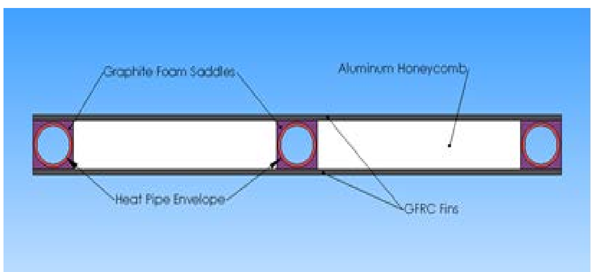
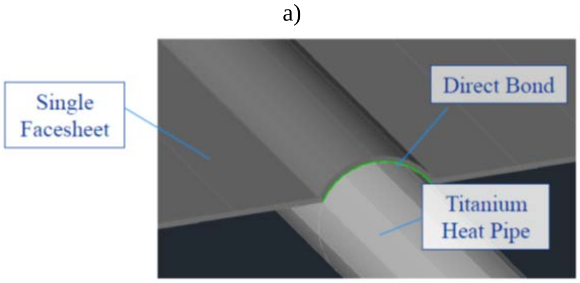
LOW COST RADIATOR FOR FISSION POWER THERMAL CONTROL. Taylor Maxwell, John R. Hartenstine, Calin Tarau, William G. Anderson[1], Theodore Stern, Nicholas Walmsley[2], and Maxwell H. Briggs[3], [1]Advanced Cooling Technologies, Inc., Lancaster, PA, [2]Vangaurd Space Technologies, Inc., San Diego, CA, [3]NASA Glenn Resarch Center, Cleveland, OH

Introduction: NASA Glenn Research Center (GRC) is developing fission power system technology for future Lunar surface power applications. The systems are envisioned in the 10 to 100kW$_e$ range and have an anticipated design life of 8 to 15 years with no maintenance. NASA GRC is currently setting up a 55 kW$_e$ non-nuclear system ground test in thermal-vacuum to validate technologies required to transfer reactor heat, convert the heat into electricity, reject waste heat, process the electrical output, and demonstrate overall system performance. Reducing the radiator mass, size, and cost is essential to the success of the program. Figure 1 illustrates a conventional dual facesheet VCHP radiator, and a single direct-bond facesheet radiator that is currently being developed under an SBIR program with NASA GRC.



a)



b)

Figure 1. Geometry of dual (a), and single (b) facesheet VCHP radiators

The single direct-bond facesheet radiator has the advantages of reducing mass and cost of the system by eliminating the POCO foam saddles, aluminum honeycomb, and one of the GFRC facesheets. However, there are several aspects of the single facesheet radiator that must be studied to verify its feasibility. For instance, in lunar applications the sink temperature is known to vary over a wide range (114 – 212K at Shackleton Crater). As a result, the epoxy bond must be able to withstand stresses induced by the CTE mismatch between the GFRC and the titanium heat pipes. A prototype of single facesheet direct-bond radiator has been fabricated (as seen in Figure 2) for the purpose of testing the integrity of the direct bond as it undergoes thermal cycling.

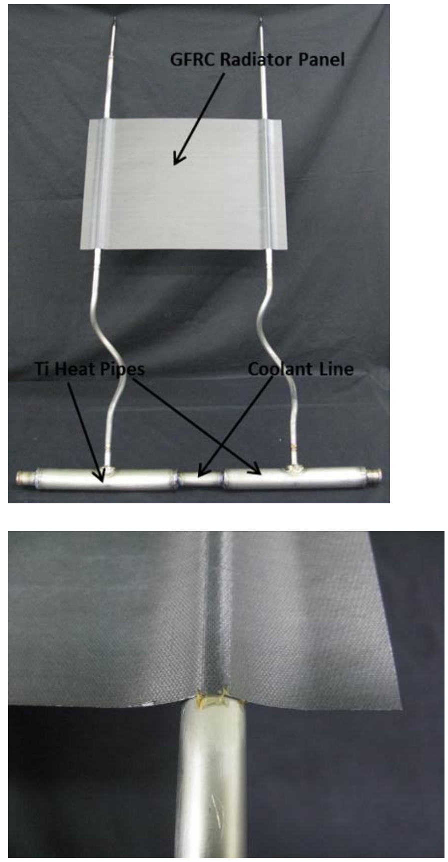


Figure 2. Single facesheet direct-bond radiator prototype

Thermal testing of the radiator will consist of a baseline thermal performance test and a series of thermal cycling tests. For the baseline thermal performance test, the radiator will operate at the nominal inlet coolant temperature (approximately 400K) in ambient conditions (~293K). A series of thermocouples, located around the periphery of the direct bond, will be used to approximate the thermal resistance of the epoxy bond layer. These thermal resistance measurements will serve as baseline values for which all other thermal resistance measurements will be referenced to. During the thermal cycling test, the coolant temperature will remain at a constant value, and the radiator sink temperature will be varied with a liquid nitrogen cold plate. After each cycle, the thermal resistances of the epoxy bond will be compared to the baseline values to determine if any change has occurred. An infrared camera will also be used to compare the thermal gradients of the direct bond before and after thermal cycle testing.

The final paper will provide a detailed look at the prototype geometry, as well as the test procedures and results.