

## Public Comments and Responses for Operator Training Module after First 60-day Review Period: Code and Annex Sections (6.1)

### 1. Cindy Burdett, Waterbury, VT

#### *Comment:*

I am an Aquatic Engineer in Vermont. Here in Vermont we have no swimming pool codes. Commercial pools are not required to have a certified operator over- seeing the aquatic environment. I very much agree with the operator training requirements that have been written and encourage a speedy implementation of them

#### *Changes to module/annex:*

No changes needed. Thank you for your support of the MAHC.

### 2. Suzie Campbell, OK City County Health Department, Oklahoma City, OK

#### Comment

**6.0 Policies and Management.** Where do we require the facility to have an operator? Each facility shall be under the supervision of a properly trained operator responsible for....

#### *Changes to module/annex:*

Section 6.1 has added wording to require A QUALIFIED OPERATOR for each AQUATIC VENUE. This requirement may ultimately be in another section (e.g. risk management) as all modules are posted.

#### Comment

**6.1.2.1.1** Shall all courses teach “the requirements of MAHC” i.,e., water disinfection- Cl<sub>2</sub> 1-5 ppm?

#### *Changes to module/annex:*

While it is hoped that “the requirements of the MAHC” will be incorporated into all operator training courses, training in a particular locale must be based on the regulations that have been adopted by the local jurisdiction. The MAHC is intended to serve as a model ordinance for those local jurisdictions to use in revising or preparing their local aquatic venue ordinances. Course instructors will need to remind trainees to check the local codes in place.

#### Comment

**6.1.2.1.1.3 Bromine** – (5) on site generation; (6) pH meter required - phenol red plus bromine gives false reading (7) bromine reused.

#### *Changes to module/annex:*

Agreed. Section 6.1.2.1.1.3 has been changed to read, “Bromine including:

- 1) Definition of bromine as an element,

- 2) Its use as a residual disinfectant and oxidizer in water,
- 3) Bromine chemistry, and
- 4) The DISINFECTION role of hypobromous acid,
- 5) On site generation,
- 6) pH meter requirements to prevent false readings, and
- 7) Bromine reuse

Comment

#### **6.1.2.1.1.4. Chlorine** - Define Oxidizer

*Changes to module/annex:*

OXIDIZER will be defined in the definitions section. All words in BLOCK capitals will be defined in the Glossary. At this time the Glossary is changing so often that it has not yet been posted.

Comment

**6.1.2.1.1.6 Breakpoint Chlorination** Effect of AQ indoors; need for air across water, especially indoors.

*Changes to module/annex:*

6.1.2.1.1.8 Added BREAKPOINT CHLORINATION including how to achieve it through calculation of chemical dosing to reach the desired free CHLORINE level and its relationship to reducing and controlling formation of combined chlorine including guidance for how to perform BREAKPOINT CHLORINATION in indoor aquatic settings.

6.1.2.1.1.8 This issue is also covered but added some wording to code and Annex language

Code: 5) Possible health effects of combined CHLORINE products in the air, particularly in indoor aquatic facilities. Annex: A discussion of deterioration of buildings, machinery, and structures due to the effects of airborne chloramines in indoor aquatic facilities is appropriate.

Comment

**6.1.2.1.1.10 Supplemental Disinfection** -There are no other approved “disinfectant chemical or systems” for PBP

*Changes to module/annex:*

None. It is important for operators to know which disinfection chemical or systems are available and approved, as well as those that are not. Many other disinfection chemicals or systems with varying effectiveness and suitability are being offered on the market for aquatic facility operators for water treatment so mentioning one would necessitate creating an exhaustive listing.

Comment

**6.1.2.1.2.4 Turbidity** - Include info on turbidity meter, DANGER OF DROWNING

*Changes to module/annex:*

This section was retitled as “Water Clarity” during the editing process. Turbidity meters will be discussed in the Monitoring and Testing Module of the MAHC.

Comment

**6.1.2.1.1.5. Cyanuric Acid** - Add info that it extends kill time (4-5X); Outdoor use only

*Changes to module/annex:*

This section will be revised to read “Cyanuric acid (CYA) including reasons for and *against* use and recommended concentrations”.

**6.1.2.1.2.5. pH.** - Make pH part of disinfection

*Changes to module/annex:*

None. While the effectiveness of disinfection is impacted by the pH of water, we believe that pH is more appropriately considered under the topic of water chemistry.

Comment

**6.1.2.1.2.6 &.7 TA/CA Relationships.** Does high pH cause turbidity?

*Changes to module/annex:*

None. While pH may affect turbidity, it is not necessarily a “cause of turbidity”.

Comment

**6.1.2.1.2.8 Water Temperature** - Add the effects on air quality indoors and also effects of hot water.

*Changes to module/annex:*

None. This section already includes water temperature health effects and operational considerations. The ventilation Module of the MAHC also addresses indoor air quality issues in greater detail.

Comment

**6.1.2.1.2.8 Water Temperature** – Indoors Range above and below air temp DBPs.

*Changes to module/annex:*

None. This is included under health effects (6.1.2.1.2.8).

Comment

**6.1.2.1.2.9 Total Dissolved Solids** - Bleach ↑

*Changes to module/annex:*

None. Please clarify the meaning of the comment.

Comment

**6.1.2.1.2.10 Water Treatment Systems** - Change to read” water quality systems”

*Changes to module/annex:*

None. This section is discussing the water treatment aspects. We believe that the term, “water treatment” is more descriptive.

Comment

**6.1.2.1.2.10 Water Treatment Systems** - Chlorine and Bromine generation.

*Changes to module/annex:* Chlorine generation is already included under this section. Section 6.1.2.1.2.10(3) has been changed to read “chlorine, ozone, and bromine generators.

Comment

**6.1.2.1.2.11 Water Testing** - Add Cu, Fe, six of H<sub>2</sub>O, Bac’t.

*Changes to module/annex:*

Section 6.1.2.1.2.11(1) has been changed to read, ”How different methods (including but not limited to colorimetric, titrimetric, turbidimetric and electronic) test water to determine free available and total CHLORINE, free available and total bromine, PH, total alkalinity, calcium hardness, temperature, TDS, CYA, metals, and any other tests (including but not limited to salt concentrations, phosphates, nitrates, potassium monopersulfate, Cu, Fe, and bacterial),

Comment

**6.1.2.1.3. Mechanical Systems** - Add acquisition and maintenance of mfg dir –heaters, ventilation

*Changes to module/annex:*

Added section 11) Maintenance.

Comment

**6.1.2.1.3.1 Calculations** - Add sizing feeders

*Changes to module/annex:*

Section 6.1.2.1.3.1 (5) has been changed to read, “Why proper sizing of filters, pumps, pipes, and feeders is important”.

Comment

**6.1.2.1.3.2 Circulation** - Add vacuum port

*Changes to module/annex:*

- 1) Section 6.1.2.1.3.2 (5) has been changed to read. “How the following components of the circulation system relate to each other: main drains, gutters

and surface skimmers, circulation pump and motor, vacuum ports, valves, and return inlets”.

Comment

**6.1.2.1.3.3 Main Drains - Entrapment, VGB**

*Changes to module/annex:*

Section 6.1.2.1.3.3 (4) includes entrapment and Section 6.1.2.1.4.7. has been added 3) Requirements of the Virginia Graeme Baker Pool and Spa Safety Act,”.

Comment

**6.1.2.1.3.5 Mechanical System Balance - Add surge systems to list**

*Changes to module/annex:*

Surge systems is not a common term. Have inserted as item (9) Collector tanks/gravity drainage systems.

Comment

**6.1.2.1.3.6 Circulation Pump and Motor - Add cross connections**

*Changes to module/annex:*

Cross connections should be addressed in Section 6.1.2.1.3.2, not 6.1.2.1.3.6. That section will have an item (13) added that will read, “ cross connections”.

Comment

**6.1.2.1.3.9 Filtration - Add zeolite, perlite**

*Changes to module/annex:*

This material is covered in section 6.1.2.1.3.9. Will add 5) A general description of sand, cartridge, and diatomaceous earth filters and alternative filter media types to include, at a minimum, perlite, zeolite, and crushed glass.

Comment

**6.1.2.1.3.9 Filtration - Add flow meters to the list**

*Changes to module/annex:*

Flow meters are already addressed under section 6.1.2.1.3.2 (6).

Comment

**6.1.2.1.4.3 RWI Prevention - Address reusable swim diapers**

*Changes to module/annex:*

None. This is covered in 6.1.2.1.4.3.

Comments

**6.1.2.1.4.15 Emergency Response Plans - Drills?**

*Changes to module/annex:*

None. Drills would be included as a part of staff training. Records of staff training are required in section 6.1.2.1.4.5 (4).

Comment

**6.1.2.1.5.1 Regulations** - Do we need to include info on personal protection, heatstroke, etc.?

*Changes to module/annex*

None. This section pertains to regulations and standards relating to operation of aquatic facilities. Personal protection is discussed elsewhere in the MAHC and under 6.1.2.1.4.6. (3).

Comment

**6.1.3.9 Suspension and Revocation** - Add Certificate revoked if evidence of cheating or obtained under false pretenses.

*Changes to module/annex:*

Section 6.1.3.9 will have add item (3) to read, "Course providers may suspend or revoke an operator's certificate based on evidence of cheating or obtaining the certificate under false pretenses".

### **3. John Comereski, General Manager, Island Health and Fitness, Ithaca, NY**

*Comment:*

The manual looks well prepared. Did I miss any area regarding pool supervision? I really think this needs to be changed in pools less than 5 feet deep.

*Changes to module/annex:*

Section 6.1.2.1.4 will add item (15) entitled "Surveillance and Supervision".. The MAHC will address pool supervision more deeply in the Lifeguarding and Risk Management sections. Thank you for your support of the MAHC.

### **4. Gerald Dworkin, Aquatic Safety and Water Rescue, Harrisville, NH.**

*Comment:*

**6.1.2.1.4 Health and Safety** - An additional item (#15) should be included titled, Surveillance and Supervision.

*Changes to module/annex:*

Section 6.1.2.1.4 will add item (15) entitled "Surveillance and Supervision".

*Comment:*

**6.1.2.1.4.4 Risk Management** - This should read, "risk management including techniques that identify hazards and risks and that prevent illness and injuries

associated with aquatic facilities open to the public."

*Changes to module/annex:*

Wording will be modified to read: "Risk management including techniques that identify hazards and risks and that prevent illness and injuries associated with AQUATIC FACILITIES open to the public."

*Comment:*

**6.1.2.1.4.9 Rescue Equipment** - An additional item (#8) should be included titled, Resuscitation Equipment. This would include positive pressure ventilation equipment (i.e. Personal resuscitation masks and bag-valve-mask resuscitators), oxygen administration equipment (i.e. Oxygen tank, regulator, and non-rebreathing masks); airway management equipment (i.e. Manual hand-held suction devices, and oropharyngeal airways), and AEDs (automated external defibrillators)

*Changes to module/annex:*

Item (8) "Resuscitation Equipment" will be added.

*Comment:*

**6.1.2.1.4.15 Emergency Response Plan** - Included within (1) steps to respond to emergencies should include management of suspected spinal injuries. And, (2) should read "communication and coordination with emergency responders...."

*Changes to module/annex:*

6.1.2.1.4.15 (2) will be modified to read "communication and coordination"

## **5. Richard Falk, Pool Owner, San Rafael, CA**

*Comment:*

**6.1.2.1.1.1 Disinfectants:** Between #2 and #3 should be an item for "**Side Effects of Disinfectant Addition**" which will describe what is additionally added in terms of increasing Calcium Hardness (CH), Cyanuric Acid (CYA), Salt (including net salt from chlorine consumption/usage) and affect on pH (including the acidity from chlorine consumption/usage). Perhaps this will be covered in #3 "How they disinfect and impact water chemistry and monitoring systems".

*Changes to module/annex:* None

This comment is not recommended code language. The Operator Training Module outlines a set of recommended training "subject areas" needed for the safe operation of aquatic venues. It is not intended to delineate specific course content nor specify how course designers and instructors cover the required "subject areas". This comment is more appropriate for pool operator course designers.

*Comment:*

**6.1.2.1.1.2 CT Values:** In the actual course content itself, I hope that the training on the CT calculation emphasizes that the “C” chlorine concentration is the hypochlorous acid concentration or an adjusted FC value accounting for CYA (i.e. the FC equivalent that gives the same hypochlorous acid concentration if no CYA were present). It seems to me that most CT values are based on FC with no CYA at a given pH and aren’t actually calculated using hypochlorous acid concentration itself even though that would be more relevant and would give a CT value that would be relatively independent of pH and CYA if one used calculated hypochlorous acid concentration for “C”. A reasonable approximation for the equivalent FC with no CYA is to use the FC/CYA ratio

*Changes to module/annex:* None

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*Comment:*

**6.1.2.1.1.5 Cyanuric Acid:** Cyanuric acid (CYA) including reasons for use, **effects on disinfection and oxidation**, and recommended concentrations.

Somewhere, probably in this training section, there should be a description of the effect of Cyanuric Acid on the hypochlorous acid concentration. CYA is a hypochlorous acid buffer. Most of the chlorine is bound to CYA and is, for practical purposes, not an effective sanitizer nor oxidizer (somewhat similar to how you describe hypochlorite ion, at least for disinfection). CYA is not just for protection of chlorine from breakdown from UV in sunlight, but significantly lowers the hypochlorous acid concentration. This is not a bad thing since it takes a very low level of hypochlorous acid to kill most pathogens (except protozoan oocysts). Also, higher levels of hypochlorous acid increase oxidation rates that increase the rate of any chemical reaction in which hypochlorous acid participates including oxidation of swimsuits, skin and hair (and production of disinfection by-products in the short-run – supplemental oxidation should be used to prevent a build-up or organic precursors).

*Changes to module/annex:* None.

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*Comment:*

**6.1.2.1.1.6 Breakpoint/Superchlorination** - I certainly hope you aren’t still going to teach the incorrect “10x” rule since that only applies to chlorine oxidation of ammonia



each in their respective differing units – chlorine measured in ppm  $\text{Cl}_2$  and ammonia measured in ppm N with the unit ratio being a factor of 5.06. The stoichiometric ratio of chlorine to ammonia is 1.5 in molar units so  $5.06 \times 1.5 = 7.6$  and with getting over the “hump” of reaction steps one has  $5.06 \times 2 = 10.1$  which is where the 8-10x rule came from that was then simplified to 10x. However, in pools one is NOT measuring ammonia, but rather Combined Chlorine (CC) which is NOT in ammonia ppm N units. It is instead in chlorine ppm  $\text{Cl}_2$  units so there is no factor of 5.06. Also, CC already has one of the 1.5 total chlorine already combined, if the CC is monochloramine, so that only 0.5-1.0x is required to complete the reaction. Even for urea, a reasonable analysis still only gives 3x. Higher hypochlorous acid levels will make chlorine reactions go faster, but there is no 10x for ensuring completion (i.e. it requires far less). **The 10x rule is for chlorine oxidation of ammonia and has been misapplied in the pool/spa industry to chlorine oxidation of Combined Chlorine (CC).**

*Changes to module/annex:* None.

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*Comment:*

**6.1.2.1.1.7 Hyperchlorination** - These procedures should also describe what to do when CYA is in the water. Roughly speaking, to achieve the equivalent of 10 ppm FC with no CYA, one needs to raise the FC to be around 10 ppm higher than the CYA level. Because hypochlorite sources of chlorine will raise the pH upon addition (and the pH will mostly drop back down when the chlorine is consumed/used), one should lower the pH first to 7.0. As an example, if one has 4 ppm FC with 20 ppm CYA which is a reasonable amount since that is roughly equivalent to 0.2 ppm FC with no CYA which is sufficient for killing most pathogens and preventing algae growth (it’s around 3 times the level needed to prevent algae growth in residential pools, but is higher for faster kill times in commercial/public pools), then adding a hypochlorite source of chlorine to raise the FC to 30 ppm would have the pH rise to about 7.5 and the hypochlorous acid concentration would be the same as a pool with 11.1 ppm FC and no CYA.

*Changes to module/annex:*

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*Comment:*

**6.1.2.1.1.8 Combined Chlorine-** Item #3 should talk about all supplemental oxidation alternatives including UV, ozone AND non-chlorine shock and enzymes. The main

advantages to UV and ozone are that they will also potentially handle the killing of protozoan oocysts including *Cryptosporidium parvum*. In addition, there should be some mention of using a lower hypochlorous acid concentration to reduce the rate of production of disinfection by-products (including the amount of nitrogen trichloride). Even indoor pools should use some CYA such as 4 ppm FC with 20 ppm CYA for the equivalent of 0.2 ppm FC and no CYA. However, with the lack of sunlight and therefore UV in indoor pools, this lower active chlorine concentration requires supplemental oxidation to prevent the buildup of organic precursors (as well as monochloramine and dichloramine). This is also true for outdoor high-bather load pools, though is not a problem for outdoor low-bather load pools such as most residential pools.

Virtually every study on disinfection by-products demonstrates that the steady-state rate of production of disinfection by-products is a function of bather load (more specifically, the rate of introduction of organic and ammonia precursors). So clearly in higher bather load situations or in indoor pools where there is no UV from sunlight to assist in faster oxidation (perhaps from the free radicals formed from chlorine breakdown), one needs supplemental oxidation. However, to reduce the rate of production of disinfection by-products, one should use lower active chlorine (hypochlorous acid) concentrations and CYA is one way to do that since it is a hypochlorous acid buffer since it would be difficult to maintain 0.2 ppm FC throughout a pool without using CYA (where 4 ppm FC with 20 ppm CYA is equivalent to 0.2 ppm FC with no CYA). The downside is that slowing down oxidation means there can be a build-up of precursor and intermediate chemicals, but with supplemental oxidation also being used this is a great combination to prevent such build-up. So the lower active chlorine levels slow down the short-term production of DBPs while the supplemental oxidation gets rid of precursor and intermediate products.

*Changes to module/annex:* None.

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*Comment:*

**6.1.2.1.2 Water Chemistry** - “Cyanuric Acid” should be added to the list of course work required. This is needed to be able to accurately calculate the saturation index because it is carbonate alkalinity that is required for that index so Total Alkalinity (TA) needs to be adjusted for the CYA level. Also, CYA significantly reduces the hypochlorous acid concentration so is an extremely important parameter to measure.

Calcium carbonate saturation is dependent on the calcium concentration and the carbonate concentration. Calcium is directly measured in the Calcium Hardness (CH) test, but carbonate is calculated from the carbonate alkalinity and the pH. The carbonate alkalinity has to be calculated from the Total Alkalinity (TA) by subtracting all other alkalinity factors such as the contribution from Cyanuric Acid (CYA) and from borates (if present).

*Changes to module/annex:* None. This section is a description of general course work for water chemistry. It is not a specific listing of chemicals that will be encountered. Cyanuric Acid is addressed in Section 6.1.2.1.1.

*Comment:*

**6.1.2.1.2.2 Water Balance** - One should include the effect of CYA on the pH dependence on hypochlorous acid concentration. Because CYA is a hypochlorous acid buffer, it significantly reduces the variation of hypochlorous acid concentration vs. pH.

*Changes to module/annex:* None

None.

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*Comment:*

**6.1.2.1.2.5 pH** - My comments above on how CYA affects the pH dependence on hypochlorous acid concentration applies to this section as well.

*Changes to module/annex:* None.

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*Comment*

**6.1.2.1.2.6 Total Alkalinity** - The “Effects of low and high total alkalinity” should explain how TA is a SOURCE of rising pH due to carbon dioxide out-gassing. Pools/spas are intentionally over-carbonated to provide a pH buffer and to protect plaster surfaces. There is more carbon dioxide in the water than the equilibrium amount from exposure to air so carbon dioxide outgases from the water. This causes the pH to rise with no change in TA (essentially, carbonic acid is removed from the water). Higher TA levels have faster carbon dioxide outgassing so faster rate of pH rise in spite of the higher pH buffering (the rate of outgassing seems to be proportional to the square of the TA, according to some studies by Wojtowicz).

The procedure for how to lower the TA should be explained which involves lowering the pH by adding acid, aerating the water, and adding acid whenever the pH rises from the aeration. When the TA target is reached, aerate to raise the pH. This is the fastest way to reduce the TA and is far safer than any slug or acid column method which is no more effective. 25-1/2 fluid ounces of Muriatic Acid (31.45% Hydrochloric Acid) lowers the TA by 10 ppm in 10,000 gallons no matter how you add the acid to the pool, but it also

lowers the pH. It is aeration of the water (turning jets upward, using waterfalls, spillovers, fountains, splashing) that forces the carbon dioxide out of the pool more quickly.

*Changes to module/annex:* None.

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*Comment*

**6.1.2.1.2.11 Water Testing** - I hope that one explains that the Free Chlorine (FC) test does not measure only the active chlorine (hypochlorous acid) concentration, but also hypochlorite ion and all chlorine bound to CYA (i.e. the chlorinated isocyanurates) so that FC alone says NOTHING about disinfection and oxidation rates. One must also know the CYA level and preferably the pH as well (temperature, to a lesser extent).

*Changes to module/annex:* None.

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## **6. Sabraya Ghale, Corporate Safety Director, American Pool Enterprises, Inc.,**

*Comment:*

Will all lifeguards have to take the Operator training, no matter what state it is?

*Changes to module/annex:*

The MAHC is intended to be a national model code that can be adopted by any state or local jurisdiction. While we hope that operator training will become a requirement in all codes, the MAHC is not a mandatory code and it is up to each jurisdiction to adopt their own code requirements. However, this will also depend on the duties of the Lifeguard, which requires specific training already. If the Lifeguard is also functioning as a Pool Operator then they will be required to also be trained as a pool operator.

## **7. Louis Fruia, Association of Pool and Spa Professionals, Shenandoah, TX**

*Comment*

**6.1.2.1 Operator Training Course Content** - Describe the relationship between air and water quality on air quality to reduce Disinfectant By Products (DBP)s

What is relative humidity (RH)

How are DBPs formed?

Why is RH important to controlling DBP-based RWIs

*Changes to module/annex:*

None. These items are already be covered under section 6.1.2.1.5.9 Air Circulation. Also the Ventilation and Air Quality Module will provide extensive coverage of these relationships.

*Comment*

**6.1.2.1.1.8 Combined Chlorine** - How combined CHLORINE and (DBPs) are formed and their impact / relationship to the air and water quality.

How organic and inorganic chloramines affect / impact maximum acceptable levels of combined CHLORINE,

How methods such as: water replacement, improved bather hygiene, BREAKPOINT CHLORINATION, ultraviolet light, ozone, supplemental oxidizers can be used with ample ventilation to reduce combined CHLORINE levels improving both air and water quality.

*Changes to module/annex:*

None. These training elements are already covered in 6.1.2.1.1.8

*Comment*

**6.1.2.1.1.9 Secondary Disinfection** - Where is an understanding of oxidation and it's role in controlling RWIs and DBPs? Do not limit operators all options Disinfection is only 1/4 of the solution!. a. Disinfection , b. Oxidation, c. Water Replacement, d. Ventilation

*Changes to module/annex:*

This is covered in 6.1.2.1.1.8 (3) but have added

How methods such as water replacement, BREAKPOINT CHLORINATION, ultraviolet light, ozone, ventilation, and use of other oxidizers can reduce combined CHLORINE level,

*Comment*

**6.1.2.1.2.6 Total Alkalinity** -

How total alkalinity relates to PH,

Describe the effects of low and high total alkalinity,

Describe factors that affect total alkalinity,

How TA /pH impact Ideal total alkalinity range,

How to increase or decrease total alkalinity

What is the difference between total alkalinity and carbonate alkalinity?

What is the effect of cyanuric acid on total alkalinity reading?

*Changes to module/annex:*

None. Not sure of the intent of these comments. They are not recommended code language. These topics are already included under this section. The Operator Training

Module outlines a set of recommended training “subject areas” needed for the safe operation of aquatic venues. It is not intended to delineate specific course content nor specify how course designers and instructors cover the required “subject areas”. This comment is more appropriate for pool operator course designers.

Comment

#### **6.1.2.1.2.9 Total Dissolved Solids**

Why concentrations of TDS increases over time,  
What is the association between conductivity and organic Contaminants  
What is the relationship between TDS levels and galvanic corrosion?  
Describe typical TDS values for chlorine generators and  
What TDS factors to use in LSI calculations for high TDS pools  
Understand the use of bi-Polymers products to supplement or act as flocculants to improve filtration and improve water clarity  
Improve filtration  
Improve water clarity  
Reduce chloramines and DBP contaminants in the water

*Changes to module/annex:*

None. These topics are already included under this section. The Operator Training Module outlines a set of recommended training “subject areas” needed for the safe operation of aquatic venues. It is not intended to delineate specific course content nor specify how course designers and instructors cover the required “subject areas”. This comment is more appropriate for pool operator course designers.

Comment

#### **6.1.2.1.4.2 Causes of RWIs**

Common infectious and chemical causes of RWIs, including but not limited to:  
**Enteric Illness** / Diarrheal distress (CRYPTOSPORIDIUM, Giardia, Shigella, and NOROVIRUS)  
Respiratory (DBPs) Illness / Distress (ingestion, inhalation, dermal)

*Changes to module/annex:*

6.1.2.1.4.2. Deleted reference to combined chlorines in other numbers and added section to read 7) Health effects of chloramines and disinfection by-products.

Comment

#### **6.1.2.1.4.3 RWI Prevention**

Methods of prevention of RWIs, including but not limited to chemical level controls;  
Why public health, operators, and patrons need to be educated about RWIs and collaborate on RWI prevention  
The role of showering,  
The efficacy of swim diapers

Formed-stool and diarrheal FECAL, vomit and blood incident response

*Changes to module/annex:*

None. These topics are already included under this section and other modules of the MAHC.

#### **Comment 6.1.3.5.2 Final Exam Administration**

Checking student's government-issued photo identification, to ensure that the individual taking the exam is the same person who is given a certificate documenting course completion and passing of exam

*Changes to module/annex:*

None. This wording is already contained in this section.

### **8. Manuel Gonzalez, San Diego County Aquatic Council, Chula Vista, CA**

Comment

**6.1.1.1 Qualifications** - We would like to express concern about the lack of definition of a pool operator. Whereas the sections that were provided thoroughly delineate the training requirements of an operator, our position on the appropriateness of the training requirements hinges on this definition.

*Changes to module/annex:*

Added. Qualified Pool Operator is currently defined as a person who meets the requirements specified in MAHC 6.1.1. This is now added to the Operator Training Module.

Comment

**6.1.1.1 Qualifications** - We are concerned that facilities might be required to have multiple operators, or that every facility be required to have an operator during operational hours.

*Changes to module/annex:*

The Operator training Module file now includes at the top proposed language from the Regulatory Program Administration Module. This should allow reviewers to understand the requirements for QUALIFIED OPERATORS as well as when and where QUALIFIED OPERATORS would be required. The proper placement for this section is under MAHC 6.3.1: Operator Staff Requirements and Availability.

Comment

**6.1.3.3 Recognized Courses** - The cost of the certification courses that currently meet the proposed training requirements for an operator would be prohibitive to some organizations, especially if this recurring cost had to be applied to multiple individuals. This dilemma would be somewhat alleviated if one operator could serve as the designated operator for multiple facilities. Agencies that have significant turnover rates

would be adversely affected by any training requirements that define the need for an operator at every facility.

*Changes to module/annex:*

The Operator training Module file now includes at the top proposed language from the Regulatory Program Administration Module. This should allow reviewers to understand the requirements for QUALIFIED OPERATORS as well as when and where QUALIFIED OPERATORS would be required. The proper placement for this section is under MAHC 6.3.1: Operator Staff Requirements and Availability.

Comment

**6.1.3.7 Continuing Education** - We support the need to have trained individuals at every facility; however, given the variation in operating models among public facilities, some agencies require more or less proficiency and knowledge from the individuals that are physically stationed at a facility. Should a requirement for continuing education be included beyond re-certification, we believe that most agencies will be unable to fiscally support this.

*Changes to module/annex:*

It is the responsibility of the authority having jurisdiction to determine training requirements acceptable to that jurisdiction. At this time the MAHC is not advocating for continuing education. The Annex discussion does bring up that there is a need for long term professionalization of pool operators and that continuing education will likely be a part of that upgrade in the future as with other certificate programs.

Comment

**6.1.3.5.1 Final Exam** - The annex section suggests the possibility of including a practical examination as part of the final exam. We are concerned about this since it could reduce the number of individuals that are able to achieve certification, and some agencies do not require that all the operators actively manage the water chemistry of the pool (i.e. service contracts). Additionally, variations in the equipment and design at facilities that host certification classes would compromise the equity of the testing process since individuals would be tested on different equipment.

*Changes to module/annex:*

None. While we believe there should be some assessment of skills for operators, the MAHC has only recommended a final exam be given. It is the responsibility of the authority having jurisdiction to determine what training and examination requirements are adopted for that jurisdiction. The Annex is intended to be a discussion area explaining the rationale for the requirement but also pointing out what the Technical Committee members saw regarding future directions

**9. Zach Hansen, Biolab, Inc., Lawrenceville, GA**

Comment



**6.1.2.1.1 Water Disinfection** - Bromine Chemistry and the role of pH. Total Available Bromine and bromine sanitizer activity

*Changes to module/annex:*

None. Course work already includes bromine.

Comment

**6.1.2.1.4.6 Chemical Safety** - How to understand NFPA 400 Oxidizer Hazard Classifications and the respective NFPA storage recommendations for each classification

*Changes to module/annex:*

Annex material will be added to mention reading labels and material safety data sheets, including but not limited to, NFPA 400 Oxidizer Hazard Classifications and storage recommendations”.

Comment

**6.1.2.1.2.11 Water Testing** - Test water to determine free available and total Chlorine, total bromine.

*Changes to module/annex:*

Section 6.1.2.1.2.11(1) will delete “free available bromine”.

## **10. Stephen Hughes, Alexandria Health Department, Alexandria, VA**

Comment

**6.1.1.1 Qualified Operator** - ~~A QUALIFIED OPERATOR~~ The PERSON-IN-CHARGE shall have successfully completed a QUALIFIED OPERATOR examination that is recognized by the REGULATORY AUTHORITY. The QUALIFIED OPERATOR examination shall cover all aspects of aquatic facility operation indicated in 6.1.2. Originals ~~or copies~~ of such certificate or documentation shall be available on site for inspection by the ~~HEALTH AUTHORITY~~ REGULATORY AUTHORITY for the PERSON-IN-CHARGE ~~each QUALIFIED OPERATOR employed at or contracted by~~ at the site, as specified in this code.

*Changes to module/annex:*

None. Under the MAHC recommended code, a “Person-in-Charge” can either be a Qualified Operator, or else can have an staff person on-site who is certified as a Qualified Operator. In any event, to be a Qualified Operator, that individual must complete an operator training course recognized by the authority having jurisdiction.

Comment

**6.1.1.3 Certificate Available** - Originals ~~or copies~~ of such certificate or documentation shall be available on site for inspection by the ~~HEALTH AUTHORITY~~ REGULATORY AUTHORITY for the PERSON-IN-CHARGE ~~each QUALIFIED OPERATOR employed at or contracted by~~ at the site, as specified in this code.

*Changes to module/annex:*

None. While it is desirable for originals to be available, the MAHC decided to allow copies since a Qualified Operator may work in more than one location, depending on schedules. Section 6.1.1.3 will be modified to additionally state that “originals shall be made available upon request by the health authority.

**6.1.2.1.5 Heating** - ~~4) Sizing gas heaters, and 5) How to troubleshoot problems with heaters.~~

*Changes to module/annex:*

Section 6.1.2.1.5 (4) will be moved to the Design Module since sizing is more appropriately a design issue. However, an understanding of troubleshooting problems is reasonable course content and will remain.

Comment

**6.1.2.1.5.9 Air Circulation** ~~1) Issues to take into account when designing an air handling system for an indoor AQUATIC FACILITY, 2) The importance of regulating humidity, 3) The need to maintain negative pressure,~~

*Changes to module/annex:*

Section 6.1.2.1.5.9 (1) will be modified to read, “Air handling system considerations for an indoor Aquatic Facility”.

Comment

**6.1.3.4 Instructor Requirements**

~~3) Successful completion of an operator training instructor course, and 4) If the operator training course is online, procedures which make such an instructor available to answer students’ questions during normal business hours.~~

*Changes to module/annex:*

None. The MAHC Operator Training Technical Committee believes that all Qualified Operator Training course providers must have completed an operator instruction course and successfully passed an examination to adequately protect public health and safety.

**Comment**

**6.1.3.** - ~~If the operator training course is online, procedures which make such an instructor available to answer students’ questions during normal business hours.~~

*Changes to module/annex:*

None. If a course is offered online, it is reasonable for the students to have online assistance access. It is up to the authority having jurisdiction to determine whether or not to permit online training.

Comment

#### **6.1.3.5.2 Final Exam Administration**

~~QUALIFIED OPERATOR training course providers shall provide final exam administration, proctoring and security procedures including:~~ QUALIFIED OPERATOR training course providers shall not provide final exam administration. Final exam administration shall be provided by a third-party that has not provided the QUALIFIED OPERATOR training course.

*Changes to module/annex:*

None. While the authority having jurisdiction ultimately determines regulations pertaining to operator training, it is appropriate for operator training instructors to provide and proctor final exams with appropriate security procedures in place.

### **11. Wally James, WWI**

Comment

**6.1.1 Operator Qualifications and Certification** - Need to define 'operator' role and responsibilities/authority in context of this code.

*Changes to module/annex:*

Added. Qualified Pool Operator is currently defined as a person who meets the requirements specified in MAHC 6.1.1. This is now added to the Operator Training Module.

Comment

**6.1.1 Operator Qualifications and Certification** - Need to stipulate acceptable training courses/programs

*Changes to module/annex:* None. The Operator Training Module is a set of recommended requirements for the safe operation of aquatic venues that can be used as guidance by the authority having jurisdiction in adopting their own regulations. The MAHC sets forth elements and requirements that should be included in training courses. It is not within the scope of the MAHC to maintain a list of acceptable training programs. It is the responsibility of the local authority to determine whether a particular trainer or training company meets the criteria based on the Operator Training Module outline.

Comment

**6.1.1.1 Qualifications** - Completion of training without stipulation as to testing of skills or certification level does not establish a minimum criteria for qualification in any given area

*Changes to module/annex:*

None. Section 6.1.3.5 requires a final examination that is intended to assess the knowledge and skills of the pool operator. There is also a discussion in the annex that provides further guidance concerning exams. While the technical committee discussed skill testing it is not included at this time. In the future it would be ideal if course final exams included more than just knowledge testing and also had skills testing. This

should include an on-site evaluation of skills such as proper calculations of gallonage and chemicals needed to be added to the AQUATIC FACILITY, how to operate the filtration/recirculation system, including backwashing the filters, and water testing (chemical and physical parameters). The Technical Committee did not feel that this was feasible at this time

Comment

**6.1.1.2 Training Documentation** - Should stipulate that ‘successful completion’ is documented

*Changes to module/annex:*

None. Section 6.1.3.6 provides for course certification and states that the certificate is the proof of successful completion. There is also further guidance in the Annex on course certification.

Comment

**6.1.2.1 Operator Training Course Content** – Add “Automation”

*Changes to module/annex:*

None. Automation would be covered under the elements shown.

Comment

**6.1.2.1 Operator Training Course Content** – Add Parameter Differences between flatwater pools and aquatic recreational facilities re automation

*Changes to module/annex:*

None. This distinction would be covered under the elements shown.

Comment

**6.1.2.1.1.1 Disinfectant Types** - Emphasize OSHA RTK and Safety Aspects

*Changes to module/annex:*

These aspects are covered under the elements shown. However, additional discussion material was added to Annex

Comment

**6.1.2.1.1.2 CT Values** - Expand published CT values beyond presently available info. Include all common RWI's and all common disinfectants.

*Changes to module/annex:*

None. CT values would be covered under 6.1.2.1.1 (2)

Comment

**6.1.2.1.1.4 Chlorine** - Emphasize proper and safe handling of erosion feeders/chemical mixing.

*Changes to module/annex:*

None. Safe handling is covered under 6.1.2.1.1.4 (7)

Comment

**6.1.2.1.1.7 Hyperchlorination** - When and why to hyperchlorinate Include language to squelch the use of the term 'shocking'

*Changes to module/annex:*

None. Section 6.1.2.1.1.7 discusses Hyperchlorination.

Comment

**6.1.2.1.1.8 Combined Chlorine** - Include discussion of deterioration of bldgs. machinery and structures due to airborne chloramines

*Changes to module/annex:*

Suggested material will be added to annex.

Comment

**6.1.2.1.1.9 Secondary Disinfection** - Add warning re side stream treatment effectiveness diminished

*Changes to module/annex:*

Suggested material will be added to annex

Comment

**6.1.2.1.1.10 Supplemental Disinfection** - Add warning re side stream treatment effectiveness diminished

*Changes to module/annex:*

Suggested material will be added to annex

Comment

**6.1.2.1.2.1 Water Balance** - Include options for treatment including priority of factors to be adjusted

*Changes to module/annex:*

Suggested material will be added to annex

Comment

**6.1.2.1.2.3 Saturation Index** - Include discussion of options to Langelier Index such as Reasoner

*Changes to module/annex:*

None. This section discusses this material.

Comment

**6.1.2.1.2.4 Water Clarity** - Add treatment priorities to improve clarity.

*Changes to module/annex:*

Suggested material will be added to annex

Comment

**6.1.2.1.2.5 pH** - Emphasize limits on Phenol Red readings when very low or very high

*Changes to module/annex:*

Suggested material will be added to annex

Comment

**6.1.2.1.2.6 Total Alkalinity** - Factors which cause TA to change beyond chemical additions

*Changes to module/annex:*

None. 6.1.2.1.2.6 (3) discusses these factors

Comment

**6.1.2.1.2.7 Calcium Hardness** - Add dealing with inherently high C.H.

*Changes to module/annex:*

None. 6.1.2.1.2.7 (3) discusses these factors.

Comment

**6.1.2.1.2.9 Total Dissolved Solids** - When is TDS worrisome?

*Changes to module/annex:*

None. This is covered in 6.1.2.1.2.9

Comment

**6.1.2.1.2.10 Water Treatment Systems** - Include alternative treatment methods such as Ionization, Salt

*Changes to module/annex:*

Alternate treatment methods will be added.

Comment

**6.1.2.1.2.11 Water Testing** - Add discussion of need to maintain test result records

*Changes to module/annex:*

None. Section 6.1.21.4.5 already addresses record keeping.

Comment

**6.1.2.1.3.2 Circulation** – Add Surge tanks as part of the recirc system. When necessary, when optional. Add basics of pump curve application and interpretation

*Changes to module/annex:*

Surge tanks will be added to 6.1.2.1.3.2 (5).

Comment

**6.1.2.1.3.3 Main Drains** - Add Safety Issues if not flush with pool floor (impact and trip/fall exposures)

*Changes to module/annex:*

Main drains are already covered under the Risk Management module.

Comment

**6.1.2.1.3.5 Mechanical Systems Balance** - Include automatic level controllers

*Changes to module/annex:*

Automatic level controllers will be as added 6.1.2.1.3.5 (9).

Comment

**6.1.2.1.3.6 Circulation Pumps and Motors** - Include discussion of submerged pumps such as turbine, mixed flow and others used in waterpark applications. Address winterizing needs for these types as well as impeller adjustments etc

*Changes to module/annex:*

Material has been added to the annex to discuss this issue.

Comment

**6.1.2.1.3.7 Valves** - Include application of the various types

*Changes to module/annex:*

None. This material is already covered in 6.1.2.1.3.7

Comment

**6.1.2.1.3.9 Filtration** - In discussing types of media include a technically accurate discussion of perlite, Crushed glass, reverse osmosis, and Zeolite

*Changes to module/annex:*

This material is covered in section 6.1.2.1.3.9. Will add 5) A general description of sand, cartridge, and diatomaceous earth filters and alternative filter media types to include, at a minimum, perlite, zeolite, and crushed glass.

Comment

**6.1.2.1.3.10 Filter Backwashing** - Include discussion of alternatives for recycling backwash water

*Changes to module/annex:*

Material will be included in the Annex.

Comment

**6.1.2.1.4.1 RWI** - Discuss in lay-person terms the most common RWI's, their symptoms and consequences

*Changes to module/annex:*

None. RWI is discussed in the Annex under 6.1.1.

Comment

**6.1.2.1.4.3 RWI Prevention** - Emphasize the need for frequent manual testing, standardization of automatic controllers, and adequately sized chemical feeders. Note the need for larger feeders for waterpark type attractions as compared to flat water pools

*Changes to module/annex:*

Material will be included in the Annex.

Comment

**6.1.2.1.4.4 Risk Management** - Start with RM basics and interpret them in terms of the aquatic environment

*Changes to module/annex:*

None. Detailed information on Risk Management is found in the MAHC Risk Management Module

Comment

**6.1.2.1.4.5 Record Keeping** - Add daily inspection requirements and the use of specific go-no go parameters. Should result in a written authorization to open an attraction or facility by upper level management

*Changes to module/annex:*

Daily inspection requirements are covered in the MAHC Operations and Management Module. The MAHC also discusses conditions that require short term and long term closures.

Comment

**6.1.2.1.4.6 Chemical Safety** - Include provisions of OSHA regs including labeling, staff training etc

*Changes to module/annex:*

None. The Annex provides further information, as well, as other sections of the MAHC such as the Risk Management Module.

Comment

**6.1.2.1.4.7 Entrapment Prevention** - Specifically reference APSP-7 and APSP-16



*Changes to module/annex:*

None. Section 6.1.2.1.3.3 (4) includes entrapment. References to these standards are best left in other sections of the MAHC rather than being part of course requirements.

Comment

**6.1.2.1.4.8 Electrical Safety** - Include OSHA & NEC provisions for GFCI and Arc Protection

*Changes to module/annex:*

None. These requirements are covered in the MAHC in the Design Module and also the Risk Management Module.

Comment

**6.1.2.1.4.9 Rescue Equipment** - Clearly allow either guard chairs or guard 'walking zones' as appropriate. Stipulate that not every provided chair or zone must be manned. Explain and mandate guard placement in accord with 10/20

*Changes to module/annex:*

None. The Swimming/Lifeguarding module will address these issues.

Comment

**6.1.2.1.4.10 Injury Prevention** - Stipulate required signs including content and nature of messages.

*Changes to module/annex:*

None. Signage is addressed in the Risk Management Module.

Comment

**6.1.2.1.4.12 Barriers** - Barrier options and requirements in a waterpark or similar aquatic complex

*Changes to module/annex:*

None. Barriers are addressed in the Facilities Design & Construction Module.

Comment

**6.1.2.1.4.13 Signs and Depth Markers** - Iterate sign requirements and offer parameters to meet them. Block Font ½" high for each 10 ft of readability; Brief Terse Messages; Separate Rules from Instructions; Sign Placement

*Changes to module/annex:*

None. Signage is addressed in the Risk Management Module.

Comment

**6.1.2.1.4.14 Facility Sanitation** - Address retrieval of pool/waterslide water discharged to adjacent decks. Prohibit foot traffic in the 'retrieval area'

*Changes to module/annex:*

None. Pool/waterslide water discharge is addressed in the Facilities Design & Construction Module.

Comment

**6.1.2.1.4.15 Emergency Response Planning** - Development of written emergency response plans. Inclusion of ERP in staff in-service training

*Changes to module/annex:*

None. Emergency Response Plan requirements are already included in the MAHC.

Comment

**6.1.2.1.5.2 Local Health Departments** - Stipulate in the absence of local rules established by Authority Having Jurisdiction, this MAHC shall apply

*Changes to module/annex:*

None. The MAHC is a recommended model code. It has no regulatory authority in the absence of local codes. We hope those jurisdictions not currently having regulations will use the MAHC as a template for adopting a local code.

Comment

**6.1.2.1.5.3 Aquatic Facility Types** - See and expand classifications by APSP. Note characteristics of each type that have influence on operations, water treatment, guarding etc

*Changes to module/annex:*

None. A discussion of pool types is included in 6.1.2.1.5.3 and the corresponding annex.

Comment

**6.1.2.1.5.4 Daily Operations** - Include standardization of automatic controllers, verification of performance of chemical feed equipment and adequacy of chemical supply levels

*Changes to module/annex:*

Section 6.1.2.1.5.4 has been modified to include additional daily inspections.

Comment

**6.1.2.1.5.5 Preventative Maintenance** - Inspection requirements after winter shutdown and/or regular detailed inspection during operations

*Changes to module/annex:*

None. The Operations & Maintenance Module provides requirements for re-opening after short term or long term closures.

Comment

**6.1.2.1.5.6 Weatherizing** - Discuss acceptable chemicals for flushing or charging pipes to prevent freezing including potable water supply

*Changes to module/annex:*

None. The Operations & Maintenance Module provides requirements for re-opening after short term or long term closures.

Comment

**6.1.2.1.5.7 Renovation** - When is professional engineering needed

*Changes to module/annex:*

None. The MAHC already discusses when A Registered Professional is required.

Comment

**6.1.2.1.5.8 Heating Issues** - Discuss the use of Thermal covers indoors and out

*Changes to module/annex:*

None. This may be problematic when it is not clear which thermal covers are referred to, the lack of data on the impact of these covers on water quality, and the fact that jurisdictional approval for these covers can differ dramatically. Please feel free to send in more detail and specifics during the next round of public comments that can be given on this module for further consideration.

Comment

**6.1.2.1.5.9 Air Circulation** - Include discussion of dealing with airborne combined chlorine and its negative effect on infrastructure. Discuss parameters for sizing humidity control equipment

*Changes to module/annex:*

None. In 6.1.2.1.1.8 annex.

Comment

**6.1.3 Requirements for Training Courses** - The lack of specificity in this entire section can allow any number of marginally qualified persons to establish a training program

*Changes to module/annex:*

None. Section 6.1.3 provides the requirements for training course providers. These are standard requirements but the local authority will need to decide how it approves course providers and content. Please submit suggested guidance in next review period.

Comment

**6.1.3.1 Course Providers** - As written anyone with a modicum of experience can establish an acceptable course?????????????

*Changes to module/annex:*

None. Section 6.1.3 provides the requirements for training course providers. These are standard requirements but the local authority will need to decide how it approves course providers and content. Please submit suggested guidance in next review period.

Comment

**6.1.3.4 Instructor Requirements** - As written any person with a minimum undefined level of training or experience can become an instructor

*Changes to module/annex:*

None. Section 6.1.3.4 provides the requirements for training course instructors. These are standard requirements but the local authority will need to decide how it approves course providers and content. Please submit suggested guidance in next review period.

Comment

**6.2 Lifeguard Training** - Before discussing training, the document should address when guards are or are not required. Exemptions based on pool venue (hotels) low use pools, small pool area, and shallow water are resulting in drownings. Let's get our heads out of the sand.

*Changes to module/annex:*

None. The Operator Training Module does not address Lifeguard training. The issues, including Lifeguard training and staffing are addressed in the Lifeguard/Bather Safety Module.

## **12. Steve Keifer, State of Oregon, Portland, OR**

**Comment**

**6.1** I am pleased at how this section came out. This is concise and thorough. I think it would be fairly easy to adopt into state rules without significant editing, other than the comment below.

*Changes to module/annex:*

None. Thank you for your support of the MAHC.

Comment

6.1.2.1 et al. I am not a big fan of laundry lists like this being in the code. This are probably not something states will want in their rules as they are not really necessary to the state. The state would publish the approved list of certifications. The course contents would be referenced in a separate document, usable when and if needed for course evaluation.

I know the committee I am on is doing the same thing with lists. With training course requirements, I think the steering committee should consider an option that places these lists into a standards document that could be referenced in the rule.

I'm not sure whether referencing the annex is appropriate or not. I might suggest a companion standard such as is referenced by the food manager training requirements. Referring to a separate standard will allow much easier editing of the lists, when necessary, and allow the state to reference the course requirements instead of listing them. This would make keeping the state's rules up to date much easier.

It could also be a mechanism for a nationally represented committee to evaluate various training programs, for the states, for recommended approval. For the FDA, we have the accreditation committee looking at courses, exams, exam security, etc. Something similar should be available to the MAHC group.

*Changes to module/annex:*

None. The MAHC is designed to be data-driven, knowledge-based, risk reduction effort that will provide a model code that can be adopted by state or local entities to help protect public health. We recognize that some of those entities may want to adopt variations of the material contained in the MAHC. The MAHC will be available for all of those entities without cost. To use parts of a code from to third parties may have cost burdens and may not necessarily conform to the public health principals set forth by the MAHC. We agree that in the future as training programs evolve the laundry lists can likely be removed to "certification" documents to be used by local authorities. At this point, we prefer to leave the choice to the local authority to remove since there is not an alternative mechanism for listing these required elements in place elsewhere.

### **13. Edward Lightcap, DuPont, Landenberg, PA**

Comment

6.1.2.1.1 Delete Item # 6) Breakpoint Chlorination – Breakpoint Chlorination should not be a stand-alone category, it should be a sub-category of Item #8) Combined Chlorine.

The rationale for this recommendation is that Breakpoint Chlorination is not an effective means for combined chlorine removal. Breakpoint Chlorination removes only a fraction of the inorganic combined chlorine, that which exists as monochloramine, dichloramine, and trichloramine, and it does not convert those inorganic chloramines to nitrogen gas (N<sub>2</sub>), as stated in most all training manuals, but rather converts them to nitrogen trichloride gas (NCl<sub>3</sub>). This is because when Breakpoint Chlorination is applied according to the method taught in CPO (and other) training classes, chlorine is over-applied and the weight ratio of chlorine to nitrogen is far in excess of that required to reach the "breakpoint". The result is that instead of removing combined chlorine as inert nitrogen gas (N<sub>2</sub>), this process results in converting inorganic chloramine to nitrogen trichloride, while not reacting with organic combined chlorine at all. (#1)

Breakpoint Chlorination has not delivered the promise of combined chlorine removal because the chemistry does not apply to directly to combined chlorine. The chemistry of Breakpoint Chlorination applies specifically to the reaction of chlorine with ammonia nitrogen (NH<sub>3</sub>), yet in our industry we have substituted "combined chlorine" for

ammonia, and they are quite different, and they react differently with chlorine and produce different byproducts. (#2,3)

Breakpoint chlorination is the primary cause of volatile disinfection byproducts that have been associated with (and potentially linked directly to) an increased risk of Asthma and bladder cancer in swimmers. (#4)

Breakpoint Chlorination should be included as a sub-category under the heading Combined Chlorine, and a scientifically based description of what Breakpoint Chlorination will and will not do, including that it produces an overall increase in volatile disinfection byproduct formation, should be included.

*Changes to module/annex:*

None. We appreciate your position and the information provided. However, we believe that it is just as appropriate to list “breakpoint/superchlorination” as it is to list “chlorine” and “combined chlorine”. The important thing is not how they are listed, but that all of these topics receive adequate consideration and discussion in an operator training course.

**6.1.2.1.1.6** Delete Section – Breakpoint Chlorination should not be a stand-alone category, it should be a sub-category of Item #8) Combined Chlorine, in line with preceding comment.

*Changes to module/annex:*

None. Please see comments on section 6.1.2.1.1 above.

6.1.2.1.2 Missing reference #10 Water treatment systems (6.1.2.1.2.10), and #11 Water Testing (6.1.2.1.2.11)

*Changes to module/annex:*

Section 6.1.2.1.2 will add item (10) Water Treatment Systems and item (11) Water Testing.

12. Michael Magnant, Iowa Department of Health, Des Moines, IA

Comment

The draft does not address chemical controllers, and particularly ORP, in any significant degree. See following comments.

Automatic control of disinfectant levels using ORP sensors has been a significant advance and benefit in the operation of swimming pools over the past 20 years, but operators for the most part still do not have a basic understanding and trust in the ORP measurement. None of the nationally available operator training courses spend significant time on controllers and ORP, largely because we regulators have not chosen to endorse ORP as a standard, but also partly, I believe, because the trainers don't have a much better understanding of the subject than the operators.

The MAHC module does not mention ORP and has one sentence about controllers. Granted, there is far too little academic work on the meaning of ORP in pool operation, but we have years of practical experience indicating the benefits of automation. Operators need to be exposed to ORP as a primary operating parameter and need to be encouraged to trust the machine readings more. They need to be taught basic maintenance and that sensors don't last forever. My view is that a minimum of 45 minutes and probably more should be provided to discuss ORP and controllers; the MAHC needs to include a discussion of ORP under "Disinfection" in addition to the discussion under "Water Treatment Systems" (6.1.2.1.2.10) in "Water Chemistry."

*Changes to module/annex:*

None. Chemical controllers and ORP are both discussed further in the Disinfection and Water Quality Module. We do agree that more scientific information is needed on the use of ORP in pools. The lack of scientific data comparing it with traditional operation has limited how ORP has been discussed and incorporated into the MAHC. As additional scientific information is collected this will be reconsidered.

**14. Joe Martinez, WY Environmental Health Association, Thermopolis, WY**

Comment

I am not understanding if this is the recommended code or if this is a guideline to creating a code. The Code of Federal Regulations actually show text in the correct form for immediate adoption. This only states general information to be adopted. I realize this is not a federal agency creating the code but even the National Electrical Code states information in Code form for quick and easy adoption.

*Changes to module/annex:*

None. The MAHC is intended to be a nationally recommended model code that can be adopted in whole, or in part, by any entity regulating aquatic venues. It is not intended to be a federal regulation.

**15. John Pinckney, Cornwall Central School District, New Windsor, NY**

Comment

**6.1.2.1.1 Water Disinfection** - Should list the halogen family of chemicals under disinfectants (Chlorine 6.1.2.1.1.4 , Bromine 6.1.2.1.1.3 and Cyanuric Acid 6.1.2.1.1.5) for readability and understanding. Initial reaction for review is there are disinfectants and then there are Bromine and Chlorine. The reader might not initial understand the sequence.

*Changes to module/annex:*

Deleted 6.1.2.1 (1) Disinfectants to remove possible point of contention

Comment

6.1.2.1.1.5 Safety Consideration of mixing organic and in-organic chlorines together or using the same chemical feeder to inject the chemicals

*Changes to module/annex:*

Added to 6.1.2.1.4.6 as 2) How to prevent individual chemicals and inorganic and organic chlorine products from mixing together or with other substances (including water) or in chemical feeders, and

Comment

**6.1.2.1.1.8 Combined Chlorine** - Move Breakpoint/Super-Chlorination 6.1.2.1.1.5 and Hyper-Chlorination 6.1.2.1.1.7 under the Combined Chlorine 6.1.2.1.1.8.

*Changes to module/annex:*

None. We appreciate your position and the information provided. However, we believe that it is just as appropriate to list “breakpoint/superchlorination” as it is to list “chlorine” and “combined chlorine”. The important thing is not how they are listed, but that all of these topics receive adequate consideration and discussion in an operator training course.

Comment

**6.1.2.1.1.8 Combined Chlorine** - This section should also explain how to remove Combined Bromine and the use of Ozone and other specialty chemicals used to oxidize Potassium monopersulfate.

*Changes to module/annex:*

This comment is not recommended code language.

The Operator Training Module outlines a set of recommended training “subject areas” needed for the safe operation of aquatic venues. It is not intended to delineate specific course content nor specify how course designers and instructors cover the required “subject areas”. This comment is more appropriate for pool operator course designers.

Comment

**6.1.2.1.1.9 Secondary Disinfection** - Explain the need for “Secondary Disinfection”

*Changes to module/annex:*

None. Section 6.1.2.1.1.9 (1) already covers this.

Comment

**6.1.2.1.2.2 Water Balance** - Change to: Water balance effects on disinfection and how things dissolve in water

*Changes to module/annex:*

None. We believe the current language describes the same material.

Comment



**6.1.2.1.4 Health and Safety** - Missing is how to clean and sanitize the pool deck. How do you keep debris and chemicals used for cleaning away from contaminating the pool water?

*Changes to module/annex:*

None. These elements are already contained in Health and Safety in (5) chemical safety, (9) injury prevention and (13) facility sanitation.

## **16. Shane Sanderson, WI Department of Health Services, Madison, WI**

Comment

**6.1.1.1 Operator Qualifications and Certifications** - All public pools shall be under the supervision of a qualified operator. A qualified operator shall have completed...

*Changes to module/annex:*

Section 6.1 will be changed as defined in the Regulatory Management Module

## **17. Teri Stroupe, Raleigh Parks & recreation Department, Raleigh, NC**

Comment

**6.1.2.1.4.2 Causes of RWS** – (3) Change to Respiratory illness and effects of combined chlorine

*Changes to module/annex:* Section will be changed to reflect comment

- 3) Respiratory illness (*Legionella*)
- 4) Neurologic infections (echovirus),
- 5) Eye/ear illness (*Pseudomonas aeruginosa*, adenovirus, *Acanthamoeba*,
- 6) Hypersensitivity reactions (*Mycobacterium avium* complex, Pontiac fever, endotoxins), and
- 7) Health effects of chloramines and disinfection by-products.

Comment

**6.1.2.1.4.2 Causes of RWI** - Change (5) to Eye/ear illness and effects of combined chlorine

*Changes to module/annex:*

See Comment above

Comment

**6.1.3.7 Continuing Education** – Change to Grade C.

*Changes to module/annex:*

None. The discussion of continuing education is in the Annex wording for this section and not the code and is therefore not graded.

## 18. Edits from MAHC Editor

Edit

### 6.1.2.1.2.8 : Water temperature including:

Repetition of wording in module

*Changes to module/annex:*

- 1) How low and high water temperatures increase the likelihood of corrosion and scaling, respectively, and
- 2) Its effect on DISINFECTION, ~~its health effects, and other operational considerations,~~
- 3) Its health effects, and
- 4) Other operational considerations.

### 6.1.3.5.2: Final Exam Administration

Error added during editing process

*Changes to module/annex:*

- 1) Checking student's government-issued photo identification, to ensure that the individual taking the exam is the same person who is given a certificate documenting course
- 2) ~~Final exam completion is without assistance or aids that may improve exam results, and~~

## Other information Received

**From:** Richard Falk [mailto:RichardFalk@comcast.net]

**Sent:** Wednesday, September 29, 2010 3:45 PM

**To:** MAHC (CDC)

**Subject:** Public Comment on 6.1 Operator Training of MAHC

To whom it may concern:

I am attaching my comment form "mahc-comment-form09-29-10.doc", but am also attaching the earlier comment form and information I sent when reviewing sections 1.0, 2.0, 3.0 since it seems that perhaps my comments weren't incorporated into the latest 6.1 section as there are some implied errors or omissions in the current 6.1 section. I also refer to some of these attachments in my current comment form. The attachments I had sent previously in earlier reviews include "MAHC\_Comment\_Form\_Mod.doc", "Further Info.docx", and "FC-CYA Ratio Derivation.docx".

In addition, I strongly encourage you to download the critically important O'Brien paper from 1974 that definitively determined the chlorine/CYA equilibrium constants (for the chlorinated isocyanurate species) since it is in an out-of-print book, though I have permission to use it as I describe here:

<http://richardfalk.home.comcast.net/~richardfalk/pool/OBrien.htm>

I would attach it, but it's large and you can easily download it from the above link.

In addition, I am attaching comments I have submitted to NSPF for improving the CPO course as I reviewed the course manual. A high-level overview of my concerns is described in the following post that also contains links to all of the scientific reference papers I referred to in my comments:

<http://www.troublefreepool.com/certified-pool-operator-cpo-training-what-is-not-taught-t18432.html>

I have also attached the more detailed comments in "NSPF CPO Suggestions" (also as "NSPF-CPO-Suggestions.pdf" though web links seem to be missing in this file). I am also attaching the PoolEquations.xls spreadsheet I wrote that calculates the hypochlorous acid concentration (among other things) given the FC, CYA, pH, etc. levels.

I know that this particular review of 6.1 is merely a high level topic list whereas most of my comments and concerns are regarding the details yet to come in the course content itself, but I am still very concerned in the direction taken so far as it seems to avoid the known science of the chlorine/CYA relationship and how pools/spas can be properly managed with this knowledge, seems to continue to misapply the 10x rule of chlorine breakpoint of ammonia to its use with combined chlorine, may not explain that TA is a source of rising pH due to carbon dioxide out-gassing, etc. Is there going to be more detailed specific guidance about the operator training outlined in 6.1?

Thanks,  
Richard Falk  
San Rafael, CA

(pool homeowner with strong interest in pool water chemistry; I do not work in the pool/spa industry nor chemical industry)

*Changes to module/annex:*

None. The Operator Training Module outlines a set of recommended training "subject areas" needed for the safe operation of aquatic venues. It is not intended to delineate specific course content nor specify how course designers and instructors cover the required "subject areas". This material is best used to engage and influence pool operator course designers.