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**Section 4.7.1**

~ National Lightning Safety Institute ~

# Lightning and Aquatics Safety: A Cautionary Perspective for Indoor Pools

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## 1. Abstract

Lightning behavior is arbitrary, capricious and random. A first flash to earth can travel tens of miles from a distant cloud to a grounded object. Statistically, more lightning originates from the back edge of a thundercloud than from the front side, making recreation activity resumption decisions difficult. Risk management of the lightning hazard necessarily calls for a cautious and conservative approach. This paper describes lightning pathways to interior structures and provides references to recent national codes and standards. It recommends guidelines for decision-making in order to maximize lightning safety for indoor pools.

## 2. Physics of Lightning

There are some 22 million cloud-to-ground lightning flashes in the USA annually. A helpful [lightning flash density map](#) can be seen on this site. Lightning travels at about 1000 feet in a millionth of a second. A typical flash is as thick as one's thumb. Lightning's currents average about 25,000 amps with voltages in the hundreds of millions. Lightning follows Benjamin Franklin's maxim of Path of Least Resistance through the air and along or through the ground. According to insurance information, the ratio of damage due to indirect effects vs. direct effects is a ratio of some 2000:1. This means that if lightning strikes the ground near to an indoor pool, depending upon localized circumstances, it may be conducted into the building via low resistance conductors. These can be:

- Buried or pole-mounted telephone and electric wires
- Buried metal water lines or gas lines
- Metal light masts in parking lots with AC power fed from the building
- Fences that are contiguous to the building
- Cable TV lines, both aerial and buried
- Root systems of nearby trees
- Wet ground and wet paved parking lots (from rain) adjacent to buildings

## 3. Statistics

Observable lightning effects inside pool buildings have included: main circulation pump destroyed; injuries to employees touching electrical panels; concrete footing of slide blown apart; and visible lightning inside natatorium. The authors know of no databases recording deaths to persons in indoor pools. Lightning studies from NOAA over a 35-year period are not detailed and show only generalized activities or locations of lightning victims as below:

- Under trees = 13.7%
- Water related (fishing/boating/swimming) = 8.1%
- Golfing = 3.9%
- Driving machinery = 3.0%
- Telephone-related = 2.4%
- Open fields/ballparks = 26.8%
- Radios/antennas = 0.7%
- All others/unknown categories = 40.4%

However, lightning incidents to persons in non-pool buildings such as houses, apartments, office buildings, small shelters, etc. are well characterized with examples in the thousands. Such incidents describe lightning insults to people indoors on telephones, in contact with domestic water (sinks, tubs, showers, etc.) and touching metal doors, windows and other outside-to-inside conductors.

## 4. Codes and Standards

An internet search in "Google" under "indoor pools and lightning" will display more than 2,700 citations. Many of them describe swimming pool safety procedures when under lightning threat. Six states have recommendations or regulations for suspending indoor pool activities when under lightning threat: Delaware, North Dakota, South Dakota, Maryland, Rhode Island, and Michigan. Delaware's state code reads "during electrical storms the use of a pool (indoor or outdoor) shall be prohibited." Several large national groups describe building interior pool hazards (\*) or have recommended indoor pool activity suspension (\*\*) when nearby thunderstorms threaten. See:

- National Athletic Trainers Assn.\*\* (NATA)  
[www.nata.org](http://www.nata.org) (type "lightning" in search box)
- National Collegiate Athletic Assn.\* (NCAA)  
[www.ncaa.org/library/sports\\_sciences/sports\\_med\\_handbook/2002-03/1d.pdf](http://www.ncaa.org/library/sports_sciences/sports_med_handbook/2002-03/1d.pdf)
- American College of Emergency Physicians \*\* (ACEP)  
[www.acep.org](http://www.acep.org) (type "lightning" in search box)
- US Swimming, Inc. \*\*  
[www.usa-swimming.org](http://www.usa-swimming.org) (type "lightning" in search box)
- YMCA Services Corporation\*\*  
[www.yservicescorp.com/Docs/Guidelines/LightningPoolGuide.doc](http://www.yservicescorp.com/Docs/Guidelines/LightningPoolGuide.doc)

All pool buildings should be equipped with lightning protection as specified in the most recent version of National Fire Protection Association NFPA-780 Standard for the Installation of Lightning Protection Systems. Special attention should be paid to surge protection and bonding issues. A comprehensive inspection should be conducted by a qualified electrician every five years.

## 5. Recommendations for Lightning Safety at Indoor Pools

**1. Recognize the threat.** We suggest detection methods such as: the TV Weather Channel; an inexpensive weather radio; seeing lightning and/or hearing associated thunder; or subscription services such as [www.lightningstorm.com](http://www.lightningstorm.com) We do not recommend expensive dedicated lightning detectors. (See more [details on lightning detection](#)).

**2. Identify in advance SAFE and NOT SAFE places:**

- SAFE = dry areas inside large permanent buildings
- NOT SAFE = near electrical conductors, electrical equipment, metal objects (lifeguard stands, ladders, diving board stanchions), and water, including showers

**3. Take action to suspend activities.** When lightning is within 6-8 miles, evacuate people to safe areas. Guards should secure the entrance to the pool deck.

**4. Determine when activities should be resumed.** Wait 30 minutes after the last observed lightning or thunder, since lightning may visit from the back end of the passing thunderstorm.

## 6. Conclusion

There is a built-in conflict between indoor pool activities and lightning safety. Both recreational swimming and competitive swimming events are based upon three icons of Entertainment, Health, and Pleasure. Lightning safety is founded on stopping all those forms of enjoyment. A Risk Management/Safety Professional will err on the side of caution every time and will be found harmless from allegations or claims of negligence. Such a conservative approach will find many objectors. Safety, however, is the prevailing directive.

## 7. References

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7.2 Caixeta, G.P. and Pissolato, Fihlo, J., 1998: Electromagnetic Field Induced In The Interior of a Building by Lightning, Proceedings Intl. Conference on Lightning Protection, Birmingham UK.

7.3 Uman, M.A., et al, 2002: Correlated time derivatives of current, electric field intensity, and magnetic flux density for triggered lightning at 15 m, Jnl. Geophysical Res., Vol 107, No. D13.

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