Data Acquisition and Analysis During a 5°Rod Drop Test

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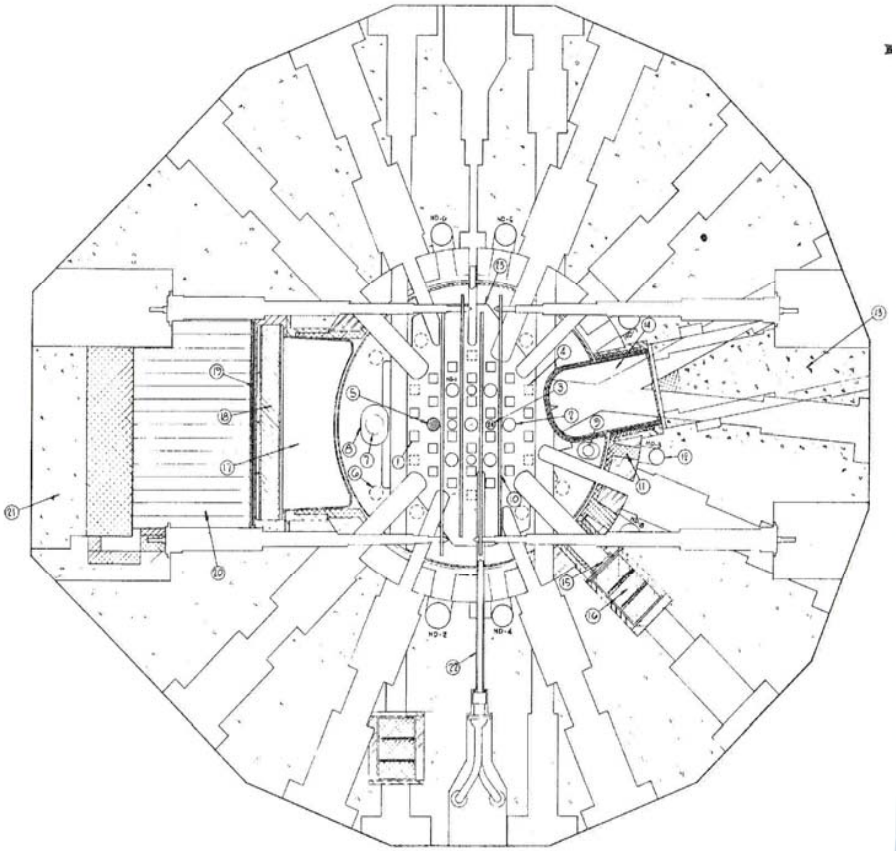
Brown University
August 2010

Reactor

- 20 MW Fission Reactor
- Neutron source
- Beam tubes lead out throughout Guide Hall

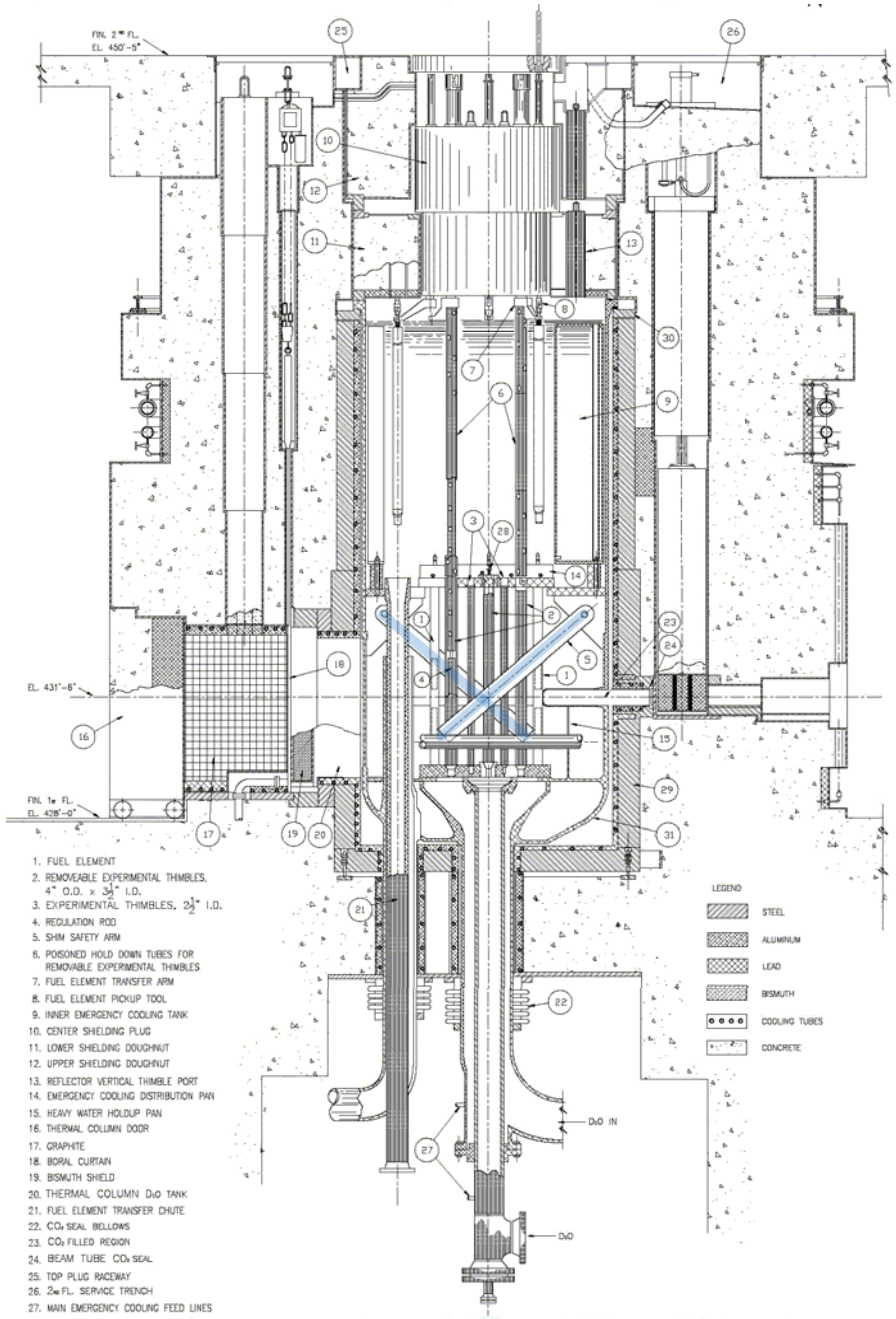


Reactor Vessel- Plan View

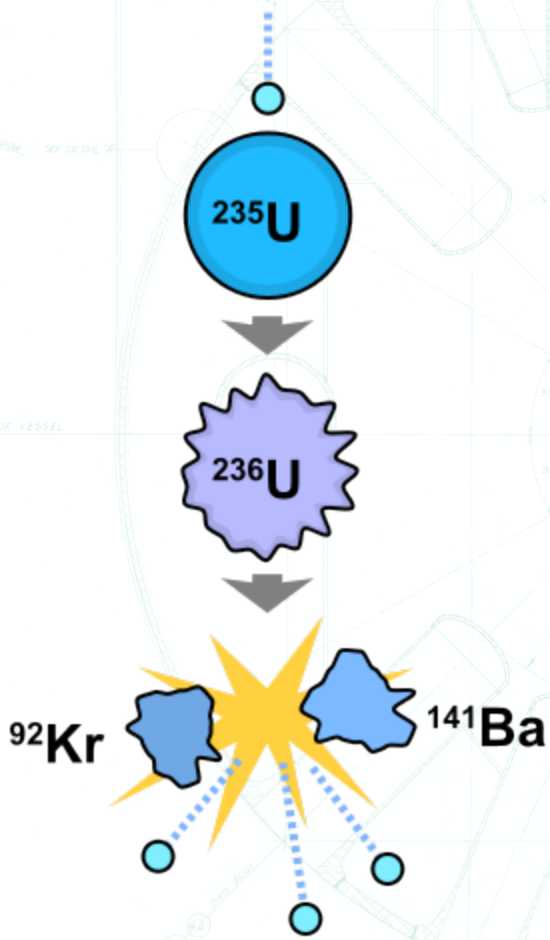
NBSR 14 Safety Analysis Documents- Chapter 3

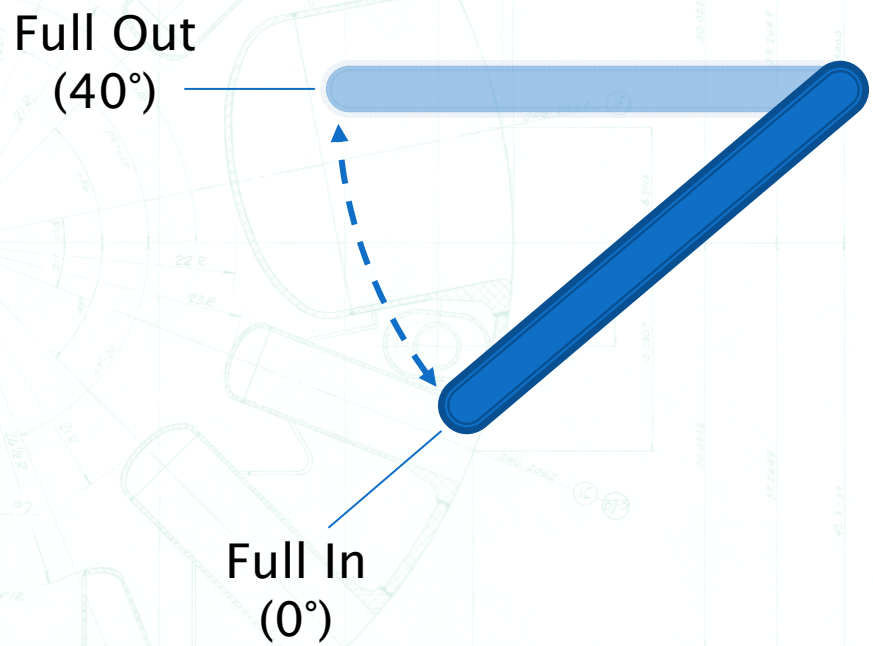
Reactor Vessel Showing Internal Components

NBSR 14 Safety Analysis Documents- Chapter 3



Controlling the Reaction





http://en.wikipedia.org/wiki/File:Nuclear_fission.svg

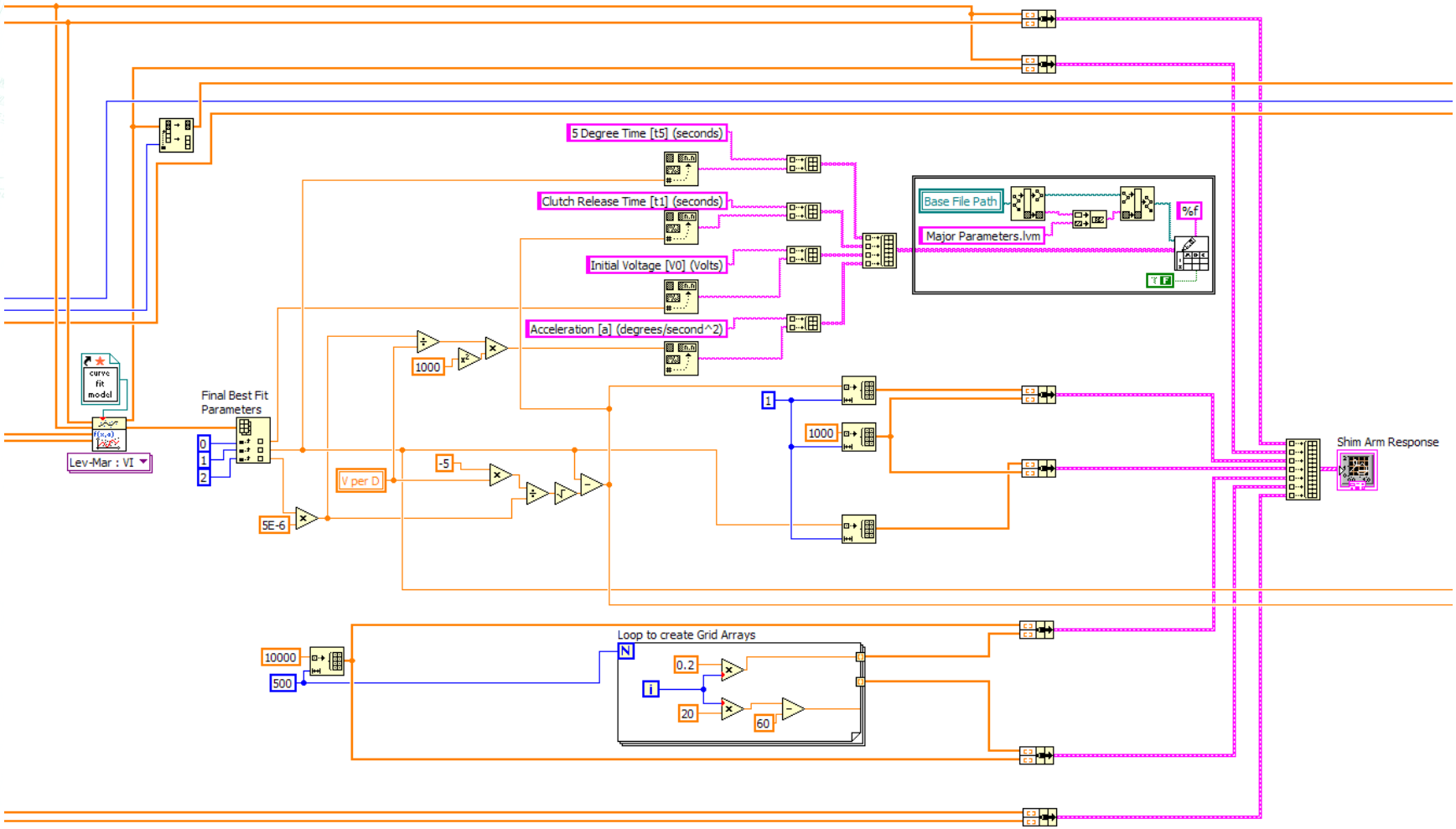
Reactor Scram

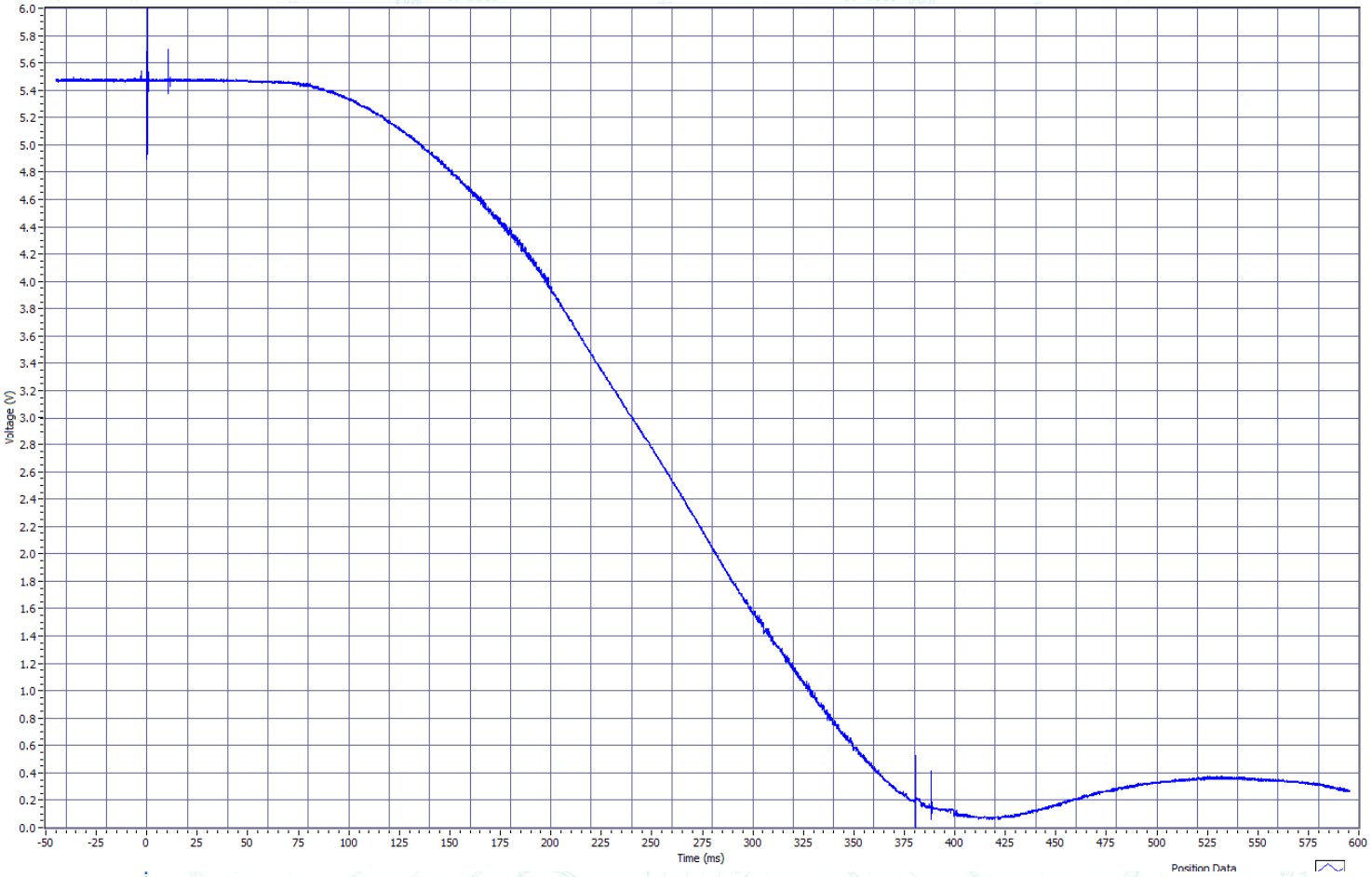
- **S**afety **C**ontrol **R**od **A**xe **M**an
- Shims rapidly inserted into reactor
- Required:
  - 5° in 240 ms

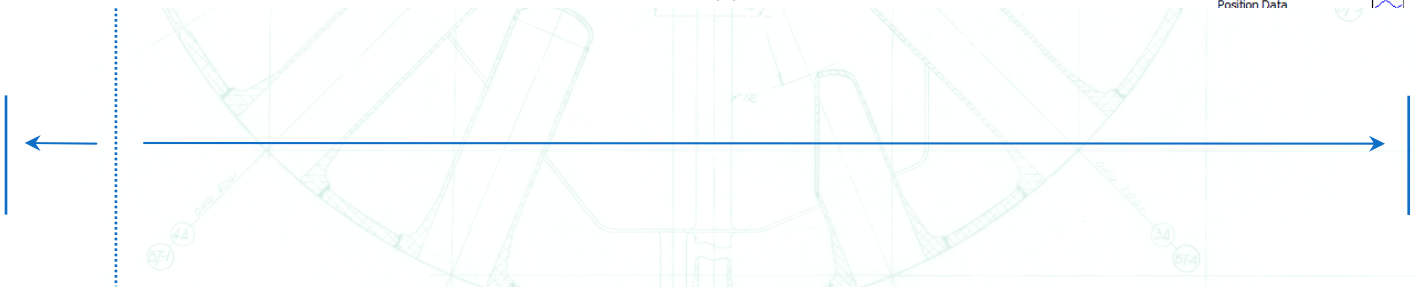
Goals

- Data Acquisition
- Curve Fitting
- Fourier Analysis
- Plot and Save Data

NI LabVIEW


5 Degree Time [t5] (seconds)
Clutch Release Time [t1] (seconds)
Initial Voltage [V0] (Volts)
Acceleration [a] (degrees/second^2)
Base File Path
Major Parameters.lvm
%f
curve fit model
Lev-Mar : VI
Final Best Fit Parameters
0
1
2
1000
V per D
-5
5E-6
1
1000
Shim Arm Response
Loop to create Grid Arrays
N
0.2
i
20
60
10000
500

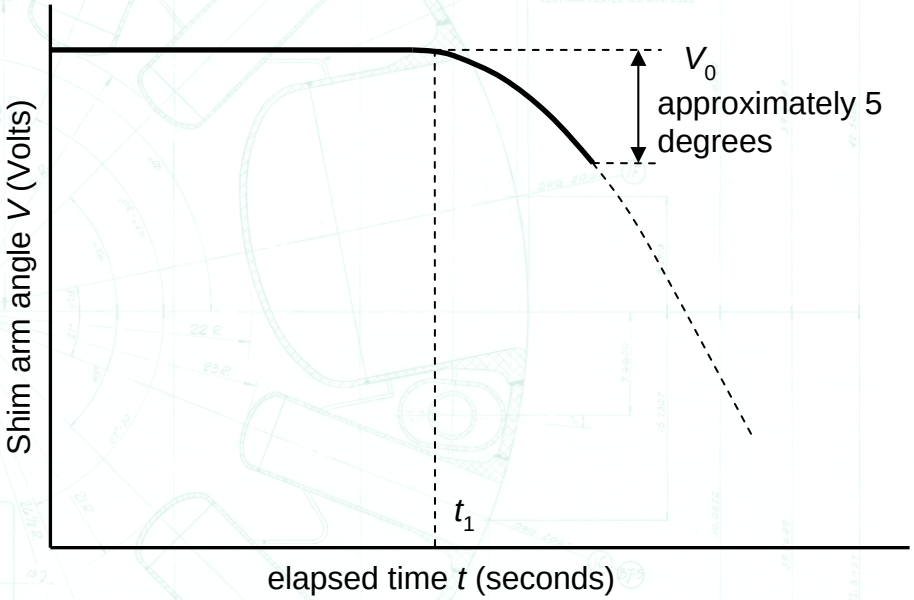




Scram Initiation

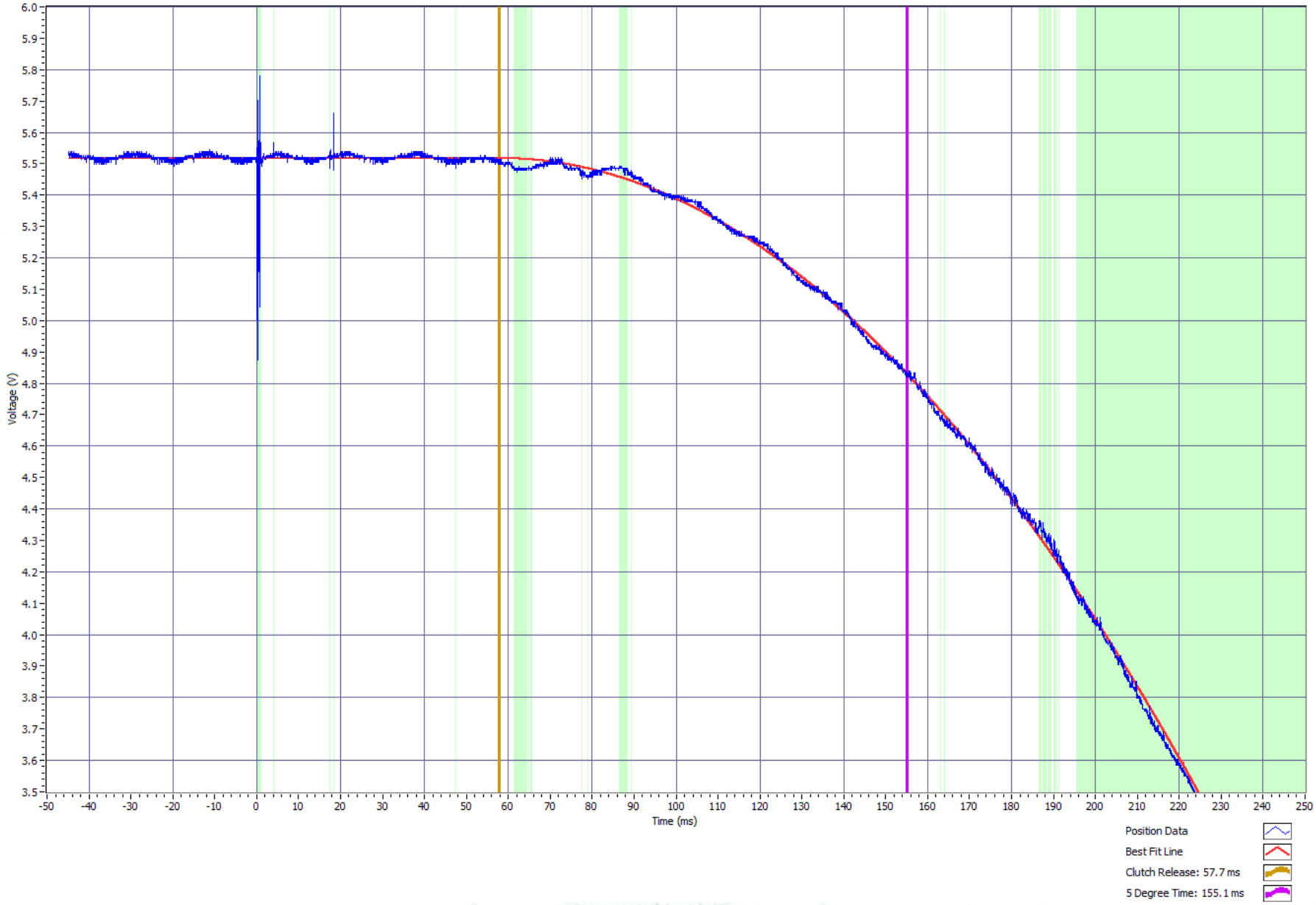
Curve Fitting

- Important Values to find:
  - 5° time
  - clutch release
  - Shim acceleration



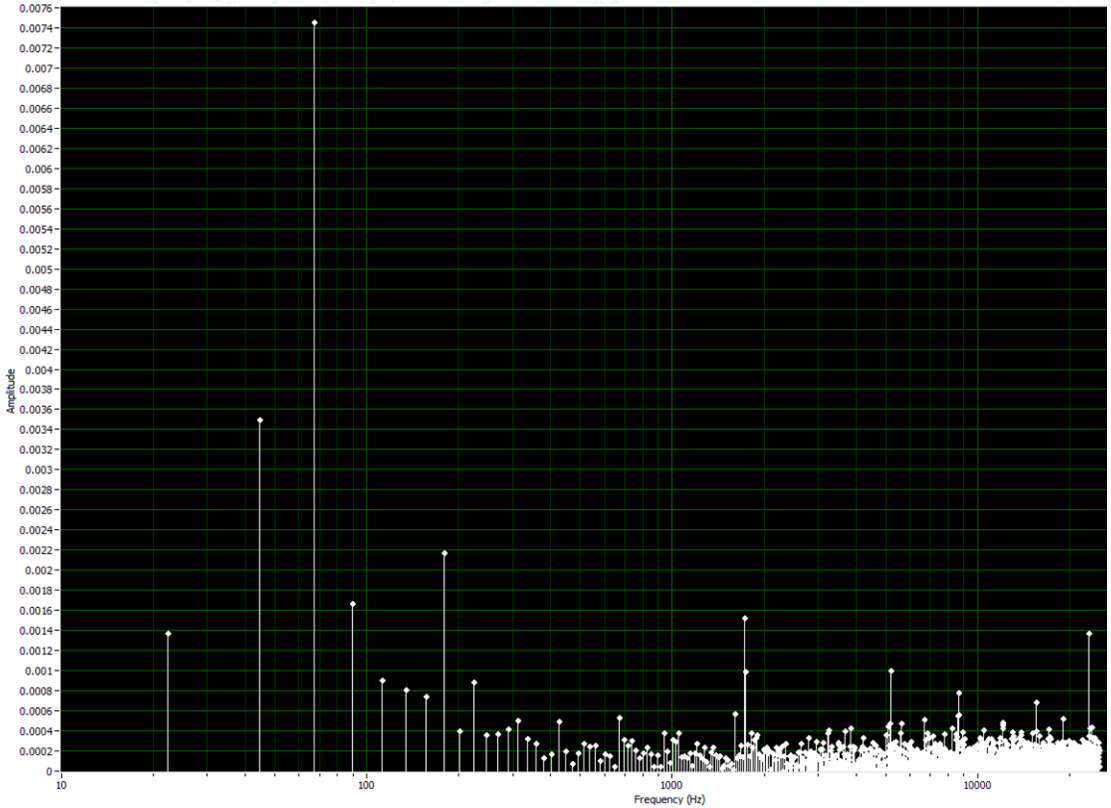
- Levenberg–Marquardt Algorithm
  - $Y(x) = f(x, a_1, \ldots, a_n)$

$$V(t) = \begin{cases} V_0 & t < t_1 \\ V_0 + a(t - t_1)^2 & t \geq t_1 \end{cases}$$

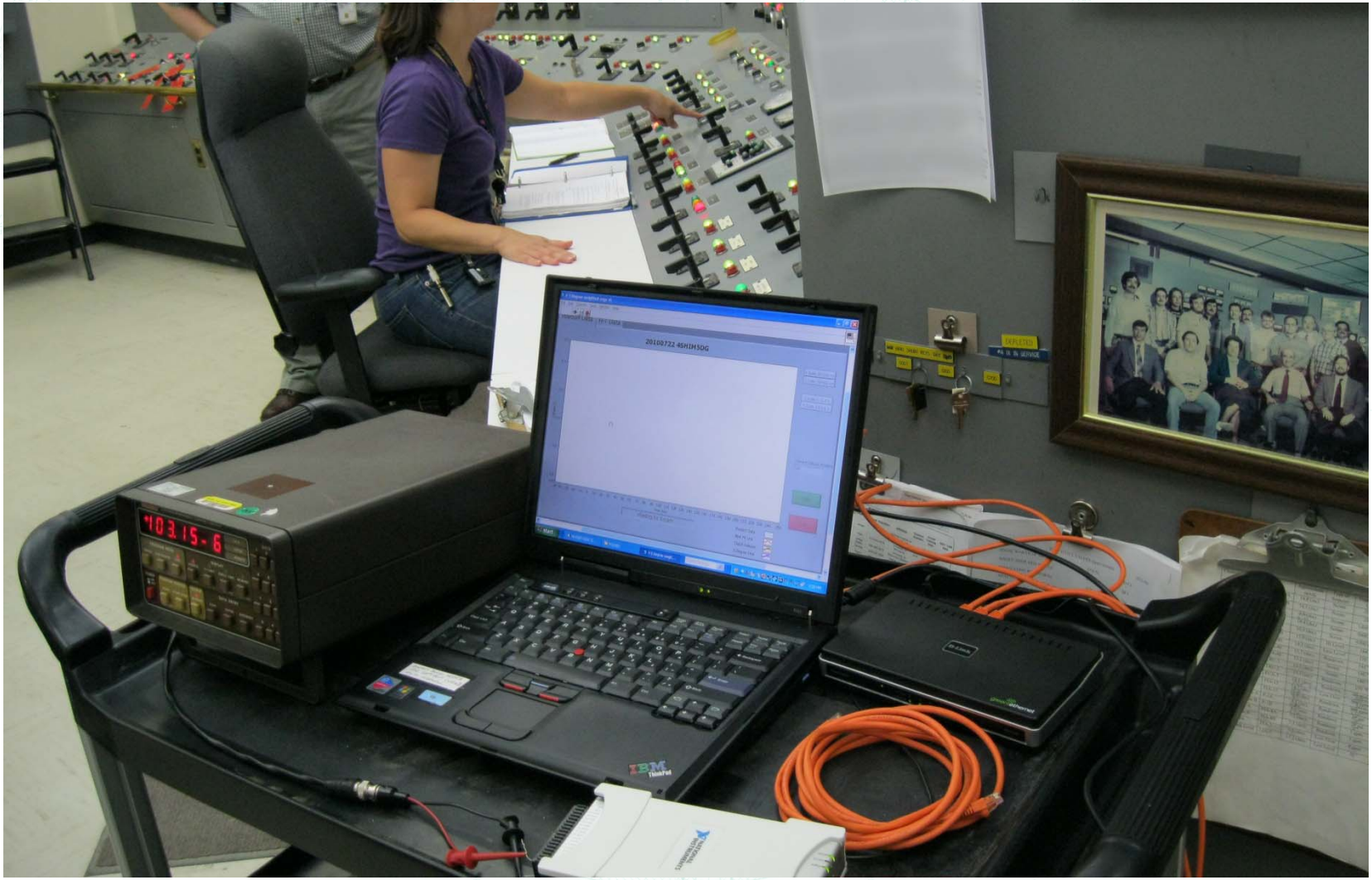

Voltage (V)
Time (ms)
Position Data
Best Fit Line
Clutch Release: 57.7 ms
5 Degree Time: 155.1 ms

Fourier Analysis

- Observe noise
- 60 Hz Power source



Testing



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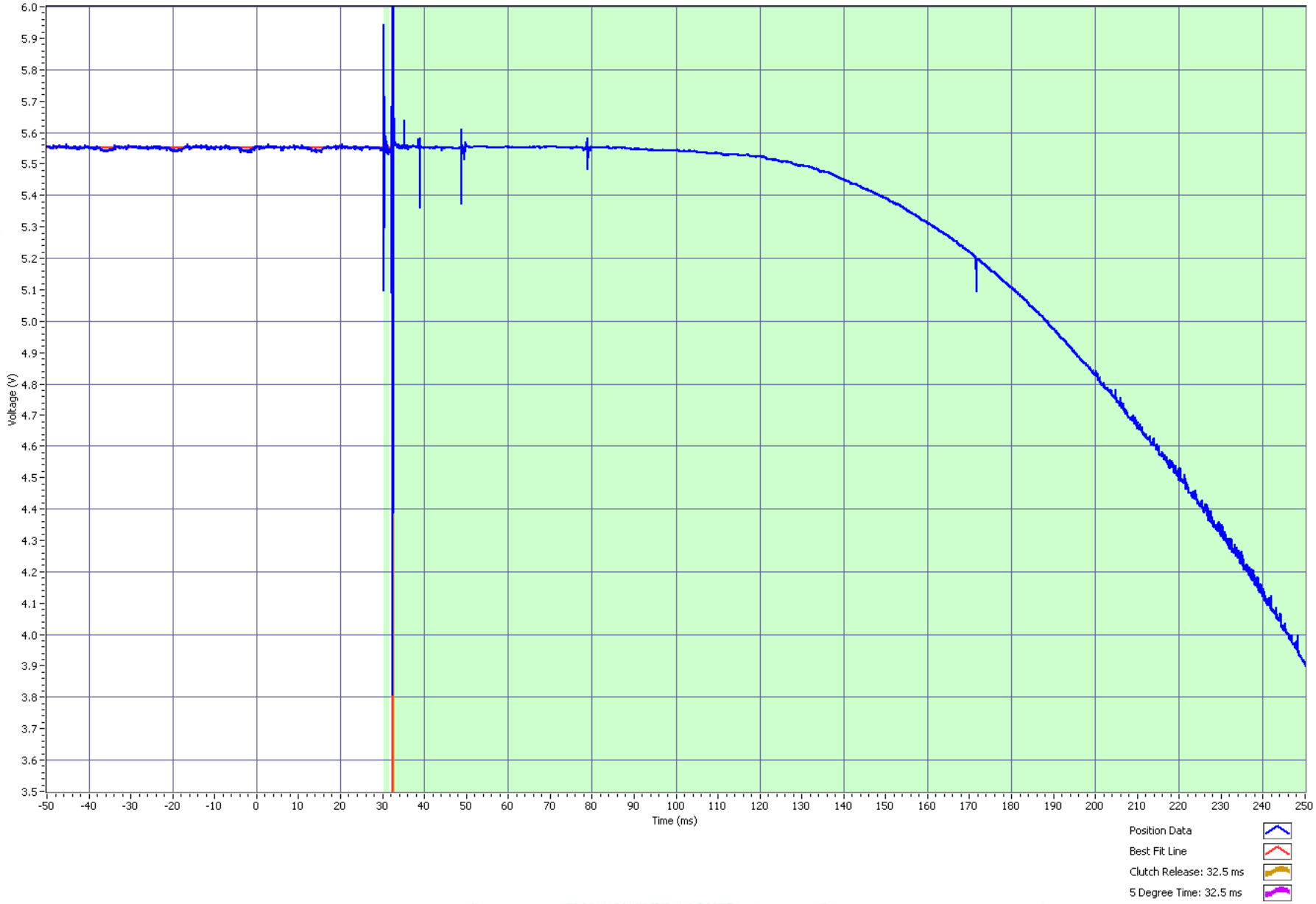

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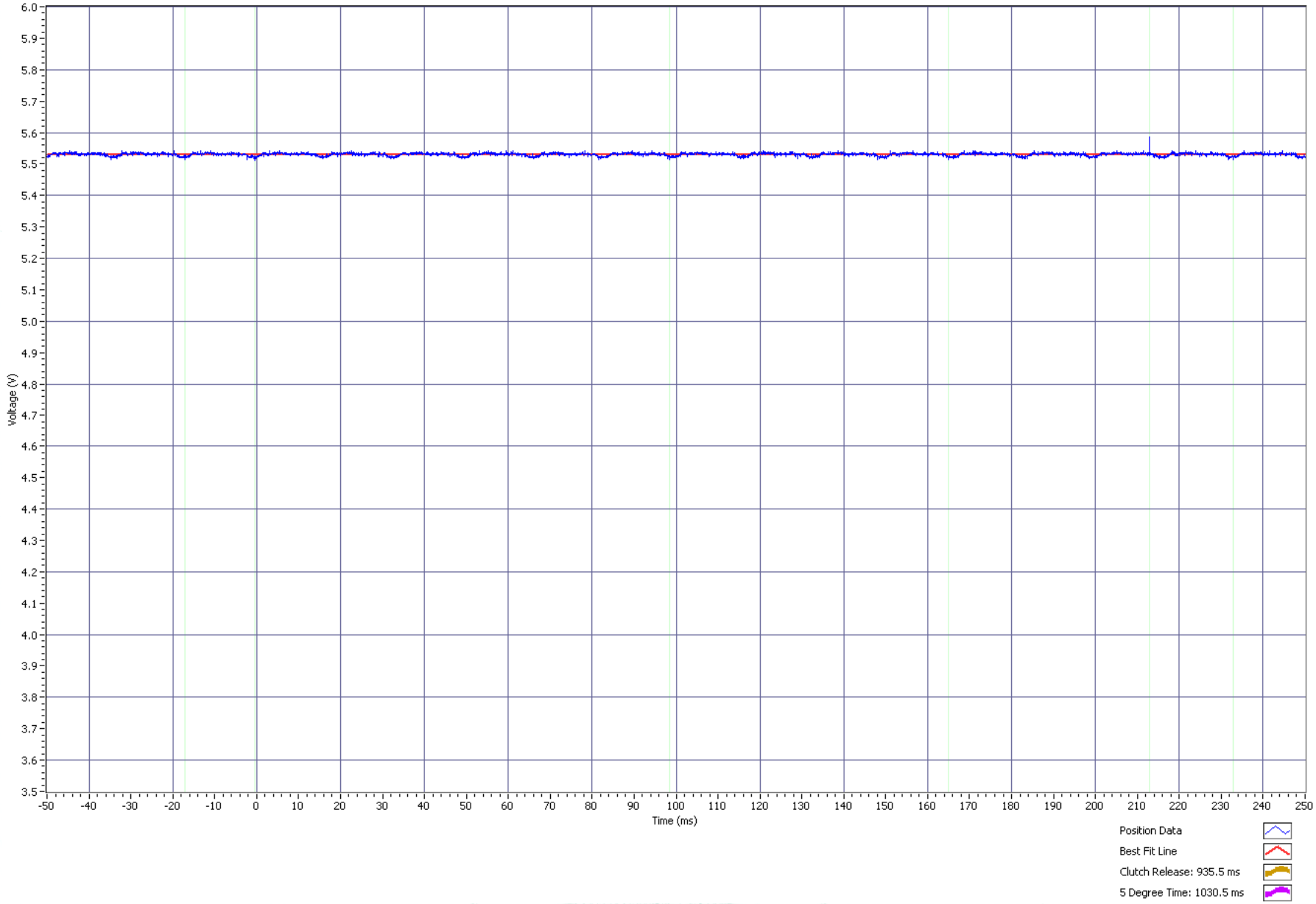

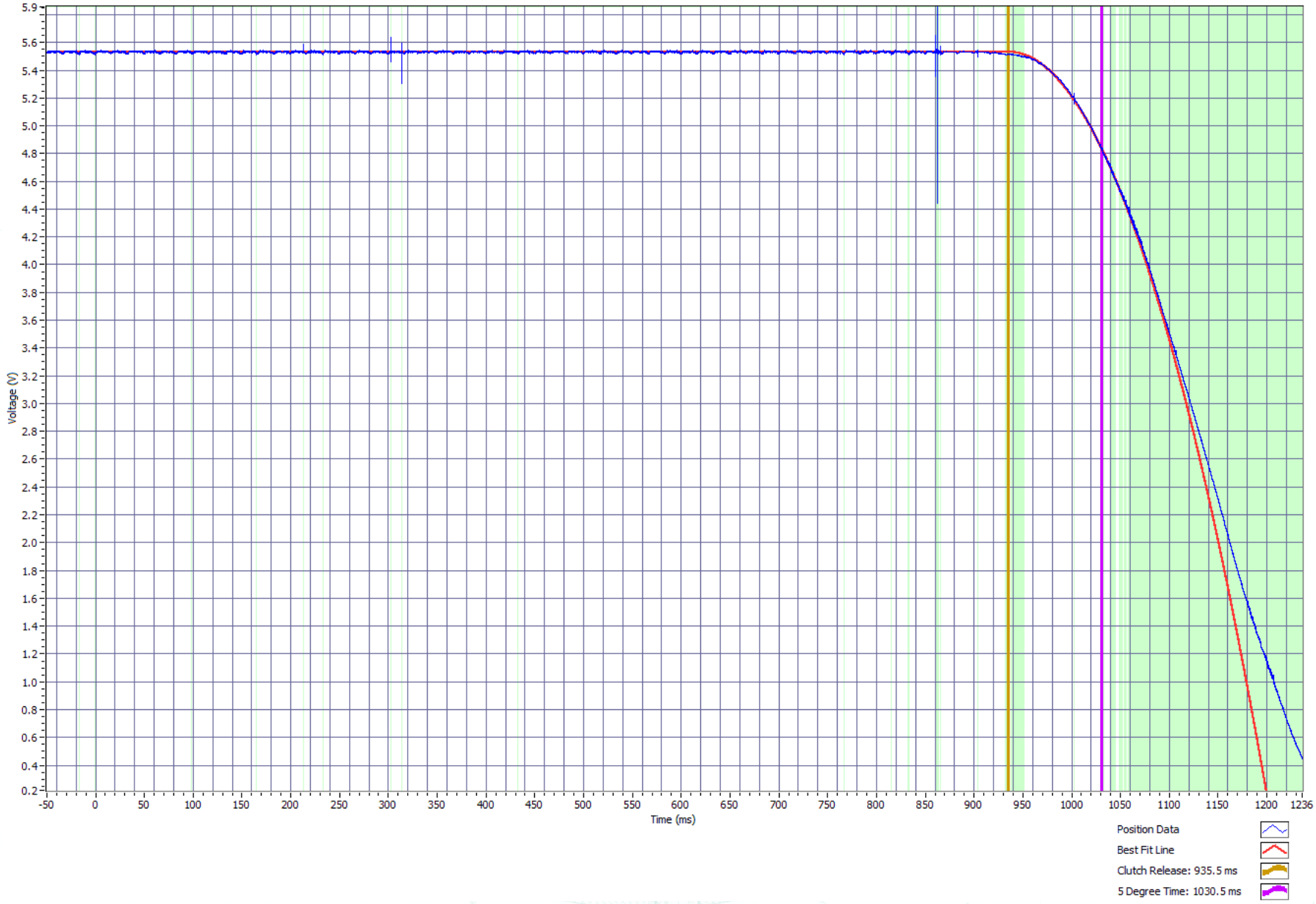

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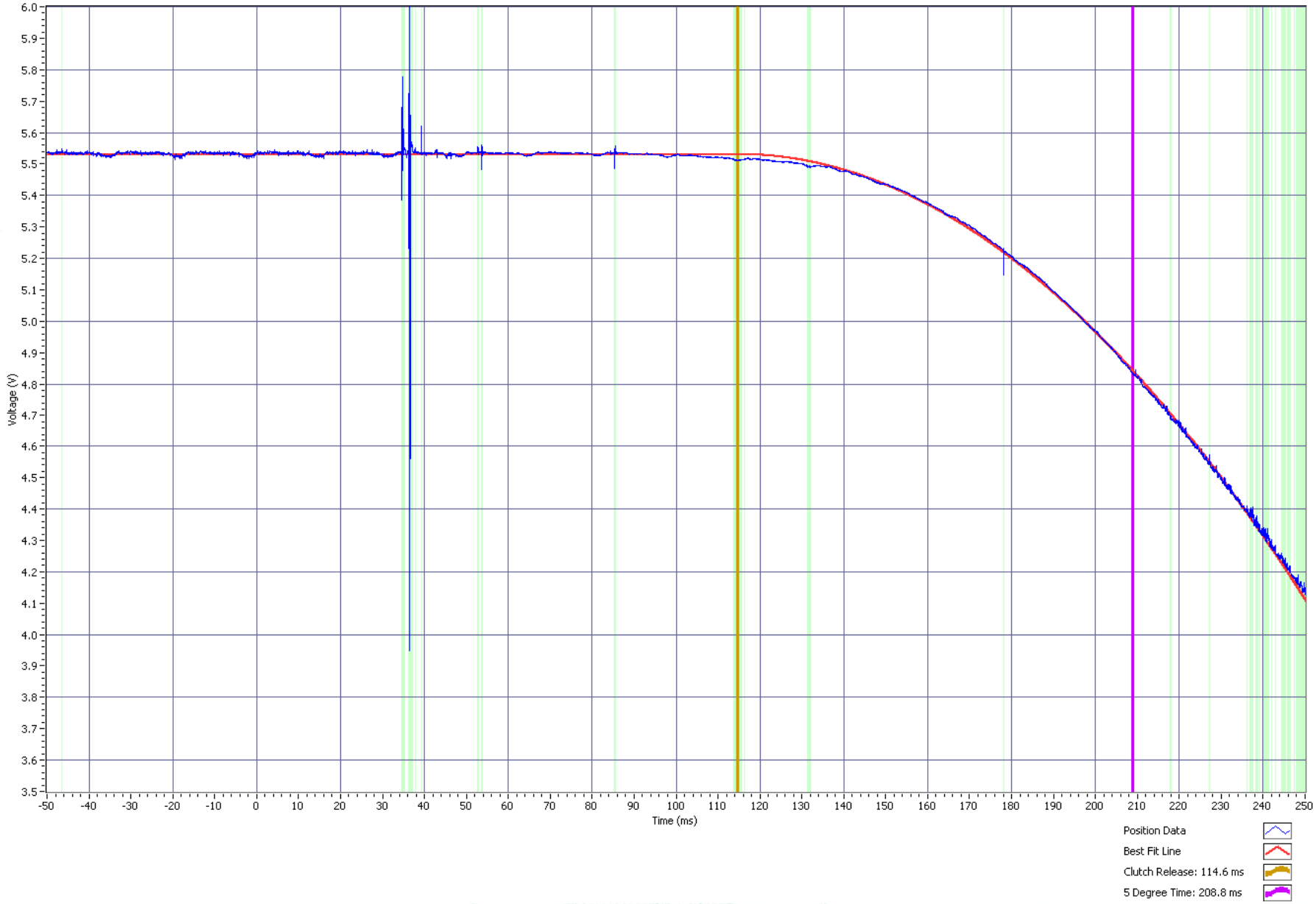

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Acknowledgements

- Joe Reyenga
- Paul Brand
- Dan Keyser
- Reactor Ops and Engineering Staff
- SURF Directors