Overview of Hydrazine Fuels Infrastructure

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Hydrazine Requirements

♦ Most “hydrazine” is, MIL-PRF-26536, HPH-grade
  ➢ No aniline
  ➢ Produced by Arch Chemical (Lonza) in Lake Charles, LA
  ➢ Used by spacecraft for in-orbit propulsion
    ▪ Most are mono-propellant applications
    ▪ HPH/N2O4 bi-prop engines are becoming less rare
  ➢ NASA uses HPH most often in its science spacecraft

♦ Other “hydrazine” is MPH grade
  ➢ Up to 0.5 wt% aniline
  ➢ Was primarily used by Shuttle for APUs and HPUs
  ➢ No longer in production by Arch
  ➢ Once DLA inventory is depleted, MPH will no longer be available
♦ Various containers are used in hydrazine service
  ➢ All constructed of 304L SS
  ➢ All pressure load and offload
  ➢ Most containers are covered by various DOT SPs
  ➢ Non-bulk containers
    ▪ No pressure relief devices
    ▪ DOT4BW specification w/ SPs
    ▪ 5-, 30-, 55- and 120-gallon water capacity
  ➢ Bulk containers
    ▪ NASA 500-gallon GPTU
    ▪ Industry-owned DOT110A500W cylinders

♦ Similar or identical container designs are used with MMH and N2O4
GPTU fluid system access is supported with roll-around platform and stairs

Gauge Valve

Pressurization/Vent Valve

Relief Valve W/ Isolation Valve

Liquid Valve W/ Dip Tube To The Bottom Sump

Containers - GPTU
Containers - Cylinders

DOT110 cylinder

DOT4BW cylinder
Toxic Vapor Scrubbers

- Hydrazine family fuels and N2O4 oxidizers produce toxic vapors
- Transfer operations use helium or nitrogen to move propellant from one container to another
- Receiving container must be vented to the atmosphere through a scrubber

- NASA standard 4-tower wet scrubber
  - Mobile and fixed versions
- Dry-bed scrubber used at Astrotech
Personal Protect Equipment

♦ Hydrazine is toxic by both dermal and inhalation exposure

♦ “Class A” PPE is required

♦ NASA developed the SCAPE suit as an alternative to industrially available PPE
  ➢ Fully encapsulated butyl-rubber-based suit
  ➢ Supply breathing air via either back-pack or air-hose

♦ Emergency escape device
  ➢ ELSA
  ➢ 10-minute breathing air supply
  ➢ Deployed in operational areas where a potential toxic vapor hazard exists
The suited technician is ready for work. Air-pack has 2-hr capacity. Radio-com allows free mobility.

Built-up suit meets the technician's size. The 35-pound liquid air-pack is adjusted for comfort.

The zipper is then closed providing the full encapsulation of the technician.
PPE - ELSA

ELSA storage box usually located at evacuation route exit points

ELSA in use
If NASA were to implement an alternative to hydrazine?

- Would only reduce (or eliminate) SCAPE for hydrazine replacement
  - SCAPE is required for MMH and N2O4 operations
- May or may not reduce scrubber requirements due to ammonia being present in the LMP103S fuel
- LMP103S is a blend; volatile components may be lost during transfer operations due to venting

Alternative fuels will probably not be a significant cost factor at KSC and CCAFS unless all MMH and N2O4 requirements shift to less-toxic alternative propellants
Acronyms

♦ APU – Auxiliary Power Unit
♦ DLA – Defense Logistics Agency
♦ DOT SP – Department of Transportation Special Permit
♦ ELSA – Emergency Life Support Apparatus
♦ GPTU – Generic Propellant Transfer Unit
♦ HPH – High Purity Hydrazine
♦ HPU – Hydraulic Power Unit
♦ MMH – MonoMethyl Hydrazine
♦ MPH – MonoPropellant Hydrazine
♦ N2O4 – Nitrogen Tetroxide; also NTO
♦ PPE – Personal Protective Equipment
♦ SCAPE – Self Contained Atmospheric Protective Ensemble
♦ SS – Stainless Steel