VIRUS: the instrument infrastructure to support the deployment and upkeep of 156 spectrographs at the Hobby-Eberly Telescope

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VIRUS: the instrument infrastructure to support the deployment and upkeep of 156 spectrographs at the Hobby-Eberly telescope

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ABSTRACT

The Visible Integral-field Replicable Unit Spectrograph (VIRUS) consists of 156 identical spectrographs fed by 35,000 fibers from the upgraded 10-meter Hobby-Eberly Telescope (HET). VIRUS is in a phased deployment. At the submission of this paper, over half of the units are installed and the full support infrastructure is operational. This paper will describe the VIRUS infrastructure which includes the physical support system, the air cooling, the cryogenic cooling, and the temperature control of VIRUS. The paper will also discuss the various installation, maintenance, and operational procedures based on growing experience with the VIRUS array.

Keywords: VIRUS, spectrograph, cryogenics, nitrogen, maintenance, Hobby Eberly Telescope, vacuum, fiber optics

1. INTRODUCTION

The Visible Integral-field Replicable Unit Spectrograph (VIRUS) is being used to investigate dark energy for the Hobby-Eberly Telescope Dark Energy Experiment (HETDEX). To make this investigation possible proper infrastructure had to be designed and installed as part of a massive upgrade at the Hobby-Eberly Telescope (HET). Procedures had to be developed to install, maintain and operate the VIRUS units. This paper will discuss the infrastructure as well as the ever-evolving installation, maintenance, and operation of VIRUS.

1.1 HET – The Wide-Field Upgrade

The HETDEX experiment is part of a larger Wide-Field Upgrade to the HET[1], which includes HETDEX and the addition of a newer High Resolution Spectrograph (HRS), a new Low Resolution Spectrograph 2 (LRS2), and the Habitable Zone Planet Finder (HPF), in addition to VIRUS. The Wide-Field Upgrade involved replacement of the old telescope bridge and tracker, the installation of a new Wide-Field Corrector and Prime Focus Instrument Package (PFIP), the installation of a new glycol cooling system and cryogenic liquid nitrogen system, and the addition of a housing and support system VIRUS.

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CCC code: 0277-786X/18/$18 · doi: 10.1117/12.2314174

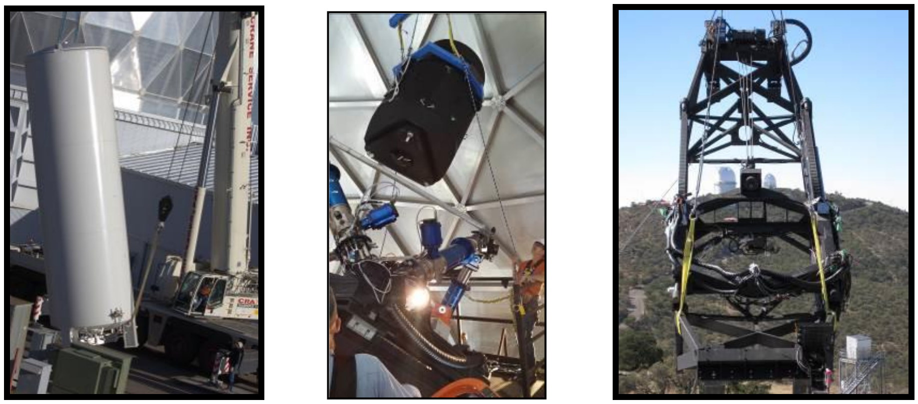

Figure 1. (Left) Liquid nitrogen tank lifted into place at HET. (Center) Wide Field Corrector being lowered into place. (Right) The new tracker bridge being lifted into the HET dome for installation. (Photos taken by R. Spencer)

1.2 VIRUS Overview

The VIRUS unit contains two spectrographs that are fed by a single Integral Field Unit (IFU), a common collimator housing, a common cryostat, and a common controller. The unit contains two independent optical paths, with two independent cameras that receive light from two separate slits of fiber bundles at the back of the unit. The VIRUS design, construction, and function have been covered in great detail in numerous papers[2,4,5,6].

Figure 2. A working VIRUS attached to the infrastructure described below. (Photos taken by R. Spencer)

1.3 VIRUS – Infrastructure Upgrade

Before VIRUS units began to arrive at the HET, support infrastructure was designed, built, and installed as part of the Wide Field Upgrade[2,3]. The primary infrastructure components consist of two large VIRUS enclosures, each with a supporting "Annex" and liquid nitrogen cooling system. The two enclosures mount to the VIRUS Support Structure (isolated from the telescope structure except during rotation) on opposite sides of the telescope. The enclosures are elevated approximately 20 feet off the ground in order to minimize the length of fiber optic bundles from the tracker to the individual units, yet still allow for access to the units via boom lifts. The enclosures will ultimately house 78 VIRUS spectrograph units and two Low Resolution Spectrograph 2 (LRS2) units. The enclosures each contain an "Annex", which houses the computer and electrical systems for VIRUS and a cooling system for the VIRUS units and the electrical components. A nitrogen system fed by an external 11,000-gallon liquid nitrogen tank provides cooling to each VIRUS unit. The front side of each enclosure (the VIRUS side) is accessed via scissor-lift or boom lift. The back side (the Integral Field Unit side) is accessed via a system of platforms and ladders.

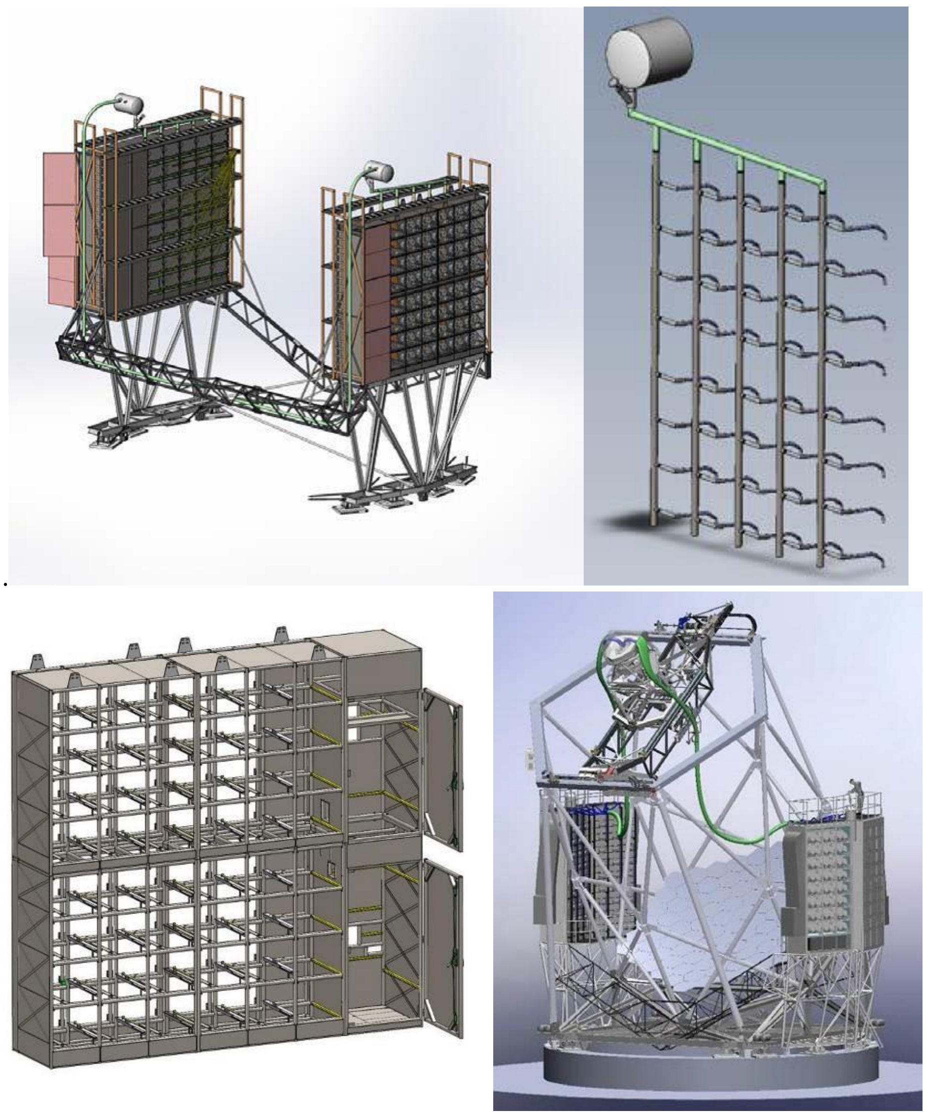

Figure 3. Conceptual drawings of the HET upgrade[1,2]. (Top Left) VIRUS Enclosures shown on the VIRUS Support Structure (VSS) with the mirror and telescope structure removed for clarity. (Top Right) Nitrogen distribution system with enclosures removed for clarity. (Bottom Left) VIRUS enclosure shown with doors removed. (Bottom Right) Full rendering of the HETDEX upgrade with an earlier iteration of the VIRUS enclosures.

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Figure 4. HET with VIRUS enclosures and nitrogen system in place. (Photo taken by R. Spencer)

2. THE VIRUS CRYOGENIC SYSTEM (VCS)

Each VIRUS contains two CCD detectors, integrated into a cryostat, that must be cryogenically cooled. A vacuum-jacketed, thermal syphon, liquid nitrogen distribution system was designed to cool the array of VIRUS detectors. A challenge faced by the design team was to create a thermal connection at each unit which provided efficient transfer of cooling power yet still allowed for separation of the nitrogen line such that an individual VIRUS unit could be pulled from the array for maintenance without disrupting the cooling to the remainder of the array. Thus a thermal "make-break" connector was designed and is currently used in the operations and maintenance of VIRUS. The design and testing of the system is covered in detail in references 7 and 8.

2.1 The nitrogen distribution system

As part of the Wide Field Upgrade, an 11,000-gallon vacuum-jacketed storage tank (also known as the Liquid Nitrogen Storage Tank or LNST) was installed to provide liquid nitrogen to cool the VIRUS camera cryostats. Nitrogen supply and exhaust lines penetrate the ring wall of the telescope dome as rigid vacuum jacketed lines. To allow for the rotation on the telescope, flexible vacuum-jacketed lines are used in the azimuth wrap. Rigid vacuum-jacketed risers route the nitrogen to the top of each VIRUS enclosure where the liquid nitrogen line feeds a 50-gallon storage tank or Thermal Syphon Vessel (TSV). Liquid nitrogen then flows from the TSV into a header that feeds into the VIRUS enclosures. Thermal syphoning occurs as the gravity-fed liquid nitrogen travels down each of 5 vertical vacuum-jacketed lines within an enclosure and cools the associated units. As the nitrogen boils off to vapor, the vapor bubbles rise back to the TSV atop the VIRUS enclosure where the nitrogen gas is then routed as exhaust out the building.

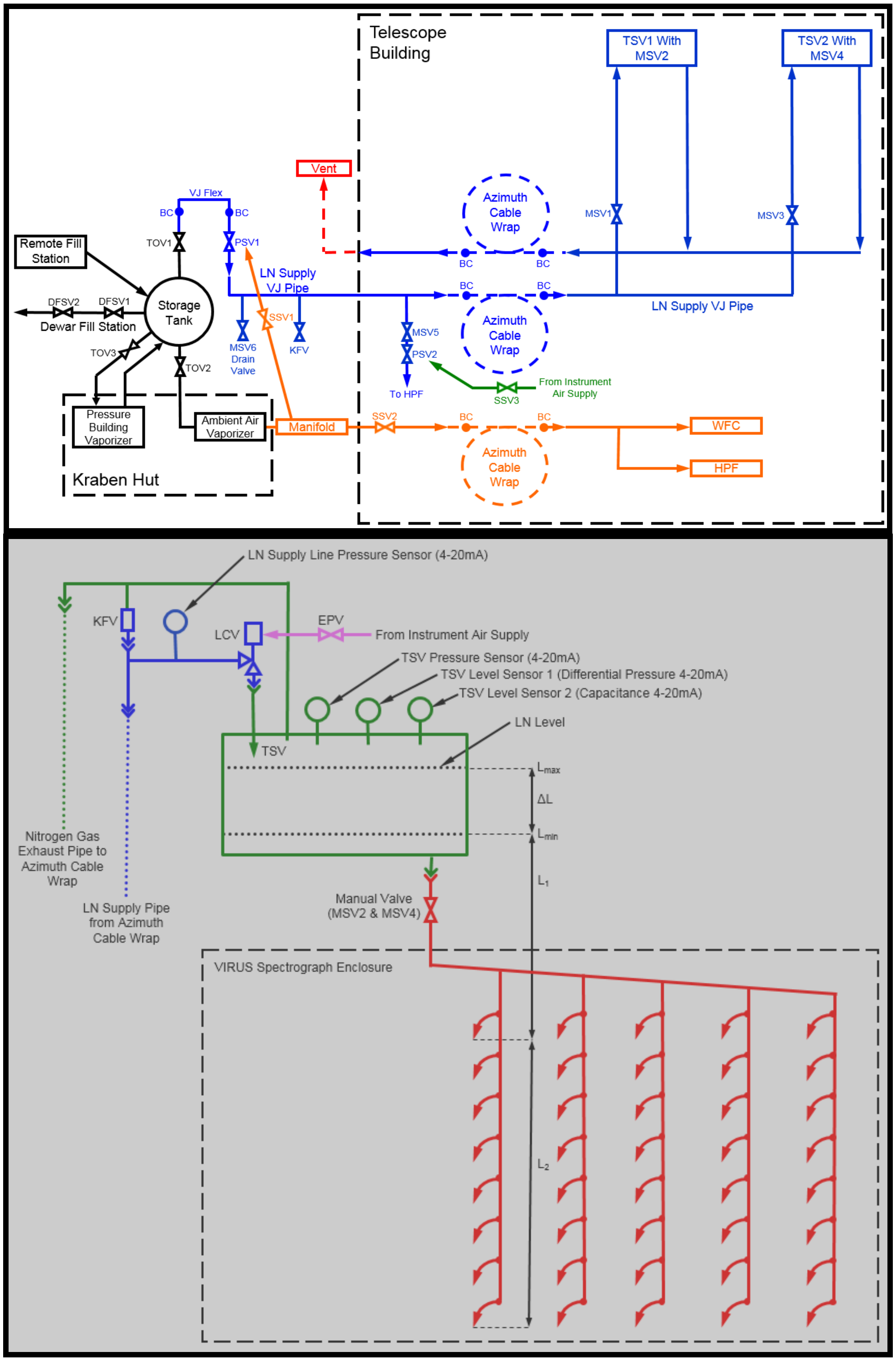


Figure 5. (Top) Schematic of nitrogen system from outside of telescope to top of VIRUS enclosures[7]. (Bottom) Schematic of nitrogen system from top of VIRUS enclosure down to each VIRUS spectrograph[7].

2.2 The "make-break" connection

As noted earlier, the "make-break" connection at each VIRUS unit is a dry connection which ties the liquid nitrogen to the VIRUS unit[8] and allows for an individual unit to be detached from the nitrogen cooling system. The connection is one of conduction from a tapered female copper cone mated to a tapered male copper plug. The female copper cone is machined at the base of a male bayonet of the nitrogen system. The tapered male copper plug exists inside a female bayonet as part of the cryostat. Heat escapes from the CCD's via cold fingers to the female bayonet of the cryostat. Figure 6 shows the "make-break" connection and heat path from the CCD out to the male bayonet of the nitrogen system.

A proper connection at the "make-break" connection cools the cryostat down to -180˚C in approximately 40 minutes. To achieve a gravity feed and thermal syphoning of the nitrogen, the nitrogen line must maintain a slight downward slope at all times. This includes the flexible line that connects the vertical vacuum-jacketed line in the enclosure to the "make-break" bayonet connection at the VIRUS unit.

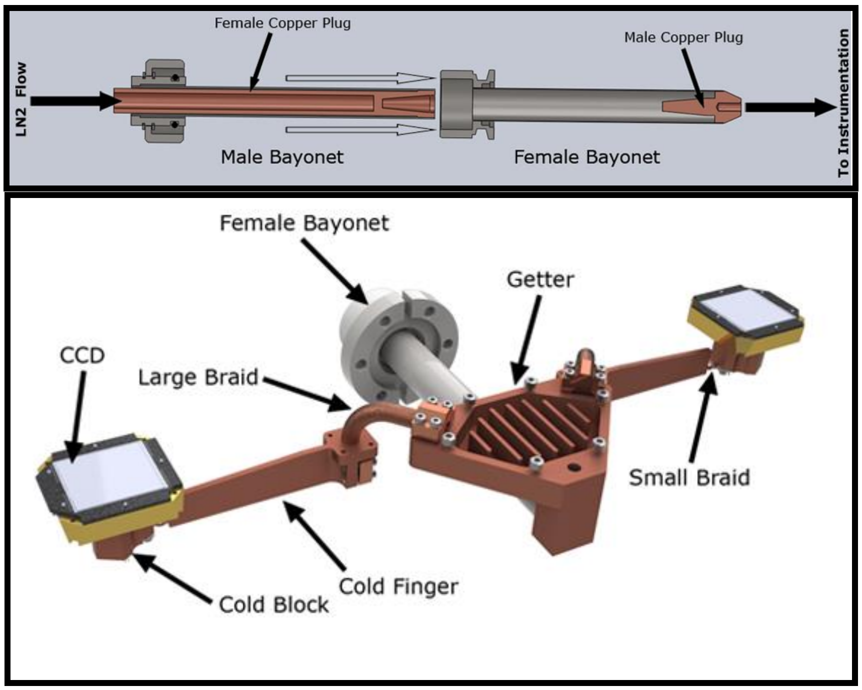


Figure 6. (Top) Drawing of the "make-break" thermal connection[8]. (Bottom) Drawing of the thermal transfer system from the female bayonet to the CCD[8].

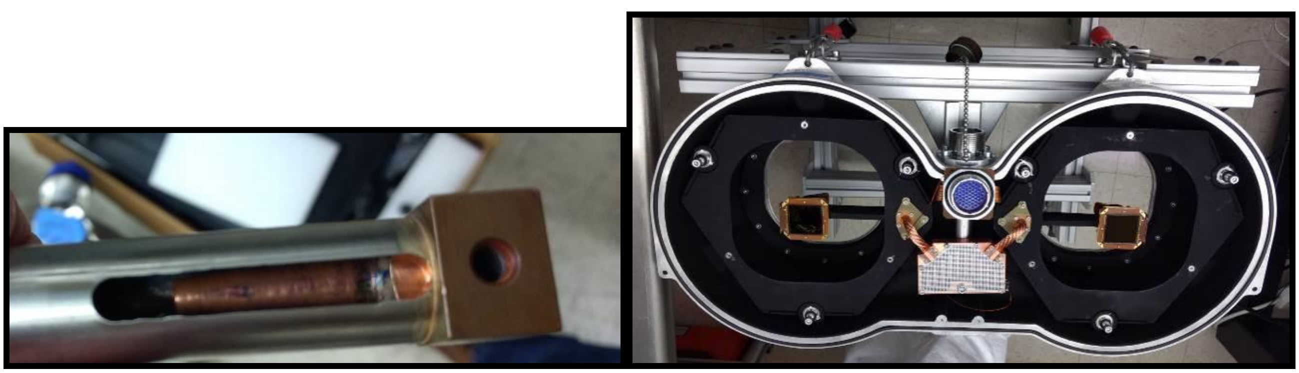


Figure 7. (Left) Photo of a female bayonet with a cut away to show the male copper plug. (Right) Photo showing the thermal transfer system from the female bayonet to the CCD during VIRUS assembly. (Photos taken by R. Spencer)

2.3 The nitrogen safety system

The nitrogen safety system is known by the acronym VCSS, the VIRUS Cryogenic Safety System. It was designed to protect personnel from the hazards associated with accidental release of both liquid nitrogen (LN2) and gaseous nitrogen (GN2). It also serves to protect the VIRUS instrumentation from accidental loss of cooling that will occur from loss of delivered LN2. The system is designed around a SCADA 3000 (Sensaphone Inc) PLC using expansion modules to interface to peripheral input/output sensors and actuators.

Central to personnel safety is the use of multiple oxygen monitors throughout the telescope facility. Detection of a low O2 atmosphere will result in 1) a telephone call to a defined call list, 2) the sounding of multiple local audible and visual alarms specific for low O2 detection necessitating evacuation of the facility and 3) closure of the main pneumatic valve that controls the flow of LN2 into the system.

In order to ensure a stable cooling environment for the VIRUS spectrographs, the VCSS includes a series of sensors for LN2 and GN2 pressure, as well as sensors for the LN2 level in the three storage tanks that include the two TSV's and the LNST. Detection of out-of-range conditions could signal danger to both personnel and equipment. Detection of these events results in 1) a telephone call to defined call list, 2) the sounding of a local audible and visual alarm at the central control panel and 3) closure of the main pneumatic valve that controls the flow of LN2 into the system. This equipment alarm does not necessitate a building evacuation.

Figure 8 below shows photographs of the SCADA 3000 PLC, the remote controlled LNST pneumatic control valve, and a remote O2 sensor.

The SCADA 3000 PLC interfaces with Windows based Graphical User Interface (GUI) designed by HET. This interface permits system programing, monitoring and control. Figure 9 and 10 below depict key operational screens used for this purpose.

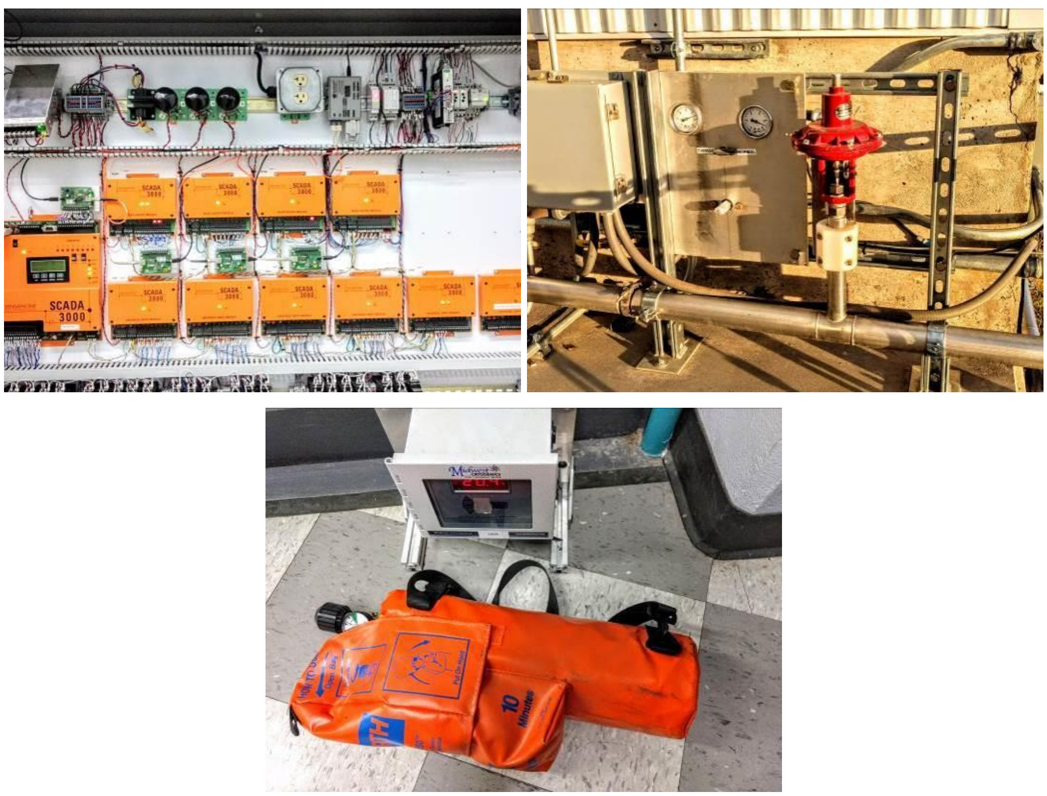


Figure 8. (Top Left) SCADA system, providing monitor and control functions of the VCSS. (Top Right) Nitrogen supply valve for the LNST. SCADA can send a command to shut down in emergency. (Bottom) Oxygen sensor will sound alarm if oxygen levels in location get to low. Some alarms will cause SCADA to send command to close main nitrogen supply valve. EEBA (Emergency Escape Breathing Apparatus) are located in numerous locations to allow personnel to escape if there is a nitrogen leak. (Photos taken by R. Spencer)

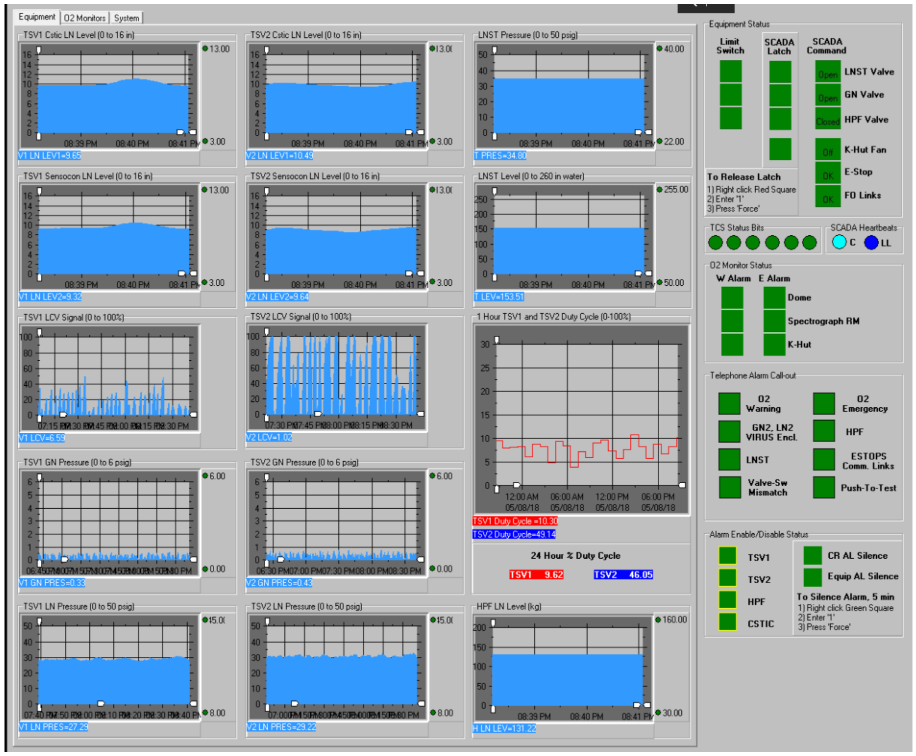


Figure 9. Screen shot of Equipment tab of SCADA 3000 GUI showing operation status of all major VIRUS Cryogenic System components.(Image provided by G. Damm)

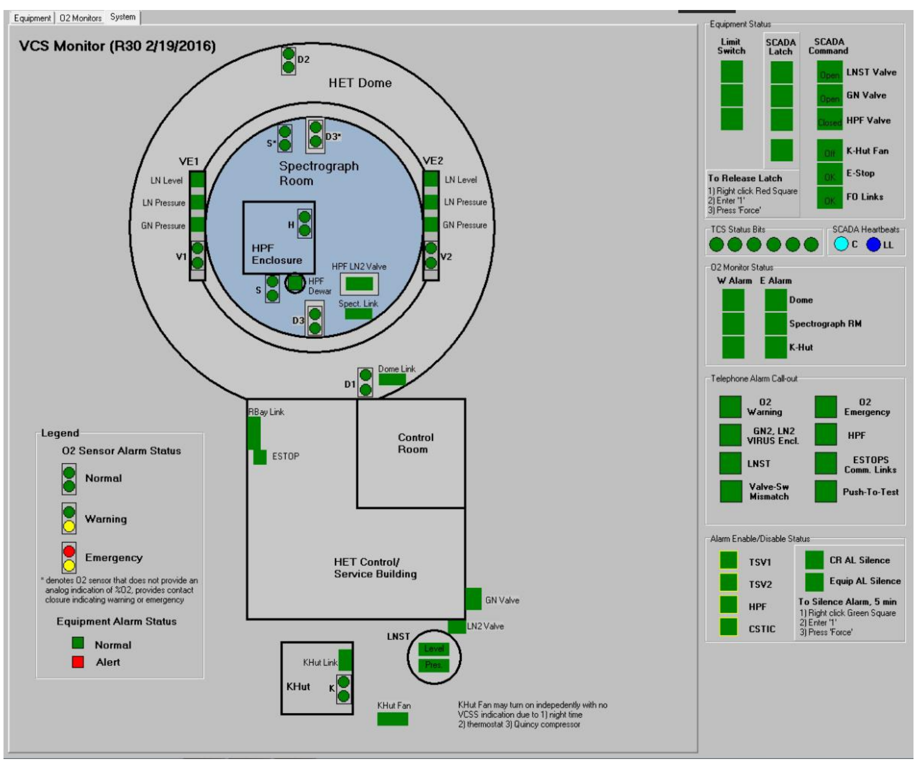


Figure 10. Screen shot of System tab of SCADA 3000 GUI showing location and operational state of all input and output sensors and actuators monitored and controlled by the SCADA 3000 PLC. (Image provided by G. Damm)

3. THERMAL MANAGEMENT OF THE VIRUS ENCLOSURE

The thermal management system of the VIRUS enclosures was designed and built by Texas A&M University.
The two separate VIRUS enclosures each consist of a large insulated, modular weldment designed to support the VIRUS in a temperature controlled, light tight environment. Within each of the two separate VIRUS enclosures are two adjacent enclosures, separated into 1) the larger spectrograph enclosure and 2) the smaller enclosure annex. The spectrograph enclosure is a compartmentalized structure that holds up to 40 VIRUS units. The enclosure annex contains the electronics to monitor and control both the VIRUS instrument as well as the environmental controls and blowers for both spaces.

Each of the spaces is designed to operate with independent environmental controls with separate heat exchanger, air flow paths and control systems. The intent is to maintain the large interior space of the spectrograph enclosure at a temperature that is referenced to the ambient telescope temperature. The smaller enclosure annex, with its independent thermal controls, is permitted to rise to a higher temperature, relying on insulation to isolate the interior of this space from the external environment of the telescope dome.[2]

3.1 Enclosure air flow and heat removal

Texas A&M designed the thermal management system as a dual air circulation system such that one flow path supplies the actual VIRUS enclosure and removes the heat created by the VIRUS controllers while the other supplies the annex and removes the heat from other electronics and motors.[3] Figure 11 below is a schematic representation.

The spectrograph enclosure air flow relies on a large cooled water-glycol/air heat exchanger and blower within the annex to direct cooled air into the large ambient space. Suction from the blower pulls air through a balanced duct system (air flow balance achieved through the use of restriction orifices within the duct) from each of the installed VIRUS spectrograph electronics, returning the waste heat to the exchanger.

The enclosure annex air flow relies on a separate dedicated heat exchanger that recirculates the air within this space, a local thermostat providing the on/off control of the dedicated heat exchange fan. A vertical duct system ensures thorough mixing of the heated air from the VIRUS control and monitoring electronics in the lower annex and the air from the upper annex. The upper annex contains the waste heat from both the enclosure and the annex blower motors, also relying on the cooled air circulated by the heat exchanger and duct system to remove the heat.

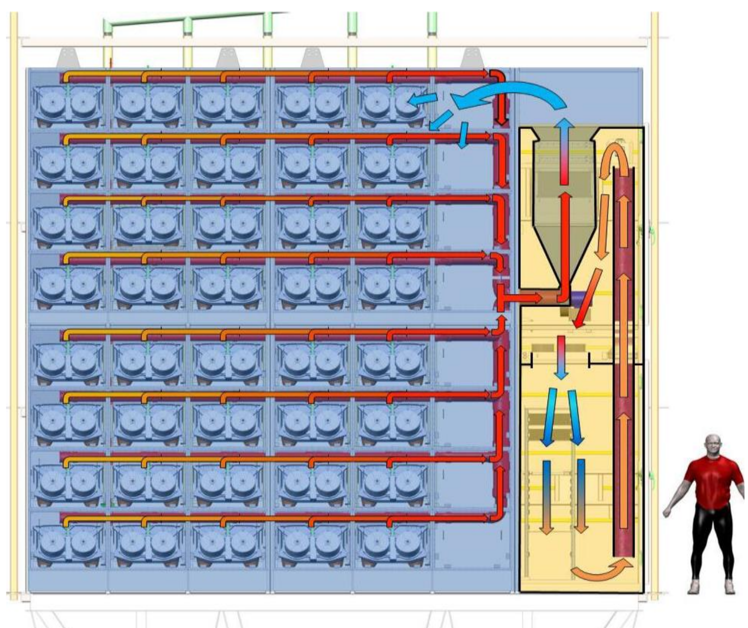


Figure 11. Illustration of the two air zones. The blue area on the left is for the enclosure which houses the VIRUS units, and the yellow area is for the enclosure annex which holds the VIRUS electronics equipment and enclosure cooling system. [3]

3.2 Chilled glycol and temperature control

A 20-ton remotely located chiller (Advantage Engineering Inc) provides the chilled water-glycol (50%/50%) thermal fluid to remove the VIRUS enclosure waste heat. The chiller capacity is controlled in discrete 1 ton increments using 2 scroll compressors, pulse width modulated in a 20 second period, to govern the water-glycol temperature. Buried, insulated piping directs the chilled working fluid into the telescope where it is distributed to both VIRUS enclosures. Flow control valves within each VIRUS enclosure permits the chilled water-glycol mixture to be properly balanced between the spectrograph enclosure and the enclosure annex heat exchangers.

Figure 12. The 20 ton Advantage chiller supplies glycol to the Hobby Eberly Telescope from its location in the remote thermal site. (Photo taken by R. Spencer)

The 20-ton chiller was selected for the ability to generate water-glycol temperatures over the range of specified telescope operating temperatures. The intent is to provide the various heat exchangers within the telescope with a working fluid that is just below the ambient temperature. The control system developed by HET balances the temperature of the cooled water-glycol fluid with the temperature of the heated return water-glycol fluid such that the difference is equal about the ambient temperature. This control method minimizes the seeing issues that may result from large differences between the heated and/or cooled water-glycol fluid and the ambient environment of the telescope dome. Measurement of both the supplied cooled water-glycol mixture and the return heated water-glycol mixture is done in the fluid lines in the telescope enclosure. These values are compared within the control system to the ambient temperature measured in the telescope dome. Figure 13 below shows a key graphical interface to the control software.

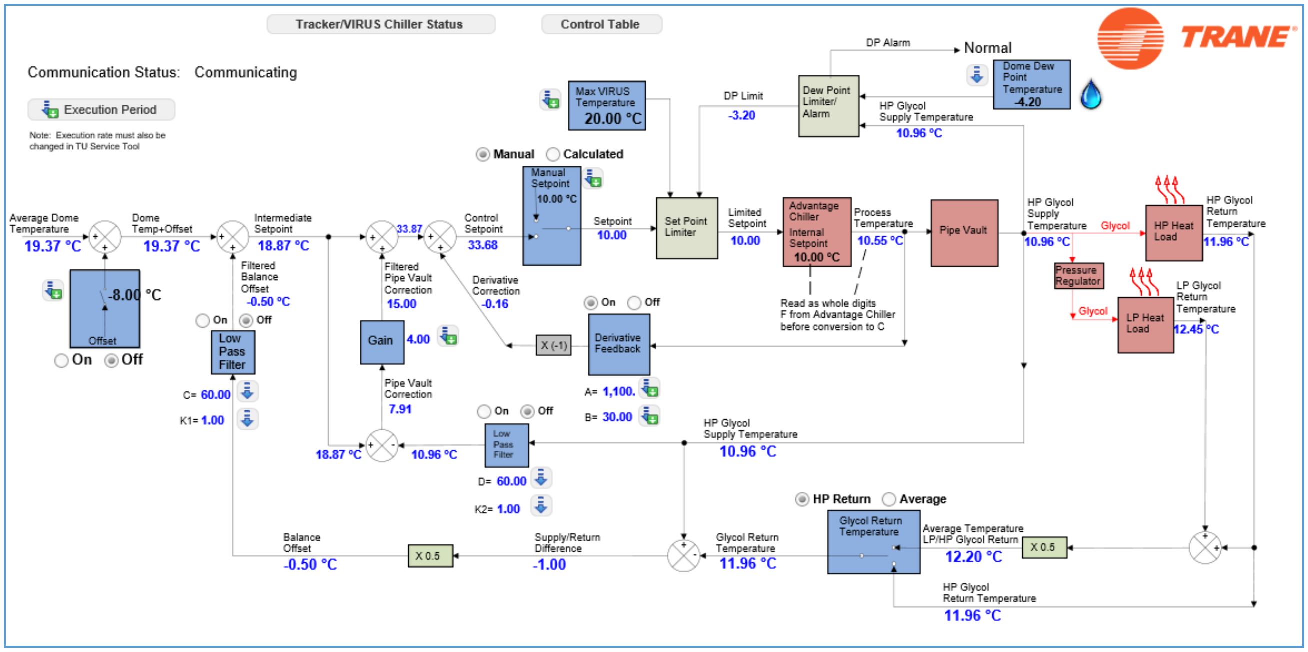


Figure 13. Graphical interface to software developed within the Trane SC programming environment to control temperature of chilled water-glycol mixture provided to the VIRUS enclosures.

4. VIRUS INSTALLATION

Installation of a VIRUS unit consists of lifting the unit into place in the enclosure, grounding the unit to the enclosure, attaching its CCD controller, verifying the cleanliness of fibers, pumping the cryostat down to a low vacuum, cooling the cryostat, and installing the IFU at the back of the unit. In the early stages of VIRUS multiple teams were used to install each unit. [9] As the installation procedure has become more defined and fine-tuned, it is now typical for one or two people to perform the entire installation procedure in as little as 3 hours.

4.1 The VIRUS lift

Using the 3-ton HET dome crane and dedicated rigging, each VIRUS is lifted up to its designated enclosure location and then pushed gently into the enclosure. Two lifting eyes attached at the front of the VIRUS housing serve as lift points for attaching two 4-foot straps which are removed once the unit is pushed into place in the enclosure. A third strap with a bulbous rubber stopper at the end serves as extra security should the unit tip forward during the lift and insertion. No load is on the cryostat during the lift.

Figure 14. A VIRUS unit being lifted to its assigned enclosure. The 2 gray straps are carrying all the weight. The yellow strap is used in case of lost balance. (Photo taken by R. Spencer)

4.2 Grounding

Early deployments of VIRUS units resulted in electronic system failures due to inadequate or intermittent grounding. The procedures now emphasize the importance of maintaining good, solid electrical connections at all times, especially during cryogenic bayonet installation/removal and CCD controller swap outs. During installation a permanent ground is attached from the enclosure frame to the VIRUS chassis. A permanent ground is installed from the nitrogen bayonet to the VIRUS chassis. Any work in the VIRUS enclosure requires personnel to wear a grounding strap.

4.3 Installation of the controller and fiber optics

Once the VIRUS is placed into the enclosure, a CCD controller is installed onto the unit using appropriate grounding techniques. Power and fibers are then connected to the controller. Just as early VIRUS deployments resulted in instability due to inadequate grounding, the team determined additional instability due to dirty communication fibers. As such, the installation procedure has been updated to include a thorough inspection and cleaning of the fiber ends and connector barrels with each installation (or controller swap). Reference Figure 15.

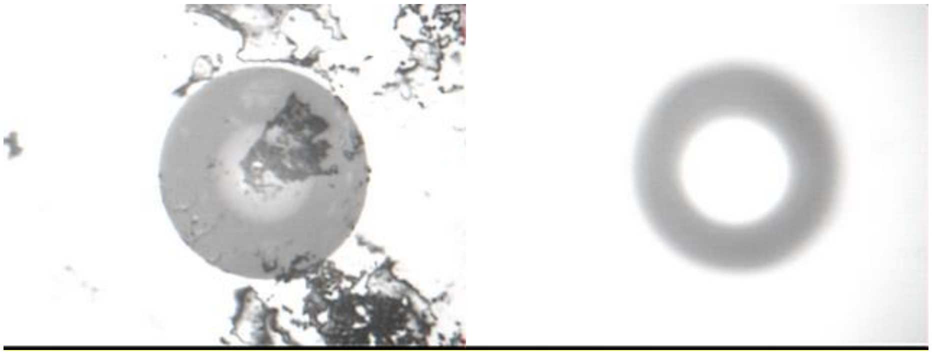


Figure 15. (Left) A dirty fiber end as seen with 400X microscope. (Right) Fiber end after cleaning. (Photo taken by R. Spencer)

4.4 Vacuum pumping and cooling

Before cryogenically cooling a VIRUS unit, it is pumped down to a vacuum of about 2E-6 mbar, with some units capable of achieving 8E-7 mbar. To achieve the vacuum, a Pfeiffer HiCube 80 ECO turbo vacuum pump is lifted into place at the VIRUS enclosure. A custom-designed mounting plate clamps to the edge of the enclosure and supports the load of the pump. With the pump in place on the mounting plate, all vacuum connections can be made, and the valve of the VIRUS unit opened.

Once the VIRUS unit achieves an acceptable vacuum, with the pump still operating, the liquid nitrogen make-break connection is made by inserting the male bayonet of the nitrogen system into the female bayonet of the VIRUS unit, as discussed in Section 2.2. Again, to achieve a gravity feed and thermal syphoning of the nitrogen, the nitrogen line must maintain a slight downward slope at all times. Since the flexible portion of the nitrogen bayonet does not always form a natural downward angle, the unit may not begin cooling; therefore, the temperatures are closely monitored to see that they are dropping at an acceptable rate. If temperatures are not dropping, the bayonet and flexible line have to be re-adjusted until there is no upward bend in the line and the temperatures begins to drop. Though the cryostat will eventually reach -180˚C, after it reaches about -110 ˚C, the vacuum pump is removed and taken to the ground to service the next unit. The enclosure door is put back into place as the unit continues cooling.

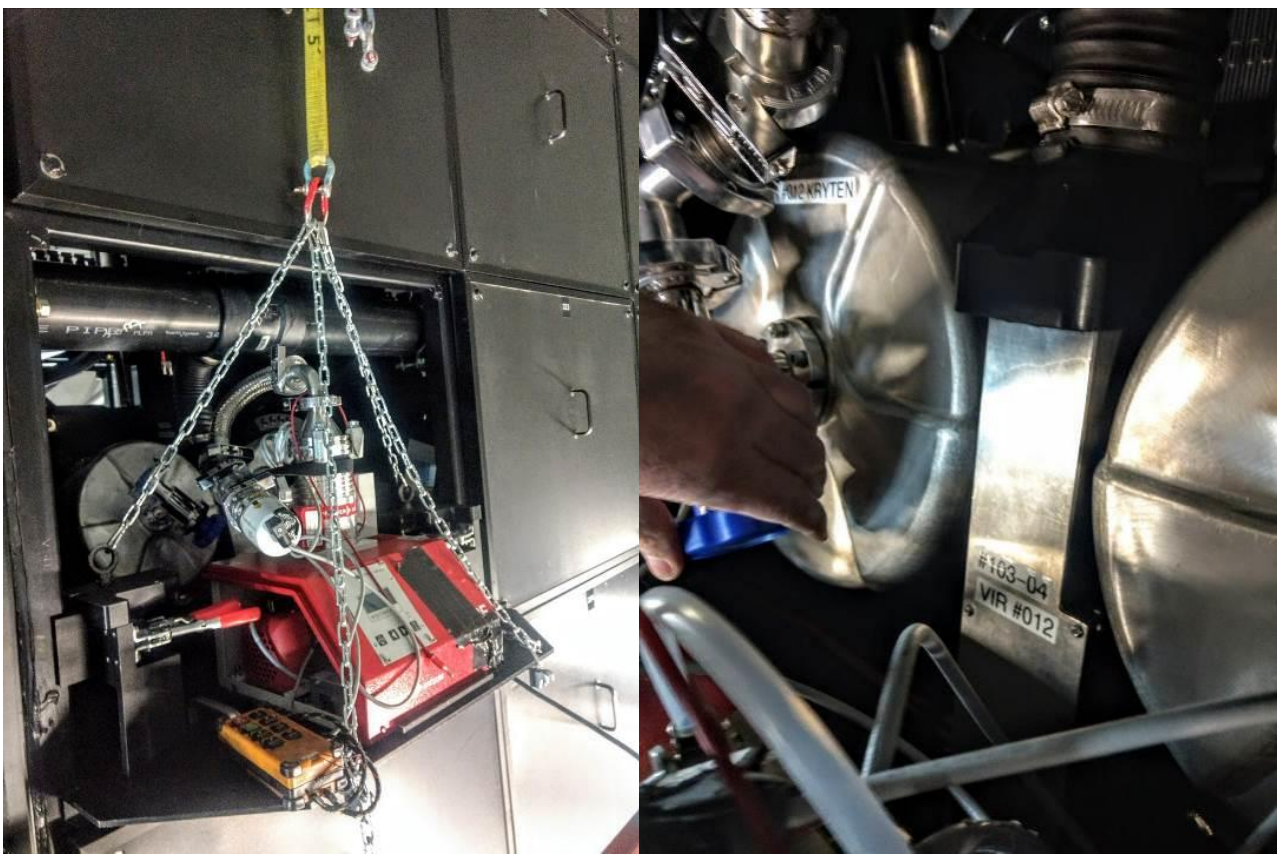


Figure 16. (Left) Vacuum pump being lifted into place. (Right) Vacuum pump attached and valve being opened on VIRUS to pump it down. (Photo taken by R. Spencer)

4.5 Attaching the IFU

The final step in the installation of a VIRUS unit is the insertion of an Integral Field Unit (IFU)[6] on the back side of the unit. Alignment pins help guide the IFU into place and kinematic mounts help achieve final alignment of the fiber-optic bundles to the VIRUS. The top cover of the IFU is removed and the fibers are inspected to verify that there is not an excessive amount of tension being placed on them. Since the other end of IFU fiber bundles move along with the tracker on a nightly basis, the IFU fiber bundles are inspected on a regular basis and photo-documented in the VIRUS Management Tool discussed below.

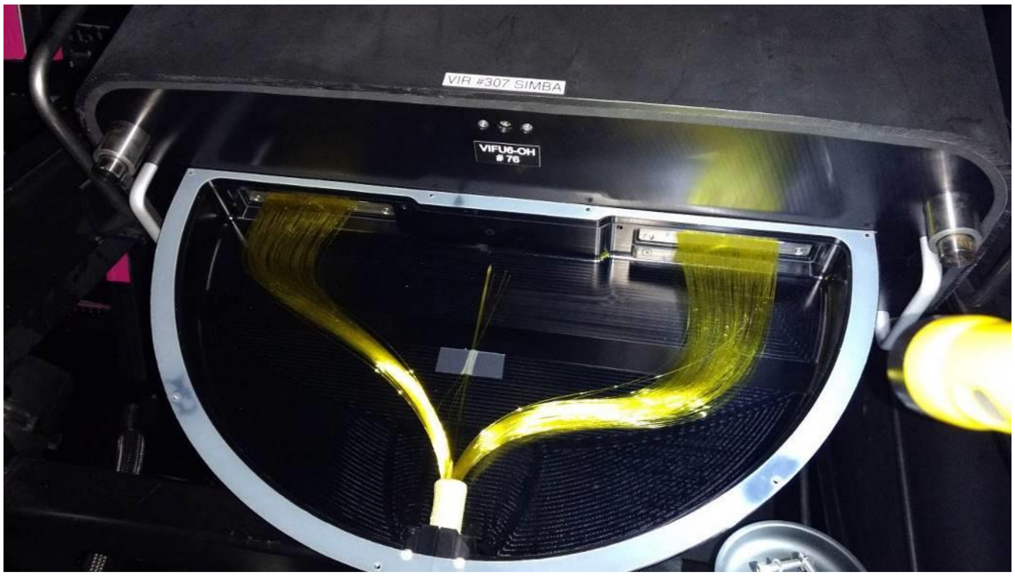


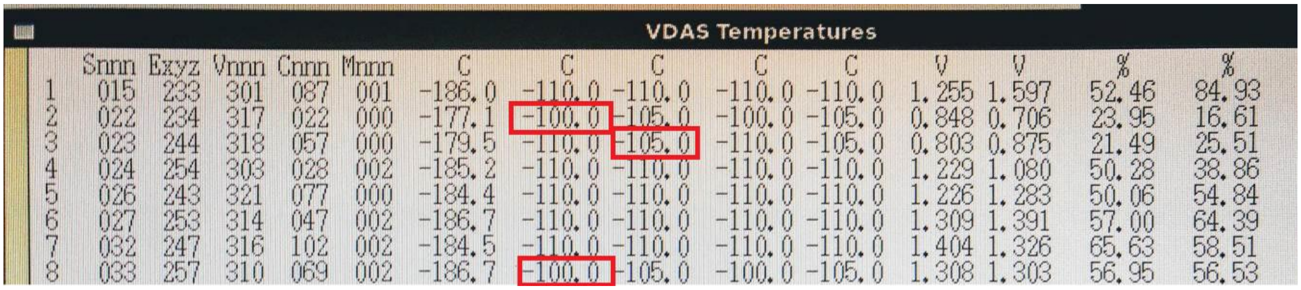
Figure 17. An IFU currently attached to the back of a VIRUS unit, with the top cover of the IFU removed for fiber tension inspection. (Photo taken by R. Spencer)

5. VIRUS MONITORING AND MAINTENANCE

VIRUS is monitored daily to ensure proper temperature control of the CCDs. By monitoring and controlling the heater voltage and temperature of a CCD, proper operation of a VIRUS unit is maintained by adjusting the temperature setpoint or improving the vacuum on a unit.

5.1 Monitoring VIRUS vacuum health

Each VIRUS spectrograph has its own temperature set point at which it was characterized in the lab. For most of the units, that number is -110˚C, with an occasional unit characterized at -105˚C. The goal is to maintain each VIRUS unit at its characterization temperature. Each day the voltage and power percentage of each CCD is noted. If a heater voltage reads <0.3V or the heater power <3%, the temperature set point is raised by 5 ˚C to prevent loss of control of the CCD temperature. If a VIRUS unit shows increased temperature, it is indicative that the vacuum has degraded and the unit needs vacuum maintenance.



VDAS Temperatures

	Snnn	Exyz	Vnnn	Cnnn	Mnnn	C	C	C	C	C	V	V	%	%
1	015	233	301	087	001	-186.0	-110.0	-110.0	-110.0	-110.0	1.255	1.597	52.46	84.93
2	022	234	317	022	000	-177.1	-100.0	-105.0	-100.0	-105.0	0.848	0.706	23.95	16.61
3	023	244	318	057	000	-179.5	-110.0	-105.0	-110.0	-105.0	0.803	0.875	21.49	25.51
4	024	254	303	028	002	-185.2	-110.0	-110.0	-110.0	-110.0	1.229	1.080	50.28	38.86
5	026	243	321	077	000	-184.4	-110.0	-110.0	-110.0	-110.0	1.226	1.283	50.06	54.84
6	027	253	314	047	002	-186.7	-110.0	-110.0	-110.0	-110.0	1.309	1.391	57.00	64.39
7	032	247	316	102	002	-184.5	-110.0	-110.0	-110.0	-110.0	1.404	1.326	65.63	58.51
8	033	257	310	069	002	-186.7	-100.0	-105.0	-100.0	-105.0	1.308	1.303	56.95	56.53

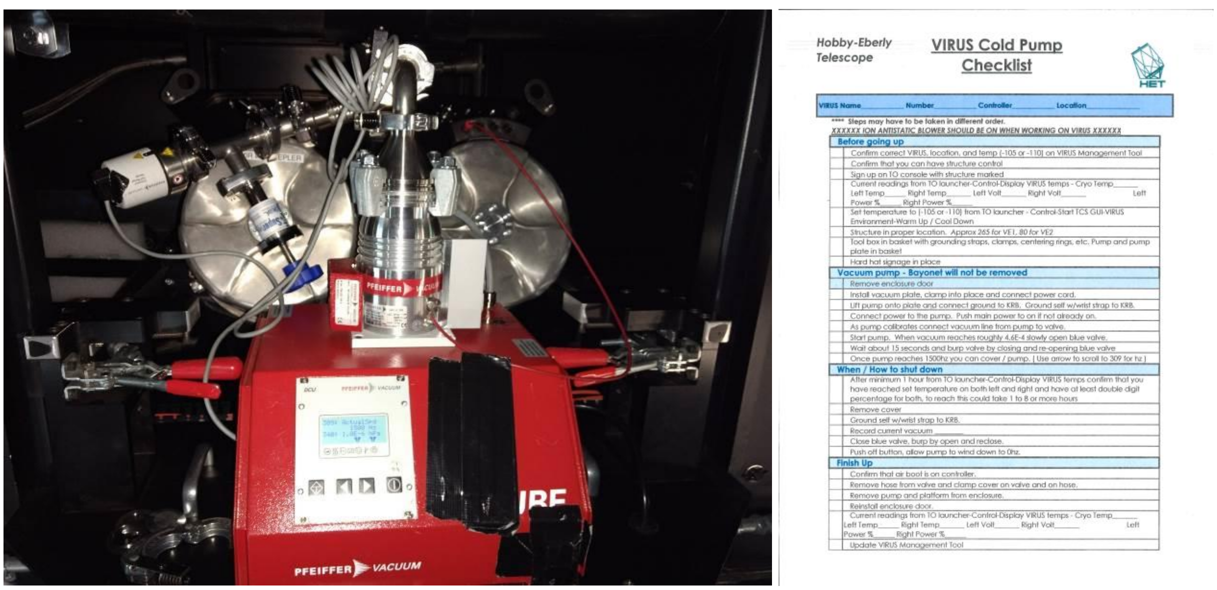
Figure 18. VIRUS temperatures, voltage, power percentage are part of deciding when maintenance is needed. This image shows 3 units in need of maintenance.

5.2 VIRUS vacuum maintenance

In the early days of VIRUS at HET, if a spectrograph unit was getting too warm and needed to be cooled, it first had to be warmed to ambient temperature. To accomplish this, the temperature set point was adjusted to +10˚C and the nitrogen bayonet was removed. After the VIRUS was warmed overnight, making it unavailable for science, a vacuum pump was installed and the system was pumped as many hours as possible before the nitrogen bayonet was re-inserted and the unit re-cooled. This process is commonly referred to as a 'warm pump'.

The newer procedure is a 'cold pump'. The temperature of the unit is set back to its characterization temperature (-110˚C or -105˚C). The pump is attached and, with the nitrogen bayonet still in place, the VIRUS is pumped during the day without a loss of science time. This also helps limit thermal stress caused by frequent warming and cooling.

If a warm pump is required to prepare for removal or valve replacement, vacuum pumping is started at the time of removal of the nitrogen bayonet and continues until the unit is fully warmed.



Hobby-Eberly Telescope

VIRUS Cold Pump Checklist

HET

VIRUS Name________ Number________ Controller________ Location________

**** Steps may have to be taken in different order.

XXXXXX ION ANTISTATIC BLOWER SHOULD BE ON WHEN WORKING ON VIRUS XXXXXX

Before going up	
	Confirm correct VIRUS, location, and temp (-105 or -110) on VIRUS Management Tool
	Confirm that you can have structure control
	Sign up on TO console with structure marked
	Current readings from TO launcher-Control-Display VIRUS temps - Cryo Temp_____ Left Temp_____ Right Temp_____ Left Volt_____ Right Volt_____ Left Power %_____ Right Power %_____
	Set temperature to (-105 or -110) from TO launcher - Control-Start TCS GUI-VIRUS Environment-Warm Up / Cool Down
	Structure in proper location. Approx 265 for VE1, 80 for VE2
	Tool box in basket with grounding straps, clamps, centering rings, etc. Pump and pump plate in basket
	Hard hat signage in place
Vacuum pump - Bayonet will not be removed	
	Remove enclosure door
	Install vacuum plate, clamp into place and connect power cord.
	Lift pump onto plate and connect ground to KRB. Ground self w/wrist strap to KRB.
	Connect power to the pump. Push main power to on if not already on.
	As pump calibrates connect vacuum line from pump to valve.
	Start pump. When vacuum reaches roughly 4.6E-4 slowly open blue valve.
	Wait about 15 seconds and burp valve by closing and re-opening blue valve
	Once pump reaches 1500hz you can cover / pump. (Use arrow to scroll to 309 for hz)
When / How to shut down	
	After minimum 1 hour from TO launcher-Control-Display VIRUS temps confirm that you have reached set temperature on both left and right and have at least double digit percentage for both, to reach this could take 1 to 8 or more hours
	Remove cover
	Ground self w/wrist strap to KRB.
	Record current vacuum _______
	Close blue valve, burp by open and reclose.
	Push off button, allow pump to wind down to 0hz.
Finish Up	
	Confirm that air boot is on controller.
	Remove hose from valve and clamp cover on valve and on hose.
	Remove pump and platform from enclosure.
	Reinstall enclosure door.
	Current readings from TO launcher-Control-Display VIRUS temps - Cryo Temp_____ Left Temp_____ Right Temp_____ Left Volt_____ Right Volt_____ Left Power %_____ Right Power %_____
	Update VIRUS Management Tool

Figure 19. (Left) Pfeiffer HiCube 80 ECO turbo vacuum pump used to restore proper vacuum on VIRUS. (Right) Check list for performing VIRUS Cold Pump maintenance.(Photo taken by R. Spencer)

5.3 VIRUS Management Tool

With a distributed system as complex as VIRUS, with multiple components (IFU, spectrograph unit, detector controller) that can change location in the array over time, tracking the system and ensuring that the downstream data analysis has accurate information, is very important. The mapping between sky position (Input Head Mounting Plate slot) and VIRUS enclosure location defines the route of each IFU fiber cable. Each enclosure location is associated with a specific spectrograph unit, once one is installed, and each unit has a CCD controller attached. This information is captured in a configuration file for each spectrograph unit and the information is then populated into the data headers for each exposure. The key mapping information is also captured in the "fplane" file which is utilized during planning and data reduction to tie the data to the sky.

Early on in VIRUS deployment, the VIRUS Management Tool spreadsheet was created by HET to track the system. The main cover sheet visually represents the enclosures, showing which enclosures are populated by VIRUS, along with the VIRUS ID and name, its associated controller, IFU, IFU Slot in the Input Head Mounting Plate (IHMP), characterization temperature and ID of each CCD, and the multiplexor number for the unit. The cover sheet carries links to a history tab for each unit. The history tab details the VIRUS installation/removal, controller installation/removal, IFU installation/removal, and pumping/cooling history of each unit.

The VIRUS Management Tool is available to all staff from the HET Engineering web page for reference, but is only modifiable from a private file. There is a utility that parses the VIRUS management tool spreadsheet to create the fplane file, but the file can also be updated manually.

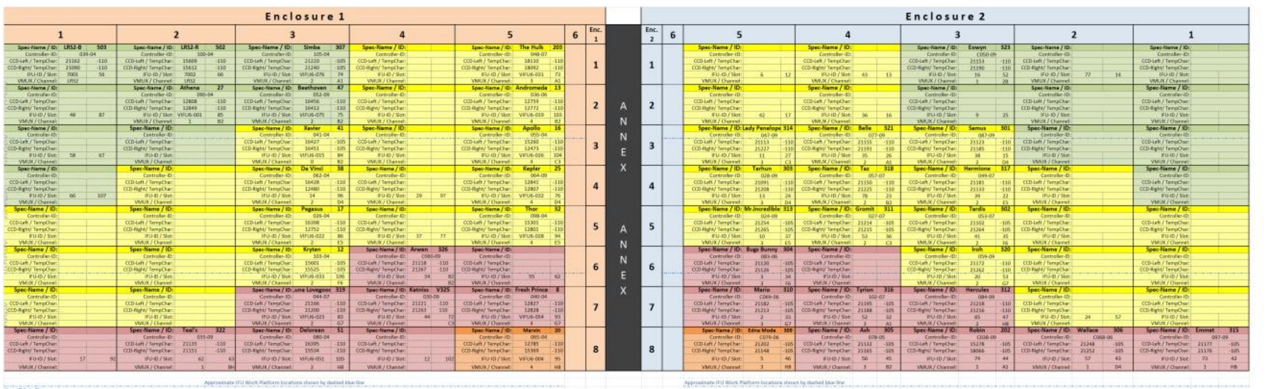


Figure 20. The front page of the VIRUS Management Tool serves as a visual representation of the enclosures.

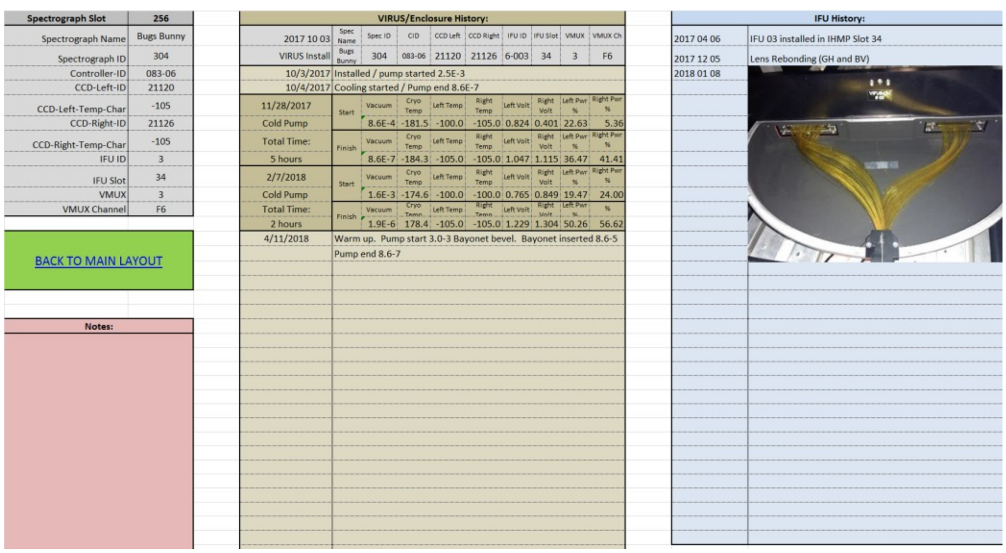


Figure 21. VIRUS Management Tool showing all information regarding the installation and maintenance history of a VIRUS unit and its associated IFU.

5.4 Future of VIRUS maintenance

Along with improved stability and better science from the VIRUS units, there is continued focus on minimizing the maintenance needs for VIRUS. One such example is the addition of an Ion Pump to each individual unit. There is presently one VIRUS unit being tested with a permanent ion pump in place. This VIRUS has needed no maintenance since the pump was installed. The goal is to outfit each individual unit with an ion pump to improve the performance of the entire system and cut the number of hours currently needed to maintain VIRUS on a weekly basis.

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