FEL TEST PLAN WORKSHEET

PROGRAM DEPUTY APPROVAL	COMPLETION INFORMATION
FEL Exp Coordinator Signoff: _____ Date: _____	Completion Date: _____
PI Reviewer Signoff: _____ Date: _____	Crew Chief/PI Signoff: _____
Expiration Date (max. 90 days from approval): _____	Comments (partial completion, etc.):
Presentation Required? ❑ yes ❑ no	❑

NOTE: Information addressing the appropriate content of each of the following sections can be found in Section 2.0 of the Test Plan Instructions.

Test Plan Title: **Testing the optics of the region 2F&G for ε-measurement**

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Brief Purpose of Test

This testplan is intended to verify that a "good" optics suitable for transverse emittance measurement in the 2F & 2G region can be achieved. We present two different settings: one allows emittance measurement in the wiggler insertion, using multi-monitor and in the 2G dump using quad-scan. The other setup permits emittance measurement in the wiggler insertion using quad-scan.

Anticipated Benefits

The setup herein will be use for transverse emittance measurements in the wiggler insertion line, to verify the proper beam parameters needed for turning on the FEL are achieved, and to study potential CSR-induced emittance growth as the beam propagates through the decompressor chicane.

Beam Conditions Required

Complete all of the following tables, entering a value or an **X** in the appropriate spaces:

Beam Type/Current (enter value)

Beam Type	Beam Current
Beam Off	
Pulsed (std. current = 1 μA)[a]	OTR limited (60 or 135pC)
CW	

a. The standard current for pulsed beam operation is 1 μA. If your test requires pulsed beam current >1 μA, then specify the required current and provide a brief explanation next to the specified current.

Beam Energy (select one)

Beam Off	350 keV	10 MeV	42 MeV	Energy Recovery dump
			X	

Beam Termination Point (select one)

Inj Dump	ER Dump	Straight Ahead Dump	Other (specify)
		X	

Type of Test (select one)

Invasive (disrupts beam delivery)	Non-invasive (does not disrupt beam delivery)
X	

Time Required

1 Shift

Preferred Time of Test

None

Staff Required to Execute the Test (including contact info)

P. Piot (X/Pgr: 5032), or D. Douglas (X/Pgr: 7512) or R. Li (X/Pgr: 7069)

Controlled Access Requirements

None

Hardware and/or Software Changes Required

NOTE: If software changes are part of the test plan, include the name of the application, the old revision level, the new revision level, and if applicable, whether or not it is possible to roll back to the old revision level (are there hardware limitations, etc.).

This testplan assumes the wiggler is removed

Insert limit stoppers on the OTR's wiggler to prevent the beam from going through the holes. If you cannot satisfy this hardware requirement, then we will have to do some steering to create an orbit bump in the wiggler insertion (see below).

Setup Procedure

1. Setup pulsed beam up to the straight ahead dump with the nominal optics

Test Procedure

EMITTANCE MEASUREMENT 2G-2F OPTICS A

This part is intended to setup the optics for transverse emittance measurement using multi-monitor technique in wiggler insertion and quad-scan technique in the 2G-dump line

1. Load the file ******* that contains the DIMAD predicted quad settings for the 2F-2G line needed for emittance-measurement.
2. ***IF YOU CANNOT USE STOPPERS ON THE WIGGLER OTRs***: we need to create an orbit bump in the wiggler insertion line
   - **a.** Pull up the bpm spike screen “absolute beam positions”
   - **b.** Apply a small kick to the beam using corrector MDJ2F00V
   - **c.** Using the corrector MDH2F02V apply a (vertical) kick in the opposite direction of the one applied on MDJ2F00V so that both BPMs IPM2F02 and IPM2F04 read approximately the same y position
   - **d.** Using corrector MDH2F04V apply a kick in the opposite diection of the one applied on MDJ2F00V and use MDJ2F06V to approximately zero the beam position on the BPM ITV0F09
   - **e.** Iterate sub-steps (a) to (d) utill you have achieved a sufficient offset on the BPM’s IPM2F02/F04 (i.e. about 1 mm)
   - **f.** Verify you can see the whole beam spot on the ITV2F03/03A/03B viewers if not call the on-call PI.
3. Insert OTR’s ITV2F03A, ITV2F03B and ITV2F03C and each time record rms beam spot size in Table 1. To do so, look at the procedure “quantitative measurement of beam spot size with the MAXVIDEO”..

Table 1: beam spot size on wiggler OTR’s

trial #	ITV2F03A σx, σy	ITV2F03B σx, σy	ITV2F03C σx, σy
#1			
#2			
#3			

4. Verify the difference between two of the three RMS beam sizes is more than 20%. If you cannot easily see the beam spot on the OTRs (and extract RMS values), it means additional focussing may be needed: call the on-call PI
5. Start the script *beast.tcl* to perform an emittance measurement using the multi-monitor technique in the wiggler insertion (the code will guide you through the steps of the procedure)

6. Note the measured emittance and Twiss parameters:
   ε=_____mm-mrad
   α=_____
   β=_____m
7. Insert ITV2G00 and measure beam spot size
   σx=_____
   σy=_____
8. Vary quadrupole MQG2F09 (nominally it should not be excited) and verify the beam position does not change on ITV2G00. If it does, you need to center the beam in the quadrupole MQG2F09 using the corrector pair MDB2F06H/V. If you change the correctors settings, print a harcopy of the corrector screen.
9. Vary quadrupole MQG2F09 (nominally it should not be excited) and make sure with sufficient high (negative and positive) gradient, you can achieve a beam spot size that at least twice as large as the above noted value and record the gradient for which beam spot is twice as large as above value:
   g+=_____
   g-=_____
10. Start the script *beast.tcl* to perform an emittance measurement using quad-scan technique with MQG2F09/ITV2G00 (the code will guide you through the steps)
11. Note measured emittance and courant snyder parameters:
    ε=_____mm-mrad
    α=_____
    β=_____m

SAVE SETTINGS

1. Print a hardcopy of the BPM absolute position screen for regions 2F and 2G
2. Print a hardcopy of the beam spot on each of the OTR's of the wiggler line including ITV2F01, 2F05, 2F09, 2G00
3. Save all corrector settings and quad settings in the region 2 in file:
   _____
4. **Download the nominal machine settings that were in use before this testplan, and make sure the correctors that have been changed are back to their <u>nominal values</u>.**

EMITTANCE MEASUREMENT 2G-2F OPTICS B

This part is intended to setup the optics for transverse emittance measurement using quad-scan technique in the wiggler insertion.

1. Load the file ******** that contains the DIMAD predicted quad settings to achieve a sufficent a round beam before the quadrupole MQB2F04, so that the beam parameters can be measured varying this quad and measuring the beam

size on ITV2F05.

2. Note the value of MQB2F04: _____
3. Insert ITV2F05, and note rms beam spot size:
   σx=_____
   σy=_____
4. Insert ITV2F05, vary MQB2F04 excitation and make sure the beam spot is not moving. It the spot moves you need to center the beam in quad MQB2F04 using the corrector pair MDB2F02H/V. If so print a hardcopy of the corrector screen.
5. Vary quadrupole MQB2F04 and make sure with sufficient high (negative and positive) gradient, you can achieve a beam spot size on ITV2F05 that at least twice as large as the above noted value and record the gradient for which beam spot is twice as large as above value:
   g+=_____
   g-=_____
6. Start the script *beast.tcl* to perform an emittance measurement using quad-scan technique with MQB2F04/ITV2F05 (chose quad-scan technique from the main menu and then the code will guide you through the steps)
7. Note measured emittance and Twiss-parameters:
   ε=_____mm-mrad
   α=_____
   β=_____m
   The results should be identical to these obtained using the multi-monitor technique (within 10%). If not there is something wrong...

SAVE SETTINGS

1. Print a hardcopy of the BPM absolute position screen for regions 2F and 2G
2. Save all corrector settings and quad settings in the region 2 in file:
   _____

Backout Procedure

1. Restore initial value for the quads and corrector that have been modified.

Test Results

Optics setup for emittance measurement, and hopefully some preliminary measurments of potential emittance growth trought the decompressor chicane.