Motion Control & Automation (MCA) Toll Gate 3 Review Process

Paul Barron

www.europeanspallationsource.se
13 February, 2018

Introduction

- Phase 2 includes detailed engineering designs -> ready to construct, procure or tender.
- Phase 2 can consist of several TGs (sub-TGs for early procurement), MCA reviews concentrate on the final TG.
- However some deliverables are still applicable for sub-TGs (components selection ToM, FAT/SAT plans).
- **ESS-0240219 *MCA TG3 Review Process for Instrument Projects*** available in Chess, consists of:
  - Part 1: Technical Designs: components, drawings etc.
  - Part 2: Planning: how the designs will be fulfilled

Part 1: Technical

Items to be assessed:

1. Components selection (ToM)
2. Electrical MCA drawings
3. Layout drawings and cable specifications
4. Prototyping report
5. FAT test plans
6. Controls related instrument component information

1. Table of Motion

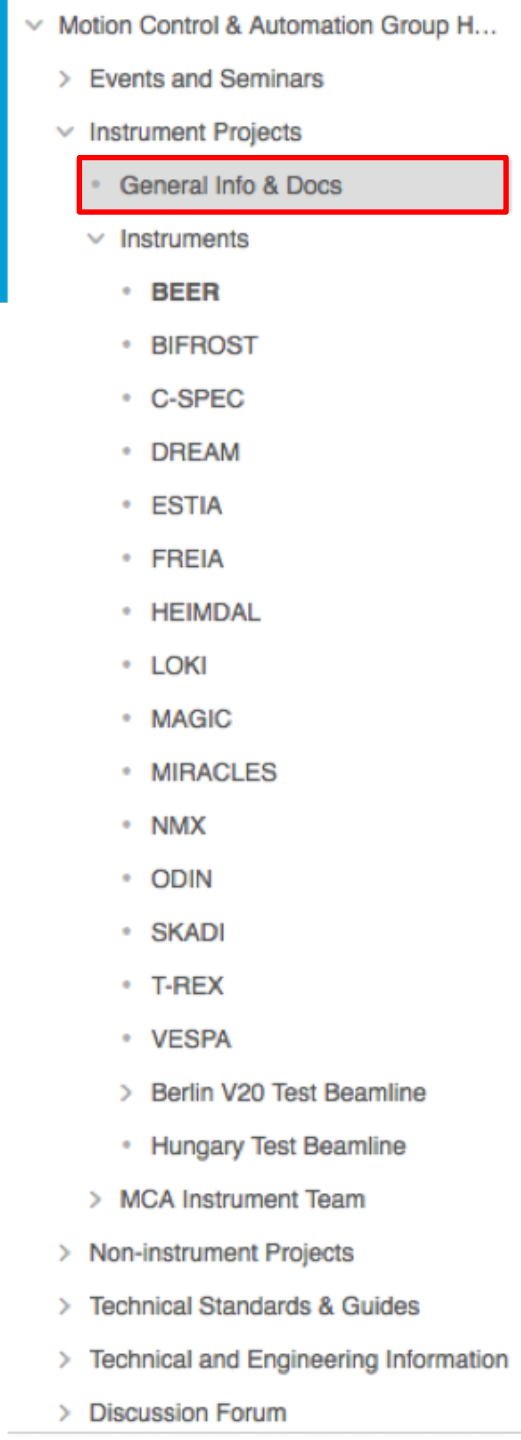
- Most important thing for us.
- New worksheet added for components selection.

	A	B	C	D	E	F	G	H
1	**Instrument Name**		**MAGIC**		Purple indicates value calculated			Blue indicate
2	**Revision**		**5**					
3				MOTION				
4	**Axis Number**	**Axis Name**	**Device**	**Motion Type of Final Axis (copied from ToM)**	**Type**	**Brand**	**Part #**	**Driver Voltage [V]**
5		Example	ESS Test Crate	Linear	2 Phase Stepper	Nanotec	ST4118	24
6	1	Y Bender translation	Bender	Linear				
7	2	Z bender translation	Bender	Linear				
8	3	Z bender rotation	Bender	Rotary				
9	4	X bender rotation	Bender	Rotary				

Revision Table | General Information | Table of Motion | **Components** | Definitions | +

1. Table of Motion

- New worksheets have been added to all ToMs and uploaded to confluence. https://confluence.esss.lu.se/display/MCAG/Instrument+Projects
- Please download these and start from there so you have correct formatting and new worksheet.
- Eventually will be frozen after the design phase and likely go into Chess.



1. Table of Motion – Motor

Instrument Name	_Instrument X_
Revision	6

Purple indicates value calculated Blue indicates need to calculate

			MOTION	MOTOR								
Axis Number	Axis Name	Device	Motion Type of Final Axis (copied from ToM)	Type	Brand	Part #	Driver Voltage [V]	Set Current [A]	Steps / Rotation (if stepper)	Gearbox Reduction Ratio *(no gearbox=1)*	Ratio of Mechanics (=pitch if ballscrew) *(no mechanics=1)*	Full Step Precision [°] (enter directly for linear motor)
	Example	ESS Test Crate	Linear	2 Phase Stepper	Nanotec	ST4118	24	1.5	200	1	60	0.03
1												0
2												0
3												0
4												0
5												0

- Motor type: stepper, servo.
- Brand
- Part #
- Voltage
- Gearbox ratio
- Etc.

1. Table of Motion - Encoder

							Rotary Encoder		
ENCODER									
Type	**Motion Type of measurement device**	**Interface**	**Brand**	**Model #**	**Supply Voltage**	**No. of Counts [#/rev OR #/mm]**	**No. of Multiturns (singleturn=1)**	**Ratio of Encoder Mechanics (no mechanics=1)**	**Total Precision (needs to be calculated for each case - dependant on encoder position)**
Incremental	Linear	Quadrature RS422	Nanotec	WEDL5541	5V	1024	4096	1	0.3515625

- Motion type: linear, rotary.
- Interface: quadrature, SSI etc.
- Brand
- Model #
- Supply voltage
- Number of counts
- Number of multi-turns
- Etc.

1. Table of Motion - Switches

CLOCKWISE-SWITCH (when looking from behind motor)					
Type	**Brand**	**Model #**	**Supply Voltage**	**PNP/NPN**	**NO/NC**
Mechanical	SAIA-Burgess	V4NCT7	24V	PNP	NC

- Type: mechanical, electrical
- Brand
- Model #
- Supply voltage
- PNP/NPN
- NO/NC (normally open/normally closed)

2. Electrical Drawings

- Motion control drawings shall be provided in EPLAN.
- Includes cabinet drawings and field drawings.
- Framework drawings must be done in EPLAN.
- EPLAN templates will be provided in the future.

3. Layouts and cabling

- Cabinet placement in CAD -> cable lengths.
- Estimates for every motion cable and which type (standard, vacuum, rad hard etc.).
- Type and length important because ESS MCA plan to consolidate cable and connector purchasing.
- Intend to supply one-side-terminated customised cable for installation.

4. Prototyping Results

- Outcomes of any MCA related development work.
- Not applicable to every instrument.
- Example: ESTIA is prototyping a selene guide system.
- Perhaps if a non-standard solution is preferred then a prototyping report could strengthen the case.

5. FAT/SAT Plans

- Complete testing documents.
- After TG3 tenders should be placed and these require FAT/SAT docs.
- MCA is only part of the overall test, but often a big part.
- Will be part of the “System Integration and Verification Plan/System Validation Plan” section in **ESS-0099059** *Neutron Instrument Design and Construction - Phase 2 Technical Data Package Specification*.

6. MCA for Instrument Components

To be included in *Design Considerations* section of Sub-System Design Document (SSDD) - described in **ESS-0099059** *Neutron Instrument Design and Construction - Phase 2 Technical Data Package Specification*.

- MCU summary: number of axis, number of cabinets, no of controllers, which controllers shall control which devices etc.

For each instrument device:

- Purpose of device.
- CAD image(s).
- Hardware description including mechanics and motion components.
- Functional description; how do the axes function to achieve the purpose.
- Description of the control: standard TwinCAT axis, EPICS, DMSC layer, PSS links or special programming, sequencing, synchronisation etc.
- Potential collisions, personnel safety or machine protection issues.
- Justification for any non-standard components.

Part 2: Planning

One page questionnaire found on MCA Confluence:

1. Manufacturing & Procurement
2. Resource Planning
3. Timelines & Milestones
4. Commissioning Plan
5. Risk Analysis

- Rationale: to work out what support/assistance instrument projects require. Also for instruments to ensure they have adequate resources.
- Link will be available on confluence in the future but questionnaire included as appendix in **ESS-0240219** *MCA TG3 Review Process for Instrument Projects*

Grading System for Criteria

- GREEN
  - Design is accepted
- ORANGE
  - Information is missing or needing clarification.
- RED LIGHT
  - Design does not meet standards or cannot be integrated into the ESS control system.
- WHITE
  - Not applicable.

Next steps

- ESS to finalise TG3 process and docs – using any feedback from instrument teams.
- ESS MCA provide standards, guidelines and templates to instrument teams.
- Instruments to complete ToM as designs are completed. Either upload on Confluence or send to your MCA contact. Sub-TGs require the ToM details completed for the relavant axes.
- Dialog between instrument teams and MCA to attempt to solve question marks before TG3.
- Submit all TG3 documentation according to **ESS-0099059** *Neutron Instrument Design and Construction - Phase 2 Technical Data Package Specification* and **ESS-0240219** *MCA TG3 Review Process for Instrument Projects* available in Chess.
- TG3 review.

Questions?