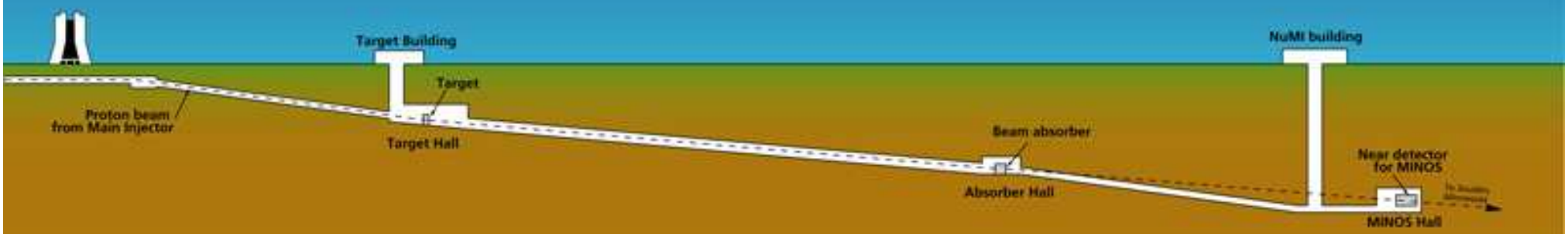
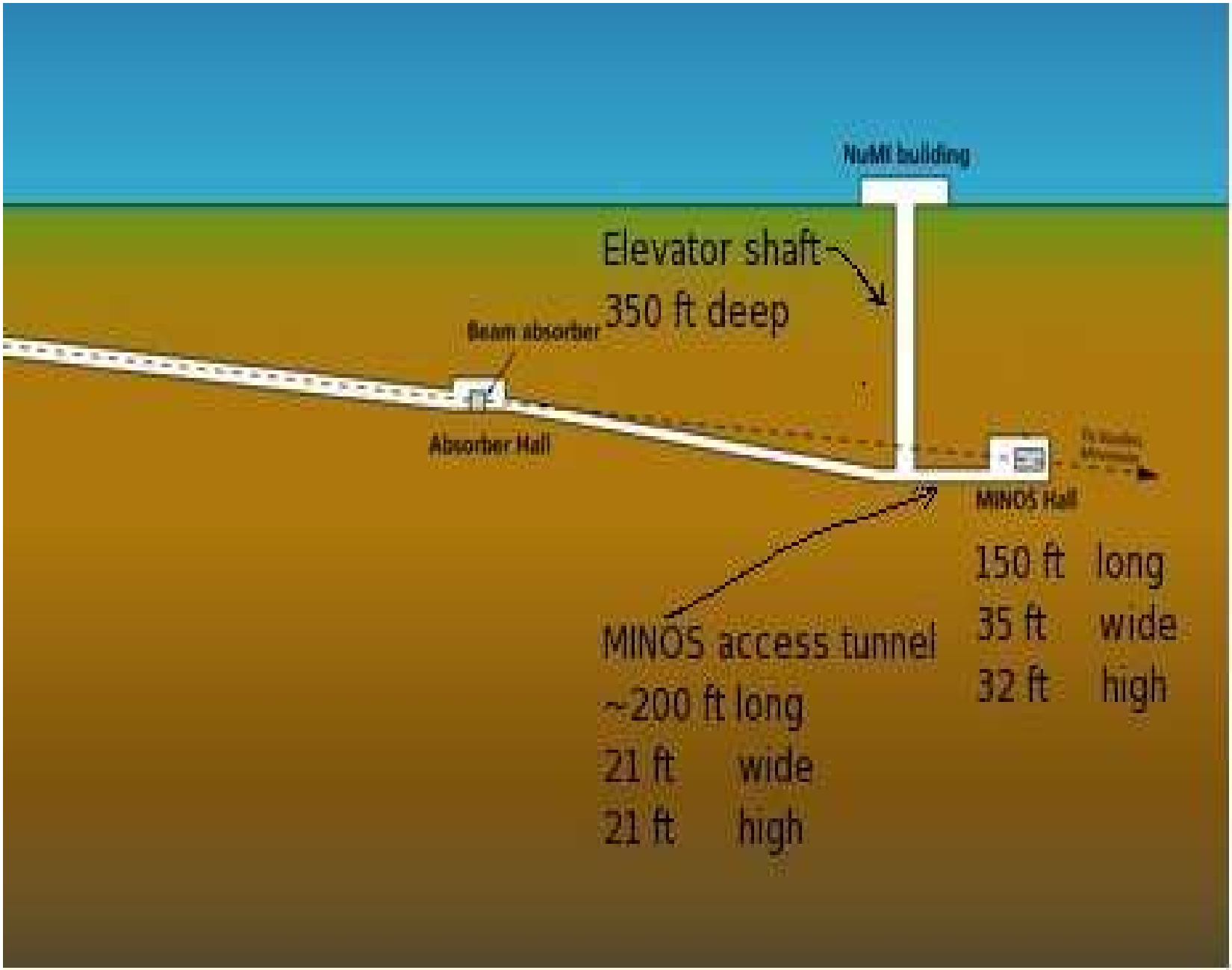
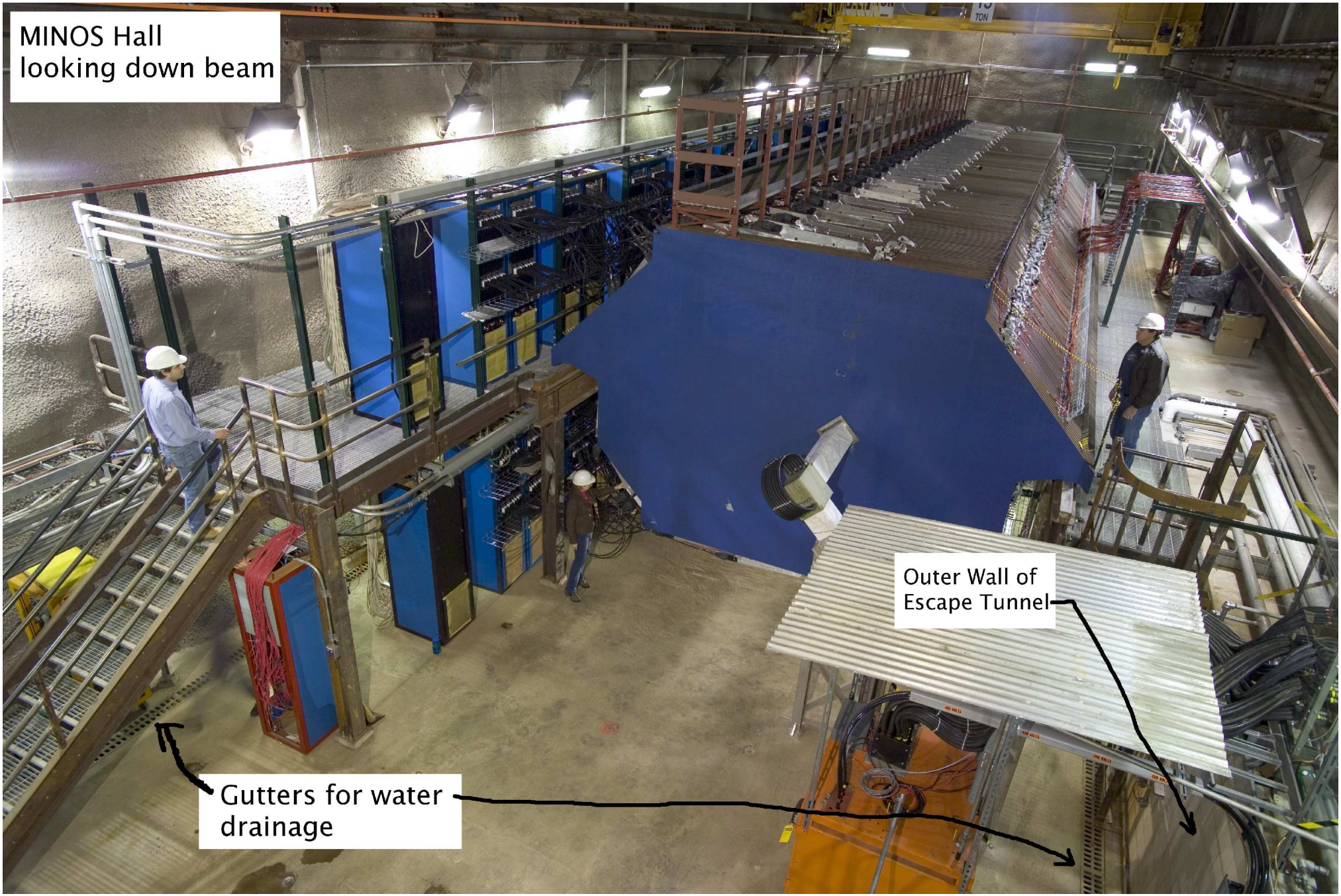
T962
PRELIMINARY ODH ANALYSIS

The purpose is to determine if it is feasible to achieve an ODH 0 classification of the MINOS hall when a 500 L liquid argon dewar is used in the T962 experiment.

NuMI Tunnel Project




NuMI building
Elevator shaft
350 ft deep
Beam absorber
Absorber Hall
MINOS Hall
150 ft long
35 ft wide
32 ft high
MINOS access tunnel
~200 ft long
21 ft wide
21 ft high


MINOS Hall
looking down beam
Outer Wall of
Escape Tunnel
Gutters for water
drainage

unistrut
frame
for vent
pipe
Escape tunnel
standing in MINOS Hall
looking up-beam
view of access tunnel
leading to elevator shaft

Volumes

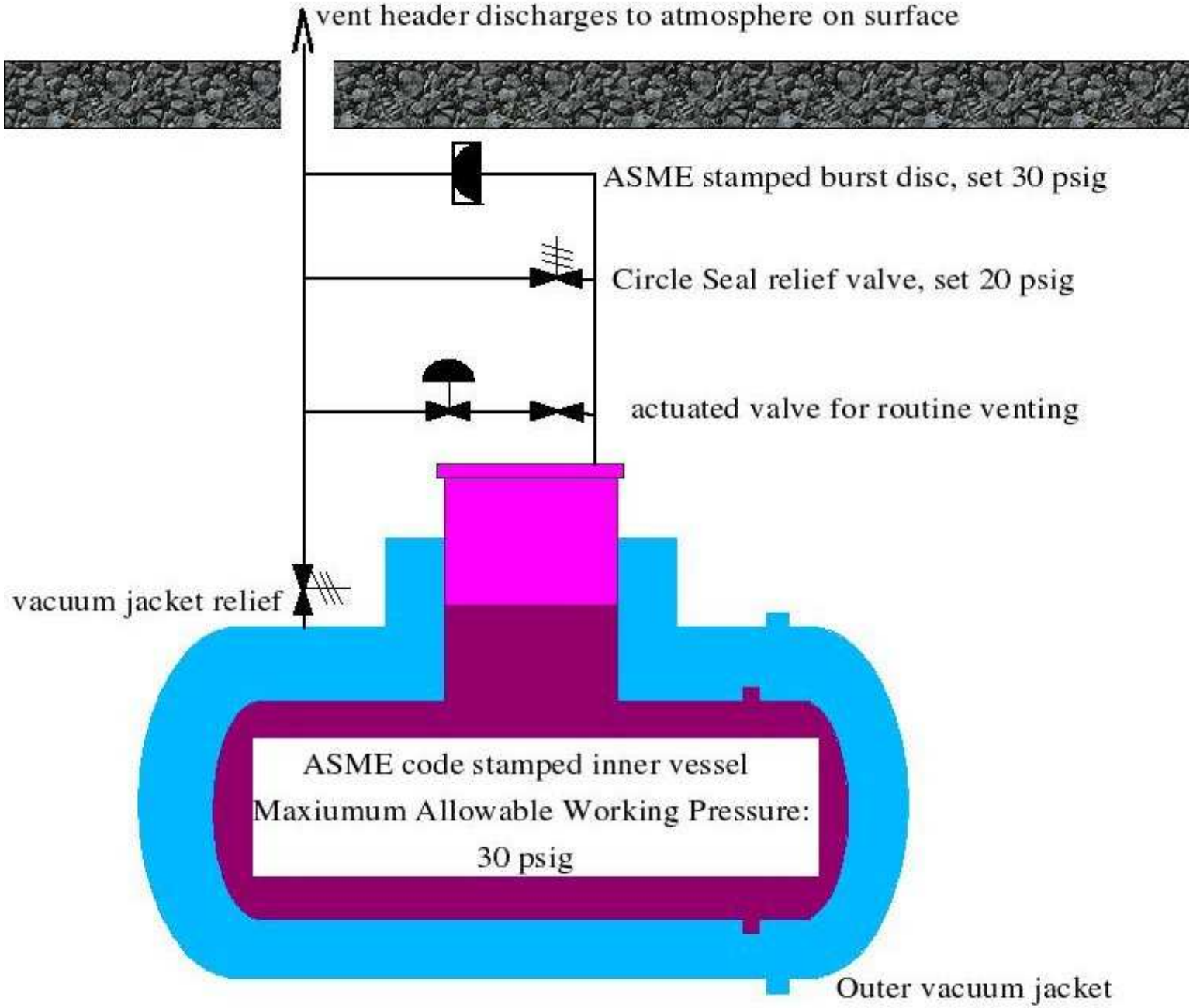
- Volume of MINOS Hall: 172,000 ft^3
- Volume of MINOS Access Tunnel: 92,000 ft^3
- Total Cavern Volume: 264,000 ft^3
- Argon Volume (@ 70F, 1 atm): 8,900 ft^3
- 5.1% of Argon Volume (@ 70F, 1 atm) 450 ft^3

Large Rapid Argon Spill

CASE	Extent of Mixing	% O2	Fatality Factor
1	Complete: floor to ceiling	20.29%	0.0 fatalities
2	bottom 7 ft from floor mixed	18.24%	0.0 fatalities
3	bottom 3 ft from floor mixed	14.56%	0.00004 fatalities
4	bottom 1 ft from floor mixed	1.69%	1.0 fatalities

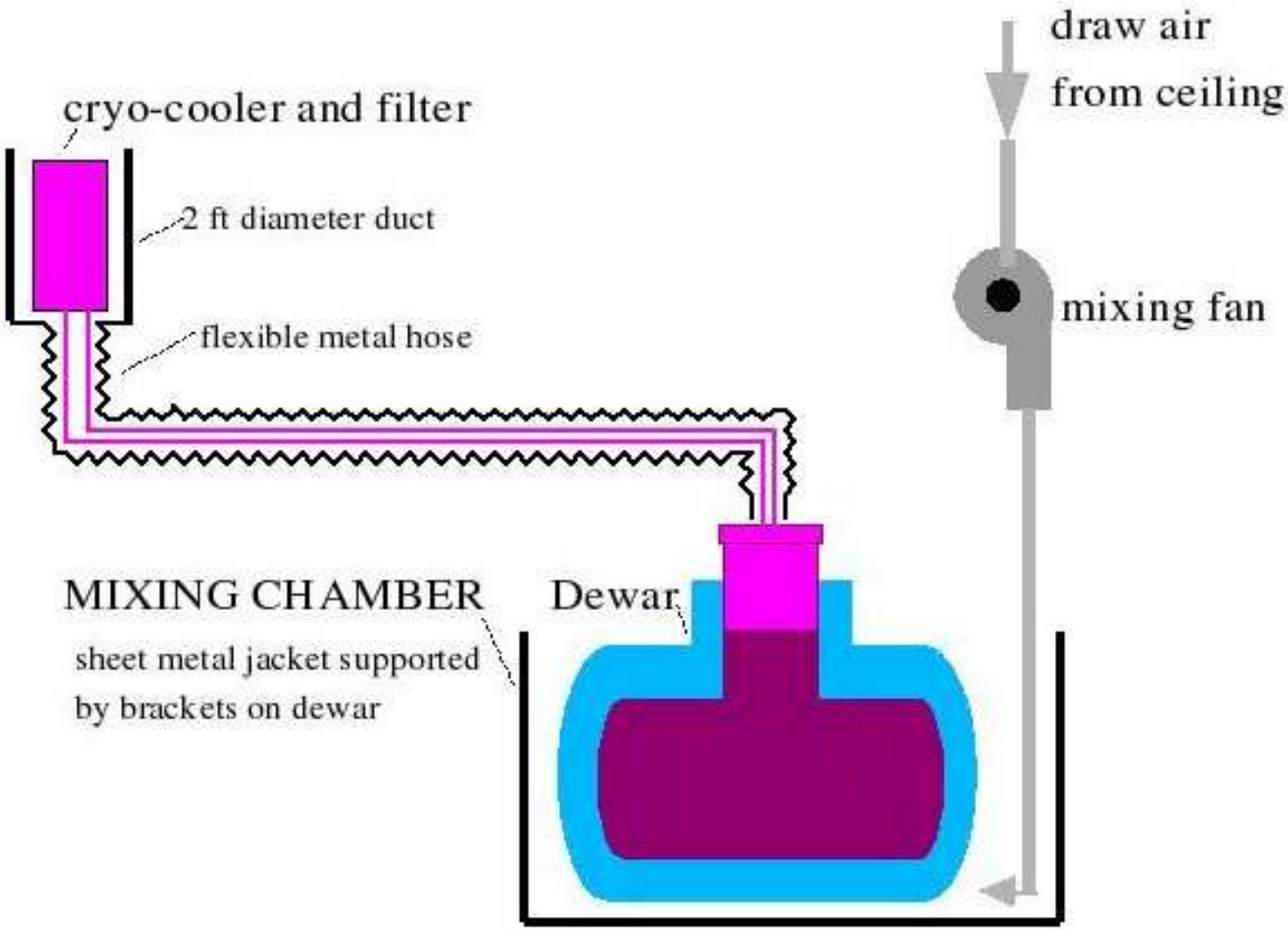
Lessons

- Assume a fatality factor of 1 (certain death) in ODH analysis for unmixed argon spills.
- Avoid spilling argon directly on floor. Some type of mixing system must be used.
- Fresh air from surface is not needed to deal with ODH emergencies. There is suffient air in the cavern.



Outer vacuum jacket
internal pressure rating:
5 psig

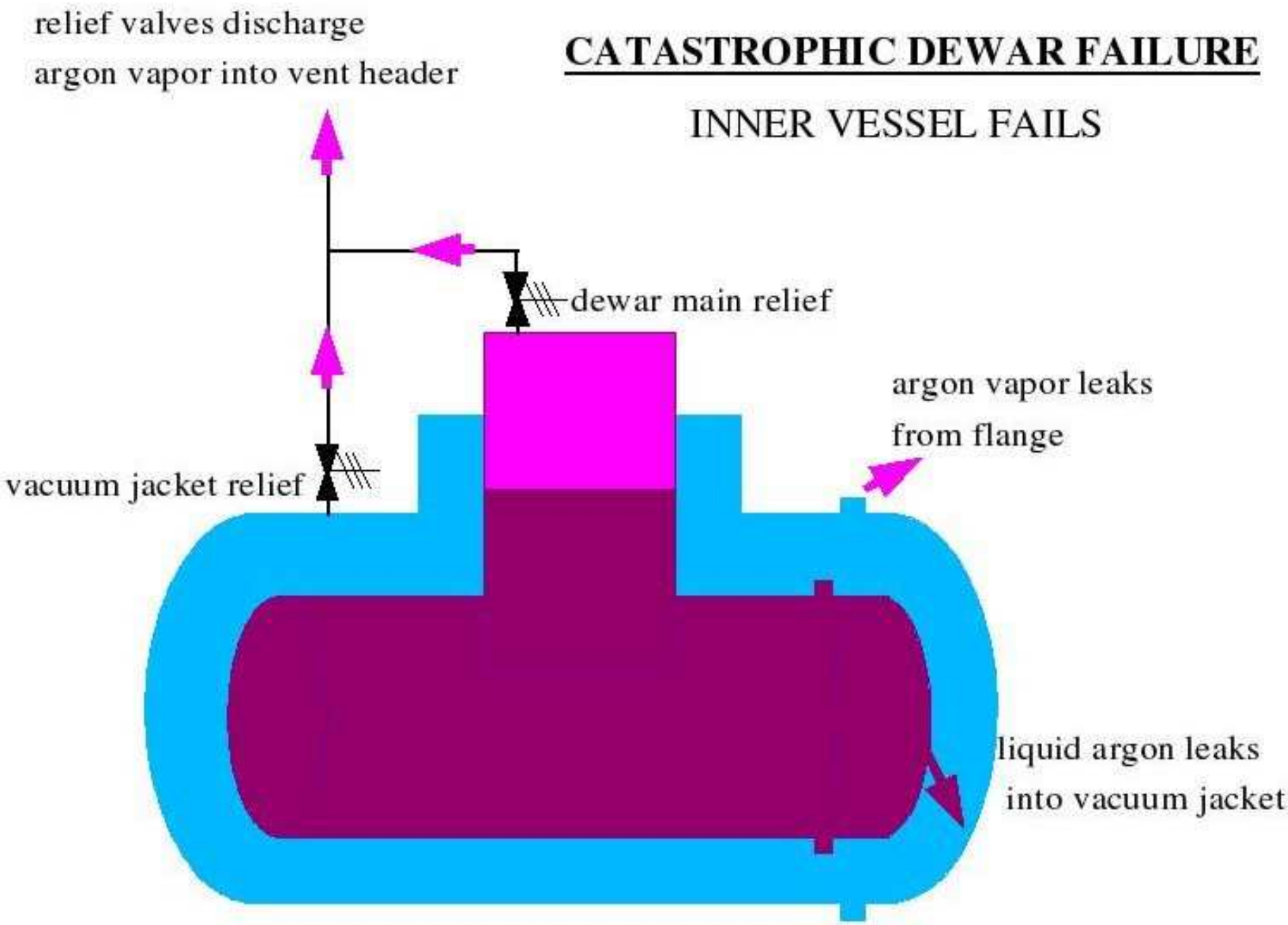
PRELIMINARY DESIGN



JACKET MIXING SYSTEM

CATASTROPHIC DEWAR FAILURE

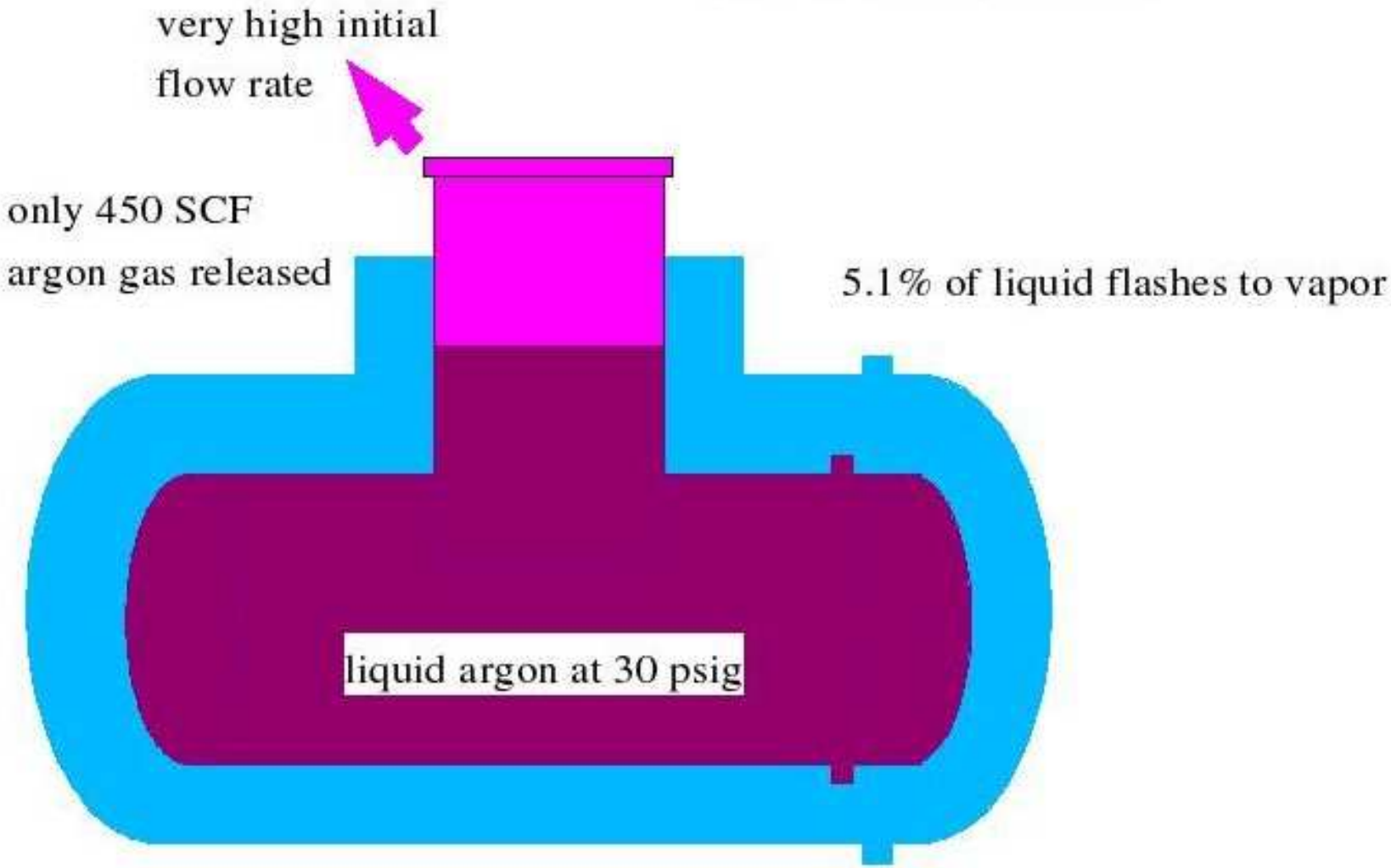
INNER VESSEL FAILS



CATASTROPHIC PIPING FAILURE

WORSE CASE: TOP FLANGE UNBOLTED

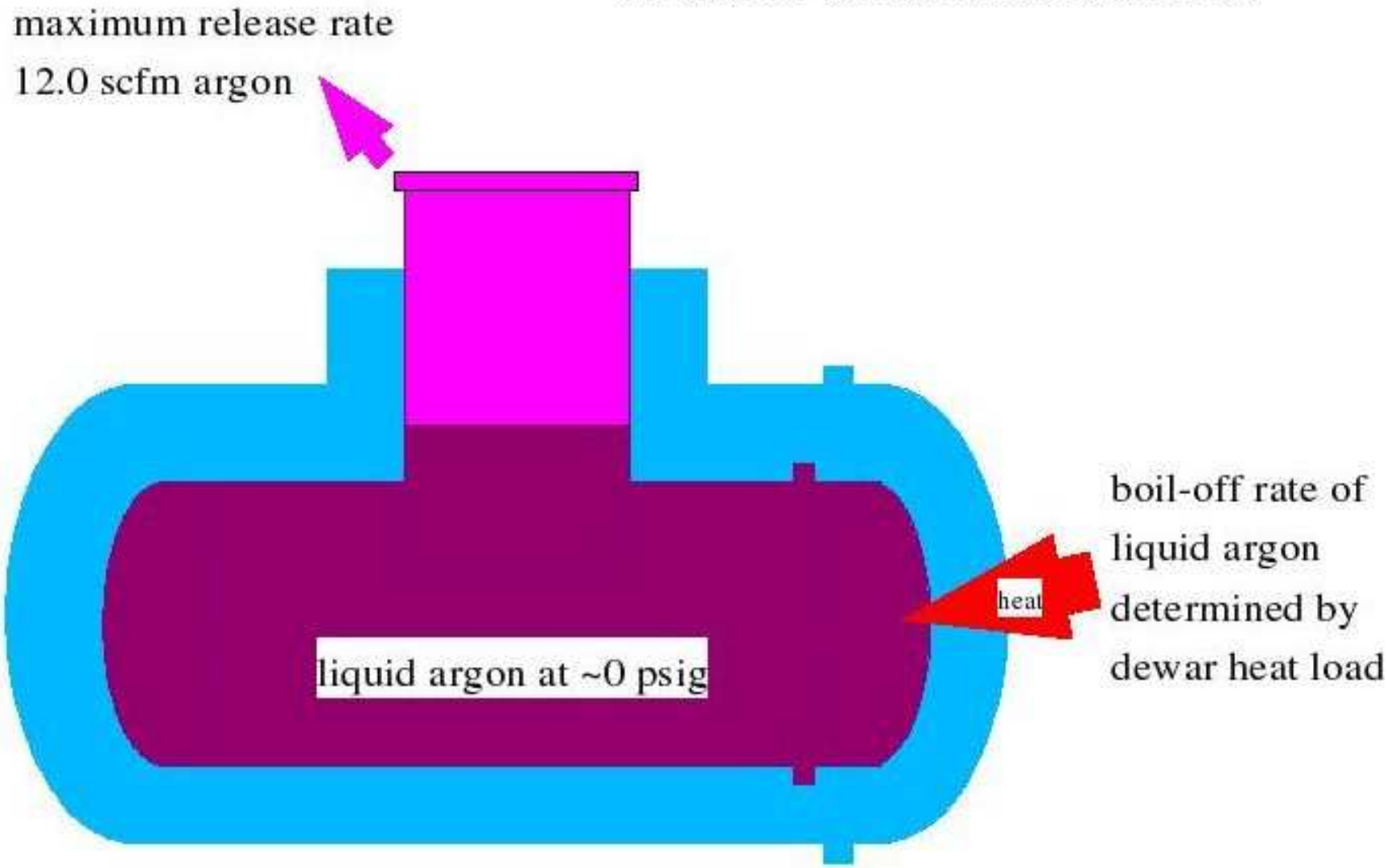
INTIAL CONDITION



CATASTROPHIC PIPING FAILURE

WORSE CASE: TOP FLANGE UNBOLTED

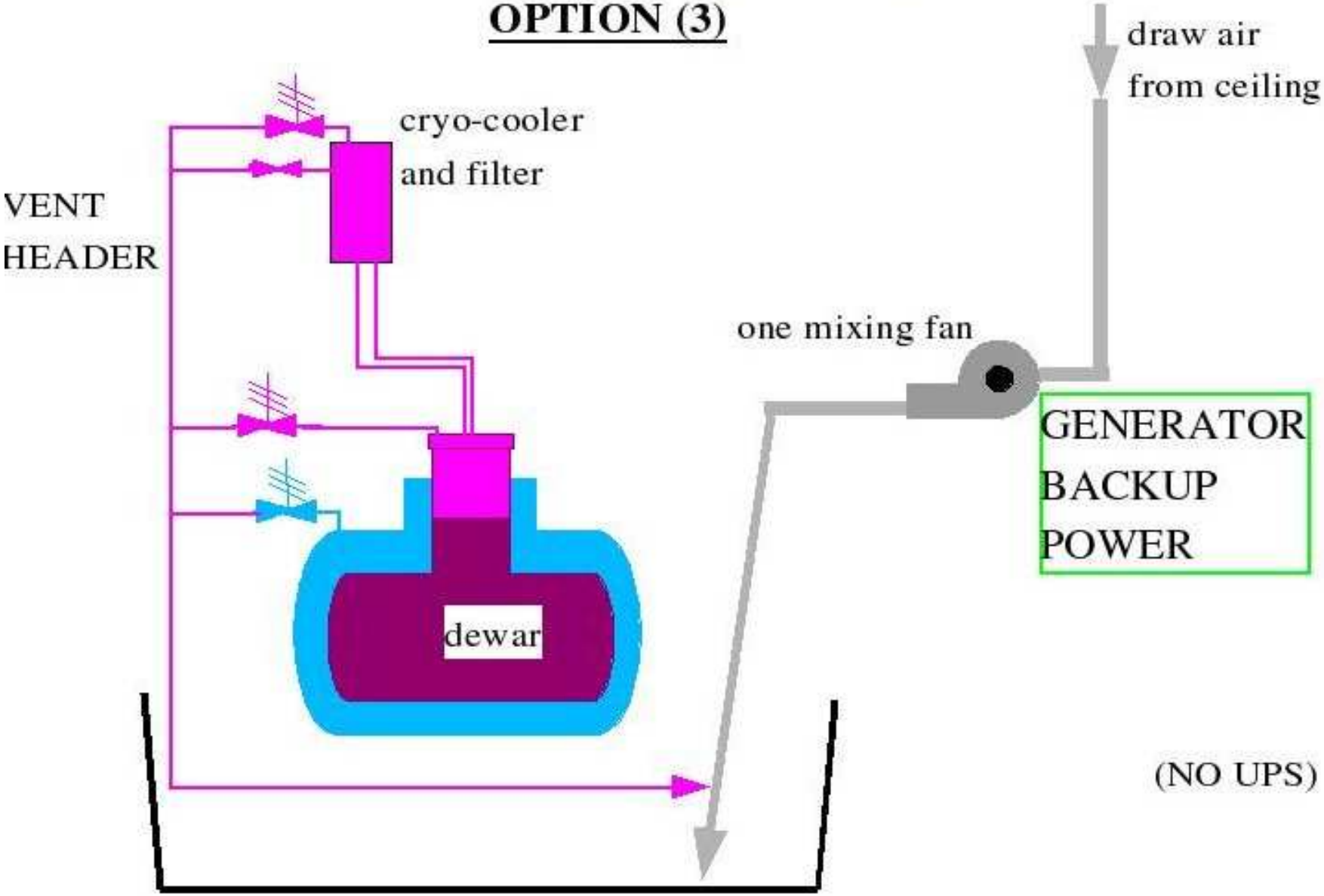
STEADY STATE CONDITION



OPTIONS CONSIDERED

- OPTION (1): Mixing system with two fans on UPS and diesel generator backup. Vent Header discharges into Mixing System.
- **-->** OPTION (2): Mixing system with one fan and diesel generator backup but no UPS. Vent Header discharges outdoors onto surface.
- OPTION (3): Mixing system with one fan on diesel generator backup but no UPS. Vent Header discharges into Mixing System.

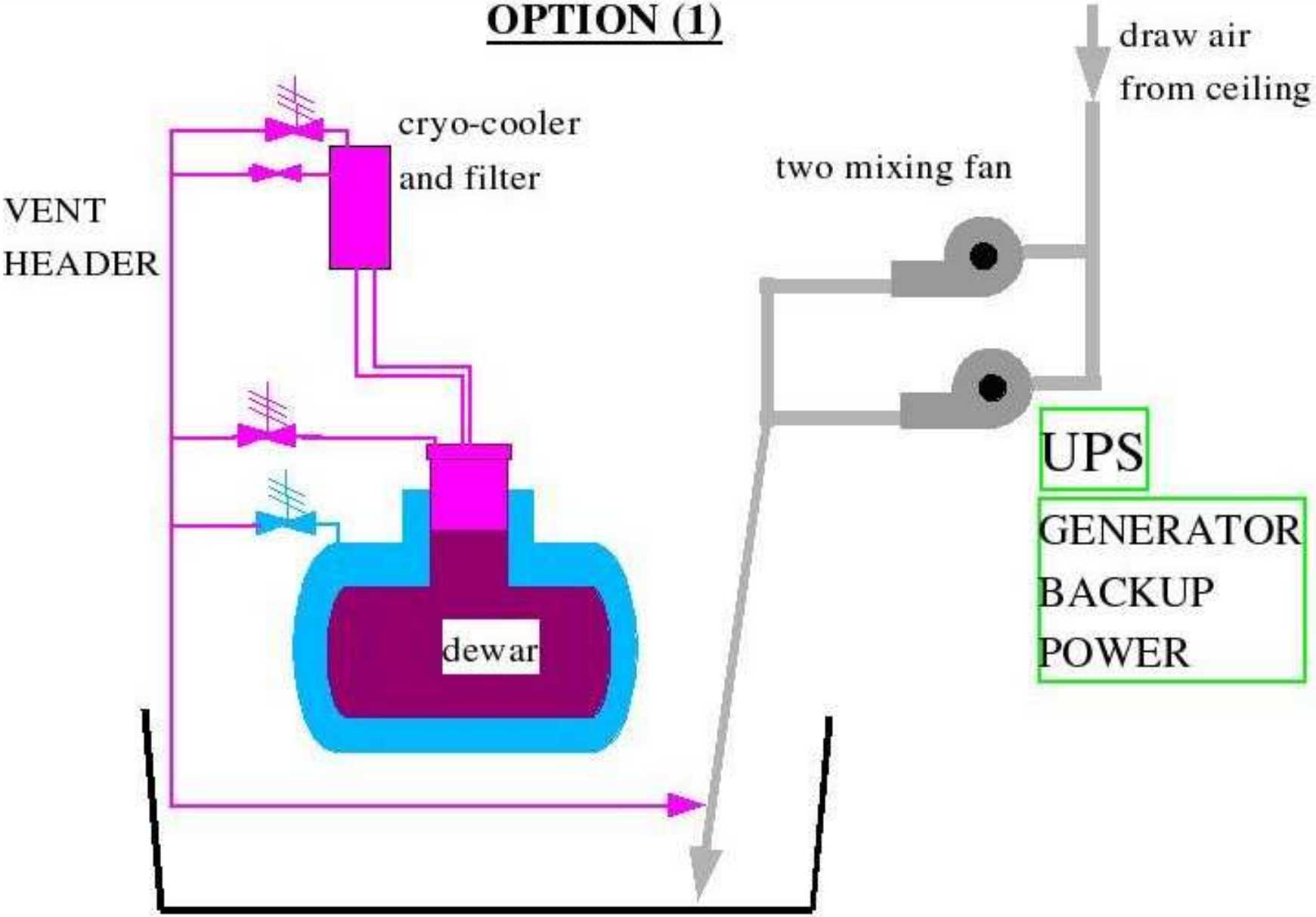
OPTION (3)


draw air
from ceiling
cryo-cooler
and filter
VENT
HEADER
one mixing fan
GENERATOR
BACKUP
POWER
dewar
(NO UPS)

OPTION (3)

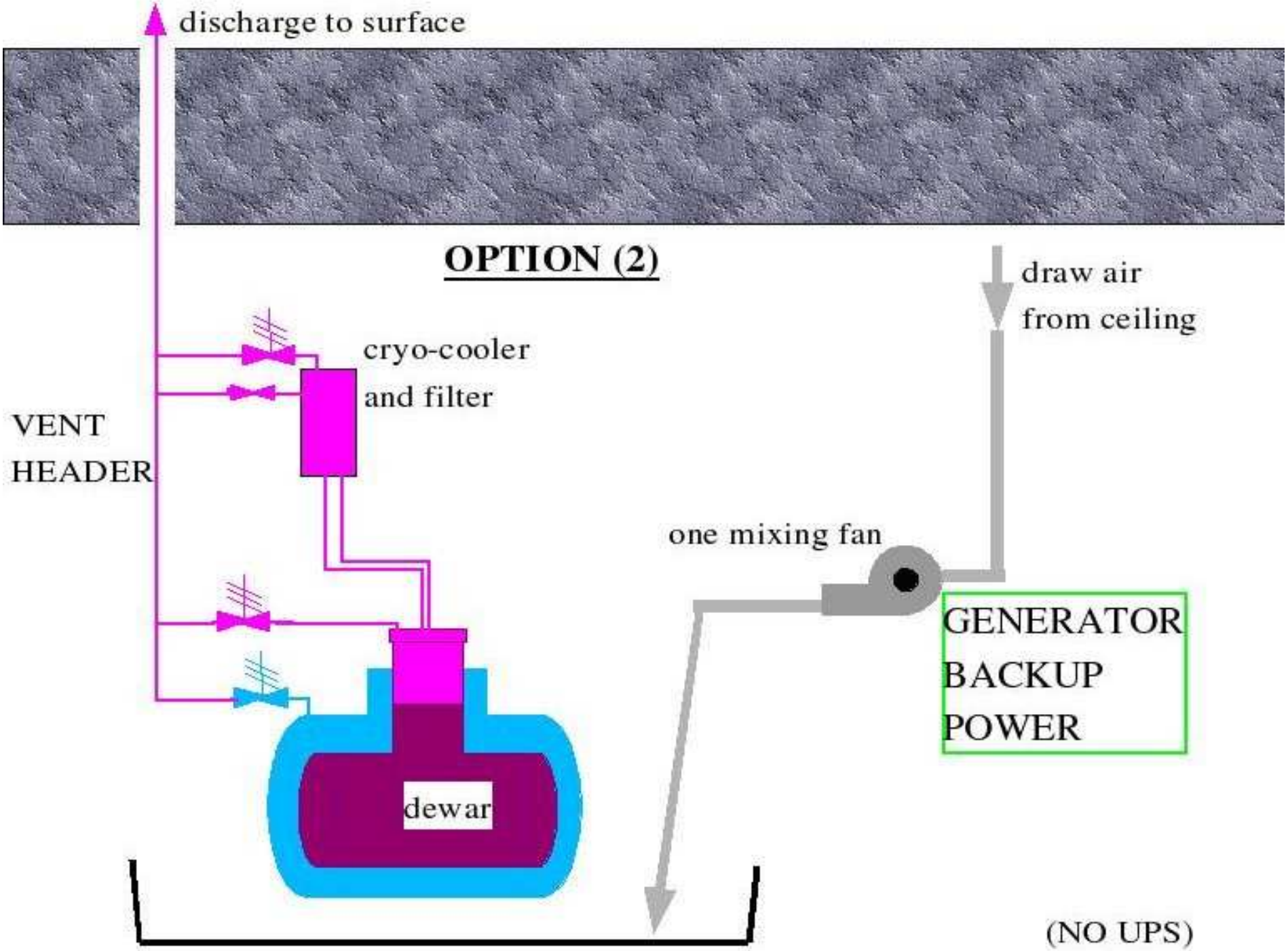
- Don't Consider It.
- might be “safe” but the engineering cost of showing it to be safe will be very high
- Almost all aspects of the cryogenic system become safety issues.

OPTION (1)


draw air
from ceiling
cryo-cooler
and filter
two mixing fan
VENT
HEADER
UPS
GENERATOR
BACKUP
POWER
dewar

OPTION (1)

- Feasible but requires a very well engineered mixing system that almost never fails.
- Safety review will be “involved”
- Use only if a better option not available.


discharge to surface
OPTION (2)
draw air
from ceiling
cryo-cooler
and filter
VENT
HEADER
one mixing fan
GENERATOR
BACKUP
POWER
dewar
(NO UPS)

OPTION (2)

- Prefered option.
- Need cost estimate for running vent header to surface.
- Not affected by operational problems.
- Only real equipment failures, such as cracked welds and leaking valves could cause ODH problems.

ODH Analysis

(1 major operational problem)/(6 months)

OPTION	Phi	ODH Classification
1	2.32 E (-11) fatalities/hr	0
2	1.09 E (-9) fatalities/hr	0
3	7.55 E (-8) fatalities/hr	0 (almost 1!)

ODH Analysis

(1 major operational problem)/(0.6 months)

OPTION	Phi	ODH Classification
1	2.08 E (-10) fatalities/hr	0
2	1.09 E (-9) fatalities/hr	0
3	6.86 E (-7) fatalities/hr	1

CONCLUSION:

It is feasible to achieve an ODH 0 classification for the MINOS hall with the 500 L liquid argon dewar