Fermilab

Particle Physics Division
Mechanical Department Engineering Note

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Project Internal Reference:

Project: NOvA

Title: FHEP Pivoter Hydraulics Commissioning Plan

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Reviewer(s): James R. Kilmer 11/5/2010

Key Words: NOvA, FHEP, CDF, Hydraulics, Commissioning

Applicable Codes: n/a

Abstract Summary:

Three commercially produced hydraulic systems are included in the NOvA block pivoter to provide the powered motion required for this device to serve its intended purpose.

This engineering note describes the plan for commissioning the systems.

Discussion:

The three hydraulic systems are:

> Kneeling Cylinders designed to allow the pivoter to set the pallet down on the floor after the block is rotated to the vertical position
>
> Drive wheel hydraulic motors designed to propel the fully loaded pivoter along the floor rails from the block assembly area to the block final located.
>
> Pivot Cylinders designed to allow the table of the pivoter to rotate from a horizontal orientation to a vertical orientation.

Refer to the NOvA Conceptual design report in Nova Document database number 536 for a description of the block assembly. Pivoter requirements are in Nova Document database number 113. Geometry and orientation of the FHEP pivoter in CDF are described in NOvA document data base document number 3564 and PPD MSD engineering note 174 and in PPD MSD engineering note 181 posted in MSD Document data base document number 1043.

Kneeling cylinder specifications are in engineering note 202 posted in MSD Document data base document number 1044

Drive motor specifications were developed with the drive motor vendor based on pivoter weights listed in MSD engineering note 184 posted in MSD Document data base document number 1003 and included as an appendix in this document.

Pivot cylinders are in MSD engineering note 184 posted in MSD Document data base document number 1003.

Commissioning Plan – General

Applicable to all three hydraulic systems, the installation will be completed by MSD technicians; power and instrumentation wiring completed by electricians, hoses and hydraulic piping installed by MSD technicians with welding performed by FNAL welders, systems filled with filtered, new, hydraulic oil (Mobil DTE 24) and prepared for initial commissioning.

When systems are individually complete, hydraulic vendor will be brought in to assist in the initial operation of the system.

First tests of each system will be performed at minimum loads.

Once successful initial operation has been demonstrated, additional testing will occur at increasing load until the design capacity is demonstrated. Vendors will not be brought in for these additional tests unless the staff members performing the tests determine it is warranted.

Weeks and perhaps months may pass before additional operations can be performed due to the time required to add and install the next component.

Commissioning Plan – Specific to the Kneeling Cylinders:

Initial Operation load:	Upper weldments only (~ 50,000 pounds combined.
Second Operation load:	Upper weldment and table (adds ~ 24,000 pounds)
Third Operation load:	Upper Weldment, Table, and Pallet (adds ~ 2000 pounds)
Forth Operation load:	Upper Weldment, Table, Pallet and dead weight (add shield blocks until a load similar to the load of the FHEP plastic assembly is achieved.
Fifth Operational load:	Table, Pallet and FHEP plastic.

Commissioning Plan – Specific to the Drive Motors:

Initial Operation Load:	NO load – Wheels blocked up to prevent pivoter axial motion.
Second Operation load:	Lower and Upper weldments only (~ 90,000 pounds combined.
Third Operation load:	Lower weldment and Upper weldment and table (adds ~ 24,000 pounds)
Forth Operation load:	Lower weldment, Upper Weldment, Table, and Pallet (adds ~ 2000 pounds)
Fifth Operation load:	Lower Weldment, Upper Weldment, Table, Pallet and dead weight (add shield blocks until a load similar to the load of the FHEP plastic assembly is achieved.
Sixth Operational load:	Weldments, Table, Pallet and FHEP plastic.

Commissioning Plan – Specific to the Pivot Cylinders:

Initial Operation Load:	NO load – Wheels blocked up to prevent pivoter axial motion.
Second Operation load:	Lower and Upper weldments only (~ 90,000 pounds combined.
Third Operation load:	Lower weldment and Upper weldment and table (adds ~ 24,000 pounds)
Forth Operation load:	Lower weldment, Upper Weldment, Table, and Pallet (adds ~ 2000 pounds)
Fifth Operation load:	Lower Weldment, Upper Weldment, Table, Pallet and dead weight (add shield blocks until a load similar to the load of the FHEP plastic assembly is achieved.
Sixth Operational load:	Weldments, Table, Pallet and FHEP plastic.

Appendix A: Drive motor vendor proposal.

CMA/Flodyne/Hydradyne

1000 Muirfield Drive
Hanover Park, IL 60133
Phone: (630) 563-3600
Fax: (630) 563-3850

Thursday, 13 August 2009

Fermilab
Kirk & Wilson Roads
P.O. Box 500
Batavia, IL 60510

Attention: Mr. David Pushka, Engineering
Subject: Hydraulic Drive for Nova Block Raiser

Dear Dave,
CMA/Flodyne/Hydradyne is please to quote a complete hydraulic solution for you Nova Block Raiser drive control. Specifications for determining the solution are as follows:

- Total maximum mass, 600,000 pounds
- Maximum speed 1 MPH
- Acceleration rate to maximum speed 30 seconds
- Road resistance polyurethane on concrete
- 1 percent grade
- Two drive wheels, 36" diameter on common axle

The system provided will consist of the following components:

- Hydrostatic closed loop drive with the following assembled skid:
  - Reservoir with filler-breather, level and temperature gauge
  - Closed loop hydrostatic pump nominal pressure rating of 5800 PSI with pressure override, variable volume
  - 75 HP 1800 RPM 460/3/60 TEFC electric motor
  - Charge pump filter with electrical bypass indicator
  - Hot oil shuttle valve
  - Return filter with electrical bypass
  - Air/oil heat exchanger to maintain adequate cool sump oil temperature
- Electrical control panel assembled and mounted on skid consisting of the following:
  - Door mounted disconnect switch

MAIN DISTRIBUTION CENTERS

3265 Gateway Road, Suite 300
Brookfield, WI 53045
Phone: (262) 781-1815
Fax: (262) 781-2521

1000 Muirfield Drive
Hanover Park, IL 60133
Phone: (630) 563-3600
Fax: (630) 563-3850

BRANCH OFFICES

Rockford, IL Tel. (815) 229-7602 Fax (815) 229-7905
Peoria, IL Tel. (309) 697-7005 Fax (309) 697-8576
Davenport, IA Tel. (563) 355-2339 Fax (563) 355-2571
Green Bay, WI Tel (920) 336-7620 Fax (920) 336-7610

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- Motor starter and overloads for 75 HP motor
- Motor starter and overloads for air/oil heat exchanger
- Pendant with disconnect for motor start/stop, emergency stop, joystick for forward/reverse motion of Nova Block Raiser
- All necessary transformers, power supplies, amplifiers and circuit breakers for complete machine control

- Two Bosch-Rexroth GFT0040 gear boxes with fixed displacement piston motors, wheel mount configuration to meet above specifications. Hydraulic motors will be mounted to gear boxes and shipped loose.
- Startup assistance provided by CMA/Flodyne/Hydradyne after unit is installed by Fermilab personnel

Net cost for above $59,260.00
Terms: Net 30 after shipment
Delivery 12 – 16 weeks after approval of drawing

Drawings and engineering review will take approximately 2-5 days after receipt of order. This quotation does not include installation at Fermilab or the first fill of oil. Hydrostatic drive will be tested at CMA/Flodyne/Hydradyne for correct operation of control, pressure and flow. As noted above CMA/Flodyne/Hydradyne will provide startup assistance after unit has been installed and piped at your facility (Batavia, IL). Startup assistance and/or service work may be contracted for at facilities outside Illinois. Commercial terms for startup may be negotiated and service is provided per our attached service rates.

Thank you for thinking of CMA/Flodyne/Hydradyne for your hydraulic and control needs. If you need further information or assistance please don't hesitate to call.

Best regards,

Norman Kronowitz
cc: Mike Colaianne, CMA/Flodyne/Hydradyne MRO Salesman

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Appendix B Hazard Analysis

Hazard Analysis Form

This form can be used by Fermilab Employees, Fermilab Supervisors, Fermilab Task Managers, Construction Coordinators, Service Coordinators, and Fermilab Subcontractors. This is a dynamic document which may require modification as the project moves from start to finish and should be readily available at the site where the work is being performed.

Note: Not all sections of the first page are applicable to every job or task, complete what is necessary for your specific job or task.

Job Title NOvA FHEP Pivoter Drive and Kneeling cylinder Hydraulics Initial Start-Up
Job Location CDF
Contract/Work Order # n/a

TO BE COMPLETED FOR WORK INVOLVING SUBCONTRACTORS

Subcontractor (if applicable)	**Fermilab**
Company _____	Project Manager _____
Project Manager _____	Phone _____
Phone _____ Page _____	TM/CC/SC _____
ESH Rep. _____	Phone _____ Page _
Phone _____ Page _____	ES&H Rep. _____
ESH Rep. _____	Phone _____ Page _
Phone _____ Page _____	

AT LEAST TWO SIGNATURES ARE REQUIRED

X Prepared Dave Pushka Date 9-22-2010

Print Name Dave Pushka

☐ Accepted_____ Date _____
Print Name _____

☐ Accepted as noted_____ Date _____

Print Name _____

Description of Work: **Initial Operation and Testing of commercially produced hydraulic jacks and drive motors. Vendor experts will be present.**

Personal Protective Equipment: (Check protective equipment required for the job.)

X Safety glasses
□ Side shields
□ Chemical splash goggles
□ Hearing Protection
□ Hard Hats
□ 3.0 Brazing goggles
□ Impact goggles
□ Face shield
□ Rubber apron

□ Leather gloves
□ Hot/Cold thermal protective gloves
□ Chemical resistant gloves (specify type): _____
□ Respirators

□ Other required PPE (specify): (specify): _____
□ Fall protection equipment

Environmental Aspects (check one):

X Yes, I have thought about the environmental aspects of this job and will document such aspects and mitigation steps within this document.

□ Yes, I have thought about the environmental aspects of this job and no such credible aspects exist and therefore do not need to be written in this document.

Equipment required for the job: (List the tools needed to perform the job.)

Spill clean-up materials and cover-alls in case a spill occurs and needs immediate clean-up

Hydraulic Oil (Mobil DTE-25) MSDS is number 7494 in the ES&H data base

Work Plan History Information: (List any lessons learned incidents from this job, tips from previous jobs)

Improvement/Feedback: At the conclusion of the job, the Task Manager, Supervisor and/ or Project Leader shall work with those involved to consider lessons learned and receive feedback in order to improve future work plans.

Check One:

□ **Yes** we have considered lessons learned and accepted feedback on this job and will communicate such information so that future work plans may be improved.

□ **Yes** we have considered lessons learned feedback and determined that future work plans do not need to be improved.

Utilizing the format below, identify hazards and environmental aspects, and their corresponding safety precautions/procedures to mitigate hazards. Use as many sheets as necessary.

HAZARD ANALYSIS

Step	Description	Hazards/ Environmental Aspects	Precautions / Safety Procedures
1	Enter CDF pit	Possible overhead lifting	If lifting occurs, wear hardhats (as is posted in area) and stay out from under load.
2	Plug in power unit to AC	Shock or flash	AC power provided by standard NEMA connectors installed by electricians.
3	Change phase rotation (if needed)	Shock or flash	Unplug from AC power before changing leads (plug connected equipment with plug in direct control of person) - LOTO program does not apply. See FESHM 5120 Section3. Application first bullet item.
4	Operate Drive Joy Stick	Wheels turn Pinch	Block wheels up off floor to prevent pivoter from moving. Stay back from rotating wheels
5	Operate Kneeling Jacks	Upper frame moves up and down with possible pinch points.	Stay back from moving items and keep fingers out of possible pinch points.
6	Operation of either kneeling jacks or drive motors	Non-directly involved people distracting crew performing work	Cease work until distractions abate. Ask sightseers to retreat to the upper level.
7	Un-intended Oil Spill or leak to the floor.	Slip Hazard	Wipe up spilled oil to remove slip hazard. If conditions warrant, were tyvek suit to protect clothing. Oil is non-hazardous, non-toxic
8			

GUIDELINES FOR COMPLETING THE HAZARD ANALYSIS

Phase of Work	Safety Hazard	Precautions/Safety Procedures
Examining a specific job by breaking it down into a series of steps or tasks, will enable you to discover potential hazards employees may encounter. Each job or operation will consist of a set of steps or tasks. For example, the job might be to move a box from a conveyor in the receiving area to a shelf in the storage area. To determine where a step begins or ends, look for a change of activity, change in direction or movement. Picking up the box from the conveyor and placing it on a hand truck is one step. The next step might be to push the loaded hand truck to the storage area (a change in activity. Moving the boxes from the truck and placing them on the shelf is another step. The final step might be returning the hand truck to the receiving area. Be sure to list *all* steps needed to perform the job. Some steps may not be performed each time; an example could be checking the casters on the hand truck. However, if that step is generally part of the job it should be listed.	A hazard is a potential danger to a person or equipment. The purpose of the Job Safety Analysis is to identify ALL hazards- both those produced by the environment and those connected with the job procedure. To identify hazards, ask yourself these questions about each step: Is there a danger of the employee striking against, being struck by, or otherwise making injurious contact with an object? Can the employee be caught in, by, or between objects? Is there potential for slipping, tripping, or falling? Could the employee suffer strains from pushing, pulling, lifting, bending, or twisting? Is the environment hazardous to safety and/or health (toxic gas, vapor, mist, fumes, dust, heat, or radiation)? Are there electrocution hazards? Close observation and knowledge of the job is important. Examine each step carefully to find and identify hazards- the actions, conditions, and possibilities that could lead to an accident. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safe job procedures needed to prevent accidents.	Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness. Begin by trying to: 1) engineer the hazard out; 2) provide guards, safety devices, etc.; 3) provide personal protective equipment; 4) provide job instruction training; 5) maintain good housekeeping; 6) insure good ergonomics (positioning the person in relation to the machine or other elements in such a way as to improve safety). List the recommended safe operating procedures. Begin with an action word. Say exactly what needs to be done to correct the hazard, such as, “lift using your leg muscles.” Avoid general statements such as, “be careful”, “use caution”, and “be alert”. List the required or recommended personal protective equipment necessary to perform each step of the job. Give a recommended action or procedure for each hazard. Serious hazards should be corrected immediately. The JSA should then be changed to reflect the new conditions. Finally, review your input on all three columns for accuracy and completeness. Determine if the recommended actions or procedures have been put in place. Re-evaluate the job safety analysis as necessary.

I have reviewed this hazard analysis and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor or Fermilab contact if I am unable to do so.

Name and ID (please print)	Signature	Date