MQW First Collaboration Meeting Summary

2016 March 11

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TRIUMF

MQW-38

Canada Foundation for Innovation

- CFI is Canada's federal agency for science infrastructure
- CFI competition is understood by CERN

Dates	Activity
June 23, 2016	Deadline for NOI (Notice of Intent)
October 11, 2016	Deadline for full proposal
November 2016 to February 2017	Expert committee meetings
April 2017	Assessment sub-committee meetings
May 2017	Assessment committee meeting
June 2017	CFI Board decisions

- CFI time frame is acceptable to CERN
- CFI funds 40%; expects 60% from partners
- ATLAS Canada @ UoT will champion MQW LOI & proposal
- TRIUMF & Alstom built 52+1 MQW for LHC (1996-2001)
- CERN is enthusiastic to collaborate with TRIUMF

Strategy

- Many MQW would reach end of life because of radiation damage to polymer-based components well before integrated luminosity reaches 3000 fb^-1 (if nothing is done)
- Comprehensive investigations and fault analysis by CERN gives confidence in solutions and MQW quantity
- Already some actions taken as per LHC-MW-EC-XX docs
- Most MWQ will survive, but a few must be replaced
- Replacement, not refurbishment
  - Pro refurb: only polymers will be damaged, not iron
  - Contra: destructive dis-assembly, re-alignment difficulty, working with & disposing radioactive materials
  - Contra: MQW in use; must wait too long for cool down of radio-activation
- Pro-active replacement of selected MQWs avoids excessive dose to workers because fewer interventions will be needed to perform repairs in LHC tunnel

Collaborator's Scope of Work

- 1 prototype* MQW
  - New team
  - New steel
  - New polymers
  - New beam loss shield
- 8 MQW production units
  - Delivery ≤ June 2023 (6 months before start of LS3)
  - Exact quantity (8±1) TBC (2016 June) pending final analysis of dose measurements and calculations
  - Scope includes improved spacer shield design, fabrication & installation of shields in factory.
  - Investigation of original material properties vs dose may impact MQW quantity, but not choice to use new coil resin
    - ALARA, innovation

* Contract must stipulate ample time for test between prototype and production

Coils and Spacers

Innovations

Technical Challenges/Solutions

Coil spacers (a.k.a shims) will reach end of life before coil insulation; need new radiation-hard materials	**▪ TBD** **▪ GSC suggested new sheath material** **▪ Tube filler material TBD** **▪ Adding chopped fibres will help**
Installed beam shields (W+Cu) reduce dose; but insufficient for spacers	At-assembly (rather than retrofit) gives opportunity to improve shield geometry w.r.t. spacers in mid-plane
Rad-hard coil insulation	▪ Cyanate-ester resin ▪ Based on literature search (e.g. ITER) ▪ Strength vs dose tests to 2017 April

Breaking News

- GE/Alstom has communicated interest in new MQW order
- Approx 1/3 of toolings (so far) have been located at CERN
- Armco can produce 1.5 mm sheet
  - Therefore existing dies will work

Proposed Actions - for LOI (May)

GSC

- Brief Alstom; Request budgetary estimate
- Send MQW drawings to Bob Orr (UoT)
- Make list of modifications – based on discussions this week
- Make timeline for prototype & production (with Norman Muller)

SK

- Brief TRIUMF deputy director & UoT/ATLAS Canada
- Gauge level of support/resources for shield re-design (&when)
- Gauge level of support for adding “quick connects” to scope
- Write NOI text on innovation & societal benefits

UoT: Define & communicate strategy for 60% (wrap with other projects?)

Proposed Actions - for LOI (May)

CERN

- Partner letter of support; include palatable statement on "in-kind contribution(s)" (e.g. steel)
- Request budgetary estimate from Armco for 100T steel
- Send drawings of shield and material supplier & costs info.
- Find/report status/locations of other toolings within 4 weeks.
- Gauge level of support/resources for FLUKA (&when)
- Confirm MQW quantity in early June (final # could still feed into the NOI)
- Continue materials testing initiatives
- Magnetic model – basis to evaluate consequences of new steel type B vs H

Actions - for Application (Sept)

Norman

- Refine cost breakdown/estimate; CERN to advise & validate line items
- Make suggestion(s) for rad-hard spacer filling material(s)

UoT/CERN/other partners

- Final quantity of MQW
- High-level discussions leading to definition of “in-kind” contributions
- Complete the MoU (Krueken, Bagger, Rossi, Bruening, etc)

2017 April-May: Post Application Interviews (if short listed)

- Norm: Refine proposal for spacer filler material (literature search)
- CERN/TRIUMF orchestrate “communiqué” to coincide with review panel
- CERN: communicate outcome of cyanate-ester “mechanical property versus dose” tests

Residual Questions (discussed Friday)

Dies

- Q: Are they worn out? Are they accurate enough? Can they be re-sharpened?
- A: CERN will make preliminary inspection
- A: GSC will contact Canadian Inspectors (ship to Canada and inspect)

Failure Modes Analysis

- Q: Water Cooling: any sign of flow degradation litre/sec/yr ?
- Q: Any evidence of erosion or blockage?
- A: Very unlikely to be a problem
- A: Nevertheless, Nicola will make some investigation.

Spacer filler material

Non-irradiated spacer cracked at ≈ 40,000 cycles, but performance was adequate to 60,000 cycles. Any new filler material would need similar accelerated cycle testing (v. unlikely to be in literature).
Agreed: testing on small samples will be needed.

Residual Questions (discussed Friday)

Irradiation of Samples

Not proceeding entirely smoothly (QA glitches); may repeat some tests.
Q: Is there facility in Canada where samples could be tested to 100 MGray?
A: Ewart Blackmore (TRIUMF) will be consulted.

Investigate & Retrofit Quick Connections (QC)

Q: Often there are cultural/legacy/geometric constraints. Is this a serious proposition?
A: There is ALARA motivation to retrofit 53, plus 8 new MQW.
A: Treat QC as a secondary exercise; leave the door open in the full proposal for collaboration of subjects of this type
A: Vendor contract must have flexibility to change QC design at no penalty/

Homework

- Post slides on CERN Indico site https://indico.cern.ch/event/508156/
- Exchange a 2-page summary of Actions and Intents from this meeting

TRIUMF

Canada's national laboratory for particle and nuclear physics
Laboratoire national canadien pour la recherche en physique nucléaire
et en physique des particules

Thank you!
Merci!

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