Task list for Scientists - SRS Review

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1 Purpose of Document

This document is intended to act as a guide to review the SRS document. The scope of this document is to involve the scientists in reading and reviewing the SRS document. To initiate the review process, we have assigned a set of tasks which needs to be completed. Every task is framed as a question in a specific section of the SRS. Each question is to be answered after reading the corresponding section in the SRS document. The tasks will be assigned to the reviewers, and the responses recorded, using GitLab issue tracking.

An SRS is an abstract document which says *what* problem is being solved, but do *how* to solve it. The SRS is used as a starting point for subsequent development phases, including writing the design specification and the software verification and validation plan. Review of SRS document is important to reach a common platform between software engineers and scientists. Any changes required in the software are finalized after the review of SRS. A properly reviewed SRS acts as an agreement between the scientists and the software engineers regarding the deliverables of the project.

2 Questions for Jeyakumar

We would like all the scientists involved in this project to go through the SRS document fully, review the document and give us suggestions. However we do understand if you cannot go through the whole document and review it. Below are the specific questions that we wanted to clarify with you. Please use the GitLab issue tracker to record your responses and suggestions.

1: Check if there are any inconsistencies in the units mentioned in the Table of Units and the units used experimentally. - **Section 1.1 in SRS**.

2: Please let me know if the symbols used in the Table of Symbols match the normal symbols from the literature. - **Section 1.2 in SRS**.

3: Go through Background section and let us know if there is anything that needs a change. Is the description clear for the scientific terms like liquidus and solidus points? Also let us know if you find anything that is confusing or any of the background information which is missing. If you know any reference that explains this background material well, please let us know. - **Section 3 in SRS**

4: Please verify if Figure 1 is correct and let us know if anything is missing or needs further explanation. - **Figure 1 in SRS**.

5: Please verify if Figure 3 is correct and let us know if anything is missing or needs further explanation. - **Figure 3 in SRS**.

6: Please go through the System Context and let us know if it is complete and unambiguous. - **Section 4.1 in SRS**

7: Please let us know if the Data Definition DD1 is explained clearly or if it needs further detail. Can you also please verify if the units in LHS and RHS of the f_s expression match. For eg: f_s is unitless. So, RHS should be unitless as well. If you are aware of a good reference that explains the material covered in the definition, please let us know. - **DD1 in section 5.2.4**

8: Please let us know if the Data Definition DD6 is explained clearly or if it needs any additional information. Also can you please verify if the units in LHS and RHS of the L expression match. If you are aware of a good reference that explains the material covered in the definition, please let us know. - **DD6 in section 5.2.4**

9: Please let us know if the Data Definitions DD7, DD8 and DD9 - *Liquidus point*, *Eutectic point* and *Solidus point* are explained clearly. If you have any other theoretical definition for the same, please explain. If you are aware of a good reference that explains the material covered in the definition, please let us know. - **DD7, DD8 and DD9 in section 5.2.4**

10: Currently we have all the inputs as a *.csv* file. Is there a possibility that the input file will be in any other format other than *.csv*?

11: Please refer to Table 3 which contains a list of inputs to SFS. Are there any other inputs to SFS other than those mentioned in the table?

12: Can you please go through the elements in the Table 5 "Specification Parameter values" and let us know if the values assumed are reasonable or require any changes. The values given in this table are mostly to define extreme bounds for the input variables. The bounds are extreme enough that exceeding them is obviously an error. - **Table 5 in SRS.**

3 Questions for Kumar

We would like all the scientists involved in this project to go through the SRS document fully, review the document and give us suggestions. However we understand if you cannot go through the entire document. Below are the specific questions that we would like to clarify with you. Please respond on the GitLab issue tracker.

13: Please go through the System Context and let us know if it is complete and unambiguous. - **Section 4.1 in SRS**

14: Please read assumption A2 and let us know if this is acceptable with respect to SFS. Are you aware of a mathematical bounds on the cylinder dimension or aspect ratio that define the limits of applicability of this assumption? - **Section 5.2.1 Assumption A2 in SRS**

15: Please read assumptions A3, A4, A5 and A6. In these assumptions, we have assumed that the material properties can be expressed as a linear combination of their values at the beginning and end of solidification. Please let us know if this seems reasonable with respect to SFS. - **Section 5.2.1 Assumption A3, A4, A5 and A6 in SRS**

16: Please read assumption A9. We have assumed that the thermal resistance due to thermocouples is negligible. Please let us know if this assumption is reasonable for SFS. - **Section 5.2.1 Assumption A9 in SRS**

17: Please read assumption A12 and let us know if it is reasonable with respect to SFS. - **Section 5.2.1 Assumption A12 in SRS**

18: Please let us know if the Data Definition 1 - Solid Fraction is explained clearly. Can you also please verify if the units in LHS and RHS of the f_s expression match. For eg: f_s is unitless. So, RHS should be unitless

as well. If you are aware of a good reference that explains the material covered in the definition, please let us know. - **DD1 in section 5.2.4 in SRS**

19: The Data Definitions DD2, DD3, DD4 and DD5 are based on the assumption A3, A4, A5 and A6. Please let us know if the definitions are correct and have been explained clearly. If you are aware of any reference from literature, where they have used this idea in a similar situation, please let us know and we will cite it. - **DD2, DD3, DD4 and DD5 in section 5.2.4 in SRS**

20: Please let us know if the Data Definition DD6 - *Latent Heat of Solidification* is explained clearly. Also can you please verify if the units in LHS and RHS of the L expression match. If you are aware of a good reference that explains the material covered in the definition, please let us know. - **DD6 in section 5.2.4 in SRS**

21: Please let us know if the Data Definitions DD7, DD8 and DD9 - *Liquidus point*, *Eutectic point* and *Solidus point* are explained clearly. If you have any other theoretical definition for the same, please explain. If you are aware of a good reference that explains the material covered in the definition,please let us know. - **DD7, DD8 and DD9 in section 5.2.4 in SRS**

22: Read IM1 and let us know if it is complete, correct and unambiguous. Also for the calibration run, we assume that the metal starts to freeze shortly after being poured and the equation (1) in IM1 is based on this assumption and GD1. Is this a reasonable assumption? - **IM1 in section 5.2.5 in SRS**

23: Read IM2, IM3 and let us know if they need more explanation. q is assumed to be 0 on all boundaries other than the bottom of the cylinder.

Please confirm if this is correct. Also please check if the units on both sides of the equation 2 and 3 in IM2 and IM3, respectively, match. - **IM2 and IM3 in section 5.2.5 in SRS**

24: Read IM4 and let us know if the equation for $\dot{fs}$ is correct. Does the units of LHS and RHS match for the $\dot{fs}$ equation? - **IM4 in section 5.2.5 in SRS**

25: The IM4 is followed by the derivation of the fraction solid. Please review the derivation and let us know if all the steps can be followed easily. If any of the steps are missing or unclear, please let us know. - **Derivation of IM4 in section 5.2.5 in SRS**

4 Questions for Sumanth

We would like all the scientists involved in this project to go through the SRS document fully, review the document and provide us with suggestions. However we understand if you cannot review the entire document. Below are the specific questions that we wanted to clarify with you. Please respond using the GitLab issue tracker.

26: Please go through the System Context and let us know if it is complete and unambiguous. - **Section 4.1 in SRS**

27: Please read assumption A2 and let us know if this is acceptable with respect to SFS. Are you aware of a mathematical bounds on the cylinder dimension or aspect ratio that define the limits of applicability of this assumption? - **Section 5.2.1 Assumption A2 in SRS**

28: Please read assumptions A3, A4, A5 and A6. In these assumptions, we have assumed that the material properties can be expressed as a linear

combination of their values at the beginning and end of solidification. Please let us know if this seems reasonable with respect to SFS. - **Section 5.2.1 Assumption A3, A4, A5 and A6 in SRS**

29: Please read assumption A9, we have assumed that the thermal resistance due to thermocouples is negligible. Please let us know if this assumption is reasonable for SFS. - **Section 5.2.1 Assumption A9 in SRS**

30: Please read assumption A12 and let us know if it is reasonable with respect to SFS. - **Section 5.2.1 Assumption A12 in SRS**

31: Can you please tell us the mathematical characterization that defines the liquidus and solidus points with respect to the data in the cooling curve? We need this information to automatically extract these points from the thermocouple data. - **DD6, DD7 in section 5.2.4 in SRS**

32: We understand that G is the temperature gradient at a point when solid-liquid interface passes through it. How should G be calculated? If possible, please point us to a reference related to G. - **DD9 in section 5.2.4 in SRS**

33: We understand that R is the Velocity of the solid-liquid interface when it passes a given location. What is the mathematical definition of R? If possible, please point us to a reference related to R. - **DD10 in section 5.2.4 in SRS**

34: Read IM1 and let us know if it is correct, complete and unambiguous. Also, for the calibration run, we assume that the metal starts to freeze shortly after poured and the equation(1) in IM1 is based on this assumption and GD1. Is this a reasonable assumption? - **IM1 in section 5.2.5 in SRS**

35: Please let us know whether the material property input for the inverse heat transfer problem in IM1 should just be α, or if it should be k, C_p and ρ? IM1 is written such that only α is needed which will be an input from the user. However, for practical purposes, we might want to have the program calculate α from the other material properties like k, C_p and ρ. - **IM1 in section 5.2.5 in SRS**

36: Read IM2, IM3 and let us know if they need further explanation. q is assumed to be 0 on all boundaries except the bottom. Please confirm if this is correct. Also please check if the units on both sides of the

equation 2 and 3 in IM2 and IM3 match. - **IM2 and IM3 in section 5.2.5 in SRS**

37: Read IM4 and let us know if the equation for $\dot{fs}$ is correct. Does the units of LHS and RHS match for the $\dot{fs}$ equation? - **IM4 in section 5.2.5 in SRS**

38: The IM4 is followed by the derivation of the fraction solid. Please review the derivation and let us know if all the steps can be followed easily. If any of the steps are missing or you feel lacks continuity and need further explanation, please let us know. - **Derivation of IM4 in section 5.2.5 in SRS**

39: In IM4, we could reduce the number of material properties needed by substituting C_V with $C_P * \rho$. The values of ρ in the numerator and denominator would cancel and hence the material properties needed would be only C_P and L. Is there any value to doing this, or is it better with C_V and ρ explicitly in the equation? - **IM4 in section 5.2.5 in SRSSFS**

40: Please read Requirement R3. During the last quarterly meeting Dr. Hamed informed us that he would be able to give the aspect ratio for the cylinder so that it can be made as a constraint to use the software. Outside the constraint, the 1D heat transfer assumption wouldn't hold. Should the input verification check the validity of the input dimensions? If so, please provide the necessary information. - **R3 in section 6.1 in SRS**

41: Please read the non functional requirements and let us know if you would like to add anything to it. - **Section 6.2 in SRS**

42: Currently we have all the inputs in a *.csv* file. Is there a possibility that the input file will be in any other format other than *.csv*?

43: Please refer to Table 3 which contains a list of inputs to SFS. Are there any other inputs to SFS other than those mentioned in the table?

44: Can you please go through the elements in the Table 5 "Specification Parameter values" and let us know if the values assumed are reasonable or require any changes. The values given in this table are mostly to define extreme bounds for the input variables. The bounds are extreme enough that exceeding them is obviously an error. - **Table 5 in SRS.**

5 Questions for Mohamed

We would like all the scientists involved in this project to review the full SRS document. However we understand if you cannot go through the entire document. Below are the specific questions that we wanted to clarify with you. Please answer using the GitLab issue tracker.

45: Please let us know the constraints in the experimental setup so that the dimensions of the cylinder can be assumed to lead to essentially one dimensional heat transfer. - **A2 in section 5.2.1, R3 in section 6.1.1 in SRS**