

EUROPEAN SPALLATION SOURCE

Machine protection plans in ESS



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Overview

- About ESS & Cosylab
- Machine Protection System
 - Overview
 - Requirements
 - Functionalities as services
 - Reliability & safety
- Questions & open dilemmas

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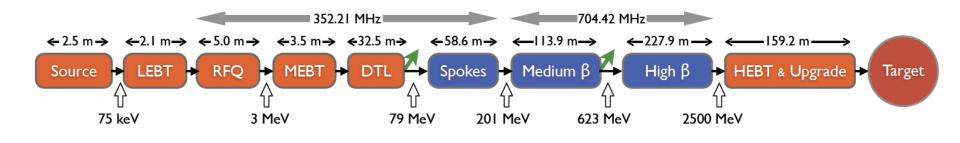
About Cosylab



- Cosylab is a company with 65 engineers, providing solutions in the area of Control System for large physics experiments
 - Conceptual studies
 - Device integrations
 - Complete timing system solution
 - Core CS development: EPICS (v4), ACS...
- Our customers are from more the 50 labs from all over the world: ITER, ESS, SNS/ORNL, MedAustron, etc...
- Our collaboration with ESS Control System group (Garry Trahern) is currently covering control system box, timing system, MPS and database



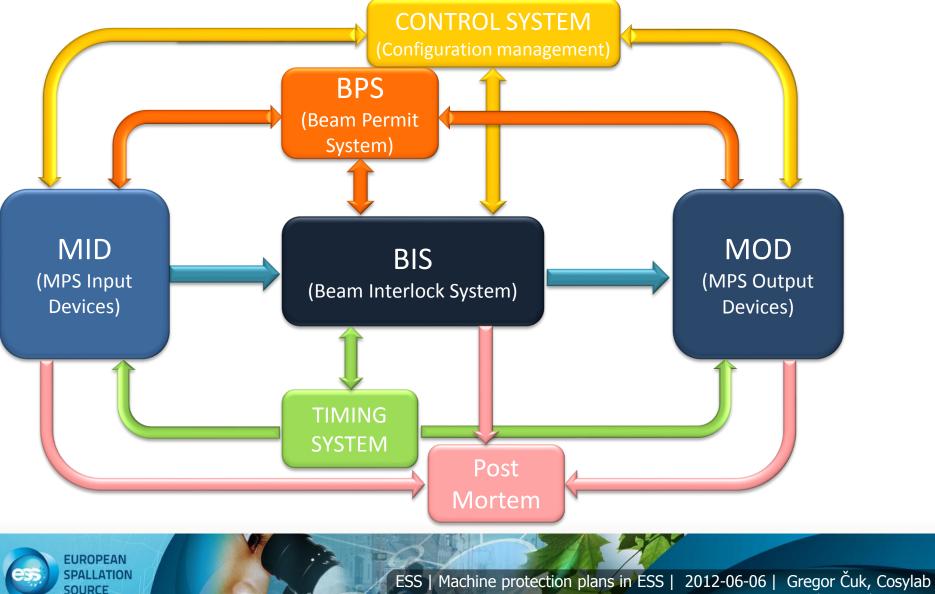
European Spallation Source



- Length: 605.2m
- Proton kinetic energy: 2.5GeV
- Beam Power: 5MW
- Pulse length: 2.86ms
- Pulse repetition rate: 14Hz

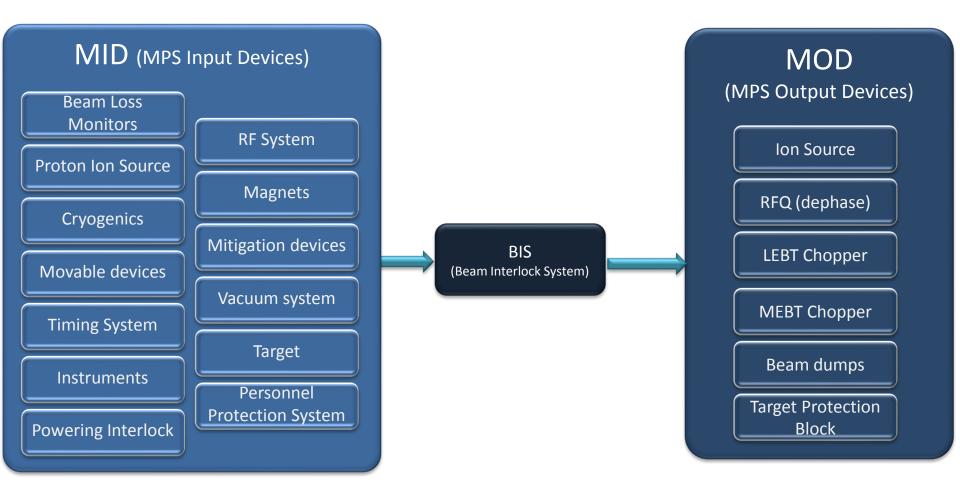
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Machine Protection System



Annika Nordt, ESS

Machine Protection System





MPS, PPS and TSS relation

Reliability / QA		Infrastructure (Conventional Facilities)	Accelerator	Target	Instruments
				Target Safety System	
		Personnel Pr	otection System		
		Machine Prot	ection System		



MPS as a service

- MPS provides service to many devices
 - Around 1000 MID devices (inputs)
 - Few MOD devices (outputs)
- Two main services:
 - Beam Permit
 - Beam Interlock
- Additional services like:
 - Support for different machine modes
 - Support for commissioning phase
 - Support for post-mortem



Beam Permit

- BPS (Beam Permit System) validates all devices including BIS devices
- If configuration is correct, BPS issues Beam Permit
- BPS revokes Beam Permit after BIS stops the beam/machine
 - Can any other system stop the machine? Which one?



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Beam Interlock

- Fast Beam Abort
 - Stop the beam a.s.a.p.
 - If the machine is in the middle of the pulse, abort it
 - Required response time 5-10µs
 - MID detection time + BIS time + MOD mitigation time
 - Exact times under evaluation
 - Propagation delay must be taking into account (3µs for 600m)
- Next Pulse Inhibit
 - MPS allows current pulse to finish, but prohibits next one
 - Pulse repetition rate 14Hz -> 68ms for response
 - Who is responsible to know when the pulse finishes?
 - BIS or mitigation device



Support for machine modes and commissioning phase

- Different configurations for different machine modes
 - Machine mode might change during run-time
- Input masking
 - Ignoring non-critical inputs temporarily (as long as the machine is in safe mode)
 - Masked signals will be logged
- Step-by-step commissioning – MPS grows with the machine



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Support for Post-Mortem

- Data from operational MID devices will be logged
 - Circular buffers may be overwritten
 - MPS tells when to stop logging (via TS)
- BIS devices log all signal changes with precise timestamp
 - All BIS devices are synchronised with TS
- Post Mortem analysis
 - Collect logs from all devices (MID, MOD, BIS)
 - Merge into a single timeline
 - Provide different views on what was happening, which device caused machine to stop, etc.

ESS | Machine protection plans in ESS | 2012-06-06 | Gregor Čuk, Cosylab

Annika Nordt, ESS



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Reliability and safety

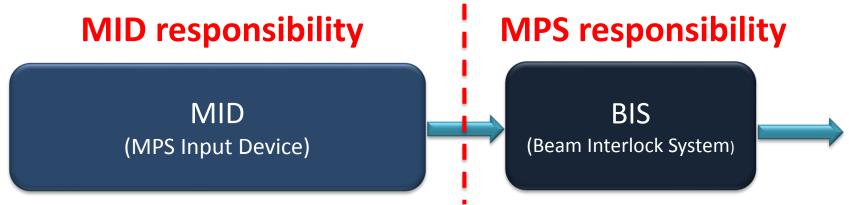
- ESS targets high reliability 95%
- MPS reliability assured with
 - Fail-safe design
 - Redundancy
 - Self-diagnostics
- MPS safety
 SIL3 ?
- MPS security
 - Configuration security: who can change settings?
 - (Re)Start security: Who has rights to (re)start the machine? What are restart preconditions?



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Other questions and open issues

MPS responsibility boundaries



- "Device Integration guidelines" should be prepared
- Machine modes/operation modes
- Confirmation on existence of mitigation devices
- MPS reliability assessment failure catalogue

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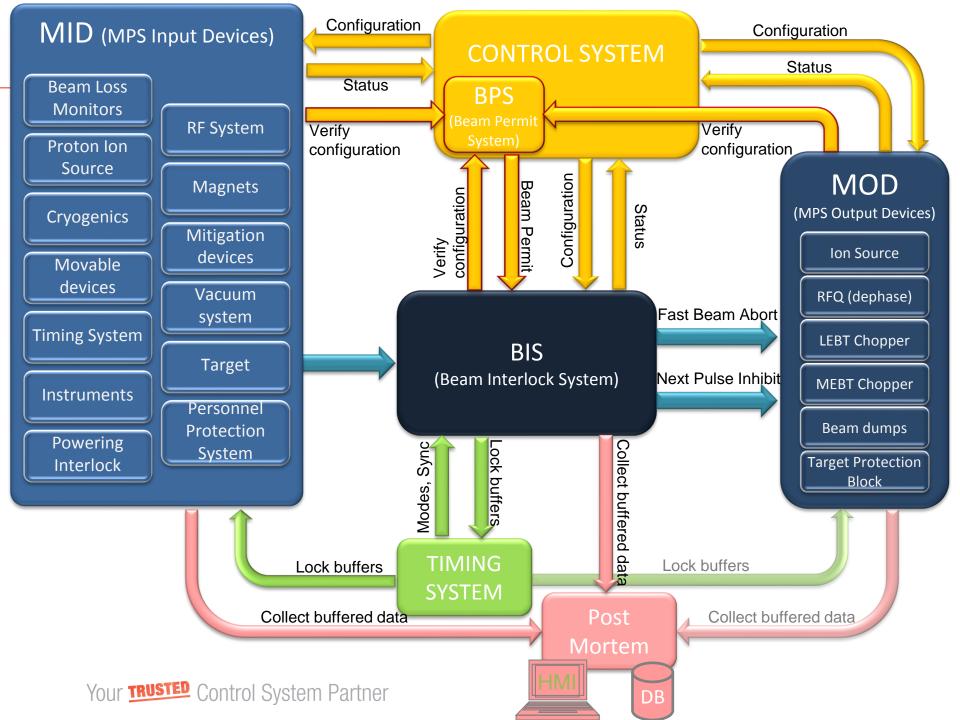
Thank you!



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Backup





Customers From Nearly All Major Labs Worldwide

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33 32 31

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In COSYLAB

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66 67

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1. Canadian Light Source - CLS (CA) 2. Brookhaven National Laboratory - BNL (05) 4. Stanford Linear Accelerator Center - SLAC (US 5. Spallation Neutron Source - SNS (US) 6. National Radio Astronomy Observatory - NRAO (USI 7. Los Alamos National Laboratory - LANL (US) 8. National Instruments - NI (US) 9. Thomas Jefferson National Accelerator Facility - JLAB (US) 10. Atacama Large Millimeter Array - ALMA (RCH) 11. Macedonia Ministry of Agriculture (FYROM) 12. Fisheries and Rural Development, Zagreb (CRO) 13. Sinchrotrone Trieste - ELETTRA (IT) 14. Kyma (IT) 15. Instituto Nazionale di Fisica Nucleare - INFN-LNL II 16. Maatel Scientific Instrumentation (FR) 17. Xenocs (FR) 18. French Atomic Energy Commision (FR) 19. International Thermonuclear Experimental Reactor - ITER (FR)

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- 20. Feinwerk-und-Messetechnik GmbH (DE)
- 21. Gesselshaft fur Schwerionenforschung (DE)
- 22. European Southern Observatory ESO (DE)
- 23. Deutsches Elektronen-Synchrotron DESY (DE)
- 24. Dortmunder Elektronen Speicherring Anlage (DE)
- 25. Forschungzentrum Karlsruhe (DE)

- 29 26. Jenoptik AG Jena (DE)
- 3. Advanced Photon Source APS at Argonne Velonal Laboratory (US) 28. European Molecular Biology Laboratory EMBL (DE) 29. Electron accelerator - ELSA (DE)
 - 30. AOCEL (DE)/ 31.Jmtech Vonk (NL)

 - 32. Kernfyzisch Versneller Instituut KVI INLJ 33. Ion Boz OApplications IBA (B) 34. CELLS ALBACS

 - 35. Observatorio Astronarico Nacional OAN ES) 20 36. CERN - European Organization for Nuclear Besearch (CH)
 - 37. Paul Scherer Institut PSI (CH) 22 38. Geographic Data Support Ltd (UK)

 - 39. Infoterra Ltd (UK)
 - 40. STAR-APIC (UK)
 - 41. Rutheford Appelton Laboratory (UK)
 - 42. Daresbury Laboratory (UK)
 - 43. Diamond (UK)
 - 44, FMBO Oxford (UK)
 - 45. Danfysik (DK)
 - 46. J. Stefan Institute (SI)
 - 47. Hidria (SI)
 - 48. ISKRATEL (SI)
 - 49. Telsima (SI)

Your TRUSTED Control System Partner

- 50 AET (SI) 27. Rive kallsch-Technische Bundesanstalt Berlin - PTB (De) 51. Slovenian Ministry of Agriculture Food and Forestry (SI) 28. European Molecular Biology Laboratory - EMBL (DE) 52. Seaway (SP 53. Slovenian Environmental Agency - ARSO [50 54. The Surveying and Mapping Authority of the Republic of Slovenia-GURS (5) 72 55.The National Veterinary Administration- VURS (SI) 56. Instrumentation Technologies - I-TECH (5) 7. Electronic Institute Milan Vidmar -EIMV (S 98. Slovenian Ministry of the Environment and Spatial Planning (SI 59. Smart Com (SI) 60. SOU (51) 61. Hitachi Zosen (JP) 62. The University of Tokyo (JP)
 - 63. Hiroshima University (JP)

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- 64. Riken (JP)
- 65. Nichizou Denshi Seigyo Kabushikigaisha (JP)
- 66. High Energy Accelerator Research Organisation KEK (JP)
- 67. Institute for Molecular Science (JP)
- 68. Japan Synchrotron Radiation Research Institute- JASRI (JP)
- 69. Japan Atomic Energy Research Institute JAERI (JP)
- 70. NSRRC -National Synchrotron Radiation Research Center (TW)
- 71. Raja Ramanna Centre of Advanced Technology RRCAT (IN)
- 72. Australian national nuclear research and development organisation ANSTO (AU)
- 73. Australian Synchrotron Project ASP (AU)