BLIND PHASE RESULTS FOR TRANSIENT SIMULATIONS OF LOFWOS TEST #13

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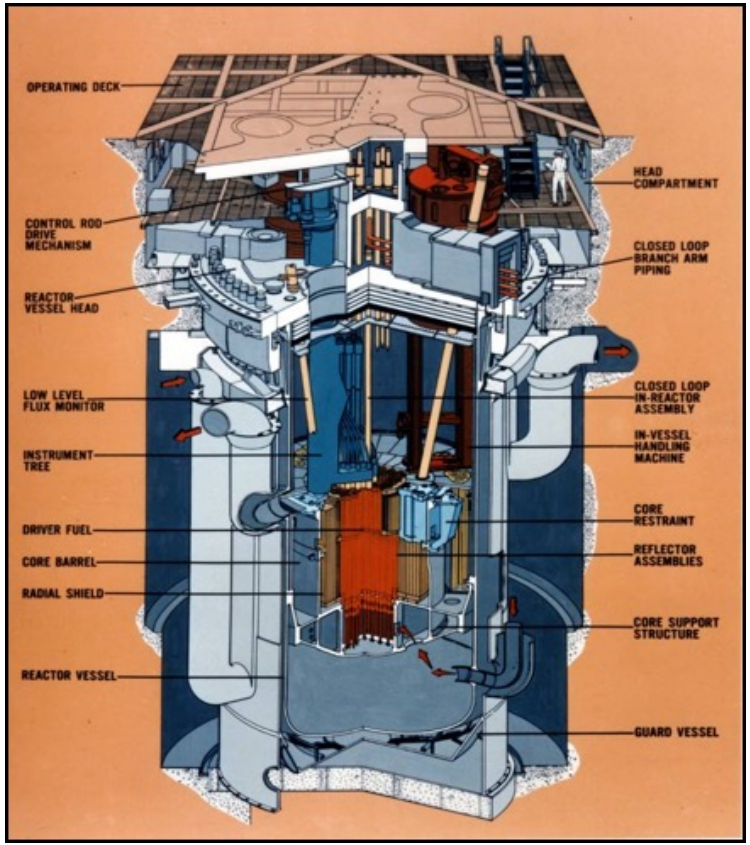
FFTF AND THE IAEA CRP

FAST FLUX TEST FACILITY

- Fast Flux Test Facility
  - 400 MWt
  - Oxide-fueled
  - Sodium-cooled
  - Built at Hanford site in Washington
  - Built for testing & development of advanced fuels and materials
- Passive Safety Testing program
  - Goals included:
    - Confirming safety margins
    - Data for code validation
    - Demonstrating inherent and passive safety benefits of design features
  - Included 13 Loss of Flow Without Scram (LOFWOS) tests
  - Other tests include static tests to measure feedbacks



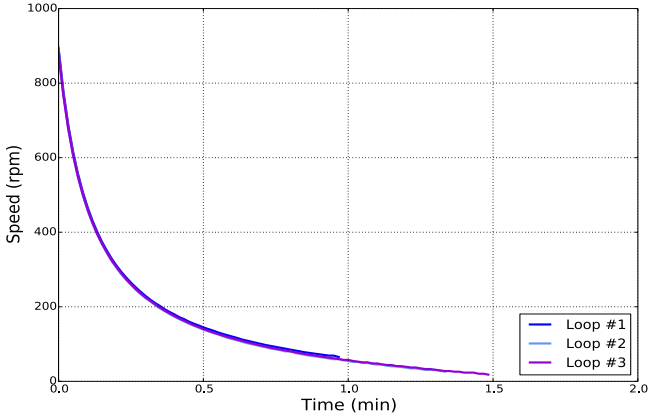
IAEA CRP ON FFTF

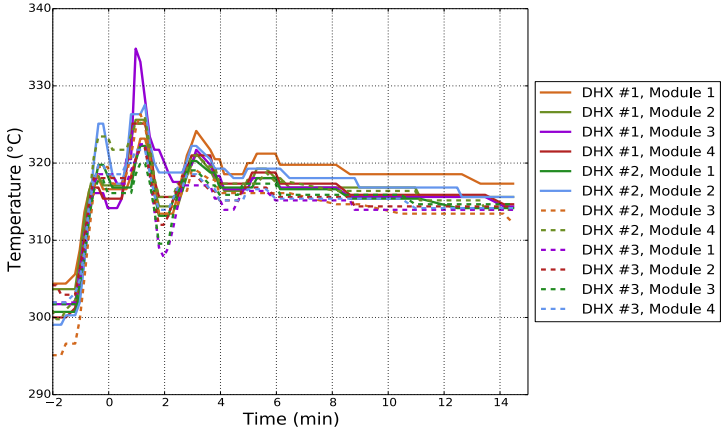
- Four year Coordinated Research Project (CRP)
  - LOFWOS Test #13:
    - Demonstrated effectiveness of GEMs as shutdown device
    - Limited free bow core restraint system
  - Benchmark specification developed by Argonne and PNNL
  - 25 participants
    - 20 submitted blind phase transient results
- CRP led by Argonne and PNNL

Participants:	
CIAE (China)	IBRAE (Russia)
INEST (China)	IPPE (Russia)
NCEPU (China)	CIEMAT (Spain)
XJTU (China)	KTH (Sweden)
CEA (France)	EPFL (Switzerland)
HZDR (Germany)	PSI (Switzerland)
KIT (Germany)	Argonne (USA)
IGCAR (India)	US NRC (USA)
NINE (Italy)	Texas A&M (USA)
Uni. of Rome (Italy)	TerraPower (USA)
JAEA (Japan)	PNNL (USA)
KAERI (Korea)	Zachry Eng. (USA)
NRG (Netherlands)	

LOFWOS TEST #13

- Performed on July 18, 1986
- Initiated at 50% power & 100% flow
- Transient Initiators:
  - Primary pumps simultaneously tripped
    - Secondary pumps not tripped
  - DHX fan speed reduced ~1 minute earlier
- PPS modified to prevent premature control rod insertion
- Transient Benchmark Boundary Conditions:
  - Primary flow rates
  - Secondary pump speeds
  - DHX sodium outlet temperatures





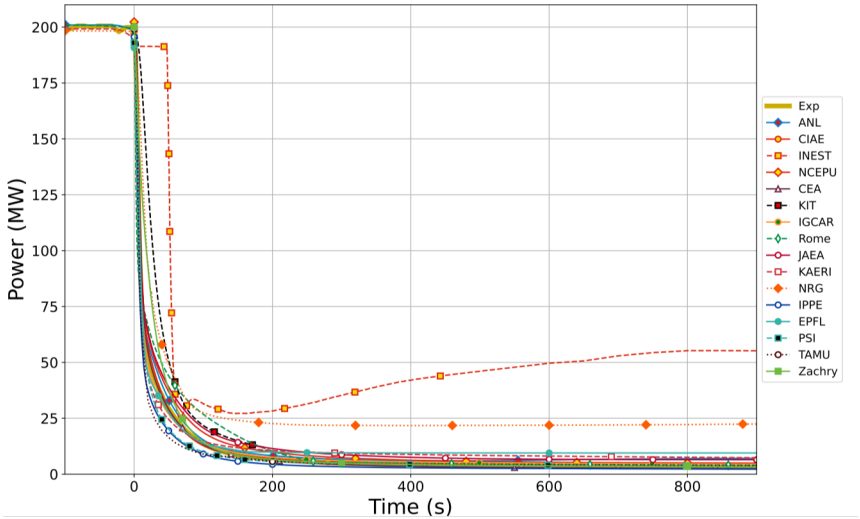
BENCHMARK PARAMETERS TO CALCULATE

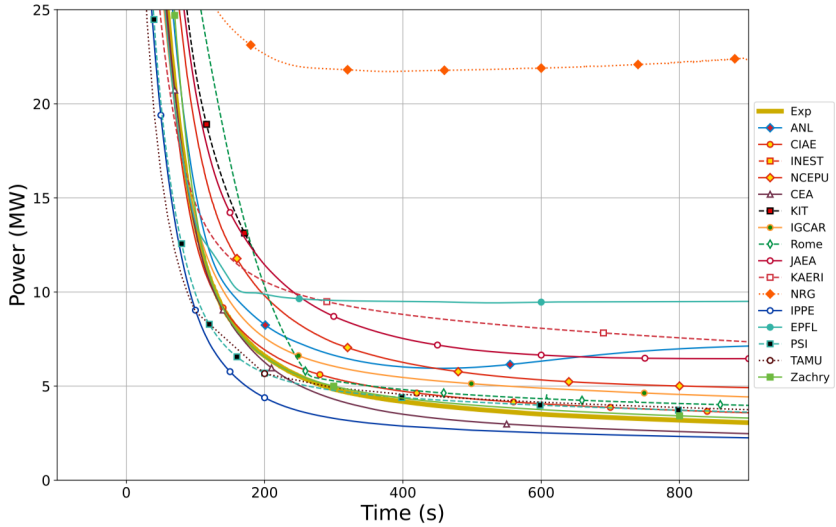
- Measured Test Data
  - Fission power
  - Row 2 PIOTA & Row 6 PIOTA outlet temperatures
  - Primary loop mass flow rates
  - Primary loop hot leg temperatures
  - Primary loop cold leg temperatures
  - Secondary loop hot leg temperatures
  - Secondary loop cold leg temperatures
  - Primary pump discharge pressures for all loops
- Calculated Test Data
  - Total power
  - Decay heat
  - Net reactivity

- For Code-to-Code Comparison
  - Reactivity feedbacks
  - Row 2 PIOTA & Row 6 PIOTA mass flow rates
  - Peak fuel, cladding, & coolant temps
  - IHX primary-side inlet & outlet temperatures
  - IHX secondary-side inlet & outlet temperatures
  - Average reactor vessel inlet & outlet temperatures
- Steady-State Parameters
  - Average fuel temperature
  - Row 2 axial fuel temperature distribution
  - Row 2 axial cladding temperature distribution
  - Row 2 axial coolant temperature distribution
  - Row 6 axial fuel temperature distribution
  - Row 6 axial cladding temperature distribution
  - Row 6 axial coolant temperature distribution

RESULTS

TOTAL POWER


Power (MW)
Time (s)
0
25
50
75
100
125
150
175
200
0
200
400
600
800
Exp
ANL
CIAE
INEST
NCEPU
CEA
KIT
IGCAR
Rome
JAEA
KAERI
NRG
IPPE
EPFL
PSI
TAMU
Zachry


Power (MW)
Time (s)
0
5
10
15
20
25
0
200
400
600
800
Exp
ANL
CIAE
INEST
NCEPU
CEA
KIT
IGCAR
Rome
JAEA
KAERI
NRG
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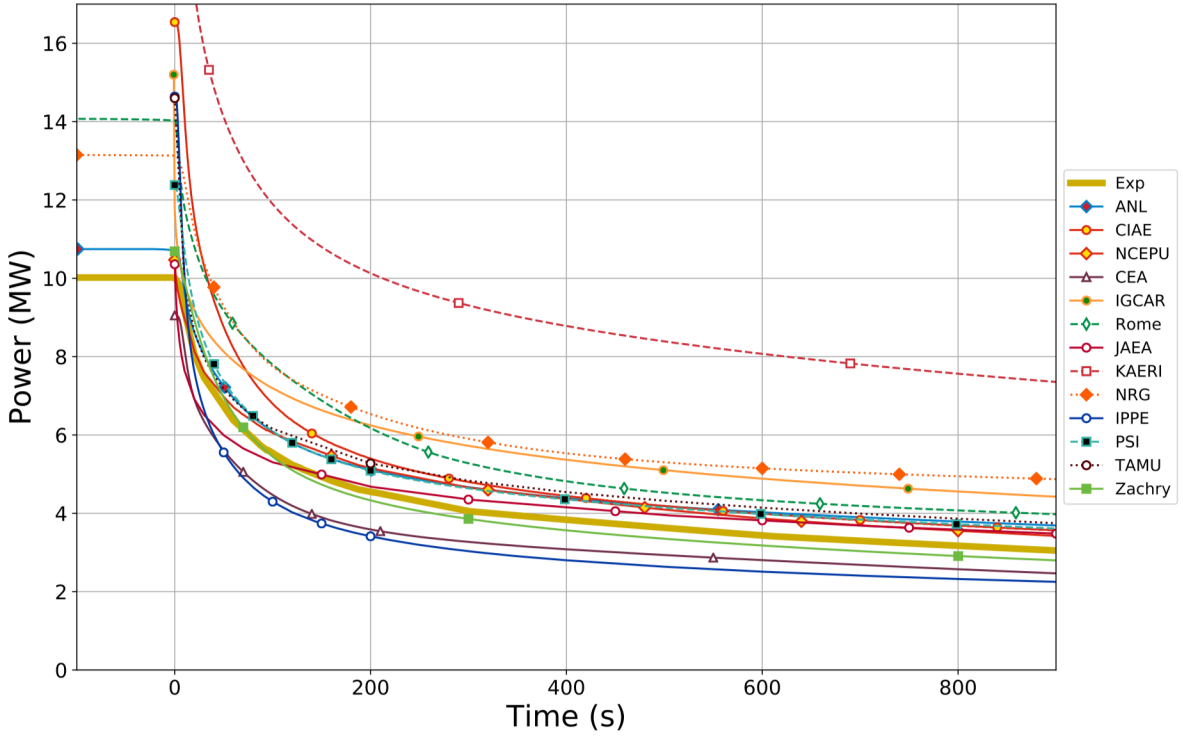
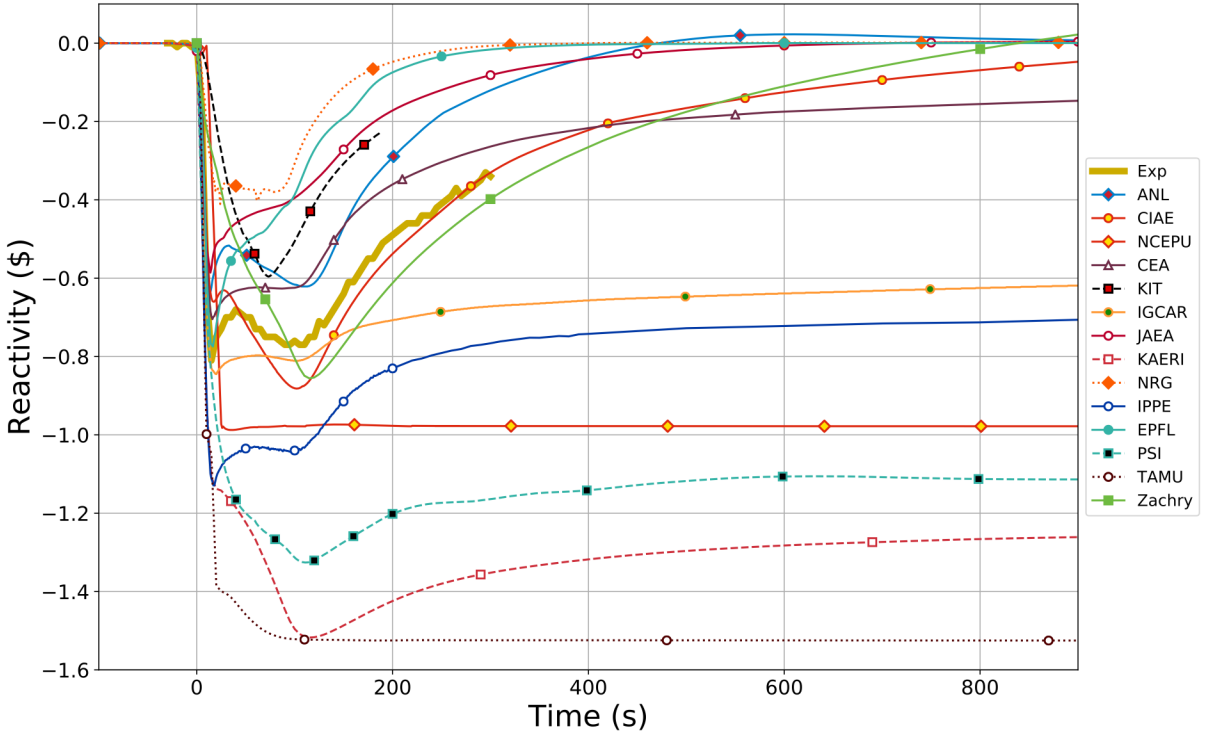
EPFL
PSI
TAMU
Zachry

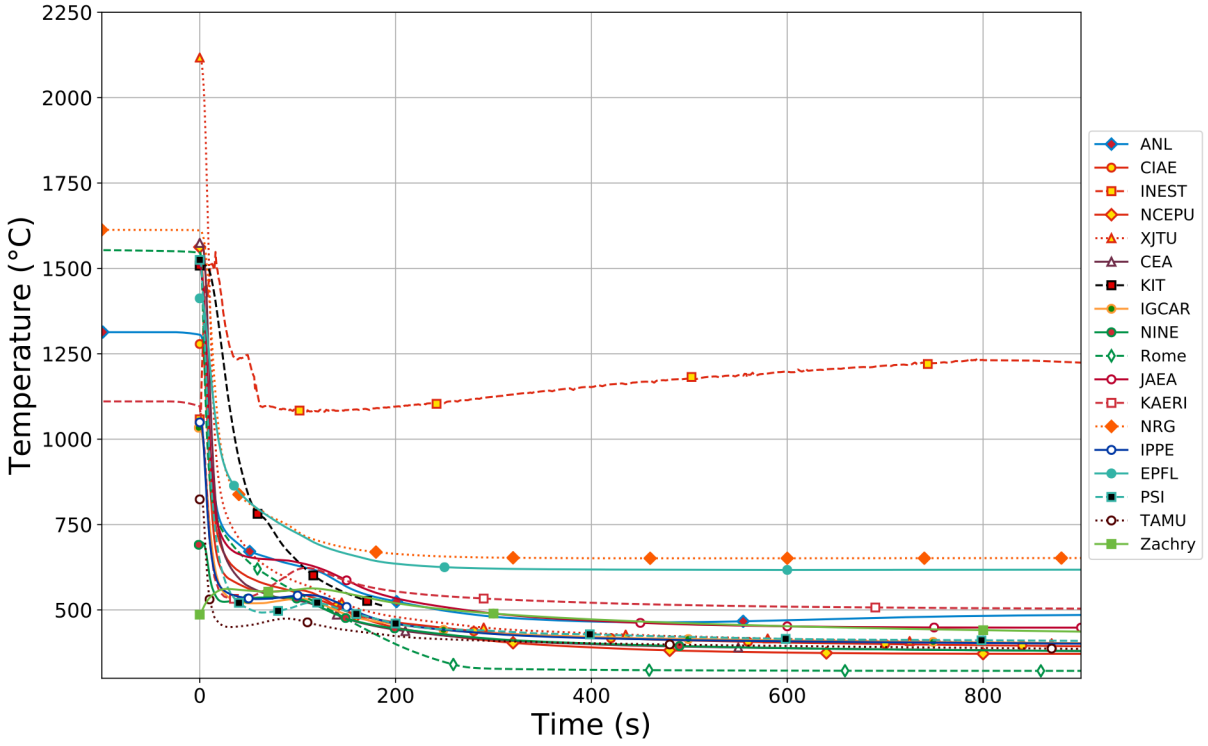
DECAY HEAT


Power (MW)
Time (s)
0
2
4
6
8
10
12
14
16
0
200
400
600
800
Exp
ANL
CIAE
NCEPU
CEA
IGCAR
Rome
JAEA
KAERI
NRG
IPPE
PSI
TAMU
Zachry

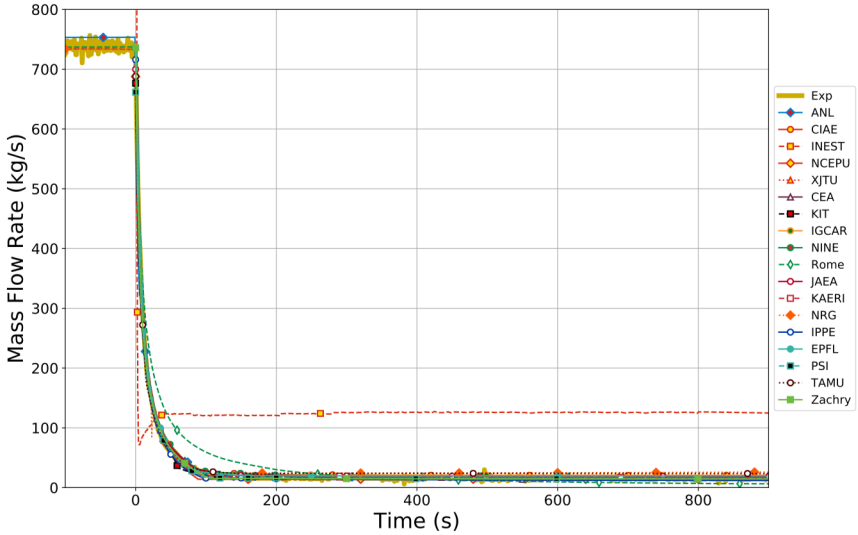
NET REACTIVITY

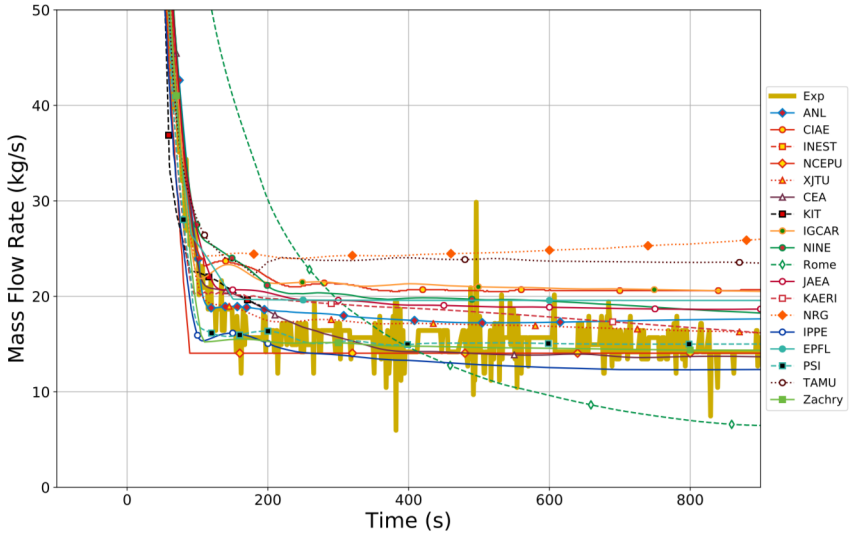


PEAK FUEL TEMPERATURES

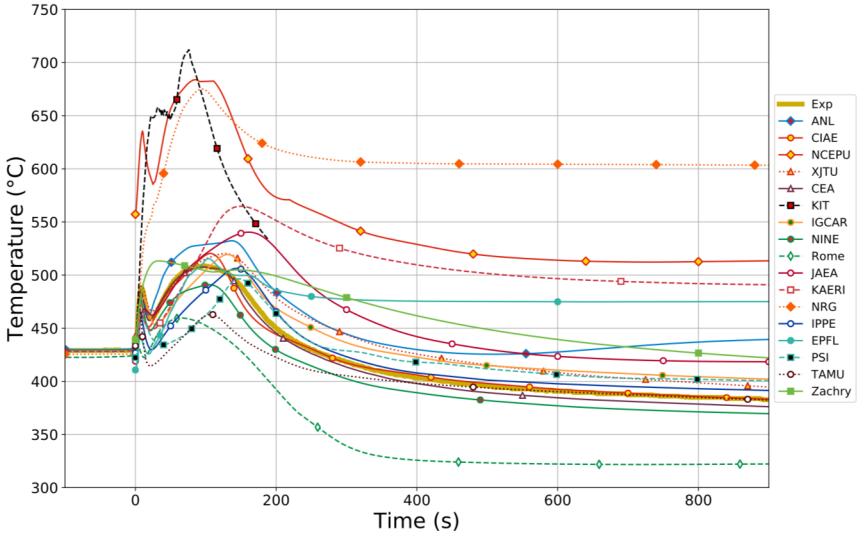


PRIMARY LOOP #1 MASS FLOW RATE

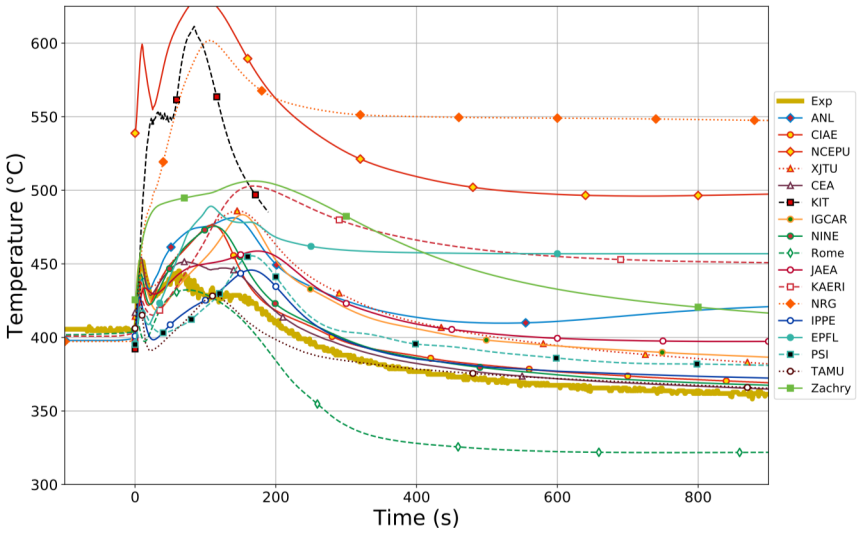




COOLANT OUTLET TEMPERATURES

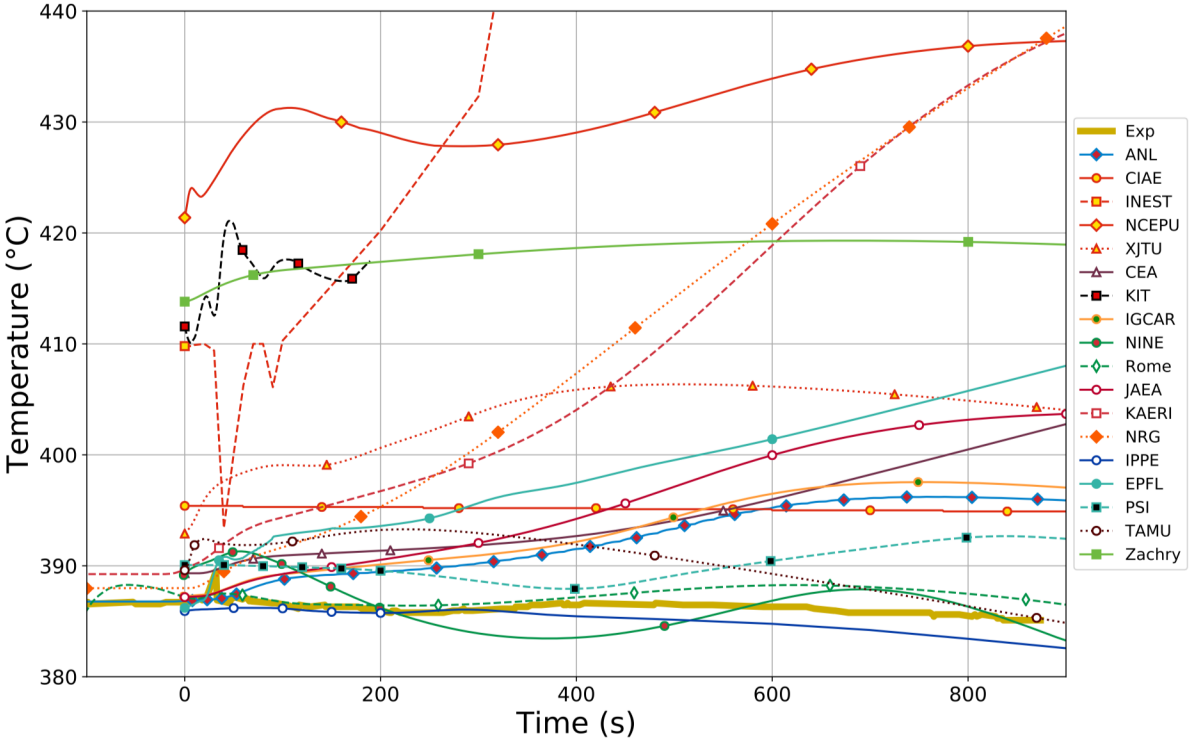


Row 2 PIOTA



Row 6 PIOTA

PRIMARY LOOP #1 HOT LEG TEMPERATURE



SUMMARY

- IAEA CRP for benchmark analysis of FFTF LOFWOS Test #13
- Unprotected loss of flow test initiated at half power and full flow
- Blind phase of the CRP concluded in October 2020
- Blind phase transient simulation predictions evaluated for agreement with:
  - Measured test data
  - Other participant predictions
- Blind phase results:
  - Provide confidence that many participants captured the transient progression of the test well
  - Provide key information for improving transient predictions
  - Modeling improvements during open phase focused on reducing discrepancies between measured and predicted results

ACKNOWLEDGEMENTS

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