

## **"How to Open and Close the Toroids in the CDF Collision Hall"**

This procedure outlines the procedure to be used to open and close the East and West Toroids in the CDF Collision Hall.

Due to the weight and cost of a Toroid, it is required that the head of the Research Division review and approve this moving procedure.

Approvals:

\_\_\_\_\_  
( Safety Committee Head ) ( Date )

\_\_\_\_\_  
( CDF Department Head ) ( Date )

\_\_\_\_\_  
( Research Department Head ) ( Date )

\_\_\_\_\_  
( Accelerator Division Head ) ( Date )

**1.0 Controlled Copies of this procedure.**

Two controlled copies of this procedure will exist.

One will be held in the CDF Department Office.

One will be held in the CDF (B-0) Office Complex, Room 171i.

All other copies will be marked, " **INFORMATIONAL COPY ONLY** "

## **2.0 The Procedure**

### **STEP 1: Identify Key Personnel and their Responsibilities**

2.0.1: Objective: To identify the responsibilities of each individual involved in the movement of the Toroid.

2.0.2 Responsibilities:

a). **Co-Ordinator:** will oversee the movement operation from a distance great enough to easily see all personnel and equipment involved in the move and to watch for over-head obstructions. He will report any developing or potential problems to the Task Leader. At no time will the Co-Ordinator take over for the Task Leader. The Co-Ordinator is there to assist and insure that overall safety is being maintained.

b). **Responsible Engineer:** may be called on to function as the Co-Ordinator. May also be called upon to solve structural / mechanical problems such as how to move obstacles. He will be a structural or mechanical engineer designated by CDF.

c). **Task Leader:** will insure that all personnel under his direction have performed their maintenance checks of the equipment and will insure that the equipment is installed properly. He will make certain that his personnel are located in their designated areas before the move begins (to include Co-Ordinator or the Responsible Engineer). He will specify who will operate the equipment such as the hydraulic pump. He will move freely in the work area to insure that the movement of the Toroid is slow and completely controlled. His directions will be followed completely and therefore he becomes responsible for the safety of the personnel and equipment involved during the move. **NO** movement of the Toroid will be conducted without his presence.

d). **Workers:** will install all equipment and will insure that the equipment is serviceable and free from defects. They will keep the area clean and free from obstructions and will follow all directions from the Task Leader.

e). **Unified hydraulic jacking system operator:** will be designated by the Task Leader and will be qualified to operate the equipment used to raise / lower and push the Toroid. He will insure that his equipment is serviceable by conducting preventive maintenance and safety checks. He will follow all directions from the Task Leader.

f). **Overhead Watcher:** will be designated and positioned by the Task Leader to have an overall view of the top area of the Toroid being moved.

## **2.1 Operating Procedures for opening and closing Toroids in CDF Collision Hall**

The following procedures for opening and closing Toroids in the CDF Collision Hall will be followed with the strictest adherence to each step and will be verified by the Task Leader.

### **STEP 2: Area Preparation**

**CAUTION!** Rolling a Toroid over loose debris could cause the Hilman Rollers to bind or stop suddenly. This could cause damage to the Hilman Rollers or the Toroid.

2.1.1: Objective: To provide a safe working environment for the safety of the personnel as well as the Toroid and chambers.

2.1.2: Procedure: The area in which the Toroid will be moved, will have all obstacles moved clear of the area and will have the floor completely swept of debris. During the move, the workers will continuously verify that no objects are lying in the movement area. **All over-head obstacles will be cleared from the area.**

### **STEP 3: Key Equipment / Inspection of Equipment:**

2.1.3: Objective: To maintain proper performance of equipment for serviceability and safety.

2.1.4 Equipment:

A) Unified Hydraulic Jacking System: will be inspected for leaks, cracks or other defects. All surfaces will be cleared of all debris.

b). Hilman Rollers: will be free from defects, will roll easily, and will utilize a friction pad/spacer (fiberboard or plywood), between Hilman Roller and pad on Toroid.

c). Push Hydraulic Cylinders: will be inspected for leaks, cracks or other defects.

### **STEP 4: Placement of Equipment / Personnel**

**NOTE:** While conducting the move, all directions will be given ONLY by the Task Leader.

2.1.5 Objective: To position equipment / personnel to properly and safely move the Toroid.

### 2.1.6 Equipment / Personnel

- a). The Unified Jacking System Operator should always be in eye or voice contact with the Task Leader.
- b). The workers will be positioned so that they can identify problems with the Hilman Rollers, the hydraulic push cylinder, cribbing and chambers. They will be able to confirm all overhead clearances.
- c). The Task Leader is free to move around the work area to supervise and give instructions.
- d). The Co-Ordinator will stay at such a distance to allow himself a clear view of all workers and the entire toroid. Overall safety is his key concern. To avoid confusion among the workers, the Co-Ordinator communicates to the Task Leader only.

**NOTE:** Use either 2.2 "Opening Procedure," or 2.3 "Closing Procedure."

**NOTE:** Forward Muon Personnel must be present to open or close Toroid

### 2.2 Opening Procedure.

2.2.1: Objective: To reposition a Muon Toroid in a slow, controlled manner so that safety to personnel and equipment is maintained.

#### **STEP 5: Points to check before beginning Toroid move**

2.2.2: Objective: To insure that Toroid is ready to move.

2.2.3 Complete Checklist under 3.0. To be completed by the Co-Ordinator.

**WARNING!** These items **MUST** be checked and confirmed before any moving operation is performed on the Toroid

#### **STEP 6: Starting/Stopping the move:**

**CAUTION!** A quick start or stop can cause damage to chambers.

**WARNING!** A very fast start/stop or impact into another object could cause damage to the chambers or personal injury.

2.2.4 A controlled, very slow move (approximately 6" per minute) of the Toroid is critical for maintaining accuracy in the location of the Toroid and more importantly, the safety of the workers.

**STEP 7:     **Confirming position of Hilman Rollers****

**WARNING!** Hands and fingers should never be placed between steel surfaces and jacks or Hilman Rollers. Loss of extremities could result.

2.2.5 Objective:     To confirm alignment of Hilman Rollers for straight movement

2.2.6             Confirming alignment of Hilman Rollers

- a).     Confirm that at least one (1) set of Hilman Rollers is parallel to the direction of travel.
- b).     Confirm that the distance between side plates of East and West Hilman Rollers is equal.

2.2.7 Objective:     To align Hilman Rollers to change direction of travel of Toroid.

2.2.8             Adjusting alignment of Hilman Rollers

- a).     Set Hilman Rollers to required position.

**STEP 8:     **Lowering the Toroid onto the Hilman Rollers:****

**WARNING:** Toroids must be Degaussed, using Procedure #504, before attempting to lower Toroid onto Hilman rollers.

**WARNING!** Hands and fingers should never be placed between hydraulic jack and Hilman Rollers.

**NOTE:**            Forward Muon personnel must be present when lowering Toroid.

2.2.9 Objective:     To safely lower the Toroid onto the Hilman Rollers, to allow the Toroid to be moved, using hydraulic push cylinder.

2.2.10 Lowering Procedures:

**CAUTION:**        Protect nearby cables from damage while installing hydraulic hose on hydraulic cylinders

- a).     Hook up hydraulic hoses per diagram 8.I.

b). The Task Leader will inspect the unified hydraulic lifting system for proper installation. He will verify that all equipment and personnel are in place before lifting begins.

**NOTE:** Mark Hydraulic Jack collar handle for revolution reference before turning handle.

c). Employing Unified Hydraulic Jacking System (using manual adjust), extend (2) lift cylinders closest to the beam line, to release the jack collar. Close "unify" and shut off valve.

d). Employing Unified Hydraulic Jacking System (using manual adjust) extend (2) lift cylinders furthest from the beam line, to release the jack collar. Close "unify" and shut off valve.

e). Confirm that "unified" valve is closed for each jack.

f). Open "shut off" valve for each jack.

g). Employing Unified Hydraulic Jacking System (using Unified jacking), extend (4) jacks to allow jack collar to move (2) revolutions down.

h). Turn hydraulic jack collar two (2) revolutions down.

i). Retract hydraulic jacks, placing load on Hillman Rollers.

**NOTE:** Remove and save Dielectric spacers from under pads and label location for re-installation.

**STEP 9: Moving one (1) half of the Toroid away from the Beam Pipe**

**CAUTION:** Protect nearby cables from damage while installing hydraulic hose on hydraulic cylinders

**CAUTION:** Make sure that cables do not get caught under Hillman Rollers.

**NOTE:** Forward Muon personnel must present while opening Toroid.

**NOTE:** Step 2 "Area Preparation" will be in effect during any portion of the Toroid move.

2.2.11 Objective: To safely move the Toroid on the Hillman Rollers and hydraulic jacks to a new position.

### 2.2.12 Moving Procedures

- a). Hook up hydraulic hoses per Diagram 8.2.
- b). The Task Leader will inspect the Unified Hydraulic Jacking System for proper installation. The Task Leader will inspect hose connections. He will verify that all equipment and personnel are in place before moving begins.
- c). Set up double-acting hydraulic jack and hardwood blocks to fill space between jacking pad and Toroid frame.
- d). Using hydraulic pump, double-acting hydraulic jack and hardwood blocks as required, push against the Toroid frame to open Toroid.
- e). Retract double-acting jack, and fill space between jacking pad and Toroid frame with hardwood blocks, as necessary.
- f). Repeat steps c and d, as necessary to move Toroid to desired position. **NOTE:** this should require the hydraulic push jack to be reset approximately (2) times.

### **STEP 10: Parking the Toroid off the Hillman Rollers (Optional)**

**WARNING!** Hands and fingers should never be placed between hydraulic jack and Toroid.

2.2.13 Objective: To safely raise the Toroid off the Hillman Rollers onto the hydraulic jacks to allow the Toroid to be stored.

### 2.2.14 Parking Procedures:

- a). The Task Leader will inspect the hydraulic lowering system for proper installation (Diagram 8.2). He will verify that all equipment and personnel are in position before lowering begins.
- b). Employing Unified Hydraulic Jacking System (using pressurize), pressurize (2) lift cylinders closet to the beam line to 1000 psi. Close "unify" and valve shutoff.



- c). Employing Unified Hydraulic Jacking System (using pressurize), pressurize (2) lift cylinders furthest from beam line to 1000 psi. Close "unify" and valve shutoff.
- d). Confirm unified valve is closed for each jack.
- e). Open shutoff valve for each jack.
- f). Employing Unified Hydraulic Jacking System (using unified jacking), extend (4) jacks to all jack collars to move (2) revolutions up.

**NOTE:** Revolutions up on the jack collar must equal the number of revolutions down in 2.2.8 (f). Return to mark.

- g). Lower the Toroid, to take the weight off the Hillman Rollers and put the weight on the hydraulic jack collars.
- h). Remove, clean and store hydraulic pump and hoses.
- i). Clean up any spilled hydraulic oil.

### **2.3 Closing Procedure.**

2.3.1: Objective: To reposition a Forward Muon Toroid in a slow, controlled manner so that safety to personnel and equipment is maintained.

#### **STEP 5: Points to check before beginning Toroid move**

2.3.2: Objective: To insure that Toroid is ready to move.

2.3.3 Complete Checklist under 3.1. To be completed by the Co-Ordinator.

**WARNING!** These items **MUST** be checked and confirmed before any moving operation is performed on the Toroid

#### **STEP 6: Starting / Stopping the move:**

**CAUTION!** A quick start or stop can cause damage to chambers.

**WARNING!** A very fast start/stop or impact into another object could cause damage to the chambers or personal injury.

2.3.4 A controlled, very slow move (approximately 6" per minute) of the Torrid is critical for maintaining accuracy in the location of the Toroid and more importantly, the safety of the workers.

**STEP 7:    Confirming position of Hilman Rollers**

**WARNING!** Hands and fingers should never be placed between steel surfaces and jacks or Hilman Rollers. Loss of extremities could result.

2.3.5 Objective:    To confirm alignment of Hilman Rollers for straight movement

2.3.6            Confirming alignment of Hilman Rollers

- a).    Confirm that at least one (1) set of Hilman Rollers is parallel to the direction of travel.
- b).    Confirm that the distance between side plates of East and West Hilman Rollers is equal.

2.3.7 Objective:    To align Hilman Rollers to change direction of travel of Torrid.

2.3.8            Adjusting alignment of Hilman Rollers

- a).    Set Hilman Rollers to required position.

**STEP 8:    Lowering the Toroid onto the Hillman Rollers:**

**WARNING:** Toroids must be Degaussed, using Procedure #504, before attempting to lower Toroid onto Hilman rollers.

**WARNING!** Hands and fingers should never be placed between hydraulic jack and Hillman Rollers.

**NOTE:**        Forward Muon personnel must be present when lowering Toroid.

2.2.9            Objective:    To safely lower the Toroid onto the Hilman Rollers, to allow the Toroid to be moved, using hydraulic push cylinder.

2.2.10          Lowering Procedures:

**CAUTION:**        Protect nearby cables from damage while installing hydraulic hose on hydraulic cylinders

- a).    Hook up hydraulic hoses per diagram 8.I.

b). The Task Leader will inspect the unified hydraulic lifting system for proper installation. He will verify that all equipment and personnel are in place before lifting begins.

**NOTE:** Mark Hydraulic Jack collar handle for revolution reference before turning handle.

c). Employing Unified Hydraulic Jacking System (using manual adjust), extend (2) lift cylinders closest to the beam line, to release the jack collar. Close "unify" and shut off valve.

d). Employing Unified Hydraulic Jacking System (using manual adjust) extend (2) lift cylinders furthest from the beam line, to release the jack collar. Close "unify" and shut off valve.

e). Confirm that "unified" valve is closed for each jack.

f). Open "shut off" valve for each jack.

g). Employing Unified Hydraulic Jacking System (using Unified jacking), extend (4) jacks to allow jack collar to move (2) revolutions down.

h). Turn hydraulic jack collar two (2) revolutions down.

i). Retract hydraulic jacks, placing load on Hillman Rollers.

**NOTE:** Remove and save Dielectric spacers from under pads and label location for re-installation.

**STEP 9: Moving one (1) half of the Toroid toward the Beam Pipe**

**CAUTION:** Protect nearby cables from damage while installing hydraulic hose on hydraulic cylinders

**CAUTION:** Make sure that cables do not get caught under Hillman Rollers.

**NOTE:** Forward Muon personnel must present while opening Toroid.

**NOTE:** Step 2 "Area Preparation" will be in effect during any portion of the Toroid move.

2.2.11 Objective: To safely move the Toroid on the Hillman Rollers and hydraulic jacks to a new position.

### 2.2.12 Moving Procedures

- a). Hook up hydraulic hoses per Diagram 8.2.
- b). The Task Leader will inspect the Unified Hydraulic Jacking System for proper installation. The Task Leader will inspect hose connections. He will verify that all equipment and personnel are in place before moving begins.
- c). Set up double-acting hydraulic jack and hardwood blocks to fill space between jacking pad and Toroid frame.
- d). Using hydraulic pump, double-acting hydraulic jack and hardwood blocks as required, push against the Toroid frame to open Toroid.
- e). Retract double-acting jack, and fill space between jacking pad and Toroid frame with hardwood blocks, as necessary.
- f). Repeat steps c and d, as necessary to move Toroid to desired position. **NOTE:** this should require the hydraulic push jack to be reset approximately (2) times.

**NOTE:** Hydraulic pressure will not be able to fully close Toroid. Bottoms will touch , tops may remain slightly open.

**NOTE:** Leave pressure on push cylinder. Close shutoff valve. Leave unified valve open.

**NOTE:** Some location adjustments may have to be performed to properly align Toroids. Perform these adjustments as necessary, using above procedures.

### **STEP 10: Parking the Toroid off the Hillman Rollers.**

**WARNING!** Hands and fingers should never be placed between hydraulic jack and Toroid.

2.3.13: Objective: To safely raise the Toroid off the Hillman Rollers onto the hydraulic jacks to allow the Toroid to be stored.

### 2.3.14 Parking Procedures:

- a). The Task Leader will inspect the hydraulic lowering system for proper installation (Diagram 8.1). He will verify that all equipment and personnel are in position before lowering begins.
- b). Re-install dielectric spacers In locations as noted on spacers when they were removed.
- c). Employing Unified Hydraulic Jacking System (using pressurize), pressurize (2) lift cylinders closet to the beam line to 1000 psi. Close "unify" and valve shutoff.
- d). Employing Unified Hydraulic Jacking System (using pressurize), pressurize (2) lift cylinders furthest from beam line to 1000 psi. Close "unify" and valve shutoff.
- e). Confirm unified valve is closed for each jack.
- f). Open shutoff valve for each jack.
- g). Employing Unified Hydraulic Jacking System (using unified jacking), extend (4) jacks to all jack collars to move (2) revolutions up.

**NOTE:** Revolutions up on the jack collar must equal the number of revolutions down in 2.2.8 (f). Return to mark.

- h). Release pressure and retract push cylinder to closed position.
- i). Remove and store cribbing
- j). Lower the Toroid, to take the weight off the Hillman Rollers and put the weight on the hydraulic jack collars.
- k). Remove, clean and store hydraulic pump and hoses.
- l). Clean up any spilled hydraulic oil.

**3.0 Checklist -- Opening Toroid**

NE \_\_\_\_\_ SE \_\_\_\_\_ NW \_\_\_\_\_ SW \_\_\_\_\_

3.0.1 Person completing Checklist \_\_\_\_\_ Date \_\_\_\_\_  
(Co-Ordinator)

3.0.2 The following **MUST** be checked and confirmed before any moving operation is performed.

\_\_\_\_\_ Confirm that power has been locked and tagged off to Toroid Power Supply, using proper LOTO procedures.

\_\_\_\_\_ Confirm that High Voltage has been turned off.

\_\_\_\_\_ Confirm that power cables on top of Toroid have been properly disconnected.

\_\_\_\_\_ Confirm that cables on top of Toroid are free to move.

\_\_\_\_\_ Confirm that all tools are away from separation line.

\_\_\_\_\_ If moving Toroid out to wall, confirm Cooling Water is disconnected.

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**3.1 Checklist -- Closing Toroid**

NE \_\_\_\_\_ SE \_\_\_\_\_ NW \_\_\_\_\_ SW \_\_\_\_\_

3.1.1 Person completing Checklist \_\_\_\_\_ Date \_\_\_\_\_  
(Co-Ordinator)

3.1.2 The following **MUST** be checked and confirmed before any moving operation is performed.

\_\_\_\_\_ Check mating surfaces for metal chips, etc. Wipe clean.

\_\_\_\_\_ Station observers at top and bottom of each chamber plane to keep chambers from hitting.

**NOTE:** Upper observers must wear a "Fall Protection" harness.



#### **4.0 Deviations from the Procedure**

Must be approved by the Responsible Engineer or Co-Ordinator.



## **5.0 Required Training and Authorized Training Personnel.**

5.0.1 To be a Responsible Engineer, the person must have several years experience as a Mechanical Engineer. The person must be designated by the CDF Department Head.

5.0.2 To be an Authorized Instructor, the person must have several years experience in the rigging field. The person must be designated by the Responsible Engineer.

5.0.3 When an Authorized Instructor is present, the operation may be declared to be a training session. No previous training is required by the other members of the team.

5.0.4 To be a Co-Ordinator: the individual must have a number of years of experience in the rigging field or have been trained by the "Authorized Instructors," in this procedure. The qualifications of this individual are evaluated by the Responsible Engineer or Authorized Instructor.

5.0.5 To be a Task Leader: the individual must have a number of years of experience in the rigging field or have been trained by the "Authorized Instructor," in the procedure. The qualifications of this individual are evaluated by the Responsible Engineer or the Authorized Instructor.

5.0.6 To be a Unified Hydraulic Jacking System Operator: the individual must be trained by the "Authorized Instructor," in this procedure. The qualifications of the individual are evaluated by the Responsible Engineer or the Authorized Instructor.

**6.0 Training Materials.**

None at this time.

**7.0 List of Trained People for this procedure.**

The most current copy of this training list must be kept with the controlled copy of this movement procedure, in the CDF Department Office and the CDF (B-0) Office Complex, Room 171 i. If the individual's name is not on the controlled copy list, then that individual is NOT authorized to operate the specified equipment.

**7.1 List of Responsible Engineers for this procedure:**

Name CARTER, HARRY ID # 3236  
Last, First

Name \_\_\_\_\_ ID # \_\_\_\_\_  
Last, First

Name \_\_\_\_\_ ID # \_\_\_\_\_  
Last, First

**7.2 List of Authorized Instructors for this procedure:**

Name SHOVAN, ROBERT ID # 851  
Last, First

Name \_\_\_\_\_ ID # \_\_\_\_\_  
Last, First

Name \_\_\_\_\_ ID # \_\_\_\_\_  
Last, First

**7.3 List of Co-Ordinators for this procedure:**

See "Training Attendance Forms," with Controlled Copy of procedure held in CDF (B-0) Office Complex, Room 171 i.

**ALL AUTHORIZED INSTRUCTORS ARE AUTHORIZED CO-ORDINATOR**

**7.4 List of Task Leaders for this procedure:**

See "Training Attendance Forms," with Controlled Copy of procedure held in CDF (B-0) Office Complex, Room 171 i.

**7.5 List of Unified Hydraulic Jacking System Operators:**

See "Training Attendance Forms," with Controlled Copy of procedure held in CDF (B-0) Office Complex, Room 171 i.

## **8.0 References and Supporting Documentation.**

None at this time