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NAU Mixing Valve Team

To: Dr. Sarah Oman

From: *NAU Mixing Valve Team*

Date: *June 17th, 2020*

Subject: *Hardware Review 1*

Introduction

This memo will discuss the team's current progress and where the team stands according to the deadlines set by both the client and course for the second semester of capstone. General Atomics has insisted on using tools such as the Drawing Tree, Gantt Chart, and the Requirement Verification Traceability Matrix. These assignments have helped the team understand the project more in depth. The overall team effort, significant progress, design plan and justification are further discussed in this memo to ensure the team is on track to complete deadlines. The progress to date is further explained in the section below.

Progress to Date

This section discusses the team's progress on the project. At this point in time, the team has all the components and has begun the final assembly of the valve. In addition, General Atomics requested a drawing tree in order to assign part numbers to all the components. Finally, the team has learned more on Flow Simulation within SolidWorks in order to test the assembly once it is complete.

Valve Model Progress

The team has made significant progress since ME 476C. At the end of the first semester, the valve assembly consisted of 10 parts and did not include any of the O-rings, gaskets, or hardware. Over the past three weeks, the team has modeled an additional 13 parts and has begun to edit components to include parametric equations. With most of the components modeled, the team is currently attempting to assemble the entire valve. Some of the components do not fit flush with one another so the team plans to rescale certain parts. Figure 1 below shows the current state of the valve assembly. The components that need rescaling have not been included.

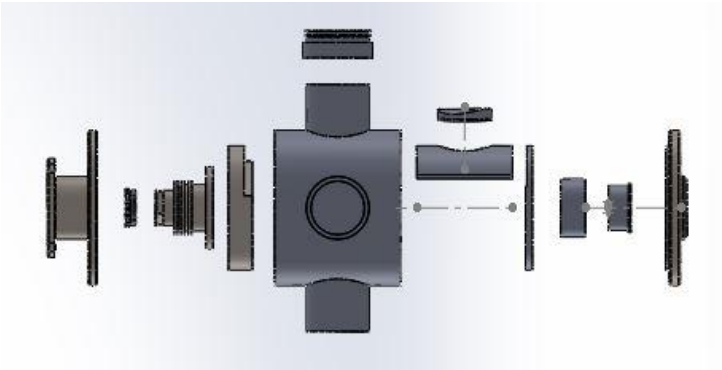

Figure 1: Valve Assembly

Drawing Tree

The drawing tree is shown below in Figure 2. The team organized it by having one large assembly that is the valve and then having four smaller sub-assemblies that broke into either a micro assembly, or individual parts. This model visually shows how the design is organized and fits together all 29 of the parts. The valve body assembly is the one that contains the valve body, the turret assembly is what turns the valve, and the bonnet and spindle assemblies are what attach the valve to the actuator.

Flow analysis Progress

SolidWorks Flow Analysis has been completed for an individual analysis and the team is starting to learn how to complete analyses as well. Members of the team are more comfortable with Flow Simulation and future testing can be worked on as a team, which will make the process simpler overall. The team will continue to communicate with General Atomics to obtain advice on SolidWorks Simulations to be sure the team is choosing the best methods for testing engineering requirements. Flow Simulation will be used to complete most testing, as seen in Table 2.

Plan moving forward

This section discusses the NAU Mixing Valve Team's plan to move forward with the design and stay on schedule. Discussed in more detail below are two organizational tools the team has recently implemented, a new Gantt chart and a Requirement Verification Traceability Matrix (RVTM). The Gantt chart and RVTM discussions are followed by the immediate upcoming task moving forward with the design.

Gantt Chart

The Gantt Chart is important to ensure that all tasks are completed on budget and on time. Staying on time is very important to all participants involved including the client, team, and instructor. Failure to meet these requirements can postpone the deadlines and upset the client. All completed and future tasks can be seen in Appendix A as Table 1 at the end o. All tasks needed for the client and course are shown in this Gantt Chart and only current tasks are shown for the individual group members. The Gantt Chart shows the duration of all deadlines throughout the second capstone semester with begging and end dates. The team plans to use this Gantt Chart as a guideline in order to stay on time. This will be done by utilizing the start time shown in the Gantt Chart for assignments to ensure that the team has enough time to complete deadlines. Currently the team is completing the assembly of the initial mixing valve in SolidWorks and is on time to start initial drawings for General Atomics.

Requirement Verification Traceability Matrix

The Requirement Verification Traceability Matrix (RVTM) is a tool that the client suggested that the team use to keep track of the engineering requirements and related verifications. The RVTM is a table that list all the engineering requirements (ER) required for the design. The RVTM is shown below in Table 2.

Table 2: The Requirement Verification Traceability Matrix as on 6/17/2020.

Requirement ID	Requirement Text	Verification method	Comments
Weight100	Reduce Valve weight by [redacted] pounds total	Analysis	Solidworks Props
Pressure100	Max operational internal fluid pressure = [redacted] PSIG	Analysis	Flow Analysis
Pressure200	Proof tested to [redacted] psig with no deformation	Analysis	Flow Analysis
Pressure300	Maximum pressure drop [redacted] psid at [redacted] gpm.	Analysis	Flow Analysis
Flow100	Max flow rate = [redacted] GPM	Analysis	Flow Analysis
Flow200	Balanced port design, constant flow through out valve swing	Analysis	Flow Analysis
Temp100	Accuracy from set point across step changes of [redacted] in hot let inlet	Analysis	From Actuator
Temp200	Set points programmable from [redacted] to [redacted]	Inspection	Actuator manual
Material100	Operational fluids = Water and possible others	Analysis	Check compatability
Material200	Allowable materials = Electropolished Stainless Steel 316L, descaled Titanium	Inspection	Solidworks Props
Material300	Allowable polymers = [redacted] , [redacted]	Inspection	Purchase
Actuator100	If alternate actuator is selected, power and interfaces must be same as the G1 unit	Inspection	Using Old Actator
Actualtor200	Design may use EMECH/Armstrong G1 actuator or other design	Inspection	Using Old Actator
Assembly100	Reduce valve ports from four inches to three inches	Analysis	Pressure Analysis
CN	Fluid connections per [redacted] Hydraflow drawings	Analysis	
CN	Valve must fit original Bracket	Inspection	Solidworks
CN	Bolts must use helicoils	Inspection	
CN	Purchased Parts must fit in machined parts	Inspection	Purchase
CN	Drawings must be machineable	Inspection	From Client

Key
Complete
Awaiting Verification
Incomplete

Show above in Table 2, each ER is given a requirement ID, followed by a brief description of the requirement. The third column is the verification method for identifying how the requirement will be tested. There are four methods of verification. The first is Test, this is done experimentally and will not apply to the mixing valve. The second is Inspection and will be how material specifications, actuator requirements and weight loss are verified. The third method is Demonstration and like Test will not apply to the mixing valve. The fourth and most applicable method is Analysis. The Analysis method accounts for most of the engineering requirements. Most of the analysis will be completed using flow simulator in SolidWorks. The other analysis will range from hand calculations to paragraphs justifying verification. The fourth column has notes for the team to reference, and the fifth column will keep track of progress as it is made.

Upcoming Task

The first step is to take all of the parts of the valve and fully assemble them in SolidWorks. After this is complete the team will add parametric equations to each of the parts so dimensions can be easily changed during analysis. Then, it will be easy to use hole wizard to add all of the screw and bolt holes in the part. Then, the team can use the SolidWorks flow simulator to do the finite elemental analysis of the part. Nine out of seventeen of the engineering requirements require using flow simulation in SolidWorks, so this step is a high priority. It will help us ensure that the pressure forces are not too much for the part, that switching to titanium didn't cause any great challenges, etc. Most if not all the remaining engineering requirements will be completed for the second individual analysis by the team members individually by July 3rd. After this date the team will be problem solving, allowing time to fix any issues that arise in the flow simulation, and complete the final report as well as all of the valve part drawings.

Conclusion

Since the end of last semester, the NAU Mixing Valve team has made significant progress. The SolidWorks Assembly of the mixing valve is under construction and will be fully assembled soon. Creating the parts for assembly has taken time, but the team is satisfied with the progress, given there were still un-made parts that had been missed last semester. Having the full valve assembly will allow the team to perform simulations with the first version of the complete mixing valve. Flow Simulation will be performed on the completed mixing valve for the engineering requirements specified by General Atomics. There have been other tasks given to the team, by General Atomics, that have also been

completed: Drawing Tree, Gantt Chart, and the Requirement Verification Traceability Matrix. Overall, the team is satisfied with the progress and performance of the members and feel that the project is on track.

Appendix A

Table 1: Gantt Chart as of June 17th, 2020