



AST Lightning Protection - API 545 Update

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HMT Inc.









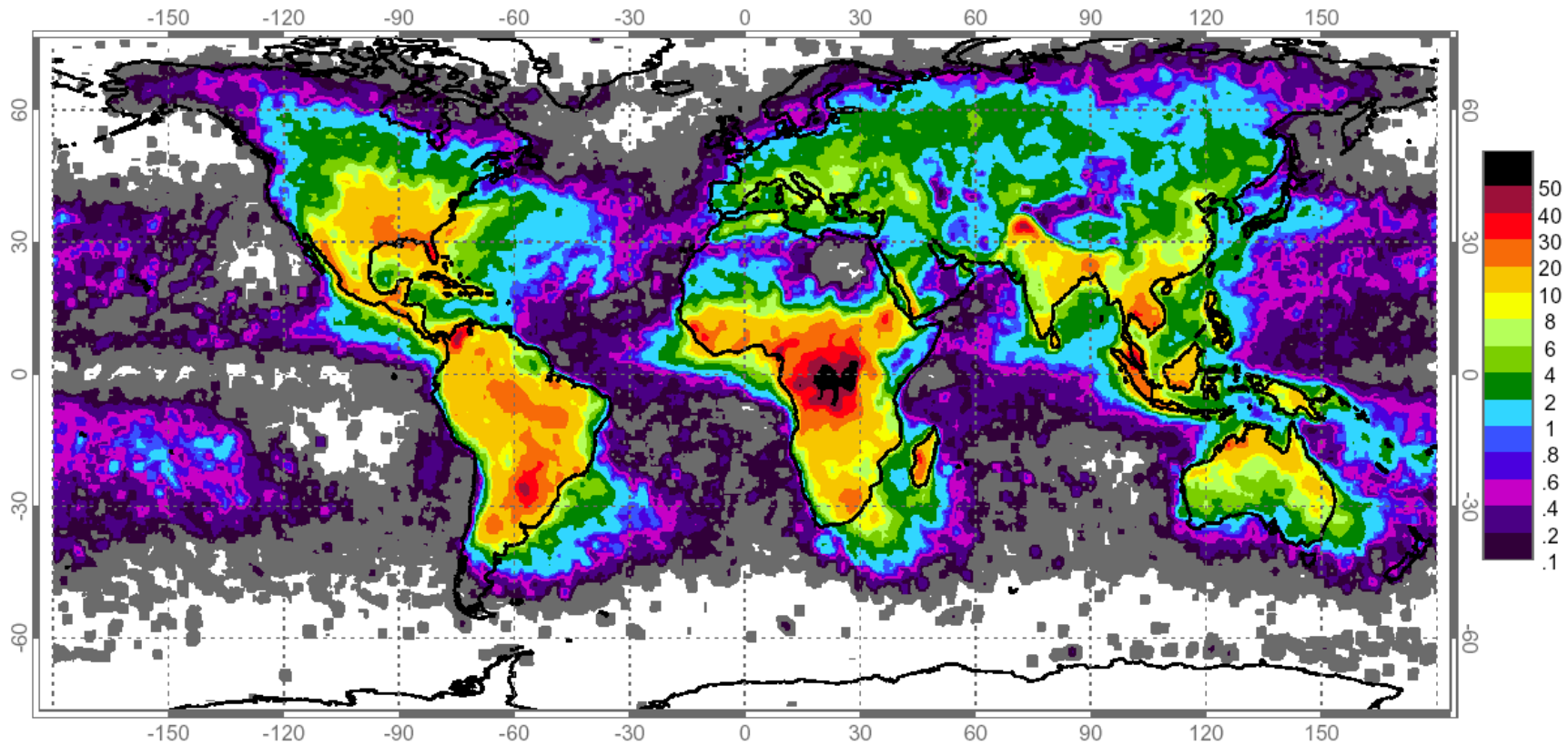


Not Cool!

- Lightning
- Venting
- Protection



Frequency of Lightning Strikes



Units: Flashes/sq km/year – Source: NSSTC Lightning Team

Lightning Strikes and AST Tank Fires

- One Study
 - 0.16% of tanks will have a rim fire each year
 - 95% of these are due to lightning
 - 1.8% of rim fires will extend to full surface fires
- Another Study
 - 5 to 7 tank fires per year caused by lightning
- Flammable vapors mixed in certain concentrations with oxygen create the potential for explosion when presented with an ignition source

Lightning Induced Fires – Fixed Roof Tanks

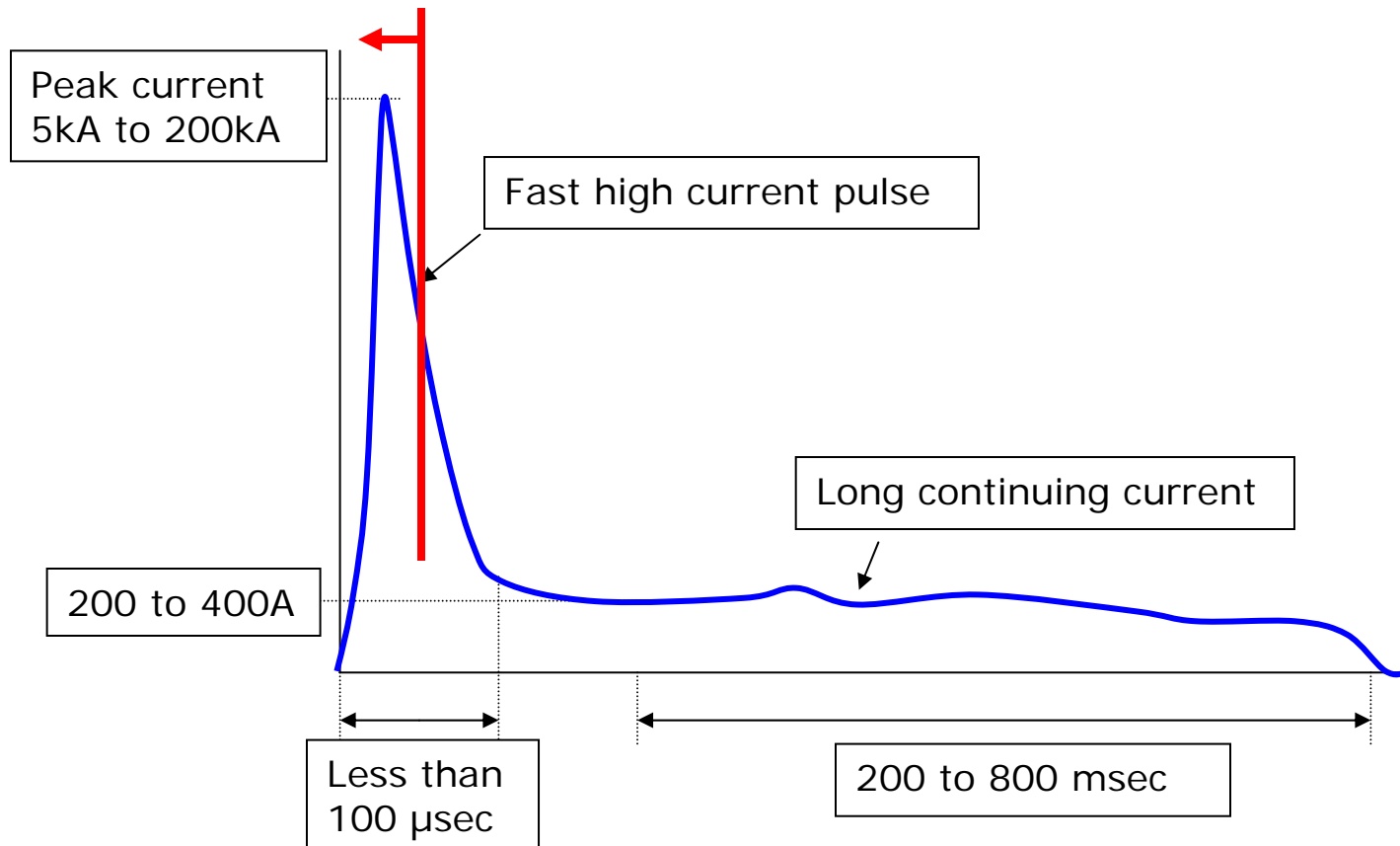
- Faraday Cage Effect
 - Current will flow over the exterior of the tank shell
- Flammable vapors present at atmospheric vents
 - Intermediate or high vapor pressures
 - No floating roof
 - Inadequate or unmaintained seals
 - Overfilling
 - Recently vented tanks for maintenance
 - Recently floated roofs
- Proper venting
 - Should be in accordance with API 650 Appendix H
- Proper seal maintenance

Lightning Induced Fires – EFR Tanks

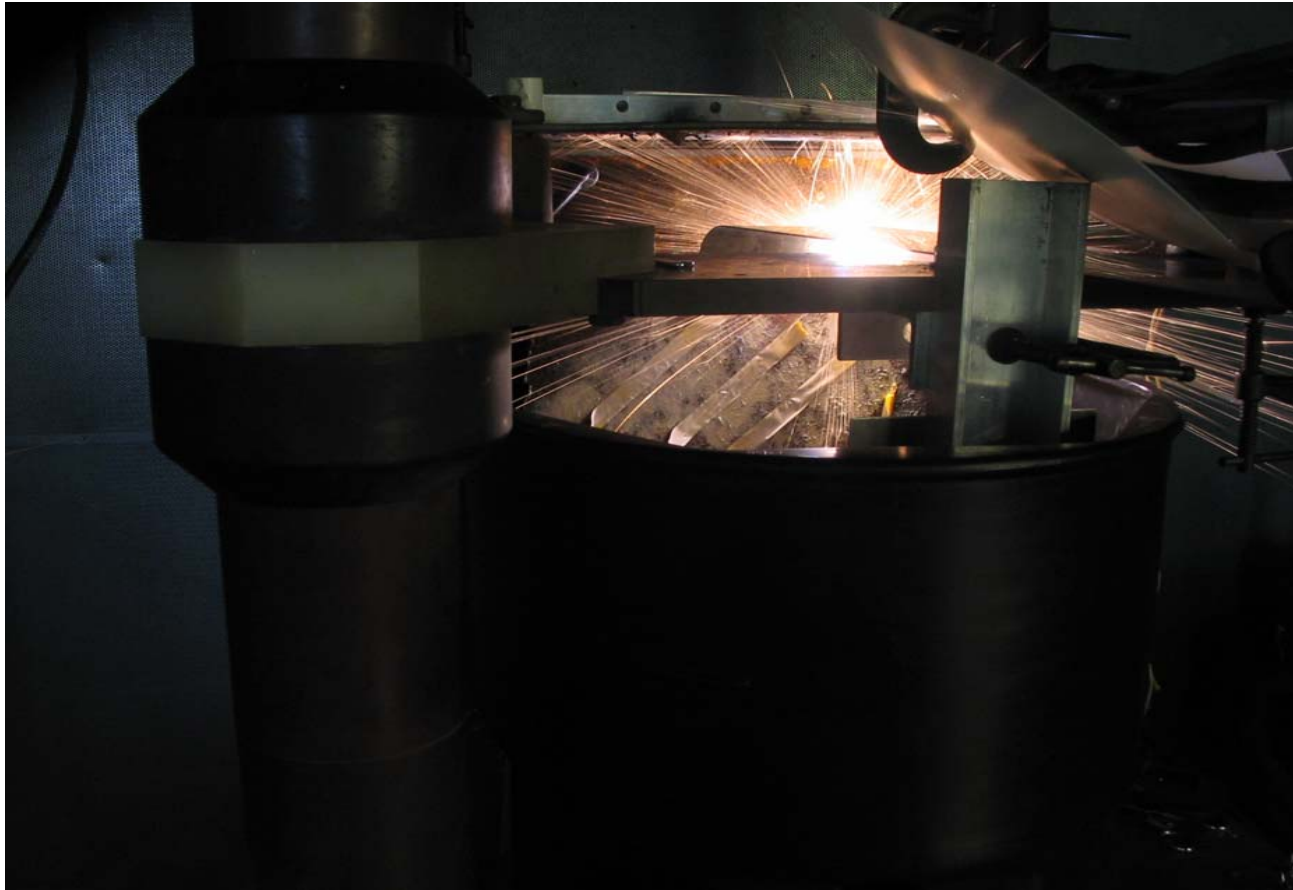
- Main focus of API 545
- Let's understand lightning a little more...



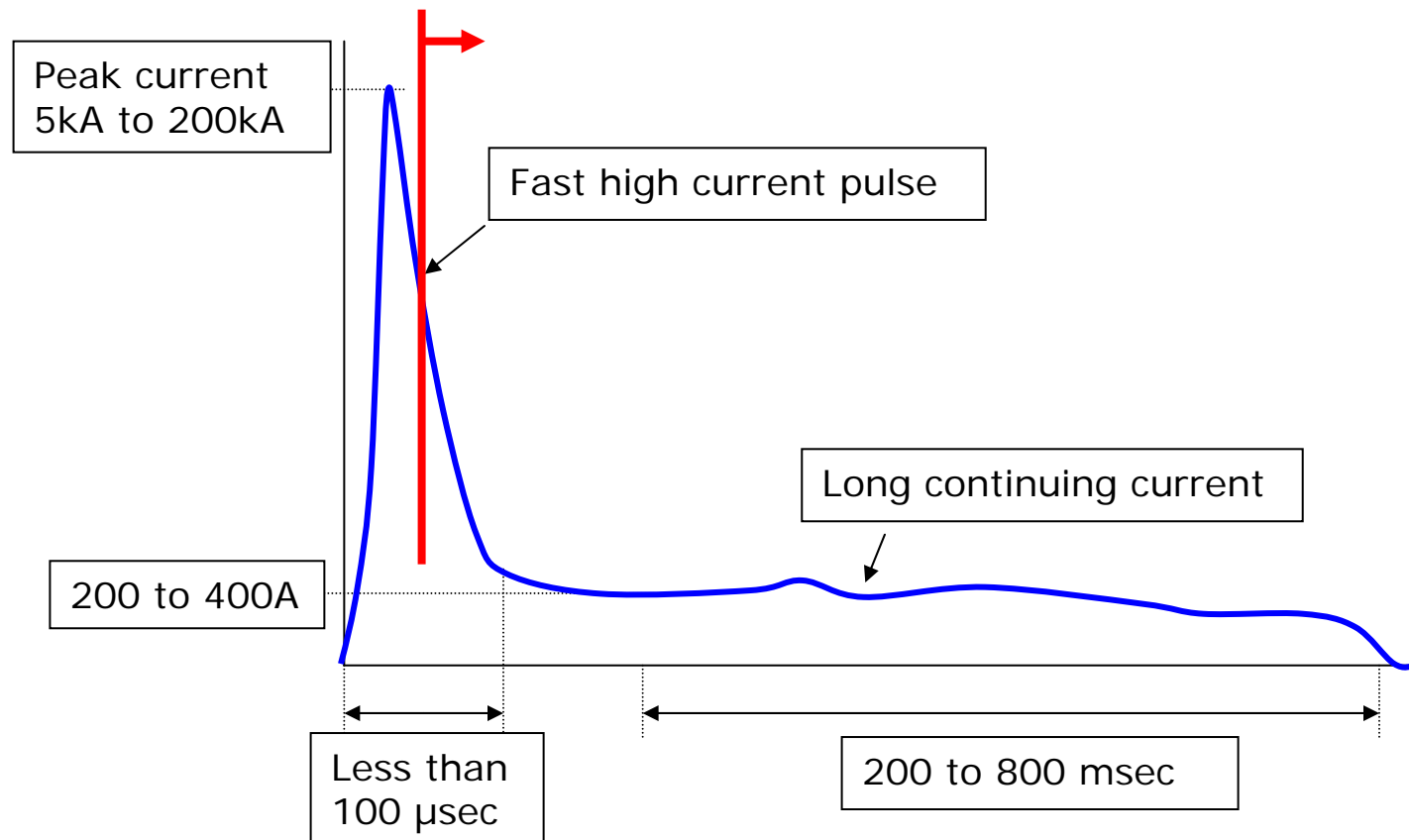
Lightning Wave Shape



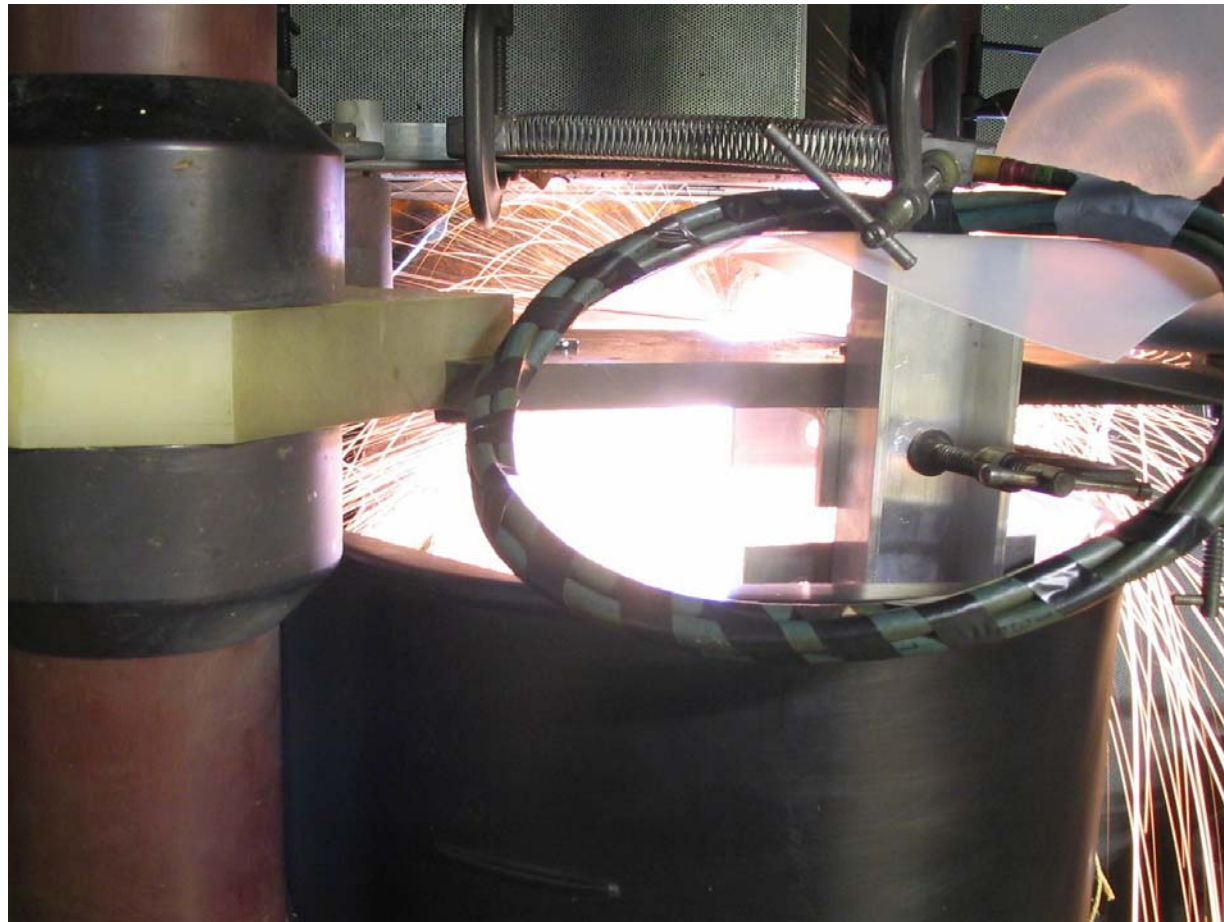
Arcing from the Fast Component



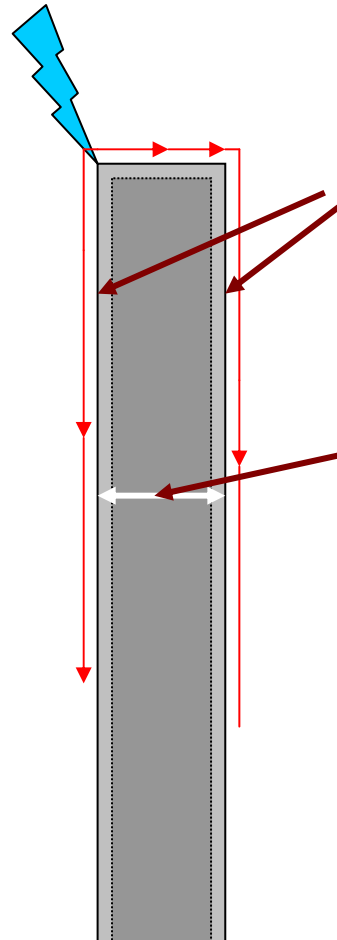
Lightning Wave Shape



Arcing from the Slow Component



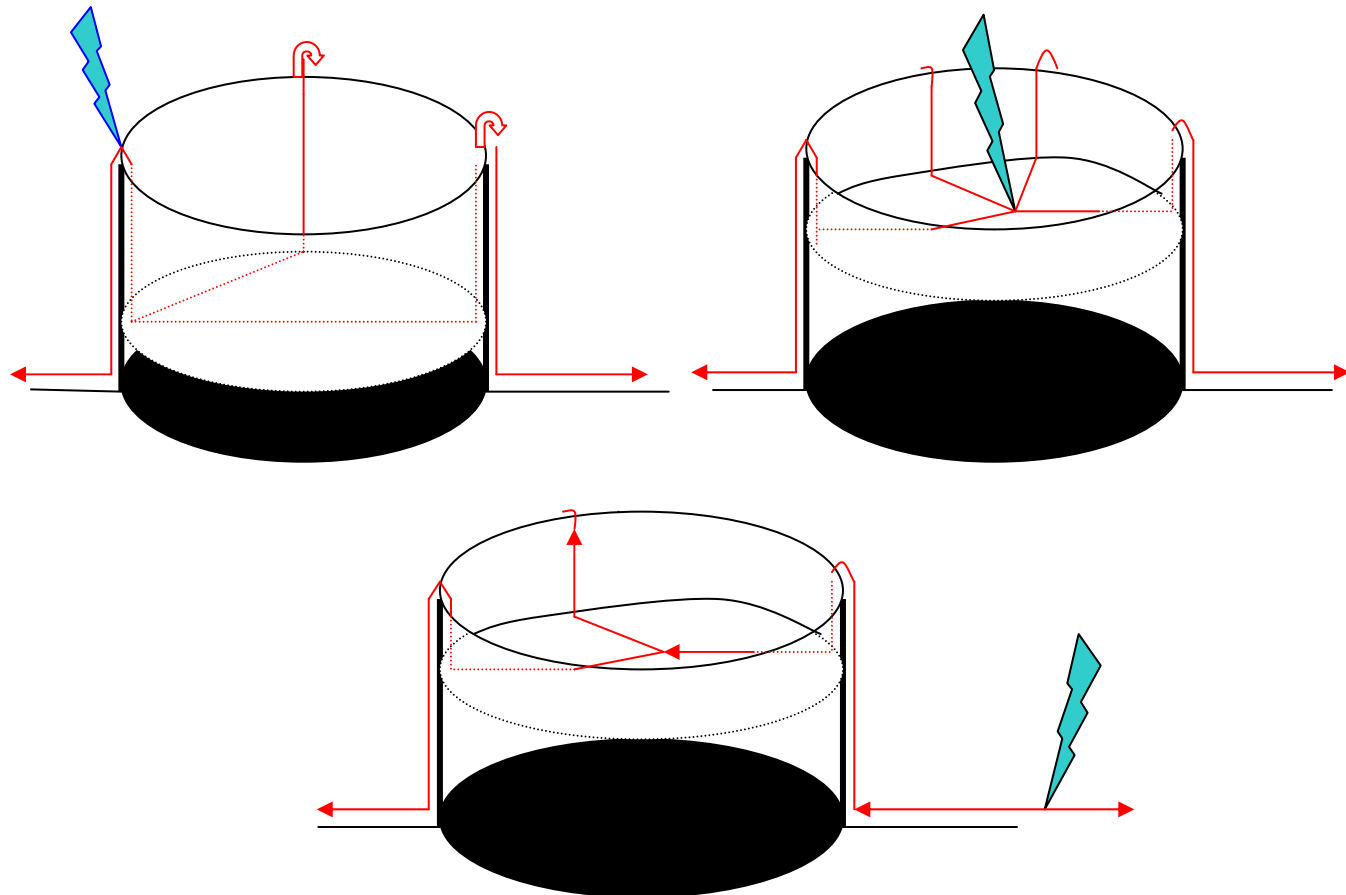
Skin Effect in Steel



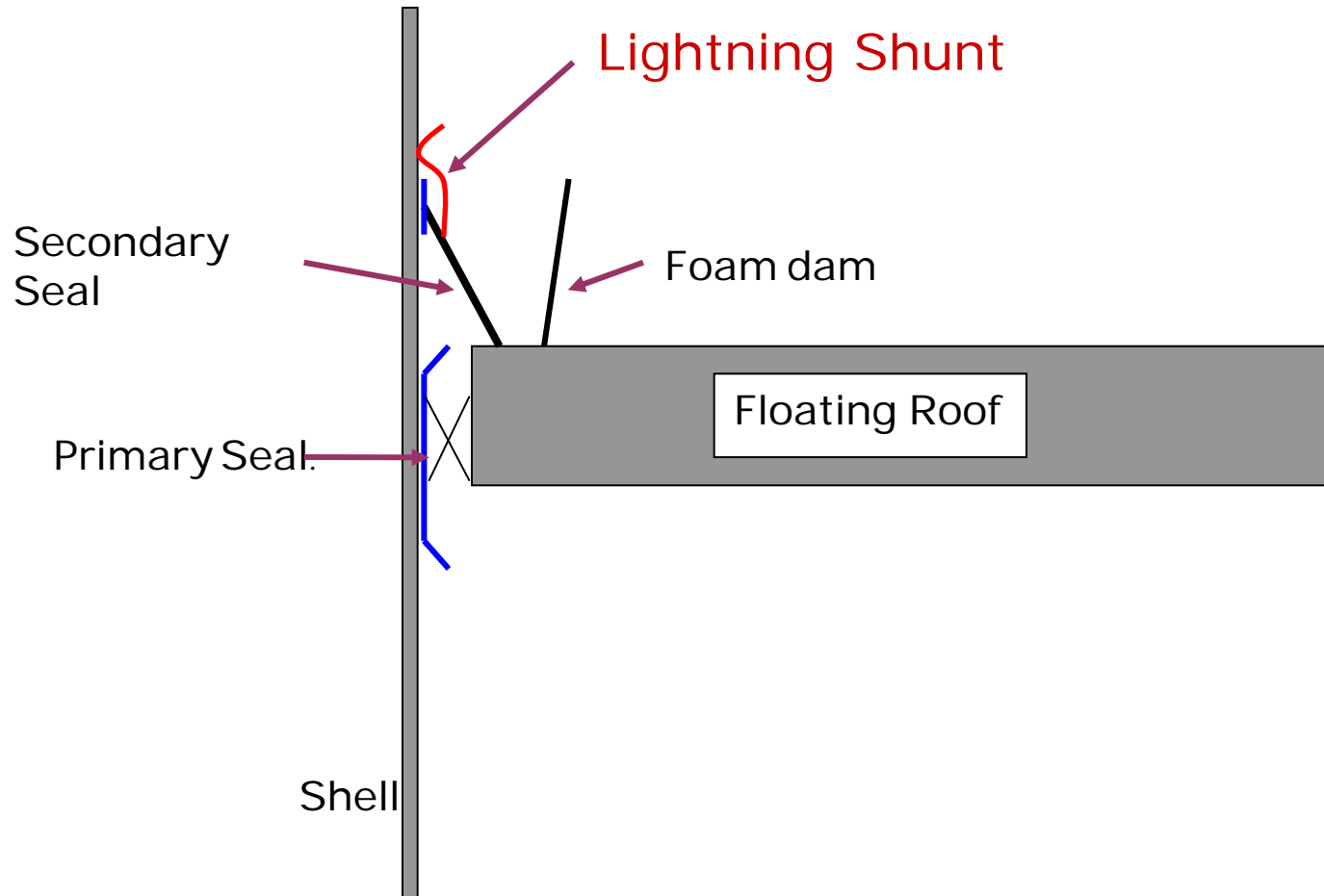
The Fast Component of the lightning wave only travels in the outermost 0.020 inches of the steel shell.

Even though the tank shell has a cross section of $\frac{1}{4}$ inch or greater.

Potential Lightning Strike Points



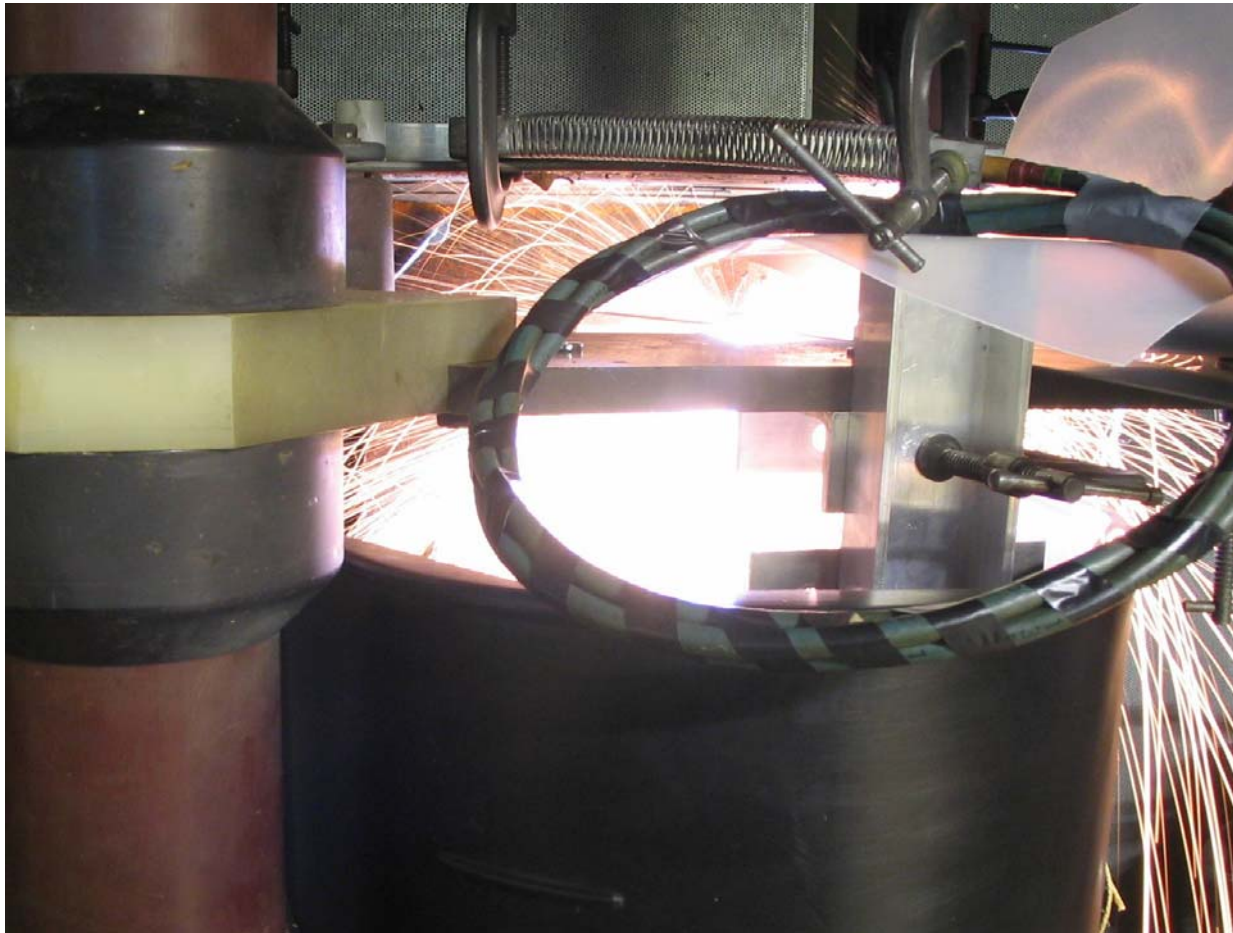
Typical Lightning Protection



Lightning Shunts



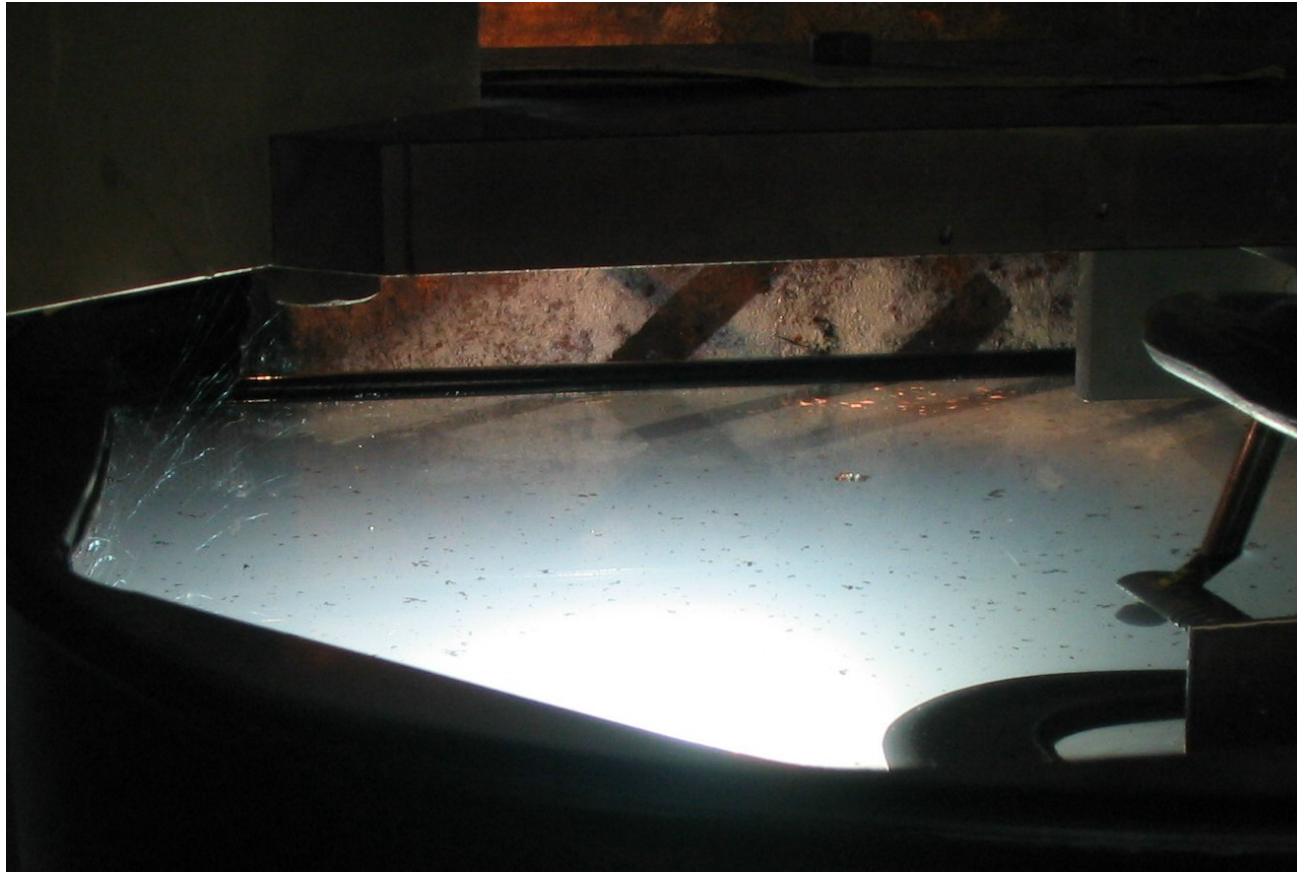
Arcing from Above Liquid Shunt



API 545 Update

- NFPA 780 required shunts can generate showers of incendive sparks.
- Roof bonding straps reduce the magnitude of sparking for the long duration component but are not effective for the fast component.
- With shunts submerged to 300mm the eruption of sparks is unlikely, even without bonding cables.
- Metallic seals must be electrically insulated.
- Bonding cables combined with submerged shunts affords the highest level of protection.

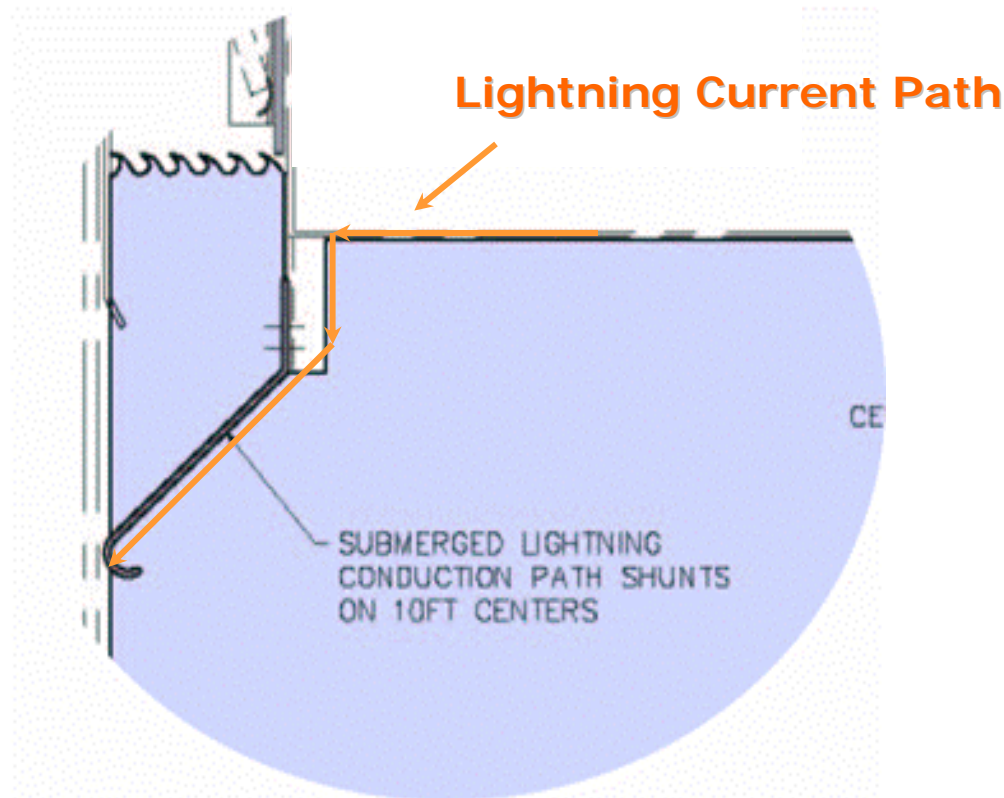
Arcing from Submerged Shunt



Effective Protection Components

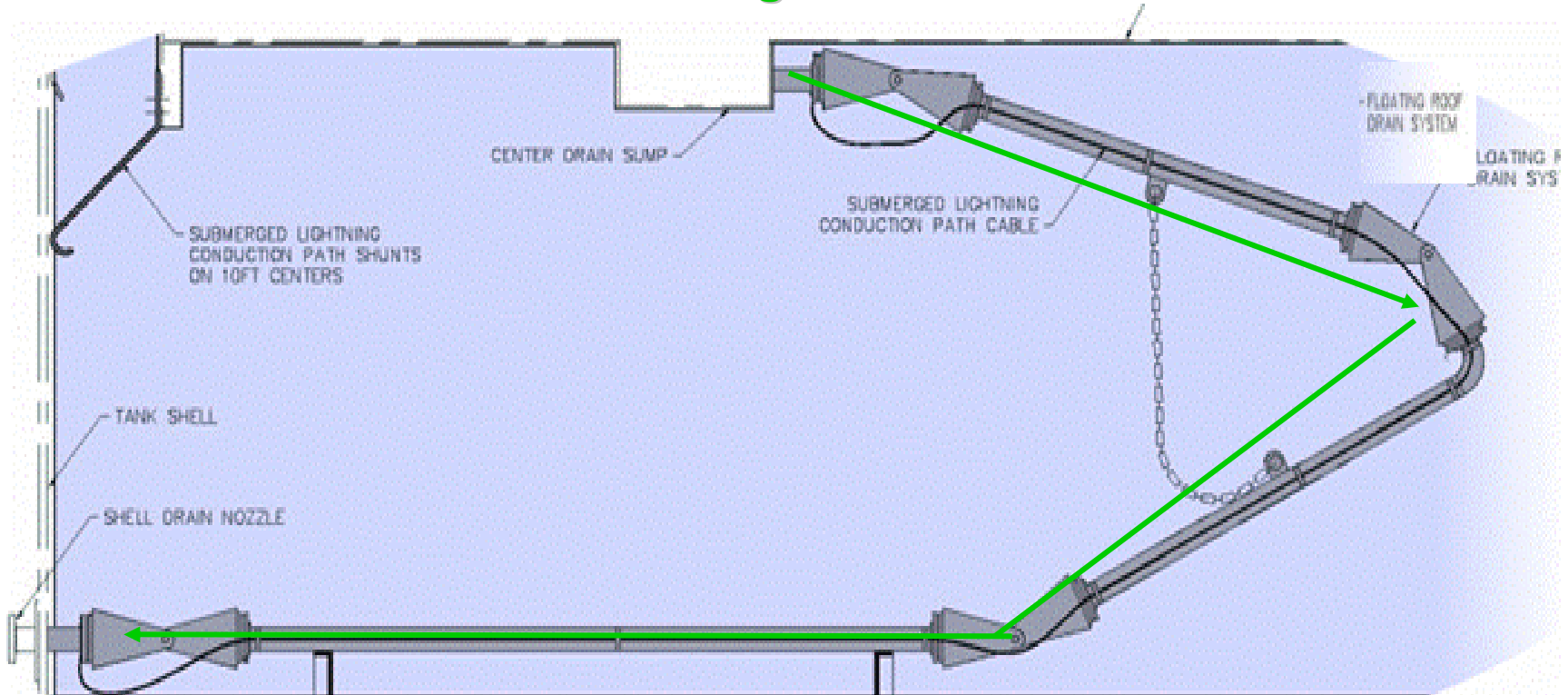
- Submerged Conduction Path Shunts
- Submerged Conduction Path Cable
- Insulated Primary Floating Roof Seal
- Insulated Secondary Floating Roof Seal
- Submerged Conduction Path Shunts for thru-deck projections

Submerged Lightning Shunts

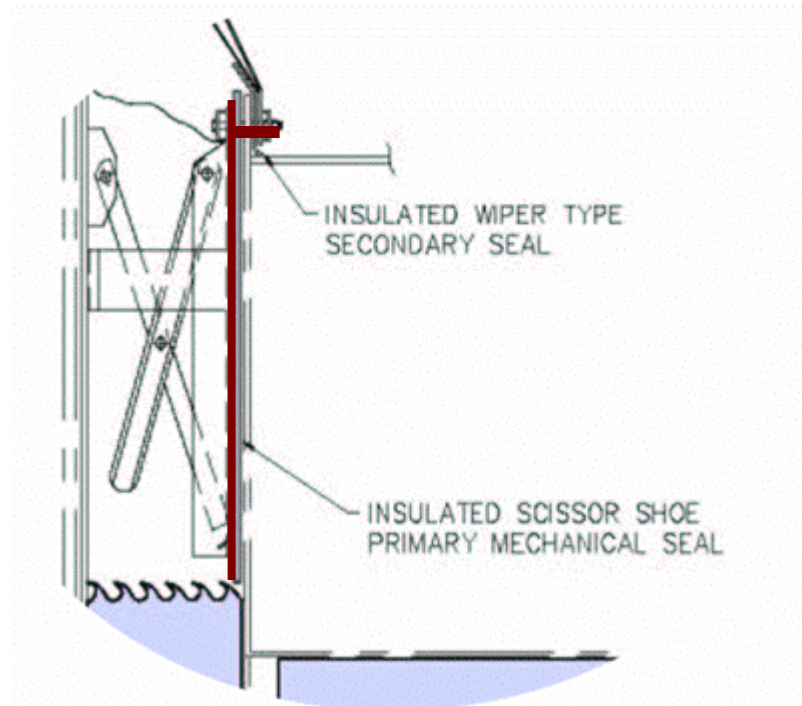


Submerged Grounding Cable

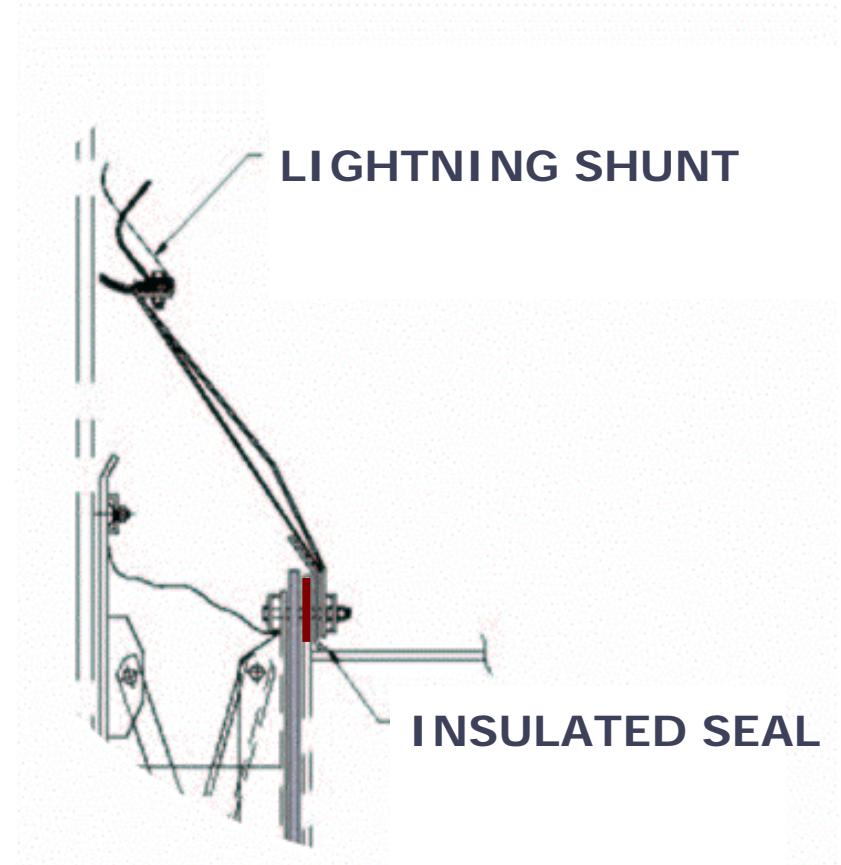
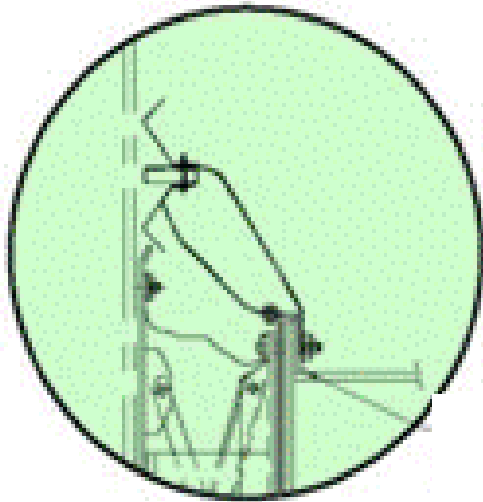
Lightning Current & Static Discharge Path



Insulated Primary Seal

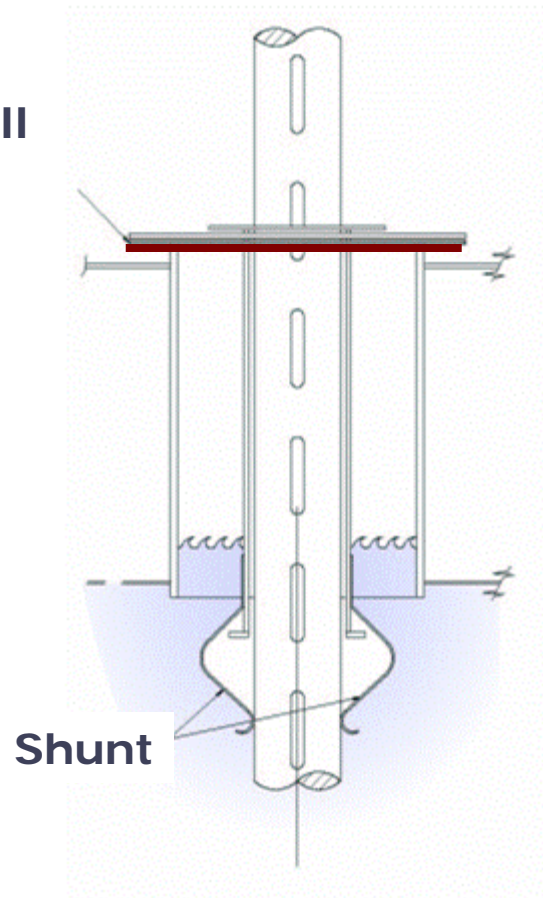


Insulated Secondary Seal

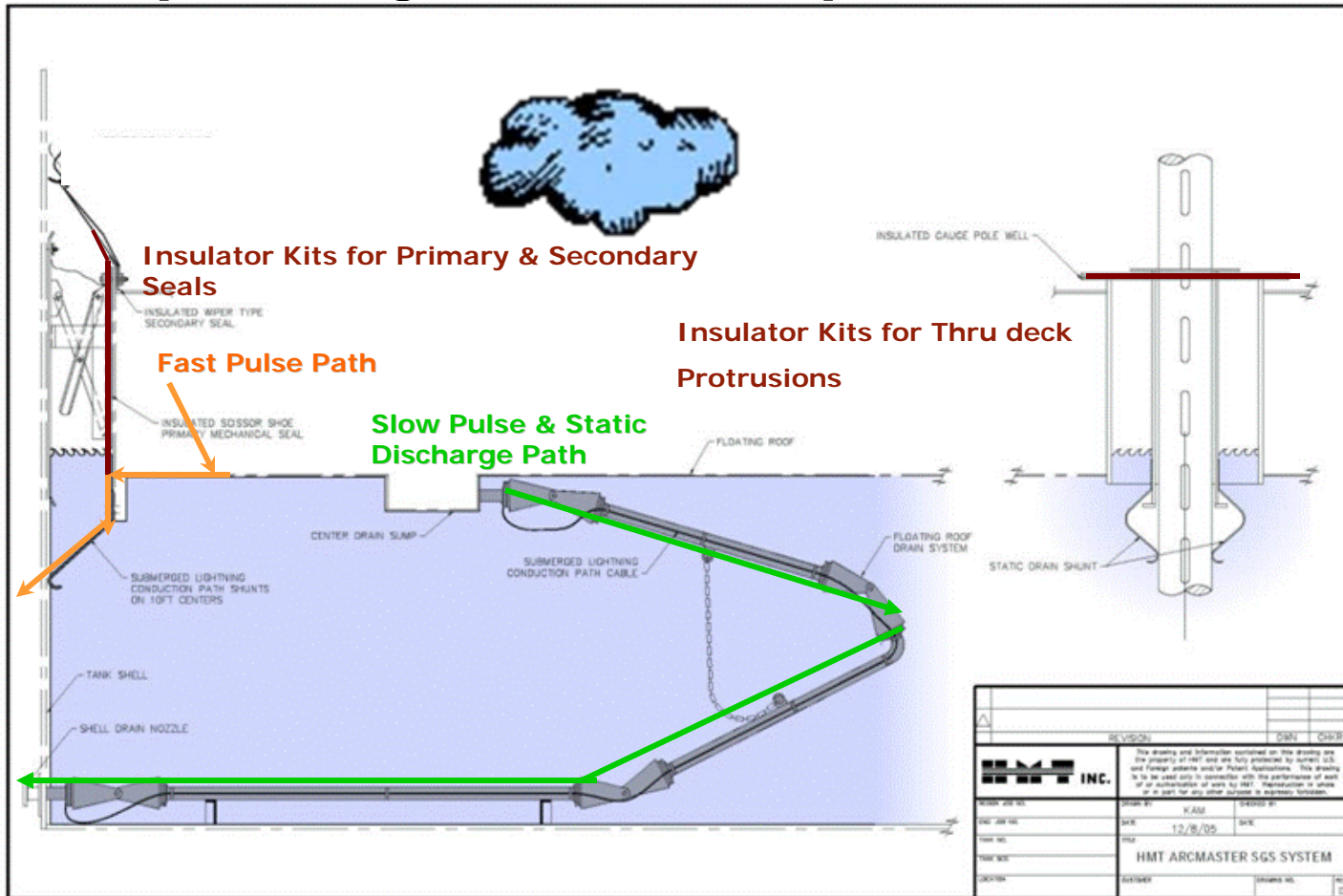


Isolated Appurtances

Insulated Gauge Pole Well



Complete System Principle



Summary

- System components must work together to provide conduction paths for lightning currents
- Tight fitting primary and secondary seal systems are necessary for an effective defense against lightning induced ignition
- Risk of lightning induced ignition is significantly reduced with a submerged protection system

Conclusion

COOL!



NOT COOL!





Thank you!

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