issue for the planned Hetch Hetchy job. Dr. Van Hoesen said there are 4 or 5 chambers in San Diego but only UCSD treats divers.

The discussions returned to what tables to reference or incorporate directly. Kevan Corson supported referencing Revision 6 of the Navy dive manual and thereby all of the tables because there is a lot of experience with their use and there may be a need for more than an air/oxygen table if future jobs require saturation work or mixed gas work. Andy Nordquist added that the proposal should permit the use of other tables approved by the Division since California may have a job in the future like Lake Mead No. 2 job which is anticipated to be done under saturation.

Dr. Van Hoesen asked if there was any concern about proposing the use of the new Navy tables as opposed to the Canadian or French tables or something else. Andy Nordquist said that as long as the proposal allows flexibility and the use of other tables approved by the Division there should not be a problem. But the flexibility is necessary because the Kindwall table is being used in Seattle and if Ted Bud was here he probably would want to be able to use that table in CA. Guy Prescott asked if the Division has the expertise to approve alternate tables as being at least as effective as the Navy tables. Tony Serpas said they would have to rely on the recommendations of outside experts whom the Division believes are qualified. The Division does that with other engineering and safety issues. It was generally agreed that any table may need to be modified to meet the particular workplace conditions. Tony Serpas said that is why Section 6120 requires the medical supervisor has experience in compressed air work. Kevan Corson said the Navy tables are generally relied upon when there is a medical problem. Andy Nordquist said the advantage of the NEIS job was that there was agreement between the medical chamber physician and the contractor's medical supervisor on how to modify the table to improve safety. Tom Mitchell said that Steve Hart, M&T supervisor, told him that the problem with decompression was recognized and corrected early at the NEIS job, and Hart wanted to see something in the proposal that would ensure this was always done. Kevan Corson asked what training a tunneling employee normally received, because what the employee does effects the outcome. Andy Nordquist said they had one of the physicians do the employee training and that was effective. Tony Serpas said that there is no training requirement in Article 154 but they rely on other sections (e.g. 3203). Guy Prescott said they should consider adding a training requirement in Article 154. Andy Nordquist said training should be supervised by the medical director. There was general agreement to consider adding employee training requirements.

Tom Mitchell mentioned the procedures that preface the French tables give more background information that is not in Article 154. Kevan Corson said that the Navy Manual also provides additional information. Tom Mitchell noted that the Navy table notes when depth / bottom times are: exceptional exposures, oxygen recommended, or oxygen required. Kevan Corson said

exceptional exposures require Chief of Naval Operations approval and are for life saving operations because of the risk. Tom Mitchell asked if any tunnel contractors are using the Navy table. Andy Nordquist said it depends on contractor. Kevan Corson said the Navy table is a good basis to compare other tables because of the experience gained with thousands of dives. Andy Nordquist said tunnel tables and dive tables are for two different environments and that it is important to do a better job collecting data on dry operations to advance the tables. There was some discussion of the costs and benefits of using the new Navy dive tables.

Tom Mitchell restated that there was agreement to replace the current OSHA table with a reference to the tables in Revision 6 of the Navy Dive Manual and to develop proposed oxygen fire safety provisions. He wanted to focus first on the tables since that required hyperbaric expertise and then focus on the fire safety because the Division has more expertise in that area. He asked group to work to define specific text regarding tables. There was discussion regarding the reference to the Navy manual and its tables. Andy Nordquist said there has been no mixed gas work done in U.S. but it's been done in Europe (LePechon used trimix) and it may be done for Lake Las Vegas job coming up. Dr. Flynn said the Navy Manual has procedures and tables for bounce diving and saturation-excursion diving on helium-oxygen, but nothing for saturation-excursion diving on trimix. He said that only Chapter 9 on air diving is germane to tunneling operations. The remainder or the Navy Manual does not cover the type of saturation-excursion diving with trimix found useful in Europe. He said saturation diving and trimix gas are highly specialized and specific to a particular operation. There was agreement to reference Chapter 9 tables for air operations and add text to allow the use of other tables that are recommended by the medical supervisor and approved by the Division.

Dr. Flynn asked if there was a need for bottom times > the times in the Navy tables because they don't go out 4, 6 and 8 hours like the OSHA tables. He said even the exceptional exposure tables do not cover bottom times as long as those in the OSHA tables. Andy Nordquist thought the longer bottoms times would be needed. Andy Nordquist said longer times would need to be approved by the Division. Tom Mitchell asked what the Division would rely on. Kevan Corson said exceptional exposure tables aren't published in the manual but can be obtained (i.e. calculated if required). Dr. Flynn said they had nitrox tables but not trimix tables but could make them up tailored to the situation. Kevan Corson said that even the commercial saturation dive tables don't generally cover shallow (<40 psi), so some other table may be needed. Dr Flynn said Kindwall tables cover bottom times of 8 hours at 44 psi or ~ 100 feet, but Navy tables stop at 150 min. Tony Serpas said that if the employer wanted to use Kindwall tables, the Division would rely on a second option from an expert, such as Kevan Corson. There was agreement to reference the Navy tables, and if conditions such as longer bottom times are not covered by the Navy tables, then an alternative table would need to be approved by the Division. Kevan Corson said that the proposal mirrors current commercial diving practices which rely on the Navy tables but modify or extend the tables where needed. He and Dr. Flynn agreed that the Rev 6 Navy tables are safer than the version it replaced but may be of limited value for long bottom times. Dr. Flynn noted that the model could be used to calculate longer times but it wasn't done because the Navy didn't need them.

There was discussion whether to incorporate the tables by reference or directly. Dr. Flynn strongly recommended replacing the OSHA tables with newer, safer tables such as Revision 6 or

Kindwall tables which were developed for NIOSH and were tested in a chamber. There was discussion regarding the scope of the incorporation by reference, i.e. whether to reference specific tables or all of Chapter 9. Flynn said that if you are going to use the tables the instructions in Chapter 9 are essential, especially when things don't go according to plan. Kevan Corson agreed. Tom Mitchell was concerned that parts of Chapter 9 may be too specific to diving and if employer was required to comply with all of Chapter 9 it may not be appropriate. Dr. Flynn agreed this could be a problem. Tom Mitchell said it may be possible to reference specific sections of Chapter 9 which explain the use of the tables, and avoid possible conflicts with non-diving operations. Kevan Corson said CFR 46 covers commercial diving and may have language that could be used as a model to reference dive tables. There was discussion regarding incorporation by reference vs. direct incorporation. Tony Serpas said he was concerned that if the tables were incorporated by reference, people may go out and get the wrong table. Dr. Flynn agreed that could happen because people still refer to Rev 4 dive tables. Kevan Corson also expressed concern that an employer may use an older version of the Navy table. Dr. Flynn said they are working on probabilistic dive tables that will have different times based on the level of risk that is acceptable. That will take about five years.

Kevan Corson said that he would mail CDs to committee members with relevant standards.

There was discussion on cost impact. Tom Mitchell invited anybody to provide cost information regarding the proposed revision. Kevan Corson said there would be savings from using oxygen because it would reduce decompression time. He also said there may be costs associated with safety equipment/procedures required for oxygen use. Tom Mitchell said that it may be reasonable to estimate that the costs will be offset by savings, unless information is presented otherwise. Dr. Van Hoesen said that hyperbaric treatment cost would be reduced because the revised tables are safer.

Tom Mitchell said he will develop a proposal to replace the OSHA table with the Revision 6 Navy tables and send that to the committee. He will also look at the information Kevan Corson is sending and work with the Division to develop proposed oxygen safety provisions. Tom Mitchell said another advisory meeting may be necessary on fire safety. Andy Nordquist said there is always a hazard because of the presence of hydraulic fluid, oil, and grease. There may have to be an exemption added for the prohibition on the use of solvents in tunnels so they can be used for cleaning oil and grease. Kevan Corson said the commercial diving has similar hazards and there may be provisions in the CFR we could incorporate. He also confirmed that there are requirements for chambers regarding purging oxygen. He said he would include pertinent standards in the information he will send out. Dr. Flynn said there is also a fire hazard in the compressed oxygen system which must be specifically designed and maintained for oxygen.

Dr. Van Hoesen noted that Article 154 prohibits work >50 psi. Andy Nordquist responded that they have not compressed to more than 50 psi in CA and that they aren't allowed to, but he can see that there will be a need in the future because there are projects proposed for that pressure. Tony Serpas said Article 154 applies to all compressed air work not just tunneling. It is difficult to comply with the size requirements for a chamber in a 14 foot tunnel when the chamber has to be 3 feet above tunnel bottom. He said we need to separate the things we have been talking about and put them in a separate section that applies to tunnels. He thinks it could be addressed in a

separate rulemaking but it will be necessary for smaller tunnels to meet size restrictions. Other than fire safety, the group did not identify any critical issues that must be addressed before oxygen is required.

Dr. Van Hoesen recommended removing subsection (a)(3) of Section 6120, Medical Control, which requires “An oxygen tolerance test shall be passed by all persons engaged in compressed air work.” She said the test is not reliable and is no longer used. She said the Navy used to do the test which put the diver on oxygen at 60 feet to be sure they don’t cease, but the results are unreliable and the test is no longer used by the Navy or commercial diving. Dr. Flynn agreed and confirmed it was removed from the Navy manual.

Dr. Van Hoesen said the Kindwall and OSHA tables go to 50psi, but the new Navy tables go much deeper. Dr. Flynn said they were not recommending the tables be used deeper than 190 feet. Dr. Van Hoesen said 190 feet is about 84.5 psi. Kevan Corson said that you would not work at 190 feet on air because of nitrogen narcosis. Dr. Flynn said that is why they limit it to 190 feet. There was a discussion of allowable pO2 levels. Dr. Flynn said in the wet, it would be about 1.3, but in the dry, about 2.4 atm. He said that mixed gas presents its own problems and it maybe that a short bottom time at 190 feet on air would be OK. There was a discussion of Equivalent Air Depth (EAD) which shortens decompression times. It was agreed to amend Section 6080(b) to allow work >50 psi if approved by the Division, and to limit the tables to 50psi, even though it is anticipated that there will be a need in the future to go deeper than 50psi. Andy Nordquist said we should also limit use of Navy table to <190 feet.

There was discussion whether the pressure units used in the table and the rest of the standard should be in feet of sea water (FSW) rather than psi. Andy Nordquist said their gauges were in bar. Kevan Corson said gauges are generally in psi and bar. There was discussion about converting the table to FSW or bar. Ron Meyers felt that the table should retain psi. Nordquest said it should be kept simple for everybody involved. Kevan Corson offered to calculate the equivalent psig for each FSW listed in the table and there was agreement to include that number in the Navy tables after FSW. Dr. Flynn said the conversion factor should be carried out one decimal place beyond 0.445 then rounded to two decimal places since some psi gauges have readouts that accurate.

Tom Mitchell said that it will take a couple of weeks to get the minutes out summarizing what was agreed upon. Then he will start work on a proposed fire safety provisions which will need to be vetted by the committee. The meeting adjourned.