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MELCOR Code Coupling

PRESENTED BY

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Why code coupling with MELCOR?

MELCOR is a fully-integrated, system-level computer code

- Prior to the development of MELCOR, separate effects codes within the Source Term Code Package (STCP) were run independently
  - Results were manually transferred between codes leading to a number of challenges
    - transferring data
    - ensuring consistency in data and properties
    - capturing the coupling of physics

Advantages of using a fully-integrated tool for source term analysis

- Integrated accident analysis is necessary to capture the complex coupling between a myriad of interactive phenomenon involving movement of fission products, core materials, and safety systems.
- A calculation performed with a single, integrated code as opposed to a distributed system of codes reduces errors associated with transferring data downstream from one calculational tool to the next.
- Performing an analysis with a single integrated code assures that the results are repeatable.
- Methods for performing uncertainty analysis with an integrated tool such as MELCOR are well established.
- Time step issues are internally resolved within the integral code

However, the rare need for coupling to MELCOR may still exist

- Development of new models for possible future integration into the code
- Internal requirement for using a specific code to model a particular aspect of the source term calculation.

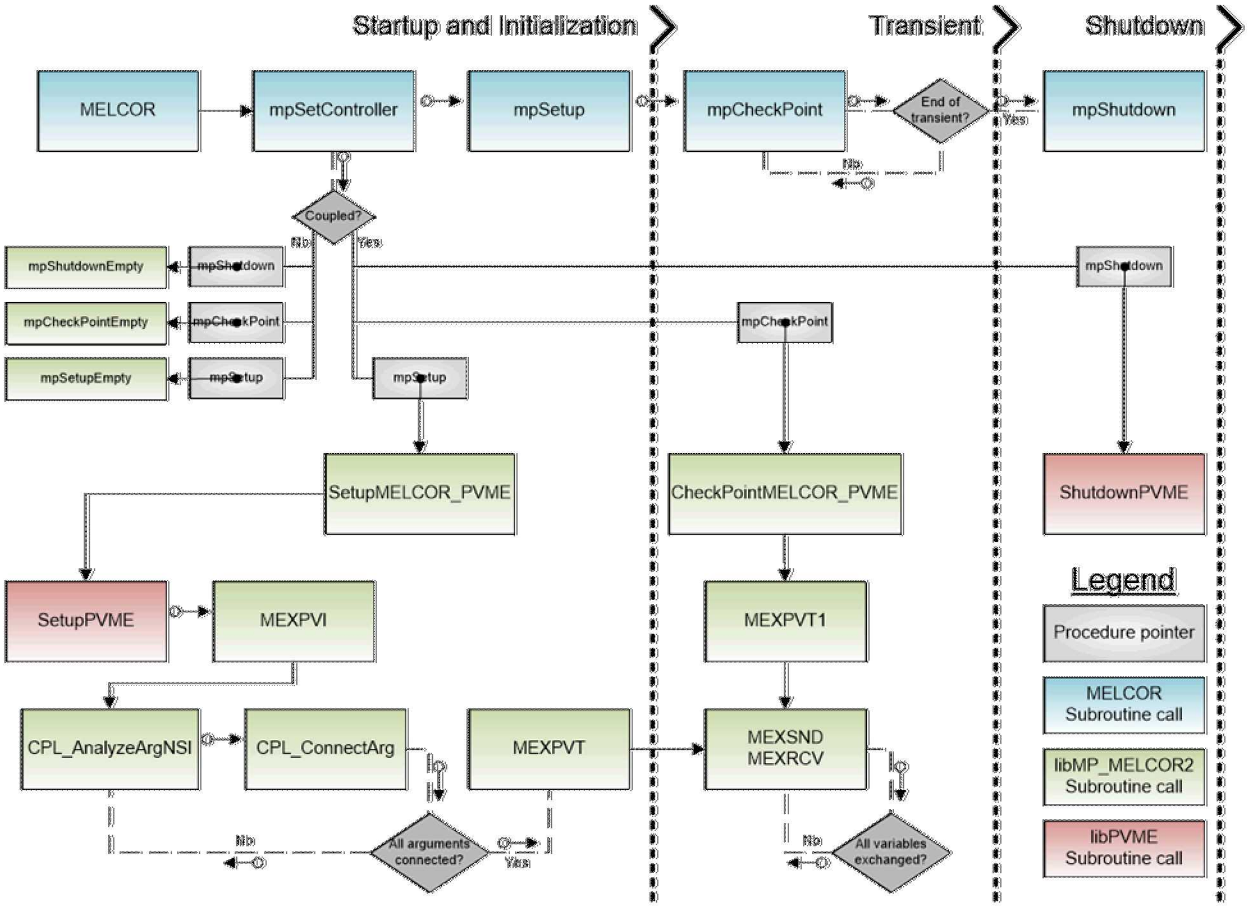
Explicit Coupling with Control Functions - PVM

PVM coupling is routinely used by at least one MELCOR licensee

- Coupling between RELAP and MELCOR v2 (containment and primary system simulated by different codes)
- Interface was updated, formalized, and documented in 2013.

PVM Coupling Requirements

- Parallel Virtual Machine (PVM) software
  - PVMEXEC Program – Developed by Idaho National Laboratory (INL).
  - PVM Library – The Parallel Virtual Machine (PVM) software library –maintained by Oak Ridge National Laboratory
- FORTRAN 2003 compliant compiler



MELCOR 'READ' and L-READ' Control Functions

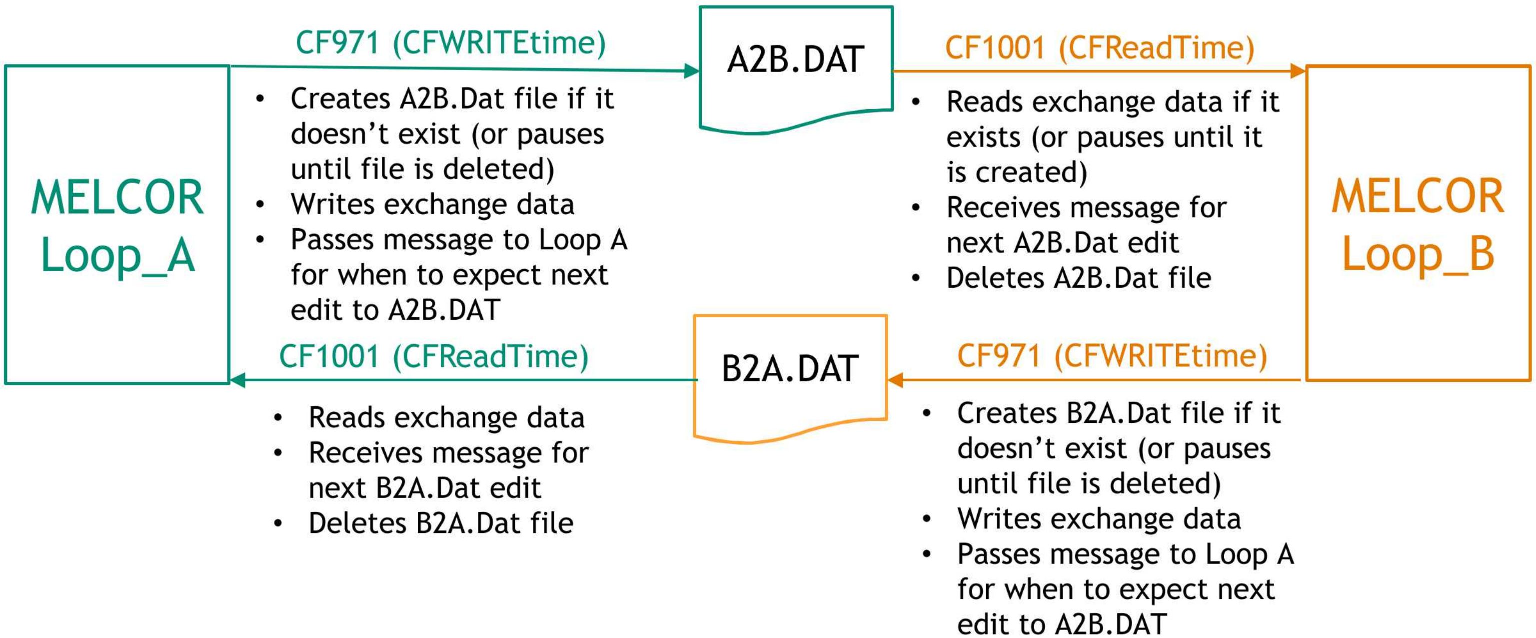
Change actual value of control function thru READ (for REAL-valued) and L-READ (for LOGICAL-valued) option during a MELCOR run

- Requires a new file containing name of CF and new value
  - New value type must match type of CF (REAL or LOGICAL)
  - New file name specified on "EXEC_CFEXFILE" record
- Can be used to simply turn-on or –off a valve without stopping and restarting a calculation
- Data file is immediately deleted after it is read by the CF

Similarly, a WRITE type CF was developed to write to a changedata file.

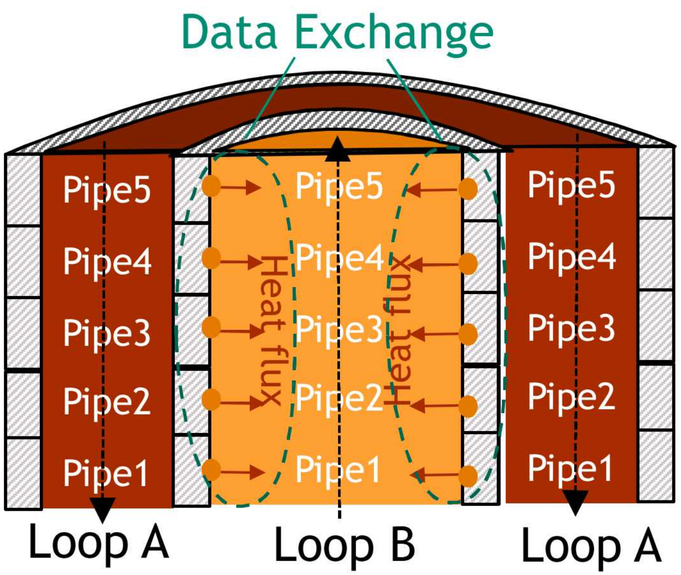
- Writes the time channel and a number of output variables to an exchange file
- Does not delete this output file
- Skips writing to the file until the file has been deleted externally.

Simple Explicit Coupling with Read/Write Control Functions



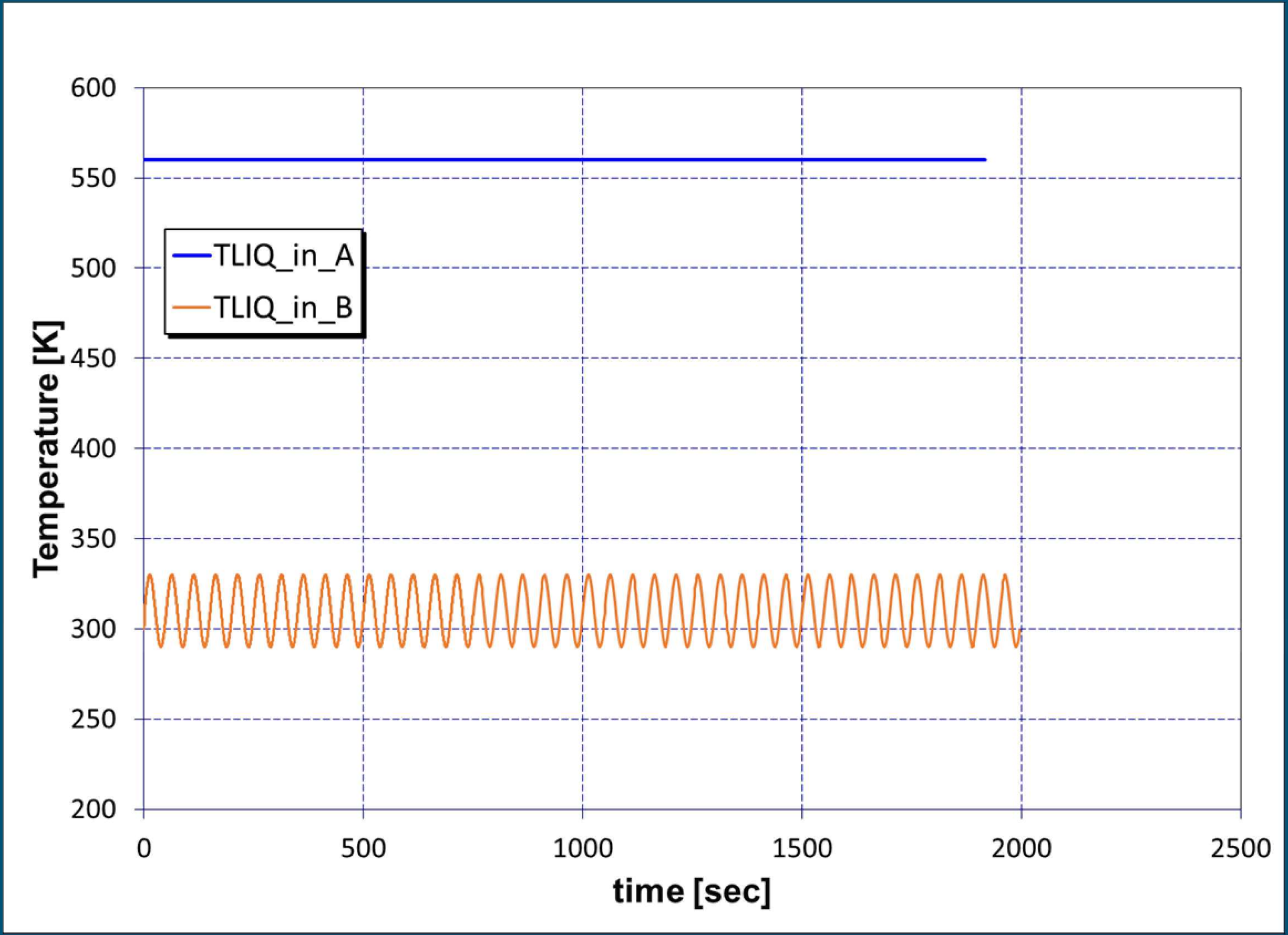
Loop_A	Loop_B
EXEC_CFEXFILE B2A.DAT … CF_ID 'CFreadTime' 1001 READ CF_ID 'CFWRITEtime' 971 WRITE CF_MSC 'CFreadTime' CF_ARG 1 ! NARG CHARG 1 CF-VALU('CFreadTime') 1.00 0.0 EXEC_CFEXFILE 'B2A.DAT' - 'CFreadTime' EXEC_CFEXWRITE '..\LOOPB\A2B.DAT'	EXEC_CFEXFILE A2B.DAT … CF_ID 'CFreadTime' 1001 READ CF_ID 'CFWRITEtime' 971 WRITE CF_MSC 'CFreadTime' CF_ARG 1 1 CF-VALU('CFreadTime') 1.0 1.0 EXEC_CFEXFILE A2B.DAT - 'CFreadTime' EXEC_CFEXWRITE '..\LOOPA\B2A.DAT'

Simple Coupling Test Problem

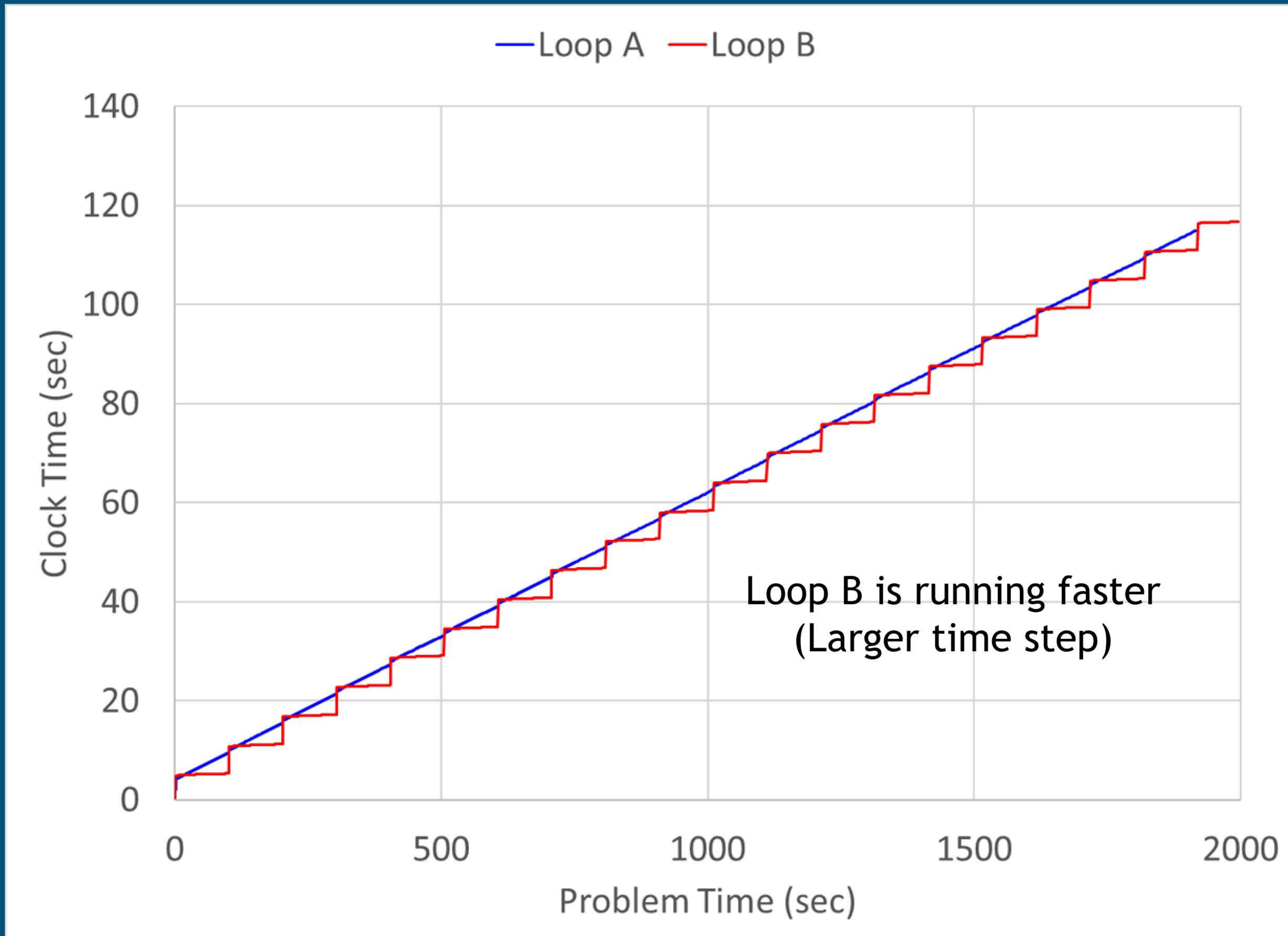


	Loop A	Loop B
Flow direction	Down	Up
Output to other loop	Heat Fluxes	Temperature
Phase Inlet	Atmosphere	Pool
Heat Direction	Heat Out	Heat In
Tinlet	560 K	300+20 *sin(t*2*p/50))

Inlet temperatures for both loops

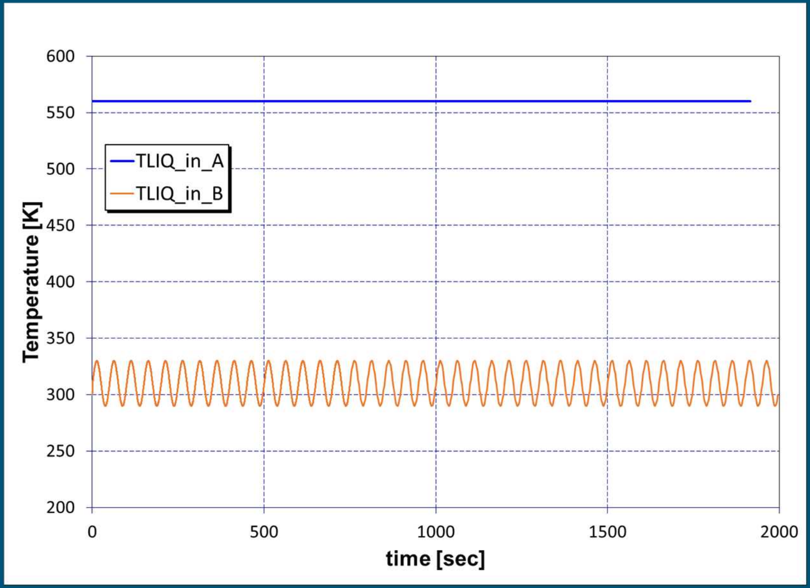


Timing of coupled calculation

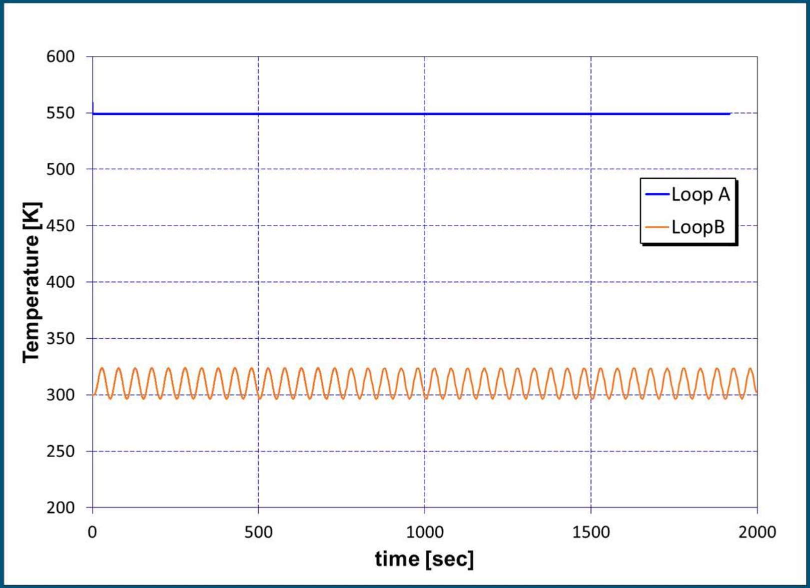


Inlet & outlet temperatures for each loop

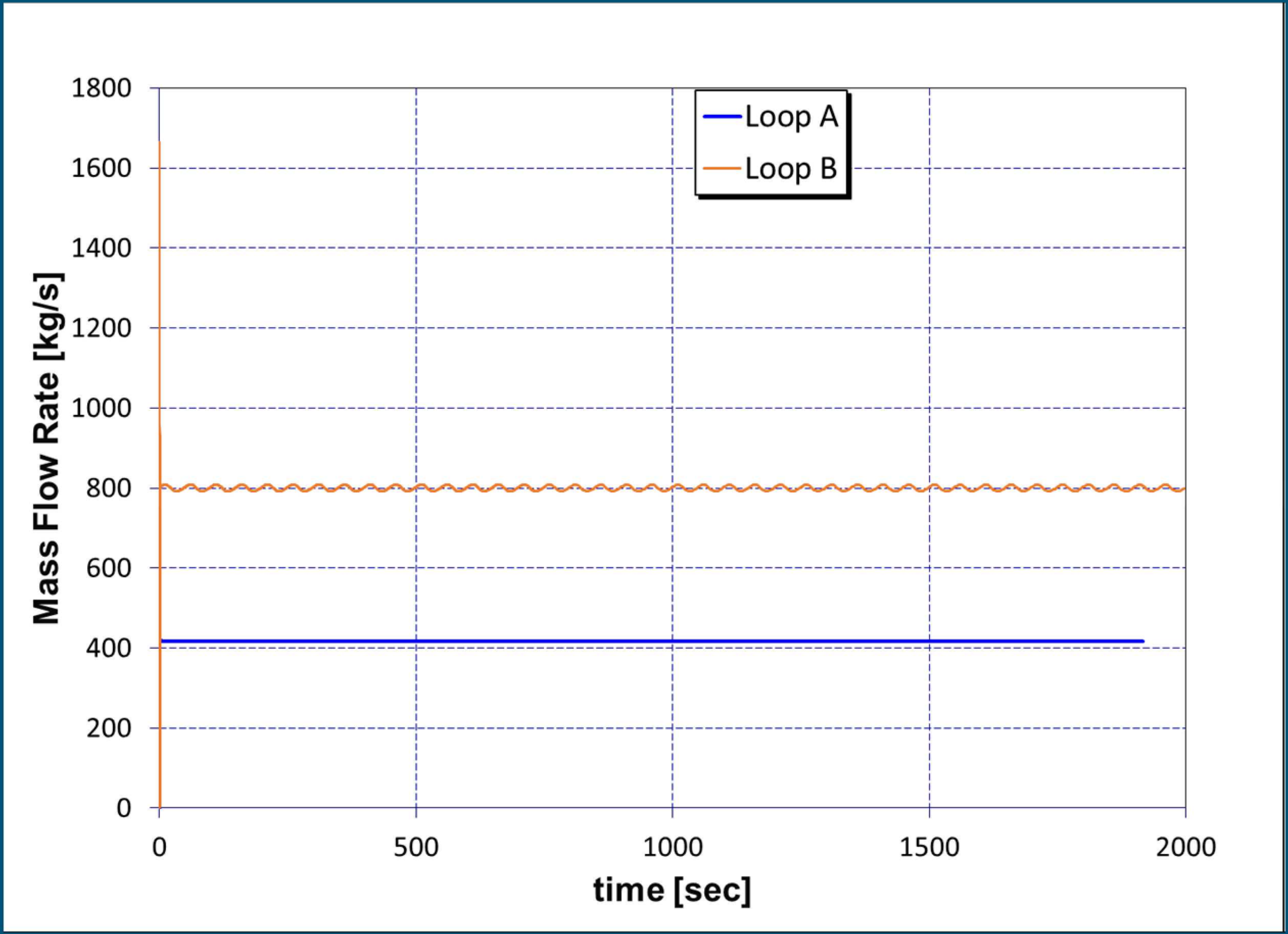
Inlet Temperature



Outlet Temperature



Mass Flow Loop A & Loop B



Loop B HS Response