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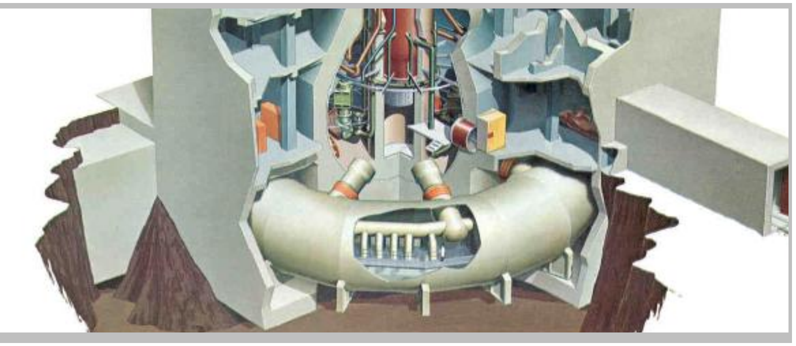

Wetwell Modeling Nodalization Study and SNAP Post Processing

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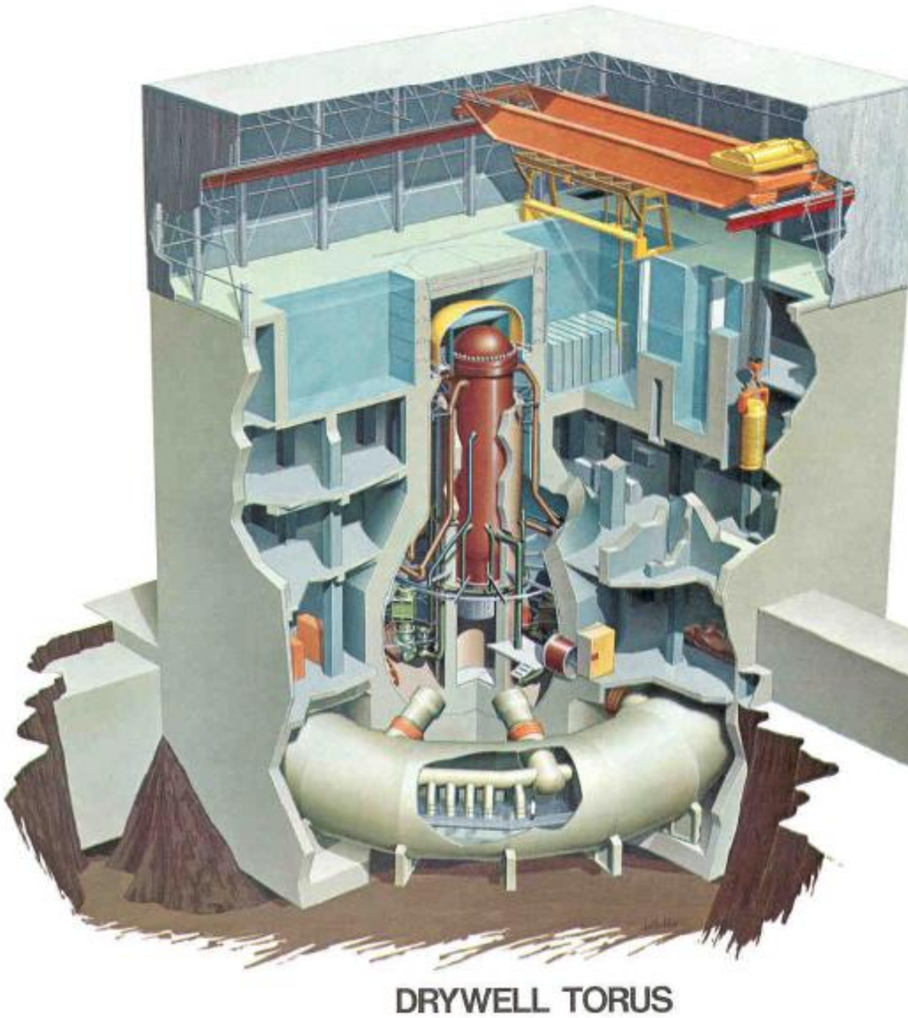
Outline

- BWR Mk I Wetwell
  - Evaluate modeling practices
    - Single CV representation
    - Multiple CV representation (16 CVs)
      - Modified version investigated
    - Near/Far Field (2 CV representation)
      - Two flow path natural circulation flow
- SNAP Post Processing
  - Example videos
  - Using Python scripts for post processing calculations

Investigating Modeling Practices

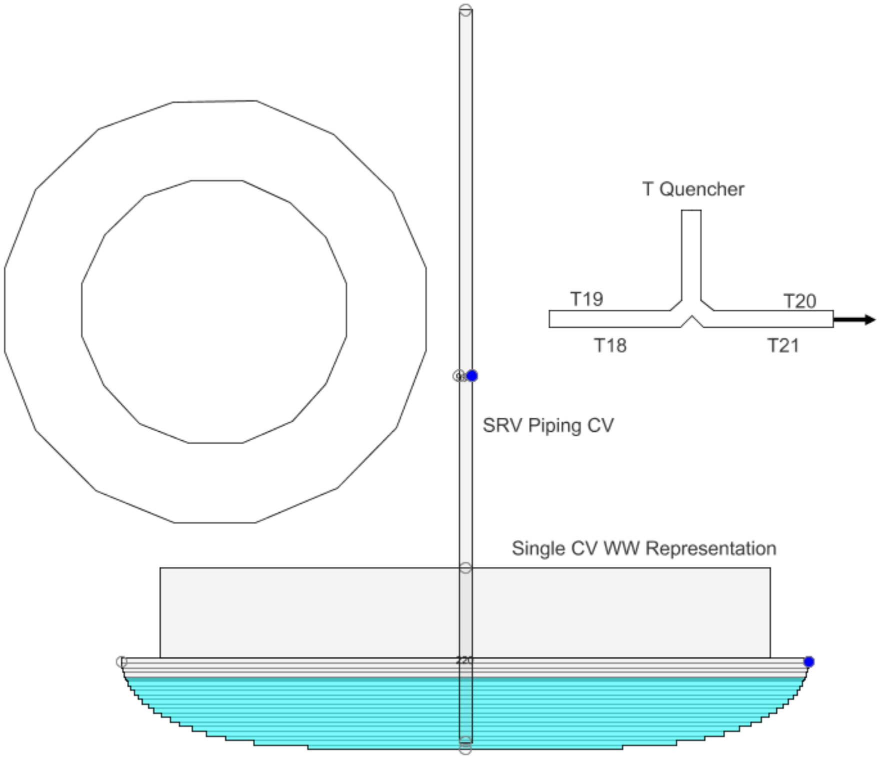
- Purpose
  - Single wetwell volume representations do not determine local saturation conditions well for station blackout accidents
    - How does this impact pressurization response, fission product scrubbing, results… ?
    - Initial investigation of potential modeling avenues compared to available test data
- Relevance
  - Fukushima unit 1 energy removal was almost entirely dependent on the lowest setpoint SRV actuations
    - The result: isolated heating of the suppression pool
      - With power available, operators will cycle SRV operations to promote more uniform suppression pool heat up.
  - Fukushima unit 2 underwent nearly 60 hours of RCIC only operation
  - Fukushima unit 3 underwent 36 hours of RCIC operation and SRV cycling
    - Provides more data to investigate the containment pressure response

BWR Mark I Containment

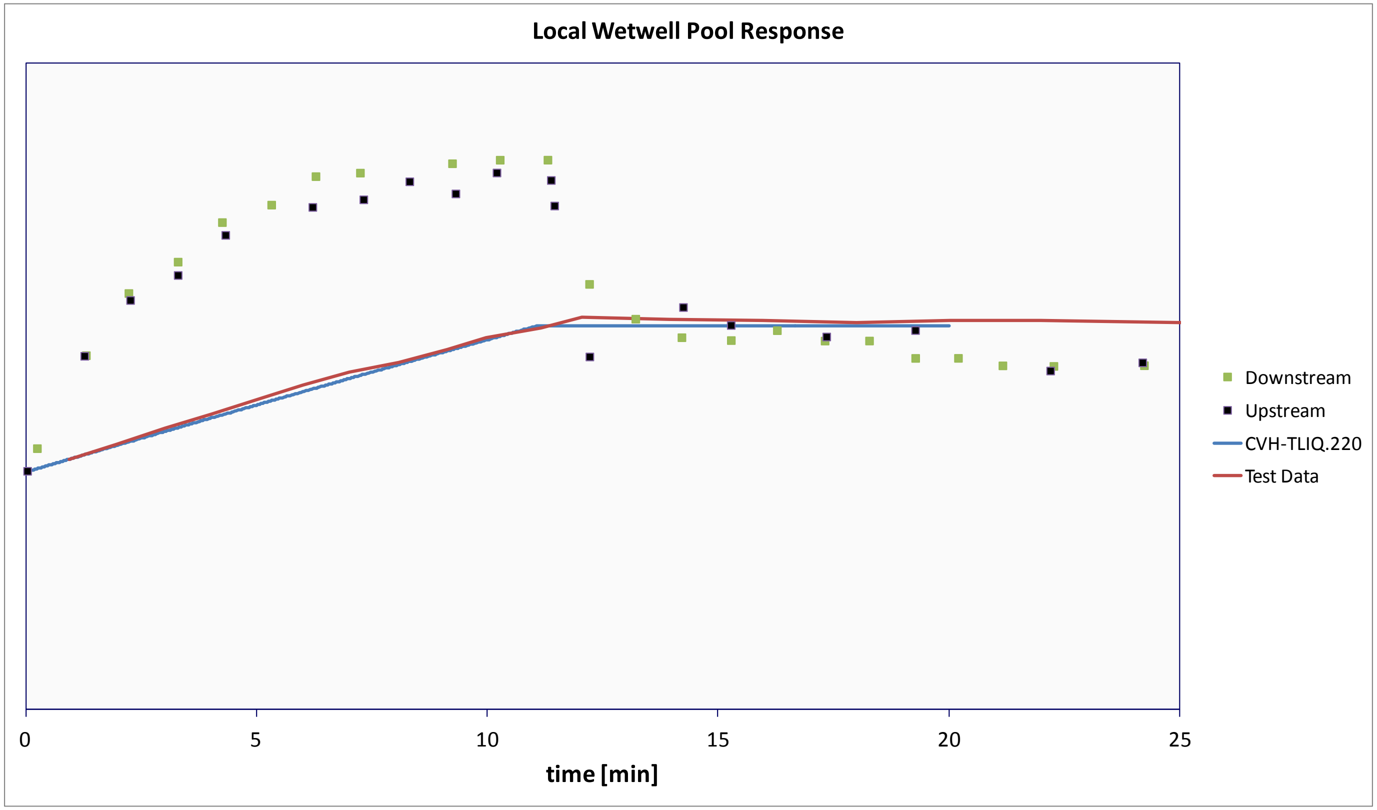


Single Control Volume Model

- Single CV representation is a typical modeling practice for severe accident analyses
  - Attempts to capture curvature (though not relevant for this analysis)
- SPARC90 model activated
  - Steam/Pool interaction
  - RN removal if present
- Losses of SRV line ignored

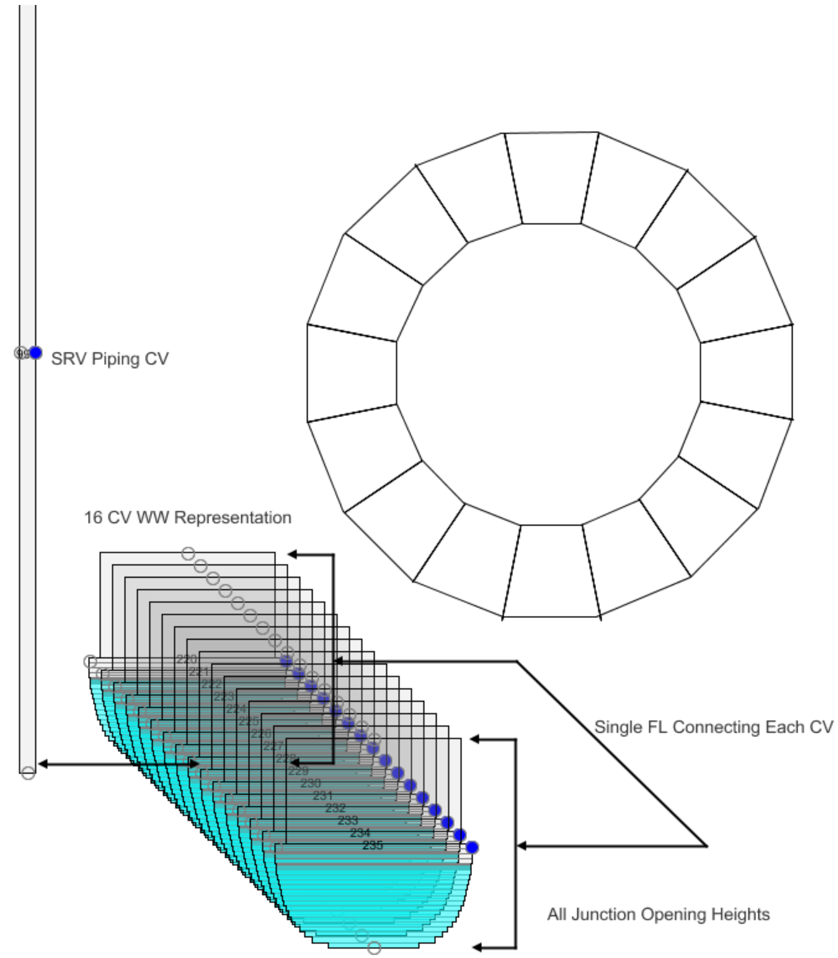


Single CV MELCOR Comparison

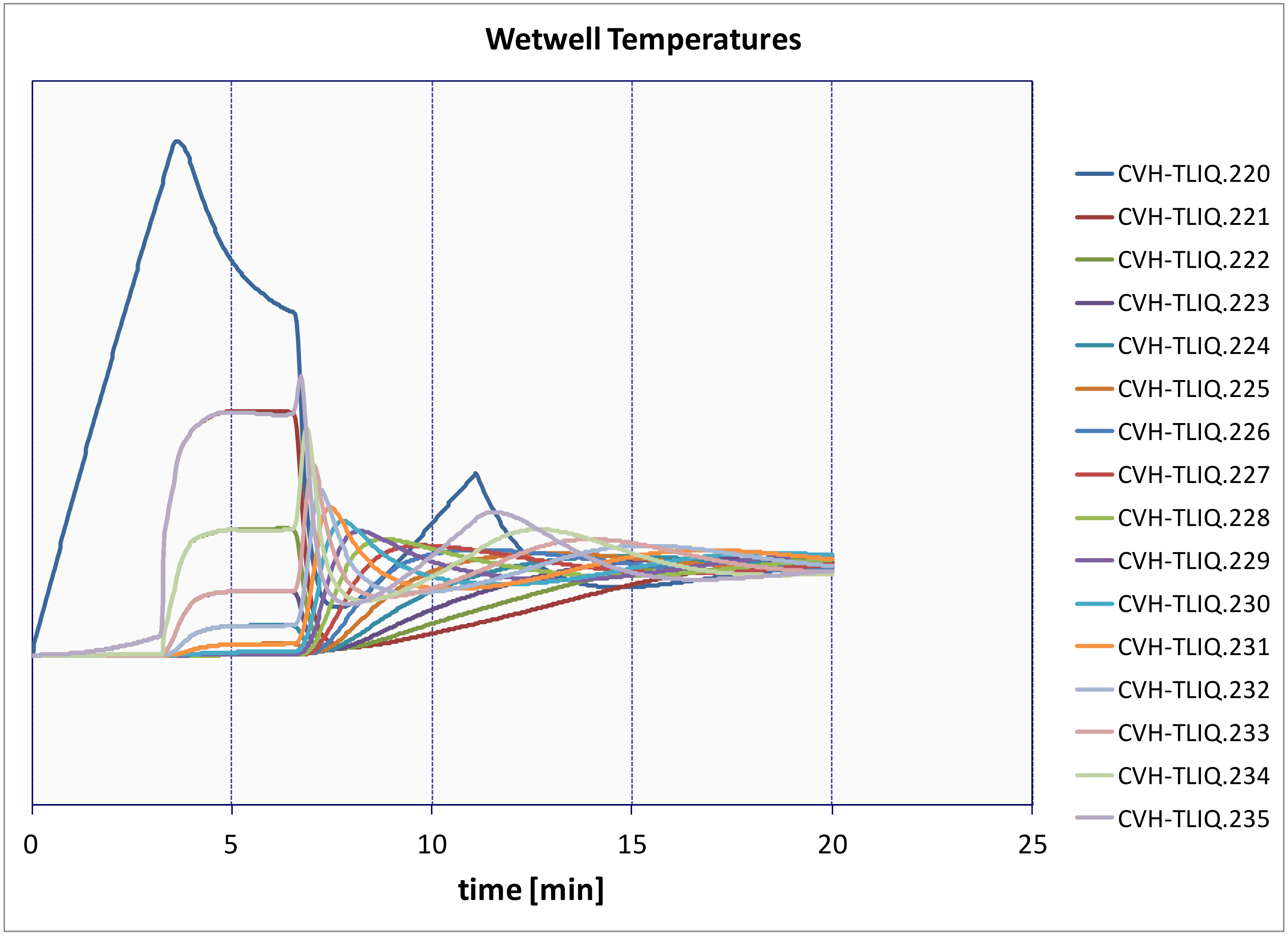


16 CV Model Depiction

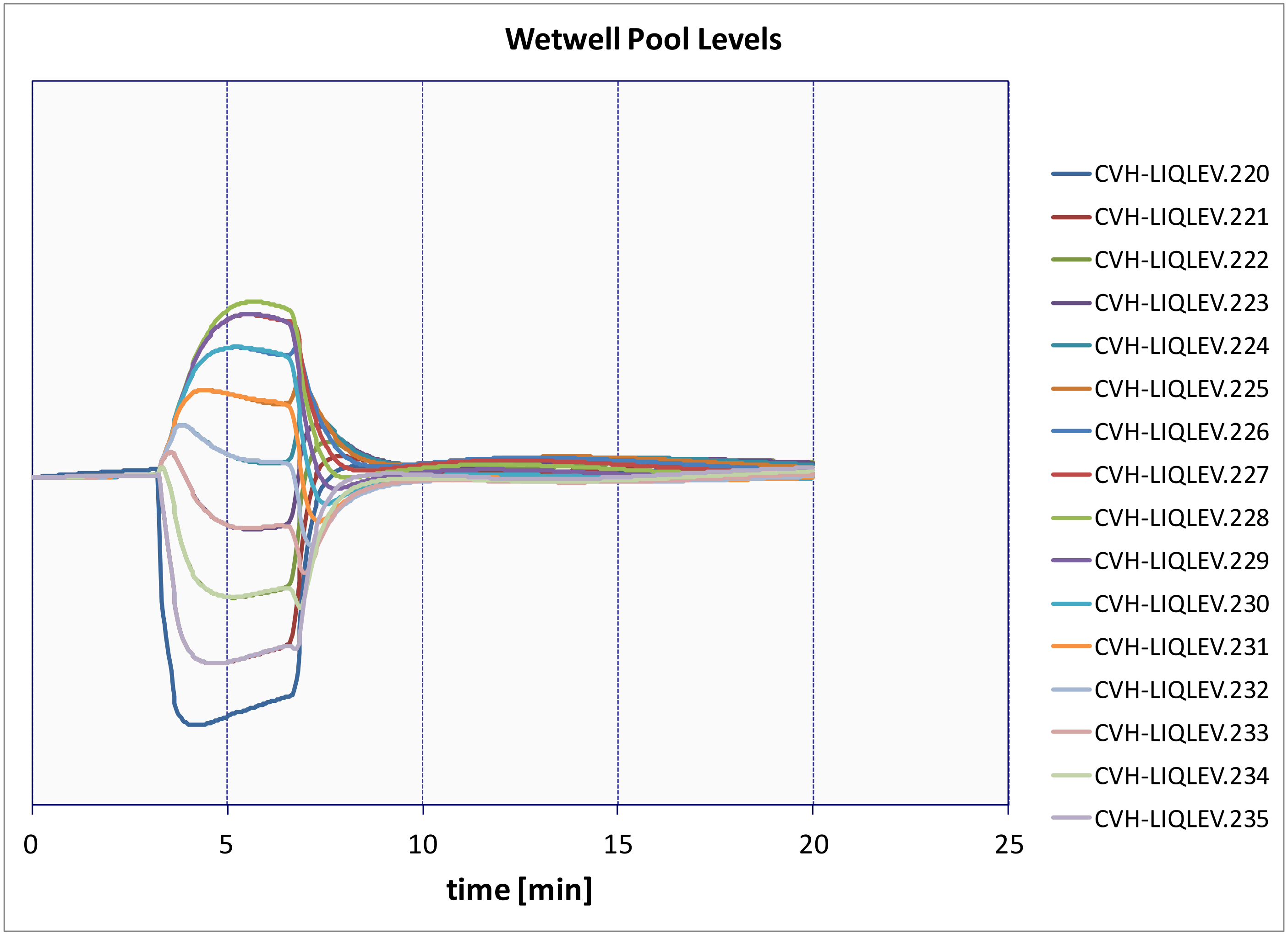
- Inertial and friction length – wetwell torus segment lengths
- Flow area – internal cross-sectional area (torus minor diameter)



16 CV Results



16 CV Results

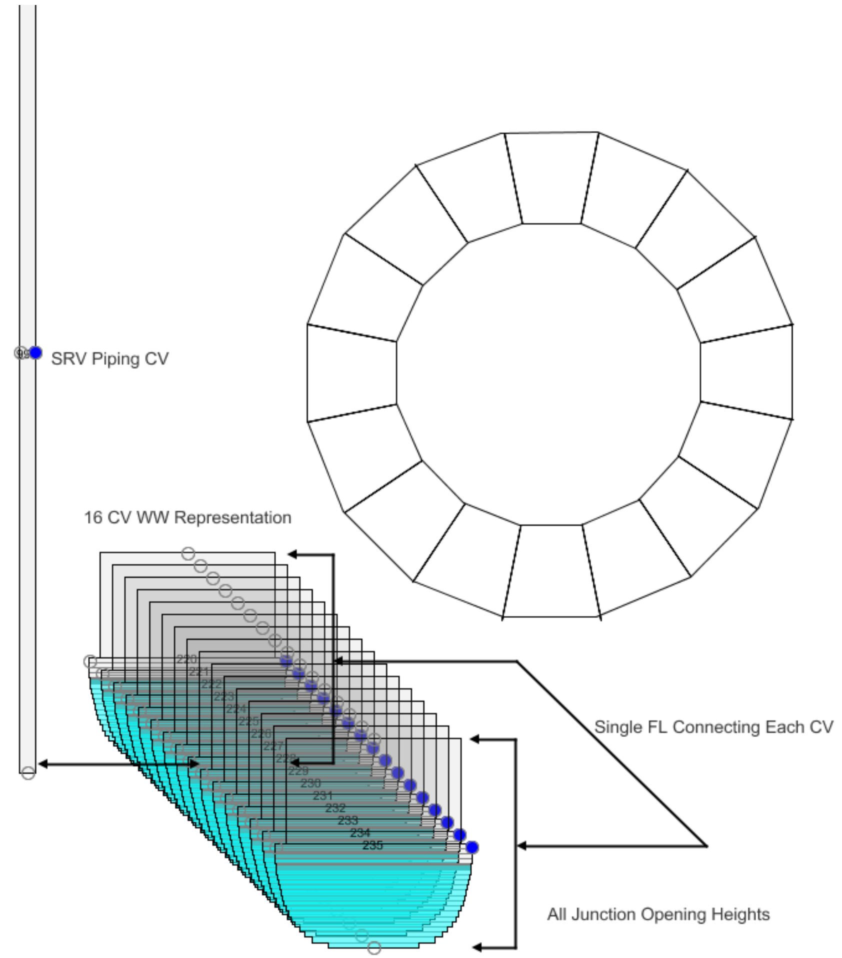


Results

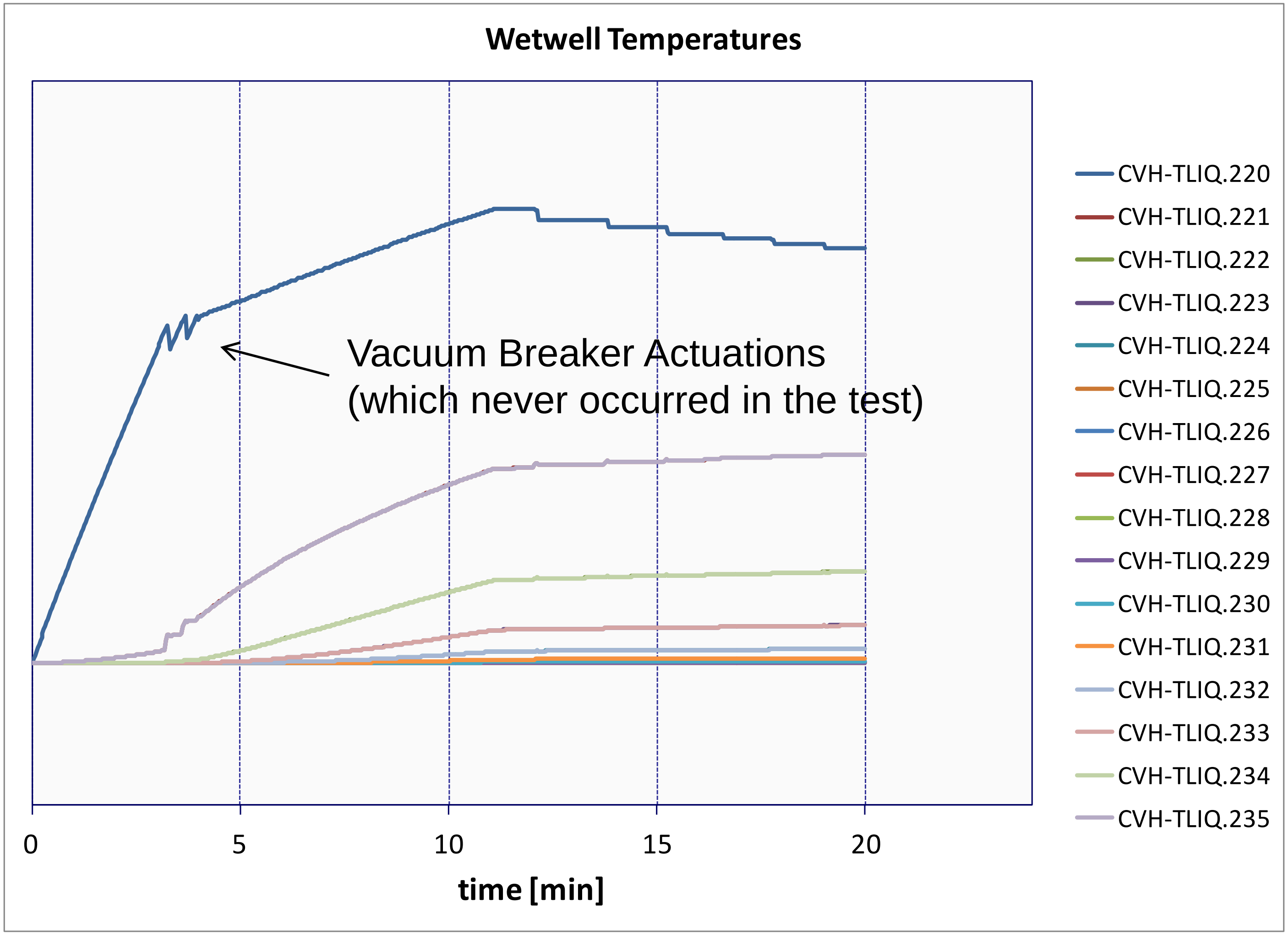
- A single flowpath connecting two CVs supports only unidirectional pool water transport
  - Does not permit natural circulation determination of any kind
- Difficult to determine appropriate losses between pool segments
- No enhanced circulation by plume
- Instability enforced circulation observed
- No point comparing these results with data

16 CV Modified Model Depiction

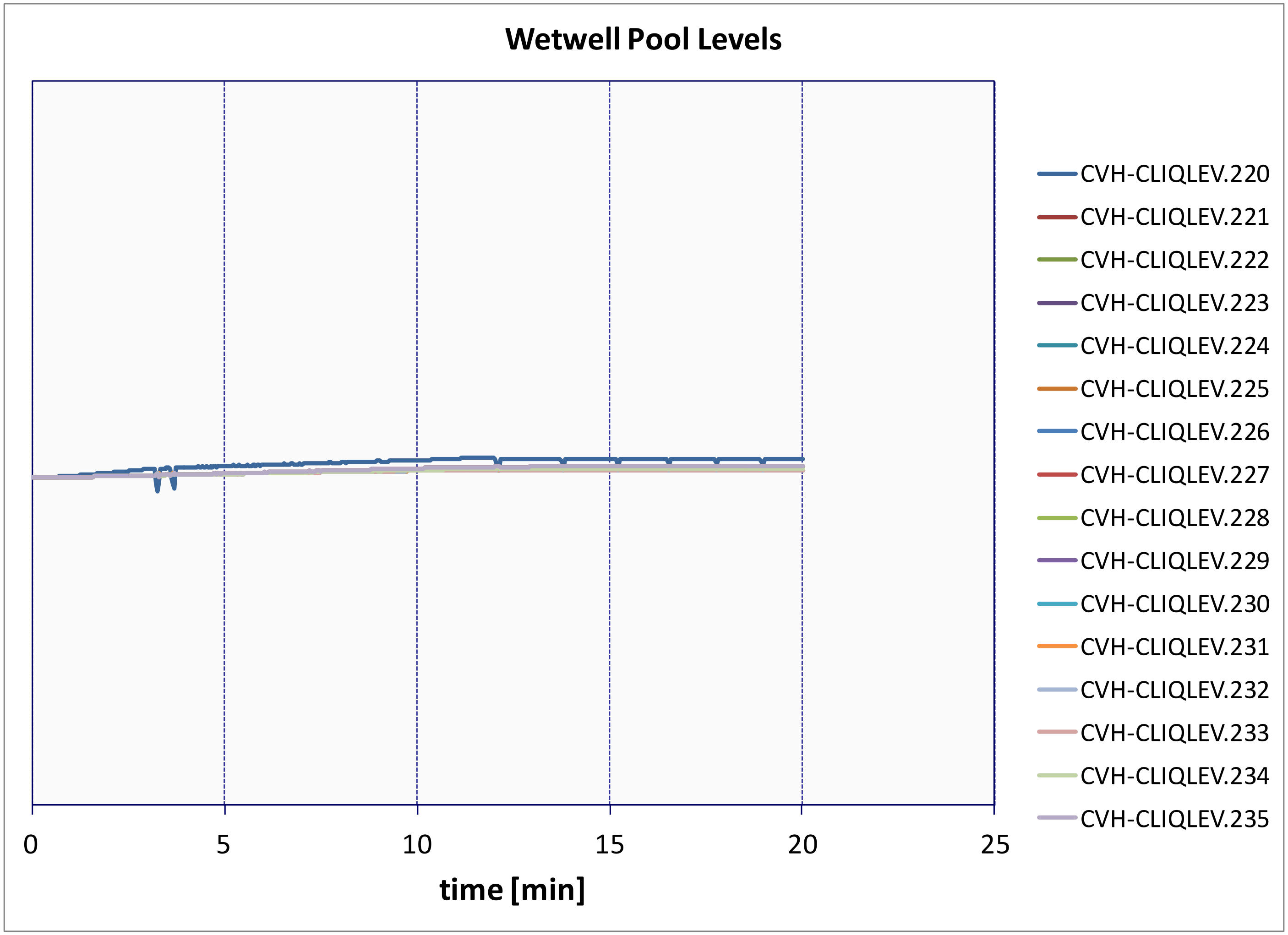
- Inertial and friction length – set to a “small” length (0.01m)
  - Reduces multiphase shear effects, permits higher fluid acceleration



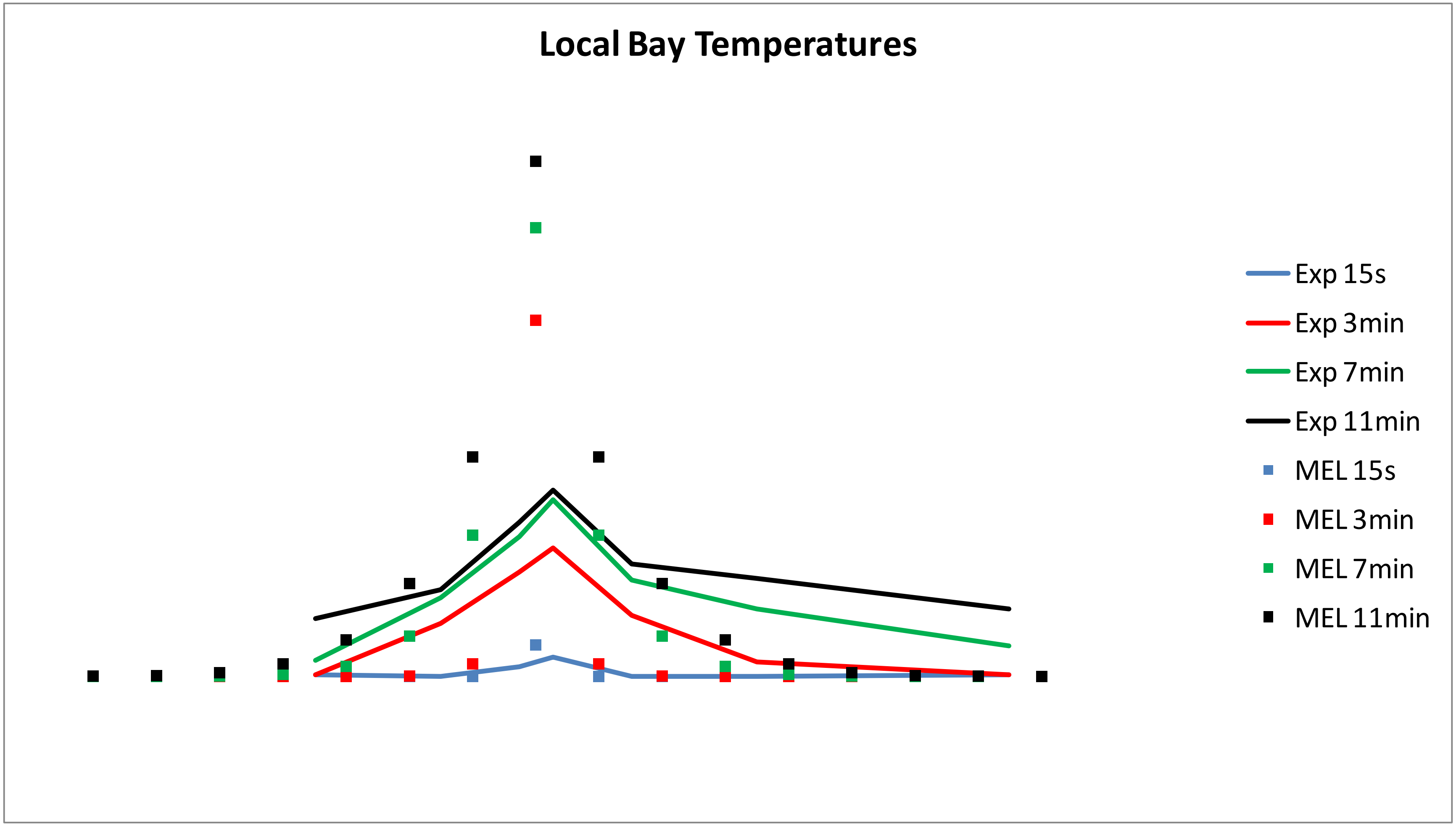
16 CV Modified Results



16 CV Modified Results

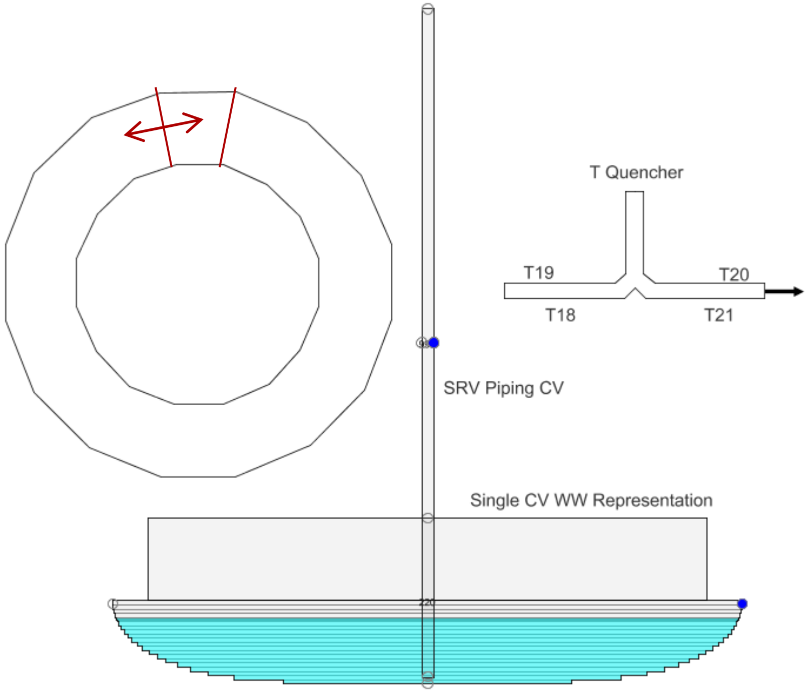


Comparison With Data



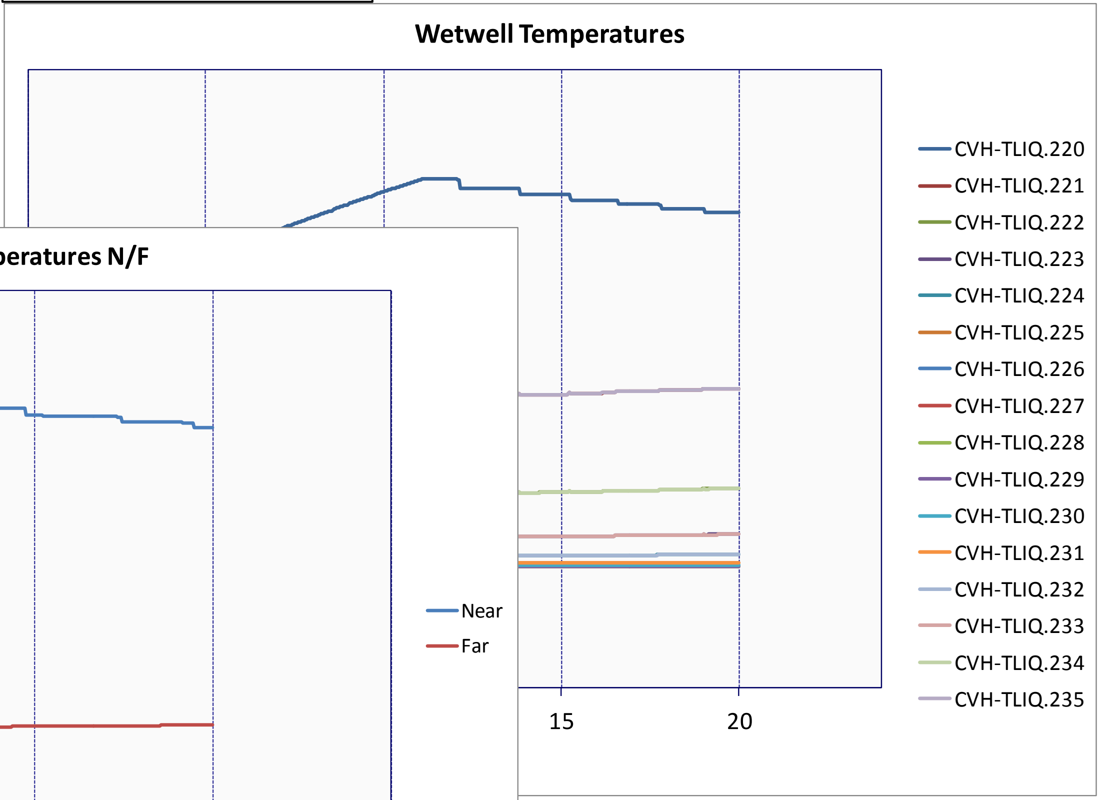
Two CV Model (WIP)

- This configuration should permit a “more” straight forward model for enforcing appropriate mixing
  - Attempts to capture near field and far field effects
  - 2x multiplier on FL area (to account for both sides and remove numerical error (round-off) instability oscillations)
- SPARC90
  - No attempt to place stacked cells due to SPARC pool height consideration

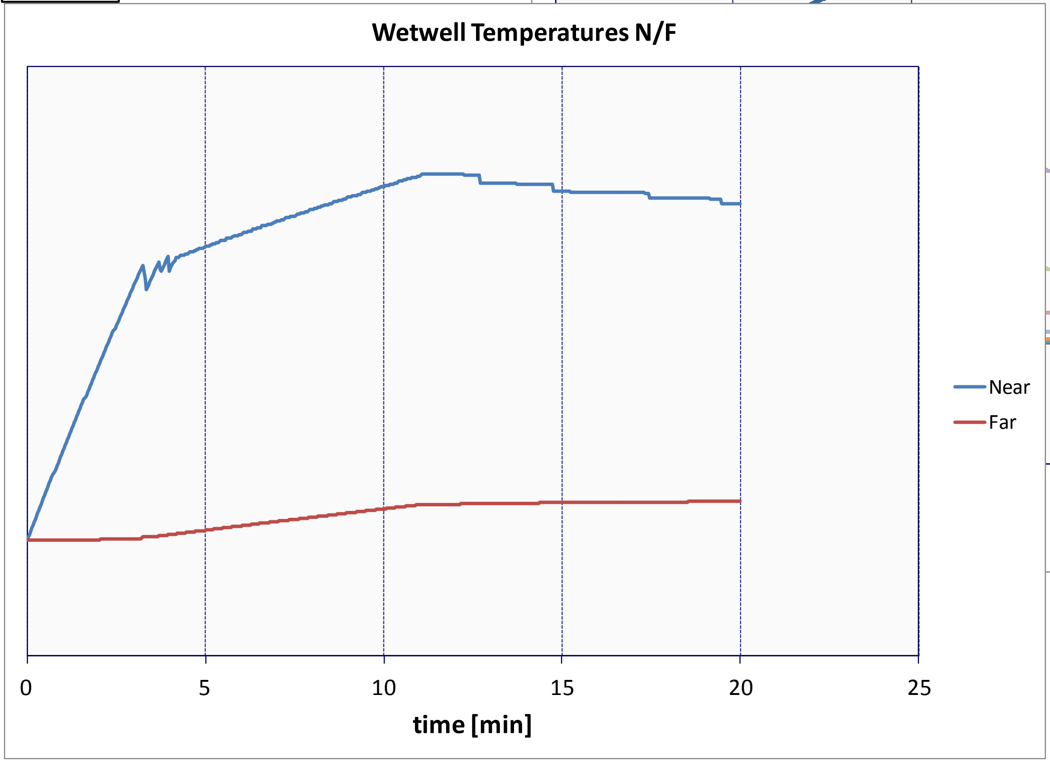


Near-Far Field Results

16 CV Modified

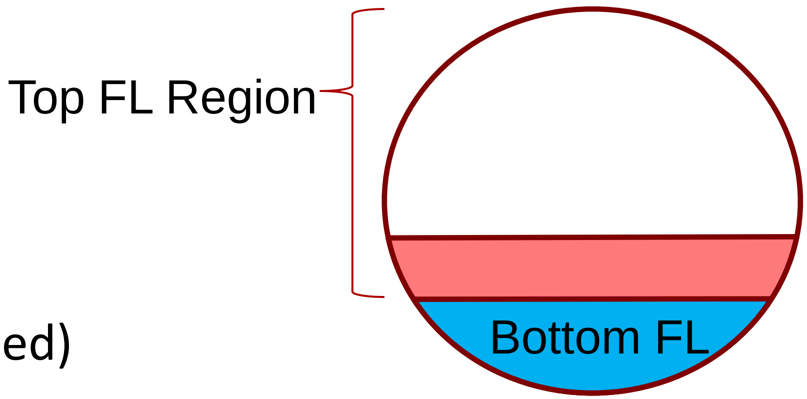


N/F

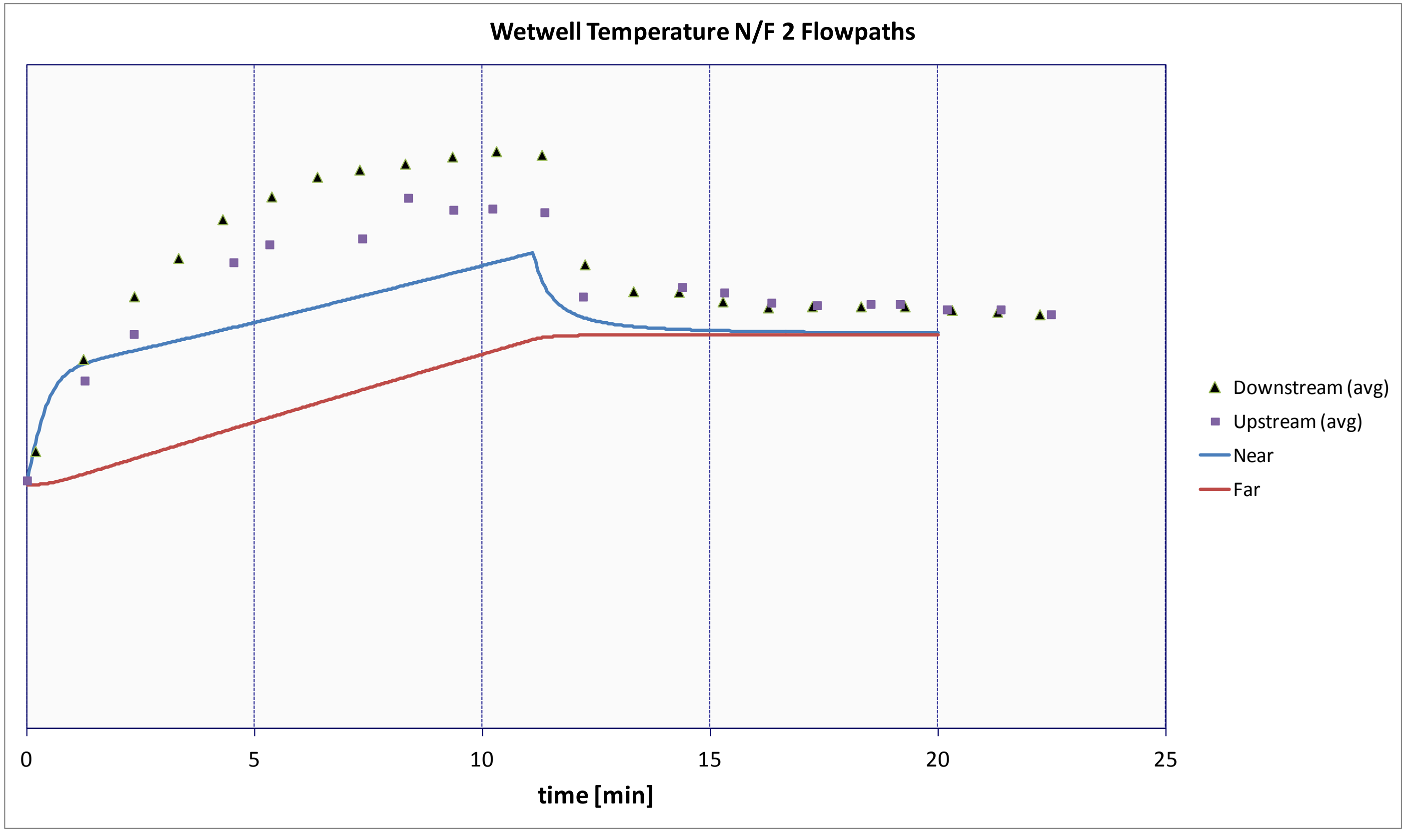


N/F Modified

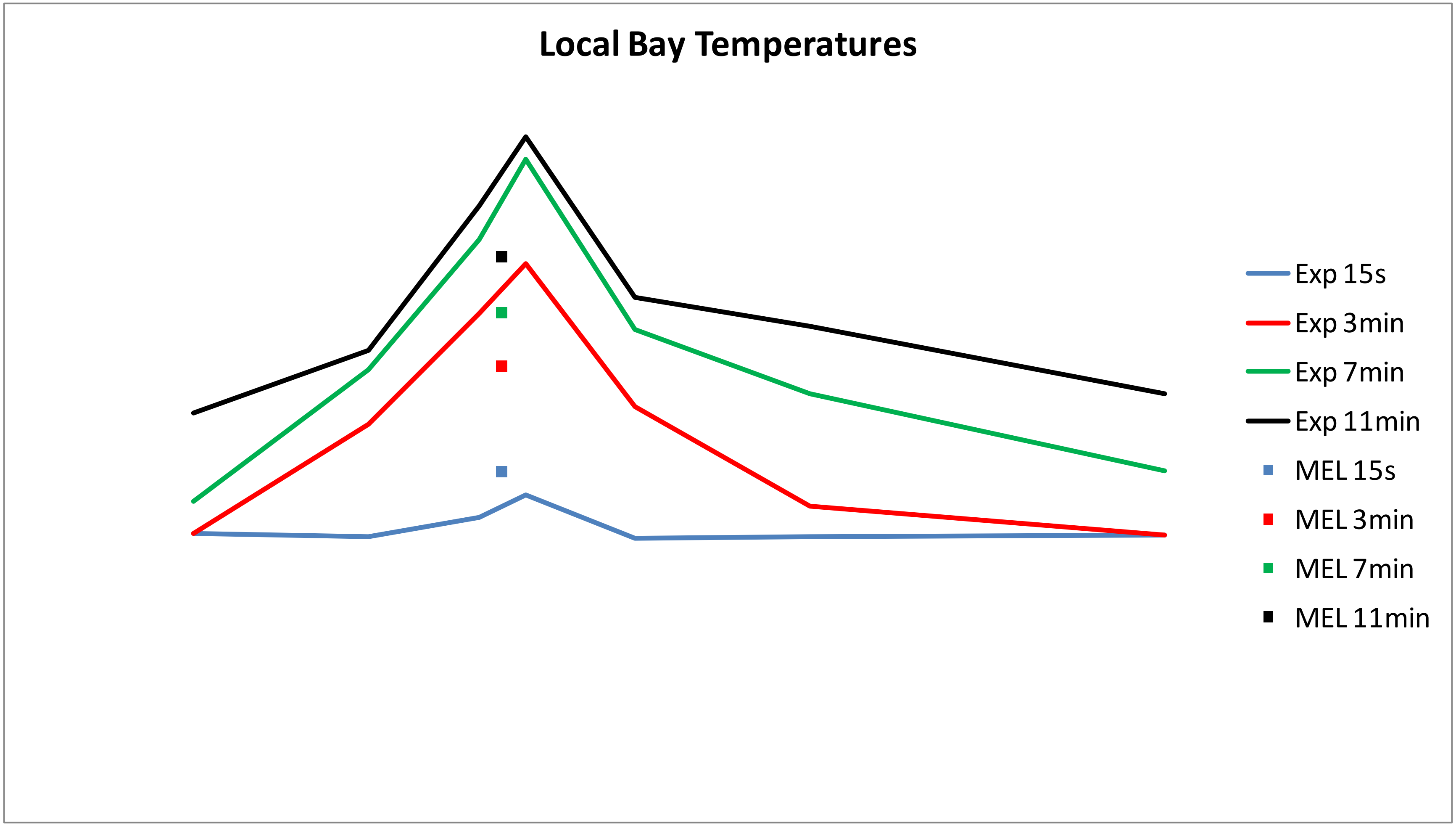
- Two flowpath definition to permit MELCOR the opportunity to determine buoyancy driven natural circulation
  - Same reduced lengths as mentioned prior
  - Radius/2 used to determine WW bottom flow area
    (note: Pool level is below the midpoint of the wetwell and no CCF coupling was applied)



N/F Modified Results



N/F Modified Comparison



N/F Modified Results

- Need to explore dependency on selected flow area
- The increased complexity of two offset flowpaths makes the model more difficult to understand
  - Early over-prediction (under mixing)
  - Later under-prediction (over mixing)
- Appears to produce improvements in the overall predictions with little added modeling effort
- Will likely over predict subcooling and a later containment pressurization breakaway due to local saturation conditions
- May demonstrate issues at saturation due to the rapid level swell when voiding begins to occur

Questions and Comments

Before Moving on to a quick SNAP Tutorial on Python Post Processing

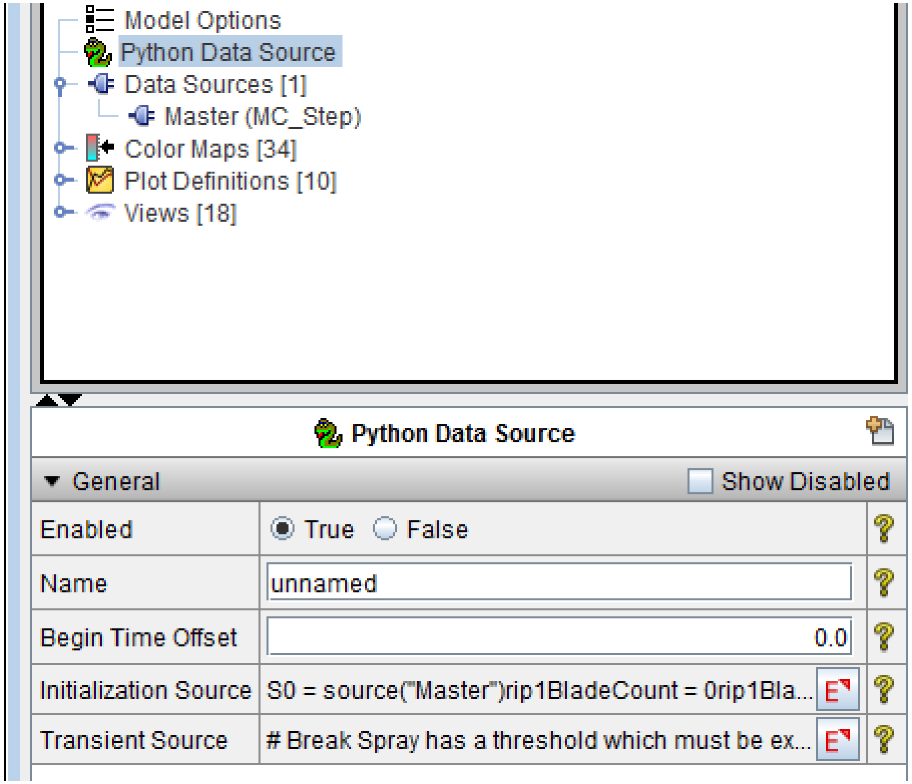
Ref: Cook D.H., “Pressure Suppression Pool Thermal Mixing”, NUREG/CR-3471, ORNL/TM-8906, 1984

SNAP Post Processing

- SNAP animations
  - Can utilize raw plot file data or Python Script generated data
- Creating a Python Script in the SNAP animation model
  - Select “Python Data Source” in the navigation tree (see next slide)
  - Click the Edit icon, a red E, next to “Initialization Source”
  - Create desired new “Virtual Channel Names” by clicking on the Add button. The new VCNs will be available as plot element (in place of the “Data Sources” identified in the plot files
    - Specify the source (example is provided)
    - If you wish, specify an initial value (example is provided)
  - Click the Edit icon next to “Transient Source”
    - Create your transient python script
  - Connect new VCN to animation element

Python Data Source

- Navigation Tree



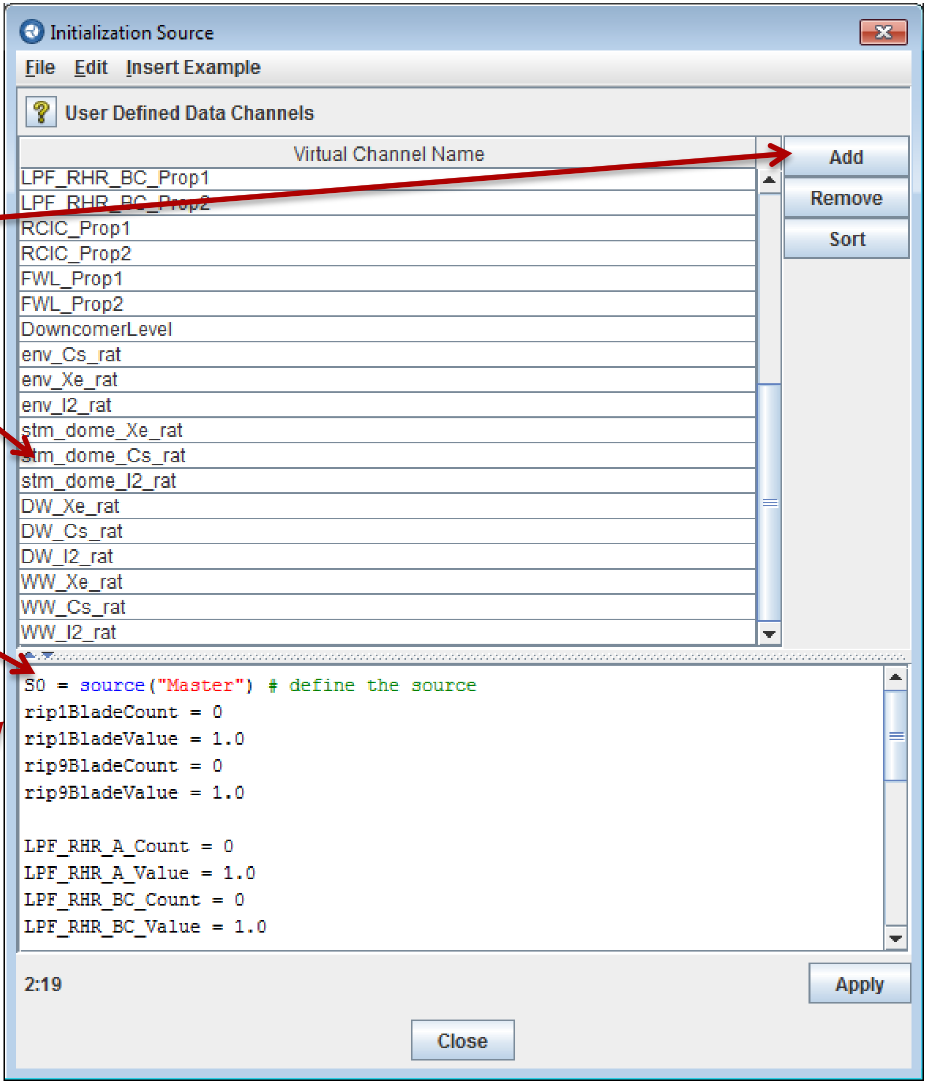
Define Source and Create Channels Editing Initialization Source

Add Virtual Data Channels

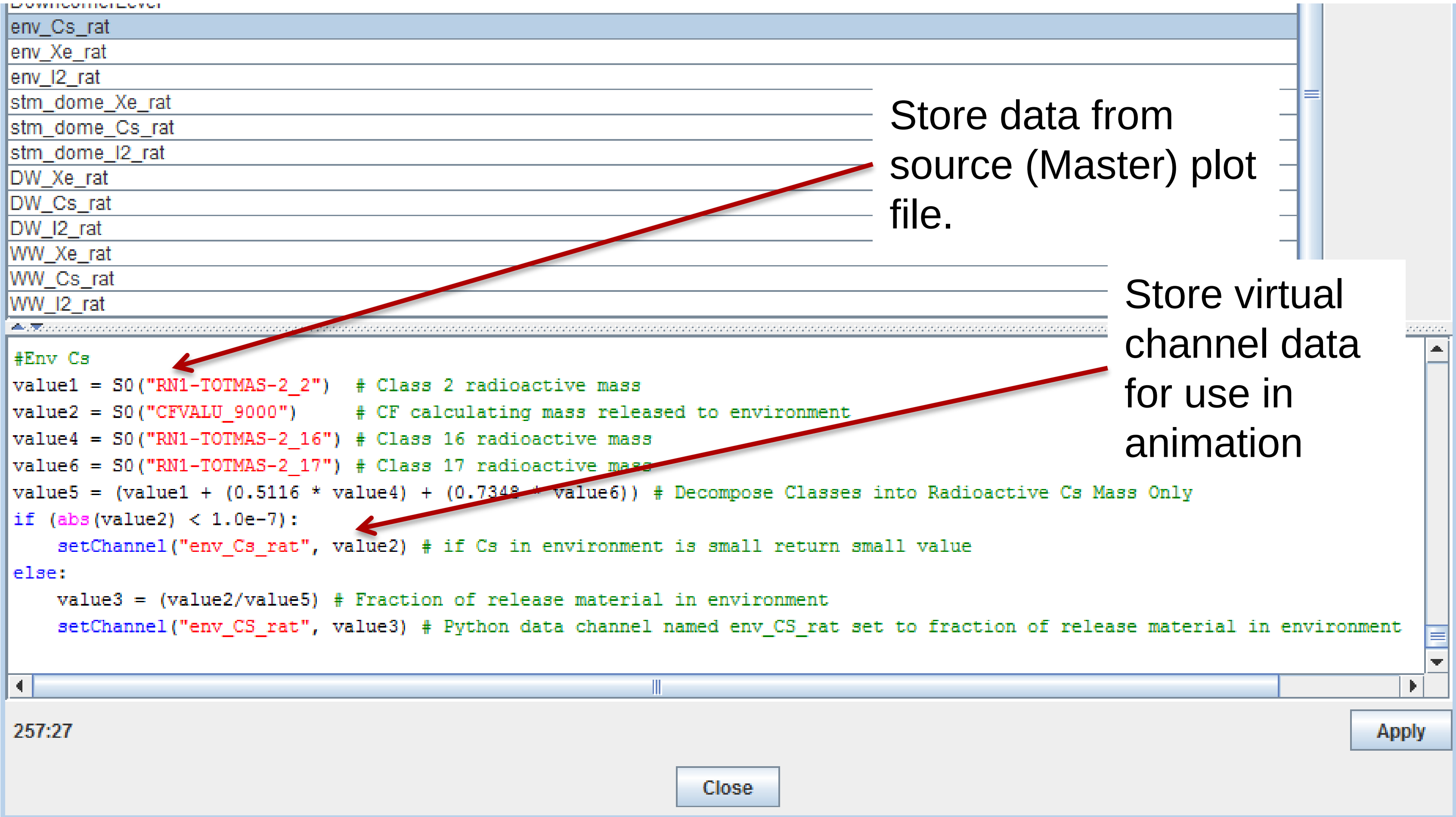
Created Virtual Data Channels

Define Source
(“Master” is named
“Data Sources” See Nav. Tree

Initialize Virtual Data Channels

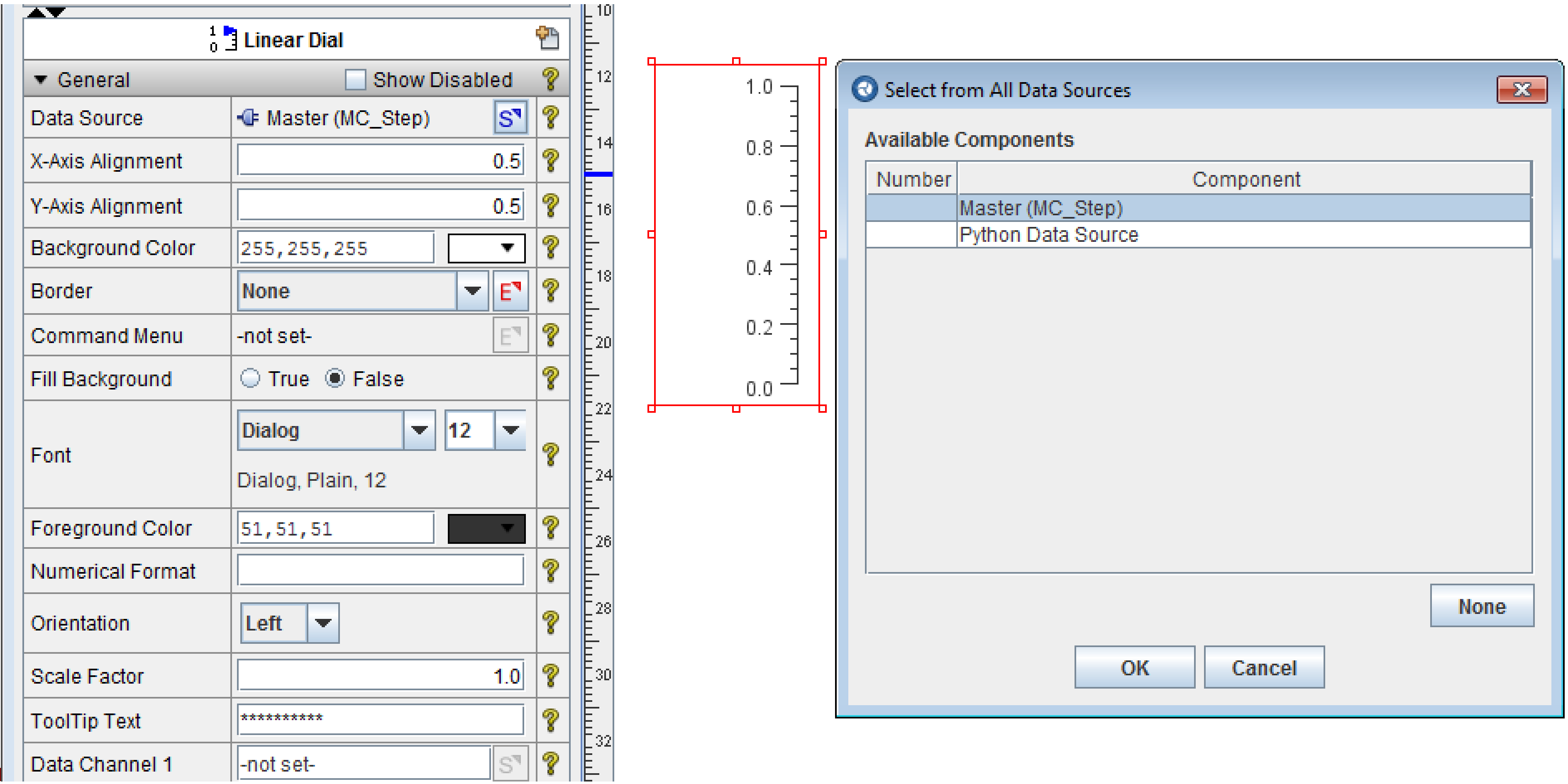


Python Script Calculations
Editing Transient Source



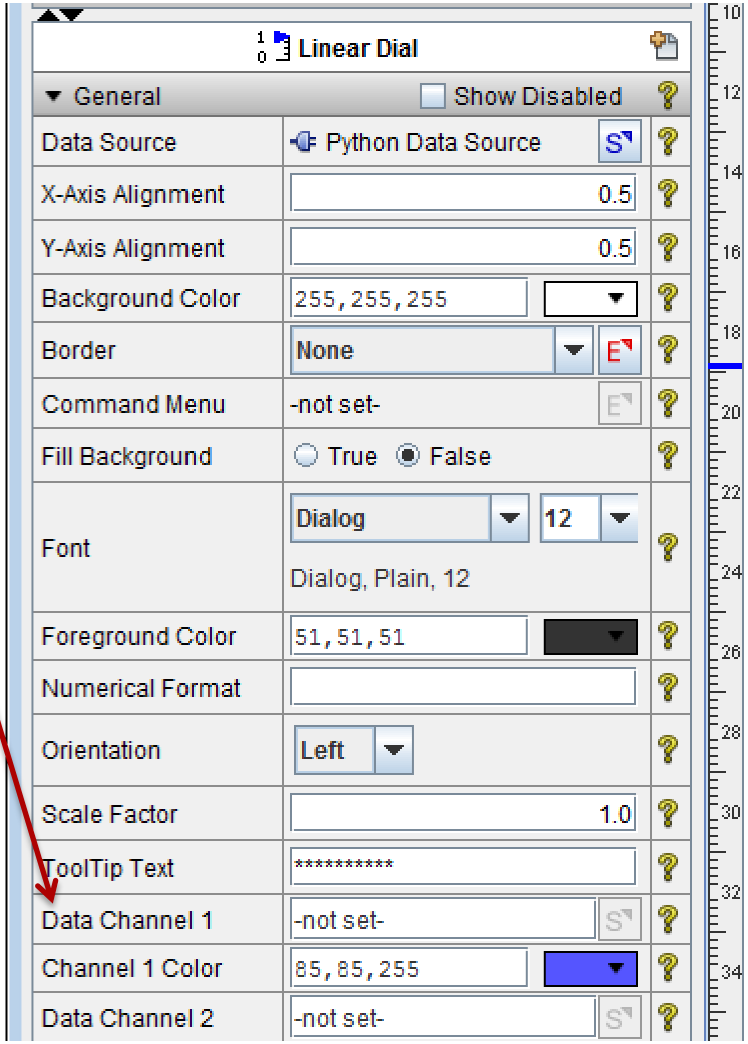
Linking Animation Element with Python Virtual Channel

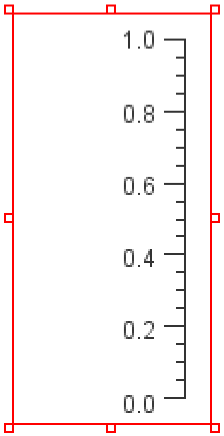
- Set the Data Source Field for any drawing element; Dial, Gauge, Polygon, etc. to utilize the “Python Data Source”



Linking Animation Element with Python Virtual Channel

Select the Virtual Data Channel that was created





Questions