E949 Work Plan - Appendix A: Detector Closing

The closing of the detector will be carried out in three stages. Some of the operations have to be performed on top of the detector at a height of about 19 ft. Appropriate safety harnesses will be used. Details of the operations are as follows:

I. Closing of the two end plates:

1) Ready pit area:

   a. Clean up pit area and tracks: remove unnecessary equipment, such as, upstream scaffolding, hydraulic platform, concrete blocks and tombstone,
   b. inspect Hillman rollers and side bearings on detector.

2) Closing of the upstream end plate:

   a. clean up iron faces of the end plates and of the center section,
   b. move center section upstream (close to upstream end plate) using hydraulic jacks,
   c. check and reposition, if necessary, all 24 s.s. boxes making sure they fit in iron slots in the end plate,
   d. position 48 sets of RSSC gas lines into iron slots,
   e. re-install water tubes for BV support,
   f. move center sector (manual cranking) until it mates with the end plate,
   g. install alignment pin and check alignment markers,
   h. torque four coupling bolts to 600 ft-lb,
   i. release come-along on upstream cable tray.

3) Closing of the downstream end plate:

   a. move detector (center section and upstream end plate) downstream (close to downstream end plate),
   b. straighten out the 48 sets of RSSC cables and gas lines and feed them through the corresponding slots in the end plate,
   c. check and reposition, if necessary, all 24 s.s. boxes making sure they fit in slots in end plate,
   d. check positions of Hall probes and thermocouples on end plate,
   e. move detector (manual cranking) until it mates with the endplate with RSSC cables pulled continuously straight through slots,

f. install alignment pin and check alignment markers,
g. torque four coupling bolts to 600 ft-lb,
h. release come-alongs on downstream cables trays.

II. Installation of detector systems (light guides, PMT’s, fibers):

Reposition detector to middle of the pit. Install scaffold upstream and tombstone and hydraulic platform downstream. The following operations will be performed simultaneously on both ends of the detector:

1) Install monitor fiber bundles:

a. mount special cable trays on both end-plates,
b. route fiber bundle from top of detector along this cable tray,
c. position each small RS bundle to one of every four sectors, position end of fibers to reach to inner-most RS PMT, coil up excessive fiber length on spool on top of detector,
d. position end of BV fibers to provide enough length to reach mixer inside detector,
e. route 2 RS and 1 BV bundles on one side in one end of the detector,
f. route all 12 reference bundles to top of detector,
g. mount all 12 main bundles onto temperature controlled driver box on top of detector,
h. mount all 12 reference bundles onto temperature controlled monitor box on top of detector.

2) RS and BVL light guides and PMT's installation, 1008 channels:

a. install BVL mixer-PMT-mushield-base unit with cookie installed, check with Boroscope for optical coupling and install screw to adjust spring tension,
b. install first half of RS light-shield for that sector, feed RSSC cables and monitor fiber through cover,
c. install monitor fiber onto mixer and tape in position,
d. install second half of RS light-shield and tape to light tight,
e. install RS light guides starting from layer 19, for each group of light guides the monitor fiber should be threaded through the corresponding jig-saw first,
f. fit light guide into Al box at end of light guide from detector and fit into jigsaw support, check alignment,
g. thread monitor fiber through appropriate hole in jig-saw and install small rubber disc, press fit monitor fiber into plastic holder on corresponding light guide and wrap tight

around light guide with Kevlar tape, use 5-minute epoxy only if the press fit is too loose, making sure end of fiber is 1/32-2/32" from end of light guide, install light filter if necessary,

h. position and install mu-shields onto the jigsaw, check and center shield to light guide,
i. install rubber boot on PMT-base unit,
j. orient base so spring taps line up with those on mu-shield before pushing to make contact with light guide, then install two springs,
k. for T-counter, insert fiber end holder into Noryl adapter, install 2 holding screws making sure end of holder is level with end of adapter,
l. install adapter into the jigsaw,
m. install mu-shield, position it as far away from beam line as possible, with new cookie and rubber boot, install PMT-base like other RS counter.

3) T-counter installation:

Sometime during the operations of 2) above, the new T-counters with fiber readout will be installed:

a. undo the 5 mounting tapes on a RS counter 2-5,
b. move T-counter into detector and thread fiber bundle of one end through opening in spider and s.s. box support with guiding tool, and push counter into spider as far as possible,
c. lift up other end of counter gradually and insert fiber bundle through the other end of detector with guiding tool, then slowly lower the counter onto counter 2,
d. position counter at center of detector, and one edge line up with that of counter 2, wrap the 5 tapes around it so that it is in contact with counter 2.

4) BV installation, 384 channels:

a. remove BV light-guide-PMT-base unit through the mu-shield,
b. re-insert unit after installing the s.s. fiber tube with two additional support rings and the foam rubber ring for light shielding and installing a new cookie,
c. orient unit so the bent s.s. tube points toward OD of detector and push in to make contact, re-install 3 springs,
d. push in foam rubber ring to make light shield,
e. insert monitor fiber into s.s. tubing and slowly push forward until it makes contact with mixer inside detector, tape fiber to s.s. tube,

f. replace mu-shield on the inner layer of BV with new type, and use modified bases.

Cable up all counters. With temporary light-protection in detector center, all counters are ready to be powered.

II. Center section installation:

1) UTC insertion:

a. setup tombstone downstream,
b. setup two reference survey-targets inside spoke area of downstream end plate,
c. with survey-targets set inside the central chamber UTC, rig and bolt it to tombstone after checking with marks on tombstone,
d. line up UTC with the reference-targets,
e. insert UTC into detector by periodically correcting its alignment w.r.t. the reference-targets,
f. at end of insertion, install three locking bolts for the UTC support iron cylinder,
g. cable up UTC and connect gas lines.

2) Upstream endcap insertion:

a. setup tombstone upstream,
b. setup two reference survey-targets inside spoke area of upstream end plate and align survey instrument on them,
c. remove survey-targets from end plate and install two survey-targets inside endcap,
d. mount endcap onto tombstone,
e. line up endcap and move to detector (manual cranking when endcap enters the RS PMT area),
f. using Mylar shoehorn on top of endcap, periodically realign endcap and make sure there is clearance between endcap and T-counter PMT base,
g. at end of insertion making sure endcap is in solid contact with end plate, lower tombstone and dismount endcap from tombstone.

3) Downstream endcap insertion:

a. same procedure as 2) above except using survey-targets inside UTC support cylinder instead of inside endcap as reference,
b. after insertion, remove UTC downstream survey-target after surveying.

4) Micro-collar insertion:

   a. install target-insertion-structure on tombstone,
   b. mount special installation structure on endcap,
   c. rig micro-collar counter onto structure,
   d. slide it into endcap.

5) Fiber-target insertion:

   a. arrange all EC cables on side of endcap support cylinder,
   b. setup two survey-targets inside micro-collar as reference,
   c. align transit upstream along the beam and center on the downstream end of UTC,
   d. setup target-insertion-structure on tombstone,
   e. lift fiber-target onto target-insertion-structure and align with the height of the micro-collar,
   f. push target into micro-collar,
   g. continue insertion by monitoring fiber-target center position with transit until its flange stops at a distance from the endcap flange as determined by three special spacers, bolt fiber-target flange onto endcap flange.

6) Beam instrument insertions:

   a. install Al-support-tube into upstream endcap,
   b. insert live-degrader-BMWC unit into Al tube,
   c. mount upstream BMWC,
   d. rig in and position beam Cerenkov counter.

At this point, closing of the detector is completed. All counter channels have to be cabled up. After checking light tightening, detector can be powered up.

D3 water supply and power supplies have to be checked out. D3 can then be powered up.