

LOCKOUT / TAGOUT PROCEDURE
FOR
D-ZERO HELIUM REFRIGERATOR DRY EXPANSION ENGINES
Written: R. BARGER 7/14/04 Revised: 11/16/05
Reviewed & Approved: _____ / ___ / ___

1.0 EQUIPMENT LOCATION: D-Zero Assembly Building, 3rd Floor Hi-Bay Refrigerator area.

2.0 EQUIPMENT IDENTIFICATION / DESCRIPTION:

One Dry Engine Distribution Valve Box, and two Dry Engine assemblies in individual cryostats, used for the D-Zero Helium Refrigerator. Engines are designated as North & East, referring to their positions relative to the Distribution valve box.

Service disconnects are located at the Dry engine Variable Speed Control boxes located on either side of the controls partition south of the dry Engine area. Additional isolation may be effected by unplugging the weld-style connections directly on the engine motor / generators, *and the large MIL-SPEC connector on the bottom left hand side of the junction box mounted on the engine shell.*

3.0 SCOPE OF WORK:

- 3.1** This procedure applies to all work performed on either Dry engine package, which involves: Removal of safety guards; disassembly of pressure components (a.k.a. “wetted parts”) in the process stream; or work on high voltage components.
- 3.2** All work on Dry engine components described in 3.1 involving removal of safety guards or disassembly of pressure components shall require both ELECTRICAL and MECHANICAL lockout sections of this procedure.
- 3.3** Due to the presence of electrical drive motors which also act as generators when driven by process pressure, both the MECHANICAL and ELECTRICAL lockout sections of this procedure must be followed; even for exclusively electrical work on drive components.
- 3.4** Excluded from this requirement is work on components designed with provision for isolation and venting for routine maintenance (e.g. small sensor lines & gauges which can be valved off from process, and minor adjustments to operating control components which do not require opening pressure boundaries or removal of guards).
- 3.5** Excluded from this requirement is electronics work on low voltage signal elements such as temperature and pressure transducers which do not require removal of machine guards for access.
- 3.6** *Excluded from this requirement is work in the control junction box on the engine: provided the control power MIL-SPEC connector has been disconnected.*

4.0 AUTHORIZED PERSONS:

All D-Zero Cryogenic Operating Crew and supervisors, with LOTO Level II and current Specific LOTO Procedures training, are authorized to perform this procedure.

5.0 NOTIFICATIONS:

In addition to affected personnel, the following persons shall also be notified **prior** to initiating this procedure, depending on the conditions as noted below to trigger notification:

- A) **PROJECT ENGINEER or his Designated on-call Staff member for the current month** (R. Rucinski X2888 pgr.: 630-218-3927, cell ph. 630-846-2527 also see the current On-Call Staff list) Whenever an engine switchover is contemplated, or when work on an offline Dry Engine will make the offline engine unavailable for more than three days; or whenever **both** engines may be offline for more than the normal switchover time of 20-30 minutes).
- B) **SHIFT CAPTAIN, D-ZERO CONTROL ROOM:** (x8800) Whenever a change from one engine to the other is contemplated. Engine switchovers should be coordinated with data taking operations ahead of time whenever possible, as they have impact on VLPC cryostat temperatures and can affect experimental data.

6.0 SOURCES OF HAZARDOUS ENERGY:

- 6.1 240V.D.C high voltage electrical power may be present. *DC power is controlled at the Dry Engine Variable Speed Control cabinets labeled "North" or "East", respectively, for each dry engine, located on either side of the controls partition south of the dry engine area.*
- 6.2 *120 V.A.C. high voltage electrical control power may be present. Control power may be isolated from the engine by removing the MIL-SPEC connector from the left underside of the control junction box mounted on the engine. This connector is identified with a yellow CAUTION tag.*
- 6.3 Pressurized helium at cryogenic temperatures may be present at pressures up to 350 psig and still be present after engine is isolated.
- 6.4 Expansion of cold helium may re-pressurize piping unless a vent path is provided.
- 6.5 Cold gases and cold surfaces may be present, at temperatures low enough to cause severe frostbite.
- 6.6 Unguarded rotating parts can produce severe injury, and may be driven by internal gas pressure even after electrical power is isolated. Also during un-powered hand rotation, the large mass of the parts can have enough inertia to produce injury. (e.g. belt / sheave pinching, cams /cam followers, etc.)

- 6.7** The DC engine drive motor / generator is capable of generating electrical current when driven by internal engine gas pressure; even after electrical power source is isolated.

7.0 LOCKOUT / TAGOUT CONTINUITY

7.1 Continuity of Lockout shall be provided as follows:

- 7.1.1** After the electrical disconnect, motor power cable connector, *control power cable*, and the corresponding Dry engine supply isolation valve for the engine to be maintained, are placed in the lockout position, a lockout device and lock shall be placed on the valve handle and secured with a lock. Lockout *devices* shall be placed on the cable plug *ends* and secured with a lock. The keys to these locks shall be captured on the ring portion of the group lockout device placed on the Dry Engine Variable Speed Control box electrical disconnect.
- 7.1.2** Each authorized employee who will work on the job shall place his/her lock & tag on the group lock device on the electrical disconnect.
- 7.1.3** When the job extends past the end of shift and is passed on to the next crew, **the relieving shift must place its locks & tags on the group lockout device before the shift to be relieved is permitted to remove their locks**, such that at no time is the group lockout without any locks.
- 7.1.4** When the job extends past the end of shift, but is **not** passed on to the relieving crew, the personnel involved in the job shall leave their locks on until the job is finished.
- 7.1.5** Prior to removing their locks & tags, the crew which finishes the job shall inspect the equipment and the work done on it to verify that the equipment has been returned to safe operating condition. This inspection shall also include checks that:
- All tools, materials and debris have been removed;
 - All machine guards and power enclosures have been reinstalled;
 - All drains and vents are closed
 - Individuals on the notification list above, and other affected workers have been notified of intent to return the equipment to operational status.

8.0 PREREQUISITE ACTIONS:

8.1 Planning and Coordination

- 8.1.1 Contact Shift Captain to coordinate equipment shutdown to minimize interference with operations and experiment data runs.
- 8.1.2 Meet with authorized persons who will be performing the work to review this procedure and plan the job tasks. This would include a Job Hazard Analysis covering hazards beyond the scope of this LOTO procedure, if any.

8.2 Performance Documents:

- Lockout Procedure (this document)
- Drawing# 3823.115-ME-317223 sheet 2 of 4.
- D-Zero Helium Refrigerator Operating Procedures: Section 8.1

8.3 Prepare Supplies, Tools & Equipment

- PPE face shield & cryo-gloves as needed, safety glasses,
- Lubricants, seals, parts etc.
- Waste containers, wipers
- Tools, Voltmeter, special fittings, *lockout devices & locks*.

8.4 Disable alarms for the Dry Engine to be shut down. (Computer Cryo page, items# 5 or 6).

8.5 Switch over to alternate Dry Engine using D-Zero Helium Refrigerator Operating Procedures: Section 8.1: Dry Engine Switch.

WARNING:
**FAILURE TO COMPLY WITH THE FOLOWING STEPS COULD RESULT IN
DEATH OR SERIOUS INJURY!**

9.0 LOCKOUT CHECKLIST:

- 9.1 **VERIFY** that the Supply (East=MV-2172, North=MV-2171) & Return (East=MV-2272, North=MV-2271) isolation valves for the expansion engine to be worked on are **CLOSED**.
- 9.2 **OPEN** Inlet Gauge vent valve (East=MV-2337, North=MV-2437). *This valve is left open to provide continuous verification that no pressure can build in the inlet chamber.*
- 9.3 **PRESS and HOLD** Purge override button for EV-2336 until it stops venting.
- 9.4 **INSERT** aluminum U-block on actuator stem to hold in open position and release button.
- 9.5 **CHECK** supply pressure gauge on distribution valve box bayonet (East=PI-2174, North=MV-2173) *for confirmation* that inlet pressure level has dropped.
- 9.6 **SWITCH** Power Disconnect on Dry Engine Variable Speed Control cabinet for the engine to be worked on, to the **OFF** position. (These cabinets are located on either side of the controls partition south of the Dry engine area.)
- 9.7 **UNPLUG** power cable connector at motor / generator.
- 9.8 **DISCONNECT** control power cable MIL-SPEC connector at engine junction box.

9.9 INSTALL lockout devices per 7.1.1 .

9.10 Each authorized employee, who will be performing the work, **ATTACH** their lock and tag on the group lockout device on the Power Disconnect.

10.0 VERIFICATION OF LOCKOUT

- 10.1 VERIFY** pressure is relieved by confirming no gas flow is exiting the opened Inlet Gauge vent valve (MV-2337= east; MV-2437=west)
- 10.2 CHECK** that variable speed control panel has no lights or lit display: (There should be none.)
- 10.3 CHECK** that red “Crash” button is not depressed.
- 10.4 STATION** a person to observe the engine.
- 10.5 ATTEMPT TO START** engine from the iFix Helium refrigerator page: click on Reset, then on Start in the dry engine control window graphic (Motor should not start.)

CAUTION

In the event that Variable Speed Control cabinet display shows lights or readout, or engine starts: IMMEDIATELY Press the red CRASH button to stop the unit; then call the Electrician to investigate. Do not proceed with work until the problem is corrected, and Verification of Lockout steps are repeated successfully.

- 10.6 CLICK** on STOP in the control window graphic. (Do not reset at this time).
- 10.7** If any electrical work on exposed conductors is to be done, the following electrical verification **MUST ALSO BE PERFORMED** by personnel wearing non-synthetic garments and safety glasses with side shields:
 - 10.7.1 TEST** a volt meter of appropriate range (0-600 VAC min.) on a known voltage source (e.g. for A.C., a working 110 VAC outlet; for D.C., use a 9-volt battery).
 - 10.7.2 VERIFY** that the weld style connector plug at the motor generator has been physically removed and enclosed in a locked lockout device. **This verifies the D.C only.**
 - 10.7.3 LOCATE** the *Control Power junction* box mounted on the side of the engine, and open the cover.
 - 10.7.4 VERIFY** that the large *MIL-SPEC control power connector with the yellow identifying tag, has been disconnected from the junction box and enclosed in a lockout device.*
 - 10.7.5 MEASURE** the voltages between the box ground and each terminal on the terminal strip inside. There should be no voltage present. Then re-close the cover.
 - 10.1.1 VERIFY** that the voltmeter has not failed during the measurement by re-testing on the same known source used in 10.7.1

CAUTION

If any of the terminals show voltage present, STOP. Call a qualified electrician to investigate. Do not proceed with work until the problem is corrected, and Verification of Lockout steps are repeated successfully.

11.0 PERFORM MAINTENANCE PROCEDURES

12.0 RETURN TO SERVICE

- 12.1 **VERIFY** that all machine guards, electrical enclosures, and access doors are installed and secured.
- 12.2 **VERIFY** that all tools, excess parts & materials, and debris have been removed from the unit.
- 12.3 **VERIFY** that all vents, drains have been closed.
- 12.4 **PERFORM** any pump & purge operations as required by the type of maintenance which has been done.
- 12.5 **PLACE** local controls in the OFF configuration.
- 12.6 **VERIFY** the overspeed brake trip lever has been reset.
- 12.7 **NOTIFY** all affected personnel and individuals who were contacted under Section 5.0 of the intent to return the unit to operational status.
- 12.8 **REMOVE** Locks and Tags.
- 12.9 **SEAT** the motor generator connector plug into its socket as far as it will go.
- 12.10 **RE-CONNECT** the *MIL-SPEC* connector to the junction box.
- 12.11 **SWITCH** the electrical disconnect on the Dry Engine Variable Speed Control cabinet to the ON position.
- 12.12 **FOLLOW** steps using D-Zero Helium Refrigerator Operating Procedures: Section 8.1: Dry Engine Switch, if putting unit on line immediately.

13.0 POST PERFORMANCE ACTIVITY

- 13.1 Return lockout locks to the LOTO station and close out the entry in the LOTO log.
- 13.2 Re-configure enabled alarms for the Dry Engine online.
- 13.3 Make return-to-operation-status entry in Operations Log.
- 13.4 Enter itemized details of work performed, parts replaced, and hourmeter reading in Engine Log.
- 13.5 Dispose of waste fluids and materials in accordance with applicable rules.