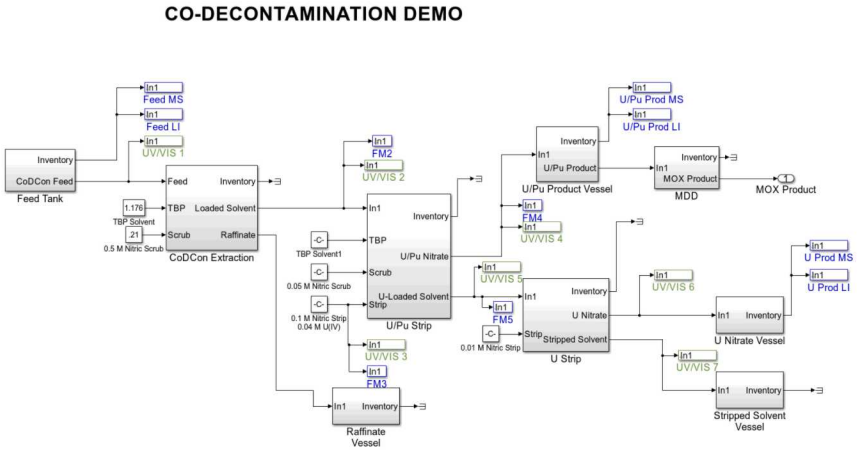
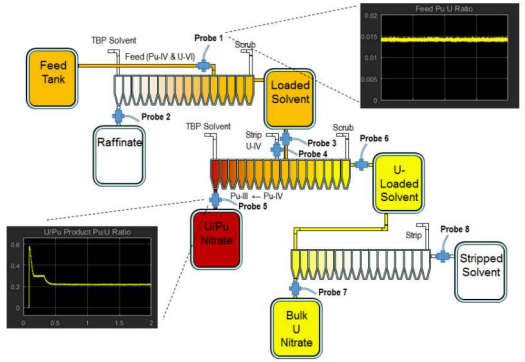
SAND2017-3347C





CoDCon Modeling

Ben Cipiti

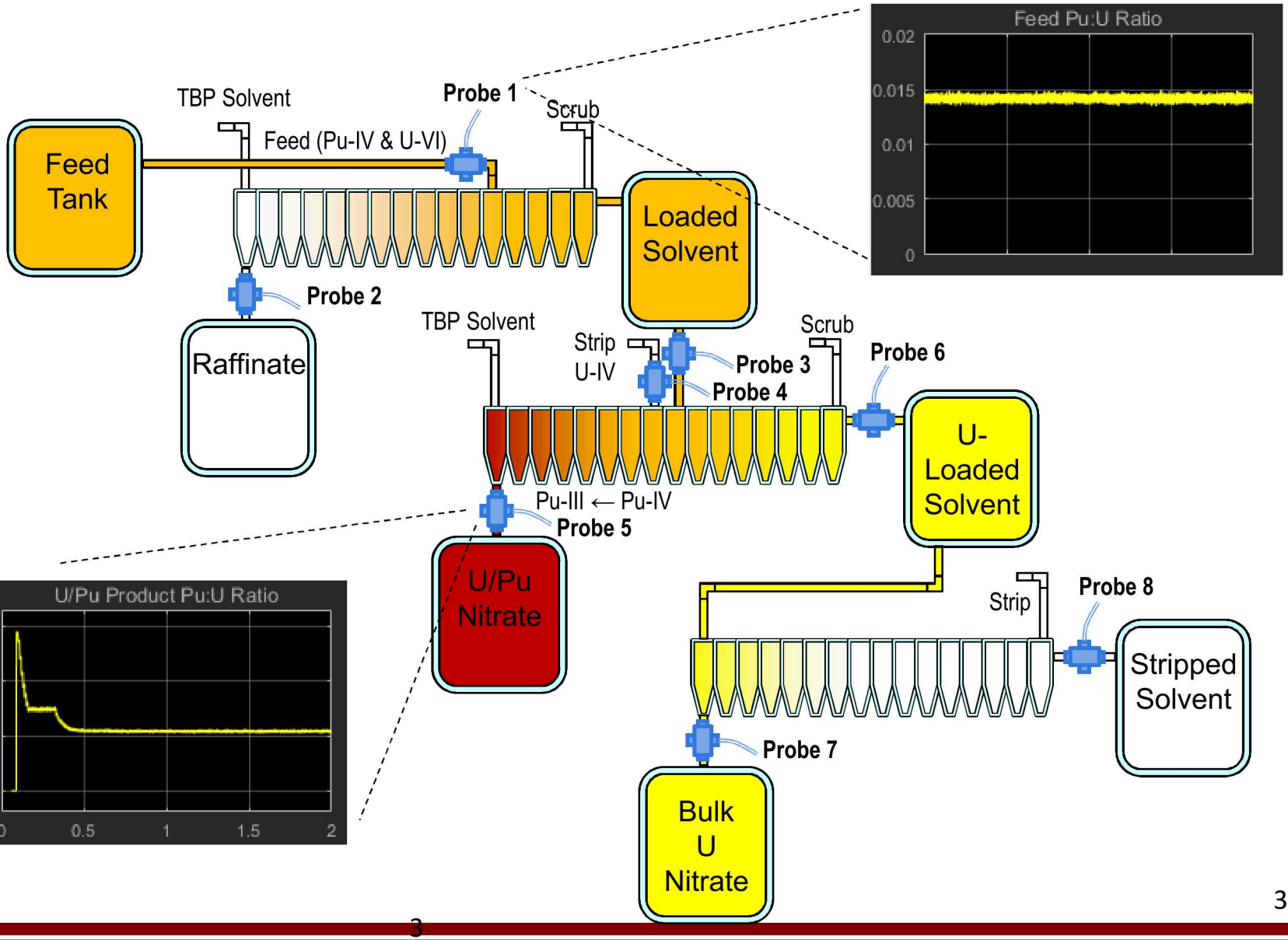
Sandia National Laboratories is a multi-mission laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND NO. 2011-XXXXP

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Overview

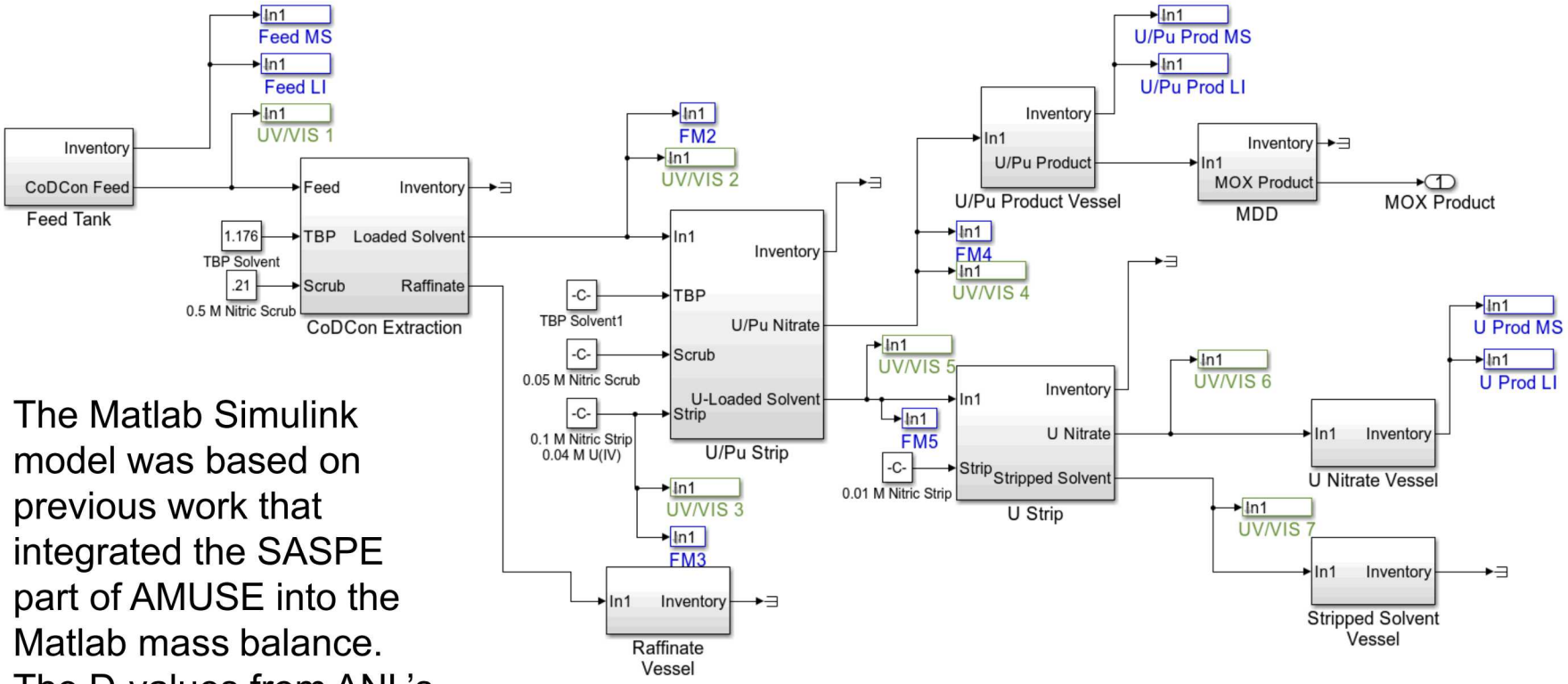
- The SSPM architecture has been used to develop a model of the CoDCon process.
- Past work that integrated AMUSE with the SSPM was used to build the model.
- One of the goals of CoDCon is to demonstrate the ability to maintain a coextraction of U and Pu at a fixed ratio—the model allows us to explore transient plant conditions that may be difficult to perform experimentally.
- In addition, the model tracks the overall uncertainty for maintaining a particular ratio.

CoDCon Flowsheet



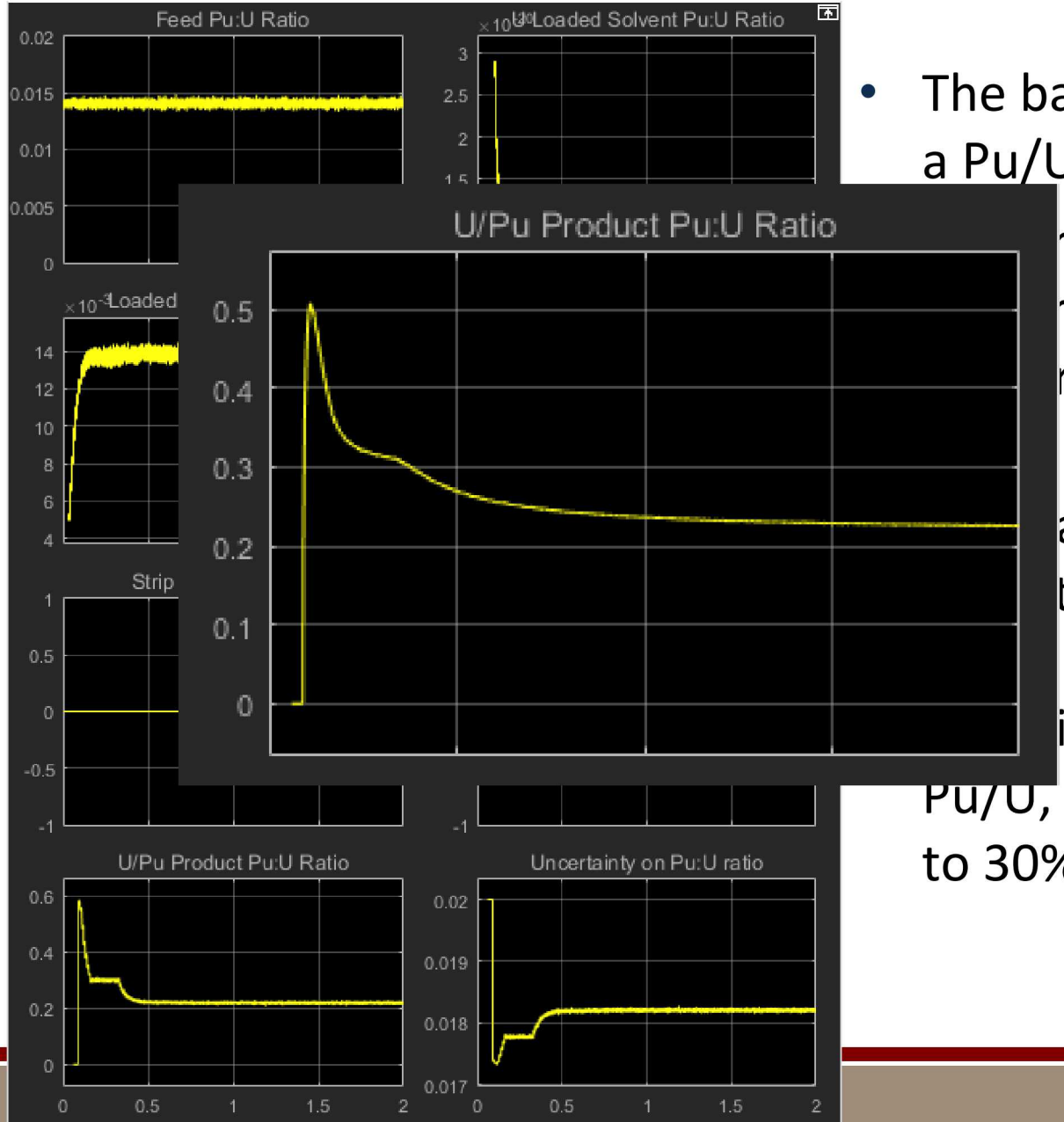
3

Simulink Model



- The Matlab Simulink model was based on previous work that integrated the SASPE part of AMUSE into the Matlab mass balance.
- The D-values from ANL's flowsheet were directly used in this case.
- While the experiment is starting with fixed U-Pu solution, the model can be used to explore varying input (as would be the case for different fuel types) or other transients and how the process can be controlled to increase or decrease the Pu/U ratio.

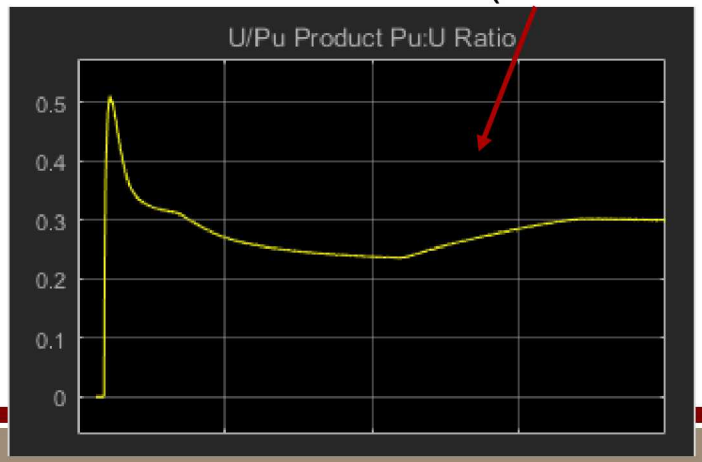
Baseline Run (Constant Conditions)



- The baseline case starts with a Pu/U ratio of 0.014.
- roduct sees a transient rtup but then levels off roduct at a 0.22 Pu/U
- ady-state, the tainty on the ratio is 1.8%, so if the goal is intain a 30% ratio of Pu/U, it would be controlled to 30% +/- 0.5%.

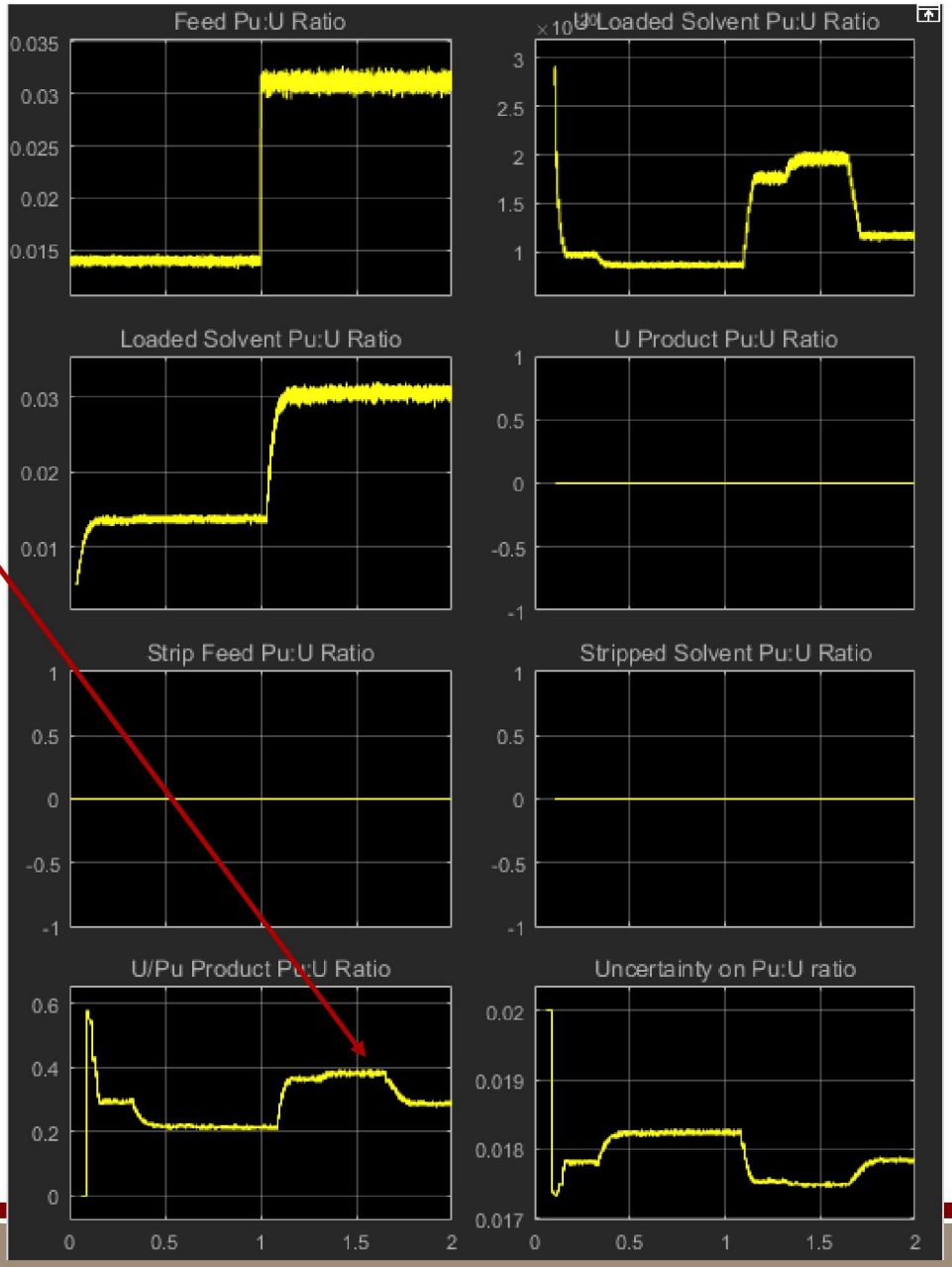
Test Run (Varying Conditions)

- The model was used to examine a change in the feed (different fuel type) half-way through the simulation (top left graph).
- This leads to an increase in the Pu/U ratio in the product (bottom left graph).
- A scrub flow rate was changed at hour 1.5 (from 0.7 to 0.8) to then reduce the Pu/U ratio.
- The final product solution Pu/U ratio is the integral of the product flow, so the effect smears with time (see below).



Test Run 2

- The same transient could also be controlled by reducing the flow of the TBP solvent in the second stage.
- The solvent flow was changed from 1.176 to 1 at hour 1.5 to reduce the Pu/U ratio.
- So there can be multiple “knobs” to turn to control the process.



Discussion

- The CoDCon model has been developed, and seems to be operating as expected so far.
- The model will be updated as the flowsheet changes, and as we get data from the experiment.
- The measurement uncertainties for the probes will also be updated as data is received.