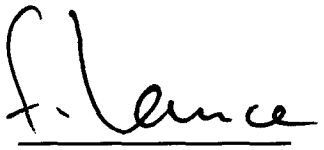
Fermilab
P.O. Box 500 Batavia, Illinois 60510

Beams Division Departmental Procedure
Mechanical Support Department
BDDP-ME-0129
MiniBooNE Target Station MI-12
Procedure for Changing, Handling, and Storing a Radioactive Horn and Installing a New Horn

Prepared by: Robert E. Reilly, P.E. Date of Preparation: 9-4-02
Mech. Engr. – B. D. Mech. Suppt. Dept.

Approved by:  Date of Approval: 4-16-04
Dept. Head – B. D. Mech. Suppt. Dept.

Revision: 1 Revision Issue Date: 12-16-03

Reviewed by: Hiepmle Date of Review: 01-20-04
Target Group Technical Leader – B. D. Mech. Suppt. Dept.

Reviewed by: V. Sidorov Date of Review: 01-20-04
Target Group Mech. Engr. – B. D. Mech. Suppt. Dept.

Reviewed by: Dan Wolff Date of Review: 1/26/04
Dept. Head – B. D. E/E Suppt. Dept.

Reviewed by: [signature] Date of Review: 4/8/04
Dept. Head – B. D. E., S. & H. Dept.

Reviewed by: [signature] Date of Review: 04/16/04
Project Leader – MiniBooNE project

Table of Contents

1.0 Purpose and Scope

The horn module in the MiniBooNe Target Station at the MI-12 service building is expected to become highly radioactive, up to 30 Rad/hr at 2 ft., and eventually expected to fail. In situ repairs are not expected to be feasible due to the radiation exposure, so the plan is for the entire horn module to be changed.

The old horn will be pulled directly into a steel coffin, which will be stored in the Target Service Building TSB in the old Proton line. A new horn will be installed by pushing it from a coffin directly into the MI-12 target shielding pile. This procedure describes all the steps required to do this.

This procedure assumes that the BPM instrumentation module and the target module will be discarded with the horn. In the event that only the beryllium target portion of the horn module is to be changed, a separate procedure has been written for that activity, BDDP-ME-0130. In the event that the BPM module is to be saved, it will be removed in accordance with certain steps included in BDDP-ME-0130.

This procedure is only intended to cover those activities which are performed by BDMS technicians. Although certain work listed in the steps of this procedure is performed by EE support techs, alignment, instrumentation and riggers, this document is not intended to delineate how to perform that work, nor to identify safety requirements specific to that work. Those groups are responsible for performing their work according to their own procedures and safety requirements.

2.0 Instructions

2.1 Preliminary preparations

2.1.1. LOTO requirements

The Beams Division Radiation Safety Officer will determine the LOTO requirements for a horn change. Devices to be locked out and/or tagged out include:

a. Horn power supplies
b. Radio Active Water (RAW) system power
c. Target Air Cooling (TAC) system power

2.1.2. Training requirements

All personnel participating in a horn change shall have current Radiological Worker CR training. Personnel disposing of radioactive waste shall have current Radioactive Waste Disposal Training. The crane operator shall have current Crane Operator training. Verification may be obtained by the FNAL TRAIN database. The Beams Division Radiation Safety Officer may specify additional training prior to the horn change.

2.1.3. Hardware certification

The lifting spreader beam used for handling horn coffins has been certified by the manufacturer, and reviewed by Fermilab in Engineering Note 1323-ES-296332.

2.1.4. Radiation safety and work permits

Prior to initiating any work associated with a horn change, a Radiation Work Permit shall be completed per the requirements of the Beams Division Radiation Safety Officer. Because of the high level of residual radioactivity in and around the horn, BD/Radiation Safety personnel will monitor and supervise horn change activities relevant to personnel radiation safety, and may specify additional precautions as deemed necessary on site during the horn change activities. All radioactive waste leaving the vault enclosure, other than the spent horn itself, shall be disposed of in accordance with Beams Division Radioactive Waste Disposal Procedure BDSP-10-0201. All personnel, tools and equipment leaving the enclosure shall follow the standard frisking procedures specified in Rad Worker Training. The securing and disposition of the spent horn shall be monitored and supervised by BD/RS personnel. Additional responsibilities of Radiation Safety include monitoring vault access, specifying clothing requirements, unlocking and re-securing appropriate radiation safety padlocks (e.g., Pad 118 locks controlled by the Radiation Safety Section), specifying special dosimetry requirements, and performing radiation surveys and contamination checks.

2.1.5. Special tools required

Long handled hooks are used to remove certain stripline parts. Long extensions and u-joints are used on socket wrench handles to raise and lower the horn on its 3-point support system.

2.1.6. Planning a horn change

Prior to performing a horn change, all Mechanical Support Department personnel involved in the activity and the BD/RSO or designee shall have a pre-job planning meeting to examine the steps required for the horn change. Goals of the meeting include:

a. Estimating the integrated exposure that workers will receive during the activity, and ensuring that it is as low as reasonably achievable (ALARA).
b. Establishing dosage points at which the job would be stopped.
c. Identifying additional radiation monitoring required for specific steps or during specific phases of the change activity (e.g., use of digital dosimeters, monitoring radiation levels with special detectors, checking surface contamination, etc.)
d. Establishing clothing, time, distance and shielding requirements for personnel during critical phases of the change.
e. Discussing previous horn changes.
f. Discussing any proposed deviations from the normal horn change procedure outlined herein. Such activities shall comply with applicable Fermilab Safety Standards.

2.2 General Instructions

In order to reduce the radiation exposure to under 100 mR/hr at 1 ft, the shielding requirement for the horn coffin is a minimum of 4.6" of steel on all sides, so the chosen thickness is 5" on all sides. Surplus steel of 1", 2" and 4" can be used to make the coffins a total of 5" wall thickness. Because a full 5" loaded coffin would be 78,000 lbs, exceeding the crane lifting capacity, the coffin is prefabricated as two separate coffins, an inner coffin, and an outer coffin, which together make 5" thickness on all sides. Because the ultimate depository of coffins containing hot horns is the Target Service Building TSB, which has a crane capacity of 20 tons, the inner loaded coffin and the outer shielding coffin have been designed so they do not exceed 20 tons weight each.

2.3 Removing an old horn module

1) Rad Safety conducts a survey under Controlled Access, noting any spilled water, and cleaning it up per Rad Safety procedures. Time Estimate 1-3 hrs.
2) BDEES techs shut off any power supplies not already locked out by the Controlled Access (LOTO required). Time Est. 0.1 hrs
3) BDMS techs shut off the Radio Active Water (RAW) system (LOTO required). Time Est. 0.1 hrs
4) BDMS techs shut off the Target Air Cooling (TAC) system (LOTO required). Time Est. 0.1 hrs
5) Supervised Access permit with Personal Protection Equipment and radiation monitoring as specified by Rad Safety.
6) BDMS techs shutoff the Low Conductivity Water system valves for the hoses to the magnets Q873, Q874, and Q875 and the TAC system. Time Est. 0.1 hrs

7) BDMS techs let up vacuum in the beamline, disconnect flanges between magnets HT872, Q873, Q874 and Q875, and remove bellows spool pieces. Rolling ladders will be needed for this and some subsequent operations. Time Est. 0.5 hrs
8) BDMS techs remove water hoses from magnets Q873, Q874, and Q875, and secure them out of the way. Time Est. 0.5 hrs
9) BDMS techs loosen two quick-disconnect flanges and remove the copper ring collimator CuCOLL875 and drop it into a steel shielding box for disposal. It is expected to be Class 3 or higher. Time Est. 0.2 hrs
10) BDEES and BD Instrumentation techs remove cables from magnets, multiwire, BPM's, toroid, loss monitors and other beamline components, and secure them out of the way. Time Est. 0.5 hrs
11) Rad Safety removes padlocks on target vault shielding. Time Est. 0.1 hrs
12) Riggers remove 93 "H" concrete shielding blocks from the pit, weight 11'550# each, 5 heavy "H" blocks weighing 18'000# each, and some steel filler plates, which are loaded on a flatbed or moved with a forklift and taken outside to be stored on the MI12 hardstand. Depending on the radiation levels of the blocks, fencing around the hardstand may be required. The blocks and steel filler plates are numbered for position. Between layers 5 and 4 there is an air barrier of Herculite which must be removed, taking note of how it was done so it can be redone later. Time Est. 40 hrs
13) Riggers remove any small hand-stacked radiation shielding blocks (if present) that may be in the way and stack them in the enclosure on a pallet. Time Est. 2 hrs
14) Alignment crew takes as-found measurements of magnets Q873, Q874 and Q875 before removal. Time Est. 1.0 hrs
15) Riggers remove magnet Q874 first, then its stand, leaving the ACME adjuster parts on a dolley in the vault. (rigging equipment needed). Time Est. 0.5 hrs
16) Riggers push Q875 upstream so it clears the horn striplines, then remove it, then its stand with the multiwire, BPM's and toroid, leaving the adjuster parts in the vault. Time Est. 0.75 hrs
17) Riggers push Q873 downstream so it clears the cable tray, then remove it, then its stand, leaving the adjuster parts in the vault. Time Est. 0.75 hrs
18) BDMS techs position the building crane to support each stripline as it is removed. Time Est. 0.2 hrs
19) BDMS techs on both the left and right sides of the horn, using hand tools and extensions (last section being flexible), loosen and remove the quick release clamps at the duct connection between the Stripline Section 1 and the horn, and remove the clam shell duct between Sections 1 and 2. Next the flexible ducts at both ends of Section 1 are pulled away from the joints and tied back to expose the joint clamps. The clamps are removed by alternately loosening the two screws to remove all tension, and then the clamps can be slid to the side away from the horn. Extract the four fluted ceramic bars at each joint. The crane is used to remove both Section 1 right side Stripline and Section 1 left side Stripline, weight approximately 150 lbs. each. Details of this operation are found in MSD Note MSDN-ME-000042 Stripline Connections. Time Est. 1.0 hrs
20) BDMS techs open valves and drain the RAW system water into the RAW skid reservoir tank. The supply and return piping may need to be blown out with air to get them sufficiently emptied that no water continues to drip out. Alternatively, the horn

module may be pitched up at the far end to get it to drain, using the vertical positioners in the adjuster module. Time Est. 2 hrs

21) BDMS techs disconnect the RAW system water return line NW50 flange joint at the horn, install a blank flange on the horn, undo the flange at the other end, and remove the length of pipe. Time Est. 0.2 hrs
22) BDMS techs disconnect six RAW system water supply line tube fittings from the horn module, one flange at the other end of the manifold, and move the supply tube manifold out of the way, capping all the ends to prevent any water spills. Time Est. 1.0 hrs
23) BDMS techs disconnect the two target module air circulation tube fittings near the horn, disconnect the two fittings away from the horn, remove two lengths of tube going to the horn, disconnect two joints at the target cooling system racks, and put caps on all the fittings to seal in any possible contamination from beryllium dust. Time Est. 0.5 hrs
24) BDMS and BD Instrumentation techs disconnect signal and power cables and water hoses and move the target air cooling TAC system racks (ME-416109) upstream 100 ft. Time Est. 0.2 hrs
25) BDMS and BD Instrumentation techs disconnect 8 BPM cables and 4 RTD cables from the bulkhead connectors. This procedure assumes that the BPM module and target module will be discarded with the horn. If the BPM module is to be saved, refer to BDDP-ME-0130 at this point. Time Est. 0.1 hrs
26) BDMS techs bring the rail structure (MC-389443, weight 5100#) and install it on the floor, leveling it with shims, for the horn coffin support trolley. Time Est. 1.0 hrs
27) BDMS techs remove air barrier panel below the horn to expose the adjuster module screws. Time Est. 0.5 hrs
28) BDMS techs crank down the adjuster module to lower the horn module onto its rollers inside the target stack using hand tools with extensions. See the MSD Note MSDN-ME-000041 Adjuster Module Operation. Time Est. 0.3 hrs
29) BDMS techs use a hand held sledge hammer to roll over the upstream edges of the horn transition duct flanges, so the edges will not touch the back wall of the coffin. Time Est. 0.1 hrs
30) BDMS techs bring the coffin support trolley (MD-389447), set it up in the pit on rails, and set the side guide rollers so the trolley is centered on the rails. (weight approx. 3600 lbs) Time Est. 0.3 hrs
31) BDMS techs bring the hydraulic cylinders and control units for moving the trolley and set the cylinders up on the rails. Time Est. 0.5 hrs
32) The yoke adapter pieces, FNAL dwg. MA-389450, are attached to the trolley. Time Est. 0.1 hrs
33) Alignment crew checks alignment of coffin support points on trolley, adjusts as necessary. Time Est. 1.0 hrs
34) Receiving Dept truck brings the first of two outer coffins (FNAL dwg MC-389359).
35) BDMS techs remove first outer coffin (weight approx. 19.5 tons) from the truck, using a special spreader bar (FNAL dwg. MD-389371) with foundry hooks which can be hooked and unhooked remotely by the crane operator (not by an assistant climbing on the coffin), swing it 90 degrees, and set it on the support trolley in the target vault (MI-12 crane capacity is 30 tons) Time Est. 0.2 hrs

36) Receiving Dept truck brings the inner coffin (FNAL dwg ME-389363, weight approx. 17 tons)
37) BDMS techs tie rope tag lines on small eyelets at the corners of the inner coffin; these are for swinging the coffin remotely while it is hanging on the crane hook. Time Est. 0.1 hrs
38) Using the special spreader bar (FNAL dwg. MD-389371), the inner coffin is lifted from the trailer, swung 90 degrees, and lowered into place inside the outer coffin on the support structure, ensuring that the plug bolt can be removed (the crane operator is above, guided by an assistant who is in the lower pre-vault area) Time Est. 0.2 hrs
39) Crane spreader bar is unhooked remotely from the coffin lifting eyes (not unhooked by someone on top of the coffin); the operator is above where he can see the hooks. Time Est. 0.1 hrs
40) Coffin door (3450#) is hooked by the spreader bar on the crane, raised by the crane, and removed from the area. Time Est. 0.2 hrs
41) Alignment crew checks that the coffin is aligned with the horn module rolling surfaces in the target stack. The highest point of the coffin door locating notches is 2" below the bottom of the "A" block above the horn. Time Est. 0.2 hrs
42) BDMS techs roll the coffin towards the shutter doors using hydraulic cylinders. Time Est. 0.2 hrs
43) BDMS techs block or C-clamp the Hilman rollers on the coffin trolley so it doesn't move. The hydraulic cylinders are removed from the trolley rails, and the support structure (FNAL dwg. no. MD-389448) for moving the horn module is set up on the rails. Time Est. 0.5 hrs
44) BDMS techs remove a plug-bolt (FNAL dwg MB-389360) in the inner coffin which secures the horn module hook-and-pulling mechanism (FNAL dwg MD-389370) inside the inner coffin, and attach a 2" dia. x 36" long extension rod (FNAL dwg MB-389425) for pulling the horn module, and a ½" dia. x 36" long extension rod (FNAL dwg MB-389426) for operating the hook. Use the rods with a threaded rod at each end first. Time Est. 0.1 hrs
45) Horn module hook-and-pulling mechanism is run out through the coffin to the downstream end (2" dia. and ½" dia. extension pieces are added for every 3 ft. of travel, a total of 18 ft.) and hooked to the horn module remotely by a tech stationed at the upstream end of the coffin, pulling on the ½" rod out about 1" to lift the hook, pushing in the 2" rod about 2", then pushing the ½" rod back in to drop the hook on the horn module trailer hitch. Pull on the 2" rod to see that the horn is well hooked, but do not rotate either of the rods. Time Est. 0.2 hrs
46) BDMS techs attach one hydraulic cylinder to the support structure, and attach a yoke adapter piece, FNAL dwg. MA-389450, to the 2" rod. Time Est. 0.3 hrs
47) ES&H removes padlocks on the shutter door hand cranks. Time Est. 0.1 hrs
48) BDMS techs open the shutter doors by hand cranks, 400 turns each. The cranks move the doors at a rate of 20 turns per inch. Time Est. 0.2 hrs
49) Horn module is pulled by the hydraulic cylinder from the target stack into the inner coffin, stopping to remove a pair of 3 ft. long extension pieces every 3 ft. of cylinder stroke, a total of six pulls. Time Est. 0.6 hrs
50) BDMS techs close the shutters by hand cranks, 400 turns each. Time Est. 0.2 hrs

51) Final pulling mechanism extension pieces are disconnected from the horn module hooking device, then the plug-bolt (FNAL dwg MB-389360) is screwed into the hook-and-pulling mechanism (FNAL dwg MD-389370), which secures the horn module inside the inner coffin. Time Est. 0.1 hrs
52) BDMS techs remove the hydraulic cylinder from the support structure, remove the support structure, and attach the two hydraulic cylinders to the rail. Time Est. 0.2 hrs
53) BDMS techs roll the coffin away from the shutter doors by hydraulic cylinders. Time Est. 0.2 hrs
54) Coffin door is hooked by the spreader bar on the crane, lifted and guided into place by guide lugs on the inner coffin, then the door is lowered into the closed position by the crane (a long sling may be needed if the crane pulley block is against the target shielding). All this is remotely, not with a person climbing on the coffin. If the spreader hooks are dragging against the shielding stack as the door is lowered, the coffin may have to be moved away from the stack about 1". Time Est. 0.3 hrs
55) Crane unhooks remotely. Time Est. 0.1 hrs
56) Cover Plate Plug (FNAL dwg MC-389358) is screwed into the outer coffin. Time Est. 0.1 hrs
57) BDMS techs place a temporary shielding block in front of the shutter doors to cover the open vault area. Time Est. 0.2 hrs
58) Receiving Dept. brings a second outer coffin (19.5 tons) on a low bed trailer of 40 tons capacity.
59) Crane operator remotely hooks the crane spreader bar onto the inner coffin lifting eyes (same lifting eyes because the center of gravity has moved only 0.9" with the addition of the horn module). Time Est. 0.1 hrs
60) Crane operator lifts the inner coffin containing the horn module (total weight approx. 19 tons). While the inner coffin is out of the outer coffin, the shielding is reduced to 1.5" on the sides, upstream end and bottom. Radiation is expected to be about 500 mR/hr @ 1 ft during this move, so appropriate ALARA measures are to be used. Time Est. 0.05 hrs
61) Inner coffin must be turned 90 degrees by BDMS techs pulling on tag lines from a distance. Time Est. 0.05 hrs
62) BDMS techs place the inner coffin inside the second outer coffin on the low bed trailer of 40 tons capacity. Time Est. 0.05 hrs
63) Receiving truck with the loaded coffin on the 40 ton trailer starts on its way to the Target Service Building TSB, at low speed. Radiation is now less than 100 mR/hr @1'. Time Est. 1.0 hrs
64) BDMS techs remove the first outer coffin (approx. 19.5 tons) from the vault and set it on another Receiving low bed trailer (this trailer need only be 20 tons capacity). Time Est. 0.2 hrs
65) Receiving Dept. takes the empty first outer coffin and the spreader bar with its cart to the Target Service Building storage enclosure (the doorway is 9' high, this is why we need low bed trailers), lifts the coffin with the spreader bar, (crane capacity in TSB is 20 tons) and offloads it onto a long railcar (railcar capacity is 40 tons, see dwg. 1210-ME-30673) Time Est. 0.5 hrs

66) Receiving Dept. truck with the inner and outer coffins containing the dead horn module (total weight approx. 40 tons) arrives at the Target Service Building and backs into the storage enclosure doorway. Time Est. 0.2 hrs
67) BDMS techs using the crane and spreader bar hook the inner coffin lifting eyes remotely. Time Est. 0.1 hrs
68) Lift up the inner coffin (weight approx. 19 tons) enough so the trailer with the second outer coffin can pull out from under it, then turn the inner coffin 90 degrees with tag lines, and set it inside the first outer coffin on the railcar, with the inner coffin door at the open end of the outer coffin, so there is 5" of steel shielding on every side. Again, during the time the inner coffin is out of the outer coffin, the exposure is expected to be about 500 mR/hr @ 1 ft, so use ALARA measures. Time Est. 0.1 hrs
69) Unhook remotely and return the spreader bar to its carrier. Time Est. 0.05 hrs
70) BDMS techs use the TSB electric locomotive to push the railcar and coffins (approx. 45 tons) into the storage tunnel. Radiation is under 100 mR/hr @ 1'. Time Est. 0.1 hrs

2.4 Installing a new horn module

71) Alignment crew checks the alignment of the coffin supports on the trolley. Time Est. 0.4 hrs
72) Receiving brings the empty outer coffin back from TSB.
73) BDMS techs lift the outer coffin using the special spreader bar with foundry hooks (FNAL dwg. MD-389371), and install it on the support trolley in the vault. Time Est. 0.2 hrs
74) Receiving brings a new horn module inside a new inner coffin, driving very slowly because the new horn is very delicate (a second outer coffin is not necessary for the installation of a new horn module).
75) BDMS techs tie rope tag lines on the corner eyelets of the inner coffin. Time Est. 0.1 hrs
76) BDMS techs hook the inner coffin (approx. 19 tons) using the special spreader bar, and lower it into the outer coffin on the support trolley. Time Est. 0.2 hrs
77) Crane operator unhooks the spreader bar remotely. Time Est. 0.1 hrs
78) BDMS techs remove the supplemental shielding in front of the shutter doors. Time Est. 0.2 hrs
79) Crane operator, with the spreader bar on a long sling, hooks the coffin door (3450#) remotely and opens it, lays the door down out of the area. Time Est. 0.2 hrs
80) Coffin trolley is rolled towards the shutter doors by hydraulic cylinders mounted on the trolley rails. Time Est. 0.2 hrs
81) Alignment crew checks that the coffin is aligned with the horn module rolling surfaces in the target stack. Time Est. 0.2 hrs
82) BDMS techs block or C-clamp the Hilman rollers on the coffin trolley so it doesn't move. They remove both hydraulic cylinders from the rails, set up the cylinder support structure on the rails, and attach one hydraulic cylinder on the support structure. Time Est. 0.2 hrs
83) Pushing mechanism is hooked to the new horn module and holding it in place with a plug-bolt through the inner coffin end wall. Remove the plug-bolt from the outside to

release the horn module, and attach the pushing extension pieces and hydraulic cylinder. Time Est. 0.1 hrs

84) BDMS techs open shutters by hand cranks, 400 turns each. The cranks move the doors at a rate of 20 turns per inch. Time Est. 0.2 hrs
85) Hydraulic cylinder mechanism pushes the new horn module on its rollers into the target stack, stopping to add a pair of 3 ft. long extension pieces every 3 ft. of cylinder stroke, a total of six times, or 18 feet of total shaft extension. Toward the end of the sixth stroke (27" into the stroke) the horn skid will contact the horn end stop causing hydraulic pressure to spike. The operator must diligently monitor the hydraulic pressure and quickly relieve the pressure to avoid any possible damage. The pressure gauge on the hydraulic cylinder will indicate when the horn is fully installed. When the indicated pressure increases, the operator releases the control so the pressure is released. The last 2" rod is exposed 27" when the horn is fully in place. Time Est. 0.6 hrs
86) BDMS techs close the shutters remotely with hand cranks, approximately 400 turns each. At this point the shutters should come to within 1" of the horn module, so there is sufficient clearance around the horn module for positioning adjustments. Time Est. 0.2 hrs
87) Pusher hook mechanism is disconnected from the horn module remotely by pulling on the ½" rod to lift the hook, then the 2" rod is withdrawn 2", after which the 2" and ½" rods can be removed one section at a time. Replace the plug-bolt to hold the hook mechanism in place. Time Est. 0.2 hrs
88) BDMS techs remove the hydraulic cylinder from the support structure, remove the structure, and set the two cylinders up on the trolley rail. Time Est. 0.2 hrs
89) BDMS techs roll the coffin away from the shutter doors using hydraulic cylinders mounted on the trolley rails. Time Est. 0.2 hrs
90) Crane operator hooks the coffin door with the spreader bar and lifts it, guides it into place with guide lugs on the inner coffin, closes the coffin door, then unhooks remotely. Time Est. 0.3 hrs
91) BDMS techs using hand tools with extensions raise the horn alignment ball socket adjuster module screw jacks to the point of contact, then raise the horn to the nominal elevated position. See the MSD Note MSDN-ME-000041 Adjuster Module Operation. Time Est. 0.3 hrs
92) Crane operator using the spreader bar hooks the inner coffin remotely, lifts out the inner coffin and places it on a Receiving trailer to be stored elsewhere. Time Est. 0.2 hrs
93) Crane operator removes the outer coffin using the spreader bar and places it on a Receiving trailer to be stored elsewhere. The spreader bar is stored at MI-12. Time Est. 0.2 hrs
94) If the target module and BPM module are already installed, skip down 4 steps.
95) BDMS techs set up the target and BPM module installation structure on the coffin trolley, with the target and BPM modules on it. Time Est. 0.3 hrs
96) Alignment crew aligns the target installation six-axis rail structure with the target rails inside the horn module. Time Est. 0.5 hrs
97) BDMS techs install the new target module and BPM module. Time Est. 0.5 hrs
98) BDMS techs take away the target installation rail structure. Time Est. 0.2 hrs

99) BDMS techs take apart the hydraulic cylinder push/pull mechanisms and remove them. Time Est. 0.4 hrs
100) BDMS techs remove the coffin support trolley. Time Est. 0.2 hrs
101) BDMS techs remove the trolley rails, carefully so as not to hit the horn stripline ends. Time Est. 0.6 hrs
102) Alignment crew aligns the horn module. Time Est. 1.0 hrs
103) BDMS techs tighten the set screws that lock the adjuster module jacks in the up position. Time Est. 0.1 hrs
104) BDMS techs close the shutter doors to within 1/4" of the horn module, their fully closed position. The shutters are not machined flat on the side adjacent to the horn, so it is necessary to look down the length of this entire surface with a flashlight as each shutter is moved into position. The greatest care must be taken to keep the shutters from hitting the horn. Time Est. 0.2 hrs
105) BDMS techs roll the target air cooling TAC system racks back into place and reinstall the connecting air tubes for it. Time Est. 0.6 hrs
106) BDMS techs reconnect water hoses to the TAC system. Time Est. 0.2 hrs
107) BDMS and BD Instrumentation techs reconnect signal and power cables to the target air cooling TAC system. Time Est. 0.1 hrs
108) BDMS techs reconnect the RAW system water supply six-tube manifold. Time Est. 1.0 hrs
109) BDMS techs reconnect the RAW system water return line pipe. Time Est. 0.3 hrs
110) BDMS techs remove the LOTO tags on the RAW system, turn the RAW system on, check for leaks. Time Est. 1.0 hrs
111) BDMS techs center the transition duct that is loosely attached to the horn stripline clamshell (both sides) and tighten fasteners. Time Est. 0.1 hrs
112) BDMS Techs replace the flexible ducts (Double Flex Connection Assembly Dwg. MC-389721) on both Section 1 striplines, and reconnect striplines following guidelines in MSD Note MSDN-ME-000042 Stripline Connections. Time Est. 2 hrs
113) BDMS techs replace air barrier panel below the horn. Time Est. 0.5 hrs
114) BDEES techs perform electrical tests on horn power supplies. Time Est. 2.0 days
115) Riggers reset any additional small hand-stacked radiation shielding blocks (if needed). Time Est. 2 hrs
116) Riggers reinstall 3 magnet stands and 3 magnets. Time Est. 2 hrs
117) Riggers remove rigging equipment from the tunnel enclosure. Time Est. 0.5 hrs
118) Alignment crew aligns magnets. Time Est. 1.0 hrs
119) BDMS techs reconnect water hoses to 3 magnets. Time Est. 1.0 hrs
120) BDMS techs turn the LCW on, check for leaks. Time Est. 1.0 hrs
121) BDMS techs reinstall beam tube spool pieces, multiwire, BPM's, toroid, a new copper collimator, loss monitors and any other beamline components. Time Est. 2.0 hrs
122) BDMS techs make vacuum connections, pump down and leak check vacuum components. Time Est. 8 hrs
123) BDEES and BD Instrumentation techs reconnect cables to magnets, multiwire, toroid, BPM's, loss monitors and other beamline components. Time Est. 2 hrs
124) Riggers bring back the 5 heavy "H" shielding blocks, the 93 standard "H" blocks, the steel plates and any other special blocks, and install them in the target vault. The

blocks are numbered for position. An air barrier of Herculite is installed between the 4th and 5th layers of blocks. Other gaps at the 5th level are filled with foam packing. Time Est. 40 hrs

125) Rad Safety secures the shielding block and shutter door padlocks. Time Est. 0.2 hrs
126) BD Operations Group Search and Secure. Time Est. 1.0 hrs
127) BDEES removes LOTO tags, turns power supplies on. Time Est. 0.5 hrs
128) Beam Permit – End of Procedure

3.0 Distribution

The controlled copy of this procedure shall be the current revision in electronic form, maintained by the BDMSD designee on the following web page:

http://www-bdnew.fnal.gov/MSDMain/BDDP/BDDP_log.htm

4.0 Responsibilities

Most steps in the procedure shall be performed by BDMS techs assigned to the Target Group.
Water hoses shall be removed and replaced by BDMS techs assigned to the Water Group.
Electrical power cables shall be removed and replaced by BDEES techs.
Electronic controls and instrumentation cables shall be removed and replaced by BD Instrumentation Dept. techs.
Concrete shielding blocks shall be removed and replaced by riggers subcontracted by FNAL.
Changes in the assignment of responsibilities may be made at the discretion of the leader of the Target Group.

5.0 Tools, Equipment and Materials

special lifting spreader bar (FNAL dwg. MD-389371)
rail structure (FNAL dwg. no. MC-389443, weight 5100#)
coffin support trolley (MD-389447)
yoke adapter piece (MA-389450)
hydraulic cylinder support structure (FNAL dwg. no. MD-389448)
two outer coffins (FNAL dwg MC-389359)
two inner coffins (FNAL dwg ME-389363)
hook-and-pulling mechanism (FNAL dwg MD-389370)
plug-bolt (FNAL dwg MB-389360)
six 2" dia. x 36" long extension rods (FNAL dwg MB-389425)0
six ½" dia. x 36" long extension rods (FNAL dwg MB-389426)

cover plate plug (FNAL dwg MC-389358)
hydraulic cylinder carts (Miller Fluid Power units Model H82S2N, FNAL PO#432340, 10/22/85)
herculite and duct tape
long railcar (FNAL dwg. 1210-ME-30673) used only at TSB

6.0 References

Basic steps of this procedure are drawn on FNAL drawing 6755.170-ME-389604 (14 sheets) which are stored with the Beams Division Mechanical Support Drafting Group, as are most tool and equipment drawings.

7.0 Records

The following photograph files of the procedure taken during the initial installation are filed with the FNAL Media Services Dept. Each file number contains 12 frames.
02-324
02-325
02-326
02-327
02-328
02-329
02-330
02-331
02-332
02-359
02-360
02-364
02-379

8.0 Supporting Documents

Prints and proof sheets of the abovementioned photographs are kept with the BDMS Target Group.

Videotapes of the initial installation are kept with the BDMS Target Group.

MSD Note MSDN-ME-000041 Adjuster Module Operation
http://www-bdnew.fnal.gov/MSDMain/MSDN/MSDN_log.htm

MSD Note MSDN-ME-000042 Stripline Connections
http://www-bdnew.fnal.gov/MSDMain/MSDN/MSDN_log.htm

9.0 Revision Notes

If this document is revised, check BDDP-ME-0130 to see if the revisions also apply to it.