
WATER PURIFICATION

VISIONIONARY OVERVIEW OF COMPANDERS IN INNOVATIVE APPLICATIONS

TWO-STAGE, FREE-SPOOLING COMPANDER/FREEZE CRYSTALLIZATION SPRAY SYSTEM

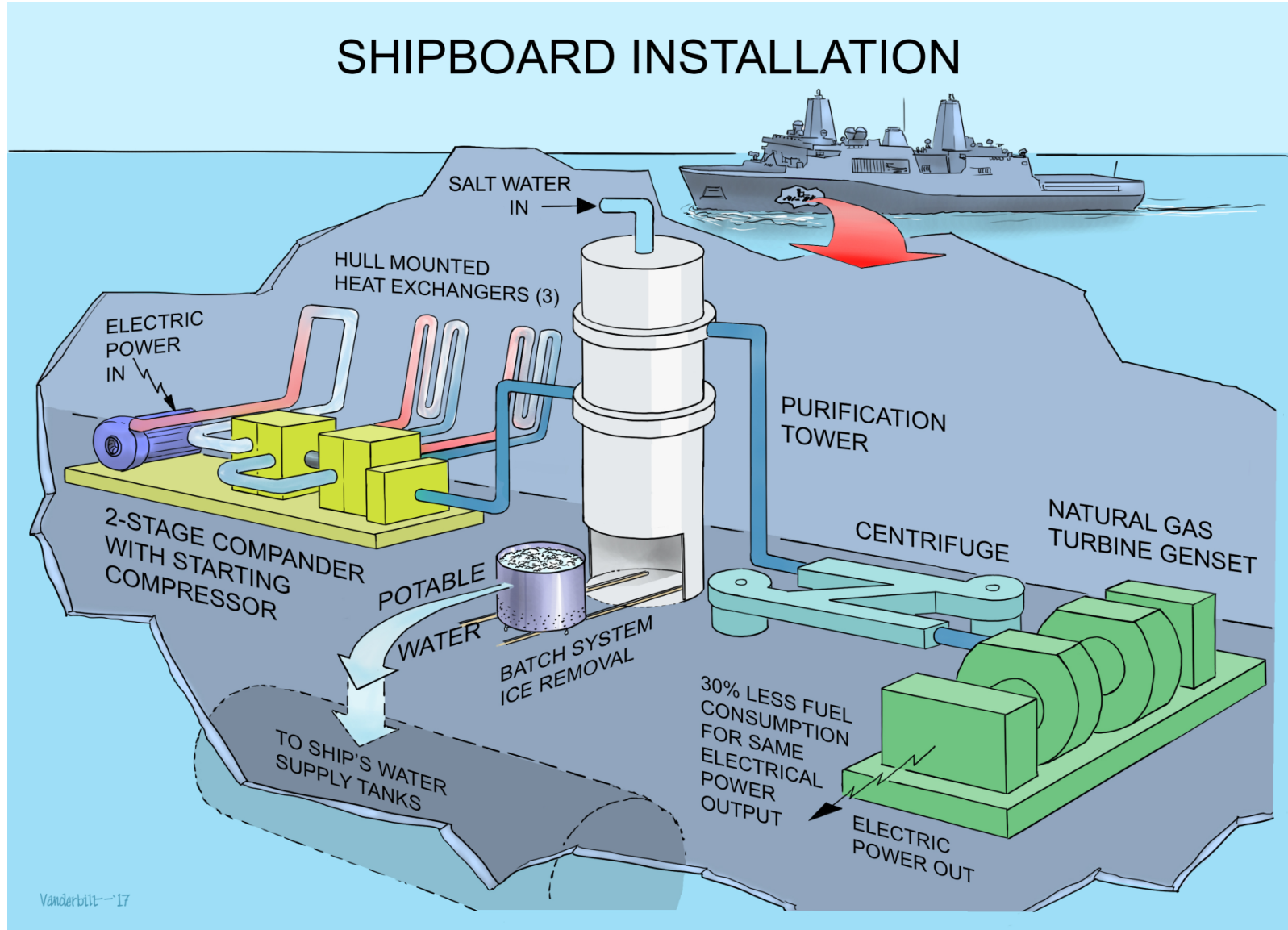
FIXED LOCATION ABOARD SHIP

COMPACT SHIPBOARD, FREEZE CRYSTALLIZATION SPRAY CHAMBER

PORTABLE LOCATION NEXT TO TOXIC WASTE WATER POOLS

TALL PORTABLE FIELD FREEZE CRYSTALLIZATION SPRAY CHAMBER

SHIPBOARD SYSTEM (UPDRAFT AIR IN SPRAY CHAMBER)

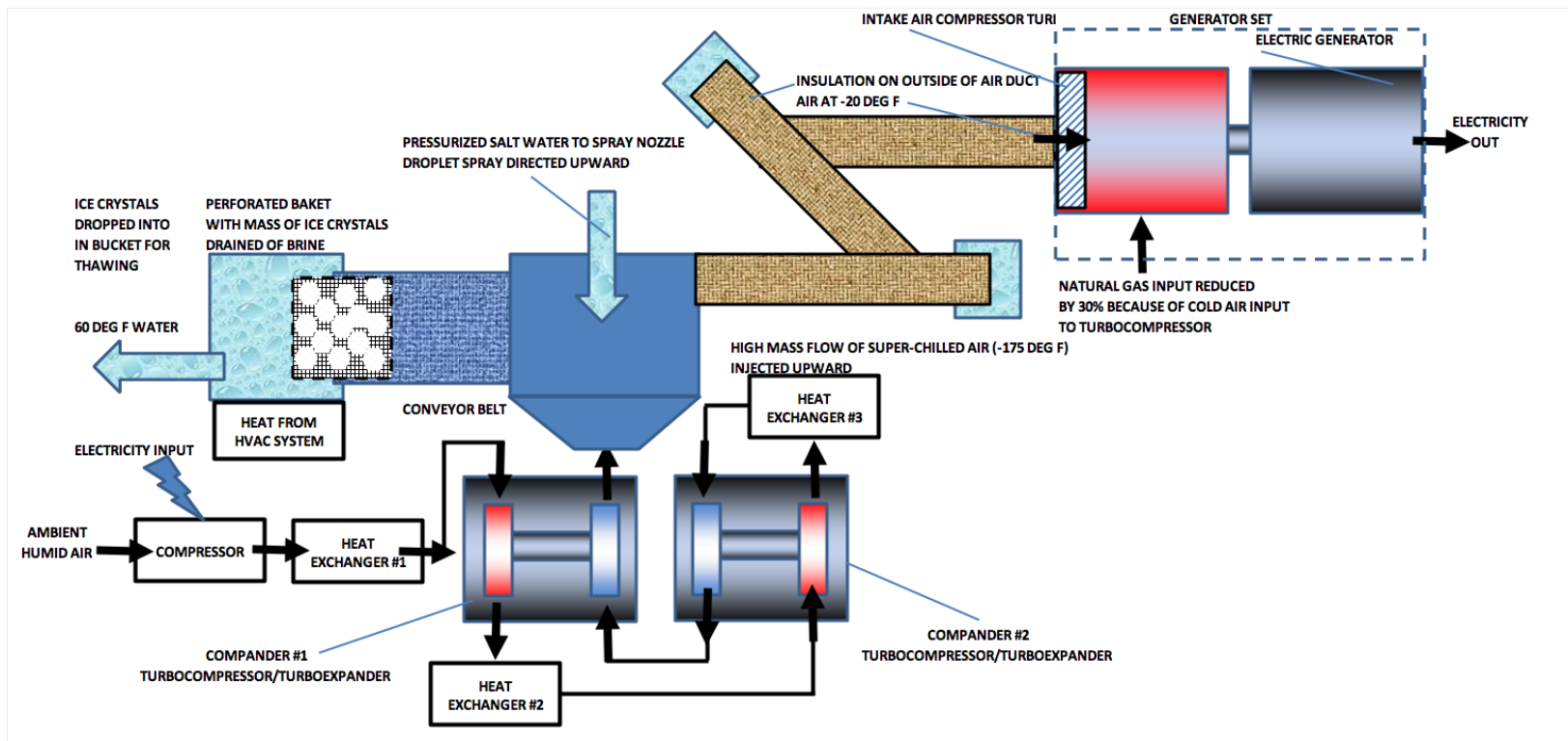


SHIPBOARD SYSTEM (UPDRAFT AIR IN SPRAY CHAMBER)

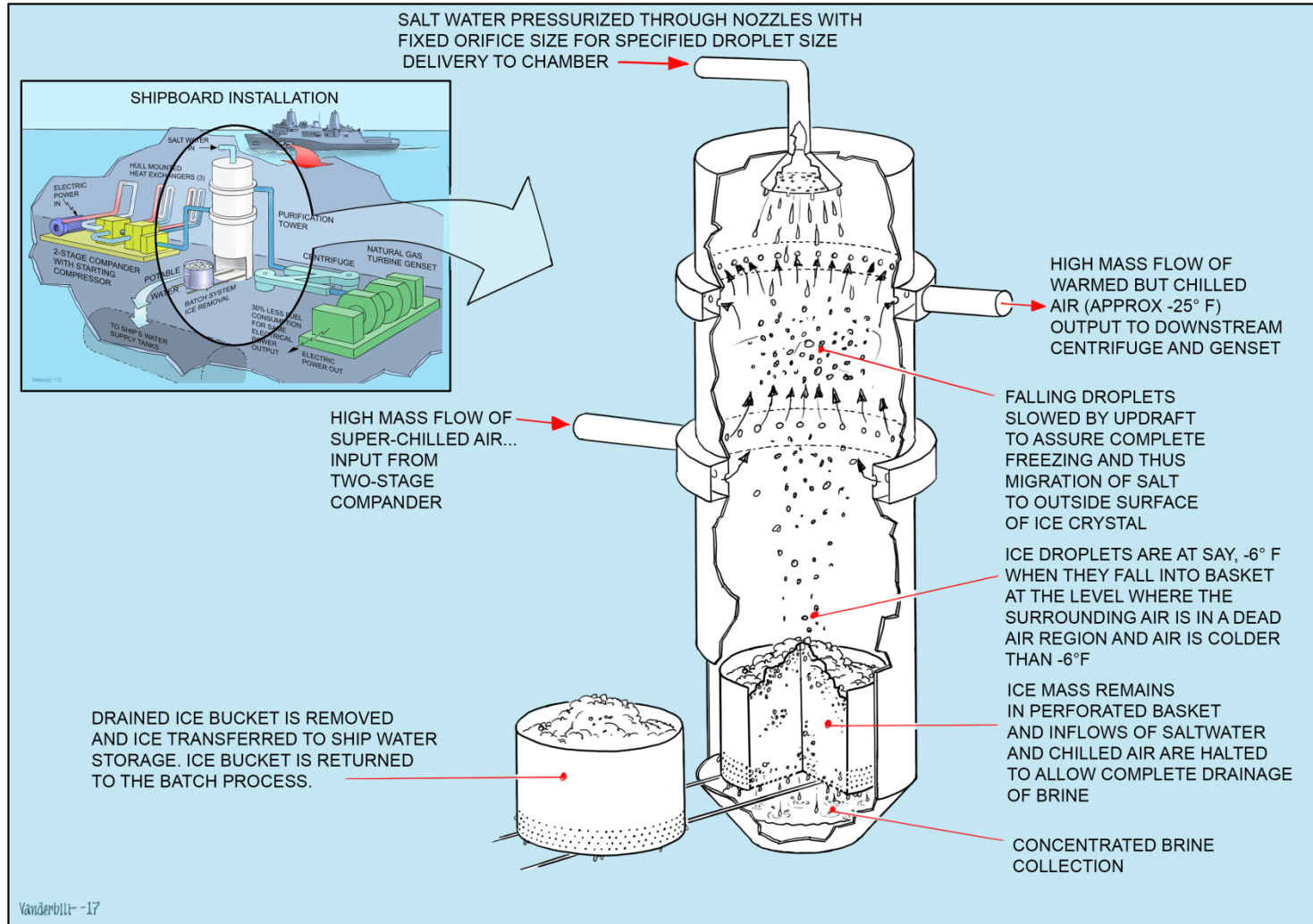
SHIPBOARD SYSTEM PERMITS ACCESS TO HEAT SINKS FOR HEAT EXCHANGERS REQUIRED BY TWO-STAGE, FREE-SPOOLING, COMPANDER

TWO-STAGE, FREE-SPOOLING, COMPANDER DOES NOT REQUIRE REFRIGERANTS...SOME REFRIGERANTS ARE TOXIC AND WHEN RELEASED FORM EXPLOSIVE MIXTURES

TWO-STAGE, FREE-SPOOLING, COMPANDER ARE COMPACT AND REQUIRE SMALL FOOTPRINT AND HEIGHT



CROSS-SECTION OF FREEZE CRSTALLIZATION SPRAY CHAMER (SHIPBOARD)



CROSS-SECTION OF FREEZE CRYSTALLIZATION SPRAY CHAMBER (SHIPBOARD)

FREEZING DROPLETS HELD ALMOST STATIONARY BY UPDRAFT OF CHILLED AIR

- LOW SPEED FALL OF DROPLETS GIVE LONG RESIDENCE TIME IN SMALL VERTICAL DISTANCE
- SMALL HEIGHT OF SPRAY CHAMBER PERMITS USE ABOARD SHIP

FROZEN DROPLETS ACHIEVE THEIR EUTECTIC FREEZING TEMPERATURE WHILE THE UPDRAFT AIR IS COLDER

- UPDRAFT AIR EXITS AT ABOUT -25°F TO FEED GEN-SET -20°F AIR
- FROZEN DROPLETS AT EUTECTIC TEMPERATURE, SAY, -6°F, CONTINUE FALLING INTO DEAD ZONE

RESIDENCE TIMES

- THERE IS A RESIDENCE TIME REQUIRED FOR FREEZING AND FOR THE SOLUTE (SALT) TO MIGRATE TOWARD AND THROUGH THE DROPLET MIXTURE OF WATER AND SALT. **SMALL DROPLETS** WITH LARGE SURFACE TO VOLUME RATIOS ARE DESIRED TO MEET THE RESIDENCE TIME REQUIREMENTS
- THERE IS A RESIDENCE TIME REQUIRED FOR THE FILM OF BRINE TO DRAIN FROM EACH ICE CRYSTAL AND THEN DRAIN THROUGH THE TORTUROUS OPEN PATHS IN THE ACCUMULATED ICE MASS. **LARGE DROPLETS** WITH SMALL SURFACE TO VOLUME RATIOS ARE DESIRED TO MEET THE RESIDENCE TIME REQUIREMENTS
- A SEPARATE EMPIRICAL TEST IS REQUIRED FOR EACH SOLUTE.

GENERATES COLD FRESH WATER