Engineering update

14th October 2014

Coming up:

- Concrete shielding installation begun Mon 13th October
- FETS meeting at RHUL on Wed 15th October
- Arrange date for next RFQ tuning meeting – possibly at next FETS meeting.
- Next OsC meeting: Thu 27th November

1) RFQ

Inspection:

- Dave Wilsher has said that he cannot inspect RFQ section 2 until the week beginning Monday 3rd November (and even then cannot guarantee it). We should consider using this time to perform the on axis bead-pull on RFQ Section 2 with the movable tuners fitted – see RFQ Testing.

Assembly:

- An alignment jig may be required to stabilise the RFQ during assembly with an O ring in-place. This idea has come from the experience of assembly with finger strip and may replace the dowel block concept. The advantage will be a removed machining step. The solution is expected to be an extruded aluminium extrusion frame fitted with adjustment screws and possibly DTIs. I will produce a concept design.

Baffles:

- Design complete, schedule manufacture with HEP workshop

Manufacture:

- Sections 3 and 4 will proceed to completion following approval from inspection of Section 2. Section 1 will proceed to completion following the aforementioned step plus the completion of updated CAD models from me to show the effect of the repair 0,4mm material removal.

Testing:

- Bead-pull
  - Existing 'chunky' input coupler is a RFQ cold model coupler that has been turned down to suit the smaller tuner port bore of the real RFQ. Believed to be working well. Ideally would be modified or redesigned to add rotation.
  - Existing field detector does not work well. Design is to be discussed on Wed 15th at the RHUL FETS meeting.
  - New bead required. Ideally with metal coating to perturb either electric or magnetic field. This would allow off-axis bead-pull testing. Dielectric constant should be known to assess magnitude of signal
  - New end flanges will be required to allow off-axis bead-pull. Simple design using crossed slots has been discussed. I will produce the design and engineering drawings. Manufacture will be from aluminium alloy and could be done at IC. Design can begin when a bead (size) has been chosen.

- Next test: On-axis bead-pull of RFQ Section 2 to observe effect of (16) manually movable tuners. RFQ to be aligned using external blocks and fitted with:
  - finger strip
  - top-hat end flanges at both ends
  - movable tuners – I need to check that 16 interface flanges and all bolts, washers etc are in the cage in R8

  [Will manufacture 48 more tuners if required].
- Fourier analysis code being developed by Alan. Algorithm to be implemented directly into Labview once proven to work.
- First off-axis test planned using RFQ sections 1 and 4, aligned and bolted together on the FETS rails. 32 manual tuners required. Bead-pull pass to be made (one pass = through all 4 quadrants and on-axis). Fourier analysis to be performed. All tuners moved by an equal amount to bring frequency close to desired frequency. Repeat bead-pull and repeat frequency tune if necessary. Once on frequency, move individual tuner to flatten any bumps in field, and move all other tuners to restore frequency. Repeat until on frequency and field is flat.

Modelling:

- Morteza required from me internal models of the RFQ to support RFQ testing.

2) Shielding

Build:

- The build is progressing well. Crane was at lifting limit for largest (3) blocks (due to reach and boom angle). Estimated to build all of North wall and East wall by end of play Friday.

Cable entry:

- Cable bend radius required from Gary to confirm 90mm deep vertical channels in shielding are sufficient.

3) RF system

Coax design:

- Dave Zakhar is working on the design of a framework to support 2 lines of 6" coax that runs from the single waveguide to the downward facing lines. This has prompted knowing the distance from the LEBT to the RFQ (established as 136,6mm). This work arose from the need to define the shielding roof assembly, which, in-turn needed a defined RF system assembly. The framework design is either complete or close to completion.

Full power Klystron test:

- H-plane waveguide mitre has been delivered to R8. Legs are required to raise dummy load 2 to the correct height to mate waveguide runs. The legs have been designed, manufactured and delivered to R8. In order to fit the legs, Bob Greenaway will lift dummy load 2 using a fork-lift, and while raised, we will remove fitted wheels and replace with legs. The load will be set just above the nominal height and will be lowered, using the adjustable feet, to match the opposite waveguide run height. The newly ordered H-plane mitre will be bolted into position. Mike has already discussed with Bob. For extra help, may schedule to coincide with Ian Clark's trip to RAL (to deliver various items from IC including final LEBT beam pipe

section). Shielding installation is taking priority but completing waveguide run may happen week starting 20th Oct. Flow switches on order with delivery due end of Oct. Flow switches will need fitting and connecting (Paul Masterston). Extensions for Klystron cables need to be investigated – Alan/Saad? Safety cage not required for this test – TBC.

Vertical run assembly:

- Mike and Dave have designed an assembly procedure for building the 2 vertical coax lines. The plan is to crane in a vertical coax piece that is enveloped in an extruded aluminium frame. That frame then acts as the support for the coax line once bolted in place. The ultimate goal is to develop a system whereby the (heavy) RFQ coupler can be mounted to the RFQ without placing any large loads on the coupler to RFQ vacuum seal.

RFQ Coupler:

- Design complete. Detailing to go to Dave Zakhar. Will discuss scheduling with Mike. Support frame will be required and is expected to be mounted directly to the RFQ.

4) R8 layout

CAD modelling:

- Dave Zakhar has been creating more accurate CAD models of R8, including the beam-line, to facilitate the building of the concrete shielding and to complement the RF system design. This work will doubtless feed into continued shielding work by ESSO. Information provided by the models has fed to Adrian who has marked out the shielding footprint with tape.

5) MEBT

Vacuum manifold:

- I have handed engineering drawings of the MEBT vacuum manifold to Dave Zakhar for checking and updating. Upon receipt of complete drawings I will approach NTE for a quote to manufacture. If the quote is reasonable the order will be placed via IC. If the quote is not reasonable we will approach RAL OM. All vacuum parts necessary for manufacture and vacuum test have been ordered and delivered (some to IC). Improved stock control system has been implemented. Ian to deliver vacuum parts to RAL. I may deliver parts to manufacturer (where appropriate). Manufacturer to perform vacuum test. Only rudimentary inspection will be performed to check port spacing and alignment (tape measure and straight edge).

Support frames:

- Mike Pottle completed the engineering drawings for the MEBT support frames. I have since changed the top rail to allow more clearance between the MEBT components and the support frames, this will make assembly easier. The drawings need to be updated to reflect the change. This task will fall to Dave Zakhar and will follow the completion of the RF coax support frame and the MEBT vacuum manifold. Manufacture will be handled via OM. Completed frames will be inspected for flatness using a DTI or similar.

Quadrupoles:

- Delivery of first quadrupoles is scheduled for November.
- Support beams: the design and engineering drawings of the quadrupole support and alignment beams (x8) has been completed. The materials and fasteners have been ordered and are at IC. Manufacture at IC has begun and is expected to be complete by 24th Nov. The completed assemblies will be inspected for flatness. Added to the order were the MEBT support frame Minitec rails.

BPMs:

- Currently being tested at RHUL to understand whether the machining error is acceptable. If the error is acceptable no further engineering support is required for these items.

Rebunching cavities:

- Charles Evans has produced engineering drawings for the cavities and has sent them out for quotes. Charles has requested a fabrication readiness review.

Choppers:

- Slow chopper:
  - An electrode design has been suggested that uses a Teflon plate with a copper meander deposited onto the surface. Supporting plates can be aluminium alloy. No cooling will be required. It will be imperative that the beam does not strike the Teflon plate. An input and output electrical connection will be required using HV feedthroughs. I have agreed to produce a concept engineering design. The manufacture of the surrounding vacuum vessel can proceed ahead of the electrode design. The vessel concept designs are complete and the engineering drawings may be passed to Dave Zakhar depending on workload and time available.

- Fast chopper:
  - The FETS team is currently evaluating whether to use contracted effort to produce the fast chopper electrode design. A decision is expected by the end of October.

Scrapers:

- Concept designs have been shown of KF40 flanged beam scrapers. They consist of a pure aluminium aperture housed within a water cooled aluminium alloy body. Two designs have been shown. Design 1 had a potentially poor thermal contact between aperture and cooled body, while design 2 had an improved clamped aperture but with reduced cooling efficiency. A third design will be produced that incorporates the best features of both designs. I aim to produce this final design following the request for quotes of the MEBT vacuum manifold and support frames. It is expected that the scrapers will be made at IC.

Chopper beam dumps

- Charles keen to be involved along with Tristan Davenne (under Chris Densham). Need to meet to get this moving.

6) Main FETS beam dumps

Post FETS meeting of 4th June 2014 – may no longer apply:

- In straight forward direction we use a newly designed flat plate type dump.
- In the (dipole) bent direction we use the existing cone-type beam dump.
- Newly designed flat plate dump will need larger area than the chopper beam dumps but will inherit the same concept design.

- Power reduction will not be required (previously had discussed running at 30% of full power).
- Interlocks get simpler because now the power does not need to be reduced while the dipole is ON.
- Beam shape through laser diagnostic is not compromised because the cone-type dump will digest all beam spread directions.

7) Laser diagnostic

- Future engineering requirements not yet understood – to be discussed.