

# Equipment Validation

Markus Olsson

Mechanical Engineer  
Neutron Chopper Group

[www.europeanspallationsource.se](http://www.europeanspallationsource.se)

14-11-21

# Overview

- Why, What, When?
- Equipment validation process
- Example case: Automatic Test sequence
- Data acquisition
- Report
- Summary

# Why validate equipment?

- Ensure performance
- Ensure compatibility
- Make integration smoother

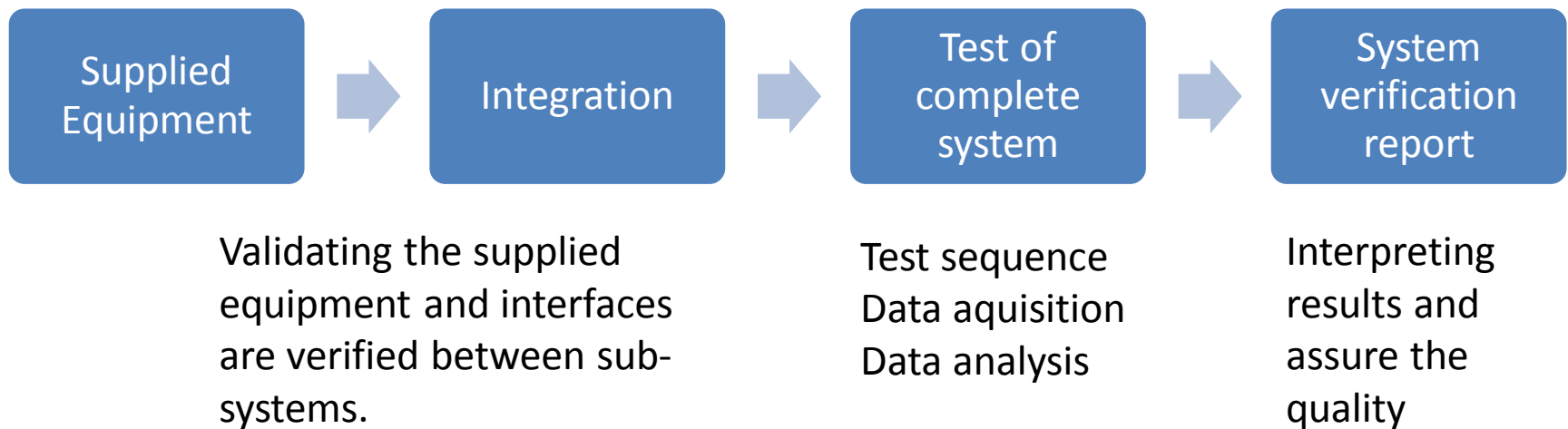
# What is validated?

- Compatibility and performance:
  - Sub system
    - Mechanical parts
    - Drive/Spindle
    - Control system and software
    - Support systems - vacuum, cooling
  - Interfaces
  - Entire system
    - Chopper performance

# When is equipment validated?

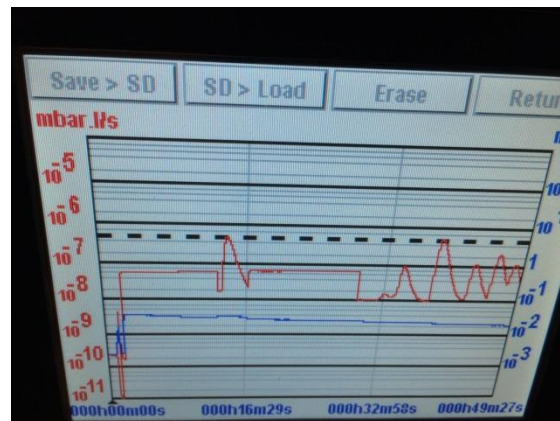
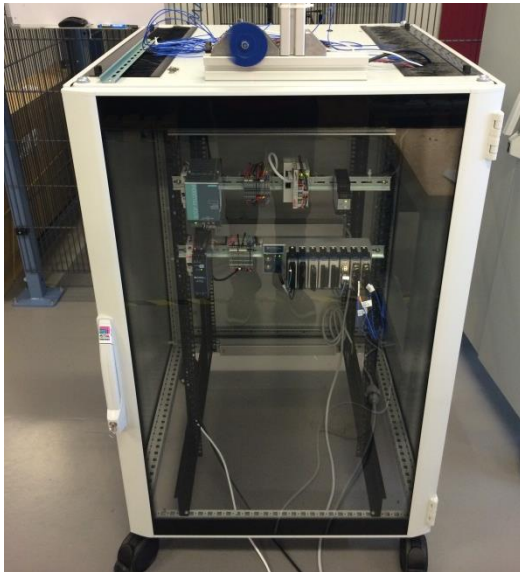
- Evaluation of equipment
  - spindles
  - sensors
  - vacuum pumps
- Verification during development
  - rotor
  - coating
- Validation of supplied equipment
- Validation after overhauling and commissioning

# Example of Equipment validation process



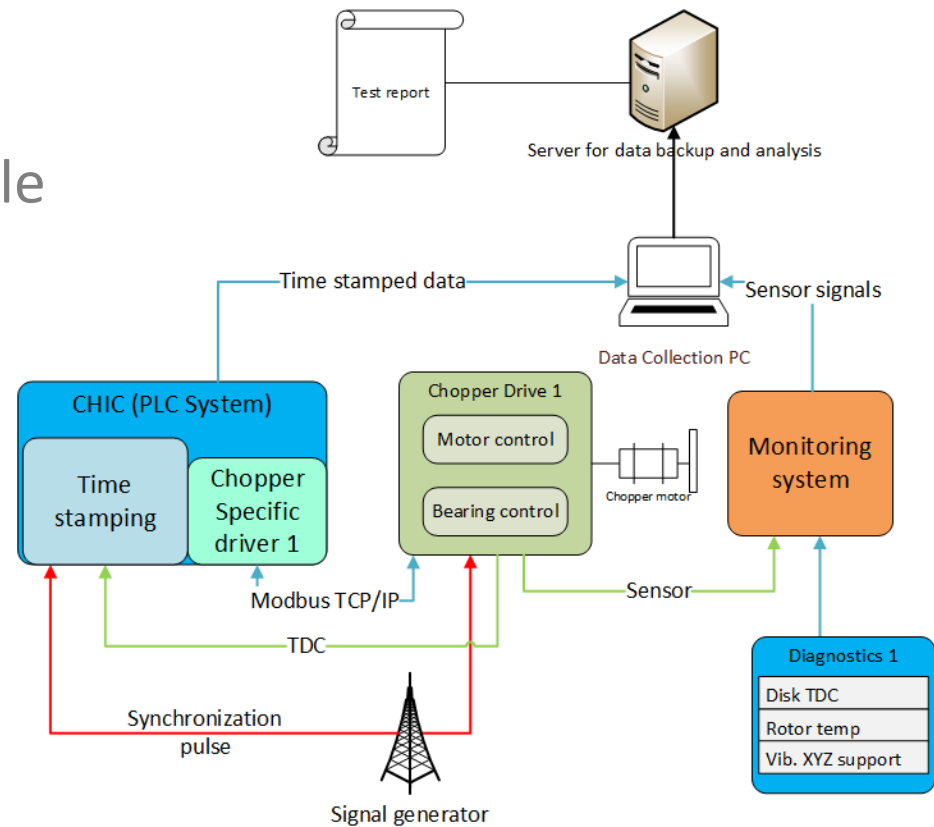
# Neutron Chopper demonstrator

## Test sequence and monitoring system



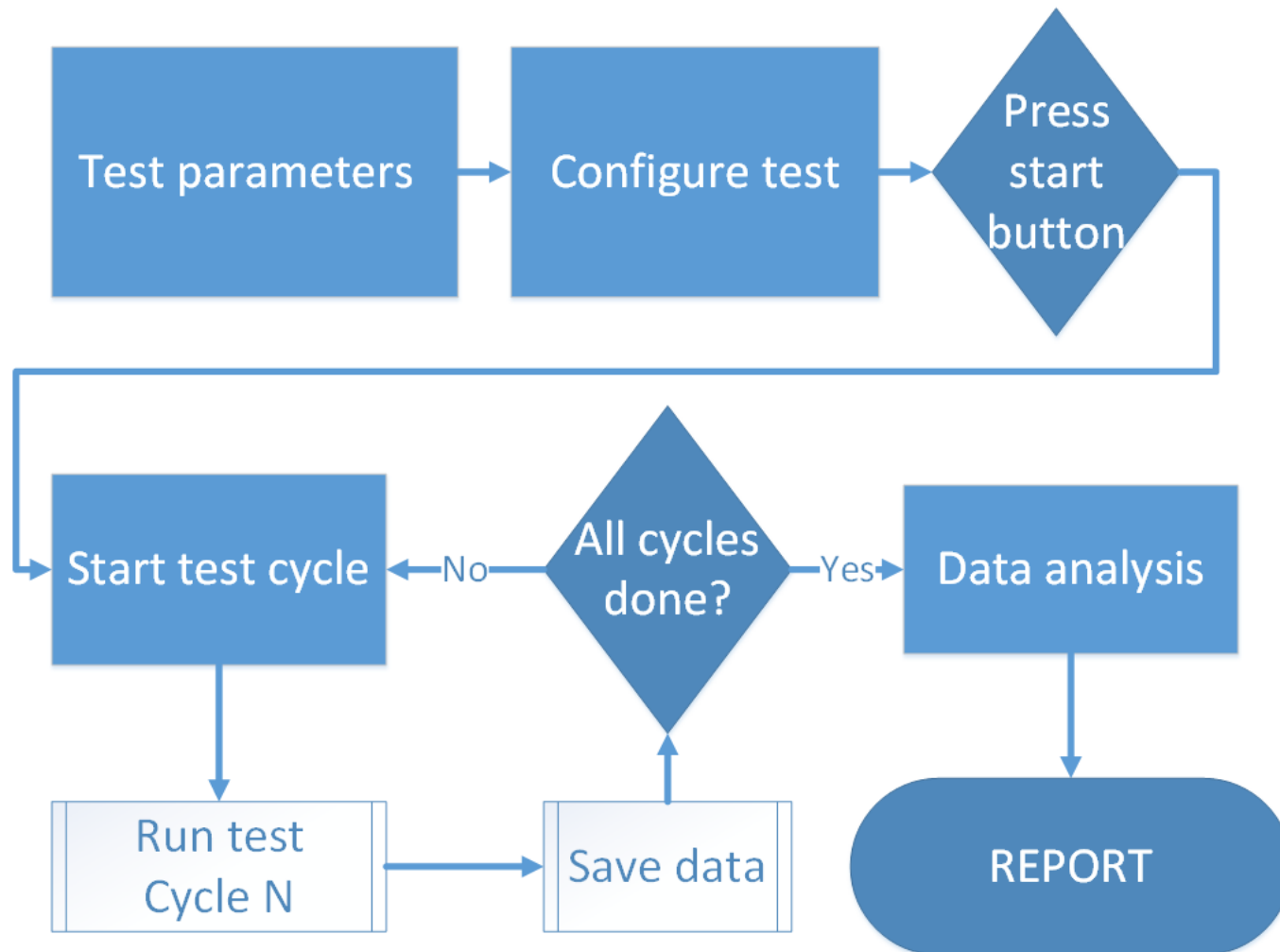
# Example case: Automatic test sequence

- Create a baseline for a chopper system
- Determine how repeatable the process is
- Understand system properties and changes
- Different systems can be compared
- Increases efficiency of validation process

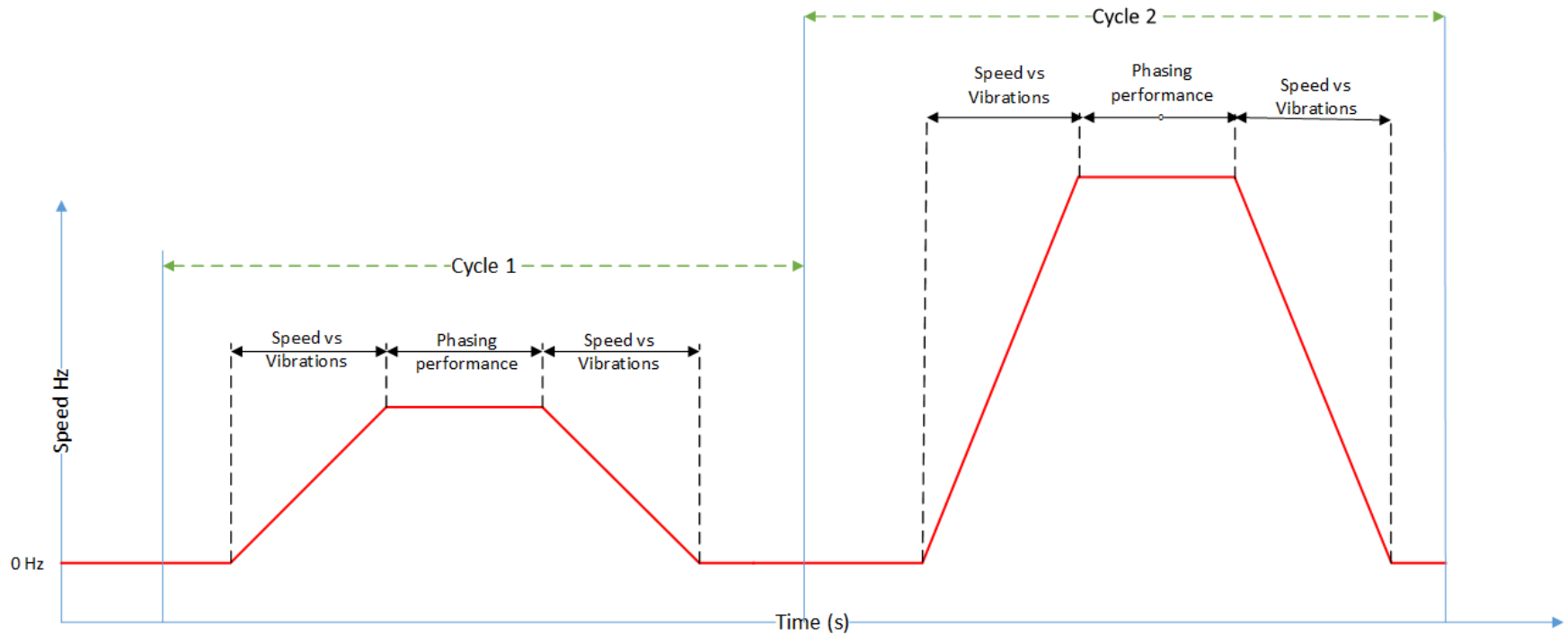




# Example case: Automatic sequence flow



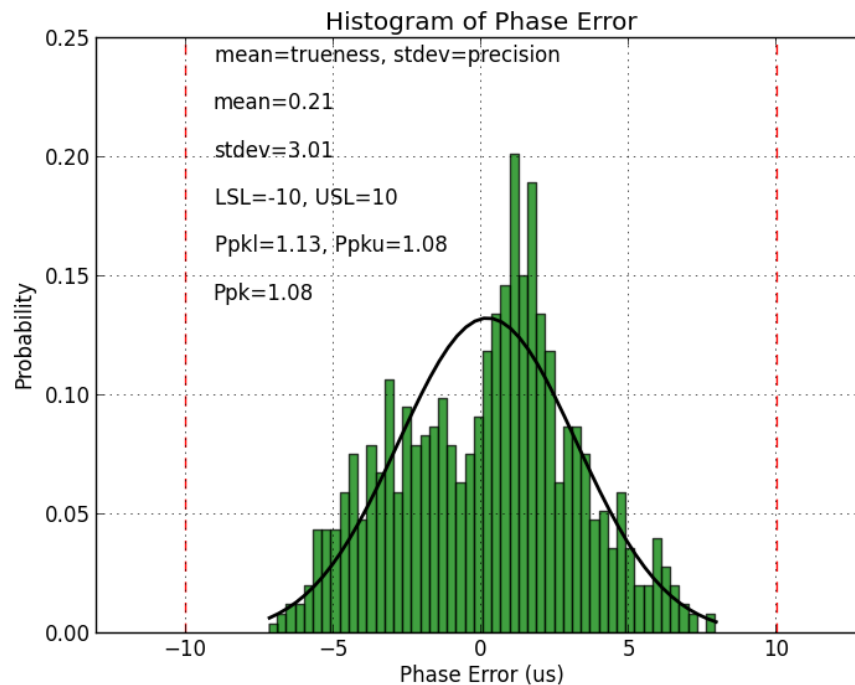
# Example case: Test sequence



- Analysis made automatically
  - Phase accuracy
  - Speed profile vs vibrations
  - FFT
  - Temperatures
  - Vacuum pressure
- Test report
  - PDF automatically generated and available on server after each run.

# Report: Phase accuracy

- **Trueness**, indicates that the process is well centred.
- **Precision**, indicates the spread of the process
- **Ppk (Process Performance Index)**, indicates the capability of the process

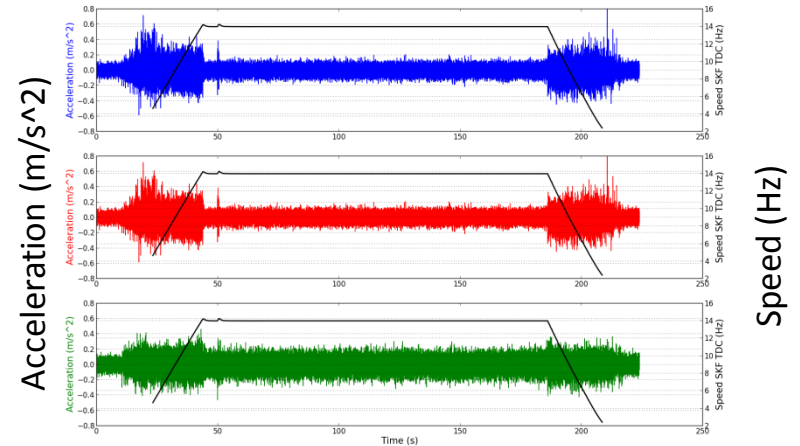


**Higher Ppk gives higher performance:**

Ppk	Within spec (%)
0.5	86.8
0.8	98.4
1.0	99.7
1.333	99.9937
1.667	99.99994
2.0	99.9999998

# Report: Vibration vs speed

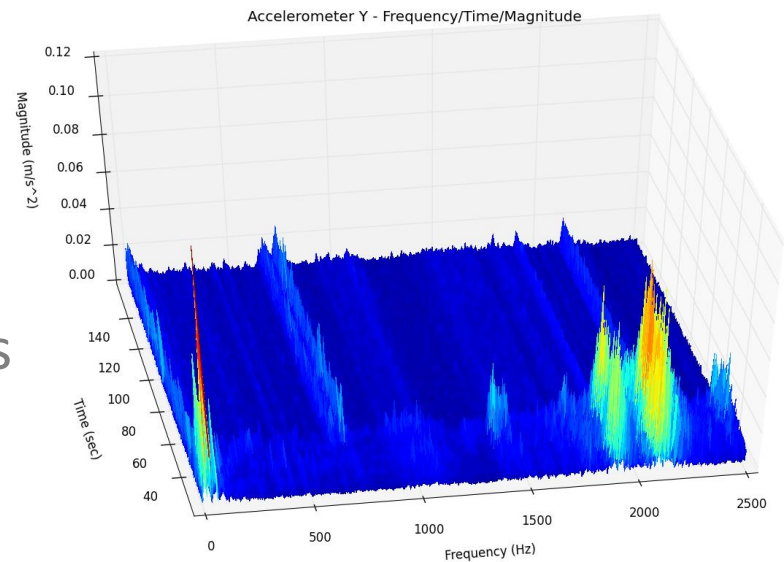
- To tie vibrations to actual speeds and speed changes
- Determine the vibration amplitudes and differences between cycles and systems
- Determine the repeatability of the system
- Comparison with baseline



# Report: System Validation

## Vibration Frequency Analysis

- Determine system normal behaviour and anomalies
- Identify sources of vibration
- Time of events
- Determine frequencies and magnitudes
  - Electrical noise
  - Mechanical vibrations
  - Limit for acceptable vibrations
- Setup thresholds for recording



- Reason for equipment validation
  - Ensure performance
  - Ensure compatibility
  - Smoothen integration with instruments and the facility
  - System quality assurance
- Demonstration of an automatic test sequence and data analysis made at ESS.

# End of presentation

Thank you for your attention  
Questions?

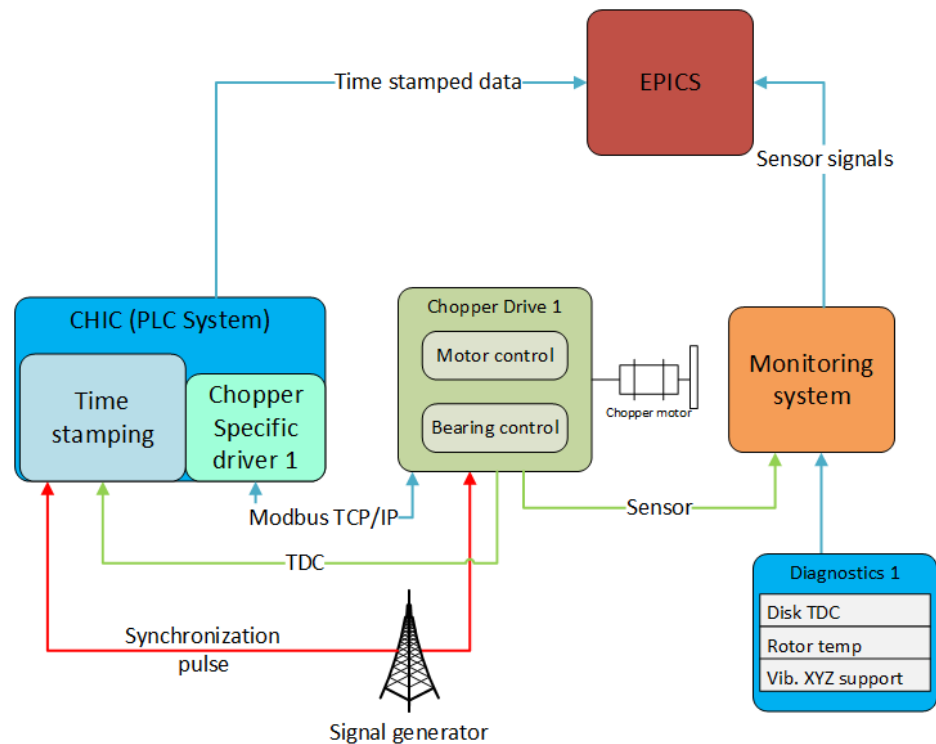


- What?
  - Mechanical validation
    - Inspection of parts, FAT, CAT
    - Rotor balancing
    - Vacuum system validation
  - Drive/Spindle validation
    - Inspection FAT, CAT
    - Functionality tests
  - Control and Monitoring
    - Automatic test sequence,
    - Data analysis
    - Reporting

- Increases the efficiency of the validation process
- Removes external interference
- Determines system repeatability
- Monitoring system
  - A way to quickly commission and evaluate any chopper at ESS
  - More sensors and data will spawn new ideas of how to evaluate chopper systems
  - Need tight collaboration with chopper suppliers to improve data acquisition from chopper internal systems, data from magnetic bearings, etc.

# Example case: Automatic test sequence

- Data could be transferred to EPICS
- Comparison to baseline system after installation



# Time line

- Q4 2014, Concept evaluation
- Q1 2015, Initial tests started
- Q2 2015, Equipment evaluation

