



**Glenpool South Tank Farm
Glenpool , Oklahoma
April 7, 2003**

**Storage Tank Explosion and Fire
ConocoPhillips**



Investigation Team and Support Staff

- **Rick Flint** Investigator-in-Charge
- **Dr. Joseph Kolly,** Explosion and Fire
Nancy McAtee &
Dr. Merritt Birky
- **Leslee Shumway** SCADA and Control Systems
- **Frank Zakar** Materials Laboratory
- **Robert Moore &** Editors
Meg Athey

Estimated man hours for the investigation: 4,500



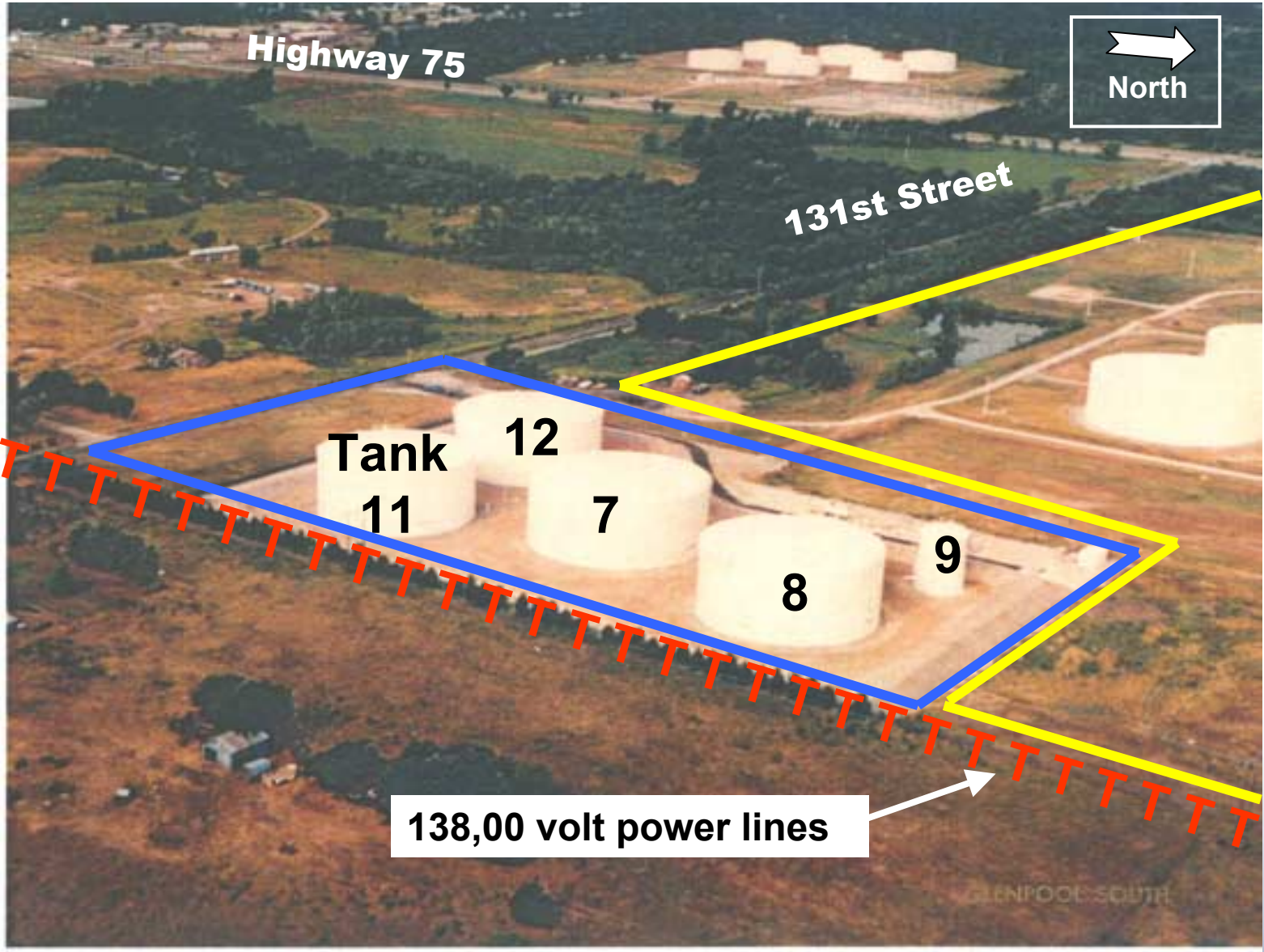
Parties to the Investigation

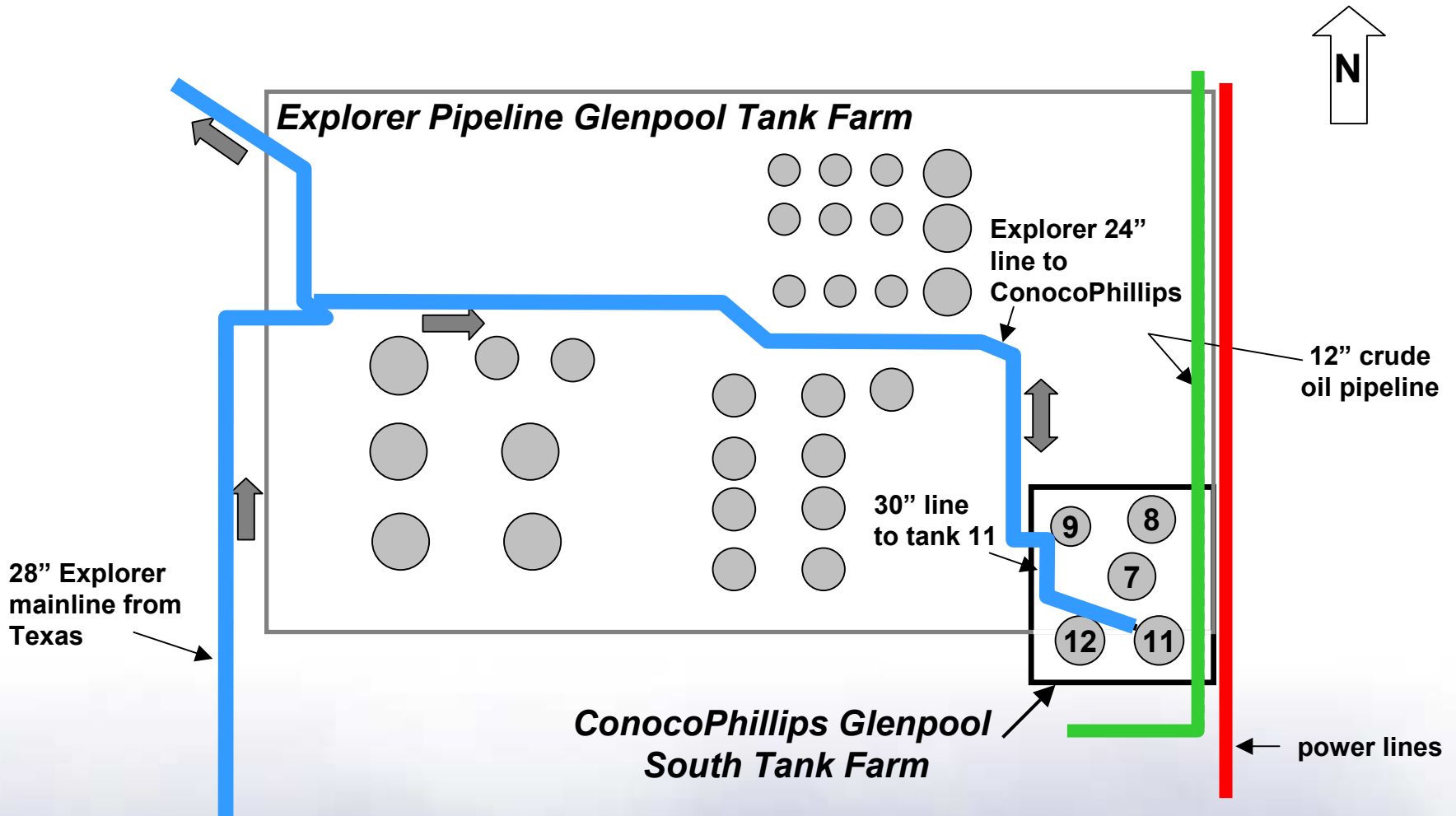
- **ConocoPhillips**
- **Explorer Pipeline**
- **Office of Pipeline Safety**
- **Glenpool Fire Department**





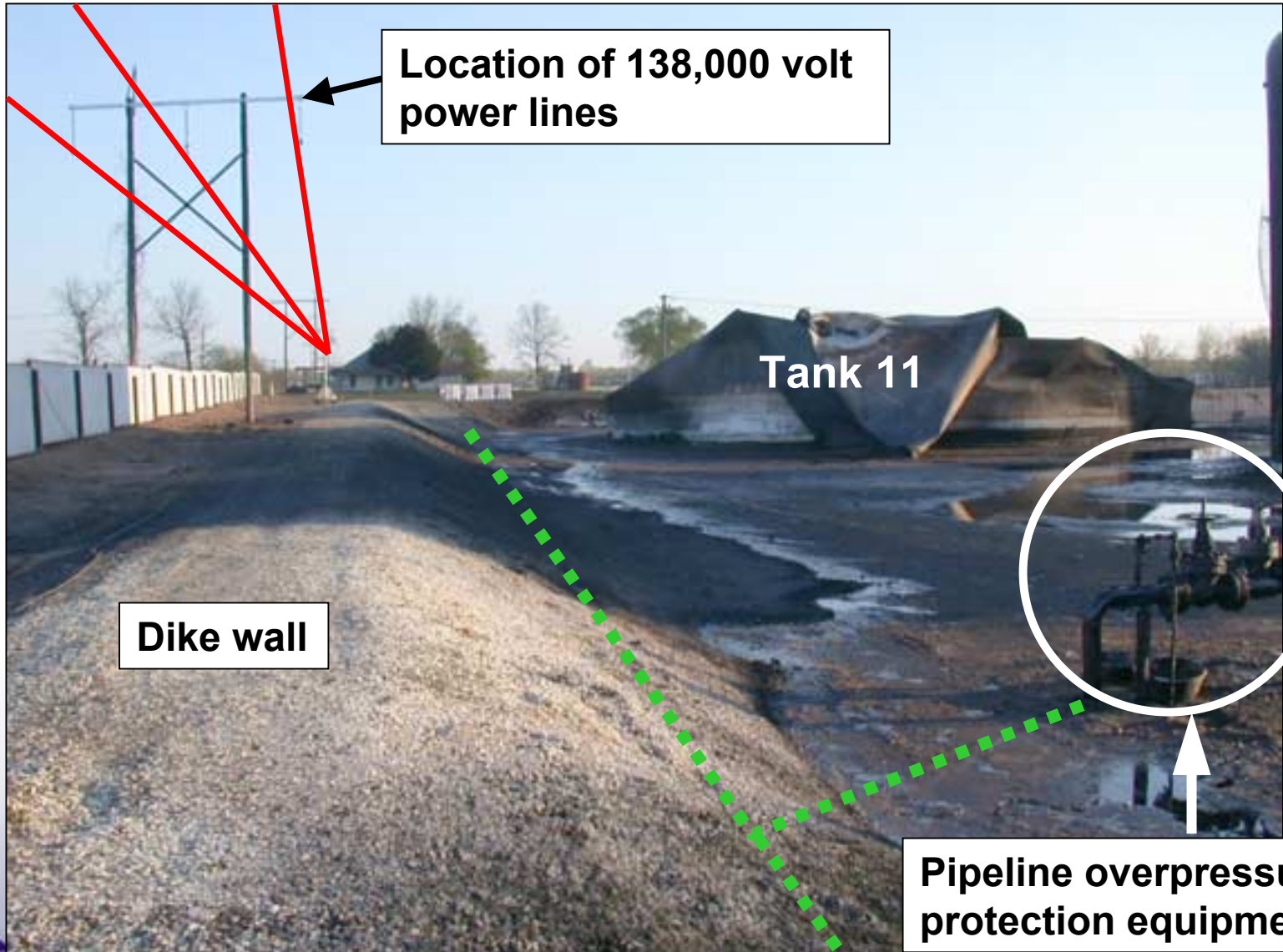
National Transportation Safety Board





Explorer and ConocoPhillips Tank Farms





Location of 138,000 volt power lines

Tank 1

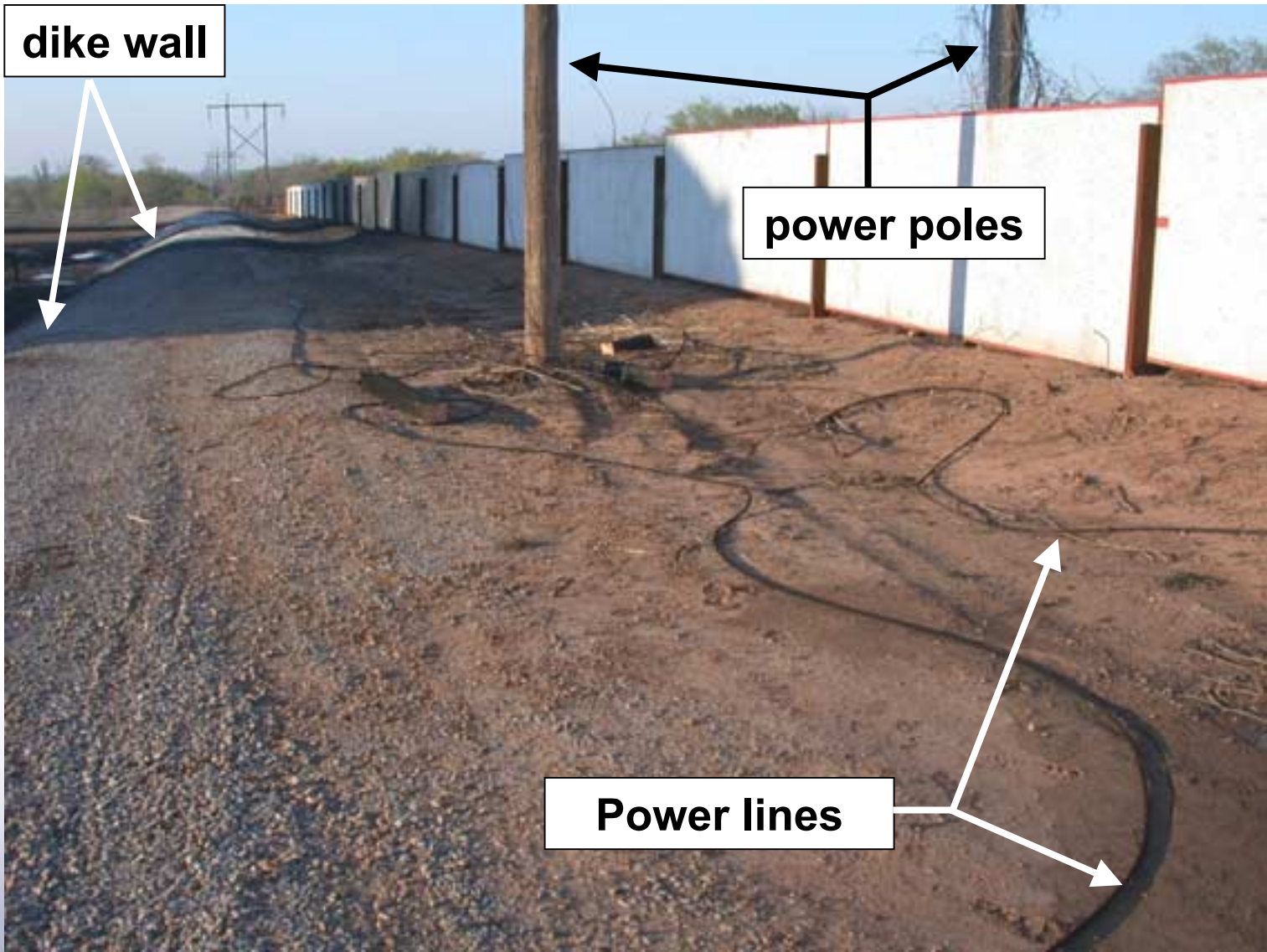
Dike wall

Pipeline overpressure protection equipment





National Transportation Safety Board



dike wall

power poles

Power lines







National Transportation Safety Board

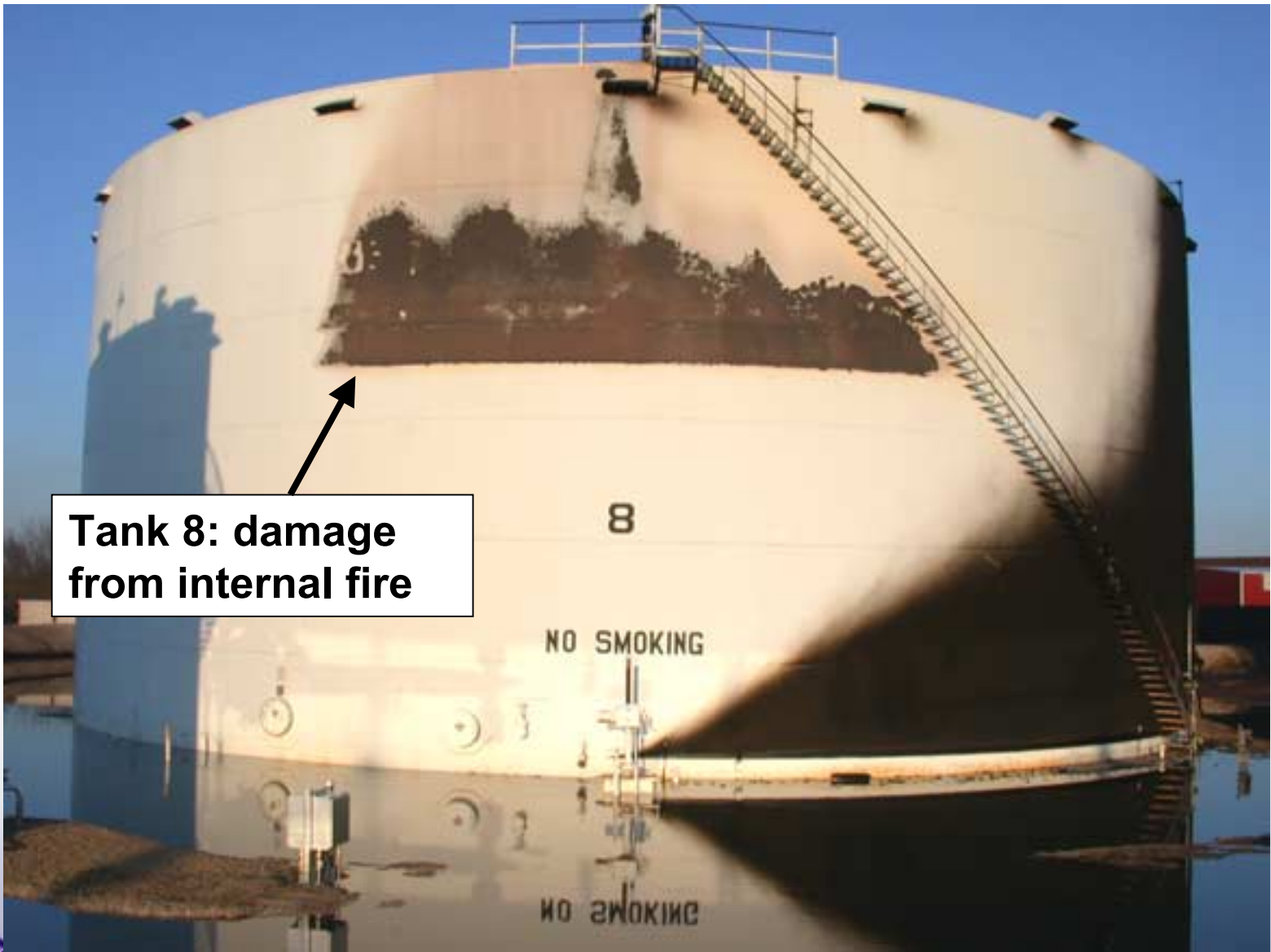


Tank 7

Tank 11



National Transportation Safety Board



Tank 8: damage from internal fire





National Transportation Safety Board



Safety Issues

- **Tank operations, including switch loading**
- **The adequacy of emergency planning and emergency response by ConocoPhillips and American Electric Power**
- **The adequacy of Federal regulations and industry standards for emergency planning**



Safety Issue #1

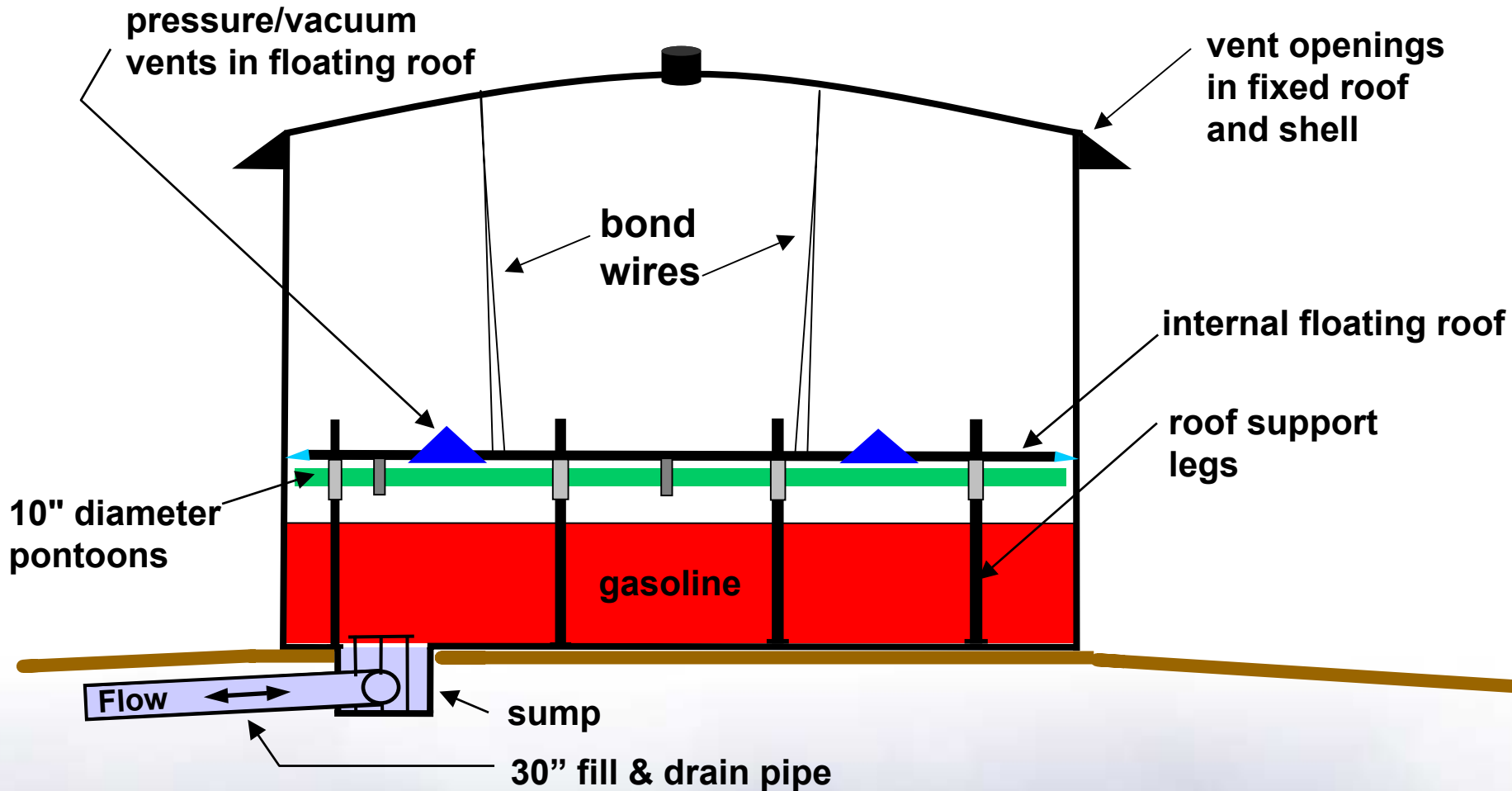
**Tank operations, including
switch loading, at the
ConocoPhillips tank farm**



Switch Loading

- **Empty tank that previously contained gasoline was being filled with diesel**
- **Hazards of switch loading**





Tank 11 with the floating roof landed



Tank Operations

- **Fill velocity and turbulence increase static charge**
- **Diesel is a static charge accumulator**
- **Increased risk of a static discharge inside tank 11**



Tank Operations - Flammability

- **Tank operations with gasoline on April 4 to 7 created a flammable mixture inside the tank**



Gasoline in storage

mechanical pressure/
vacuum vents in floating
roof (closed)

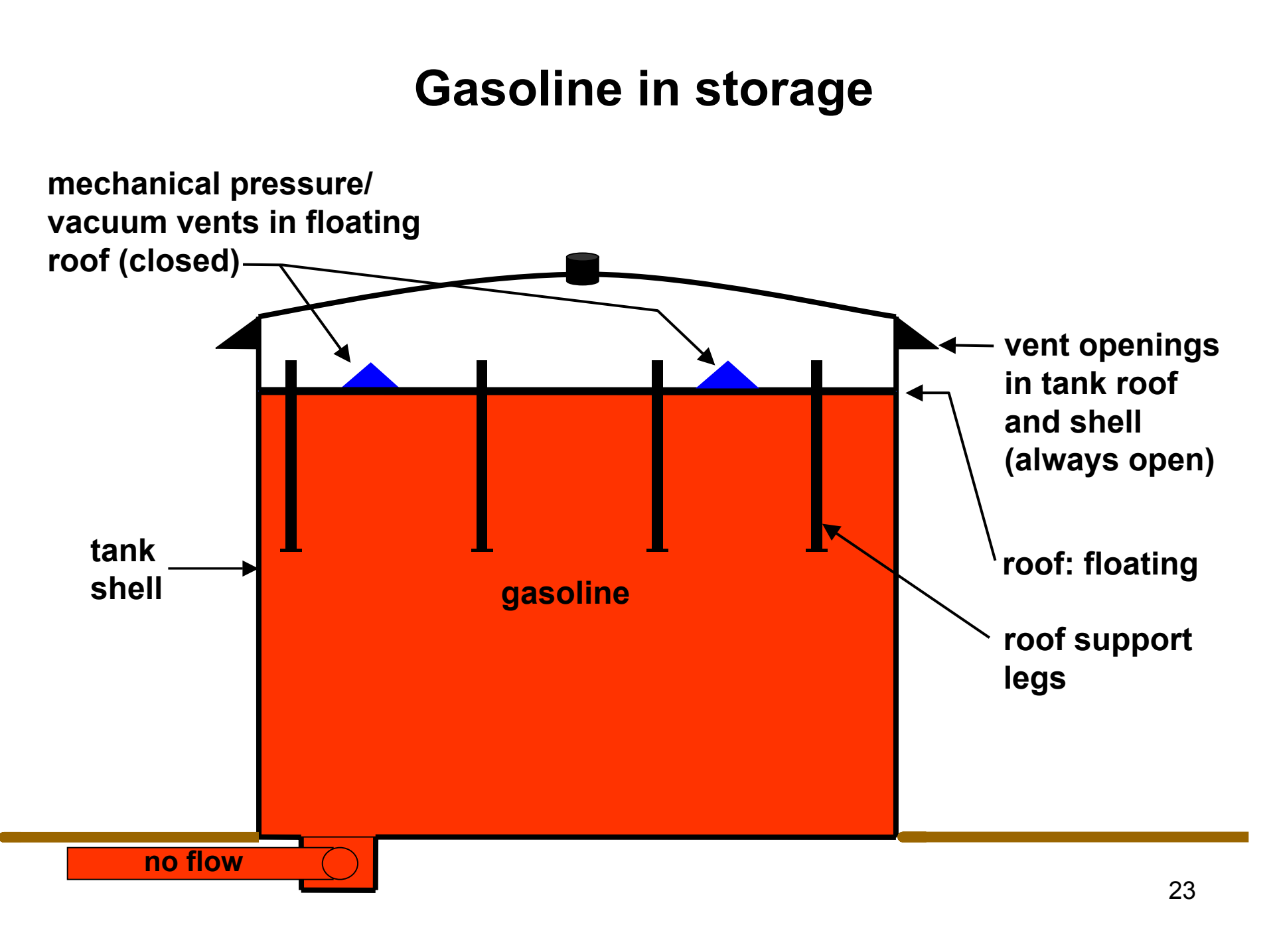
vent openings
in tank roof
and shell
(always open)

roof: floating
roof support
legs

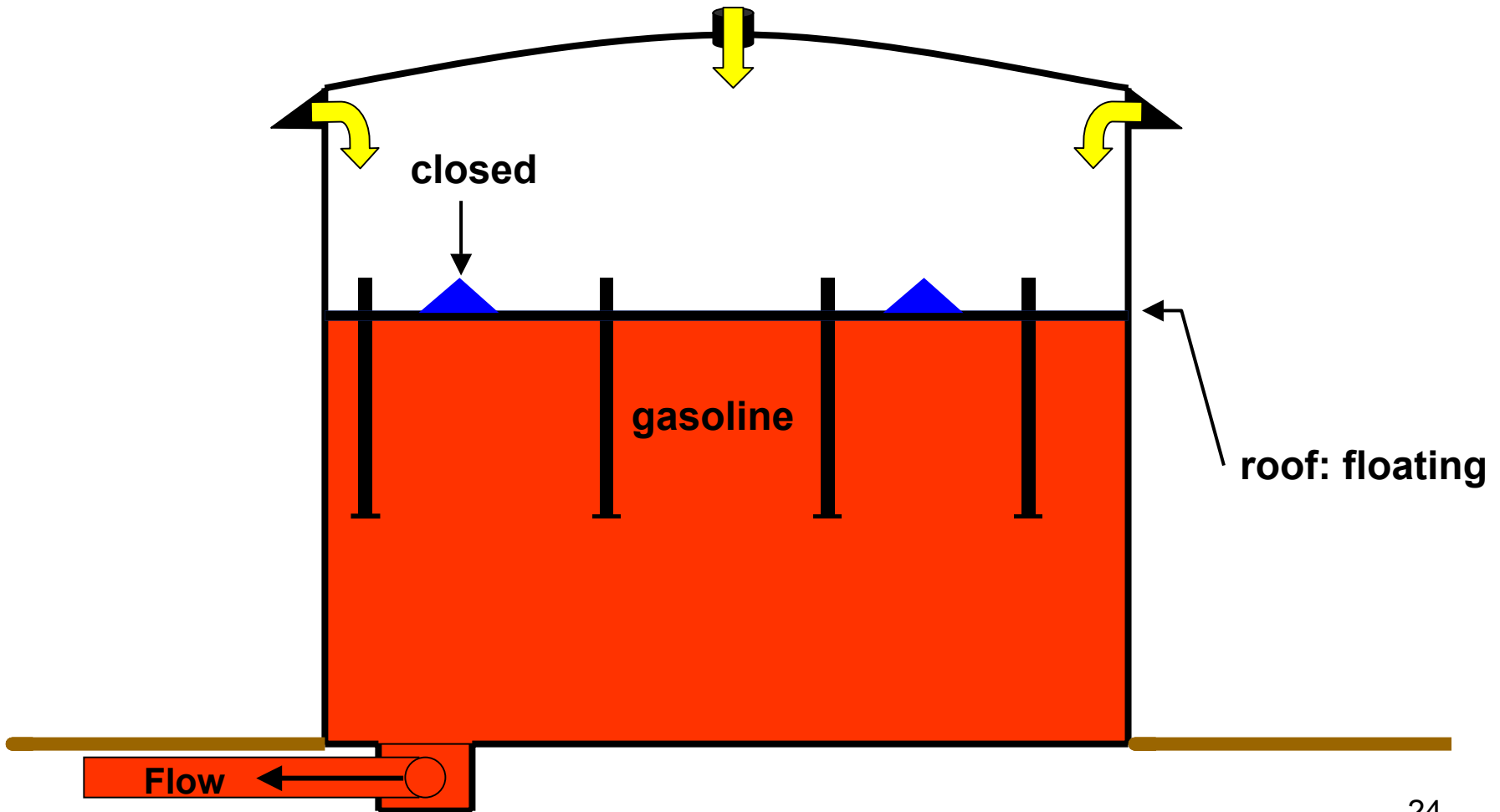
tank
shell

gasoline

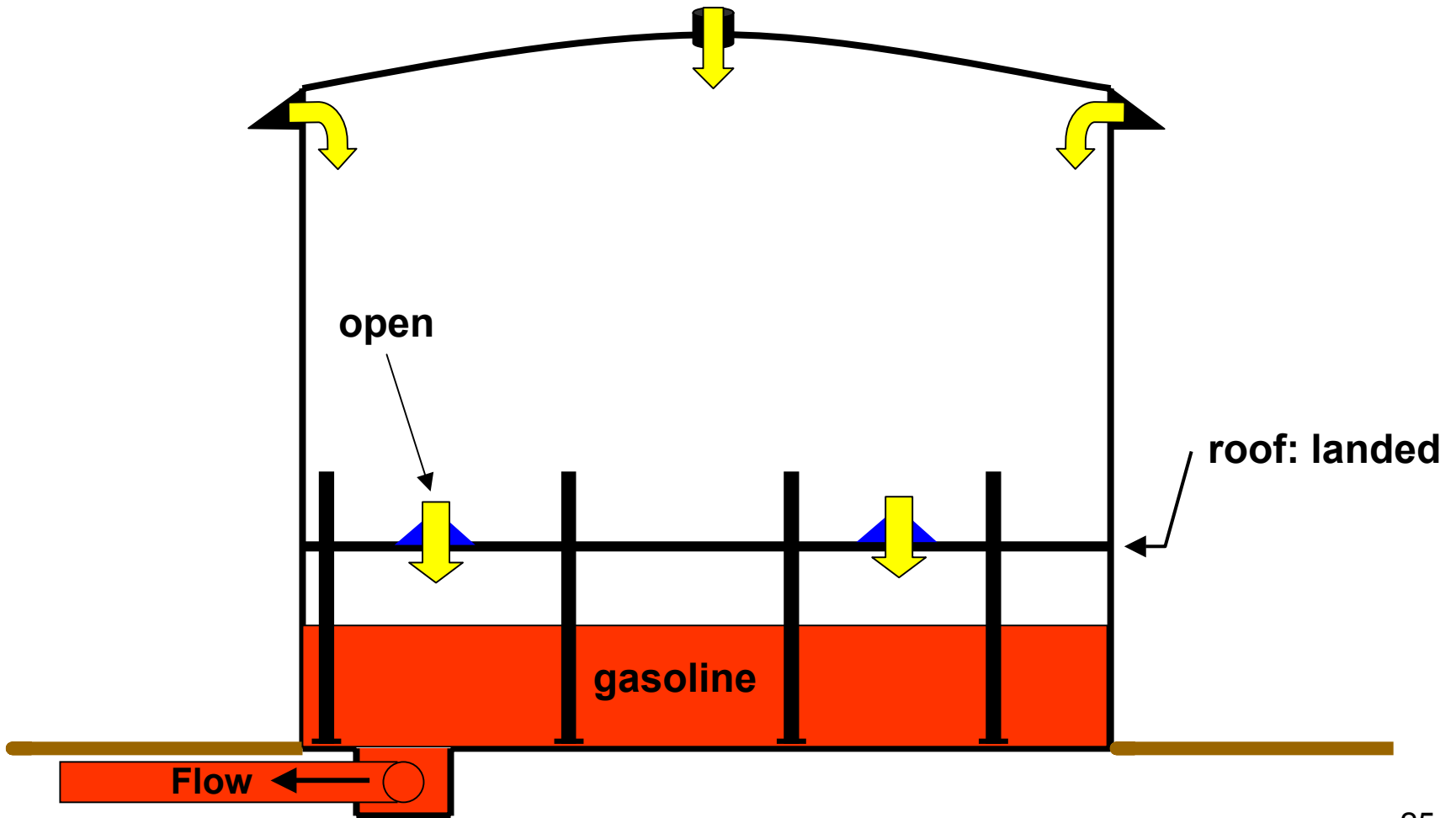
no flow



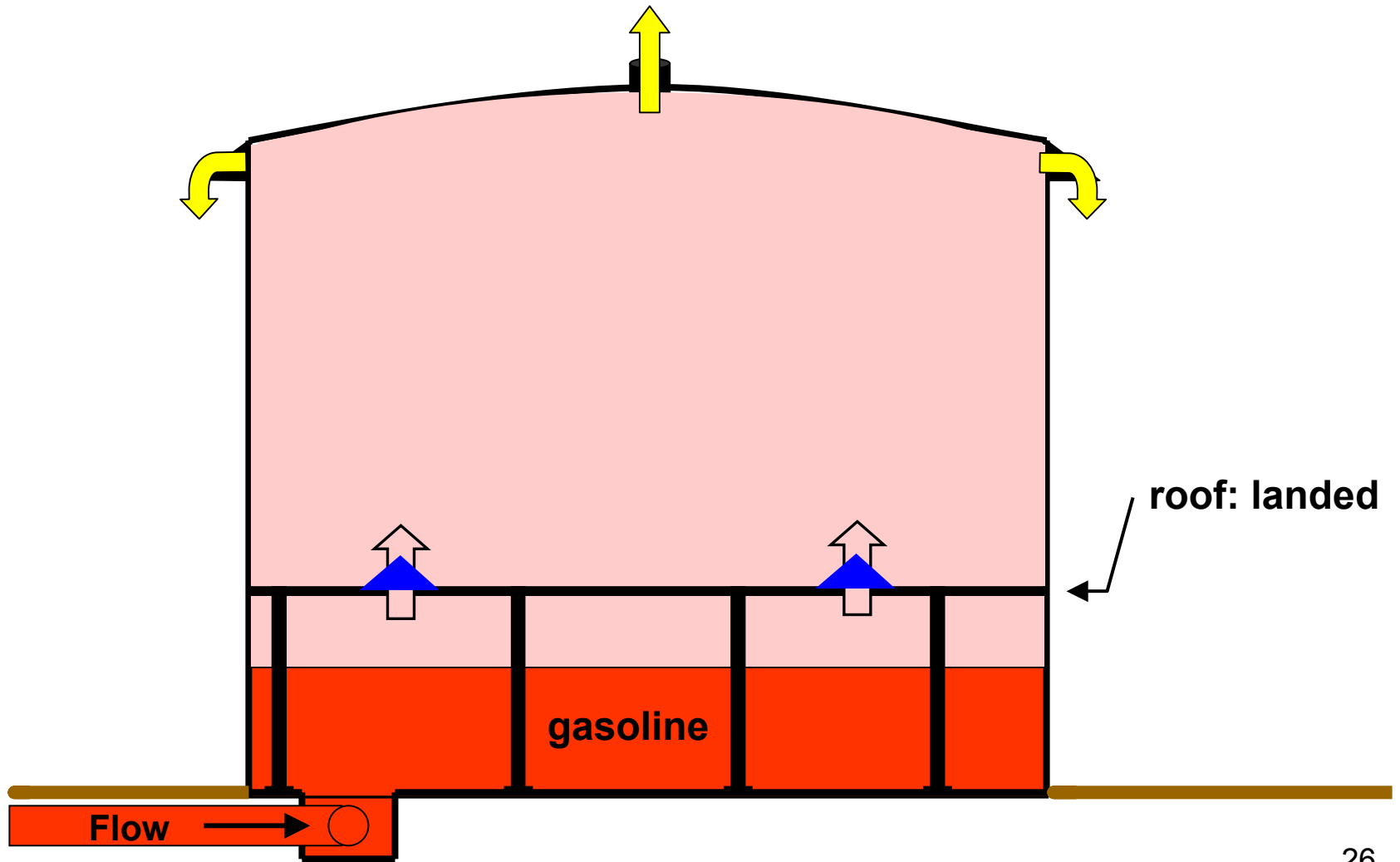
Gasoline removed (roof floating)



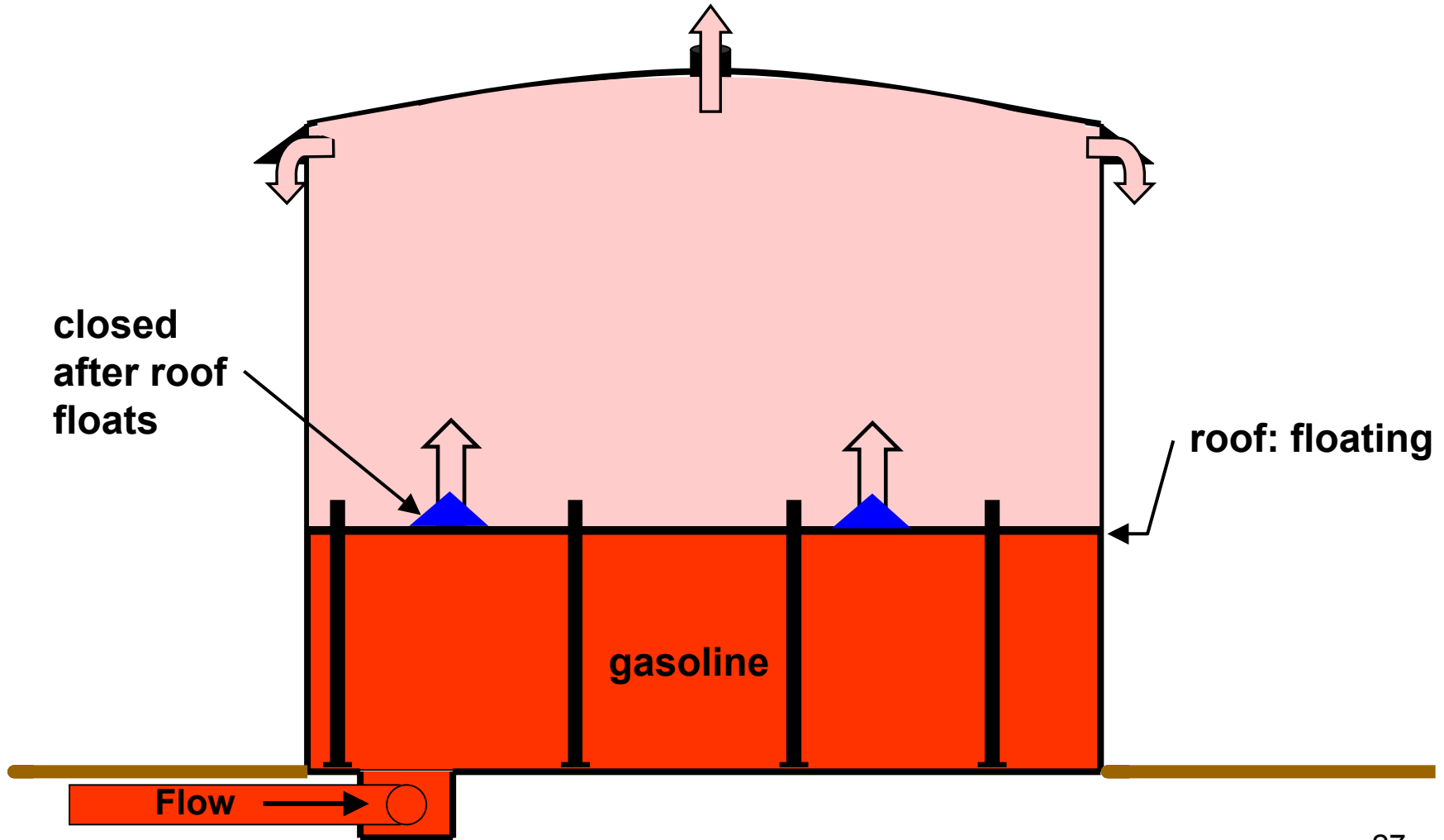
Gasoline removed (roof landed)



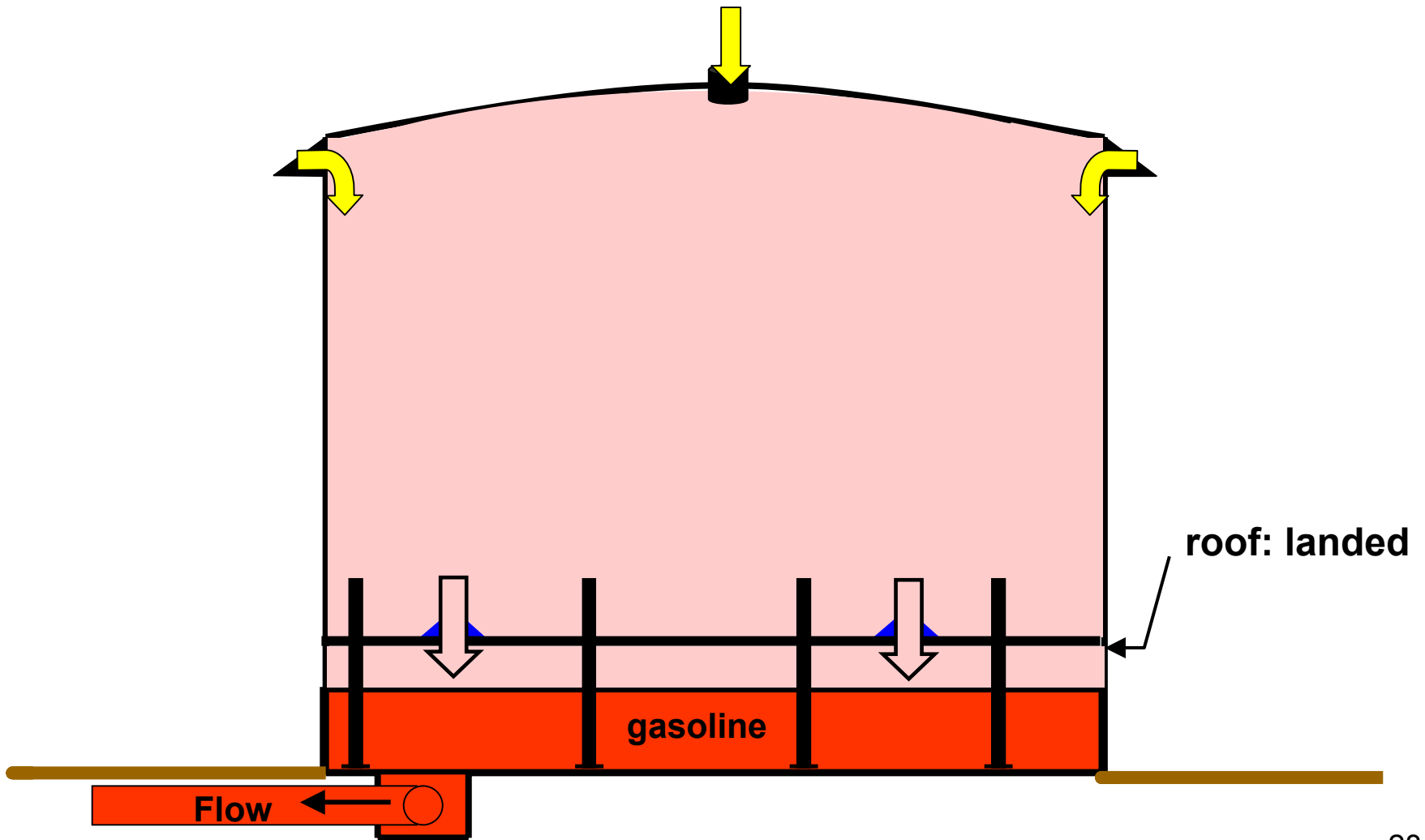
Gasoline added (roof landed)



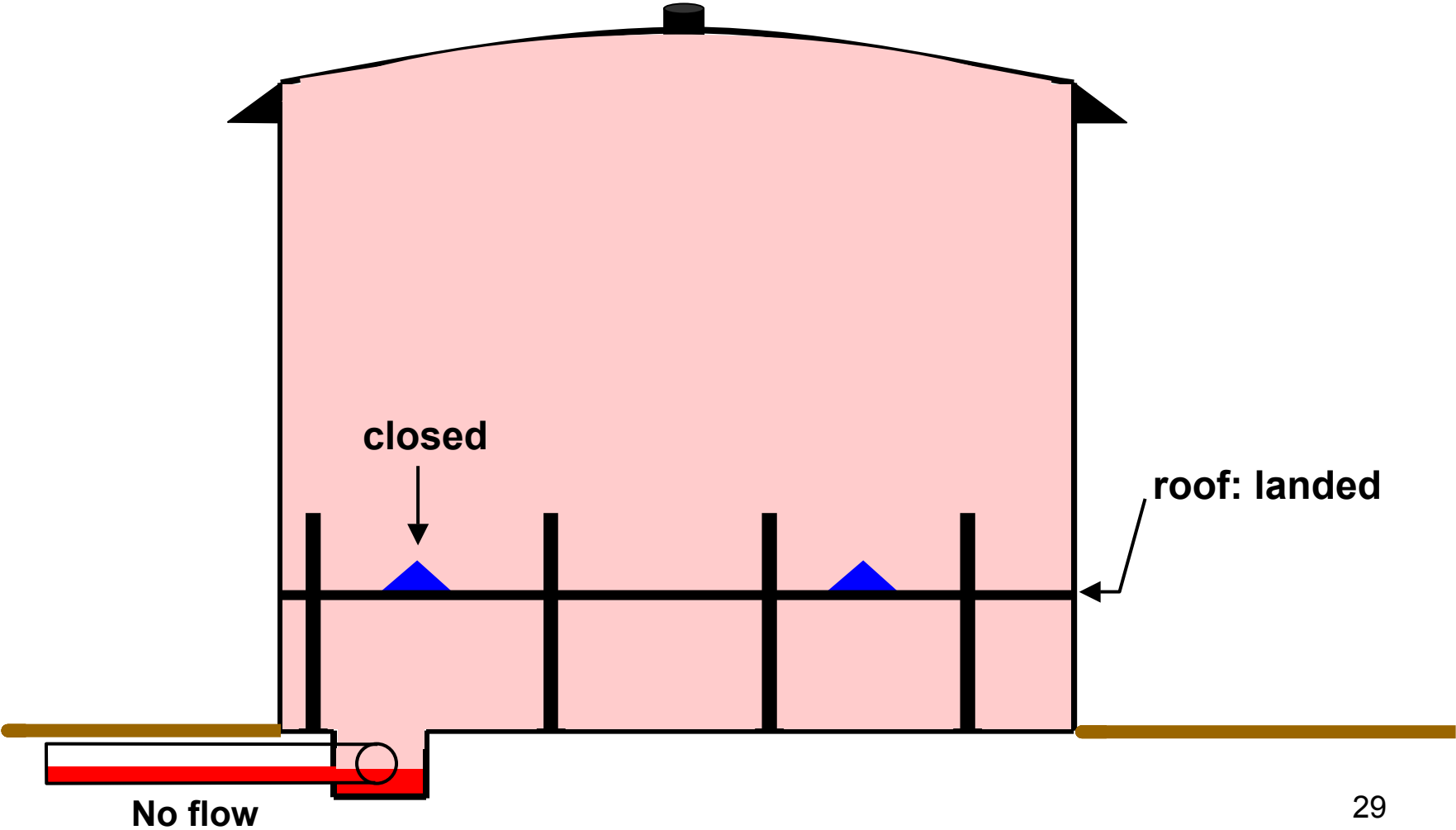
Gasoline added (roof floating)



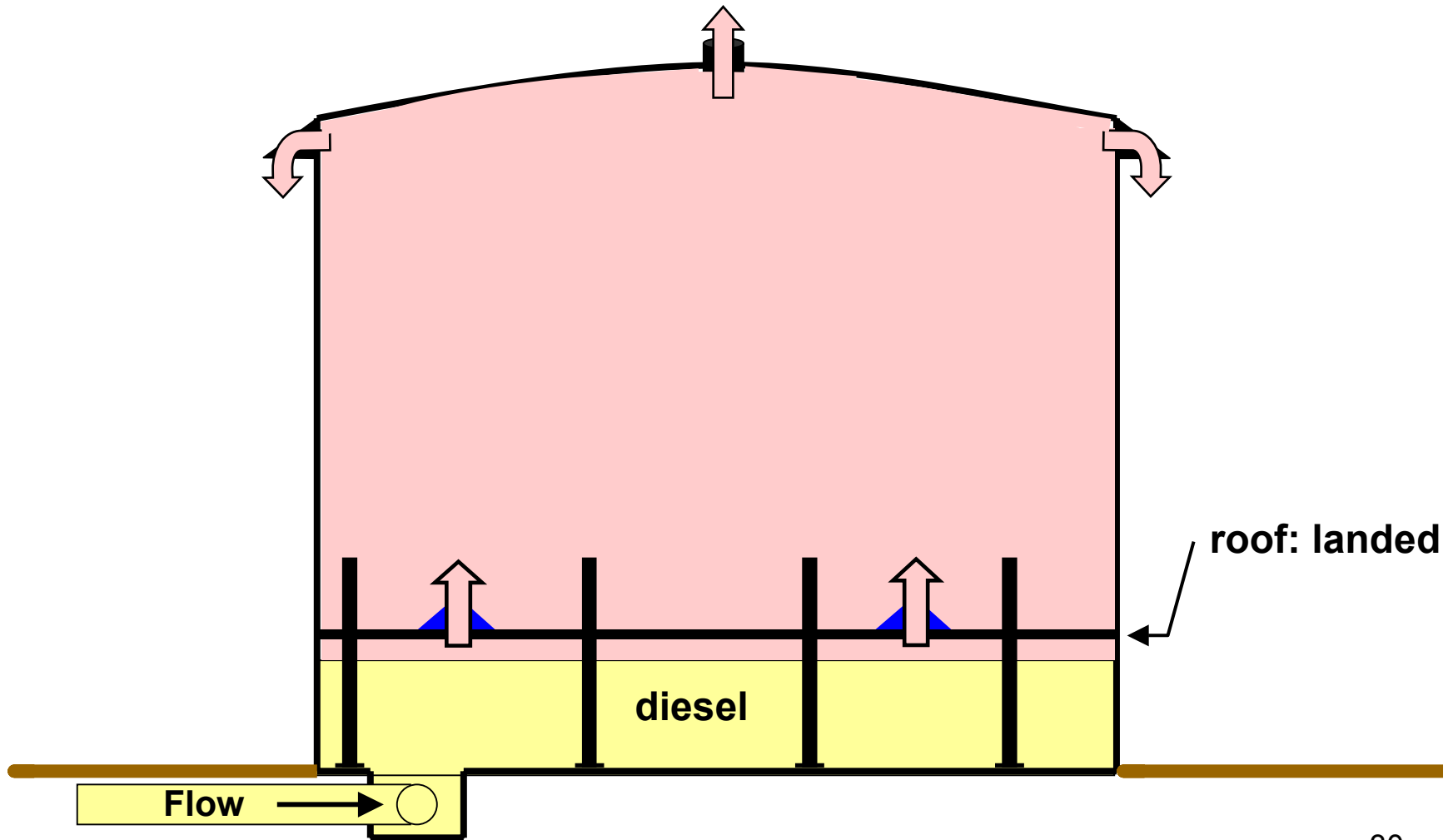
Gasoline removed (roof landed)



Tank empty



Diesel added (switch load)



Conclusion

All the conditions necessary for fuel vapor ignition were present in the storage tank at the time of the accident, and the explosion most likely occurred when a static discharge ignited a flammable fuel-air mixture in the space between the surface of the diesel and the floating roof. The extensive damage to the tank is consistent with the flammable fuel-air mixture above the floating roof contributing to the force of the explosion.





Safety Issue # 2

Emergency Response and Emergency Planning



Emergency Response

- **Emergency response by American Electric Power**
- **Failure of energized power lines and additional fire**
- **Unsuccessful management of the electrical hazard**



Emergency Planning

No coordinated emergency planning between facility operators



Conclusions

The American Electric Power responder did not coordinate his actions with the incident command staff, and American Electric Power did not take effective emergency action.



Conclusions (Continued)

Because ConocoPhillips Company and American Electric Power did not preplan their response to emergencies near the Glenpool South Tank Farm, the emergency response was unsuccessful in managing the electrical hazard caused by the tank explosion and fire.





Safety Issue #3

Federal Regulations and Industry Standards for Emergency Planning



Federal Pipeline Regulations

- **Require operators to prepare an emergency plan**
- **Emergency plan must include procedures for notifying appropriate fire, police and other public officials**
- **No requirements to coordinate with electric utilities**



Industry Standards

- **American Society of Mechanical Engineers (ASME) pipeline codes do not require pipeline operators to coordinate with electric utilities**
- **Institute of Electrical and Electronic Engineers (IEEE) electrical safety code has no requirements for emergency response planning**



Conclusion

Comprehensive, practical industry guidance for the preparation of emergency plans would help operators of electric systems respond effectively to emergencies involving their utilities.



