

# Safety, Risk, Compliance & Quality

Neil Swidey

*Trapped Under the Sea*

# Lessons that hit home



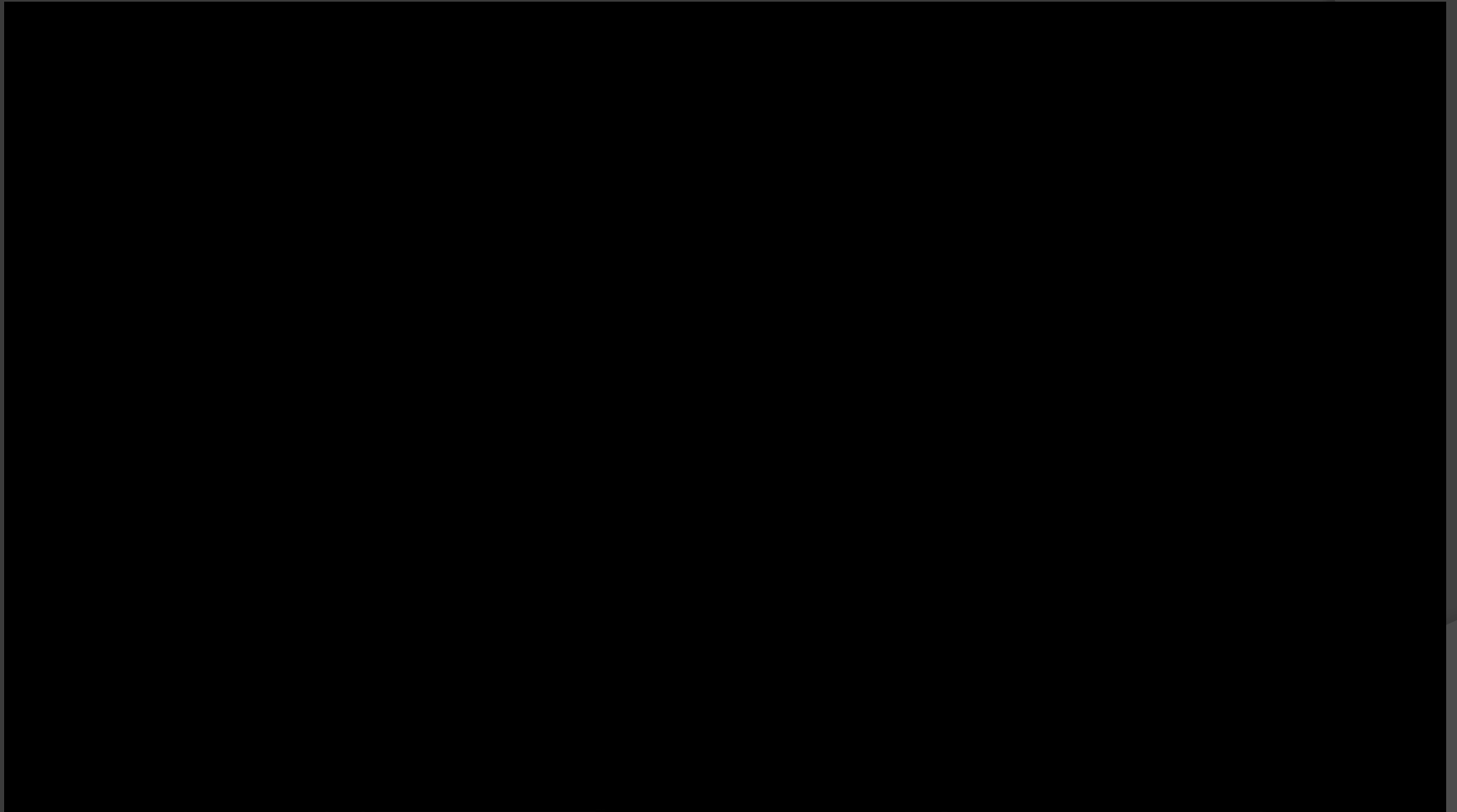
"A harrowing account of one of the largest engineering projects in U.S. history and of the hubris and ignorance that led to tragedy ... Swidey writes with splendid heart." —**WALL STREET JOURNAL**

# TRAPPED UNDER THE SEA

ONE ENGINEERING MARVEL, FIVE MEN, AND  
A DISASTER TEN MILES INTO THE DARKNESS

NEIL SWIDEY

1988





# 'The Dirtiest Harbor in America'



# Today





# USA choice to host 2024 Summer Olympics

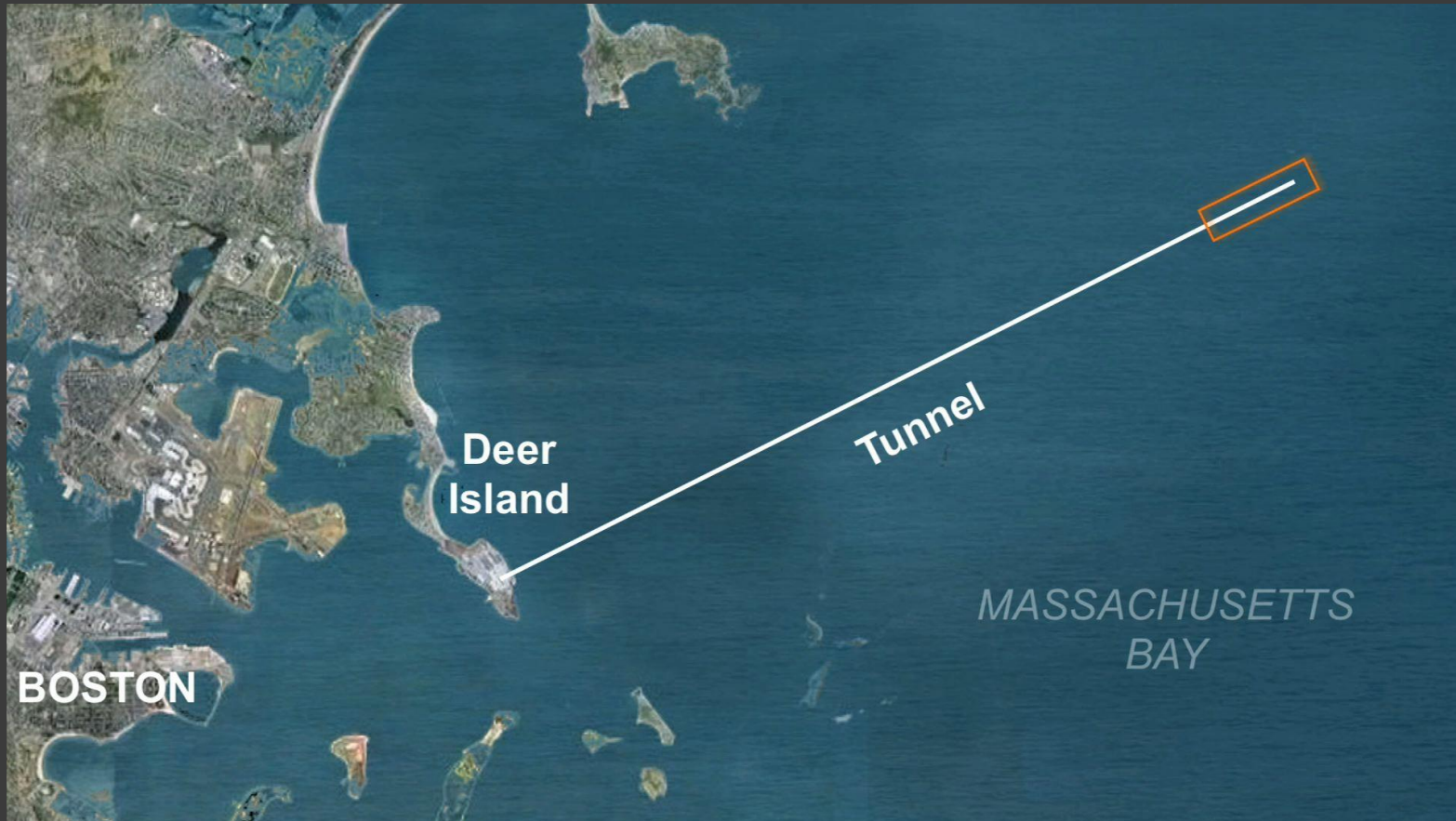


# The visible component





# The invisible component



# Engineering marvel, harnessing gravity



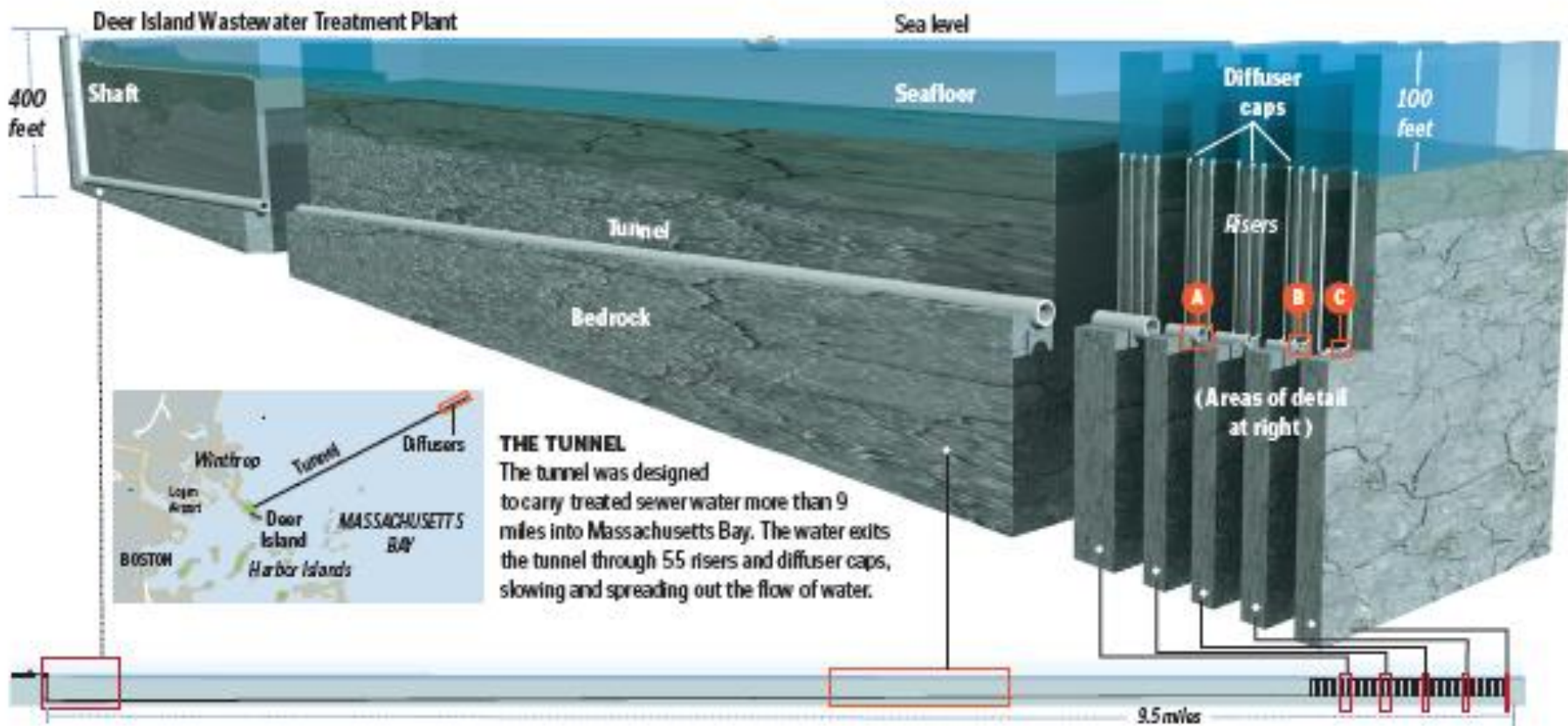
# Offshore jack-up barge to install 55 risers



9 miles out into Mass Bay - Different contractor/JV/crews



# 55 Sub-sea hookups



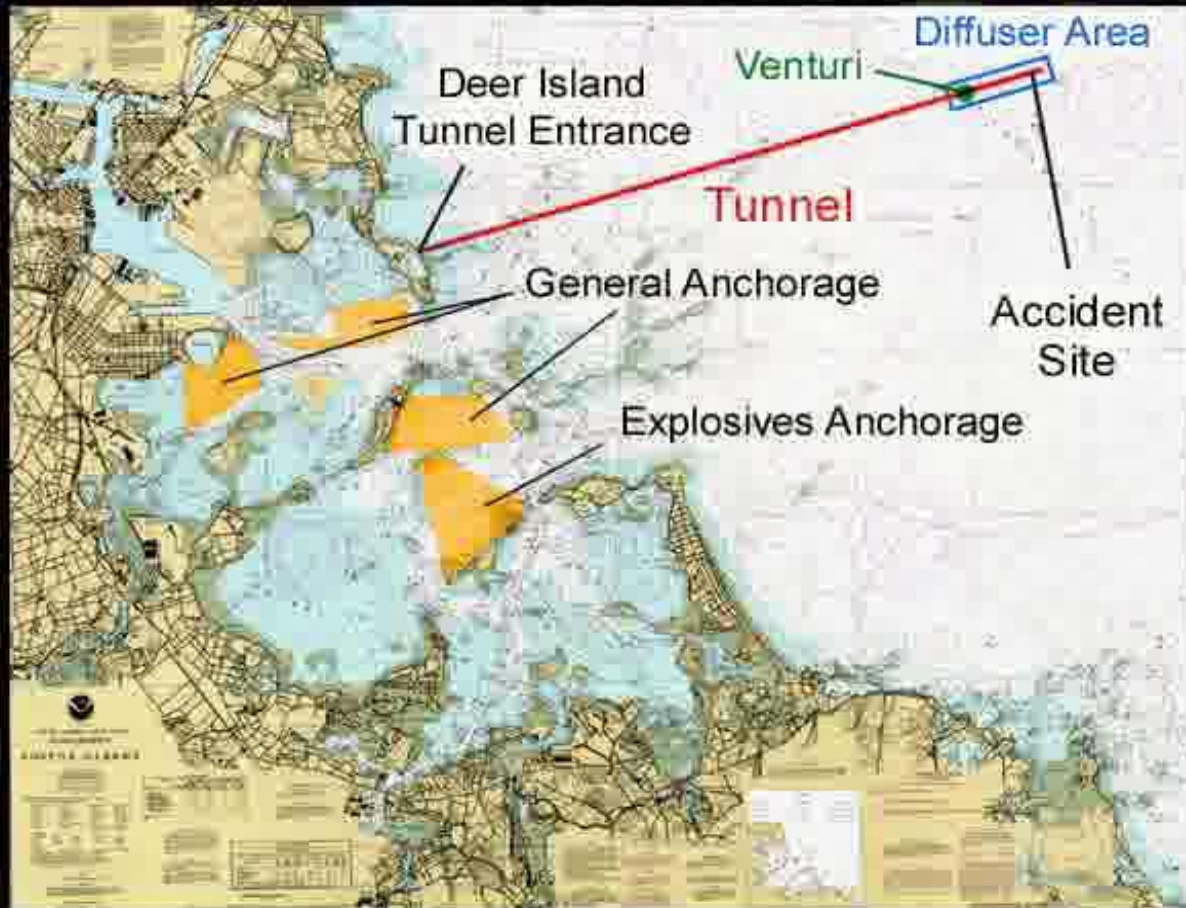
# Seafloor diffuser heads



# Secondary safety plug











By now,  
the tunnel is  
devoid of light  
and oxygen

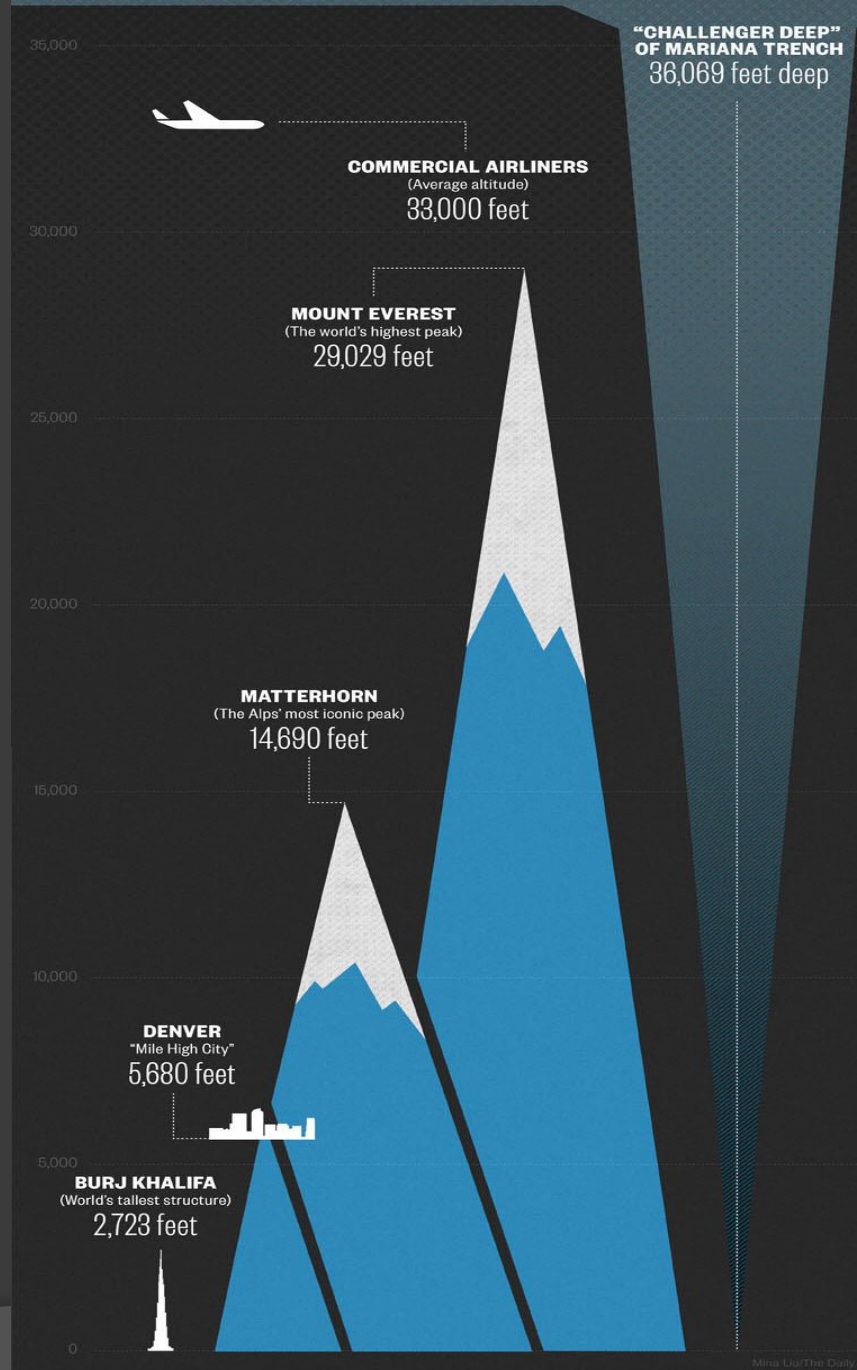




# Challenger Deep, Mariana Trench: Deepest ocean point on Earth



# Distance, in perspective



# Distance from surface



Challenger Deep: 36,070 ft.

Deer Island Tunnel: 49,626 ft.



# A tunnel that gets narrower and narrower

Diameter at start: 24 feet

Diameter at end: 5 feet

Diameter of side tunnels: **30 inches**



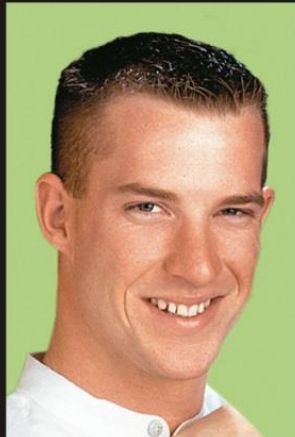
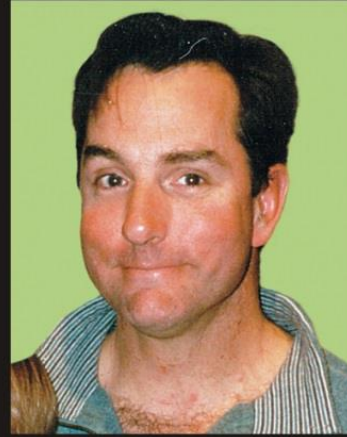
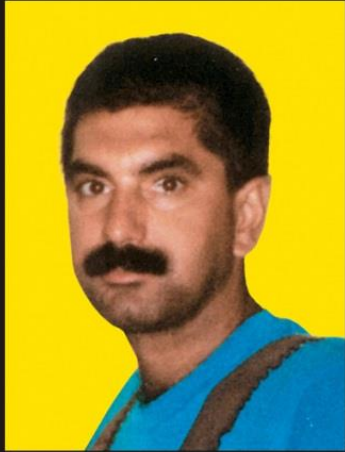
How can very SMART people  
make very BAD decisions  
that put others' lives at RISK?



Years of battles involving contractor, construction manager, project designer, and the agency that will own the tunnel.



# The dive team



# East Coast guys: DJ and Billy



# West Coast guys: Riggs, Tim & Hoss





# Special Ops plan: As pitched



# The innovative air system

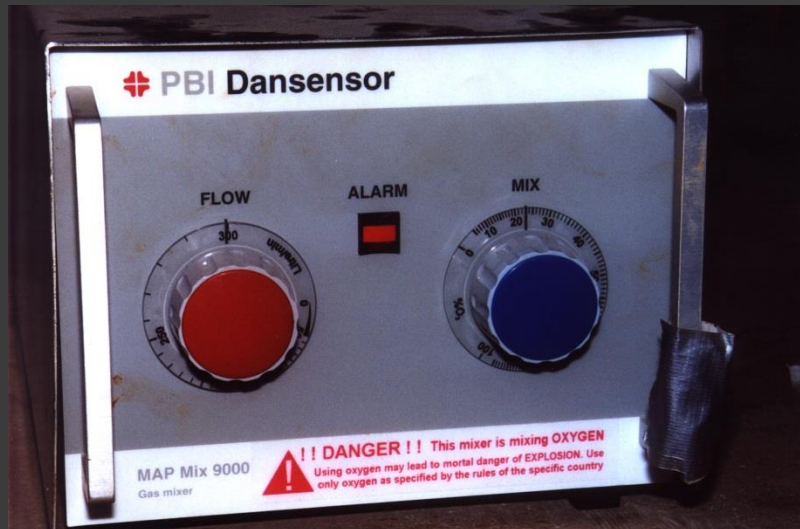


# Inside the tunnel

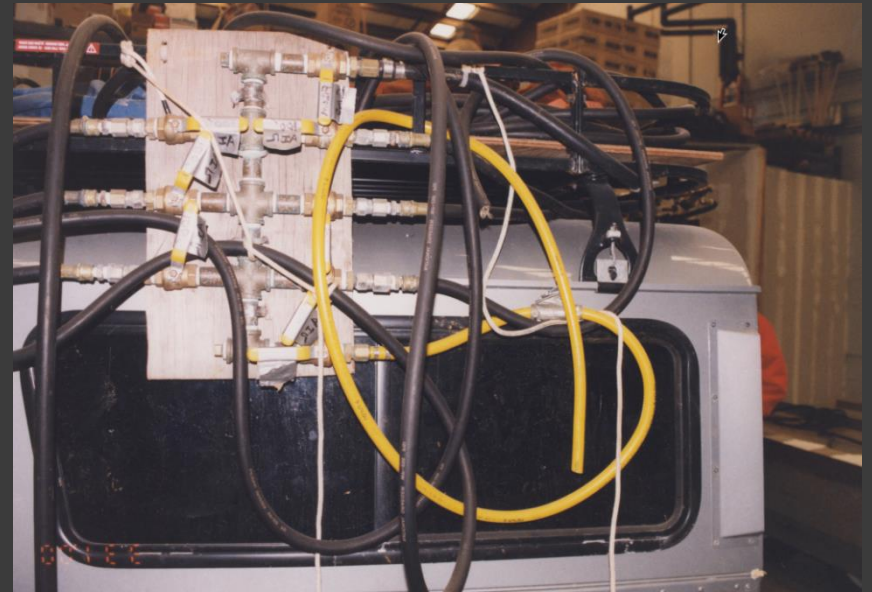




# Special Ops plan: In reality



# Special Ops plan: In reality



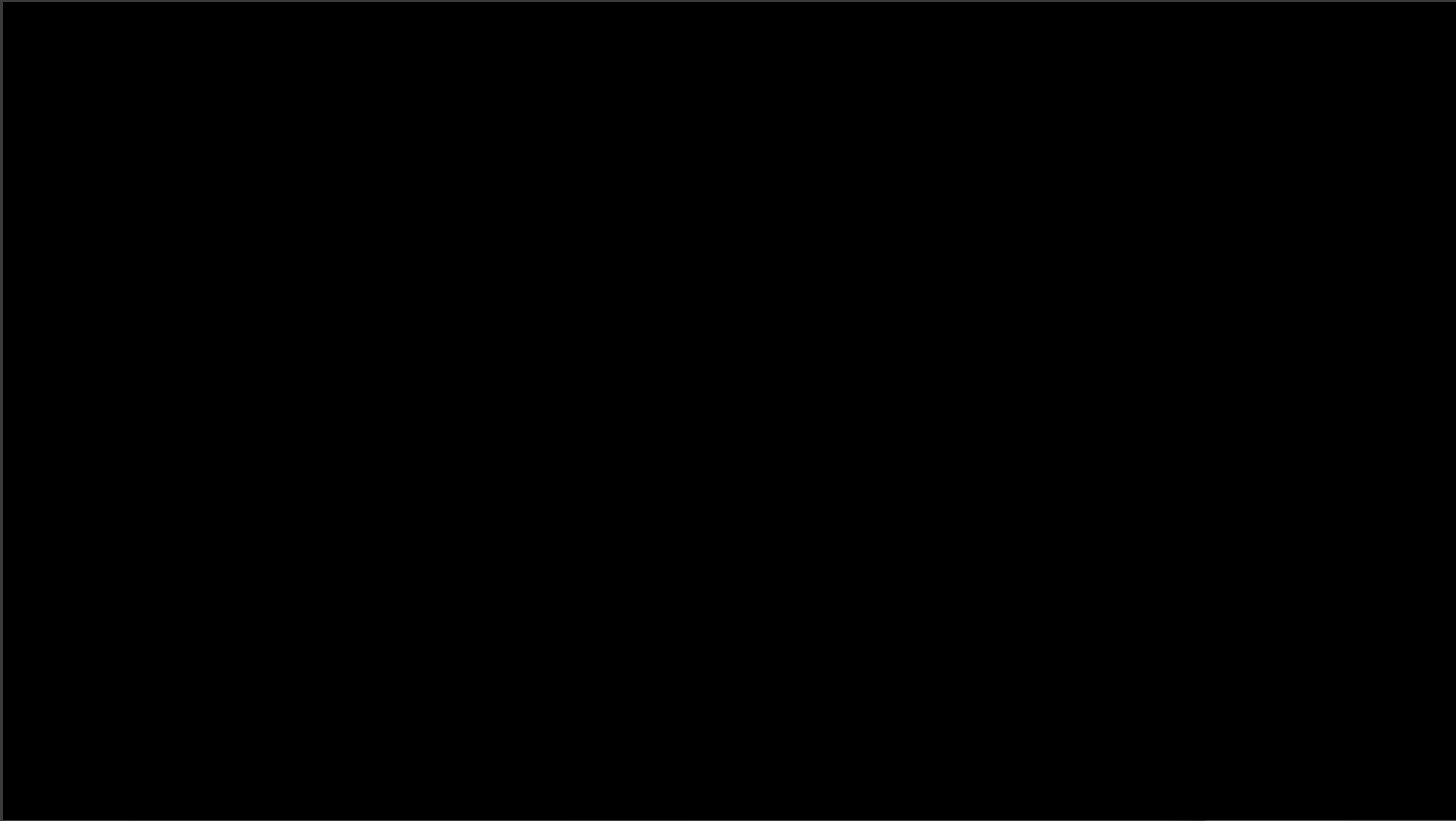
# Communications with Mission Control





**WEDNESDAY, JULY 21, 1999**

# Riding the plan into the tunnel



# At the end of the line





# What went wrong?



# OSHA officials had been warned that plan violated regulations

or in the air return, steps shall be taken to increase ventilation air volume or otherwise control the gas concentration, unless the employer is operating in accordance with the potentially gassy or gassy operation requirements. Such additional ventilation controls may be discontinued when gas concentrations are reduced below five percent of the lower explosive limit, but shall be reinstituted whenever the five percent level is exceeded.

(viii) Whenever 10 percent or more of the lower explosive limit for methane or other flammable gases is detected in the vicinity of welding, cutting, or other hot work, such work shall be suspended until the concentration of such flammable gas is reduced to less than 10 percent of the lower explosive limit.

(ix) Whenever 20 percent or more of the lower explosive limit for methane or other flammable gases is detected in any underground work area(s) or in the air return:

(A) All employees, except those necessary to eliminate the hazard, shall be immediately withdrawn to a safe location above ground; and

(B) Electrical power, except for acceptable pumping and ventilation equipment, shall be cut off to the area endangered by the flammable gas until the concentration of such gas is reduced to less than 20 percent of the lower explosive limit.

(2) *Additional monitoring for potentially gassy and gassy operations.* Operations which meet the criteria for potentially gassy and gassy operations set forth in paragraph (h) of this section shall be subject to the additional monitoring requirements of this paragraph.

(i) A test for oxygen content shall be conducted in the affected underground work areas and work areas immediately adjacent to such areas at least at the beginning and midpoint of each shift.

(ii) When using rapid excavation machines, continuous automatic flammable gas monitoring equipment shall be used to monitor the air at the heading, on the rib, and in the return air duct. The continuous monitor shall signal the heading, and shut down electric power in the affected underground work area, except for acceptable pumping and ventilation equipment, when 20

percent or more of the lower explosive limit for methane or other flammable gases is encountered.

(iii) A manual flammable gas monitor shall be used as needed, but at least at the beginning and midpoint of each shift, to ensure that the limits prescribed in paragraphs (h) and (j) are not exceeded. In addition, a manual electrical shut down control shall be provided near the heading.

(iv) Local gas tests shall be made prior to and continuously during any welding, cutting, or other hot work.

(v) In underground operations driven by drill-and-blast methods, the air in the affected area shall be tested for flammable gas prior to re-entry after blasting, and continuously when employees are working underground.

(3) *Recordkeeping.* A record of all air quality tests shall be maintained above ground at the worksite and be made available to the Secretary of Labor upon request. The record shall include the location, date, time, substance and amount monitored. Records of exposures to toxic substances shall be retained in accordance with §1910.20 of this chapter. All other air quality test records shall be retained until completion of the project.

(k) *Ventilation.* (1)(i) Fresh air shall be supplied to all underground work areas in sufficient quantities to prevent dangerous or harmful accumulation of dusts, fumes, mists, vapors or gases.

(ii) Mechanical ventilation shall be provided in all underground work areas except when the employer can demonstrate that natural ventilation provides the necessary air quality through sufficient air volume and air flow.

(2) A minimum of 200 cubic feet (5.7 m<sup>3</sup>) of fresh air per minute shall be supplied for each employee underground.

(3) The linear velocity of air flow in the tunnel bore, in shafts, and in all other underground work areas shall be at least 30 feet (9.15 m) per minute where blasting or rock drilling is conducted, or where other conditions likely to produce dust, fumes, mists, vapors, or gases in harmful or explosive quantities are present.

(4) The direction of mechanical air flow shall be reversible.



Poor  
design





# Equipment less than billed



# Humvee vs. humans



HP vs.  
blended air:  
lack of  
transparency

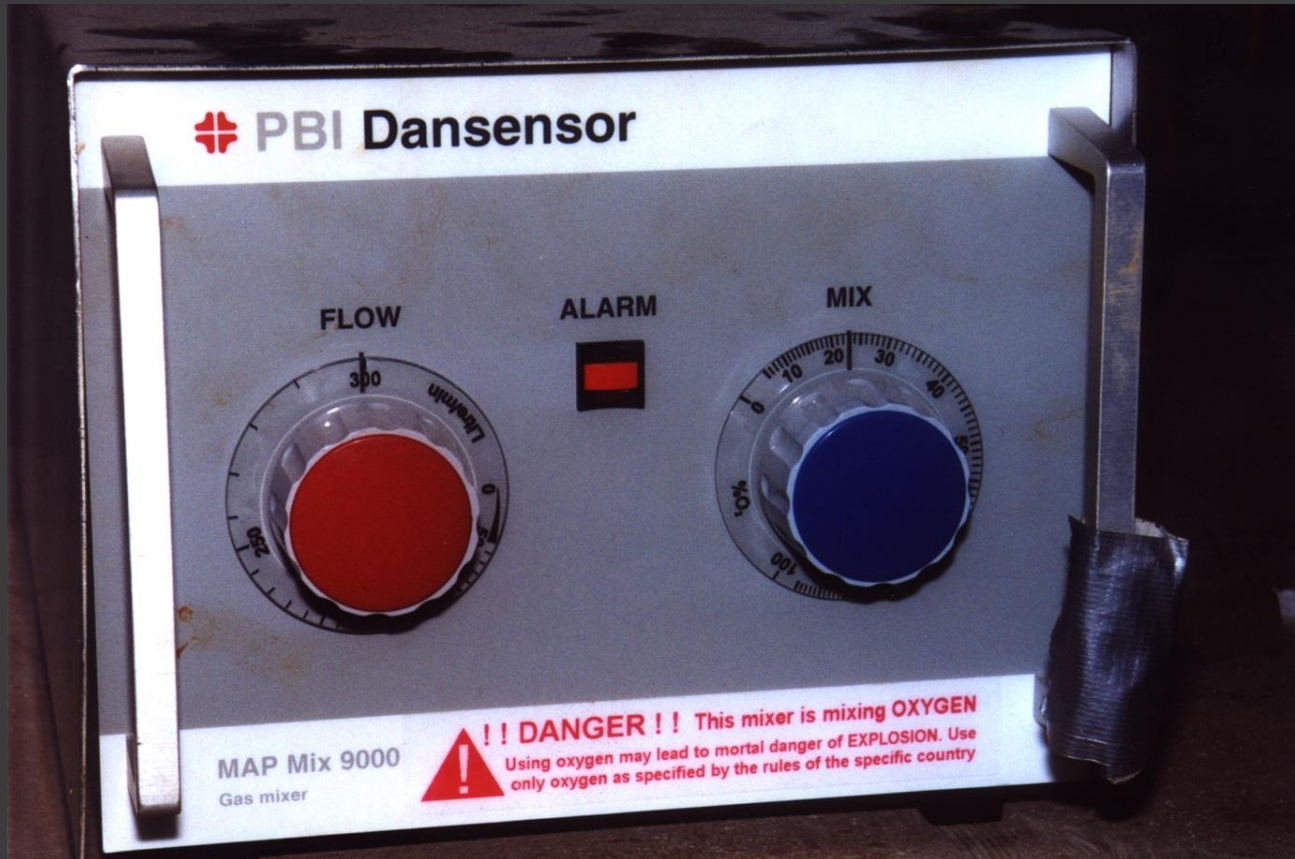




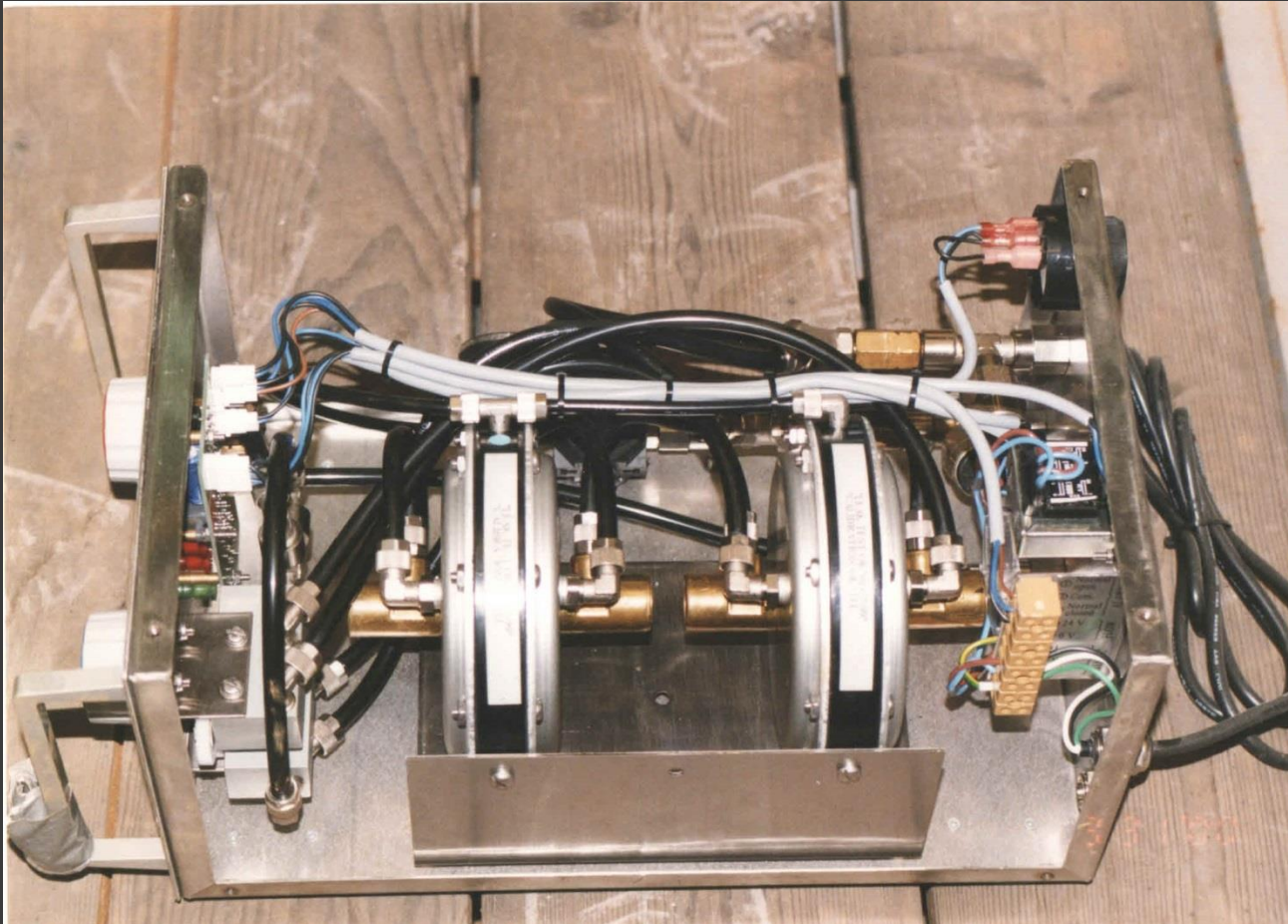
# Unplugged pressure alarm



# The elusive MAP Mix 9000



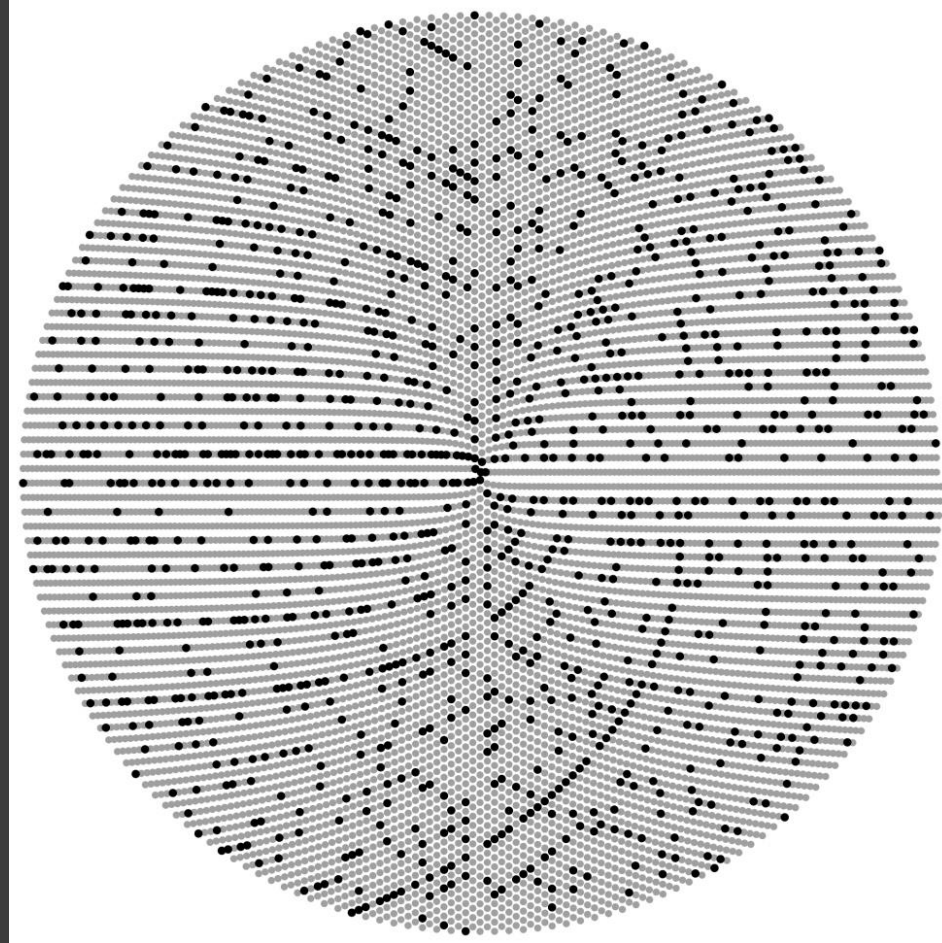
# Mixer bombshell





# Lessons

# Unique particulars, universal forces



# When a job ends in disaster





A parallel disaster: 51 dead,  
30 million cars recalled, \$4.1 billion

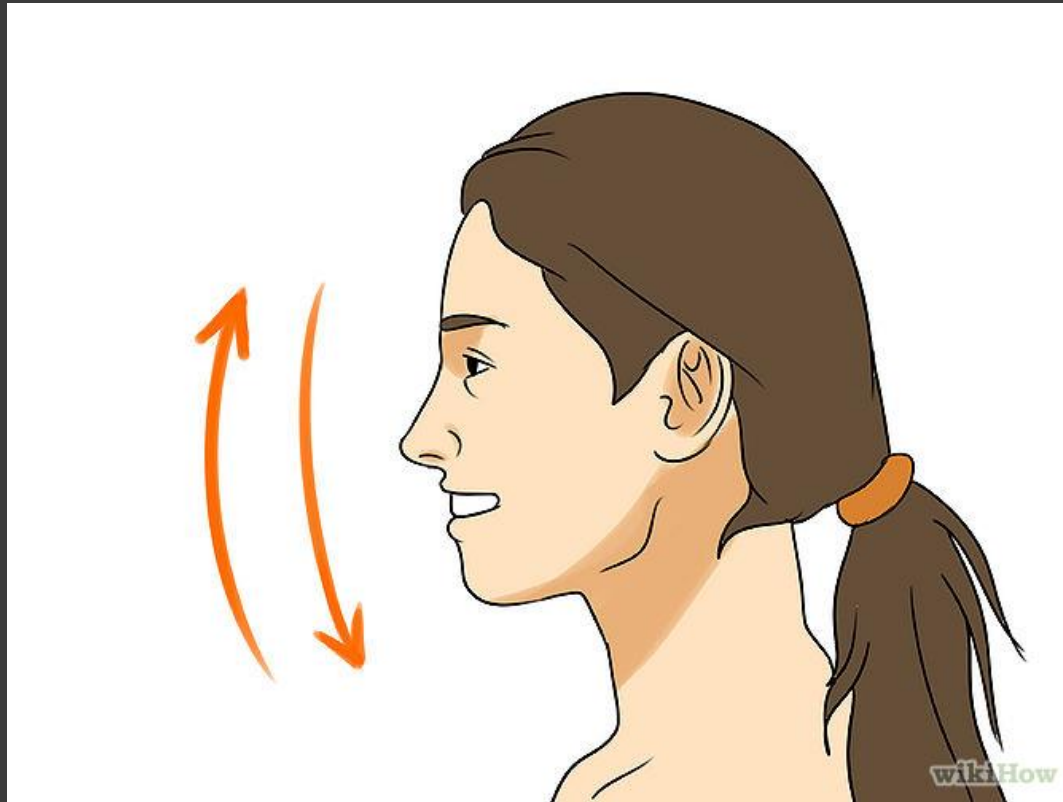


# Classification of the problem



**Safety vs. quality/customer satisfaction**

# The “GM nod”





Just because it's a billion-dollar project ...



# ‘Go Fever’

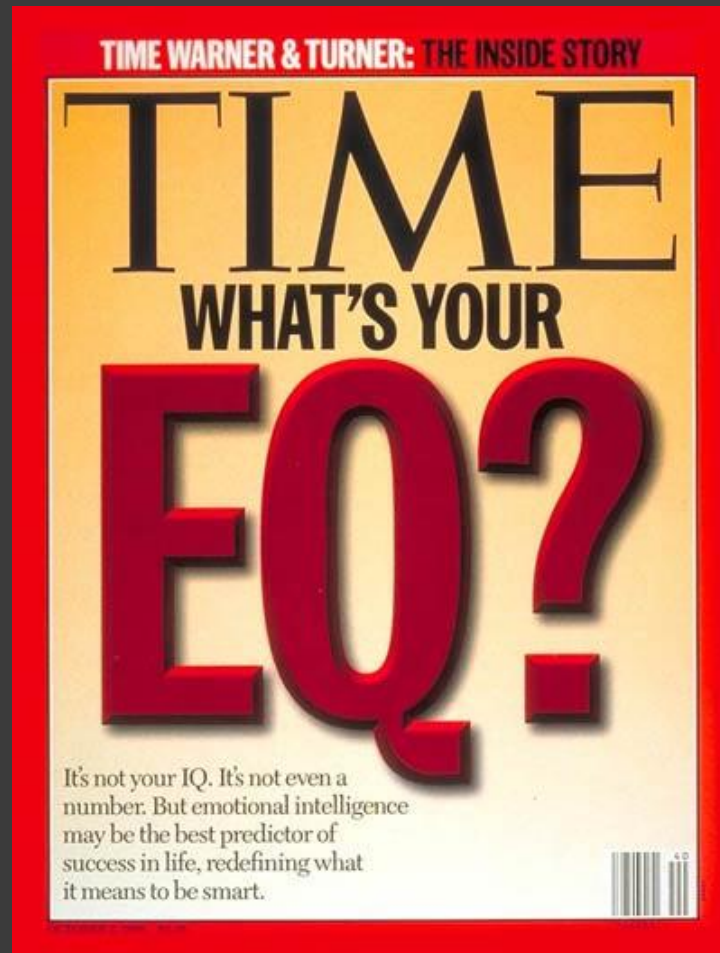


# ‘STOP WORK’ safety policy vs. culture





# IQ vs. EQ



A poorly thought-  
out safety  
measure is worse  
than none at all



# Assigning vs. offloading risk





AVAILABILITY  
BIAS

# Seductive appeal of the outsider



# Outside thinking from the inside



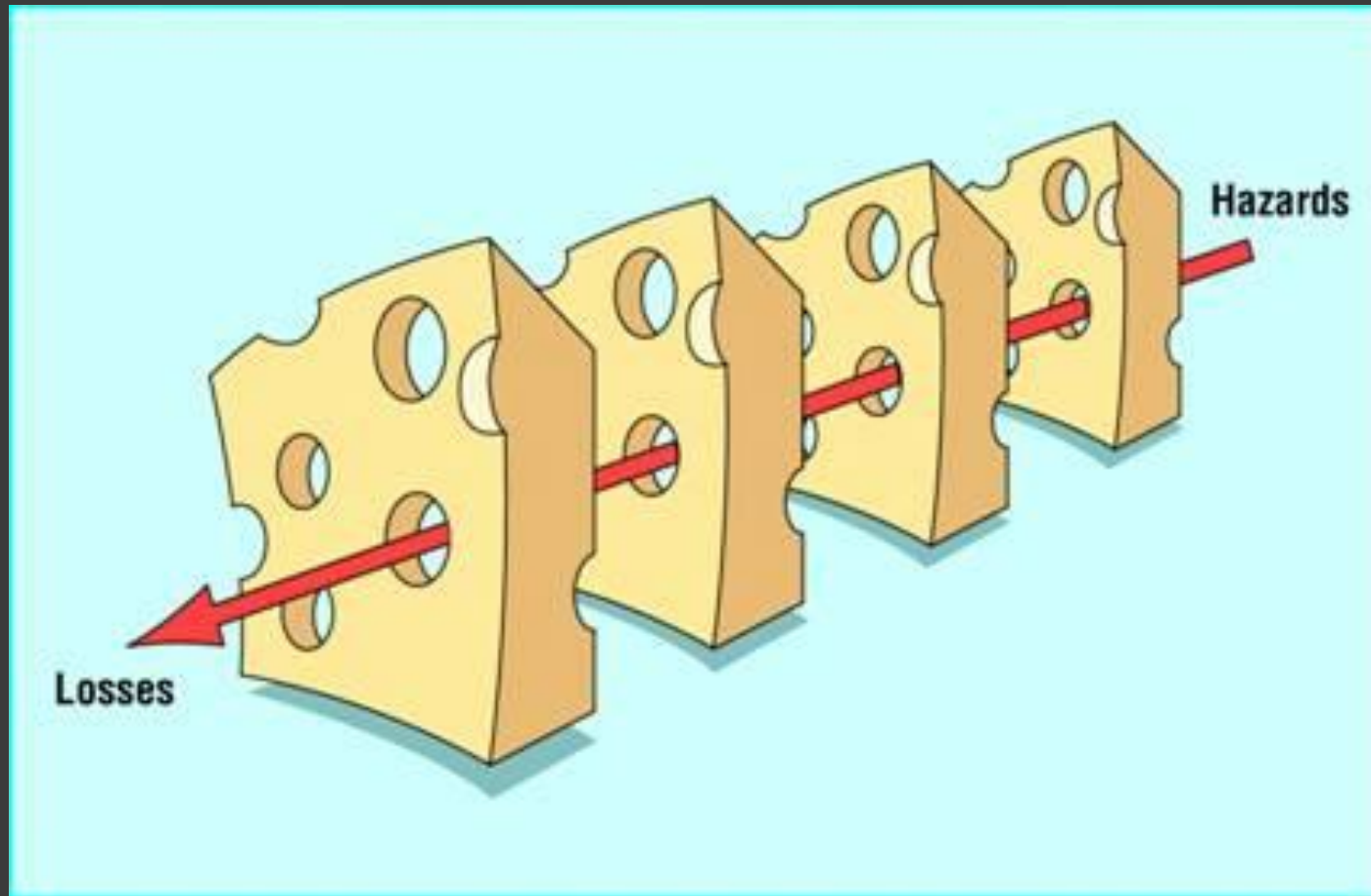
**Interplay of trust, creativity, and financial pressures**



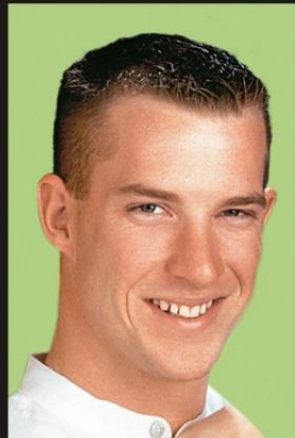
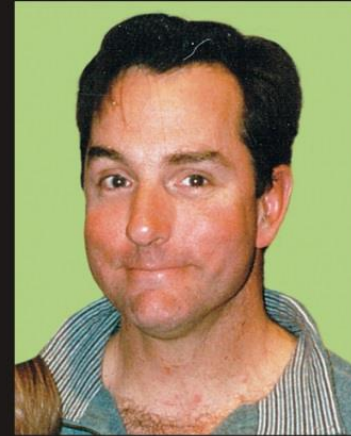
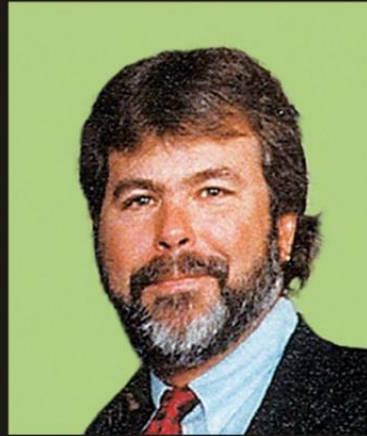
# Normalization



# The holes in the Swiss Cheese



# Remember the ordinary heroes





# More info:

[Neilswidey.com](http://Neilswidey.com)

[Trappedunderthesea.com](http://Trappedunderthesea.com)

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