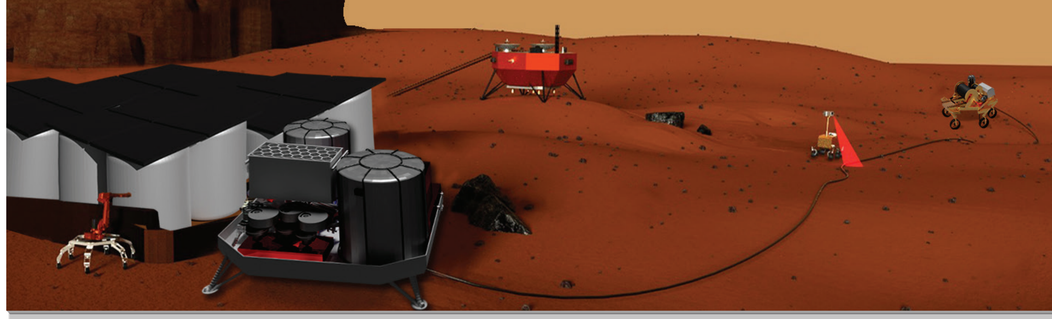


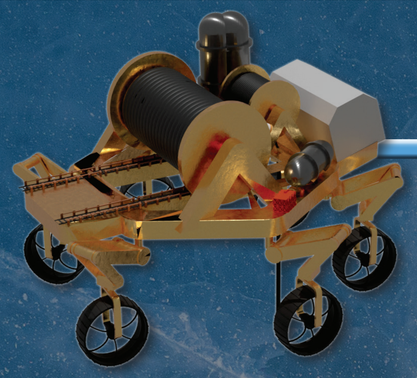
SALVARE

/ sal·và·re /
[v, Italian.] to rescue

SELF-ACQUISITION OF LIQUID PROPELLANT VERSATILE ARSENAL OF RESOURCES ENDEAVOUR

POLITECNICO MILANO 1863

1 WATER EXTRACTION & TRANSPORTATION



- Wireline drilling to reach maximum depths using minimal mass, volume, and risk
- Rotary-percussive drill system breaks through hard rock with a limited Weight on Bit (WOB)
- Cuttings removed through intermitted blasts of compressed Martian air
- Water extraction via the Rodwell method

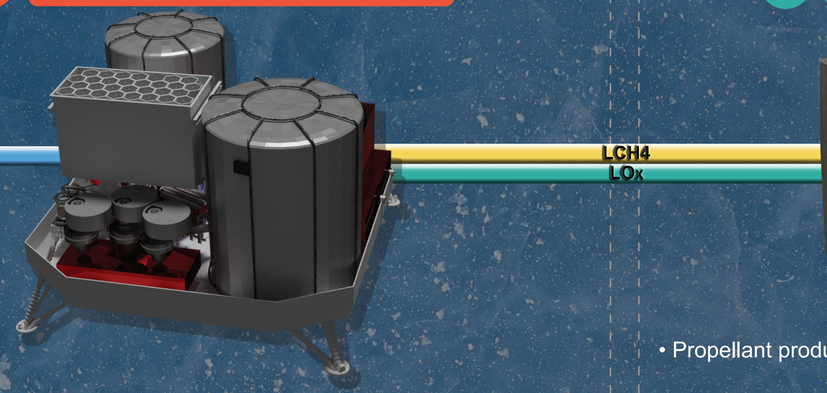
DRILLING SYSTEM

- Components miniaturized and placed in the Bottom Hole Assembly
- Percussor, hammer, drill motor, pump, and heater liquify the ice. An anchor inflates to seal the borehole preventing sublimation of ice.
- Water is then heated prior to its transportation towards the production plant (C3P).
- A dedicated flexible pipeline in NERO is extended through an unwinding mechanism based on the “endless screw concept”

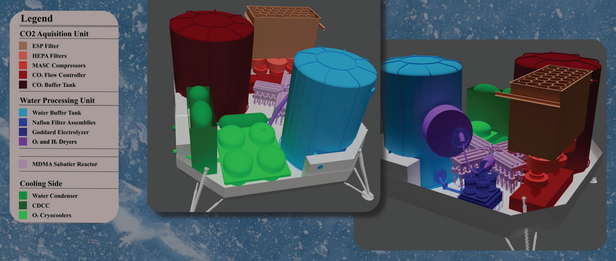
KEY INNOVATIONS

- Coiled tubing drill approach combined with Rodwell method
- Robust and compact pipeline design for water transportation
- Preemptive use of buffer tanks during dust storms
- Maintenance mechanism for HEPA and ESP filters
- Mechanical Scroll Compressors
- Proton Exchange Membrane Electrolyzer
- Microlith Sabatier Reactor
- Condensation Distillation Column for the separation of chemical products
- Mechanical and thermal protection of tanks through Additive Manufacturing
- Zero Boil-off through Broad Area Cooling
- Architecture and environment monitoring rover (MINIATURE)
- Snake train deployment concept for Kilopower reactors
- Dust storm detection LIDAR

2 PROPELLANT PRODUCTION



C3P is the heart of propellant synthesis for the SALVARE architecture, the main part of which is an innovative Microlith catalyst Sabatier reactor.



- Extracted water processed and split using a PEM electrolyzer
- Atmospheric CO_2 acquired using mechanical scroll compressors
- Two-stage filtration system for CO_2 acquisition and buffer tanks for CO_2 and H_2O are used to extend operations during dust storm events, during which the CO_2 acquisition rate should be decreased
- Enhanced robustness of the architecture enables satisfaction of annual propellant production requirement even during shut-down of up to 65 consecutive sols during dust storms

SALVARE BY THE NUMBERS

5 Years of duration

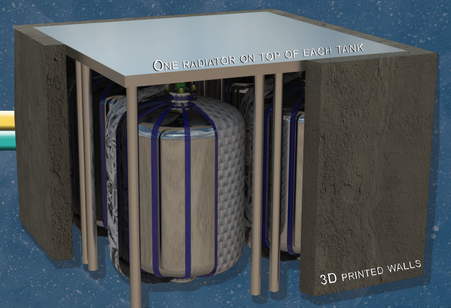
3 Total launches

27.7 Billion USD Cost

146 Metric tons

1.01 Million kW per year

3 PROPELLANT LONG-TERM STORAGE

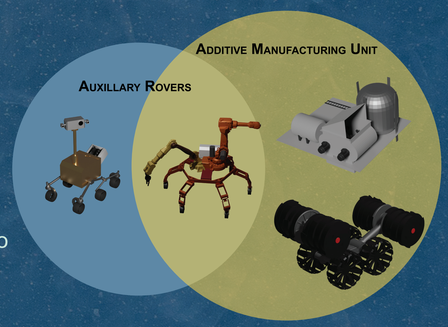


- Propellant produced across 5 years is stored in 32 tanks (16 LOx,16 LCH_4)
- Due to boiloff, SALVARE adopts a combination of an active and passive Thermal Control System (TCS).
- Broad area cooling with Reverse Turbo-Bryton cycle used to achieve zero-boiloff through the circulation of a coolant (Helium).
- Layered Composite Insulation layer (LCI) wrapped around each tank
- Use of alternated layers of 3D-printed concrete and geopolymer foam reduces TCS power consumption by 20 kW and protects LCI from mechanical loads caused by dust storms.

AUXILIARY ASSETS, TELECOMS, & POWER SOURCE

MINIATURE

- Light rover designed for terrain mapping using the Simultaneous Localisation And Mapping (SLAM) technique
- Ground Penetrating Radar to identify optimal water extraction sites and relies on an IR camera to perform monitoring.



ATHLETE

- Performs the electrical and pipeline connections through a robotic arm
- Uses printing arm to produce a 3D-printed thermal and mechanical protection of the tanks
- Necessary imported material for this operation is included in a dedicated cluster of tanks

MGCH

- Telecommunication hub for surface and Earth links
- Includes dust storm detection LIDAR and the Power Distribution Center (PDC)

KILOPOWER REACTORS (KPs)

- Power source for fixed assets (C3P, Cryocooler, MGCH)
- Deployed via “snake train” concept