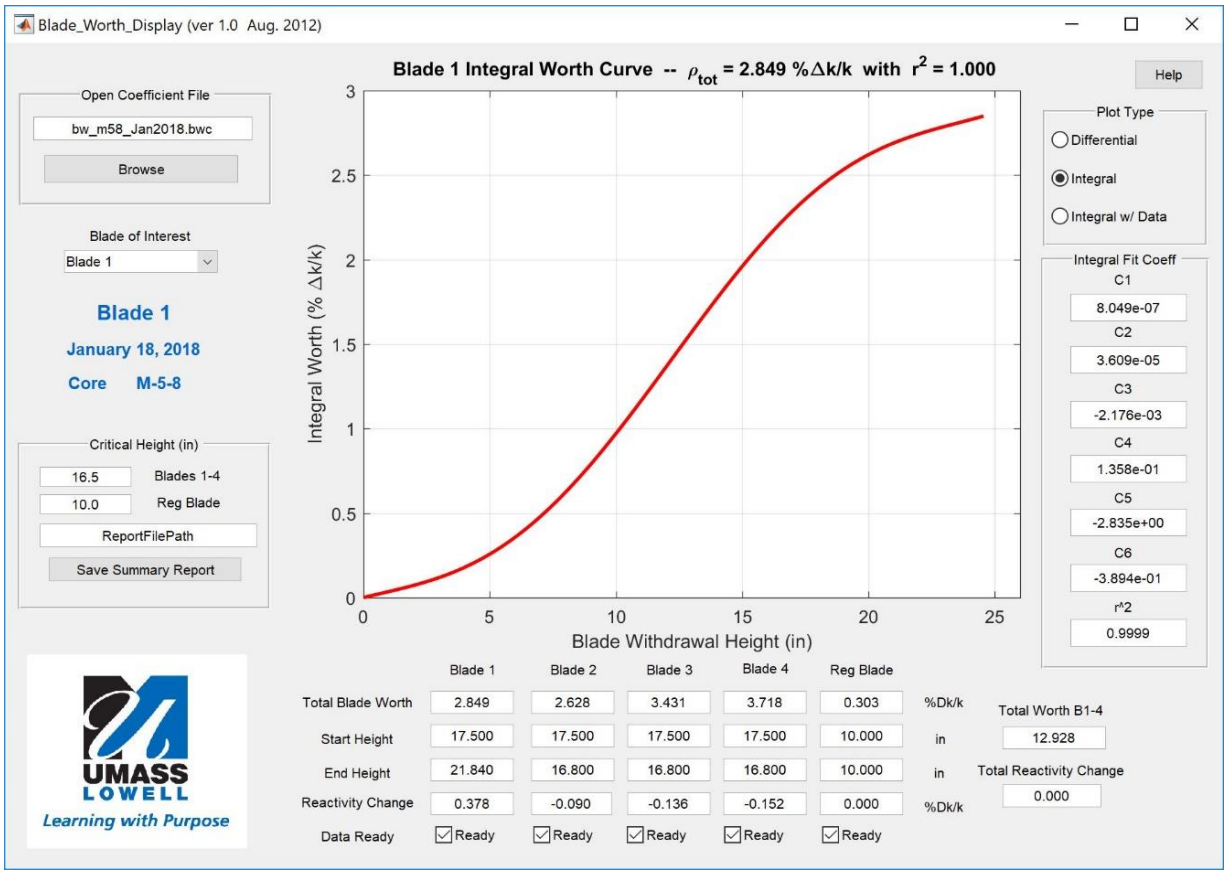
Blade_Worth_Display (ver 1.0 Aug. 2012)
Blade 1 Integral Worth Curve -- ρ_{tot} = 2.849 %Δk/k with r^2 = 1.000
Help
Open Coefficient File
bw_m58_Jan2018.bwc
Browse
Blade of Interest
Blade 1
Blade 1
January 18, 2018
Core M-5-8
Critical Height (in)
16.5 Blades 1-4
10.0 Reg Blade
ReportFilePath
Save Summary Report
Integral Worth (% Δk/k)
Blade Withdrawal Height (in)
Plot Type
Differential
Integral
Integral w/ Data
Integral Fit Coeff
C1 8.049e-07
C2 3.609e-05
C3 -2.176e-03
C4 1.358e-01
C5 -2.835e+00
C6 -3.894e-01
r^2 0.9999
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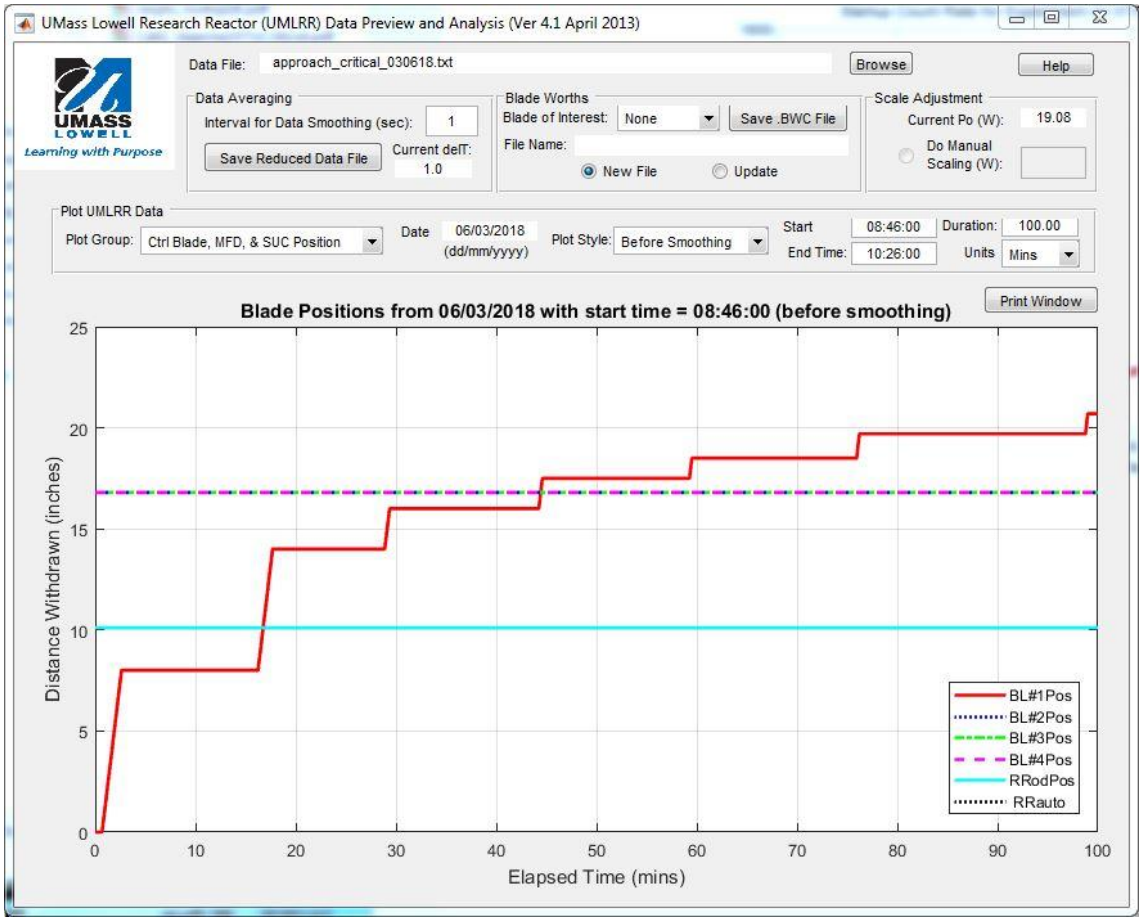
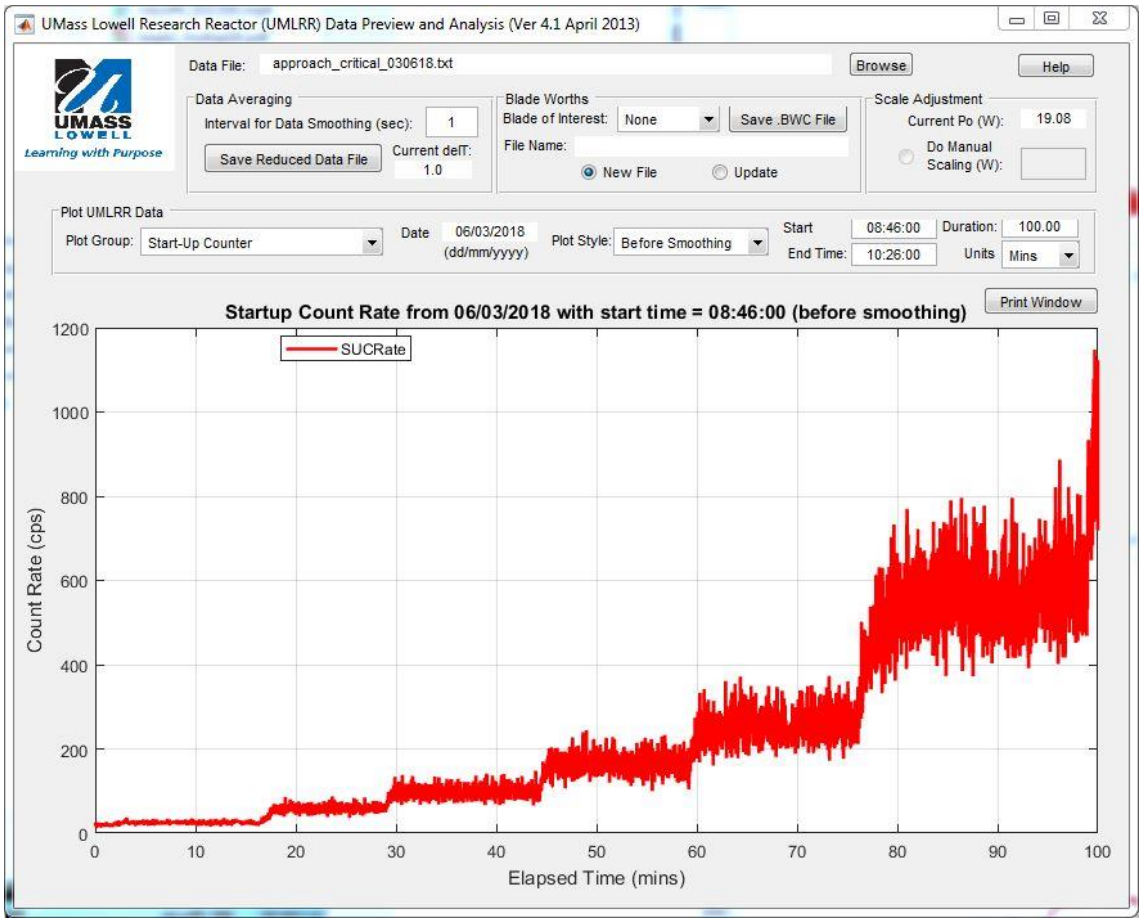
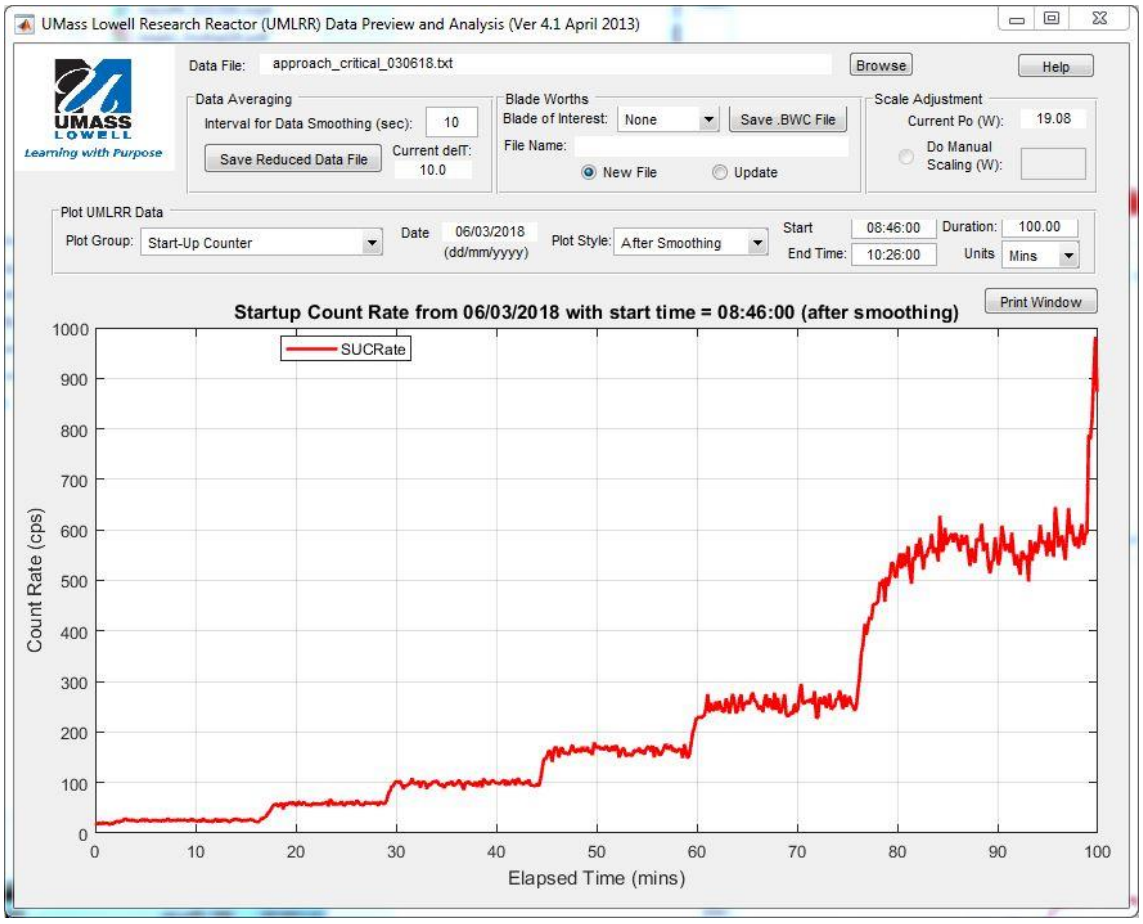
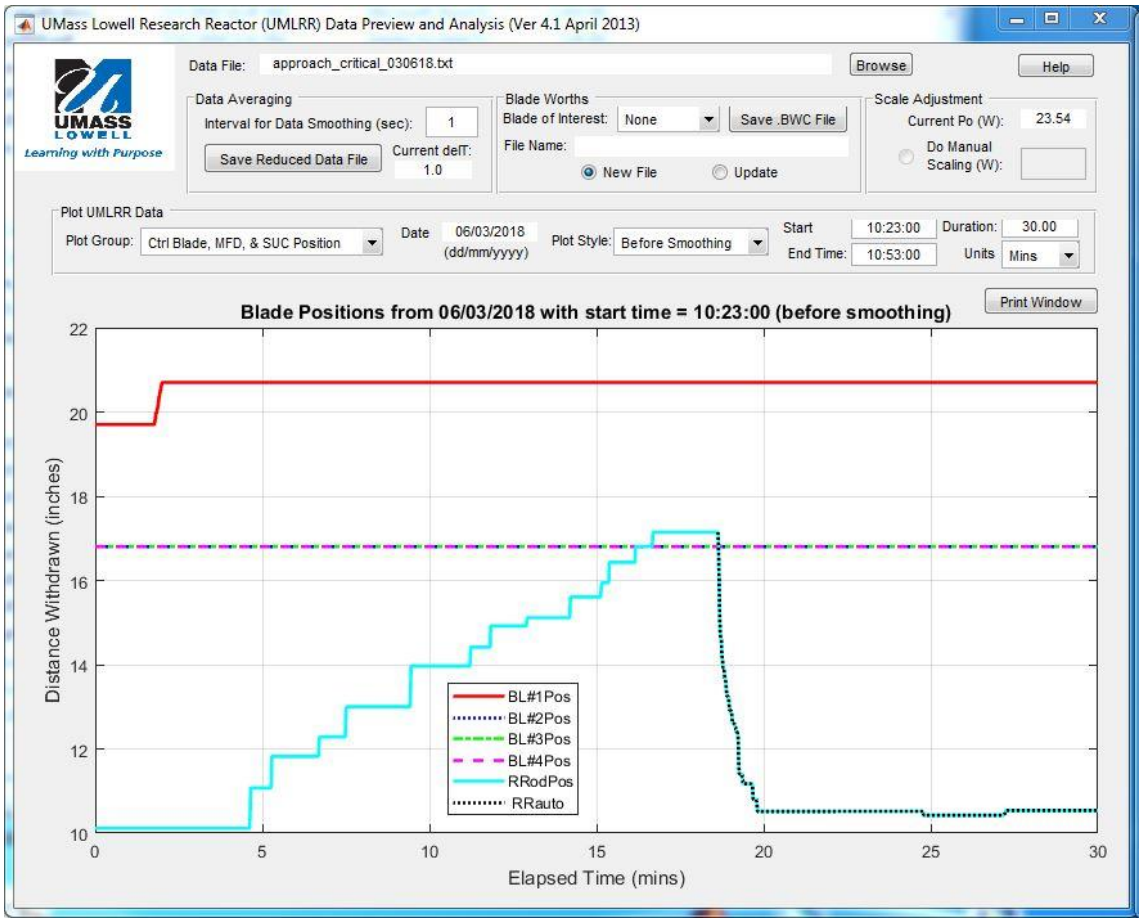
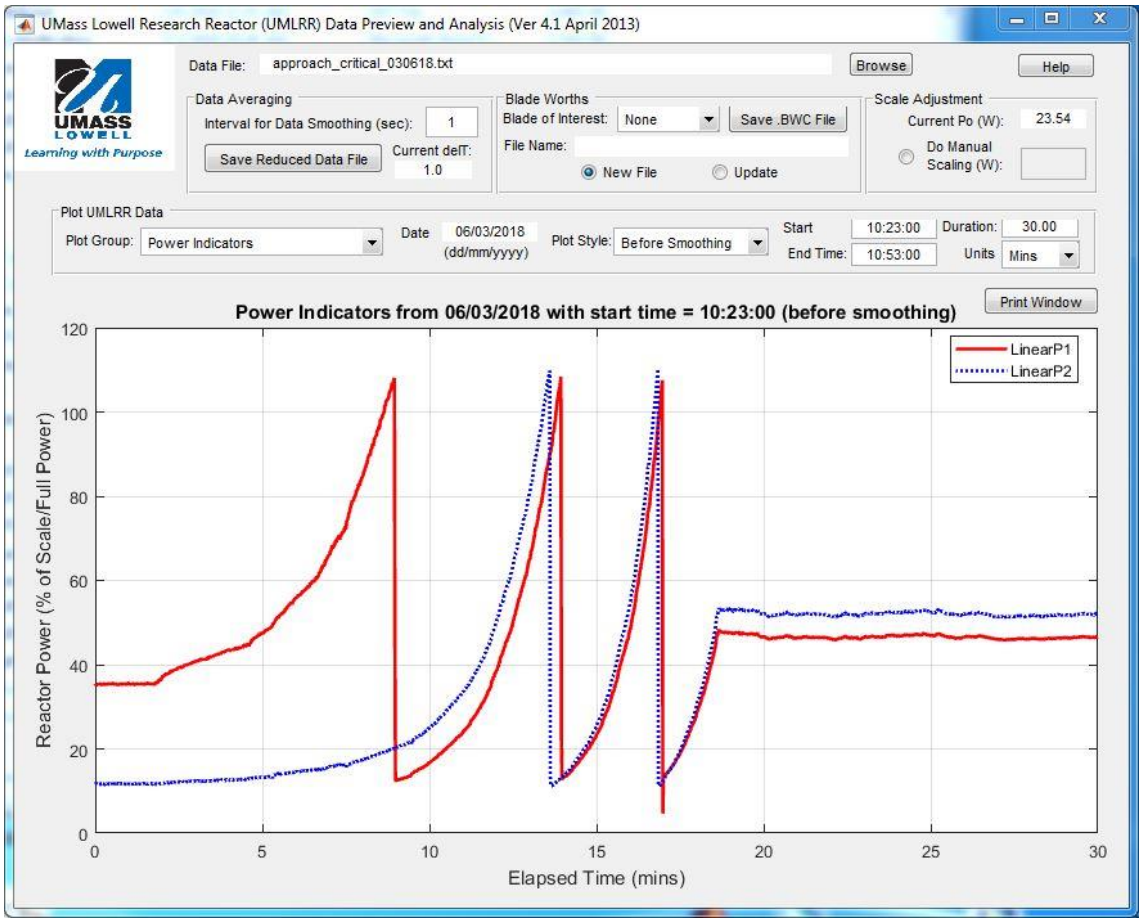
Blade 1 Blade 2 Blade 3 Blade 4 Reg Blade
Total Blade Worth 2.849 2.628 3.431 3.718 0.303 %Dk/k
Start Height 17.500 17.500 17.500 17.500 10.000 in
End Height 21.840 16.800 16.800 16.800 10.000 in
Reactivity Change 0.378 -0.090 -0.136 -0.152 0.000 %Dk/k
Data Ready Ready Ready Ready Ready Ready
Total Worth B1-4 12.928
Total Reactivity Change 0.000


UMass Lowell Research Reactor (UMLRR) Data Preview and Analysis (Ver 4.1 April 2013)
Data File: approach_critical_030618.txt
Browse
Help
Data Averaging
Interval for Data Smoothing (sec): 1
Save Reduced Data File
Current delT: 1.0
Blade Worths
Blade of Interest: None
Save .BWC File
File Name:
New File
Update
Scale Adjustment
Current Po (W): 19.08
Do Manual Scaling (W):
Plot UMLRR Data
Plot Group: Ctrl Blade, MFD, & SUC Position
Date 06/03/2018 (dd/mm/yyyy)
Plot Style: Before Smoothing
Start 08:46:00
End Time: 10:26:00
Duration: 100.00
Units Mins
Print Window
Blade Positions from 06/03/2018 with start time = 08:46:00 (before smoothing)
Distance Withdrawn (inches)
Elapsed Time (mins)
BL#1Pos
BL#2Pos
BL#3Pos
BL#4Pos
RRodPos
RRauto


UMass Lowell Research Reactor (UMLRR) Data Preview and Analysis (Ver 4.1 April 2013)
Data File: approach_critical_030618.txt
Browse
Help
Data Averaging
Interval for Data Smoothing (sec): 1
Save Reduced Data File
Current delT: 1.0
Blade Worths
Blade of Interest: None
Save .BWC File
File Name:
New File
Update
Scale Adjustment
Current Po (W): 19.08
Do Manual Scaling (W):
Plot UMLRR Data
Plot Group: Start-Up Counter
Date 06/03/2018 (dd/mm/yyyy)
Plot Style: Before Smoothing
Start 08:46:00
End Time: 10:26:00
Duration: 100.00
Units Mins
Print Window
Startup Count Rate from 06/03/2018 with start time = 08:46:00 (before smoothing)
SUCRate
Count Rate (cps)
Elapsed Time (mins)


UMass Lowell Research Reactor (UMLRR) Data Preview and Analysis (Ver 4.1 April 2013)
Data File: approach_critical_030618.txt
Browse
Help
Data Averaging
Interval for Data Smoothing (sec): 10
Save Reduced Data File
Current delT: 10.0
Blade Worths
Blade of Interest: None
Save .BWC File
File Name:
New File
Update
Scale Adjustment
Current Po (W): 19.08
Do Manual Scaling (W):
Plot UMLRR Data
Plot Group: Start-Up Counter
Date 06/03/2018 (dd/mm/yyyy)
Plot Style: After Smoothing
Start 08:46:00
End Time: 10:26:00
Duration: 100.00
Units Mins
Print Window
Startup Count Rate from 06/03/2018 with start time = 08:46:00 (after smoothing)
SUCRate
Count Rate (cps)
Elapsed Time (mins)


UMass Lowell Research Reactor (UMLRR) Data Preview and Analysis (Ver 4.1 April 2013)
Data File: approach_critical_030618.txt
Browse
Help
Data Averaging
Interval for Data Smoothing (sec): 1
Save Reduced Data File
Current delT: 1.0
Blade Worths
Blade of Interest: None
Save .BWC File
File Name:
New File
Update
Scale Adjustment
Current Po (W): 23.54
Do Manual Scaling (W):
Plot UMLRR Data
Plot Group: Ctrl Blade, MFD, & SUC Position
Date 06/03/2018 (dd/mm/yyyy)
Plot Style: Before Smoothing
Start 10:23:00
End Time: 10:53:00
Duration: 30.00
Units Mins
Print Window
Blade Positions from 06/03/2018 with start time = 10:23:00 (before smoothing)
Distance Withdrawn (inches)
Elapsed Time (mins)
BL#1Pos
BL#2Pos
BL#3Pos
BL#4Pos
RRodPos
RRauto

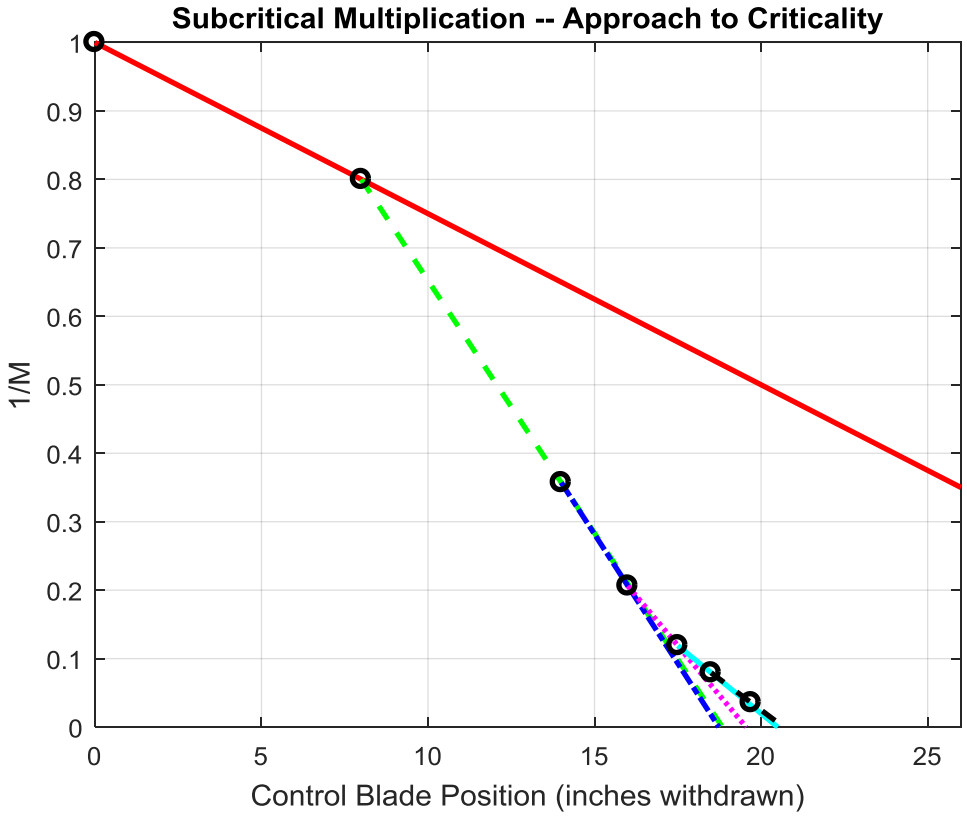

UMass Lowell Research Reactor (UMLRR) Data Preview and Analysis (Ver 4.1 April 2013)
Data File: approach_critical_030618.txt
Browse
Help
Data Averaging
Interval for Data Smoothing (sec): 1
Save Reduced Data File
Current delT: 1.0
Blade Worths
Blade of Interest: None
Save .BWC File
File Name:
New File
Update
Scale Adjustment
Current Po (W): 23.54
Do Manual Scaling (W):
Plot UMLRR Data
Plot Group: Power Indicators
Date 06/03/2018 (dd/mm/yyyy)
Plot Style: Before Smoothing
Start 10:23:00
End Time: 10:53:00
Duration: 30.00
Units Mins
Print Window
Power Indicators from 06/03/2018 with start time = 10:23:00 (before smoothing)
Reactor Power (% of Scale/Full Power)
Elapsed Time (mins)
LinearP1
LinearP2

```
>> critical_height(h,c)
```

Data using in-class estimates…

Summary Data for 1/M Plot and Estimate of Critical Height

Expt. Pt	Blade Pos. (inches out)	Count Rate (cps)	M = Ci/Co	1/M	Est. Crit. Ht. (inches out)
0	0.000	20	1.00	1.000	
1	8.000	25	1.25	0.800	40.000
2	14.000	56	2.80	0.357	18.839
3	16.000	97	4.85	0.206	18.732
4	17.500	168	8.40	0.119	19.549
5	18.500	252	12.60	0.079	20.500
6	19.700	560	28.00	0.036	20.682

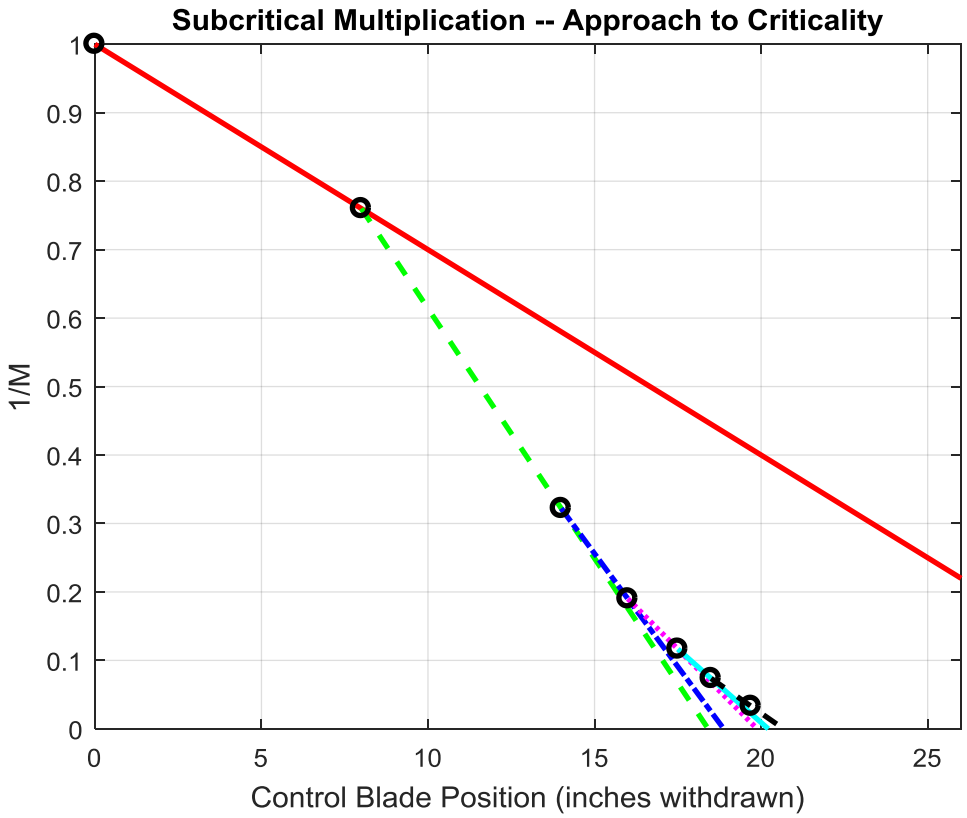


```
>> critical_height(h,c)
```

Post analysis data from umlrr_data GUI…

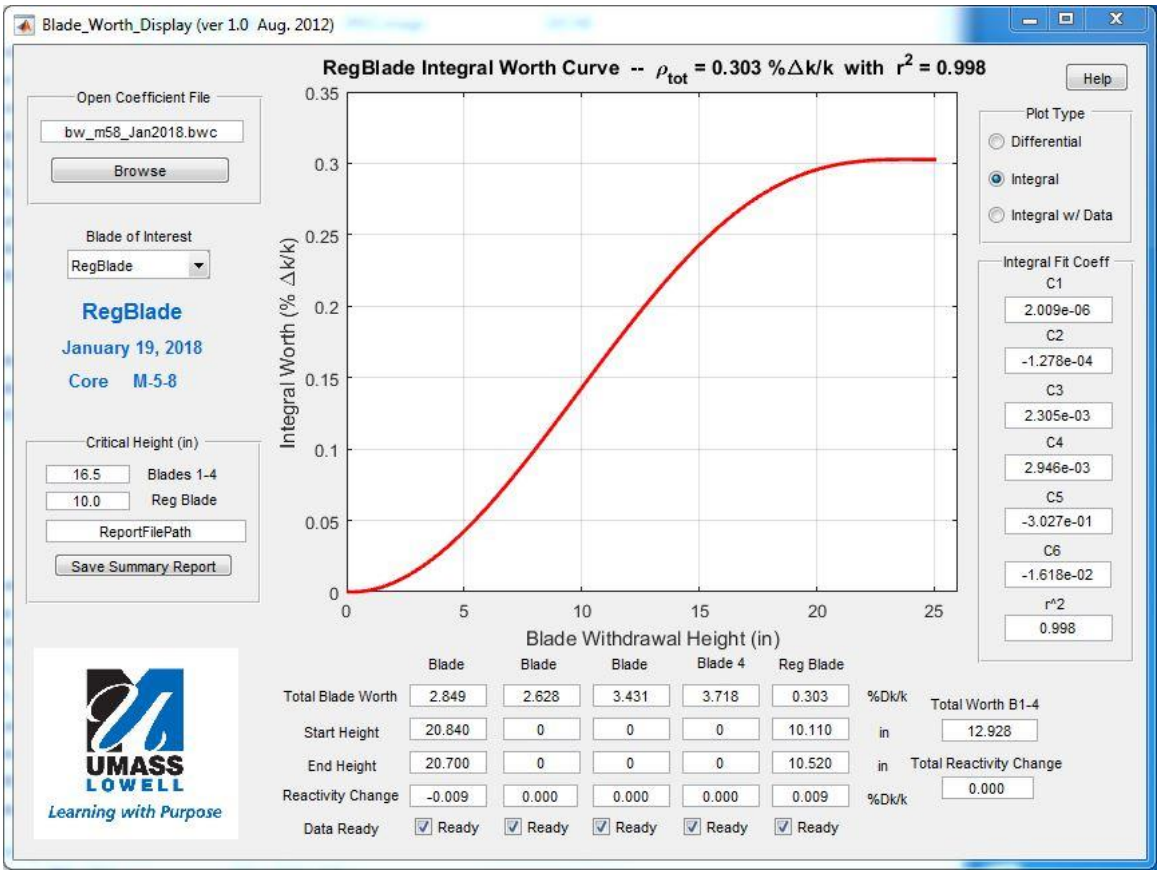
Summary Data for 1/M Plot and Estimate of Critical Height

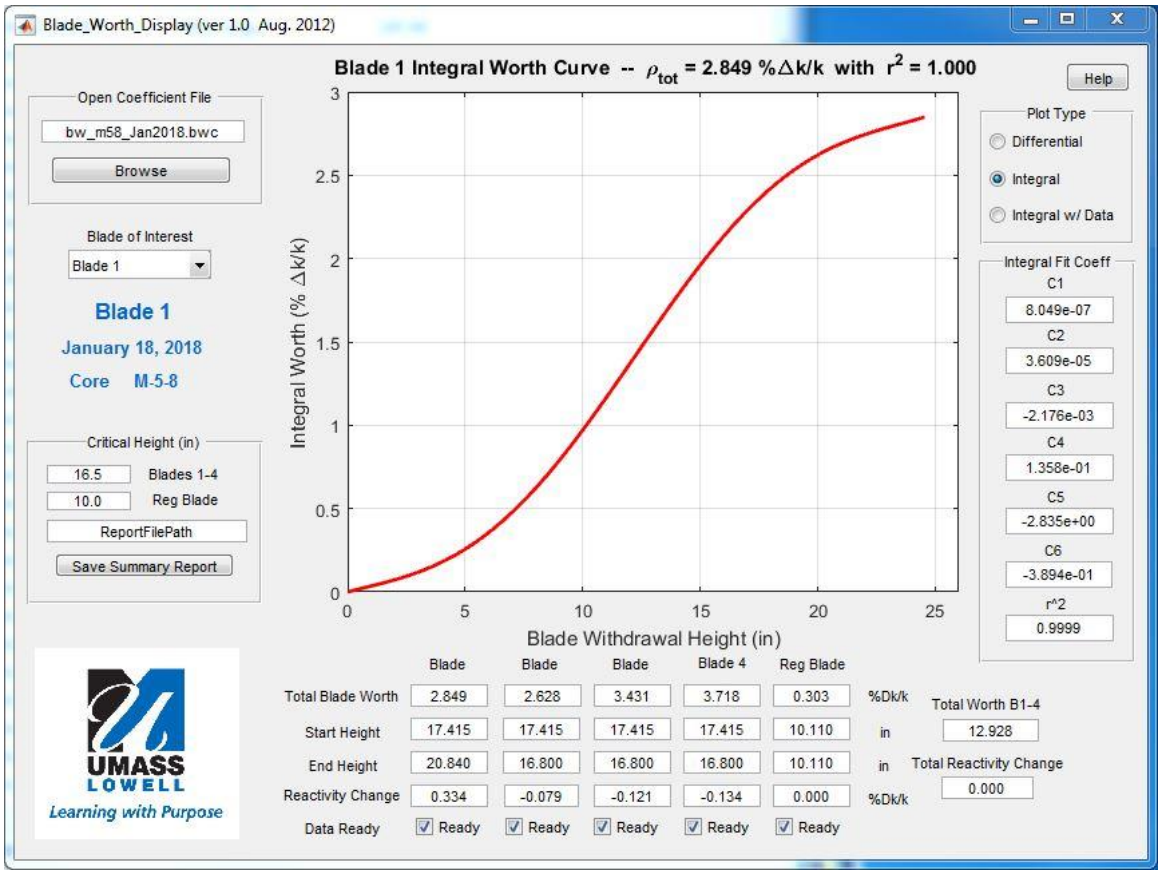
Expt. Pt	Blade Pos. (inches out)	Count Rate (cps)	M = Ci/Co	1/M	Est. Crit. Ht. (inches out)
0	0.000	19	1.00	1.000	
1	8.000	25	1.32	0.760	33.333
2	14.000	59	3.11	0.322	18.412
3	16.000	100	5.26	0.190	18.878
4	17.500	163	8.58	0.117	19.881
5	18.500	258	13.58	0.074	20.216
6	19.700	575	30.26	0.033	20.677



Conclusion: The raw in-class and post-lab count rate data are very similar and they give essentially the same final result, with the estimate of criticality occurring with Blade 1 at about 20.7 inches withdrawn. As a final step, the reactor operator then put Blade 1 at 20.7 inches out and went supercritical with the RegBlade until the reactor was at 500 W. At this point the RegBlade was put into auto mode and it drifted back down to a final critical position of 10.52 inches withdrawn. Thus, during this last step of the experiment, the RegBlade went from 10.11 inches to about 10.52 inches out. From the **bw_display** GUI with blade worth data from January 2018, this small difference in RegBlade height of about 0.41 inches is worth about 0.009 %Δk/k. From the same dataset for Blade 1, this worth corresponds to going from 20.7 to 20.84 inches out (see figure below). Thus, our best estimate of the **actual critical height is 20.84 inches** withdrawn for the current configuration. **This compares quite nicely with the 1/M curves which predicted criticality with Blade 1 at about 20.7 inches withdrawn** -- this gives a difference of less than 0.15 inches, and we can't really expect much better than this (with noisy data, approximate blade worth curves, the assumption that the proportionality constants in the theoretical development are configuration-independent as we approach criticality, etc., etc.)!!! **Thus, I think we did pretty well here!!!**

Note: In planning this experiment, I predicted that the critical height of Blade 1 would be about 21.8 inches withdrawn for a xenon-free core (see the **bw_display** screen on page #1). This made the assumption that the critical height would be exactly 17.5 inches out for Blades 1-4 with the RegBlade at 10 inches out. This, of course, was just a rough approximation of reality, but it was expected to be pretty close based on recent reactor operations. As apparent, I missed the critical height estimate by about an inch. However, this actually was not a bad estimate, since 1 inch in Blade 1 (from 20.8″ to 21.8″) corresponds to less than 0.1″ in my critical height guess of 17.5″ (see final plot below). Thus, everything here is pretty consistent with expectations -- this just says that the blade worth curves are pretty accurate for predicting the expected changes in reactivity seen here…




Blade_Worth_Display (ver 1.0 Aug. 2012)
Blade 1 Integral Worth Curve -- ρ_{tot} = 2.849 %Δk/k with r^2 = 1.000
Help
Open Coefficient File
bw_m58_Jan2018.bwc
Browse
Blade of Interest
Blade 1
Blade 1
January 18, 2018
Core M-5-8
Critical Height (in)
16.5 Blades 1-4
10.0 Reg Blade
ReportFilePath
Save Summary Report
Integral Worth (% Δk/k)
Blade Withdrawal Height (in)
Plot Type
Differential
Integral
Integral w/ Data
Integral Fit Coeff
C1 8.049e-07
C2 3.609e-05
C3 -2.176e-03
C4 1.358e-01
C5 -2.835e+00
C6 -3.894e-01
r^2 0.9999
Blade Blade Blade Blade 4 Reg Blade
Total Blade Worth 2.849 2.628 3.431 3.718 0.303 %Dk/k
Start Height 17.415 17.415 17.415 17.415 10.110 in
End Height 20.840 16.800 16.800 16.800 10.110 in
Reactivity Change 0.334 -0.079 -0.121 -0.134 0.000 %Dk/k
Data Ready Ready Ready Ready Ready Ready
Total Worth B1-4 12.928
Total Reactivity Change 0.000
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