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# NUMI Horn-1 Module Rebuild Steps

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# Hazards

- Numerous crane operations
- Trip hazards on top of and inside work cell
- Radiation exposure
- Radiation contamination

# Remove motors, gearboxes and mounts.

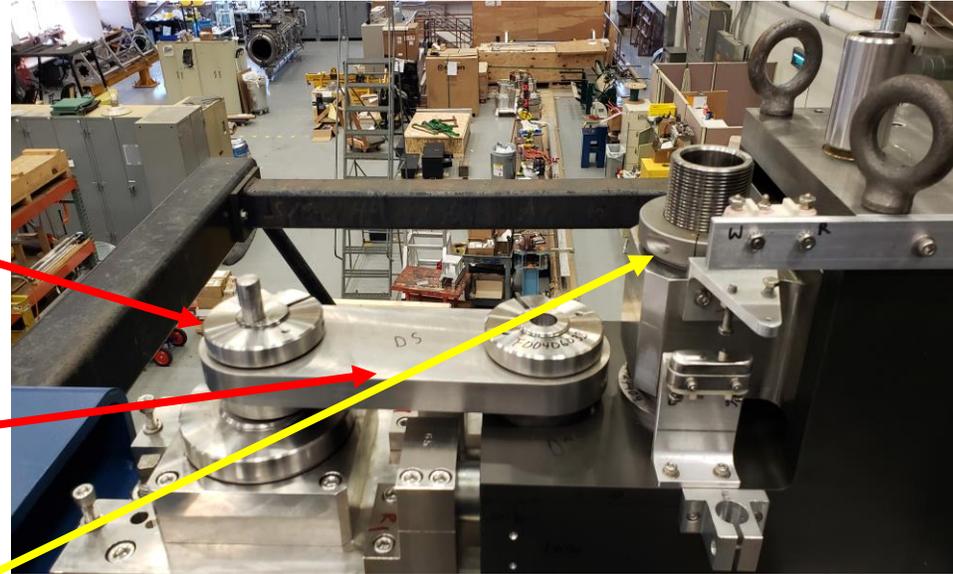
All work done on top of work cell.

- Disconnect limit switches
- Disconnect LVDTs
- Disconnect Motors
- Loosen Set screws on motor couplers
- Remove 8ea 5/16-18 SHCS from motor mounts.
- Lift and remove motor assemblies from top of module.



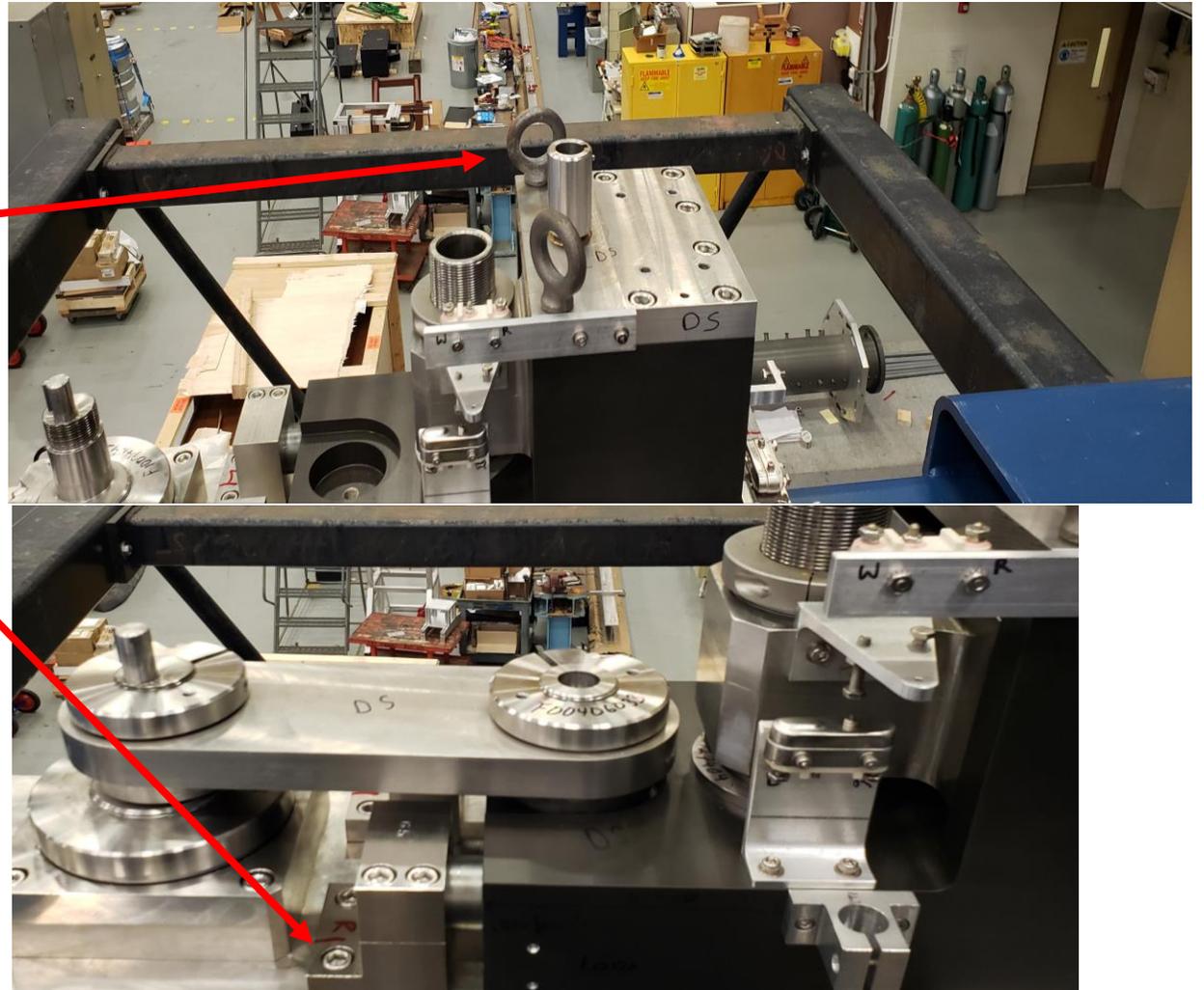
# Remove upper transverse drive assembly

- Remove shaft collar from transverse drive shaft
- Remove ½-13 SHCS from Pivot shaft
- Lift and remove transverse shaft link
- Raise lift table to support main shaft
- Remove shaft collar from main shaft
- Lower lift table until main shaft rests on module



# Upper transverse Cont...

- Remove 2ea ½-13 SHCS from cover plate
- Install 2ea ½-13 lift eyes
- Remove 8ea 5/16-18 SHCS from shaft mounts
- Secure sling to lift eyes
- Lift upper lift assembly off shaft and place in cask
- Remove 4ea 3/8-16 SHCS from bearing block



# Test freedom of lower assembly drawbars

- Test each drawbar one at a time
- Loosen 1-8 nut
- Attempt to loosen drawbar
- Hand tighten drawbar and nut
- Note any bar which doesn't loosen
- **May want to pour Penetrating oil in holes of rods that don't loosen easily**
- **If center drawbar can be loosened, then unthread completely and remove nut**
- Install shaft lifting devices onto top of shafts
- Remove 8ea ½-13 SHCS from module top plate
- Install 2ea 5/16-18 lifting eyes in top plate



# Remove main shaft and transverse shaft

- Move module to chase and install T-block
- Attach sling to transverse shaft
- Lift transverse shaft and place in cask
- Attach sling to module top plate
- Lift and remove top plate
- Attach sling to main shaft
- Lift main shaft and place in cask
- Attach lifting device to center drawbar and remove
- Insert long threaded rod into center drawbar hole



# Reconfigure Work cell for lower assembly removal

- Remove main shaft support structure
- Install lower assembly cask onto frame
- Remove cask cover
- If it is determined that we will need to cut drawbars, then the cutting tool assembly will be installed at this point.
- Return Module to work cell



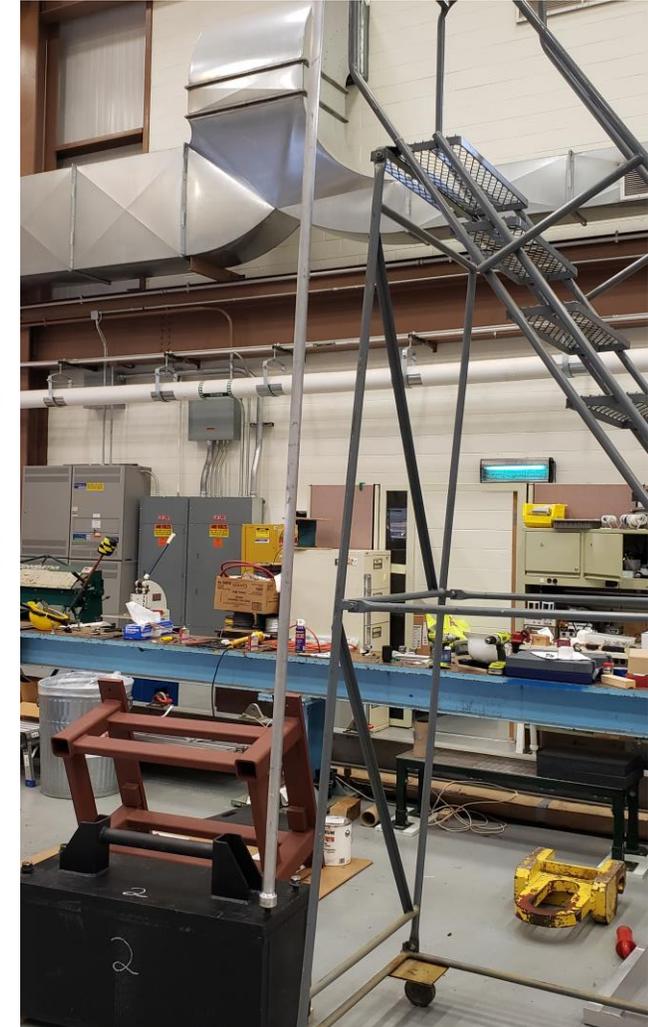
# Remove lower assembly

- Raise cask base to position under lower assembly
- Thread in long threaded rod and snug nut and support with crane
- Loosen nuts on 2 remaining drawbars and long threaded rod
- Lower crane to see if lower assembly is free
- If lower assembly is not free, tap top of drawbars to free lower assembly
- Unthread 2 remaining drawbars leaving nuts in place
- Support long threaded rod with crane and loosen nut
- Lower assembly onto cask base and unthread long rod
- Return module to chase



# Place and secure lower cask cover

- Using crane and T-block fixture place lower cask cover onto base
- Reinstall Work cell covers leaving gap over cask
- Using extended socket tighten cask cover bolts
- Remove work cell covers
- Remove cask from work cell and place in outer cask



# Reconfigure Work cell for lower installation

- Install Lower assembly support structure onto stand
- Place lower assembly onto structure
- Insert lower drawbars with nuts into module
- Return module to work cell



# Install lower Assembly

- Using lift table and cameras, raise lower assembly to bottom of module
- Carefully monitor position of alignment pins and adjust table position as necessary
- Stop raising when draw bars begin to lift
- Thread in draw bars one at a time until they stop turning
- Starting with center draw bar tighten nuts until lower assembly is seated on bottom of module
- Torque nuts to desired torque
- Lower lift table



# Install module upper plate

- Set module upper plate on top of module
- Insert and tighten 8ea  $\frac{1}{2}$ -13 SHCS
- Install Main shaft assembly support structure
- Insert and snug 8ea 5/16-18 SHCS into angle brackets
- Return module to chase



# Insert main shaft and transverse shaft assemblies into module

- Bolt transverse support to bottom of transverse bearing housing
- Using crane and lifting device raise transverse shaft and lower into module until support rests on module
- Using crane and lifting device raise main shaft assembly and lower into module
- **The above steps require a person in chase to guide shafts into module**
- Return module to the work cell



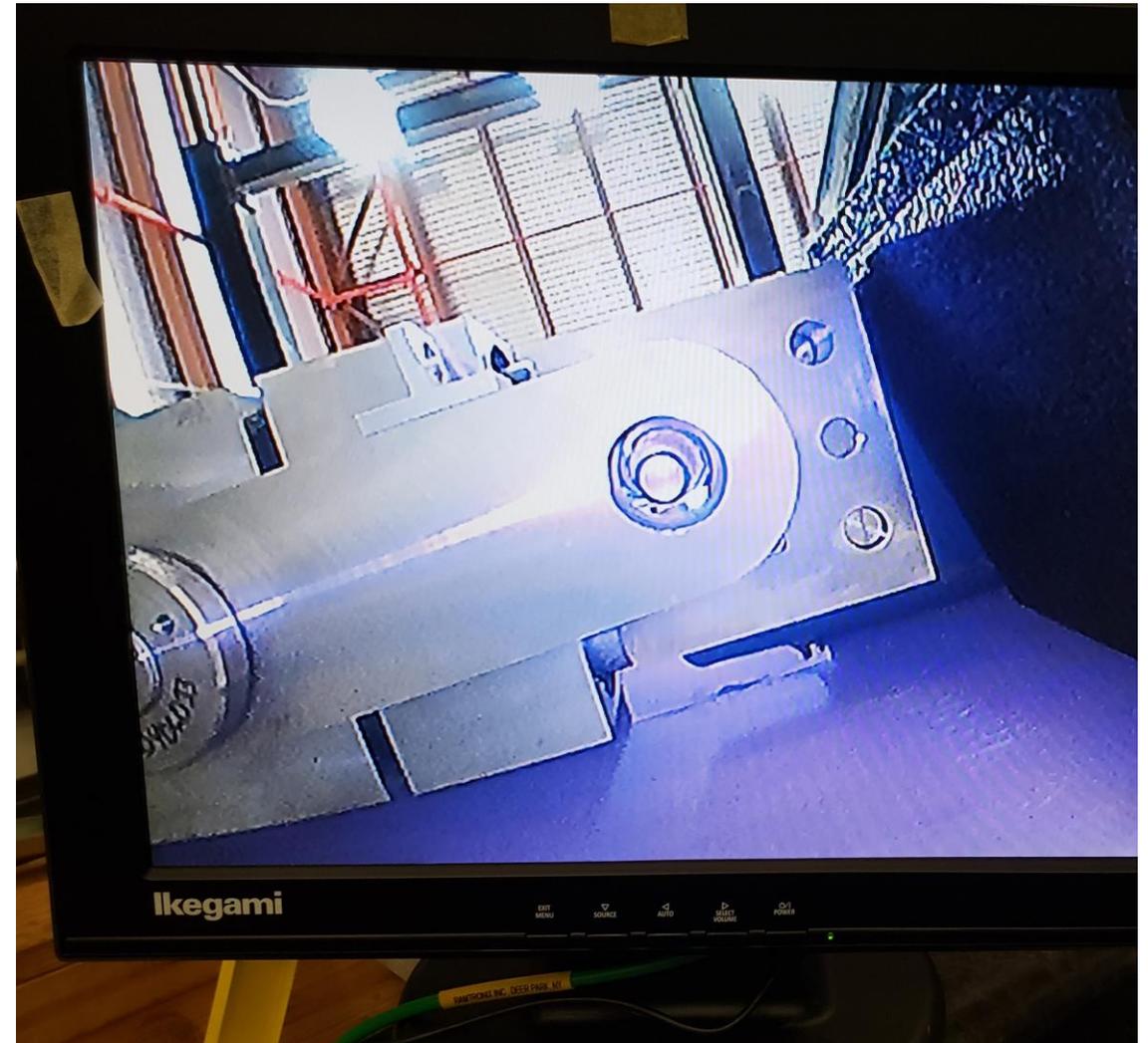
# Lower main shaft to final position

- Align camera to view end of main shaft through lower bearing
- Lift main shaft with crane about 2 inches
- Remove main shaft support structure
- Slowly lower main shaft assembly until it rests on module
- Install 8ea SHCS into shaft support blocks and tighten



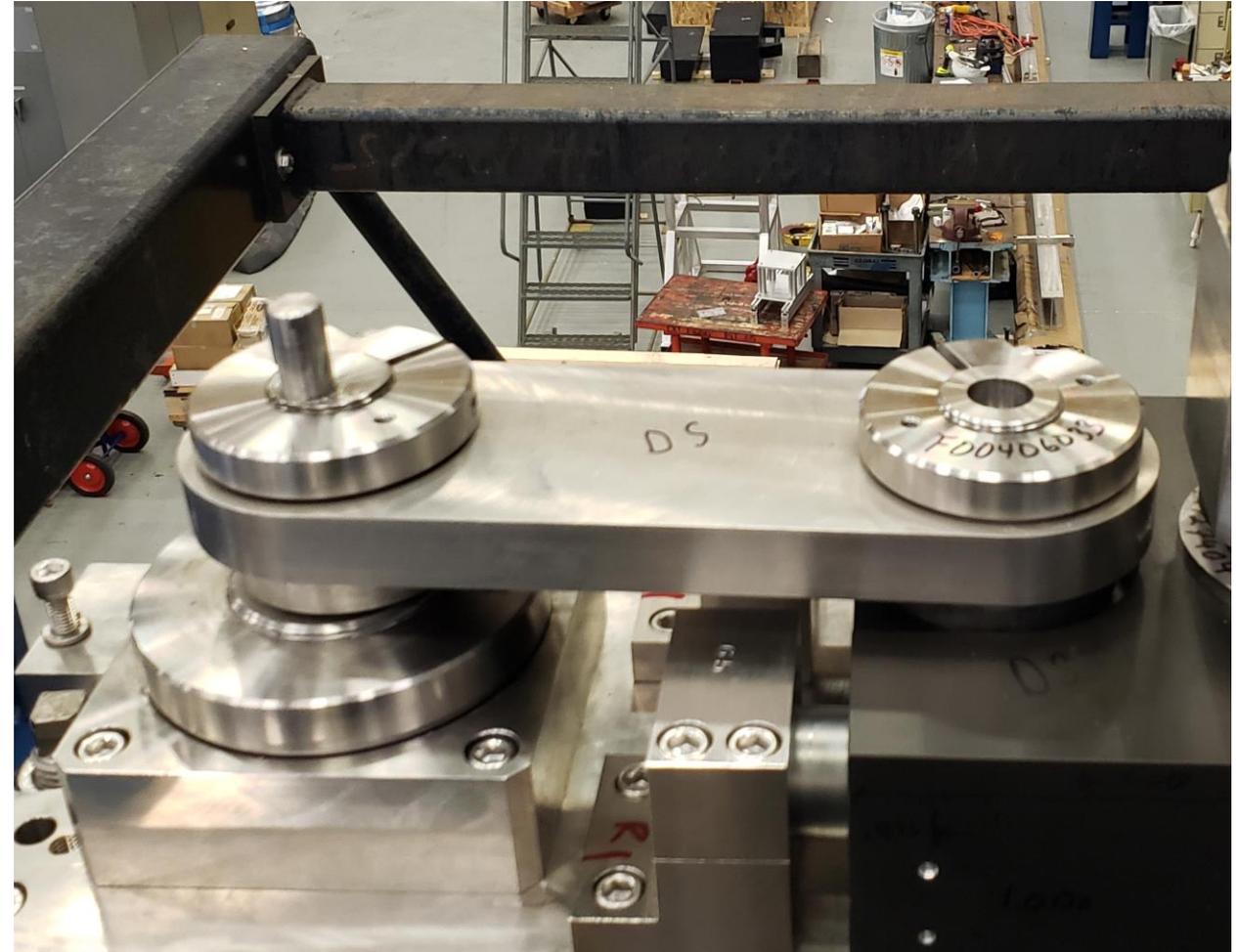
# Lower Transverse shaft into final position

- Align camera view to bottom of shaft
- Support shaft with crane
- Remove shaft support
- Slowly lower shaft until it rests on module
- **May need to use hook to align lower link**
- Install and tighten SHCS for bearing block



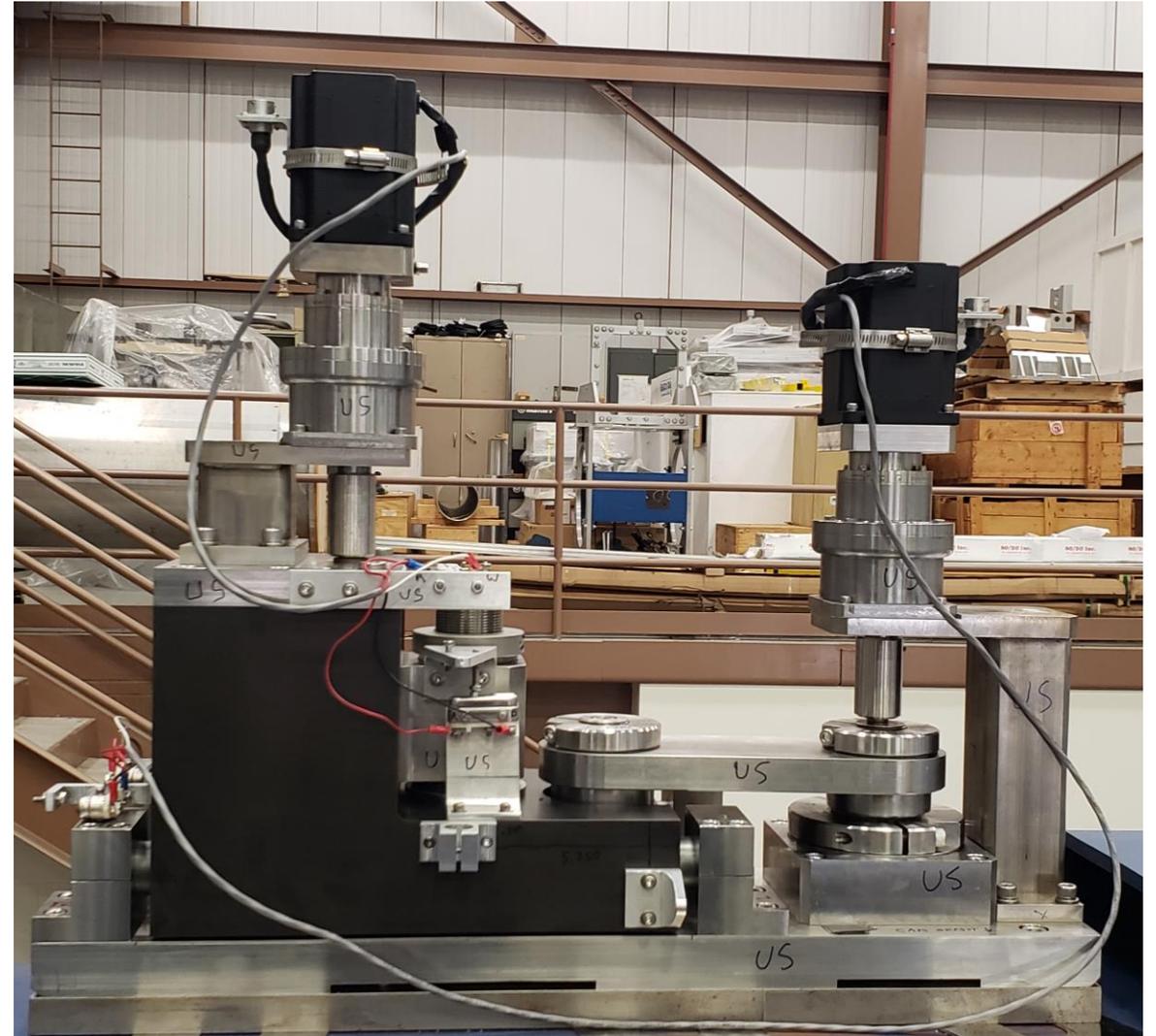
# Test shafts for freedom of movement

- Install upper link assembly
- Rotate main shaft to ensure it rotates freely
- Rotate transverse shaft to ensure it rotates freely
- If either shaft shows binding, then shimming may be required where their mounts meet the top plate



# Install motor assemblies

- Install transverse drive motor assembly
- Install Vertical drive motor assembly
- Connect limit switches
- Install LVDTs
- Test operation



**Repeat for other end of  
module**