National Aeronautics and Space Administration

RADIOISOTOPE POWER SYSTEMS

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Radioisotope Power System Pool Concept

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POWER TO EXPLORE

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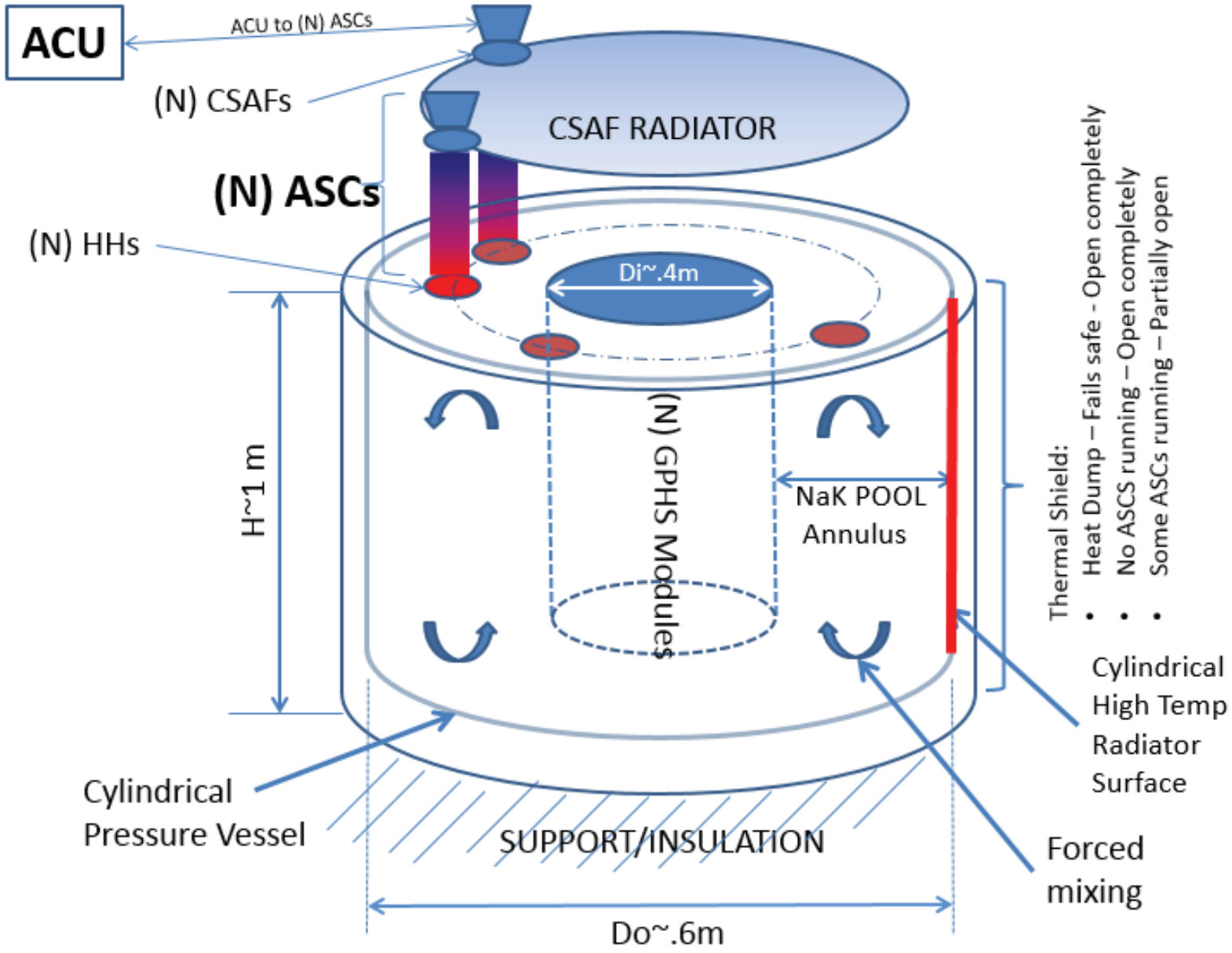
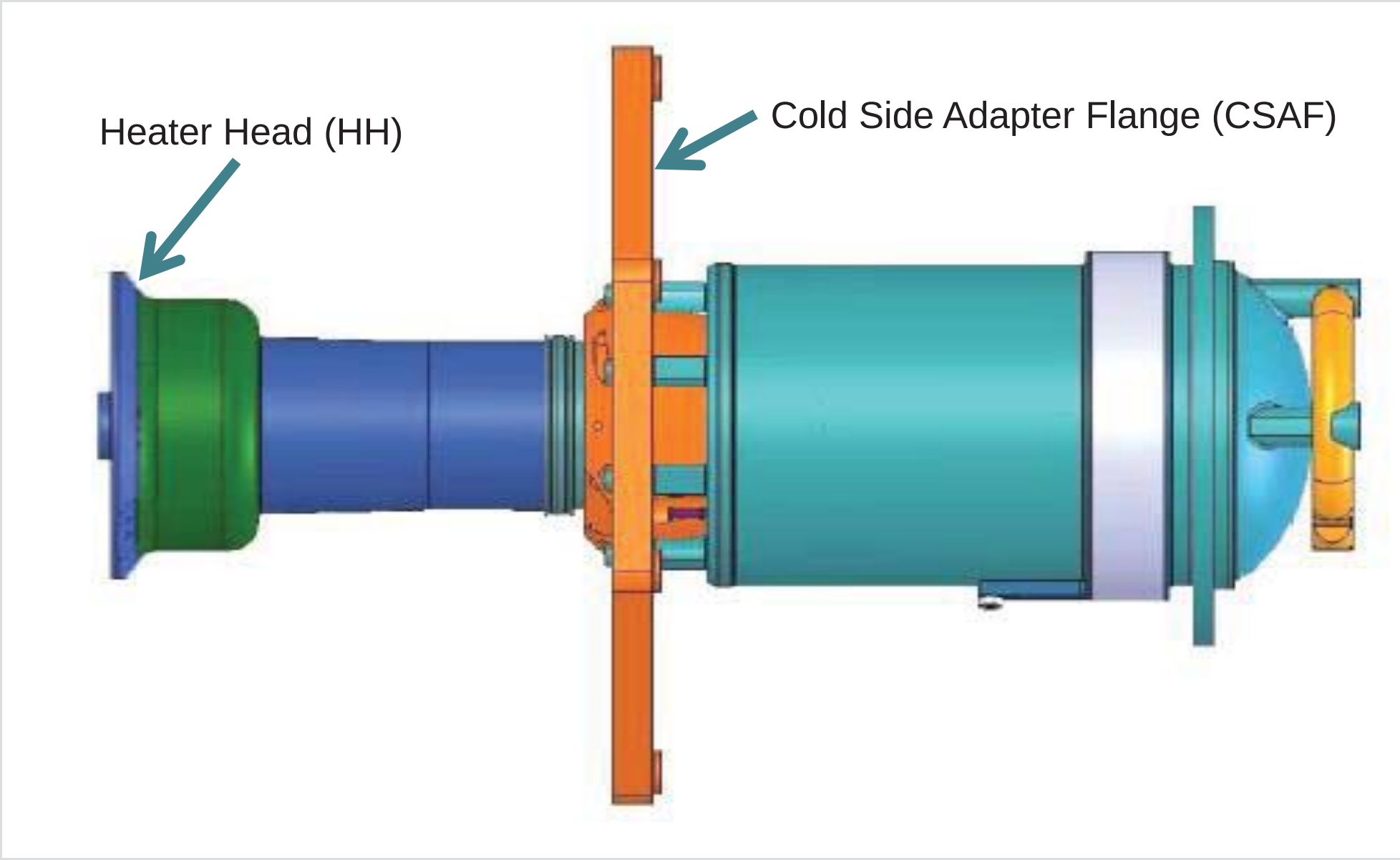
Pool Concept Architecture



Advanced Stirling Converter (ASC)



Pool Concept Elements

- (N) Advanced Stirling Converters (ASCs) which produce AC power
- Advanced Controller Unit (ACU) that can run (N) ASCs and produce DC power
- Cold Side Adapter Flange (CSAF) on each ASC cooled by a space radiator
- Heater Head (HH) on each ASC which is heated by the hot NaK
- Radioisotope General Purpose Heat Source (GPHS) modules to heat the NaK
- CSAF low temperature space radiator
- High temperature radiator that can radiate GPHS heat directly to space

Pool Concept Elements

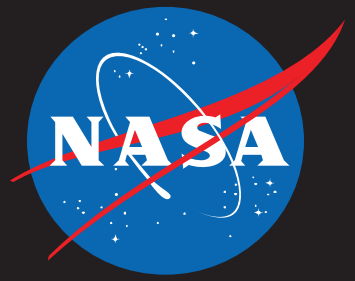
- Thermal shadow shield that opens completely to provide fail safe cooling of all GPHS modules, or partially opens when some ASCs are running and cooling the GPHS modules.
- Modular - Variable number (N) of ASCs and GPHSs can be integrated to produce up to 1 KWe of DC power
- Electric motor driven NaK mixers to minimize temperature gradients in the NaK pool annulus
- A low pressure vessel concept with the highest NaK temperature below 785 C, the boiling point for NaK
- A vibration damper is associated with each ASC, so individual ASCs can be turned on and off without inducing large spacecraft vibrations

Pool Concept Reliability Benefits

1. Turn on/off individual ASCs
    a. GPHS heat is shared amongst the ASCs via the NaK pool, so individual ASCs can be turned on and off while other ASCs pick up the heat load; cold spare ASCs are possible
2. Reset of ACU controller cards by powering off
    a. The ACU concept contains a controller card for each ASC and extra controller cards, so cards can be powered on or off as needed to reset bit errors, ASC control can be transferred from one card to another, and ASC control can be transferred to a backup card in the event of a card failure or an upset.
3. Cooling of all GPHSs without the ASCs running via a high temp radiator
    a. Heat is either removed actively by operating ASCs, or passively via a high temperature radiator with no flight hardware damage.
4. Stirling Generator Safe Mode (ASCs and ACUs off) enabled
    a. All ASCs and ACUs can be turned off, and the GPHSs passively cooled by the high temperature radiator, as long as stored energy is available on the spacecraft.

Pool Concept Reliability Benefits

5. ASCs not running during spacecraft integration and storage
    a. The concept includes a canister for the (N) GPHSs that can be inserted at the cape, so storage, and then integration at the cape can be accomplished without ASCs running. This is a reliability improvement (storage and integration without ASCs running), in addition to being an operations advantage.
6. Multiple 80 We or higher power ASCs running in parallel to achieve high reliability via redundancy.
    a. 18 - 80 We ASCs running provides about 1 KWe, and high reliability, and other intermediate power levels can be achieved by turning off and on ASCs as needed, and using the high temperature radiator to passively dump the excess heat not used in the Stirling cycle, or using the excess heat to warm critical spacecraft components.
7. Extra power margin can be integrated into the design, e.g. 25%
    a. Extra ASCs can be included to improve spacecraft power margin.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