Rev Date: 09/16/2015
Author: Barrett Clay
Approved: 09/16/2015

Title	Name	Approval Date
Controls Infrastructure Group Leader	Ruslan Kadyrov	09/16/2015
ES&H Operations Manager	Lori Stiegler	09/16/2015
Quality Assurance Engineer	Joseph Zipper	09/16/2015

Serial No	Part No	Part Rev	ECN	Rev	ECN	Rev
	Beamline: 02-ID SIX					

Deviation & Waiver: _____

OP	Description	Name/Life #	Date	DR
10	Follow the ES&H and Personal Protective Equipment Requirements for the area.	R. Kadyrov 25392	12/19/16	
20	Verify measuring and test equipment used for this procedure contains a valid calibration label in accordance with NSLS-II Calibration Procedure PS-QAP-0901, where applicable. The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with NSLS-II Discrepancy Reporting Procedure PS-QAP-0002.	R. Kadyrov 25392	12/19/16	
30	BEAMLINE INFORMATION - This step shall be performed by the cognizant EPS Engineer. A) Record the relevant Beamline name on this sheet, in the box for "Part No". B) Review this entire traveler and write in the relevant drawing, software, and procedure numbers where required	R. Kadyrov 25392	12/19/16	
40	INSTALLATION VERIFICATION A) List the relevant drawing(s): Drawing No.: LT-EL-BL-ET-EPS-1020-99 Rev. No.: A Drawing No.: _____ Rev. No.: _____ B) Verify the following items are acceptable: ✓ System layout configured per drawing(s) ✓ System Labeled / Tagged	R. Kadyrov 25392	12/19/16	

OP	Description	Name/Life #	Date	DR
50	SOFTWARE CONFIGURATION A) Download PLC software to controller and verify it was accepted by the controller. B) Record the software part number: LT-EL-BL-EI-EPS-1020-J0 Part No.: _____ Rev. No.: _____	R. Kadyrov 25392	11/17/17	
60	ACCEPTANCE TESTING A) List relevant testing procedure PS-R-XFD-EPS-Chk-001 Procedure No.: _____ Rev. No.: 2 B) Verify acceptable completion of test procedure C) Attach test report to this traveler	R. Kadyrov 25392	11/17/17	
65	WATER LEAK DETECTION SYSTEM TEST Verify water leak detection system, as designed for this beamline, functions correctly.	R. Kadyrov 25392	11/7/16	
70	Verify All Traveler Operations Complete	R. Kadyrov 25392	11/17/17	
80	REVISION HISTORY (This step is informational and does not require signoff) Rev - Description - Date A First Release 8/27/2014 B OP#65 added 9/16/15 Joe Delong removed as approver Ruslan Kadyrov added as approver			

Beam Line: SIX 2-ID

Test Date: 12/19/16

EPS Engineer: Ruslan Kadyrov

BL Group Leader: Ignace Jarrige

Beam Line master spreadsheet: LT-R-XFD-CO-DR-SIX-002

Test Set 4a: EPS/PPS interface

For the primary Photon Shutter:

Front End: If *FRONT END ENABLE STATUS* and *FOE SECURE* and not *USER INTERLOCK* command the front end shutter to open.

Front end opens and ***FRONT END OPEN STATUS*** = OPEN: ✓

Command the front end shutter to close.

Front end closes and ***FRONT END OPEN STATUS*** = CLOSED: ✓

With the front end open force a user interlock.

Front end closes and ***FRONT END OPEN STATUS*** = CLOSED: ✓

Attempt to open the front end shutter through EPICS while not all gate valves in white-beam region down to next secondary shutter are open.

Front end cannot be opened through EPICS: ✓

For each secondary photon shutter:

If PHOTON SHUTTER x ENABLE STATUS = 1 (ABILITY TO OPEN) and ESEE x SECURE command the shutter to open.

Shutter opens and **PHOTON SHUTTER x *OPEN STATUS*** = OPEN ✓ ✓

Command the shutter to close.

Shutter closes and **PHOTON SHUTTER x *OPEN STATUS*** = CLOSED ✓ ✓

Attempt to open the shutter through EPICS while not all gate valves in white-beam region downstream the shutter are open.

Shutter cannot be opened through EPICS: ✓ ✓

Prepared by:

X

Barrett T. Clay
Document Preparer

Approved by:

X

Ruslan Kadyrov
Deputy Controls Group Leader
Controls Infrastructure

X

Ignace Jarrige
Appropriate Beamline Group Leader

NSLS-II

NATIONAL SYNCHROTRON LIGHT SOURCE II

Beamline EPS Acceptance Testing

Rev Date: 09/16/2015
Author: Barrett Clay
Approved: 09/16/2015

Title	Name	Approval Date
Controls Infrastructure Group Leader	Ruslan Kadyrov	09/16/2015
ES&H Operations Manager	Lori Stiegler	09/16/2015
Quality Assurance Engineer	Joseph Zipper	09/16/2015

Serial No	Part No	Part Rev	ECN	Rev	ECN	Rev
	Beamline: 02-ID SRX					

Deviation & Waiver: _____

OP	Description	Name/Life #	Date	DR
10	Follow the ES&H and Personal Protective Equipment Requirements for the area.	R. Kadyrov 25392	11/3/16	
20	Verify measuring and test equipment used for this procedure contains a valid calibration label in accordance with NSLS-II Calibration Procedure PS-QAP-0901, where applicable. The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with NSLS-II Discrepancy Reporting Procedure PS-QAP-0002.	R. Kadyrov 25392	11/3/16	
30	BEAMLINE INFORMATION - This step shall be performed by the cognizant EPS Engineer. A) Record the relevant Beamline name on this sheet, in the box for "Part No". B) Review this entire traveler and write in the relevant drawing, software, and procedure numbers where required	R. Kadyrov 25392	11/3/16	
40	INSTALLATION VERIFICATION A) List the relevant drawing(s): Drawing No.: LT-EL-BL-ET-EPS-1020_90 Rev. No.: A Drawing No.: _____ Rev. No.: _____ B) Verify the following items are acceptable: ___System layout configured per drawing(s) ___System Labeled / Tagged	R. Kadyrov 25392	11/3/16	

OP	Description	Name/Life #	Date	DR
50	SOFTWARE CONFIGURATION A) Download PLC software to controller and verify it was accepted by the controller. B) Record the software part number: Part No.: LT-EL-BL-EI-EPS-1020_70 Rev. No.: A	GB G. Bischet	11/7/16	
60	ACCEPTANCE TESTING A) List relevant testing procedure Procedure No.: PS-R_XFD-EPS_CHK-001 Rev. No.: 1 B) Verify acceptable completion of test procedure C) Attach test report to this traveler	R. Kadyrov 25392	11/7/16	
65	WATER LEAK DETECTION SYSTEM TEST Verify water leak detection system, as designed for this beamline, functions correctly.	R. Kadyrov 25392	11/07/16	
70	Verify All Traveler Operations Complete	R. Kadyrov 25392	11/7/16	
80	REVISION HISTORY (This step is informational and does not require signoff) Rev - Description - Date A First Release 8/27/2014 B OP#65 added 9/16/15 Joe Delong removed as approver Ruslan Kadyrov added as approver			

Beam Line: SIX 2-ID

Test Date:

EPS Engineer: Ruslan Kadyrov

BL Group Leader: Ignace Jarrige

Beam Line master spreadsheet: LT-R-XFD-CO-DR-SIX-002

Pre-test setup:

Connect PPS interface test box at beam line EPS/PPS interface connector.

The Beam Line Master Spreadsheet contains a comprehensive list of all EPS related signals. As this test plan is executed note the results in the "test results" column of this spreadsheet.

Test Set 1: Vacuum

Vacuum Section:

Starting conditions: pressure at or below acceptable limits, GVs open.

Simulate pressure rise (toward poor vacuum) by disabling the vacuum gauge controller channel. Ensure EPICS PVs enter proper alarm states, photon shutter closes[1] and vacuum section is isolated. Two local gate valves and one (or more, if it is required to isolate upstream section, e.g. section branching) upstream gate valve close. Record results for the following:

EPICS PV Alarm

EPS fault

Photon Shutter closes

GVx closes

GVy close:

GVz closes

Attempt to open the front end shutter and gate valves through EPICS.

Photon shutter and gate valves cannot be opened through EPICS (1)

Enable vacuum gauge controller and ensure EPICS alarms clear. Open gate valves and photon shutter through EPICS.

Photon shutter and gate valves can be opened through EPICS (2)

[1] if the intensity of the beam in the section cannot cause damage to its valves, poor vacuum doesn't have to cause shutter close

Gauge name:	EPS fault:				(1)	(2)
	Shutter:	d/s GV:	u/s GV:	D u/s:		
XF:02IDA-VA{BC:1-CCG:1_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{BC:1-TCG:1_1}	—	—	—	n/a	✓	✓
XF:02IDA-VA{BC:1-CCG:2_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{BC:1-TCG:2_1}	—	—	—	n/a	✓	✓
XF:02IDA-VA{Diag:1-CCG:3_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{Diag:1-TCG:3_1}	—	—	—	n/a	✓	✓
XF:02IDA-VA{Mir:1-CCG:4_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDA-VA{Mir:1-TCG:4_1}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:6-CCG:6_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:6-TCG:6_1}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:7-CCG:7_3}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-TCG:7_3}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:8-CCG:8_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:8-TCG:8_1}	—	—	—	—	✓	✓
XF:02IDB-VA{Mono:1-CCG:9_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{Mono:1-TCG:9_1}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:10-CCG:10_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-TCG:10_1}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:10-CCG:10_3}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-TCG:10_3}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:10-CCG:10_5}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-TCG:10_5}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:11-CCG:11_1}	—	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:11-TCG:11_1}	—	—	—	—	✓	✓
XF:02IDB-VA{BT:11-CCG:11_3}	—	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:11-TCG:11_3}	—	—	—	—	✓	✓
XF:02IDC-VA{BT:11-CCG:11_4}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:11-TCG:11_4}	—	—	—	—	✓	✓
XF:02IDC-VA{BT:12-CCG:12_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:12-TCG:12_1}	—	—	—	—	✓	✓
XF:02IDC-VA{Mir:3-CCG:13_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Mir:3-TCG:13_1}	—	—	—	—	✓	✓
XF:02IDC-VA{BT:14-CCG:14_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:14-TCG:14_1}	—	—	—	—	✓	✓
XF:02IDC-VA{Slt:1-CCG:15_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Slt:1-TCG:15_1}	—	—	—	—	✓	✓
XF:02IDC-VA{BT:16-CCG:16_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:16-TCG:16_1}	—	—	—	—	✓	✓
XF:02IDC-VA{BT:16-CCG:17_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:16-TCG:17_1}	—	—	—	—	✓	✓
XF:02IDC-VA{Mir:4-CCG:18_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Mir:4-TCG:18_1}	—	—	—	—	✓	✓

Simulate pressure rise (toward poor vacuum) by disabling the vacuum pump controller channel. Ensure EPICS PVs enter proper alarm states, photon shutter closes[2] and vacuum section is isolated. Two local gate valves and one upstream (or more, if it is required to isolate upstream section, e.g. section branching) gate valve close. Record results for the following:

EPICS PV Alarm

EPS fault

Photon Shutter closes

GVx closes

GVy closes

GVz closes

Attempt to open the front end shutter and gate valves through EPICS.

Photon shutter and gate valves cannot be opened through EPICS (1)

Enable vacuum pump controller and ensure EPICS alarms clear. Open gate valves and photon shutter through EPICS.

Photon shutter and gate valves can be opened through EPICS (2)

Repeat for each vacuum section on beam line. For the sections adjacent to Front end and End Station, also simulate poor vacuum signal from remote systems.

EPS fault:	Front end:	End station:
Photon Shutter closes	FE SH *	n/a
GVx closes GV:2	✓	n/a
GVy closes	n/a	n/a
GVz closes	n/a	n/a
Shutter and GVs cannot be opened	✓	n/a

* FE SH = Front End shutter closes, tested to the interface connector

[2] if the intensity of the beam in the section cannot cause damage to its valves, poor vacuum doesn't have to cause shutter close

Gauge name:	EPS fault:				(1)	(2)
	Shutter:	d/s GV:	u/s GV:	D u/s:		
XF:02IDA-VA{BC:1-IP:1_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{BC:1-IP:1_2}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{BC:1-IP:2_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{Diag:1-IP:3_1}	FE SH	✓	✓	n/a	✓	✓
XF:02IDA-VA{Mir:1-IP:4_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:6-IP:6_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-IP:7_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-IP:7_2}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-IP:7_3}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-IP:7_4}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:7-IP:7_5}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:8-IP:8_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{Mono:1-IP:9_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-IP:10_1}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-IP:10_2}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-IP:10_3}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-IP:10_4}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:10-IP:10_5}	FE SH	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:11-IP:11_1}	—	✓	✓	✓	✓	✓
XF:02IDB-VA{BT:11-IP:11_2}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:11-IP:11_4}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:12-IP:12_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Mir:3-IP:13_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:14-IP:14_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:14-IP:14_2}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Slt:1-IP:15_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Slt:1-IP:15_2}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:16-IP:16_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{BT:17-IP:17_1}	—	✓	✓	✓	✓	✓
XF:02IDC-VA{Mir:4-IP:18_1}	—	✓	✓	✓	✓	✓

FE SH - Front End Shutter closes, tested to the interface connector. The test set has to be repeated upon the PPS completion.

Test Set 2: Water flow

Water flow Section:

Record initial flow through section with all valves fully open.

Slowly close supply valve and record the LOW and LOW LOW PV Alarm levels.

If the channel is associated with an EPS actionXFD-EPOS, also register the flow at which the EPS fault occurs. Ensure cable disconnection results in EPS action.

Repeat for each water circuit on beam line.

Sensor name:	Nominal flow: GPM	LOW:	LOLO:	EPS:
XF:02IDA-OP{Msk:WB}F:1-2A	—	—	—	— *
XF:02IDA-OP{Msk:WB}F:1-2B	—	—	—	— *
XF:02IDA-OP{Diag:1}F:3-3	1.91	1.2	1.2	FE SH
XF:02IDA-OP{DI:Mark}F	11.66	—	—	—
XF:02IDA-OP{Mirr1-Msk4-1}F:4A	—	—	—	— *
XF:02IDA-OP{Mirr1-Msk:4-1}F:4B	—	—	—	— *
XF:02IDA-OP{Mirr1}F:4-5	1.07	0.9	0.9	FE SH
XF:02IDA-OP{Mirr1-SH:4-D-1}F:6	1.08	0.7	0.7	FE SH
XF:02IDA-OP{PSh:2}F:5-7A	—	—	—	— *
XF:02IDA-OP{PSh:2}F:5-7B	—	—	—	— *
XF:02IDB-OP{Msk:PB}F:6-8A	—	—	—	— *
XF:02IDB-OP{Msk:PB}F:7-8B	—	—	—	— *
XF:02IDB-OP{Mono:1}F:9	0.9	0.75	0.75	FE SH
XF:02IDB-OP{Mono:1}F:10	0.55	0.35	0.35	FE SH
XF:02IDB-OP{Mono:1}F:11	0.86	0.65	0.65	FE SH
XF:02IDB-OP{Mono:1}F:12A	—	—	—	— *
XF:02IDB-OP{Mono:1}F:12B	—	—	—	— *
XF:02IDB-OP{PSh:Mono}F:13A	—	—	—	— *
XF:02IDB-OP{PSh:Mono}F:13B	—	—	—	— *
XF:02IDC-OP{Mirr3}F:14	0.59	0.2	0.2	FE SH

* PPS circuit, no reading from PPS flow interface. Test will be repeated on PPS completion

Test Set 3: Thermal

For each temperature transducer ensure the temperature measurement reports expected value.

Attach an appropriate adaptor and transducer simulator to the temperature input of the EPS system (remote IO chassis or Armor Block). Raise the temperature above each of the HI and HIHI PV alarm limits and ensure the alarm is reported. If the transducer is associated with an EPS interlock, continue to raise the temperature until the EPS trip level is exceeded. Ensure the appropriate EPS mitigation process occurs. Ensure channel cable disconnection results in EPS action.

Sensor name:	Temperature: °C	HI: °C	HIHI: °C	EPS: *
XF:02IDA-OP{Msk:1}T:1_I1	28.6	60.0	80.0	FE SH
XF:02IDA-OP{Msk:1}T:1_O1	28.4	60.0	80.0	FE SH
XF:02IDA-OP{Msk:1}T:1_B1	28.6	60.0	80.0	FE SH
XF:02IDA-OP{Msk:1}T:1_T1	28.5	60.0	80.0	FE SH
XF:02IDA-OP{Diag:1}T:3_B1	28.4	40.0	50.0	FE SH
XF:02IDA-OP{Diag:1}T:3_B2	28.4	40.0	50.0	FE SH
XF:02IDA-OP{Diag:1}T:3_B3	28.7	40.0	50.0	FE SH
XF:02IDA-OP{Diag:1}T:3_O1	28.6	40.0	50.0	FE SH
XF:02IDA-OP{Diag:1}T:3_O2	28.4	40.0	50.0	FE SH
XF:02IDA-OP{Diag:1}T:3_O3	27.7	40.0	50.0	FE SH
XF:02IDA-OP{Mir:1-Msk:4_U_1}T:1	28.7	50.0	60.0	FE SH
XF:02IDA-OP{Mir:1-Msk:4_U_1}T:2	28.7	50.0	60.0	FE SH
XF:02IDA-OP{Mir:1-Msk:4_D_1}T:1	28.9	50.0	60.0	FE SH
XF:02IDA-OP{Mir:1-Msk:4_D_1}T:2	26.1	50.0	60.0	FE SH
XF:02IDA-OP{Mir:1-BS:4_1}T:1	29.0	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-BS:4_1}T:2	28.2	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-IM:4_1}T:1	26.3	33.0	35.0	FE SH
XF:02IDA-OP{Mir:1-IM:4_1}T:2	26.8	33.0	35.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:T1	28.4	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:T2	25.5	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:B1	26.3	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:B2	26.2	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:O1	26.0	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:O2	25.7	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:I1	25.6	60.0	80.0	FE SH
XF:02IDA-OP{Mir:1-Slt:4_D_1}T:I2	25.6	60.0	80.0	FE SH
XF:02IDA-OP{Msk:2}T:5_1	28.0	35.0	40.0	FE SH
XF:02IDA-OP{Msk:2}T:5_2	27.4	35.0	40.0	FE SH
XF:02IDB-OP{Msk:3}T:6_1	26.3	35.0	40.0	FE SH

XF:02IDB-OP{Msk:3}T:6_2	26.7	35.0	40.0	FE SH
XF:02IDB-OP{Msk:4}T:7_1	26.0	35.0	40.0	FE SH
XF:02IDB-OP{Msk:4}T:7_2	27.7	35.0	40.0	FE SH
XF:02IDB-OP{Msk:5}T:8_1	26.3	35.0	40.0	FE SH
XF:02IDB-OP{Msk:5}T:8_2	26.9	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-Slt:8_U_1}T:T1	28.1	60.0	80.0	FE SH
XF:02IDB-OP{Mono:1-Slt:8_U_1}T:B1	25.0	60.0	80.0	FE SH
XF:02IDB-OP{Mono:1-Slt:8_U_1}T:O1	27.9	60.0	80.0	FE SH
XF:02IDB-OP{Mono:1-Slt:8_U_1}T:I1	27.8	60.0	80.0	FE SH
XF:02IDB-OP{Mono:1-Grt:9_1}T:1	26.3	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-Grt:9_1}T:2	28.1	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-Grt:9_3}T:1	—	—	—	— **
XF:02IDB-OP{Mono:1-Mir:9_1}T:1	24.4	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-Mir:9_1}T:2	26.4	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-IM:9_1}T:1	28.2	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-IM:9_1}T:2	28.0	35.0	40.0	FE SH
XF:02IDB-OP{Mono:1-IMA:9_D_1}T:1	28.4	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-IMA:9_D_1}T:2	28.3	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-EMA:9_D_1}T:1	23.0	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-EMA:9_D_1}T:2	22.7	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-Slt:9_D_1}T:T1	24.1	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-Slt:9_D_1}T:B1	23.7	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-Slt:9_D_1}T:O1	24.2	40.0	50.0	FE SH
XF:02IDB-OP{Mono:1-Slt:9_D_1}T:I1	23.9	40.0	50.0	FE SH
XF:02IDC-OP{Mir:3-IM:13_1}T:1	24.1	40.0	50.0	FE SH
XF:02IDC-OP{Mir:3-IM:13_1}T:2	23.7	40.0	50.0	FE SH
XF:02IDC-OP{Slt:1}T:15_1	23.7	40.0	50.0	FE SH
XF:02IDC-OP{Slt:1}T:15_2	23.5	40.0	50.0	FE SH
XF:02IDC-OP{Mir:4-Slt:18_U_1}T:T1	24.7	40.0	50.0	FE SH
XF:02IDC-OP{Mir:4-Slt:18_U_1}T:B1	24.9	40.0	50.0	FE SH
XF:02IDC-OP{Mir:4-Slt:18_U_1}T:O1	24.9	40.0	50.0	FE SH
XF:02IDC-OP{Mir:4-Slt:18_U_1}T:I1	24.8	40.0	50.0	FE SH
XF:02IDC-OP{Mir:4-IM:18_1}T:1	—	—	—	— **
XF:02IDC-OP{Mir:4-IM:18_1}T:2	24.1	40.0	50.0	FE SH

* FE SH - Front End Shutter interlock tested up to PPS connector.

** Gratings 2 & 3 are not in scope and were not installed.

Test Set 4: EPS/PPS interface

For the primary Photon Shutter:

Front End: If *FRONT END ENABLE STATUS* and *FOE SECURE* and not *USER INTERLOCK* command the front end shutter to open.

Front end opens and ***FRONT END OPEN STATUS*** = OPEN: ✓ *

Command the front end shutter to close.

Front end closes and ***FRONT END OPEN STATUS*** = CLOSED: ✓ *

With the front end open force a user interlock.

Front end closes and ***FRONT END OPEN STATUS*** = CLOSED: ✓ *

Attempt to open the front end shutter through EPICS while not all gate valves in white-beam region down to next secondary shutter are open.

Front end cannot be opened through EPICS:

For each secondary photon shutter:

If PHOTON SHUTTER x ENABLE STATUS = 1 (ABILITY TO OPEN) and ESEE x SECURE command the shutter to open.

Shutter opens and **PHOTON SHUTTER x *OPEN STATUS*** = OPEN ✓ *

Command the shutter to close.

Shutter closes and **PHOTON SHUTTER x *OPEN STATUS*** = CLOSED ✓ *

Attempt to open the shutter through EPICS while not all gate valves in white-beam region downstream the shutter are open.

Shutter cannot be opened through EPICS: ✓ *

* Tested to the interface connector

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