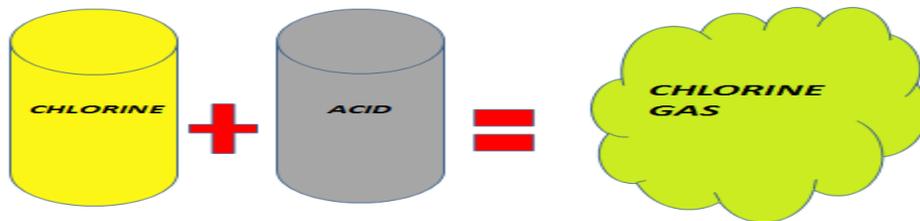


CHLORINE OFF GASSING AT PUBLIC SWIMMING POOLS

Chemical reactions can cause various hazards, including poisonous fumes, caustic liquids and even explosions. Chlorine and acid are incompatible chemicals necessary for proper pool disinfection. Improper and uncontrolled mixing of the two can likely yield dangerous chlorine gas, yet pose minimal risk when dosed separately and rendered comparatively harmless when diluted by the vast amounts of pool water. Exposure to chlorine gas can result from manual or hand mixing of incompatible chemicals, typically within the chemical room, and may result in vapors traveling into the pool as well as other common areas. Exposure can also result from liquid chlorine and acid being inadvertently drawn, mixed, and then accumulated within the pipework when circulation or flow has ceased from an inactive pump. Therefore, when power to the pump is eventually restored, a release of the yellowish-green gas occurs abruptly within seconds after flow is reinstated, with the chlorine gas entering the pool through the pool return inlets. Any disruption to flow or pool circulation must likewise interrupt chemical feeding to prevent a potential chemical build up within the pipework.



Cause and solution

Without power to the pump, there can be no flow through the pipes. The unwanted blend of chlorine and acid starts with disruption to power, both deliberate (during routine equipment maintenance) and unintended (during power outages). When power is restored, certain pumps (particularly those with integrated starting features) will not automatically restart to safeguard against damaging the pump. On the other hand, the chemical feed pumps and chemical control system are not always equipped with such features, causing both chlorine and acid pumps to re-start – injecting acid and chlorine into the pipework of stagnant water without flow. As such, the chemical feed pumps and the chemical control system must be equipped with safeguards against indiscriminate feeding, which at a minimum should include an electrical interlock between the chemical control system and the starting controls of the pump in addition to establishing a link between chemical dosing and pump failure. However a pump running under cavitation with loss of prime could stop or limit the circulation flow, yet fail to restrict the chemical pumps from continual feeding. To overcome this complication, supplemental *flow switches or sensors* relayed to the chemical dosing equipment should serve to disrupt chemical feeding upon loss of circulation flow. This would require routine testing of flow switches to be performed since switches in general may not

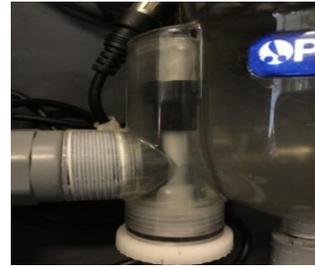
always be reliable. The installation of two or more redundant switches can further reduce the possibility of failure.



Rotary Flow Switch



Paddle Flow Switch



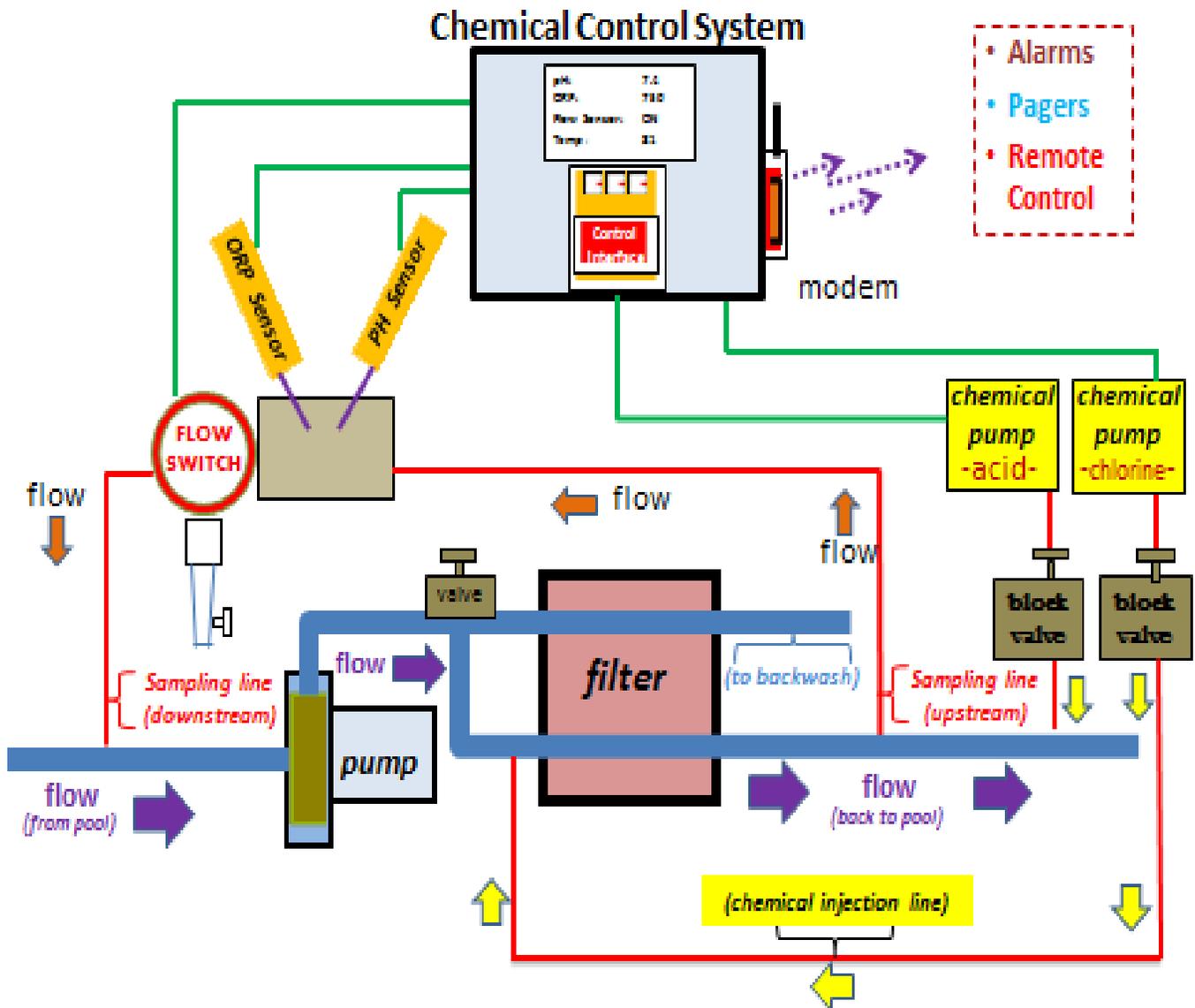
*Bobbing Float or Magnetic
Flow Switch*

Equipment safeguards

Equipment will vary and differ in features, capabilities, appearance, and repair. Operation and routine testing in accordance with the manufacturer's specifications are critical to ensure adequate performance. Malfunctions must be averted to prevent incompatible chemicals from mixing.

- **Chemical pumps and feeders** are responsible for chlorine and acid delivery and can vary from relatively simple with minimal parts and components, to more elaborate mechanisms. Peristaltic pumps apply rollers that squeeze a feeding tube, grabbing the liquid chemical through the tube. Erosion feeders can be used for feeding dry chemicals by applying the water stream through the pipework to dissolve the dry chemical tablets or granules. A diaphragm or piston pump functions with a motorized cam and series of check valves. One contributing factor to failure could result from contaminants (sand or grit) lodged within a valve. To minimize the blending of chlorine and acid, installing the chlorine injection line before (upstream) the filter, with the acid injection line after (downstream) filter – is suggested to reduce the risk of merging both chemicals. If this isn't possible, the injection points should be at a minimum of 10 pipe diameters apart. Chemical **tubing** is also subject to wear and deterioration and can only be replaced with an equivalent specifically intended for the chemical feed pump. Given the variation in moving parts and components, periodic testing and maintenance is highly recommended.
- **Anti-syphon valves** in the chemical feeder pumps are highly recommended and may be required by the chemical pump manufacturer. If chemical containment vessels, injection points, pipework, and filtration are located above the pool, liquid contained within the system above the pool water level may drain back into the pool and moreover syphon or draw both chlorine and acid into the system pipework.
- The installation of **flow switches** or any electrical component and corresponding relays require methods approved and intended by the manufacturer. Repairs or alterations to electrical devices, associated components, and equipment must sustain compliance with the National Electrical Code (NEC), or with applicable local codes. The installation of such items or fail-proof features including flow switches, may fall outside the scope of Environmental Health and may require further consultation and approval from the local Building Authority.
- The **chemical control system** dictates how much and when to feed chemicals to the pool. These systems are typically equipped with a flow switch and an integrated alarm, intended to prevent chemicals from feeding with interrupted flow and should operate continuously. However power outages may cause disruption and possible malfunction of system parts and components.

Following a power outage, consult with a service professional with chemical control system expertise for further evaluation of the chemical controller.



Procedural safeguards

Strategies beyond equipment design should be implemented to further reduce any likelihood of unwanted chemical releases, and should include routine testing of the chemical control system. Manual water sampling of the chlorine and pH levels using a separate test kit can be performed to compare chemical reading accuracy with the chemical control system. The flow switch and alarm should also be tested periodically according to the system manufacturer. When performing maintenance, service repairs, or any work to the chlorination or chemical feeding system, isolation of the chemical feeders from the rest of the water circulation system with closing block valves – should be fulfilled in conjunction with standard procedures for *lockout-tagout (LOTO)*. The locked unit is then tagged with an inscription identifying the worker who has placed it. This prevents accidental startup and unintended chemical feeding from the unit.

Chemical containers and tubing should also be color coded and labeled accordingly to prevent accidental mixing.

Contingency planning is strongly recommended with an emergency action plan that includes a protocol to evacuate the pool after a pump failure, with safeguards against reentry – including *safety signs displaying warning announcements not to enter the pool with an inactive pump*. Additional signs should be posted announcing this requirement. The plan should have further measures against chemical off gassing disasters and be site specific and customized to meet the needs of the facility.



EMERGENCY ACTION PLAN

An effective emergency response plan begins and ends with good management and supervision. Planning will include procedures for emergency situations, reporting requirements, restoration of facility operations, implementing practice drills, and performing self-inspections; all of which should be incorporated into a written emergency action plan. The written plan should be specifically developed and tailored to characteristics unique to each facility.

Consult with service professionals with expertise in developing emergency action plans specific to public pools. Local hazardous material and fire personnel should be consulted for issues pertaining to chemical storage. Once complete, put the plan into action. Emergency drills should be practiced routinely.

Emergency Response

Dangerous situations can vary. Irrespective of risk level, any situation with imminent hazards jeopardizing health and safety can be considered an emergency. Applying the following countermeasures in response to emergencies is recommended:

1) Manage the emergency

- Coordinate with staff and confirm your mode of communication. Effective communication is essential.
- Develop a chain of command as part of your emergency response plan. Phones must be available and conveniently located. Emergency phone numbers must be prominently posted. A method of communication between staff using whistles or hand signals should also be established.
- Develop a contact list prescribing assignments and responsibilities.

2) Assign Responsible Staffers

Designate staff members for emergency situations. Assignments should be relegated according to skill. For instance, lifeguards are better qualified to perform emergency rescue than the facility manager. Likewise, the facility manager may be better equipped to report incidents and supervise exercise drills. Assign staffers for each of the following actions:

- Emergency rescue and first aid to injured parties (typically performed by lifeguards).
- Immediate contact of emergency personnel (local fire and rescue).
 - Search for lost patrons or pool users: Time can be crucial when searching for a lost bather, particularly for large scale facilities with multiple patrons. Get a description of the missing individual with last location seen and immediately search the water and facility grounds. Lifeguards are trained on search methods which can vary and should be site specific depending on facility characteristics. Establish lifeguard search procedures specifically tailored for your site.
 - Initiate closure of the facility. Begin evacuation and clearing procedures and install closure signs at all entrances.
- Direct traffic
 - Crowd control: Usually a large number of people congregate at the scene of an emergency. The emergency plan must include clearing the incident area and crowd control with on-going supervision of the facility.
 - Meeting and guiding emergency personnel to the site and/or injured party. During an emergency it's extremely important to provide rescue personnel with detailed directions to your bathing facility. Access for emergency personnel should be evaluated with routes determined in advance.

Reporting Requirements

Any drowning, chemical injury, waterborne illness, and rescue requiring resuscitation or medical facility attention will require reporting to Contra Costa Environmental Health as quickly as possible but **within 24 hours**.

- Produce records indicating the number of pool users, all lifeguards on duty, water characteristics, equipment maintenance including failures and malfunctions.
- These records must be available for review by the Permit Issuing Official for at least 2 years.

Restoration of Facility Operations

Depending on the state and complexity of the operations, consultation from service professionals may be necessary to evaluate all system operations prior to resuming reopening. Equipment function and water characteristics must be restored. Regulation components and automation systems must be assessed and adjusted accordingly. Keep inventory record and data of all incident situations including written assessments with corrective measures taken by you and consultant or service professional.

Practice Drills

Practice makes perfect and training is essential for emergency response situations. Staffer members assigned to emergency response must be trained. Provide training with frequent practice to reinforce the principles and routinely rehearse the plan.

- Practice emergency response drills including passage routes for directing emergency personnel.
- Practice lifesaving skills to sustain proficiency in performing rescues.
- Practice search procedures for lost bathers.
- Practice flashlight distribution for staff, applicable to indoor pools or pools open at night, without the presence of natural night.
- Practice all other response protocols; site specific and tailored for your facility.

Self-Inspections

Ensuring good facility maintenance will minimize equipment failures, disruptions, and reduce delays during emergencies. To help ease your response to emergency situations, perform compliance checks of your own accord. Develop an inspection checklist or adapt the inspection report issued by Contra Costa Environmental Health to identify the wide range of health hazards including unsafe water conditions, broken equipment, inadequate safety signs, missing rescue devices, electrical equipment malfunctions, broken/loose suction outlet covers, missing first aid kits, broken gates and fences, etc. Take action to correct any deficiencies. Close the pool, restrict public access, and post closure signs when encountering imminent health hazards that can't be corrected.

After the emergency

Preparing for an emergency is extensive and includes many responsibilities. Proficiency in record keeping, retaining reports, reassessing and replacing equipment are few of the multiple issues to deal with. Staff debriefing should be implemented following the emergency. For further information on developing and emergency response plan, consult with industry professionals and refer to the following online resources:

<https://emergency.cdc.gov/>

<https://nspf.org/>

<https://apsp.org/>

ADVERSE WEATHER AT PUBLIC SWIMMING POOLS

Yes, emergency situations do occur and can be brought on by unexpected events, weather catastrophe, and power outages; causing equipment failure or heavy contamination of the pool. Flood waters can carry waste and sewage. Tornados and lightning can injure or kill. Forecasting these events, identifying the problems, and developing solutions will leave you better prepared and ready to bring your pool back in safe operation. Conditions may require the evacuation of the pool during emergencies. Every facility should have procedures for clearing the pool, reporting the incident, restoring all operations, keeping track of records, and readiness for recovery.



Refer to the Contra Costa Environmental Health Guidelines for Power Disruptions & Outages At Swimming Pools

Above all, there's no need to panic. The key word is prevention. An effective prevention program can reduce the risk of injury and help save lives through coordinated efforts between management and staff. This requires specific staff assignments and written procedures aimed at responding to emergency situations. Any delay in response may increase the risk. Being prepared will minimize that delay. This means having an ***emergency action plan***.

Contingency planning with emergency action is strongly recommended for countermeasures against potential disasters and should be site specific and customized to meet the needs of your facility; aimed at safeguarding your patrons, operations, and assets. Consult with professionals in risk management and pool service expertise for developing a plan best suited for your facility.

FLOODING

Contamination from substances and objects in contact with flood or storm water can be released into a pool, bringing water pollution with high numbers of disease causing organisms. Contamination may include sewage, garbage or refuse, waste debris, mud, and other sources rich in germs. Flooding may result in the power outages, loss of safe water supply, and sewer overflows; all of which can lead to imminent health and safety hazards.

Take the following steps in the event of a flood:

1. Immediately evacuate then CLOSE the pool.
2. Install closure signs at every entrance.

The pool must remain closed and can only be reopened after OPERATIONAL CONDITIONS ARE REINSTATED with water either replaced or sufficiently treated. Prolonged closure with disrupted flow and stagnant water can lead to increased risk of high algae and mosquito breeding conditions, requiring water treatment and continued circulation.

Water Replaced – Pool Emptied

Replacing the pool water in its entirety is the best option for optimizing restoration of water characteristics. However, depending on your site location and topography, the groundwater table may be higher than normal during wet weather seasons. Emptying a pool situated in a high water table area can place the pool shell under stress that can fracture or collapse the pool walls or cause enough force to lift the pool from the ground. Hence consulting with qualified professionals for appropriate draining options may be needed prior to emptying your pool. Once the water is removed and the pool rendered free from debris, dirt, slime, bio-film, and other pollutants, decontamination of the shell surfaces and equipment can be followed by water replacement using potable (drinking water) sources. Start-up procedures for restoration of all chemical levels can now begin. Consult with service professionals in pool chemistry prior to proceeding with water treatment or chemical adjustments.

Water Treated – Without Emptying the Pool

Given the scarcity of water throughout many regions of the state and ongoing efforts in water conservation, alternatives to water dumping and replacement may be preferable. Additionally, restrictions on storm drain discharging of pool water must be met according to your local sanitary district. Other water treatment options include water recycling and reverse osmosis. Consult with service professionals to discuss these options and determine the appropriate treatment. Procedures for clean-up and water treatment can vary from one facility to another depending on existing equipment and pool volume; requiring the use of specific chemicals, flocculants, and remediation implements without the need to replace the entire water contents of the pool. Once the clean-up is completed, chlorine and chemical restoration can now commence. However parasites (like Cryptosporidium) resistant to conventional pool disinfection may have been introduced by flood waters; requiring higher levels of disinfection with the following super-chlorination procedures:

Raise the free-chlorine concentration in the pool to 20 ppm and maintain that concentration for at least 12.75 hours. If that public pool water contains a chlorine stabilizer such as cyanuric acid, lower the pH to 6.5 and raise the free-chlorine concentration in the public pool to 40 ppm and maintain that concentration for at least 30 hours. Take measures to protect your copper heat exchangers against low pH damage by incorporating bypass valves, sacrificial anodes, or other suitable alternatives. Test the free-chlorine residual at multiple points to ensure the required free-chlorine concentration is achieved throughout the public pool water for the entire disinfection time. Replace any affected cartridge filters and backwash non-cartridge filters after the disinfection process has been completed. Ensure the effluent is discharged directly to the sanitary sewer or other approved wastewater-disposal process in accordance with State or local requirements. Do not return the filter backwash water to the pool. Replace the filter media if necessary. Do not allow pool users back into the public pool until the disinfection process has been completed and the free-chlorine concentration and pH of the public pool water have returned to normal operating ranges. Ensure appropriate turnover rates are met to achieve adequate filtration of pool water.

(Prior to proceeding with super-chlorination and pH reduction, consult with pool service professionals on safeguarding your pool heater from low pH corrosion).

Advance Preparation Before the Flood

Plan in advance. Having a contingency plan will leave you better prepared for action and recovery. The plan should be site specific and tailored for your facility. As mentioned before, consult with professionals in risk management and pool service expertise for developing a plan best suited for your facility. Include a separate **emergency action plan** for addressing injury prevention and rescue.

Anticipate problems and develop solutions. Reduce your inventory supplies to minimize losses. Discard or recycle cast-off or unnecessary items. Know your equipment location and safeguard them accordingly. Secure your inventory above the anticipated flood level. These chemicals which require dry storage and not mixed for risk of explosion. Other supplies such as filter media, furniture, and portable equipment or items should also be included. Secure and tie down items that can float. When flooding is imminent, deactivate the main gas valve, main water valve, and electricity at the main breaker when flooding is imminent.

Include a plan for maintaining sump pumps, downspouts, plumbing, exterior surface grading, storm drains, and other contributing factors to flooding. During flooding sanitary sewer lines can overflow through the drain pipes. Backflow valves are designed to temporarily prevent overflow. The installation of backflow valves must be performed by a licensed plumbing contractor with appropriate permits from the local building or sanitary authority.

Develop a contact list with the names and contact information of key personnel and emergency services.

THUNDERSTORMS

Thunderstorms can be accompanied by cloud-to-ground lightning, high winds, and hail. The National Lightning Safety Institute (NLSI) recommends the closure of both indoor and outdoor pool facilities during a thunderstorm. Safety measure intended to reduce accidents resulting from thunderstorms and lightning include the following:

- Designate a responsible person for weather monitoring.
- Obtain advanced weather information via a “weather radio” or the Weather Channel or other TV program.
- Preferably, any sight of lightning should prompt immediate evacuation of the pool. However, with continued monitoring for storm activities swimming need not be suspended until lightning is within 6-8 miles. To determine its rough distance and speed, apply the Flash-To-Bang (F-B) method when first noticing thunder or lightning. This technique measures the time from seeing lightning to hearing associated thunder. For each five seconds from F-B, lightning is one mile away. Thus, the F-B of 10 = 2 miles; 15 = 3 miles; 20 = 4 miles; etc. At the F-B count of 30, the pool should be evacuated and patrons directed to safety shelter.
- Stay informed by checking your local radio stations for continued weather updates and safety information. Having a battery-operated radio is highly recommended. Use of the pool should be suspended until 30 minutes after the last thunder or lightning strike.
- The American Red Cross provides the following suggestions:
 1. When a thunderstorm threatens, clear the pool. This also applies to the surround deck area. If possible, get all patrons inside and away from the water.
 2. Keep everyone away from windows inside. People can be injured by flying debris or glass if the window breaks.
 3. Do not let anyone take a shower during a thunder storm. Water and metal can conduct electricity of lightning.
 4. Do not use the corded telephone except for emergencies.
 5. Keep away from water and grounded objects, such as metal fences, tanks, rails, and pipes.
- Debris introduced into the pool and surrounding deck by high winds must be removed, with equipment and water characteristics restored prior to reopening the pool.

TORNADOS

In the event of a tornado warning, the pool must be evacuated and closed with patrons directed to safety. Depending on the damage caused by the tornado, closure could be extended until water characteristics, equipment, and structures are restored.

EMERGENCY ACTION PLAN

An effective emergency response plan begins and ends with good management and supervision. Planning will include procedures for emergency situations, reporting requirements, restoration of facility operations, implementing practice drills, and performing self-inspections; all of which should be incorporated into a written emergency action plan. The written plan should be specifically developed and tailored to characteristics unique to each facility.

Consult with service professionals with expertise in developing emergency action plans specific to public pools. Local hazardous material and fire personnel should be consulted for issues pertaining to chemical storage. Once complete, put the plan into action. Emergency drills should be practiced routinely.

Emergency Response

Dangerous situations can vary. Irrespective of risk level, any situation with imminent health hazards jeopardizing health and safety can be considered an emergency. Apply the following countermeasures in response to emergencies:

1) Manage the emergency

- Coordinate with staff and confirm your mode of communication. Effective communication is essential. Develop a chain of command as part of your emergency response plan. Phones must be available and conveniently located. Emergency phone numbers must be prominently posted. A method of communication between staff using whistles or hand signals should be established.
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2) Assign Responsible Staffers

Designate staff members for emergency situations. Assignments should be relegated according to skill. For instance, lifeguards are better qualified to perform emergency rescue than the facility manager. Likewise, the facility manager should be better informed at reporting incidents and supervising exercise drills. Assign staffers for each of the following actions:

- Emergency rescue and first aid to injured parties (typically performed by lifeguards).
- Immediate contact of emergency personnel (local fire and rescue).
- Search for lost patrons or pool users:
Time can be crucial when searching for a lost bather, particularly for large scale facilities with multiple patrons. Get a description of the missing individual with last location seen and immediately search the water and facility grounds. Lifeguards are trained on search methods which can vary and should be site specific depending on facility characteristics. Establish lifeguard search procedures specifically tailored for your site. Initiate closure of the facility. Begin evacuation and clearing procedures and install closure signs at all entrances.
- Direct traffic.
 - Crowd control. Usually a large number of people congregate at the scene of an emergency. The emergency plan must include clearing the incident area and crowd control with on-going supervision of the facility.
 - Meeting and guiding emergency personnel to the site and/or injured party. During an emergency it's extremely important to provide rescue personnel with detailed directions to your bathing facility. Access for emergency personnel should be evaluated with routes determined in advance.

Reporting Requirements

Any drowning, chemical injury, waterborne illness, and rescue requiring resuscitation or medical facility attention will require reporting to Contra Costa Environmental Health as quickly as possible but **within 24 hours**.

- Produce records indicating the number of pool users, all lifeguards on duty, water characteristics, equipment maintenance including failures and malfunctions.
- These records must be available for review by the Permit Issuing Official for at least 2 years.

Restoration of Facility Operations

Depending on the state and complexity of the operations, consultation from service professionals may be necessary to evaluate all system operations prior to resuming reopening. Equipment function and water characteristics must be restored. Regulation components and automation systems must be assessed and adjusted accordingly. Keep inventory record and data of all incident situations including written assessments with corrective measures taken by you and consultant or service professional.

Practice Drills

Practice makes perfect and training is essential for emergency response situations. Staffer members assigned to emergency response must be trained. Provide training with frequent practice to reinforce the principles and routinely rehearse the plan.

- Practice emergency response drills including passage routes for directing emergency personnel.
- Practice lifesaving skills to sustain proficiency in performing rescues.
- Practice search procedures for lost bathers.
- Practice flashlight distribution for staff, applicable to indoor pools or pools open at night, without the presence of natural night.
- Practice all other response protocols; site specific and tailored for your facility.

Self-Inspections

Ensuring good facility maintenance will minimize equipment failures, disruptions, and reduce delays during emergencies. To help ease your response to emergency situations, perform compliance checks of your own accord. Develop an inspection checklist or adapt the inspection report issued by Contra Costa Environmental Health to identify the wide range of health hazards including unsafe water conditions, broken equipment, inadequate safety signs, missing rescue devices, electrical equipment malfunctions, broken/loose suction outlet covers, missing first aid kits, broken gates and fences, etc. Take action to correct any deficiencies. Close the pool, restrict public access, and post closure signs when encountering imminent health hazards that can't be corrected.

After the emergency

Preparing for an emergency is extensive and includes many responsibilities. Proficiency in record keeping, retaining reports, reassessing and replacing equipment are few of the multiple issues to deal with. Staff debriefing should be implemented following the emergency. For further information on developing and emergency response plan, consult with industry professionals and refer to the following online resources:

<https://emergency.cdc.gov/>

<https://nspf.org/>

<https://apsp.org/>

POWER DISRUPTIONS & OUTAGES AT PUBLIC SWIMMING POOLS

During a power outage, pool filtration and water quality can be disrupted, causing unsafe conditions with insufficient disinfectant levels and water characteristics ripe for disease causing organisms. Power outages can also cause system failures prompting loss of pool lighting necessary for nighttime use. System failures can also trigger uncontrolled feeding of chemicals; raising the possibility for exposure at highly toxic levels. Proper reinstatement of all equipment function is a necessary safeguard against possible injury or death. The California Code of Regulations, Title 22, Chapter 20, Article 3, Section 65525 requires the recirculation system be in operation when the pool is available for use.



Initiate your **emergency action plan**. Take the following steps in the event of a power outage:

1. Distribute flashlights for staff to direct evacuation (indoor pools and pools open at night)
2. Immediately evacuate then CLOSE the pool.
3. Install closure signs at every entrance.

The pool must remain closed and can only be reopened once POWER IS RESTORED TO ALL EQUIPMENT and the following conditions are met:

- Recirculation, filtration, and lighting are fully functioning.
- Disinfectant, pH, and all other water characteristics are reestablished.
- Regulating components and timers (if used) are reset.
- Automated control systems, if available, are restored to full operation with functioning flow switch or sensors. Chemical controllers should at all times operate continuously and in accordance with manufacturer specifications. However power outages may cause disruption and possible malfunction of systems and components. Following a power outage, consult with a service professional with chemical control system expertise for further evaluation of the chemical controller. Malfunctions must be prevented from allowing incompatible chemicals to mix. To safeguard against exposure to high levels of

chemicals from any type of system or component failure, low flow, or interrupted operation; fail-proof features for chemical feed systems are necessary.

Refer to the Contra Costa Environmental Health Guidelines for Chlorine Off-Gassing At Swimming Pools for further information.

Repairs or alterations to electrical devices, associated components, and equipment must sustain compliance with the National Electrical Code (NEC) or with applicable local codes. The installation of such items or fail-proof features falling outside the scope of Environmental Health may require consultation and approval from the local Building Authority.

- Finally, record all calendar dates and timeframes associated with the incident and include written assessments with corrective measures following consultation with your service professional.

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