

## Arter, Wayne

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**From:** Sue Thorne - STFC UKRI <sue.thorne@stfc.ac.uk>  
**Sent:** 30 September 2022 17:05  
**To:** Arter, Wayne; Neptune Progress  
**Cc:** Andrew Sunderland - STFC UKRI; Tyrone Rees - STFC UKRI  
**Subject:** NEPTUNE Mathematical Support: Coupling Deliverables  
**Attachments:** 2060049-TN-02\_revision\_Sept22.pdf

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Dear Wayne,

Attached is the revised version of the Coupling Report. We would like to thank the referee for their very helpful comments. As well as smaller modifications (SPH -> SpH etc.), we would like to highlight the following:

- The updated definition of the Knudsen number: we now use the more general definition instead of that used by Borodin et al.
- We have included references to use cases for CWIPI and MUI that have compared simulations with analytical solutions, demonstrating accuracy. We have also highlighted work that provides methodologies for improving/maintaining accuracy when using CWIPI (with Nektar++) for a time-dependent problem where the two coupled problems use different sizes of time step.
- We have extended the SpH section and included the hypersonic spacecraft re-entry problem, which also has regions where the Knudsen number determines whether a kinetic or fluid method (or combination of both) should be used: the different regions then need coupling together.

We have also set-up a repository <https://github.com/ExCALIBUR-NEPTUNE/MathsSupportCoupling>, which Andy will populate with the proxyapp over the next two weeks along with writing a report on his experiences of using Nektar++ with CWIPI to couple together the agreed example.

Tyrone is emailing you with the deliverables for the preconditioning and time advance techniques.

We have received approval to start the Numerical Analysis project "at risk," starting from Monday 3<sup>rd</sup> October.

We hope that you have had a good week of annual leave.

Best,  
Sue

**Dr. Sue Thorne**

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