EVLA Cryogenics Cost Impact of an additional Compressor and Coldhead for X-Band Upgrade

EVLA Helium Circuit

Cryogenics Overview on Existing Helium Circuit and X-Band Upgrade

- EVLA Required Cryogenics and Vacuum System Upgrades
  - Design Parameters
    - Gas flow demand on existing EVLA system
  - Gas flow demand on upgrading X-Band receiver to a 350 coldhead

EVLA Upgrades

- EVLA upgrades to the receiver system include:
  - S-Band (350) 17 SCFM L-Band (350) 17 SCFM
  - Ka-Band (350) 17 SCFM K-Band (350) 17 SCFM
  - C-Band (350) 17 SCFM X-Band (22) 9 SCFM
  - Ku-Band (350) 17 SCFM Q-Band (22) 9 SCFM
  - Upgrading the X-Band receiver to a 350 coldhead would require 17 SCFM which would overload our current helium compressor capacity from 45 SCFM to 51 SCFM. NRAO Compressor Rated @ 48 SCFM

Gas Flow System Design Parameters

- Existing Compressor Circuit A, B & C
  - A S and KU = 34 scfm
  - B Ka, Q and K = 43 scfm
  - C L, X and C = 43 scfm

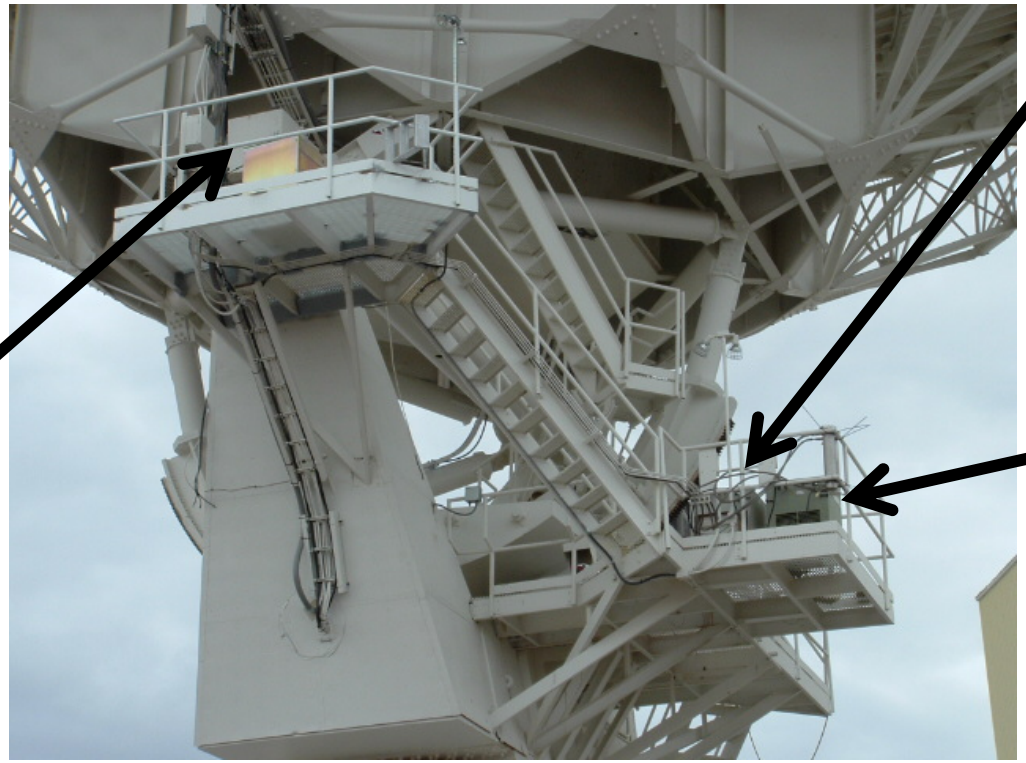
Gas Flow System Design Parameters

- EVLA gas flow requirements dictated by upgrading the X-Band receiver to a 350
  - Compressor A circuit requires 43 scfm
    - S(350), Ku(350), Q(22)
  - Compressor B circuit requires 51 scfm
    - K(350), Ka(350), X (350)
  - Compressor C circuit requires 34 scfm
    - L(350), C(350)

Four-Compressor Gas Flow Design Parameters

- Compressor Circuit
- A KU and S = 34 scfm
- B KA and K = 34 scfm
- C C and X = 34 scfm
- D L and Q = 37 scfm
- By reducing the gas flow we can reduce the supply pressure which reduces the current draw and increases compressor reliability.

Helium Compressors



Cost Impact of additional (4th) Helium Compressor & Coldhead

Compressor & Coldhead Cost Impact

- 30 ea 350 Coldhead $ 180K
- 30 Helium Compressor $ 210K
- 30 ea Charcoal Traps $ 36K
- Antenna Helium Circuit $ 25K
- Re ocurring maint. Cost $ 15K
- Cryo Tech (1FTE) 1 $ 60K

Summary

- Cool down test on an upgraded X-Band receiver using the existing model 22 coldhead show that the receiver reached a temperature of 14K in 18 hours during the first cool down with no electrical load applied. Second cool down took 36 hours to reached a temperature of 25 K with a 2 watt load.
- Question to be answered and facts about model 22 versus 350 coldheads
- 1. Do we really want a 18 plus hour cool down? (Down Time Concern)
- 2. Will the receiver recover in a reasonable amount of time after a power hit?
- 350 coldhead recovery time much faster.
- 3. Pm requirements : Model 22 average 9-10 months versus 350 3-5 years.

CTI Acceptance Criteria

- ## Model 22

Load (watts)		Temp. K	
1st Stage	2nd Stage	1st stage	2nd stage
1	1	49 K	14.6 K
8	1	88 K	21 K

Model 350

• 10	2	74 K	19 K
• 20	2	100 K	21 K

Cryo's Recommendation

- It is a known fact that the helium compressor is the heart of a cryogenic system. Increasing the gas demand on the compressor will disrupt the oil management and oil cooling system on the compressor affecting the known reliability of NRAO's compressors. By installing a forth compressor the receiver systems can be split in such a way that the demand on the compressor is about 10 scfm less than the rating on the compressor. This will allow us to drop the supply pressure which in turn lowers the current draw on each compressor. This would also allow us to upgrade the L-Band if the need arises in the future.

Helium Compressors