HIGH HEAT FLUX TESTBED

UCI MECHANICAL ENGINEERING STUDENTS

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Introduction

Background

The internal components of jets and rockets can reach very high temperatures, posing a threat to the integrity of the electronics inside of them. Our goal is to design a rod that will be able to dissipate enough heat to keep one section of the rod at room temperature, given one side being very hot, and another side very cold.

Goal and Objective

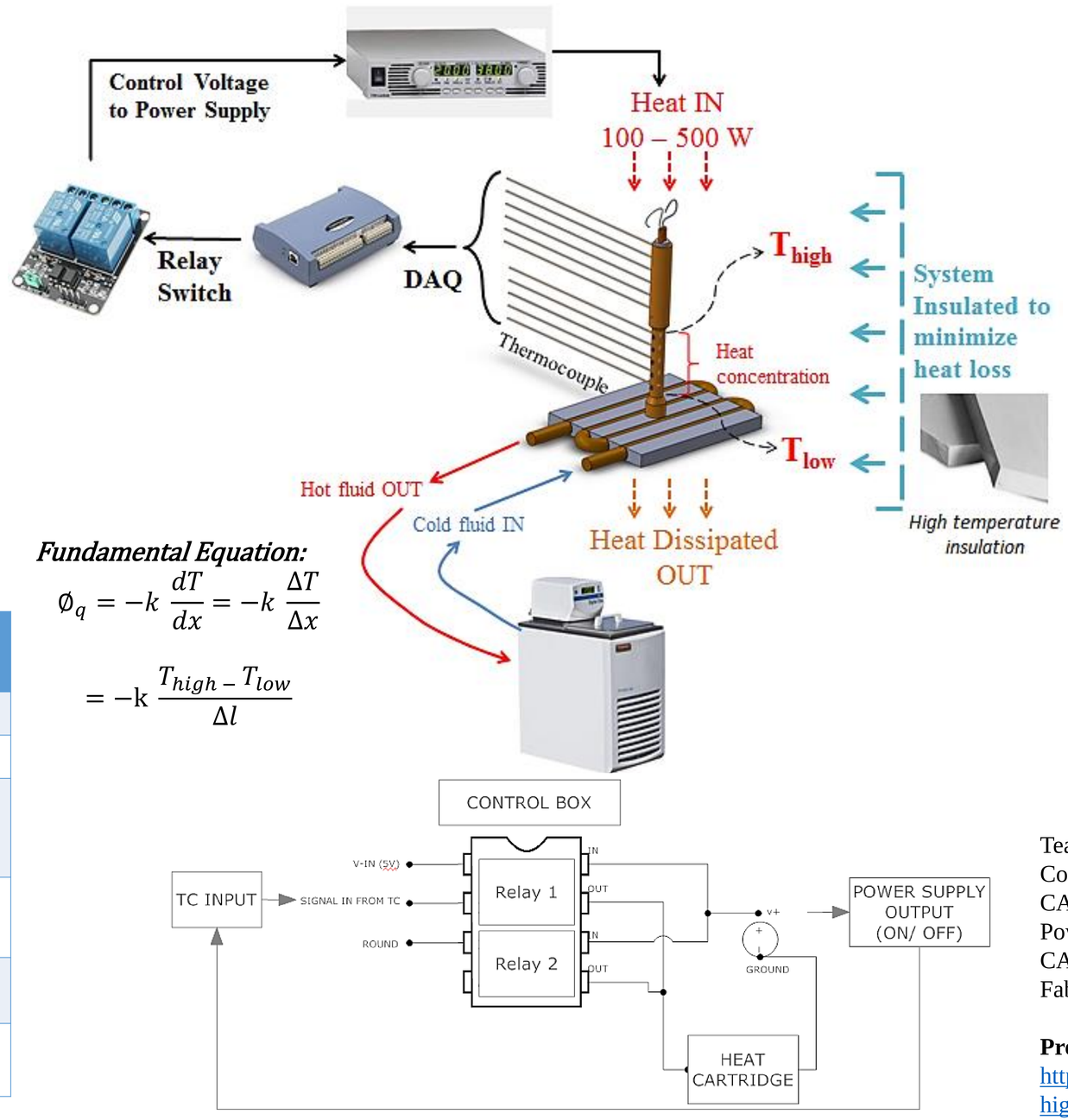
The goal is to design and build a testbed capable of generating and dissipating high heat fluxes

The objective is to create heat flux as high as 500W/cm^2 by supplying heat from one side of the testbed and dissipated heat rapidly by using SOTA cooling technologies.

Requirements

#	AFRL Requirements	UCI Design Compliance	UCI As Built Test 2015 - 2016	Projected for Fall 2016 - 2017
1	Vacuum Compatibility	Yes	None	Not required
2	Thermal Source	Yes	Cartridge Heater (14 Ohm)	Same
3	Thermal Sink	Yes	AFRL Refrigerated bath + Cold plate ➔ Lowest temp = 4C, using water as coolant	Use same equiment but explore different coolant to obtain lower cooling temperature
4	Max heat load of **500 – 2000W**	Targeted for **100W**	Not achieved – due to limitation of power supply ➔ Max power 60W	Look into increase power as much as possible ➔ Targeted for 100W or more
5	Max heat flux **500 – 2000 W/ cm^2**	Targeted for **50 – 100 W/cm^2**	Up to ~60 W/cm^2	Targeted for 100W/ cm^2 or more
4	Safety System with shutdown power feature	Safety shutoff controlled by electronics	Not achieved	Shutoff system by using relay switch and arduino

System Design



Fundamental Equation:

$$\emptyset_q = -k\frac{dT}{dx} = -k\frac{\Delta T}{\Delta x}$$

$$= -\mathrm{k}\frac{T_{high} - T_{low}}{\Delta l}$$

Current Status

1. **Be able to produce high heat to the rod** without damaging thermocouple bonding

1. **Designed safety shut-off** and **demonstrate** that the safety shut-off features works repeatedly and reliably.

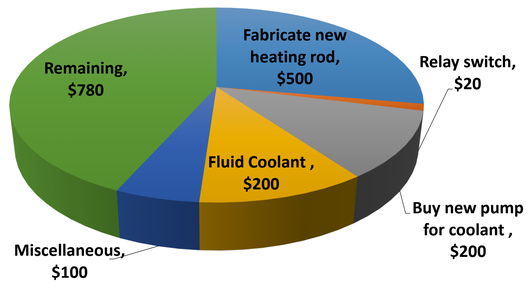
Next Step

1. **Redesign the cooling system** with new cold plate and fluid coolant ➔ Research on SOTA cooling system.

2. **Fabricate new heating rod** for better heat transfer and thermocouple bonding.

3. **Use high capacity power supply** to supply heat to the rod.

Budget and Team Structure



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Project Website:
http://www.ucimaeprojects.com/projects/2016-2017-afrl-high-heat-flux-test-bed/