VLBI-F-REP-4101-890 Refrigeration system integration report for Matera VGOS receiver

Yebes Observatory Receivers Group

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Contents

Index of Figures

Introduction

In this report, the VGOS Matera cryogenic refrigeration system installation is described. The integration of the cold head in the cryostat was performed in Yebes Observatory, and the installation of the cryogenic compressor external and internal units as well as the helium lines was performed on-site in Matera station by OHB Digital Connect personnel.

Component description

Table 1 shows the list of items that compose the refrigeration system:

Stock ID	Description	Quantity
RDK-408S	10K Cold head	1
FA-70H	Air cooled compressor. Outdoor and indoor units included	1
RV21ZN0173	Input power cable	1
RV21ZN0220	Cold head power cable 20m	1
Cable 1-1D, 10m	For outdoor	1
Cable 1-2, 10m	For outdoor	1
Cable 1-3, 10m	For outdoor	1
Installation kit	Gas exchanger, spanner29, spanner 26, quick wrench	1
RW20ZN1765	Flexline, supply 20Ax20m (F-F), single braid (2x10m sections interconnected)	1
RW20ZN1766	Flexline, return 20Ax10m (F-F), single braid	1
RW20ZN1774	Flexline outdoor supply 20Ax10m (F-M), single braid	1
RW20ZN1775	Flexline outdoor return 20Ax10m (F-M), single braid	1
RE05TN1288GQ	Adsorber F-50	1

Table 1: Refrigeration system components

A schematic of the installation is depicted in Figure 1.

Note: The helium pipes in the schematic connected to the cold head are connected to the trolley back plate instead. A built-in helium copper pipes have been added from the cold head to the trolley back plate for installation ease in the radio telescope feed cone.

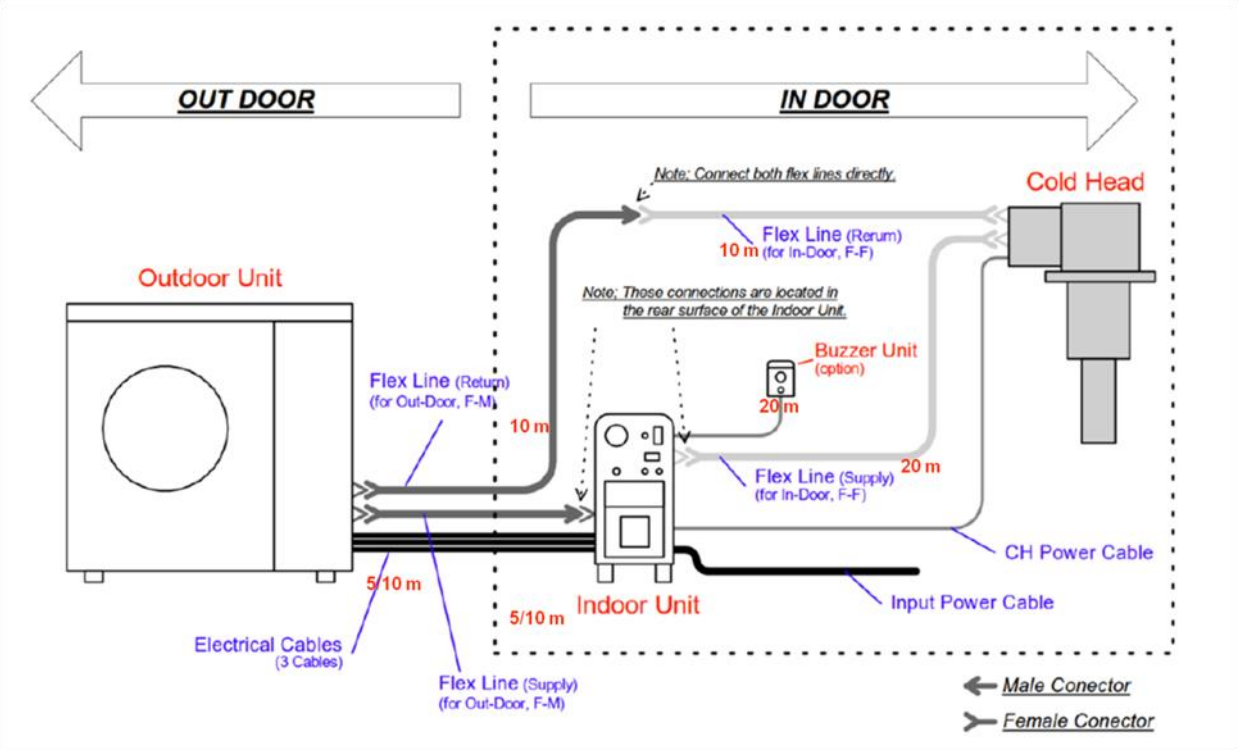

Figure 1: Installation schematic

Additional requirements for the installation

Other elements necessary for the installation of the refrigeration system are the following:

- 7 x pressurized helium elbows: 2 attached to the compressor outdoor unit, 1 in compressor indoor unit, 2 in Az cabin, 2 in receiver back panel (optional).
- Bolts and silent blocks for the outdoor unit attachment to the balcony floor.
- A 20-meter 2 wire (minimum 24 AWG) cable to remote control the compressor. This cable goes from the receiver trolley in the radio telescope elevation cabin cone to the compressor indoor unit in the azimuth cabin.
- 380V 3-phased power supply in an electrical cabinet with a 3-phase D-40 Circuit breaker and a 3-phase differential switch. It is recommended to have it connected to the UPS of the station.

Tools and maintenance

During the normal operation of the system, sometimes it is needed to pressurize/depressurize the compressor helium circuit to achieve the specified He gas working pressure, or to purge the helium circuit from impurities caused by compressor oil or external contaminants.

For this purpose, it is recommended to have on-site the following items:

- 99.999% He gas bottle.
- Helium pressure regulator and 20m pipe with connectors for the compressor gas exchanger and manifold input.

- Maintenance manifold.
- Helium leak detector.

Receiver interfaces for the refrigeration system

The compressor is turned on and off remotely with the CVCU module in the receiver´s trolley. The connection interfaces in the receiver´s trolley is shown in Figure 2.

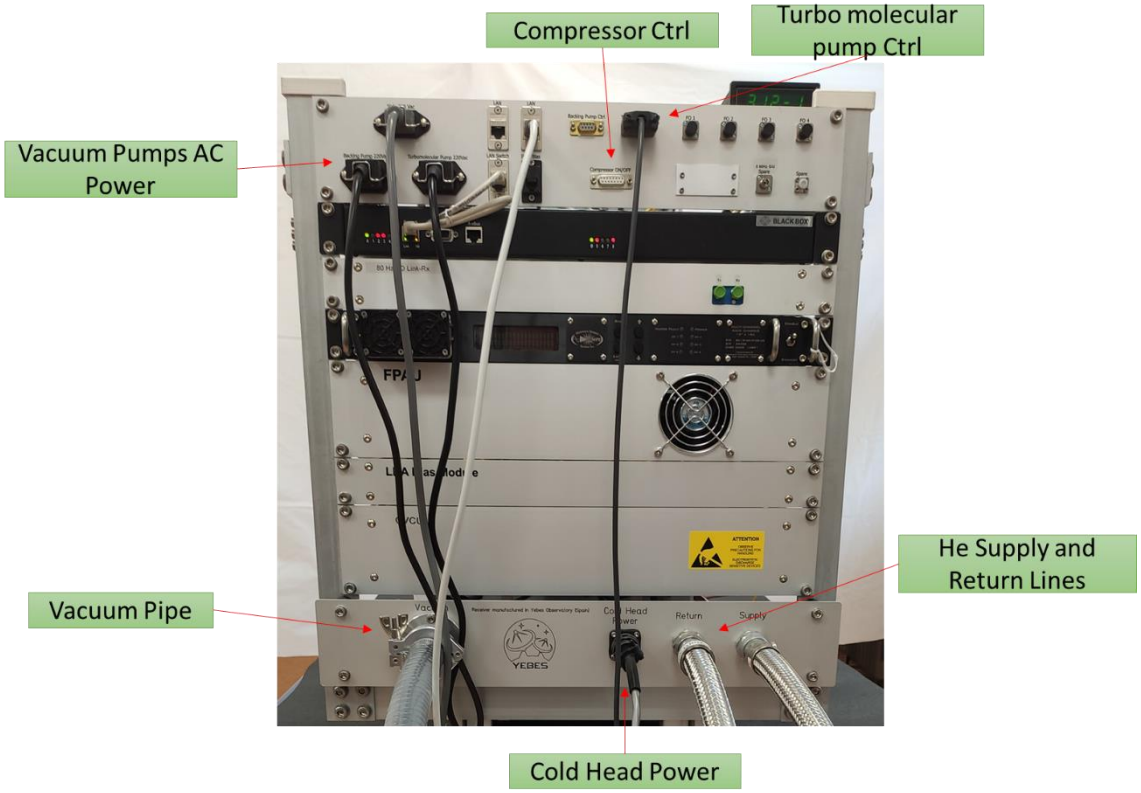

Figure 2: Refrigeration system and vacuum pumps interface

The compressor control cable must have at least 2 contacts (24 AWG minimum) and a length of 20 meters running from the compressor internal unit in the azimuth cabin to the feed cone in the elevation cabin. It is recommended for future CVCU module updates to use a 15-contacts (24AWG) shielded cable.

For the current version of CVCU the cable end connectors are two DB-15 male connectors with a pinout: pin 8 to pin 8 and pin 15 to pin 15 on each side.

Pumping system installation over the feed cone rails.

The pumping system is installed in the feed cone over the rails in front of the receiver´s trolley after fixing the trolley in its position. For this it is necessary to drill four M8 tapped holes into the rails. The interface holes (F1, F2, F3 and F4) are shown in Figure 3.

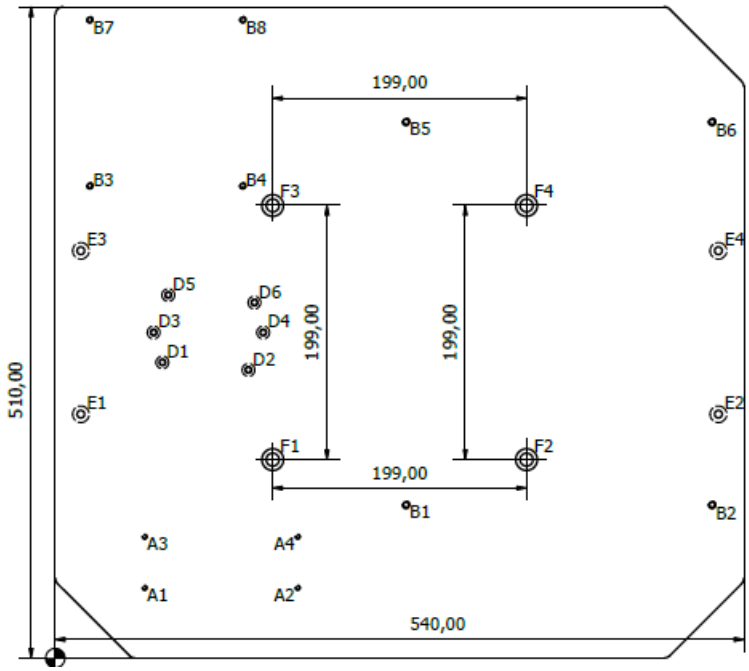

Figure 3: Pumping system interface holes

For more information about the pumping system refer to *VLBI-F-REP-4101-890 Vacuum Pumps Integration Report for Matera VGOS receiver.*

Helium lines installation example

Figures 4 and 5 shows an example of helium lines installation in the radio telescope.

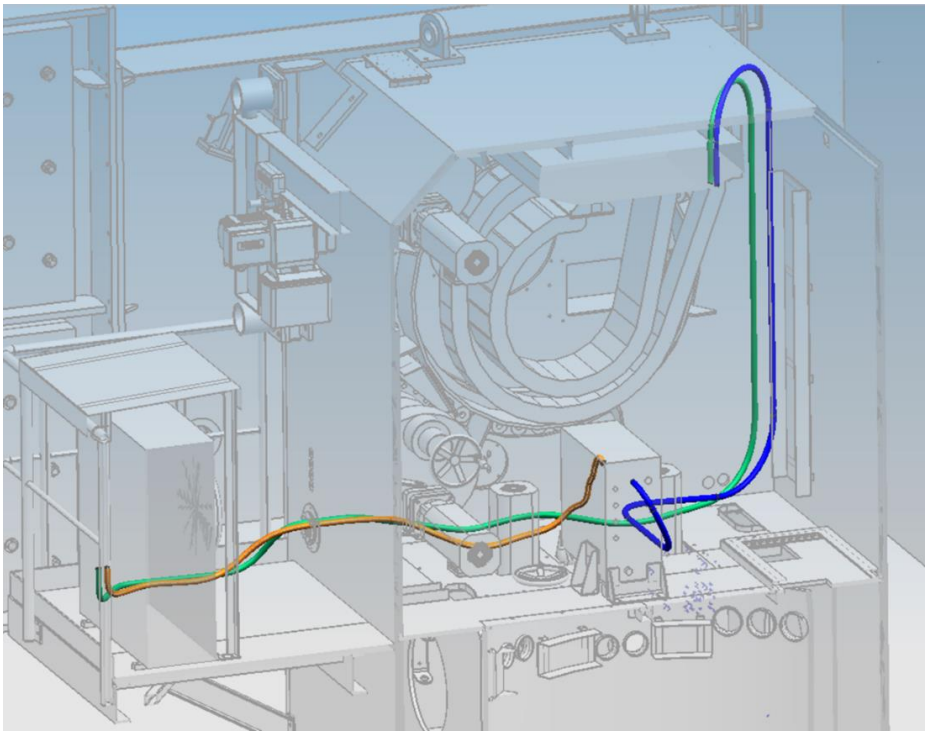

Figure 4: Helium lines from external unit to internal unit

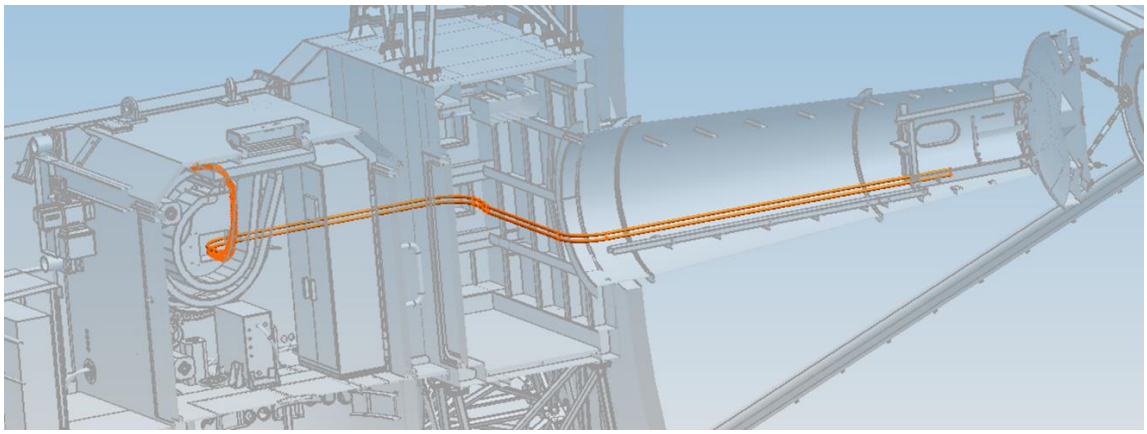

Figure 5: Helium lines from azimuth cabin to feed cone.

Conclusions

The refrigeration unit (cryogenic compressor and cold head) has been installed partially in Yebes Observatory (cold head in the cryostat) and tested with the Sumitomo CNA-61D compressor (old version of FA-70H) in Yebes Observatory laboratories. The rest of the refrigeration unit have been installed on-site on Matera station, and will be connected and tested with the receiver during SAT (on-Site Acceptance Test).

A detailed operation and maintenance manual will be provided, for the full operation of the cryogenic receiver.

For mor information about the installation or electrical connections, please refer to the compressor operation manual supplied with it.