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| Traveler Title | LCLSII-HE LERF Prep & Cooldown | | | | |
| Traveler Abstract | Outlines the preparation for and Cool-Down of an LCLSII-HE Style Cryomodule in the LERF | | | | |
| Traveler ID | L2HE-LERF-CM-PREP | | | | |
| Traveler Revision | R1 | | | | |
| Traveler Author | Matthew Weaks | | | | |
| Traveler Date | 7-Feb-22 | | | | |
| NCR Informative Emails | Hogan,Huque | | | | |
| NCR Dispositioners | Drury | | | | |
| D3 Emails | Hogan,Huque,Drury | | | | |
| Approval Names | M. Weaks | N. Huque | L. King | M. Drury | J. Hogan |
| Approval Signatures |  |  |  |  |  |
| Approval Dates |  |  |  |  |  |
| Approval Title | Author | Reviewer | Reviewer | Reviewer | Project Manager |

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| References | List and Hyperlink all documents related to this traveler. This includes, but is not limited to: safety (THAs, SOPs, etc), drawings, procedures, and facility related documents. | | | |
| [Point to Point Wiring V2](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-137208/p2888v10_20160804_V2.6_LCLS-II_1.3GHzProto_JLAB_Instrument_Pt_to_Pt_wiring.xlsx) | [LERF Operational Safety Procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-190618/operational_safety_procedure_form_81378.pdf) |  |  |  |
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| Revision Note |  |
| R1 | Initial release of this Traveler. |

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| **Step No.** | **Instructions** | **Data Input** |
| 1 | Record the Cavity SN’s for each cavity position.  \*Note: Cavity 1-Supply Side; Cavity 8-Return Side | [[CMSN]] <<CMSN>>  [[Cav1SN]]<<CAVSN>>  [[Cav2SN]]<<CAVSN>>  [[Cav3SN]]<<CAVSN>>  [[Cav4SN]]<<CAVSN>>  [[Cav5SN]]<<CAVSN>>  [[Cav6SN]]<<CAVSN>>  [[Cav7SN]]<<CAVSN>>  [[Cav8SN]]<<CAVSN>>  [[IDsRecordedBy]]<<SRF>>  [[TimeIDsRecorded<<TIMESTAMP>>  [[PullCavSNsFromCMSNifPossible]]<<NOTE>> |
| 2 | Record whether the Cryomodule is installed level or tilted. | [[CMAlignment]] {{Tilted,Level}}<<RADIO>>  [[AlignmentCheckedBy]] <<SRF>>  [[TimeAlignmentRecorded]] <<TIMESTAMP>> |
| 3 | Attach ground cable to the Cryomodule.  Record username and time of completion. | [[GroundCableTech]] <<SRF>>  [[GroundCableTime]] <<TIMESTAMP>>  [[GroundCableComm]] <<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 4 | Verify that the Insulating Vacuum signal is connected to the data acquisition system, and is reading back correctly in EPICS.  **Verify the Insulating Vacuum is <1x10-4 Torr, if the Insulating Vacuum cannot be maintained below 1x10-4 Torr, generate an NCR.**  Record the Insulating Vacuum (In Torr).  Note any problems/issues in the comment box.  \*Note, in some cases it may not be possible to output the Insulating Vacuum signal to EPICS, in this case a pressure sensor capable of local readback must be installed to allow monitoring. | [[WarmInsVacTech]] <<SRF>>  [[WarmInsVacTime]] <<TIMESTAMP>>  [[WarmInsVacPressure]]<<SCINOT>> Torr  [[WarmInsVacComm]] <<COMMENT>> |
| 5 | Verify that the Beamline Vacuum signal is connected to the data acquisition system, and is reading back correctly in EPICS.  **Verify the Beamline Vacuum is <1x10-8 Torr, if the Beamline Vacuum cannot be maintained below 1x10-8 Torr, generate an NCR.**  Record the Beamline Vacuum pressure (In Torr).  Note any problems/issues in the comment box. | [[WarmBLVacTech]] <<SRF>>  [[WarmBLVacTime]] <<TIMESTAMP>>  [[WarmBLVacPressure]]<<SCINOT>> Torr  [[WarmBLVacComm]] <<COMMENT>> |
| 6 | Verify that the Warm Coupler Vacuum signals are connected to the data acquisition system, and are reading back correctly in EPICS.  **Verify the Warm Coupler Vacuum is <1x10-7 Torr, if the Warm Coupler Vacuum cannot be maintained below 1x10-7 Torr, generate an NCR**  Record the Warm Coupler Vacuum pressures (In Torr).  Note any problems/issues in the comment box. | [[WarmWCVacTech]] <<SRF>>  [[WarmWCVacTime]] <<TIMESTAMP>>  [[WarmWCVacPressure]]<<SCINOT>> Torr  [[WarmWCVacComm]] <<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 7 | Connect Stepper Motor and Main Coupler RTDs (Cavity X Connector A-02) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD or Stepper is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[Cav1A02]] <<CHECKBOX>>  [[Cav2A02]] <<CHECKBOX>>  [[Cav3A02]] <<CHECKBOX>>  [[Cav4A02]] <<CHECKBOX>>  [[Cav5A02]] <<CHECKBOX>>  [[Cav6A02]] <<CHECKBOX>>  [[Cav7A02]] <<CHECKBOX>>  [[Cav8A02]] <<CHECKBOX>>  [[A02Tech]]<<SRF>>  [[ConnectorA02Time]]<<TIMESTAMP>>  [[ConnectorA02Comments]]<<COMMENT>> |
| 8 | Connect Helium Vessel and HOM RTDs (Cavity X Connector A-03) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[Cav1A03]] <<CHECKBOX>>  [[Cav2A03]] <<CHECKBOX>>  [[Cav3A03]] <<CHECKBOX>>  [[Cav4A03]] <<CHECKBOX>>  [[Cav5A03]] <<CHECKBOX>>  [[Cav6A03]] <<CHECKBOX>>  [[Cav7A03]] <<CHECKBOX>>  [[Cav8A03]] <<CHECKBOX>>  [[A03Tech]]<<SRF>>  [[ConnectorA03Time]]<<TIMESTAMP>>  [[ConnectorA03Comments]]<<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 9 | Connect HOM and Beam Tube RTDs (Cavity X Connector A-04) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[Cav1A04]] <<CHECKBOX>>  [[Cav2A04]] <<CHECKBOX>>  [[Cav3A04]] <<CHECKBOX>>  [[Cav4A04]] <<CHECKBOX>>  [[Cav5A04]] <<CHECKBOX>>  [[Cav6A04]] <<CHECKBOX>>  [[Cav7A04]] <<CHECKBOX>>  [[Cav8A04]] <<CHECKBOX>>  [[A04Tech]]<<SRF>>  [[ConnectorA04Time]]<<TIMESTAMP>>  [[ConnectorA04Comments]]<<COMMENT>> |
| 10 | Connect Upstream (Connector L2-01) and Downstream (Connector E2-01) Liquid Level Probes to the data acquisition system, and verify that each is reading back correctly in EPICS.  **If either LL Probe is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[DownstreamLL]]<<CHECKBOX>>  [[UpstreamLL]]<<CHECKBOX>>  [[LLProbeTech]]<<SRF>>  [[LLCompleteTime]]<<TIMESTAMP>>  [[LLComments]]<<COMMENT>> |
| 11 | Connect Internal Helium Vessel RTDs for Cavities 5 and 8 (Connectors E2-02 and E2-04) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[Cav5HeSideRTD]]<<CHECKBOX>>  [[Cav8HeSideRTD]]<<CHECKBOX>>  [[HeSide58Tech]]<<SRF>>  [[HeSide58Timestamp]]<<TIMESTAMP>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 12 | Connect Internal Helium Vessel RTDs for cavities 1 and 4 (Connectors L2-03 and L2-04) RTDs to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[Cav1HeSideRTD]]<<CHECKBOX>>  [[Cav4HeSideRTD]]<<CHECKBOX>>  [[HeSide14Tech]]<<SRF>>  [[HeSide14Timestamp]]<<TIMESTAMP>> |
| 13 | Connect Split Quad and Corrector Magnet Diodes (Connectors F-01 through F-04) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any Diode is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorF01]]<<CHECKBOX>>  [[ConnectorF02]]<<CHECKBOX>>  [[ConnectorF03]]<<CHECKBOX>>  [[ConnectorF04]]<<CHECKBOX>>  [[MagnetDiodesTech]]<<SRF>>  [[MagnetDiodesTimeComplete]]<<TIMESTAMP>>  [[MagnetDiodesComments]]<<COMMENT>> |
| 14 | Connect Magnetic Shield, 5K Coupler, and Faraday Window RTDs (Connectors D-09 through D-11) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorD09]]<<CHECKBOX>>  [[ConnectorD10]]<<CHECKBOX>>  [[ConnectorD11]]<<CHECKBOX>>  [[MagShieldTech]]<<SRF>>  [[MagShieldTimeComplete]]<<TIMESTAMP>>  [[MagShieldComments]]<<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 15 | Connect Cool Down RTDs (Connectors K-01 through K-05) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any RTD is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorK01]]<<CHECKBOX>>  [[ConnectorK02]]<<CHECKBOX>>  [[ConnectorK03]]<<CHECKBOX>>  [[ConnectorK04]]<<CHECKBOX>>  [[ConnectorK05]]<<CHECKBOX>>  [[CoolDownRTDsTech]]<<SRF>>  [[CoolDownRTDsTimeComplete]]<<TIMESTAMP>>  [[CoolDownRTDsComments]]<<COMMENT>> |
| 16 | Connect the Cavity 1, 2, 5, 7 and 8 Fluxgates (Connectors D-05 and D-06) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If any Fluxgate is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorD05]]<<CHECKBOX>>  [[ConnectorD05]]<<CHECKBOX>>  [[FluxGateTech]]<<SRF>>  [[FluxGateTimeComplete]]<<TIMESTAMP>>  [[FluxGateComments]]<<COMMENT>> |
| 17 | Connect the Internal Helium Vessel Fluxgates for cavity 5 and 8 (Connector E2-02) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If either Fluxgate is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorE202]]<<CHECKBOX>>  [[HeV58Tech]]<<SRF>>  [[HeVFluxGate58TimeComplete]]<<TIMESTAMP>>  [[HeVFluxGate58Comments]]<<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 18 | Connect the Internal Helium Vessel Fluxgates for cavity 1 and 2 (Connector L2-02) to the data acquisition system, and verify that each is reading back correctly in EPICS.  Check off each connection as it is completed.  **If either Fluxgate is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ConnectorL202]]<<CHECKBOX>>  [[HeV12Tech]]<<SRF>>  [[HeVFluxGate12TimeComplete]]<<TIMESTAMP>>  [[HeVFluxGate12Comments]]<<COMMENT>> |
| 19 | Verify that Pressure Transducers (100 Torr, and 5000 Torr) are connected properly, and that each is reading back correctly in EPICS.  If necessary, isolate and calibrate the Pressure Transducers.  Check off each connection as it is completed.  **If either Pressure Transducer is determined to be non-functional, replace the sensor and verify functionality of the replacement.**  Note any problems/issues in the comment box. | [[PT100]]<<CHECKBOX>>  [[PT5000]]<<CHECKBOX>>  [[PTInstTech]]<<SRF>>  [[PTTimeComplete]]<<TIMESTAMP>>  [[PTComments]]<<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 20 | Verify the JT and CD Valve actuators are installed and set up properly.  Verify that each LVDT is set up correctly, and reading back properly in EPICS.  Run each valve through its full range, verify proper operation and readback.  **\*Note: This step must be completed before U-Tubes are stabbed. If any of the primary U-Tubes are in place, both JT and CD Valves must remain closed until cool-down.**  **If either Valve or LVDT is determined to be non-functional, generate an NCR.**  Note any problems/issues in the comment box. | [[ValveCheckTech]]<<SRF>>  [[ValveCheckTime]]<<TIMESTAMP>>  [[ValvesGood]]<<YESNO>>  [[ValveCheckComments]]<<COMMENT>> |
| 21 | Measure the Warm Cavity Passband Frequencies.  Enter the frequency data in a spreadsheet as measurements are taken.  Upload a copy of the spreadsheet when completed.  **\*Note: This measurement must be completed prior to the cooldown, and prior to any movement of the tuners** | [[WarmPassBandTech]]<<USERNAME>>  [[WarmPassBandTime]]<<TIMESTAMP>>  [[WarmPassBandComments]]<<COMMENT>>  [[WarmPassBandData]]<<FILEUPLOAD>> |
| 22 | Verify that all preceeding Cool Down Preparation steps have been completed, and that all requested information has been input into the appropriate fields.  This step must be completed before the cooldown operation can begin. | [[ReadyForCD]] {{drury,weaksmc,dsavr,king,michaelm}} <<HOLDPOINT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 23 | Record the date and time when the U-Tube installation was completed.  Note any issues or observations in the comment box. | [[UTubeTech]]<<SRF>>  [[UTubeInstallCompleteTime]]<<TIMESTAMP>>  [[UTubeInstallComments]]<<COMMENT>> |
| 24 | Record the date and time when the Primary 4K circuit has completed cool down.  Use the Lower Cavity 8 Diode as reference.  Note any issues or observations in the comment box. | [[4KCooldownOperator]] <<SRF>>  [[4KCooldownCompleteTime]]<<TIMESTAMP>>  [[4KCooldownComments]]<<COMMENT>> |
| 25 | Record the date and time when the Downstream Liquid Level reaches 78% (If the Cryomodule is level) or 81% (If the Cryomodule is tilted)  Note any issues or observations in the comment box. | [[4KFillOperator]] <<SRF>>  [[4KFillCompleteTime]] <<TIMESTAMP>>  [[4KFillComments]] <<COMMENT>> |
| 26 | Record the date and time when the Pumpdown to 2K has been completed.  Record the final pressure in the helium circuit as measured by the 100 Torr pressure transducer.  Note any issues or observations in the comment box. | [[2KPumpdownTime]] <<TIMESTAMP>>  [[PrimaryCircuitPressue]] <<SCINOT>> Torr  [[2KPumpdownComments]] <<COMMENT>> |
| 27 | Record the date and time when the Downstream Liquid Level reaches 78% (If the Cryomodule is level) or 81% (If the Cryomodule is tilted)  Note any issues or observations in the comment box. | [[2KFillOperator]] <<SRF>>  [[2KFillCompleteTime]] <<TIMESTAMP>>  [[2KFillComments]] <<COMMENT>> |

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| **Step No.** | **Instructions** | **Data Input** |
| 28 | Verify the Insulating Vacuum at 2K is <1x10-6 Torr.  **If the Insulating Vacuum cannot be maintained below 1x10-6 Torr at 2K, generate an NCR.**  Record the 2K Insulating Vacuum (In Torr).  Note any problems/issues in the comment box.  \*Note, in some cases it may not be possible to output the Insulating Vacuum signal to EPICS, in this case it may be necessary to read to Insulating Vacuum locally. | [[2KInsVacTech]] <<SRF>>  [[2KInsVacTime]] <<TIMESTAMP>>  [[2KInsVacPressure]]<<SCINOT>> Torr  [[2KInsVacComm]] <<COMMENT>> |
| 29 | Verify the Beamline Vacuum at 2K is <1x10-9 Torr.  **If the Beamline Vacuum cannot be maintained below 1x10-8 Torr at 2K, generate an NCR.**  Record the 2K Beamline Vacuum pressure (In Torr).  Note any problems/issues in the comment box. | [[2KBLVacTech]] <<SRF>>  [[2KBLVacTime]] <<TIMESTAMP>>  [[2KBLVacPressure]]<<SCINOT>> Torr  [[2KBLVacComm]] <<COMMENT>> |
| 30 | Verify the Warm Coupler Vacuum at 2K is <5x10-8 Torr.  **If the Warm Coupler Vacuum cannot be maintained below 5x10-8 Torr at 2K, generate an NCR**  Record the 2K Warm Coupler Vacuum pressures (In Torr).  Note any problems/issues in the comment box. | [[2KWCVacTech]] <<SRF>>  [[2KWCVacTime]] <<TIMESTAMP>>  [[2KWCVacPressure]]<<SCINOT>> Torr  [[2KWCVacComm]] <<COMMENT>> |
| 31 | Upload any Logfiles containing data from the cooldown. | [[CoolDownFiles]]<<FILEUPLOAD>> |