

Chemical Engineering 512

Nuclear Reactor Transient Modeling

Lecture 15

PYGI, Restart, Control Variables II



Spiritual Thought

“Please, please, remember your Kirtland’s
when you have your Nauvoo’s”

- President Lonny Gleed



Practice Problem 1

- You have a fuel rod, component 1112 (joined to a pipe, volume 112) which represents the hottest rod in the core (center rod).
- There are 15 axial nodes to this heat structure, all producing power
- There are 10 radial nodes; from inside to outside, 7 are fuel, 1 is gap, and 2 are clad.
- Write a control variable (shortest possible) that will return:
 1. Peak fuel temperature (named pfuel)
 2. Peak clad temperature (named PCT)



- 2050010 pct stdfnctn 1.0 0.0 1
0
- 2050010 max httemp 111200109 httemp 111200209
1 httemp 111200309
- 2050010 httemp 111200409 httemp 111200509
2 httemp 111200609
- 2050010 httemp 111200709 httemp 111200809
3 httemp 111200909
- 2050010 httemp 111201009 httemp 111201109
4 httemp 111201209
- 2050010 httemp 111201309 httemp 111201409
5 httemp 111201509
- *
- 2050011 pfuel stdfnctn 1.0 0.0 1
0
- 2050011 max httemp 111200101 httemp 111200201
1 httemp 111200301
- 2050011 httemp 111200401 httemp 111200501
2 httemp 111200601
- 2050011 httemp 111200701 httemp 111200801
3 httemp 111200901
- 2050011 httemp 111201001 httemp 111201101
4 httemp 111201201
- 2050011 httemp 111201301 httemp 111201401
5 httemp 111201501



Practice Problem 2

- You have a decay heat removal heat exchanger that is cooling your core during an accident. The primary coolant pipe is 430, while the secondary side pipe is 540. The heat structure is 1430.
- Each pipe component has 40 axial nodes, while 1430 has 3 radial node.
- Develop a single control variable, 2050440, that will return the heat exchanger power in MW. Please name this variable htrecpow.
- The initial value for this control variable should be -1224.762, though you should also have RELAP calculate an initial value, in case this has changed.



```

*ctlvarname  type  factor  init  f c  min  max
2050440      htrecpow sum    1.0e-06 -1224.762 1
*           0

```

```

*ctlvar      a1  v1      p1      a2      p2
                v2

a0
20504401      0.0  1.0 q      430010000      1.0 q      430020000
20504402      1.0 q      430030000      1.0 q      430040000
20504403      1.0 q      430050000      1.0 q      430060000
20504404      1.0 q      430070000      1.0 q      430080000
20504405      1.0 q      430090000      1.0 q      430100000
20504406      1.0 q      430110000      1.0 q      430120000
20504407      1.0 q      430130000      1.0 q      430140000
20504408      1.0 q      430150000      1.0 q      430160000
+           1.0 q      430170000      1.0 q      430180000
+           1.0 q      430190000      1.0 q      430200000
+           1.0 q      430210000      1.0 q      430220000
+           1.0 q      430230000      1.0 q      430240000
+           1.0 q      430250000      1.0 q      430260000
+           1.0 q      430270000      1.0 q      430280000
+           1.0 q      430290000      1.0 q      430300000
+           1.0 q      430310000      1.0 q      430320000
+           1.0 q      430330000      1.0 q      430340000
+           1.0 q      430350000      1.0 q      430360000
+           1.0 q      430370000      1.0 q      430380000
+           1.0 q      430390000      1.0 q      430400000

```



Practice Problem 3

- You want to know how much power (in MW) is added to a water stream by a compressor (component 465)
- The volume before the compressor is 461010000, and the volume after is 470010000 (no change in elevation or velocity)
- Please provide a series of no less than 10 control variables that will calculate and then return the power delivered to the fluid in MW
- hint: `cprtrq` and `cprvel` provide the torque and velocity of a compressor, respectively
- Hint: mechanical energy balance...



*ctlvar name 20504690

h470

Solution 3

Solution 3

						type	factor	init	f c	min	max				
						sum	1.0			327204.1					
*ctlvar	name	type		init	f c	max	*ctlvar	a0	v1	p1	a2	v2	p2		
		factor			min			a1							
20504660	pv461	div		12820.44	1		20504691	0.0	1.0	ug	470010000		1.0 cntrlvar 468		
		1.0													
*							*								
*ctlvar		v1	p1	p2			*ctlvar	name	type	factor	init	f c	min	ma	
			v2												
20504661	rho	461010000	p	461010000			20504700	dh	sum	1.0	20663.75	1			
*							*								
*ctlvar	name	type		init	f c	max									
		factor			min										
20504670	h461	sum		306540.	1		*ctlvar	a0	a1	v1	p1	a2	v2	p2	
		1.0					20504701		0.0	1.0	cntrlvar 469	1.0	cntrlvar 467		
*							*								
*ctlvar	a0	a1	v1	p1	a2	v2	p2								
20504671	0.0	1.0	ug	461010000	1.0	cntrlvar 466		*ctlvar	v1	p1	v2	p2			
*								20504711	mflowj	465010000	cntrlvar 470				
*ctlvar	name	type	factor	init	f c	min	max								
20504680	pv470	div		1.0	27982.14	1		*ctlvar	name	type	factor	init	f c	min	max
*								20504720	qmc-shf	mult	-1.e-6	35.06105	1		
								*							
*ctlvar	v1	p1	v2	p2				*ctlvar	v1	p1	v2	p2			
20504681	rho	470010000	p	470010000				20504721	cprtrq	465	cprvel	465			

