

To-do list at NM4

e-log link: https://dbweb8.fnal.gov:8443/ECL/spin_quest/U/login?message=Login%20required&ret_url=/ECL/spin_quest/E/index

Ordering from Stock-Room (FNAL)

Example procedure

<https://news.fnal.gov/fermilab-at-work> Quick links Stock Catalog (https://fermi.servicenowservices.com/stock_catalog) login with SSO Search for "Helium" look for the code "1980-115500" (~\$12.09) Fill out the form with 'Project#' etc. location = NM4 gas rack Add to the Cart Checkout.

Focus	Task	Responsible person	Status	Notes
Warm gHe circulation			Ongoing	Fridge and roots exhaust Magnet path
Cold gHe circulation				
Circulation test for QT		Dustin, Ishara	Done	Transfer-line getting back via vaporizer is done
Slow Controls Rack	<p>Lakeshore testing (We tested the hardware but only a few channel. We need to test all of 8 channels):</p> <ul style="list-style-type: none"> Test 8 channel of the readout for all Lakeshores in the counting house Test the LabView-VI using laptop in the counting house & decide which version of VI that we use Test the Lakeshores readout in the rack after the fridge/stick in place and read from the target computer <p>MKS 670:</p> <ul style="list-style-type: none"> Produce/purchase the cable, and install Baratron 1000 Torr sensor Produce/purchase the cable, and install MKS615 sensor <p>Purchasing (a total of ~\$ 4,300 for items related to SC /magnet rack needed to be purchase:</p> <ul style="list-style-type: none"> Purchase ~\$1,900 with UVA account Arrange other institution to purchase another ~\$2,400 items <p>Fridge-valve control:</p> <ul style="list-style-type: none"> Build the mechanics <p>Backup cable</p> <ul style="list-style-type: none"> Produce and install the cable or Lakeshore, AMI1700, etc after the order from Digikey arrive Install the cable after the order from Pfeiffer and AMI1700 arrive <p>Automatic Annealing backup:</p> <ul style="list-style-type: none"> Finish the labview Send to Fermilab and test the VI from target computer <p>ORC:</p> <ul style="list-style-type: none"> New Annealing box Final SC Rack 	<p>Waqar, Kenichi</p> <p>Kenichi</p> <p>??</p> <p>??</p> <p>??</p> <p>??</p>	<ul style="list-style-type: none"> The fridge reading was completed. The insert reading? <ul style="list-style-type: none"> The cable parts were delivered. Will assemble cables and connectors. <p>We have something that works</p> <p>Working on it</p> <p>Start work</p>	<p>https://onedrive.live.com/view.aspx?resid=37680BBD4932CB7F!5061&ithint=file%2cxlsx&authkey=!AFcAgwJ2yR8s9P4</p>

Magnet Rack	<p>AMI1700 testing:</p> <ul style="list-style-type: none"> Put liquid nitrogen, and test the readout all the way to PLC (the AMI readout should be consistent with PLC readout) Test the Labview VI or browser based readout (not urgent) <p>Mercury ITM:</p> <ul style="list-style-type: none"> Test the VI from the target computer <p>Maxigauge:</p> <ul style="list-style-type: none"> Fix the VI readout (currently the instrument readout and VI does not match) <p>Magnet & Shim PS:</p> <ul style="list-style-type: none"> Check the DC voltage/current on the cave side of the cable <p>Pressure sensor:</p> <ul style="list-style-type: none"> Install Aux sensor <p>ORC:</p> <ul style="list-style-type: none"> Final Magnet Rack Automatic annealing box 	<p>Waqar, Kenichi</p> <p>Kenichi</p> <p>Zulkaida</p> <p>??</p> <p>??</p> <p>??</p>	<p>Done</p> <p>Done</p> <p>Will compare them at low pressure.</p>	<p>Waqar and Sam are working on having the readings on HMI.</p> <p>Need to find variable names for LHe and LN2 levels</p>
In-cave piping and other pumping	<ul style="list-style-type: none"> Setting up the safety manifold to be pressure tested Pressure test for helium safety relief manifold Installing the manifold with the Rigging team Installing insulation for LN2 supply line Installing remaining gHe hoses Installing two relief valves (gHe safety, gN vent) 		Pressure test was completed for both Magnet Dewar and Manifold.	
Fridge & Target stick & insert	<ul style="list-style-type: none"> Install all temperature sensors Install heater/annealing plate + sensors Install Fridge in the Magnet Setting up He3 level probe Target insert test: Connect to Lakeshore to see the temperature sensor 		Waqar is working on fridge	
NMR	<ul style="list-style-type: none"> Noise test comparison between UVA & NM4 Ask Kun what's the plan (maybe the long term plan) with LANL rack Preparing for 2 channels available for UVA-NMR 		Kun will move to other place and will switch between UVA-LANL NMR	
Thermocouples (Temperature sensor)	Install MCC E-TC and sensors and testing.	Kenichi	<ul style="list-style-type: none"> Completed 	
Microwave system	Order parts?		Vibodha will working on it	
PLC & QT & Root	Installing thermocouples to check the LCW temperatures at the coldhead compressors' inlet/outlet	Kenichi, Sam (ACU)	<ul style="list-style-type: none"> Installed all hardware. Tested the readout using simple VI. Developing VI. 	https://labjack.com/All-Categories/thermocouple-daq <ul style="list-style-type: none"> Omega Type-J TC LabJack U3-LV
Operation Manual Documentation	<p>How to operate</p> <ul style="list-style-type: none"> Turbo Pump Magnet & Shim PS QT PLC 			
Continuous /routine tasks	<ul style="list-style-type: none"> Ordering LN2 (reminding Kun ahead of time) Filling LN2 purifier Checking LCW parameters Checking levels 	Undergrad students		
elog		Zulkaida		
Engineering notes		Vibodha		
Cryogenic Control Panel	<ul style="list-style-type: none"> Fridge, Insert sensors Fridge valve controls Need to get info from level probe have P&ID on screen 	Kenichi	<ul style="list-style-type: none"> Can control the fridge valves already. Will calibrate parameters once hardware gets ready. Which level probe? Include P&ID when having a time. 	
Leak checking	Higher level leak-checker			

LHe	Check , take photos from Messer			
Others				

----- below Previous tasks list (will be deleted)

* Critical Path Items

Focus	Task	Responsible person	Status	Notes						
Hall-Preparation	Setting up zoom meetings in the Hall (mapping out the bad locations and trying to enhance the signal as needed)	Ishara	Checked with Anchit, Vibodha & Nuwan on 31 Mar 2021	<table><tr><th>Location</th><th>Audio</th><th>Video</th></tr><tr><td>All areas</td><td>fair</td><td>fair</td></tr></table>	Location	Audio	Video	All areas	fair	fair
			Location	Audio	Video					
			All areas	fair	fair					
			(see notes)							
			02 Apr 2021	<ul style="list-style-type: none">• fair audio is somewhat clear to deliver the message• fair/low has some delay on audio (experiencing frozen video, but less frequent than "low" mode)• low experiencing silence/frozen video very frequently						
Rick contacted FNAL to install signal enhancers.										
06 Apr 2021										
Rick will follow up with Andrew (FNAL)										
19 Apr 2021										
Rick and Hugo confirmed that the additional wifi enhancer is installed and checked.										
Communication	Order at least three very good walkie talkies	Ishara								
QT System	Finish QT Electrical setup with ODH interface, level probe setup and read-in (LN2 and LHe, purchase new ones), pressure transducers (all prep for QT visit)	Waqar								
Microwave Setup	Setup both independent EIO tubes (one in cave, one in counting house) both with remote operation of PS and both with remote control of stepper motor for frequency control. Need cooling water monitor and PS interlock for each.	Waqar								

NMR	Setup remote NMR testing with crystal signal readout at counting house target computer as well as pressure readout in PDP for manometer. Also make adjustments to PDP software to be able to read in multiple units into the slow controls BNC patch panel. Setup coil and target insert for reading NMR data.	Kenichi/Ishara	<ul style="list-style-type: none"> The VNC server is running on the NMR computer to accept a remote control from the target computer etc. Able to add an indicator of BNC connector on PDP as we need. 	Plans: <ul style="list-style-type: none"> Move the NMR rack into the hall. When? Make a cable to connect MKS 670 (at the Slow-Control rack) and the BNC connector (at the NMR rack). 1 day.
Temp Sensors 1	Setup a set of 8 temperature sensors on the magnet coils in the cave. Those should be setup now to read from the target computer.	Kenichi	<ul style="list-style-type: none"> Decided to use MCC E-TC 	Plans: <ul style="list-style-type: none"> Install TC extension cables from the slow control rack to the cave. Design a connector between the feedthrough TC wires and the readout device. Produce it. Configure VIs for this set and launch it on the target computer.
Temp Sensors 2	Setup a set of 7 (or possibly more?) temperature sensors for transfer lines: two for LN2, one for two LHe, two on outside of magnet dewar, two on outside of purifier.	Kenichi	<ul style="list-style-type: none"> Decided to use MCC E-TC 	Plans: <ul style="list-style-type: none"> Install TC extension cables from the slow control rack to the cave. Purchase (or find) the TC wires. Attach TC wires to the proper locations Configure VIs for this set and launch it on the target computer.
Pressure Readout	Make sure we can ready out three critical pressures from system into PDP.	Kenichi/Ishara	<ul style="list-style-type: none"> Able to add an indicator of BNC connector on PDP. 	Need nose pressure which has two units 100 Torr and 1000 Torr. Try to get them both read in to PDP. If possible also the He3 Pressure probe as well. All 3 are used in the fridge.
PDP patch panel	BNC patch panel to read in other slow control devices on the fly.	Kenichi/Ishara	<ul style="list-style-type: none"> Able to add an indicator of BNC connector on PDP. 	The slow controls part should already be working so I think you just need to map out the channels and try to read in different types of hardware. Basically anything with a voltage, temp, pressure, flow, just so we know what channel are ready in case we need this.
PDP mod	Learn PDP code	Kenichi/Zulkaida		Learn PDP code enough that if we have to make some simple modification that we can do that will out much effort. No big modification should ever be needed. Know how to run and modify NMR part, and pressure part, and how to run and take TE measurements.
Zulkaida	Get both Turbos running	Zulkaida		Get both the big turbos systems running that connect to the target vacuum. Document and post how to do these operations and setup.
SCM Vacuum	Vacuum for SC magnet needs repair and leak checking. Once working again and leak tight then must readout vacuum pressure on target computer and monitor for several days.	Zulkaida/Ernesto		
Fridge box, Annealing box, Microwav e box	Finish construction of the electronics and boxes and submit ORC and install boxes to rack in Hall. Test operation of systems once possible.	Waqar/Vibodha		Can setup and test all of these units use mock devices so we don't have to wait to finish them.
All MFM and MFC systems	There is two Mass Flow Control (MFC) and one Mass Flow Monitor (MFM). The MFCs are connected before the KNF pumps and the MFM is connected after the Roots exhaust piping.	Kenichi/Ishara		
Documents	Document all QT and Roots PLC/HMI controls for easy operations and diagnostics	Waqar	Document and train for operations	Put in both our website and docdb
KNF pumps	Add plug to KNF pump so it can be plugged into the socket	Waqar		We will eventually have to of the normal plugs here but right now need to fix power cable.
Roots	Setup Roots to run and monitor from control room	Waqar		Need to have up and running full system monitor of roots pump including all pressure and temperature and flow sensors, maybe all not read out by system, if not determine which pressure transducer we can readout and setup that up to read in the data stream .Make all documentation about roots PLC/HMI and how these are monitored remotes during shifts and remote operation. We may need to add sensors for monitoring. Need exact interlock limits in schematic/interlock write up and posted to docdb or somewhere our group can find it (what pressure and flow, temperature switches are set to). <ul style="list-style-type: none"> We need water flow (LCW) monitor to be seen from counting house Pressure before & after the roots system to be seen from counting house

Magnet and shim PS	Learn how to operate and document and post. Do PS tests and post results.	Waqar/Zulkaida		Document all setup so other people can do operate and diagnose as needed
Magnet and shim PS	Complete all the connections in the magnet rack and test shim and magnet PS from control room (make sure can do this test using proper Mag PS cable in cave)	Waqar / Zulaida		
Magnet and shim PS	Testing each device on Magnet rack get new relay for shim PS and a backup	Zulkaida / Waqar	document all details for easy setup and diagnostics	Magnet_and_cryo_rack_(see page 4,5,6)
Magnet	Get some new level probes with readout for magnet fast	Zulkaida / Waqar		
Backup mag turbo	Need to have backup cable and turbo ready	Zulkaida / Waqar		
Piping, line, tube, QT, Mechanics & Dewars	QT System preparation (see list)	Ishara/Waqar	In progress: 90%	Work with Rick and Dustin to get these things setup
Fridge	Pressure test on the shell	Dustin/Zulkaida		Done at UVA
Roots gate valve	Setup controls for main gate valve	Waqar		Need connections from pneumatic air compressor (have to ask Rick where to connect). And need electronics to open/close gate valve from counting house. All analogue control is preferred.
Magnet Risers	Make new magnet risers and install	Vibohda		redesign to have fill and u-tube fit, make drawings to submit to Meyer or FNAL (not UVA) shop.
Pressure sensors	6 pressure sensors (two roots, four cave (2 He/N2 exhaust), one intake manifold, one before intake manifold)	Zulkaida		Setup all auxiliary pressure sensor to read in to target network and have a VI ready for them.
Slow Controls	Readout in control room on target computer	Zulkaida/Ishara /Kenichi		Have all system working in Hall and readout to target computer: NMR, microwave controls and EIP, all pressure/temp sensors, all flow meters, monitoring systems
Cave piping	Cave Flex hose order and install with pressure rating specifications	Vibohda		flex hose, EVAC seals, EVAC clamps and all cave utilities
Microwave Control System	This is a control system that optimizes polarization automatically	Vibohda		Requires remote control and modulation of the microwave frequency, automatic moving of the microwave frequency with accumulated dose, fast changes from positive to negative polarization. Read in of polarization from NMR and adjust to ideal frequency to optimize highest polarization.
Fridge Box	Make box to control fridge valves	Vibohda/Harsha		The box and cables should be in place soon as we can just use dummy stepper motors until the fridge is actually in place.
E. Notes	Engineering notes for Fridge (separator, shell, nose)	Dustin		
Cave	Make and install N2 vapor manifold to nitrogen return line	Ernesto/Ishara		
Cave	Install in-cave He flex tube	Ernesto/Vibohda		
Cave	Install in-cave N2 flex tube	Ernesto/Vibohda		
ROOT-pump	<ul style="list-style-type: none"> Establish communication with Oerlicon Bump test 	Misha/Dustin		
UVA-NMR System	<ul style="list-style-type: none"> Complete custom components recommendations Submit commercial components Prepare the rack for ORC walkthrough Prepare lambda/2 cable in the hall 	Ishara	<ul style="list-style-type: none"> Done 	

Target Lifter	<ul style="list-style-type: none"> • Test the lifter from the control room • Make a VI communicate the ADC power supply • Update the ADC readout in the VI • Adjust the locations of the position switches according to the target stick 	Vibodha		
Microwave Motor Setup	<ul style="list-style-type: none"> • Interface the Motor with the controller and the driver • Create a VI library for the Motor • Create a function with frequency and the step count of the motor 	Vibodha		

QT PLC test summary (on 10 Aug 2021)

----- email from Sam (start) -----

Here's a quick recap of what we did.

- Connected through Zoom
- Changed PLC IP address
- Ping devices worked, connection through software did not. Relocated the laptop to the system to avoid going through any facilities managed switches.
- Established connection, upgraded firmware and loaded latest software
- Enabled VNC server (SmartServer) on the HMI screen
- Went through the analog input signals, reconfigured some IO cards and fixed some minor bugs in code.

Overall I was very pleased with the progress and was happy to see that most of the analog inputs were giving correct readings On the link below is the systems IO list. Note that we only checked analog inputs.

https://docs.google.com/spreadsheets/d/1eKmwuwjwN85ZBP1T2PJBcUxGWTd9zdNdLz_mwY0kc7o/edit?usp=sharing

System: Is there any pressure in the system? I'm picking up some good looking signals but it seems like I might have the wrong scaling factor. PTA and PTB did not give readings, are these wired in? TX1 transferline thermocouple, is this in place? TIDA and TIDB: Quantum to look into this.

We would need to schedule another meeting when we can sort the above out and continue with the following

4) Verify all remaining (low power) instruments.

Requirement: Someone on site that verifies operation of valves and some other equipment such as flow controllers.

5) Establish connections with the instruments on site.

Requirement: On site hardware connected.

6) Verify the Helium compressors connections (see if each compressor is connected with the correct cable) and operation

Requirement: Power for the helium compressors. Someone on site that can verify each compressor actuates for ~10seconds.

If we can get to this point we can start planning the actual commissioning of the system

Thanks again to everyone involved.

Kind regards,

Sam Crauwels

----- email from Sam (end) -----

*Non-critical Path Items

Location	Task		Status	Notes
All places	Organizing all areas, organize tool boxes, keep all tables clean, labeling all cables and designate places	Every one		

Counting-house work area	Find all large boxes that need to be going to the storage and arrange those to be moving to storage (the boxes that will be used frequently can be stored on top of those cupboards, other rest of all boxes can be disposed)			
	Find items that can be shipped to UVA			
	Collect all unwanted items in each cupboard and move them to different location/storage/throw			
	Assign designated locations in those cupboards to store cables/parts/items relevant to the systems (eg: Microwave related, Actuator related, Magnet rack-related, etc.) Once this is organized, there will be a dedicated web page in this wiki to keep an inventory list with pictures (then anyone can find anything easily)			
	Arrange all the tables for anyone to work at any time (there shouldn't be cables/parts/screws/items etc on these tables because those should be in their designated place)			
	Purchase a wise and set it up on a table			
	Prepare the second target stick (as same as the one is hanging on the fridge-frame)			
	Find all fittings, bolts, etc. (eg: water fitting..) stuff that we don't need, and keep those somewhere else. Organize "Swadgelocks, NPT, stuff that have KF flange" in those yellow boxes			
	Label all cables (using the stickers with the relevant system) and identify the cables that need to be shipped to UVA			
	Prepare dedicated toolboxes for NMR, Microwave, Cryogenics (there three small table-top toolboxes)			
Hall - Loading dock area	Check/open all the boxes (including wooden ones) and identify which of those should go to storage and arrange the move			
	Clean-up loading dock area (move all pipes, boxes, items etc. to proper places to store)			
	Move the vacuum pump to the downstairs (right below the loading dock: area next to the beam dump in the downstream)			
	Check whether that black tool box's lower part can be used for the leak-checker's lower part (which has wheels), and the upper part can be used as a Target Toolbox in the work area next to the beam dump (where the target cups are refilled)			
Hall - Cryorack	Identify and label all cables that need to be connected to all devices on the cryo rack (slow controls rack)			
Hall - Roots pumps (on cryo platform)	Move scroll pump (right now it is close to NM3 enclosure / upstream beamline area) to here	Anchit	Done	
	Design and make a small rack to hold all Vacuum pumps (scroll pump and other two pumps that are currently sitting on the platform base)	Anchit	Solidworks design In progress.	have taken the measurements and started design work. currently soliworks model in progress.
	Setup a He bottle in the corner near the roots pumps	Anchit	Done	Do we need another bottle?
	Setup the control patch panel for roots pumps in the cave	Waqar/ Anchit		
Hall - NM3/3 enclosure area (including the area under the beamline)	Clean up the area			
	Organize the cart that is sitting in that area only with the KF parts and other essential parts: all tools should be kept in the relevant toolbox(s)			
Hall - Turbopump	Move the Pfeifer Vacuum (ACP) device to here and set it up			
	Setup with proper flangers			
	Calibrate manometer and set it up in the small space close to the west penetration			
Hall - Cave	Cover all tube-ends to avoid dust inside			

	Setup the control/patch panel for roots (contains series of swage-locks and hand-control-valves and three outputs to barbs)			
	Need a safety-engineered solution to reach the target lifter to work on EIO			
	Adjust L-bows that are going to be connected to Keithley			
	Connecting the shell and nose			
	Welding one of those connections			
	Purchase a pully			
	Remove the cable conduit part from the cables coming from the magnet rack and arrange it in a way those cables can reach easily to its designated connection			
	Perform leak-checks			
Hall	Request 3 He gas bottles from FNAL <ul style="list-style-type: none"> • Close to beamline area • Counting-house • 2nd floor (loading dock area) 			
Hall - area next to the beam dump	Clean up the area			
	Identify all boxes, items that can be moved to the storage and arrange the move			
	Arrange two tables and chairs and arrange as a work area close to the ventilation <ul style="list-style-type: none"> • Material making station (eg: refilling target material) • Worktable 			
	Arrange that top part of the black-tool-box (currently sitting on the loading dock) to here with the necessary tools			

Cryo-commissioning check/steps list (from Misha)

QT commissioning who is responsible?

1. what can be tested without Target or FNAL zone equipment?
2. did QT provide prerequisite for tests?
3. who can operate, personnel training?

Target commissioning

1. Leak checker, roots+rotary, KNFs, turbo+roughing are working in manual mode (1-4 days) (in remote +1-4 days)
2. OVC is leak checked (~1 week)
3. Shell+nose (removed) is leak checked (ideally with LN2 in it) (1-2 days)
4. Insert (removed) is leak checked (1-2 days)
5. Fridge+turret only is leaked checked (1-2 days)
6. Separator only is leaked checked (1-2 days)
7. Turret-gate valve pipe only (if possible) is leaked checked (1-2 days)
8. Gate-roots pipe only (if possible) is leaked checked (1-2 days)
9. Magnet tank+dewar (?)

10. Manifold (?)
11. Warm gas system only (backfill) is leaked checked (1-2 days)
12. Pumping and purging (GHe, GN2 purchase) all (3-5 days)
13. Precooling magnet (LN2?) while checking OVC leaks untill empty (4-5 days)
14. LN2 fill (are we allowed to use purchased dewar-kept LN2?) (~1-2 days)
15. Cooldown transfer LHe line (is manual possibele?) (1-3 days)
16. LHe fill + QT education (4-5 days)
17. Energizing magnet (2-3 days)
18. Fridge fill (no insert) (2-3 days)
19. Soft Quench practice? (1-2 days)

FNAL commissioning who is responsible?

1. Over pressure tests (is it possible to compartmentalize LN2 sytem?) (1-2 days)
2. Leak check tests (is it possible to compartmentalize LN2 system?) (3-5 days)
3. Who can operate, personnel training?

Cryo Controls prepare local (laptop) system

1. prepare remote (counting room) system
2. All initial commissioning tests are done with local system
3. LN2, He/LHe purchase

Safety Understanding

1. ODH implications for running
2. Who can give a "green light" (once, daily)?