Proposal to build a Wideband Cryogenic Front-End

For the Arecibo Observatory 12m Antenna

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This proposal identifies the tasks, the deliverables and a timeline required to complete the project. The proposed work is performed in 7 phases over a 21-week period following the timeline outlined below.

Over the course of the project, CryoElec LLC will be responsible for the following tasks:

* Hardware Design and Analysis
* Hardware Procurement using funds from Arecibo Observatory
* Hardware Assembly
* Hardware Testing
* Generate documentation
* Sending progress reports and updates regularly
* Attending meetings and design reviews(online)
* Responding to reviews and making revisions if needed
* Reporting problems or issues affecting: schedule, budget or performance

Phase1: Cryogenic Design, Analysis and Procurement

During this Phase, the following tasks are performed:

* Cryogenic System Design: Mechanical, thermal and Electrical design
* Parts and Key components are selected
* Design Review
* Design Revision if needed
* Procurement of parts and Materials after design acceptance

Phase 1 duration: ~ 1 Month @ full time

Phase 1B (**Optional**): R&D

During this Phase, the following tasks are performed:

* Investigate feasibility of 4K cryogenic cooling for lower receiver noise temperature
* Testing of critical components at 4K
* Investigate potential cost/benefit of 4K cooling

Phase 1B duration ~ 1 Month @ full time

Phase2: M&C System Design

During this Phase, the following tasks are performed:

* M&C System Design: Electronic Design
* Parts and Key components are selected
* Design Review
* Design Revision if needed
* Procurement of parts and Materials after design acceptance

Phase 2 duration: ~ 1 Month @ full time

Phase3: System Assembly

During this Phase, the following tasks are performed:

* Mechanical Assembly of the Vacuum Chamber / Cryogenic system
* Installation of electronic components
* RF Cabling installation
* DC Wiring
* Connection to M&C system

Phase 3 duration: ~ 1 Month @ full time

Phase4: System Testing

During this Phase, the following tasks are performed:

* Vacuum test of the cryostat
* Cryogenic test: Heat load on the cryogenic cooler test
* Electronics components testing
* M&C system Testing
* Vacuum Window Test
* RF Tests: Noise temperature Measurements of the Front end

Phase 4 duration: ~ 1 Month @ full time

Phase5: Integration with Room Temperature Electronics and Testing

During this Phase, the following tasks are performed:

* Integrating the Cryogenic front end package with the room temperature electronics.
* Testing of the full system

Phase 5 duration: ~ 2 Weeks @ full time

Phase6: Documentation

During this Phase, the following tasks are performed:

* Gathering and combining all design files + Drawings + Test data in one User/Maintenance Manual
* Writing a Standard Operating Procedure (SOP)

Phase 6 duration: ~ 2 Weeks @ full time

Phase7: Field Deployment and on-Antenna Testing

During this Phase, the following tasks are performed

* Installation of the system on customer site
* Conducting On-site on-antenna testing
* Training customer personnel on operating the system

Phase 7 duration: ~ 1 Weeks @ full time

(Note: Phase 7 involves traveling, Travel expenses will be estimated during time date of travel and added to the total)

Deliverable: Cryogenic Front-end system with room temperature and M&C electronics and documentation and including on-site customer training

Materials, Parts and Tools used for the Design/Assembly and testing:

(Provided by Hamdi Mani/CryoElec LLC and used for the project but not delivered)

- Mechanical CAD software License

- Alcatel Vacuum Pump + Vacuum hose

- CTI SC compressor for driving the CTI-350 1 phase cold head (Provided by Arecibo)

- Fasteners: Stainless steel screws, bolts, nuts, washers...

- Vacuum grease: for the vacuum chamber O-rings

- RF test equipment used for components testing and Receiver testing (Yfactor/Noise, Stability, linearity...): VNA, Spectrum Analyzer (R&S 26.5GHz), power meter / Signal generator

- Power Supplies + Voltmeters + Labjack DAQ

- Miscellaneous RF components used for testing: Amplifiers, Attenuators, cables, connectors, adapters...

- Miscellaneous Materials and Laboratory consumables: Soldering, electronics cleaning tools and solutions…

- Electrical power: 220V @15A used to run the vacuum pump + cryogenics