FETS Task List

Updated 21st August 2012

Key Item	End Date	Comment
Waveguide installed.	Apr-13	Tested and ready for first RF into RFQ. Designed to be extendable towards MEBT.
First RF into RFQ	Jul-13	RFQ on stands, aligned, populated with all components, vacuum tested. Shielding project underway.
Beam Dump on rails with water	Dec-13	Mounted on stand, tested for leaks, interface to RFQ manufactured, ready for beam through RFQ.
Shielding	Dec-13	Ready for beam through RFQ. Designed to be extended for 'future projects'.
First beam through RFQ	Dec-13	RF conditioning complete. Shielding in place. Full power through RFQ.
MEBT component installation	Jun-14	All MEBT components complete. Start to install, align and commission.
End diagnostics installation	Aug-14	Dipole mapped, vacuum vessel tested, laser system tested.
First beam through MEBT	Oct-14	All components installed and aligned. Power and water installed.
FETS End Date	Mar-15	Proposal for extra year of funding to be submitted mid 2013
Experiments	Mar-16	Beam tuning and period for experiments.

Work Package	Manager	Description
1	Dan Faircloth (STFC)	Ion source development and beam delivery
2	Juergen Pozimski (IC)	RFQ Commissioning
3	Juergen Pozimski (IC)	Design of a CH-Linac
4	Peter Savage (IC)	MEBT
5	Christoph Gabor (STFC)	Diagnostics
6	Alan Letchford (STFC)	Future of FETS
7	?	Supporting infrastructure

	Tasks	Who?	Where?	When?	Comment
1.00	**General**				
1.01	MEBT optics design	Morteza			Morteza to take over from Chip. Need optics simulation using simulated RFQ beam. Input from Simon's RFQ work.
1.02	MEBT beam dynamics	Morteza			Matching beam from RFQ to MEBT. Rotation of chopping plane. Extending existing GPT simulations.
1.03	Support structures	Pete, Alberto			
1.04	Component datums	Pete, Alberto			Consult with Dave Wilsher at design stage
1.05	Component alignment	Jim Loughrey, Adrian			Consult with at design stage - Adrian to revisit FETS datums prior to RFQ instasllation
1.06	Cooling	Duncan Couchman			Design of RFQ cooling underway, Scott experienced with CFD.
1.07	Power	Mike Perkins?			Need electrical services contact
1.08	Link to OM	Phil			Peter Clarke, Richard Day etc.
1.09	MEBT beam pipe	Pete, Alberto			Designed around KF40? - TBC
1.10	MEBT beam scrapers	Pete, Alberto			Protect chopper plates by scraping off beam halo using water cooled scrapers.
1.11	Overview CAD model	Pete, Alberto			One model, probably to be held by Pete
1.12	LEBT spectrometer	Juergen, Pete, Saad			Initial tests look positive
1.13	CH studies	Juergen, Morteza, Pete			Modelling in COMSOL - next step is end flange design
1.14	Mag field measurement facility	Juergen, Saad, Pete			Hall probe bought. Saad to look at control for linear stages.
1.15	Personnel	N/A			Who is part of the team?
2.00	**Project Engineering**				
2.01	Function	N/A			To get the MEBT built on time and to within budget
2.02	First steps	N/A			Assigining tasks to the right people and checking on progress.
2.03	Time	Pete, Juergen, Alberto	IC, AVS		
2.04	Budget	Alan, Juergen	RAL, IC		
3.00	**Ion source**				
3.01	Plans?	Dan, Scott			
4.00	**LEBT**				
4.01	RFQ input distributuion	Simon, Juergen, Alan	UCL, IC, RAL		Simulations to define RFQ input beam
4.02	LEBT Output	John Back	Warwick		Simulations (and testing?) to determine correct length for LEBT final beam pipe section.
4.03	LEBT final section beam pipe - design	Pete	IC		Concept design complete
4.04	LEBT final section beam pipe - drawings	Pete	IC		Awaiting length from John Back.
4.05	LEBT final sectuion beam pipe - manufacture	OM	NTE (Poole)		Will need advice on design for bellow welding
4.06	Fit final beam pipe section	Pete	R8		Will no longer interface to moving diagnostics vessel
4.07	Beam position	John, Christoph	Warwick, RAL		
5.00	**Bead-pull test apparatus**				
5.01	Order items to extend current set-up	Pete	Automotion	Jul-12	Arrived
5.02	Extend set-up	Pete, Ian	IC		
5.03	Make or modify carriage	Ian	IC		
5.04	Modify pulley axles	Ian	IC		
5.05	Measure line sag	Pete, Ian	IC		
5.06	Demonstrate drive with stepper motor	Saad	IC		
5.07	Assemble around simple cavity	Saad, Pete	IC		Make measurements with netwrok analyser over new length.
5.08	Transport to RAL	Saad, Pete	To RAL		
6.00	**RFQ**				
6.01	Transport	NAB	To RAL metrology	Aug-12	Section 1, major vanes x 2, minor vanes x2
6.02	Measure vanes	Dave Wilsher	RAL metrology		
6.03	Align and assemble RFQ	Alberto, Dave	RAL metrology		
6.04	Measure assembled RFQ clover leaf(s)	Dave Wilsher	RAL metrology		
6.05	Bead-pull test 1	Saad, Juergen	RAL metrology		Confirm 324Mhz and other modes are far from 324MHz
6.06	Transport	Tim	To NAB		
6.07	Machining op 1	Tim	NAB		Machine end faces flat, square and to length
6.08	Machining op 2	Tim	NAB		Machine end face grooves.
6.09	Machining op 3	Tim	NAB		Add dowel blocks and drill through them together. Fit dowels.
6.10	Transport	Tim	To RAL metrology		
6.11	Disassembly	Alberto, Dave	C		
6.12	Cut and bond O ring	Pete	IC		
6.13	Clean	Alberto, Dave	RAL metrology		
6.14	Fit finger strips and 3D O ring	Alberto, Dave	RAL metrology		
6.15	Reassembly	Alberto, Dave	RAL metrology		
6.16	Mechanical Measurement check	Alberto, Dave	RAL metrology		Re-check clover-leaf profile at each end
6.17	Transport	Alberto	To R8		
6.18	Populate RFQ ready for vacuum test	Pete	R8		End flanges, tuners, vacuum port, couplers
6.19	Vacuum Test	FETS team	R8		
6.20	Bead-pull test 2	Saad, Juergen, Alan	R8		Test for field flatness - evaluate required tuner depth (more extensive)
6.21	Machine tuners to length	Pete, Ian	IC		
6.22	Repeat bead-pull test	Saad, Juergen, Alan	R8		Is the field flat now?
6.23	LLRF test with tuners	Saad, Juergen, Alan	R8		Can we keep the RFQ on tune?

6.24	Plumb cooling system	Pete, Duncan	R8		
6.25	Repeat (most) steps above for sections 2, 3 and 4.				
6.26	Conditioning	Saad, Juergen, Alan	R8	Jul-13	* Needs couplers and shielding (but maybe not at 100% level) to be in place
6.27	Ready for beam	N/A		Dec-13	
7.00	**RFQ Ancilliaries**				
7.01	Tuners	Pete	IC		Built, need vacuum brazing
7.02	Baffles - design	Pete	IC		Concept design complete. To be checked with Duncan for Reynold's number.
7.03	Baffles - manufacture	Ian Clark	IC		
7.04	End flanges - design	Pete	IC		Concept design complete. Needs to be approved by FETS team.
7.05	End flange assemblies - manufacture	Ian Clark	IC		Underway
7.06	RF test end flange - modelling	Morteza, Pete, Saad	IC		Simulations underway. Converging on solution.
7.07	RF test end flange - design	Pete	IC		
7.08	RF test end flange - manufacture	Ian Clark	IC		
7.09	RF test flange - vacuum test flanges	Ian Clark	IC	Jul-12	Complete
7.10	Mid flanges - design	Pete	IC		Concept designs complete. Flat Viton rings need to be detailed and ordered.
7.11	Mid flanges - manufacture	Ian Clark	IC	Jun-12	
7.12	3D O ring bonding jig - design	Pete	IC		Copy of design used for testing
7.13	3D O ring bonding jig - manufacture	Ian Clark	IC	Jun-12	
7.14	Assembly jig -design	Alberto	AVS @ RAL	Jan-12	Complete
7.15	Assembly jig - manufacture	Outisde manufacturer	Senar	Jun-12	Complete
7.16	RFQ pick-ups x 4 - design	Pete	IC		Complete, parts on order
7.17	RFQ pick-ups x 4 - drawings	Pete	IC		
7.18	RFQ pick-ups x 4 - manufacture	Ian Clark	IC		
	RFQ Tuner drives	Saad	IC		
8.00	**Shielding**				
8.01	Function	N/A			To protect us from radiation
8.02	Description	N/A			Large concrete blocks arranged to enclose RFQ and MEBT
8.03	Calculations	Alan, Juergen	RAL		
8.04	Design	Trevor Pike, Pete	RAL, IC		
8.05	Risk assessment	Alan, Dan, Juergen	RAL		Dan is radiation safety officer for R8
8.06	Interlocks	Alan, Mike Perkins, Gary	RAL		
8.07	Purchasing	Alan	RAL		
8.08	Installation	John Govans, Phil	RAL		Take advice from installers and existing experience from ISIS
8.09	Lighting	John Govans, Phil	RAL		
8.10	Ventillation	John Govans, Phil	RAL		Comfort only
8.11	Lifting gantry	Pete, Alan	IC, RAL		For inside the shielded areas, 500kg block and tackle.
8.12	Completion	N/A		Dec-13	
9.00	**RF System**				
9.01	Function	N/A	-		To transport RF power from the Klystron to the RFQ and MEBT
9.02	Description	N/A	-		Waveguide (Mega Industries W2300) followed by coaxial cable
9.03	Purchasing	Saad, Alan	IC, RAL		
9.04	Design	Saad, Pete	IC		Preliminary layouts have been made.
9.05	Circulator testing	Saad	RAL		
9.06	Circulator support frame design	Pete	IC		
9.07	Circulator support frame manufacture	OM	OM		
9.08	Circulator installation	RAL Heavy gang	RAL		Saad to make plan with RAL heavy gang
9.09	Circulator low power test	Saad	IC		
9.10	Circulator low power test blanking plates	Pete	IC		
9.11	Circulator antenna EM design	Alan	RAL		
9.12	Circulator antenna design and build	Pete, Ian	IC		
9.13	Waveguide installation	John Govans	RAL		Circulator and waveguide arrived.
9.14	Waveguide support structure	Pete	RAL		MiniTec framework - make it up as you go.
9.15	Waveguide testing	Saad	RAL		
9.16	Coax specification	Saad	IC		
9.17	Coax installation	John Govans	RAL		
9.18	Commissioning	Saad	RAL	Mar-13	
9.19	Klystron dummy load plumbing	Duncan Couchman	RAL		Duncan aware that new pump, flow switch and associated pipework need to be fitted
9.20	Cooling control panel	Mike Perkins	RAL		For the Klystron, load and circulator
10.00	**RF Couplers**	**ESSB**			
10.01	Function	N/A			To introduce RF power into accelerating structures
10.02	Description	N/A			Tapered coax line terminating in water cooled loop
10.03	Quantity	N/A			Six (2 RFQ + 4 MEBT) + 2 etxra for RFQ if power density is too high
10.04	RF / EM Simulations	Juanlu			
10.05	Engineering design	ESSB, Alberto			
10.06	Prototype manufacture	ESSB			
10.07	Testing	FETS team			Someone with a Klystron! What do we test into? RFQ cold model?
10.08	Manufacture	ESSB			
10.09	Cooling	Duncan Couchman			Only cooled in region of loop.
11.00	**Chopper**				**Fast and slow electrostatic choppers**
11.01	Function	N/A			To create precise gaps in the beam
11.02	Description	N/A			Series of electrodes within vacuum vessel
11.04	Length	N/A			~450mm
11.05	Beam pipe diameter	N/A			20mm in X
11.06	EM design	Mike Clarke-Gayther	RAL		
11.08	Optics design	Mike Clarke-Gayther	RAL		How does this interface with wider MEBT optics design?
11.09	Electrode design	Mike Clarke-Gayther	RAL		Helical prototype, planar prototype, water cooled
11.10	Engineering design	RAL Engineer	RAL		Mike to advise on how much engineering support to be provided.
11.11	Vacuum vessel design	Pete, Alberto	IC		Milled from solid using low radiation aluminium alloy
11.13	Vacuum pump mounting	Pete, Alberto	IC		MAG830 mounted underneath
11.14	Slow chopper electronics	Mike Clarke-Gayther	RAL		Sit on ground plane chassis on top of chopper lid.
11.15	Slow chopper feed-throughs	Mike Clarke-Gayther	RAL		Off-the-shelf 5kV water cooled feed-throughs.
11.17	Manufacturing	External co.			Mike to advise.
11.18	Testing	Mike Clarke-Gayther	RAL		Mike to advise.
11.19	Commissioning	Mike Clarke-Gayther	RAL		Mike to advise.
11.21	Electrical requirements	Mike Clarke-Gayther	RAL		Pulse generators, low level controls, cabling
11.22	Support structure design	Pete, Alberto	IC, AVS		
11.23	Support structure manufacture	External co.			
11.24	Alignment tolerances	Mike Clarke-Gayther	RAL		Mike to advise on sensitivity to alignment.
11.26	Installation and alignment	Jim Loughrey	RAL	Jun-14	Consult with Jim at design phase.
12.00	**Chopper beam dumps**				**2 required - see CERN and SNS designs**
12.01	Function	N/A	-		Place where chopped beam is dumped into.
12.02	Description	N/A	-		Vacuum vessel with moveable water cooled target and mount for vacuum pump.
12.03	Length	N/A	-		~ 450mm
12.04	How many bunches?	N/A	-		Fast chopper removes two sets of three adjacent bunches. Slow chopper removes central set.
12.05	Optics design	Morteza	IC		Implementing angled screen to get dump data for Alberto's thermal modelling.
12.06	Chopping orientation	N/A	-		Vertical - unidirectional for both choppers?

12.07	Material	N/A	-		Dump requires good thermal conduction + low radiation = aluminium (pure). Coating (graphite) to prevent sputtering?
12.08	Specification	Morteza	IC		Lengths, angles from chopper
12.09	Thermal simulation	Alberto	AVS		Apply angled screen to MEBT optics design.
12.10	Engineering design	Alberto	AVS		
12.11	Manufacture	OM	AVS		
12.12	Support structure design	Pete, Alberto	IC, AVS		
12.13	Support structure manufacture	External co.	AVS		
12.14	Cooling	Duncan Couchman	RAL		Power? 600W? (18kw/10/3)
12.15	Vacuum test	FETS team member	RAL		Good to pump at this higher pressure location.
12.16	Installation and alignment	Jim Loughrey	RAL	Jun-14	Consult with Jim at design phase.
13.00	**Rebuncher Cavities**				**3 to 4 required, designed and built in partnership with whom?**
13.01	Function	N/A	-		To bunch the beam (by slowing particles at the head of the bunch and speeding up particles at the back of the bunch).
13.02	Description	N/A	-		Water cooled copper cylinders with re-entrant noses.
13.03	Length	N/A	-		~200mm
13.04	EM design	Ciprian, Morteza	RAL, IC		Need to know who are our partners soon - ESSL? ESSB? Both?
13.05	Frequency / tolerance studies	Saad, Morteza	IC		
13.06	Thermal simulations	Scott?, Morteza	RAL, IC		
13.07	Tuning system design	Saad	IC		
13.08	Test model design	Engineer			May serve as final item
13.09	Test model testing				LLRF? Bead pull? Confirm frequency.
13.10	Tuners - mechanics	Pete	IC		3 x stepper motor drives from VG Scienta
13.11	Tuners - control system	Saad	IC		
13.12	Engineering design	Engineer			
13.13	Support structure design	Pete, Alberto			
13.14	Support structure manufacture	External co.			
13.15	Manufacture	External co.			
13.16	Testing / commissioning	Saad	RAL		Will require (some) shielding
13.17	Cooling	Duncan Couchman	RAL		
13.18	Installation and alignment	Jim Loughrey	RAL	Jun-14	Consult with Jim at design phase.
14.00	**Quadrupoles**				**Several required, common design, designed and built in partnership.**
14.01	Function	N/A			To focus or de-focus beam (and steer?)
14.02	Description	N/A			Water cooled (possibly) quadrupole
14.03	Length	N/A			~70mm
14.04	Weight	30 kg			Guess
14.05	Specification	Alan			Magnetic field strength, bore, Z length
14.06	EM design	OM			
14.07	Power supply	External co. (OM)			Possibility to control pairs of poles (steering) at extra cost (two power supplies).
14.08	Cooling	Duncan Couchman			If standard design is chosen
14.09	Magnetic field map check	Imperial, Daresbury	R8		Imperial will have system in place by then.
14.10	Manufacture	External co.			Alberto finding out who exisiting manufacturers are.
14.11	Support structure design	Pete, Alberto	IC, AVS		
14.12	Support structure manufacture	OM			
14.13	Alignment precision	Morteza			Part of particle tracking work
14.14	DOF to be allowed				
14.15	Installation and alignment	Jim Loughrey	RAL	Jun-14	Consult with Jim at design phase.
15.00	**In-line diagnostics**				**Can be added to MEBT at anytime, i.e. not required for running of MEBT.**
15.01	Function	N/A	N/A	N/A	To tell us about the beam
15.02	Description				Various types of device at positions along MEBT line.
15.03	Completion date			Apr-14	
15.04	Components				BPMs, toroids, wire scanners etc.
15.05	Beam Position Monitors (BPM)				Probably button type (instead of strip-line) due to FETS bunch length and timing.
15.06	BPM Function	FETS team			To tell us the position of the beam and possibly TOF between 2 BPMs
15.07	BPM Description	FETS team			Small vacuum flanged cylinder with 4 feedthroughs
15.08	BPM Specification	Simon Jolly	UCL		
15.09	BPM Design	Simon Jolly	UCL		
15.10	BPM Manufacture	Simon Jolly	UCL		
15.11	BPM data analysis	Simon Jolly	UCL		
15.12	Toroids				Buy from Bergoz
15.13	Toroid Function	FETS team			To tell us the beam current
15.14	Toroid Description	FETS team			
15.15	Toroid Specification				
15.16	Toroid Positions in MEBT				
15.17	Toroid Quantity				Several, maybe 5
15.18	DAQ	Gary Boorman	RHUL		EPICS system
15.19	Installation and alignment	FETS team	RAL	Jun-14	
16.00	**End diagnostics**				**Christoph's laser based system**
16.01	Function	N/A			To inspect beam at the end of the MEBT.
16.02	Description	N/A			Vacuum vessel sitting inbetween large dipole with with laser system to separate beam.
16.03	2D vessel design	Christoph			Initial investigations underway.
16.04	3D vessel design	Pete, Alberto, Christoph			
16.05	Assembly / alignment plan	Christoph			
16.06	Magnet design	External co, Morteza			Approach companies this summer.
16.07	Magnet manufacture	External co.			Christoph in talks with whom?
16.08	Magnet field map check	Daresbury, Imperial			Imperial may have system in place by then.
16.09	Magnet support design	Pete, Alberto			Could weigh 1000kg
16.10	Magnet support manufacture	Pete, Alberto			
16.11	Vessel manufacture	External co.			Can be machined from solid rather than fabricated if preferred.
16.12	Vessel internals specification	Christoph, Gary	RAL, RHUL		Heason stages, optics mounts, beam dumps
16.13	Vessel internals purchasing	Christoph			
16.14	Laser specification	Alessio, Gary			
16.15	Laser purchasing	Alessio			
16.16	Laser alignment plan	Gary, Christoph, Alessio			
16.17	Laser safety	Alessio, Christoph	RHUL, RAL		
16.18	Laser saftey enclosure design	Gary			
16.19	Laser saftey enclosure manufacture	Gary			
16.20	Shielding and interlocks	Gary			
16.21	Cooling for bending magnet	Duncan Couchman			
16.22	Detector / readout	Christoph			
16.23	DAQ	Gary	RHUL, RAL		EPICS
16.24	Magnet power supply	OM (of magnet)			
16.25	Installation and alignment	FETS team	RAL	Aug-14	
x	**Moving diagnostics**				**Beam after RFQ is ~25mm diameter versus ~ 80mm diameter in LEBT.**
x.01	Function	N/A			To inspect the beam at different places along beam line
x.02	Description	N/A			Existing diagnostics with modifications to suit MEBT.
x.03	Adapt existing	Pete, Alberto, Phil			Insufficient funding or staff for new diagnostics
x.04	Existing slit slit scanners	N/A			Should work fine - resolution 0.1mm?
x.05	Pepperpot	Pete, Alberto, Phil			Radiation issue.
x.06	Profile	Pete, Alberto, Phil			Useful to have. Quartz may take higher power density due to greater penetration depth.

x.07	Camera position	Pete, Alberto, Phil			Needs to be moved closer to head due to smaller beam. Investigate.
17.00	**Beam dumps**				**One completed by TEKNIKER - in R8**
17.01	Function	N/A			To stop / absorb beam
17.02	Description	N/A			Water cooled aluminium cone.
17.03	Cooling	Duncan Couchman			
17.04	Support structure	Pete, Alberto			Make 2 identical
17.05	Fit beam dump to FETS rails	Pete, Alan	R8		Initially on FETS rails. On own stand once MEBT is built?
17.06	Align beam dump	Pete, Alan	R8		Assumed alignment not critical
17.07	Beam dump cooling test	FETS team			
17.08	Beam dump vacuum test	FETS team			
17.09	Attach beam dump to downstream RFQ flange	FETS team		Dec-13	
18.00	**Electrical installations**				
19.00	**Public Relations**				
20.00	**Future of FETS**				
21.00	**Communications**				
19.01	FETS webpage	All	RAL		Online information source with public and private areas
19.02	FETS calendar	All	RAL		Help with R8 work scheduling. Read/write access for all FETS team.