

A Revolution in Performance

# Interoperation of PRO/II Controllers and CAPE-OPEN unit operations in PRO/II v8.3

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# Agenda

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- **Introduction**
- **Enhancements to Controller Referencing**
- **Enhancements to Flowsheet Parameter Referencing**
- **Demonstration**
- **Lessons Learned**

# Introduction

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- **CAPE-OPEN vision**

- A compliant unit operation can be used in any compliant process modeling environment with all the features and capabilities of the native unit operations of that environment.

- **PRO/II 8.2 – limitations**

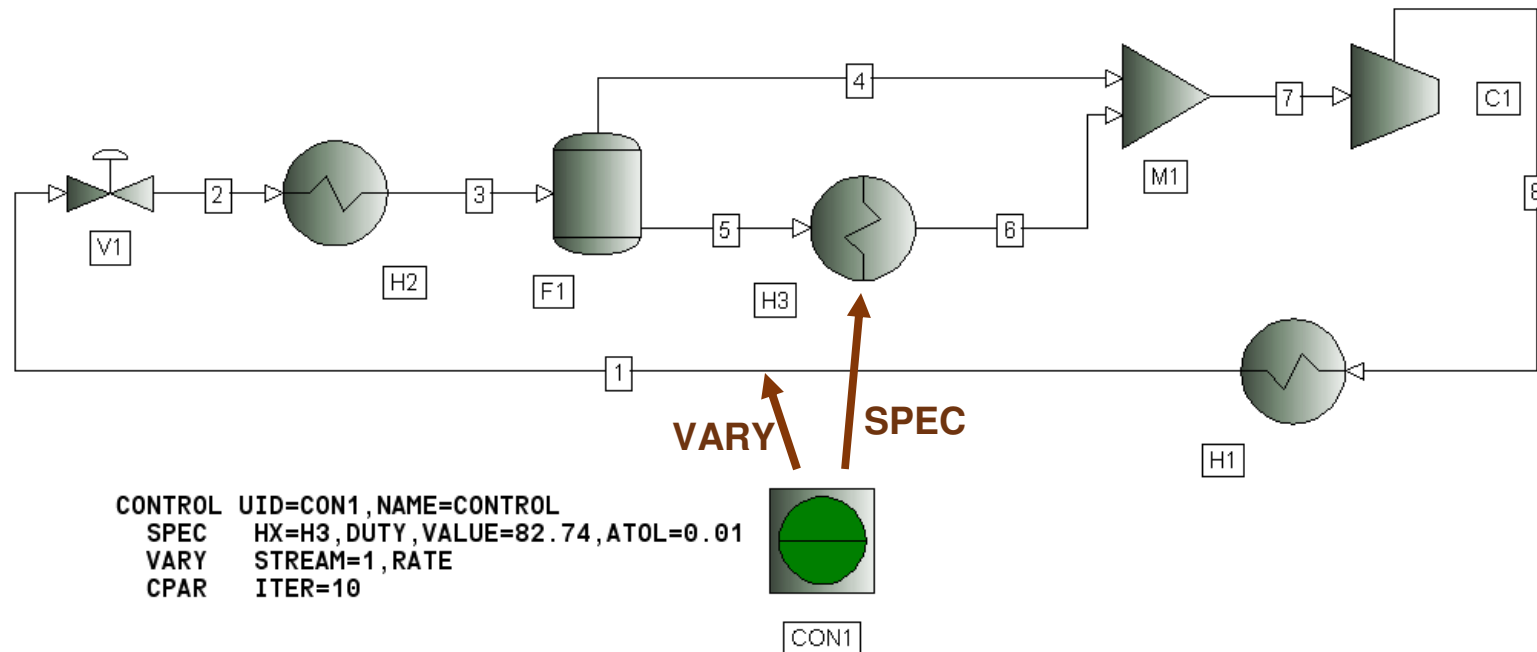
- Compliant unit operations can be used in a flowsheet, but public parameters are not available to PRO/II's controllers, optimizer, and case study feature.
- Parameter values cannot be linked to other flowsheet parameters using PRO/II's "define" infrastructure.

- **PRO/II 8.3 – enhancement**

- Extend the controller support and the "define" infrastructure to include real parameters of CAPE-OPEN unit operations.

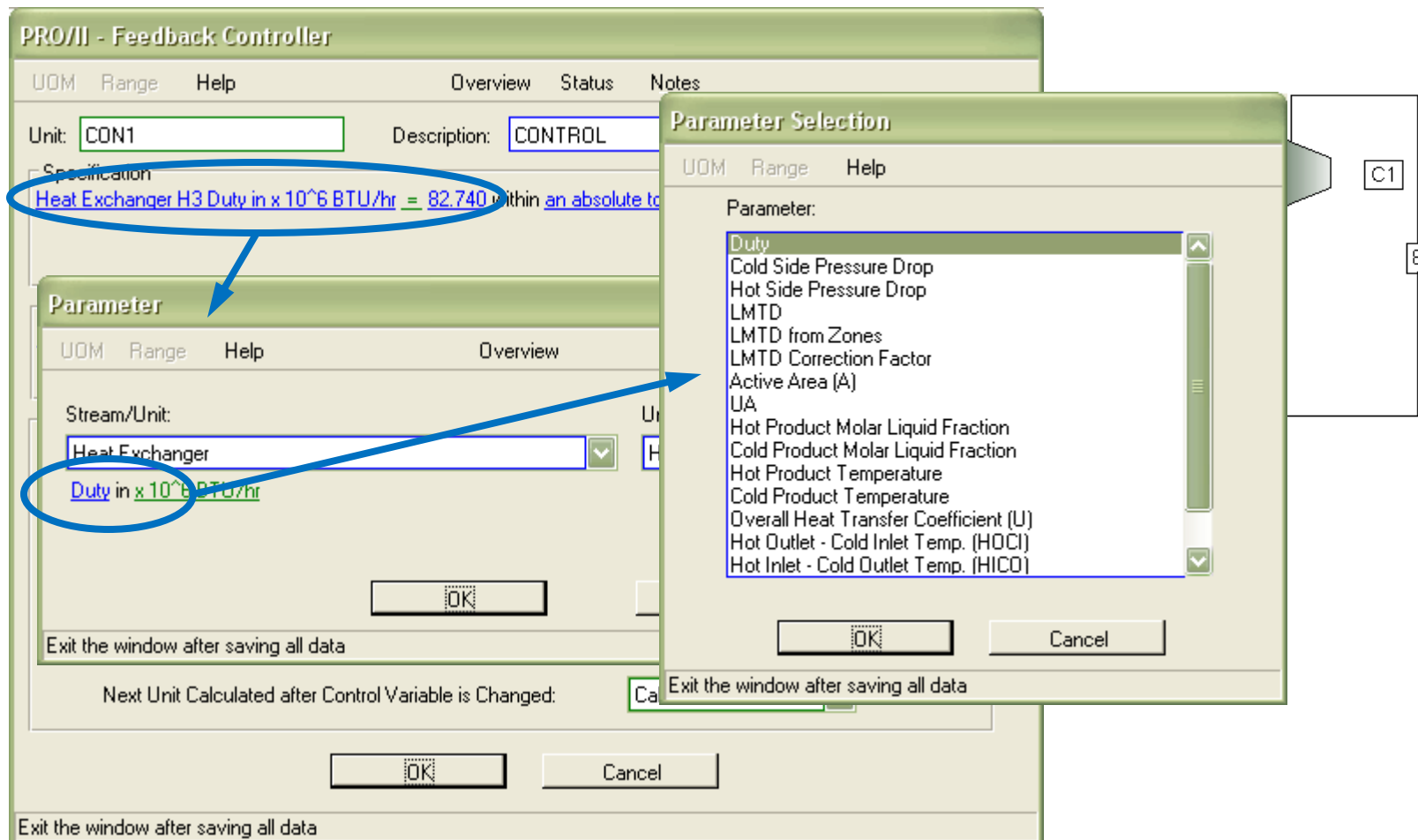
# PRO/II Controllers – 1

- PRO/II uses **SPEC** and **VARY** statements in the keyword file to specify controller access to flowsheet parameters.



# PRO/II Controllers – 2

- In the GUI, PRO/II uses common dialog boxes to specify controller access.



# Keyword Enhancements

OPTIMIZER UID=OPTIMIZER1

VARY ID=OPT1VARY1, CAPE=CAPEXACE,  
PNAME(BTU/HR)="DutyIn", MINI=1.7, MAXI=2.4

CONSTRAINT ID=OPT1CONS1, STREAM=PRODUCT,  
RATE(LBM/H),TOTAL, WET, MINI=150

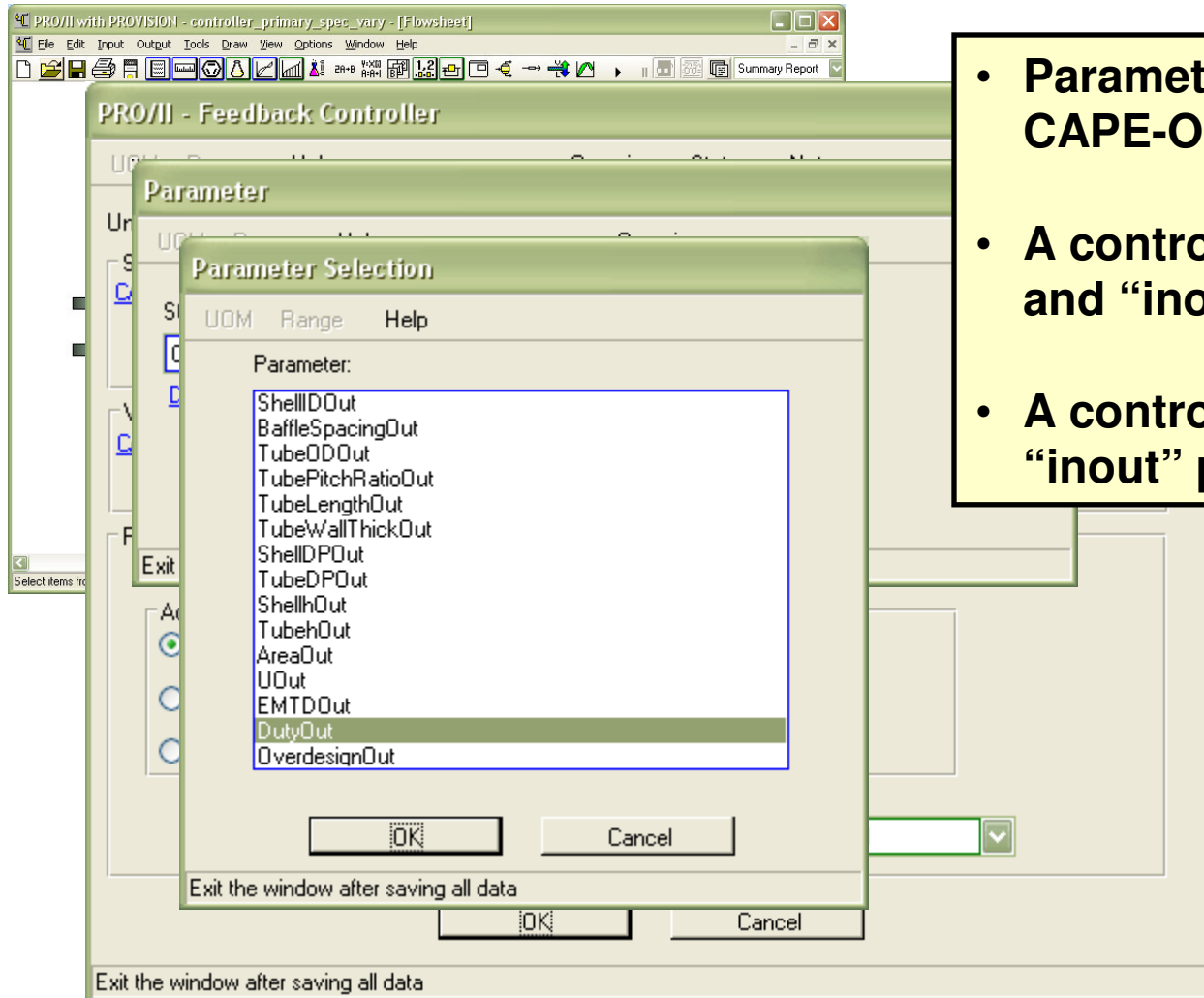
OBJECTIVE STREAM=PRODUCT, RATE(LBM/H),  
COMP=5,6, WET, MINIMIZE

Identifies parameter

Unit-of-Measure

Identifies type and name  
of unit operation

# GUI Enhancements – Common Dialogs



- Parameters are taken from the CAPE-OPEN unit and filtered.
- A controller can SPEC “out” and “inout” parameters
- A controller can VARY “in” and “inout” parameters

# Flowsheet Referencing

- PRO/II uses the “DEFINE” system to provide parameter referencing functionality

The image displays the PRO/II software interface for configuring a compressor unit. The main window is titled "PRO/II - Compressor" and has a menu bar with "UOM", "Define", "Range", and "Help". The "Define" menu is highlighted with a blue circle. Below the menu bar, there are buttons for "Product Phases...", "After-cooler...", and "Calculational Method...".

The "Definition" dialog box is open, showing a table with columns "UOM", "Range", "Help", and "Overview". A checkbox labeled "Set Up Definition for Compressor Work" is checked. Below this, the text "Compressor C1 Work in HP = Expander X1 Actual Work in HP \* 0.9" is displayed, with "Expander X1 Actual Work in HP" circled in blue.

The "Parameter" dialog box is also open, showing a table with columns "UOM", "Range", "Help", and "Overview". The "Constant/Stream/Unit:" field is set to "Expander" and the "Unit Name:" field is set to "X1". The "Actual Work in HP" is circled in blue.

The "Parameter Selection" dialog box is open, showing a list of parameters: "Temperature", "Pressure", "Pressure Drop", "Actual Work", "Head", "Adiabatic Efficiency", and "Pressure Ratio". "Actual Work" is highlighted in the list.

At the bottom of the main window, there is a small schematic diagram of a compressor unit with a tank and a stream labeled "10".

## Enhanced Keyword Syntax for DEFINE

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- **Similar to SPEC/VARY shown previously**
- **PRO/II unit operations can use DEFINE to access CAPE-OPEN parameter values**
- **CAPE-OPEN unit operations can use DEFINE to access parameter values from other PRO/II and CAPE-OPEN units**
- **GUI support of this is provided through the CAPE-OPEN Settings Dialog...**

# CAPE-OPEN Settings Dialog

**PRO/II - CAPE-OPEN Unit**

Unit: CO2 Description: [ ]

CAPE-OPEN Unit Ports:

Name	Direction	Stream	Thermodynamic System
HotInlet	inlet	S5	
ColdInlet	inlet	S7	
HotOutlet	outlet	S6	Default (PR01)
ColdOutlet	outlet	S10	Default (PR01)

CAPE-OPEN Unit Parameters:

Name	Mode	Value	UOM
ShellIDIn	in	1.5441	ft
DutyIn	in	0.00000	x 10 <sup>6</sup> BTU/hr
RunType	in		
ShellIDOut	out	1.5441	ft
BaffleSpacingOut	out	1.6667	ft
TubePassesOut	out	1	
TubeODOut	out	0.062500	ft
TubePitchRatioOut	out	1.3333	

OK Cancel

Exit the window after saving all data

- Parameters are taken from the CAPE-OPEN unit.
- Only “in” and “inout” parameters can be DEFINED
- When you click on an eligible parameter value, the Define button is enabled.

# Demonstration

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- **Feature Demonstration**

## Limitations

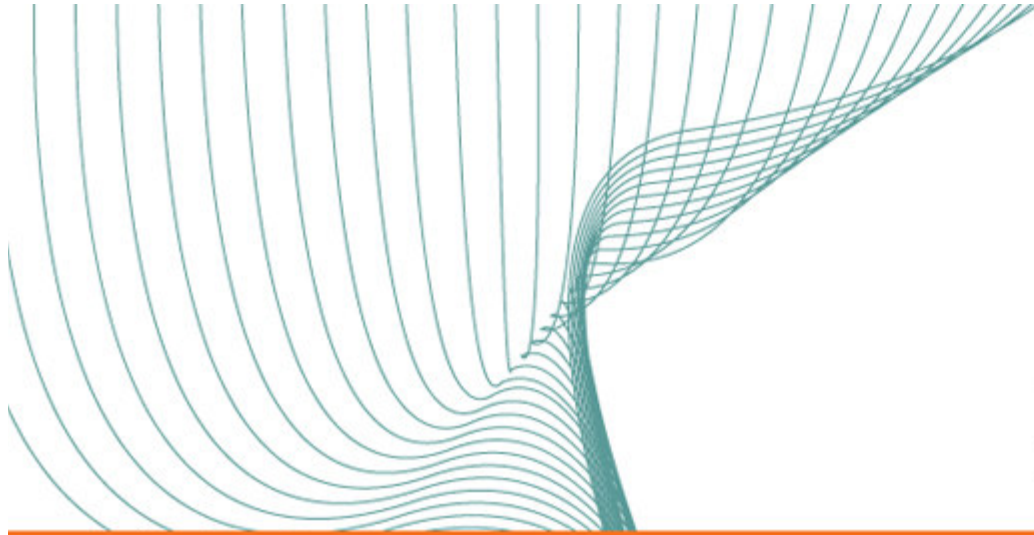
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- **Controller access and Flowsheet referencing are only available for CAPE-OPEN “real” parameters.**
- **Unit-of-Measure support is only available for CAPE-OPEN parameters that support Dimensionality.**

# Lessons Learned - Dimensionality

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- **Some CAPE-OPEN “dimensionality” values can be associated with more than one unit-of-measure “class” in PRO/II.**
- **CAPE-OPEN dimensionality does not currently distinguish between concepts such as “temperature” vs. “temperature difference”.**
- **These observations have important consequences for integration into a PME. The PME may need to work around these issues by**
  - providing ability of user to select PME-specific UOM consistent with dimensionality or
  - assuming the “lowest common denominator” or least-risky UOM association.



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**Thank You**

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