Aloha Power System Testing
Standards and Procedures

In order to devise a thorough testing plan for the Aloha Power System we should first define and specify the normal operating conditions. This power supply operates from a constant current SL280 fiberoptic communications cable. The shunt regulator maintains a practically constant voltage on primary and secondary, while the Makaha-end Power Supply maintains the constant current. In other words, the converter stack always runs at a constant maximum power, regardless of user load. Meaningful testing should focus on extended operation of the stack at maximum power. This requires conservative and comfortable margins on voltage, current and power (heat) dissipation.

The Shunt Regulator on the other hand runs at maximum power *only* if there is zero load. As the load increases, the shunt regulator dissipation decreases, going to near-zero at maximum load. Shunt regulator testing should cover the entire range from no load to maximum load.

There is a danger (discussed elsewhere) of the stack input voltage collapsing under even transient overload conditions. Testing must include testing the trip circuit under a wide variety of circumstances. Since the bus trip level is yet to be determined exactly, testing should seek to determine the limits at which the trip circuit performance becomes problematic so that we can rationally determine how much margin the deployed system should have.

One area of testing which causes some concern is the issue of destructive testing (or even "dangerous" testing). A serious over-current or over-voltage excursion could potentially cause some damage or degradation to a part that might not be evident during routine testing. To address this issue, there will be a test log sheet for every converter. If one unit is subjected (purposely or by accident) to a particularly stressful incident, that unit will move to the bottom of the list, to be used only as a backup part. The decision will have to be made on a case-by-case basis whether suspect parts on those units should be routinely replaced.

Testing will be divided into three phases:

1) MODULE TESTING:

Having DC-DC converter modules that plug into a backplane greatly simplifies testing of individual modules since a Test Backplane can be wired for specific tests such as standoff-voltage dielectric breakdown, conversion efficiency, etc. This allows a wider variety of tests and more thorough tests to be run at the module level.

Each Converter will be tested for all parameters over the full operating range. This includes minimum start-up voltage, primary/secondary ratio, switching frequency and efficiency.

At this level we will test the dielectric insulation. If there is ever a second or third Observatory daisy-chained farther out, the Makaha line voltage could go as high as 8kV and the Aloha Observatory could conceivably go over 7kV. Since good insulation enhances the reliability at lower voltages, the transformers are specified for a minimum voltage rating of 10kV. We will conduct partial-breakdown testing on all converter modules. Our modified dielectric tester is capable of detecting partial breakdown or corona leakages on the estimated order of 10nA or less. The units with the lowest leakages will be assigned to the deployed Observatory.

Burn-in testing at full load will be performed on all units for a minimum of one week, followed by a repeat of the parameter testing. Any unit showing significant shift in any parameter is suspect and will move to the bottom of the list and be subject to further testing.

The Shunt Regulator will be operated first on a bench current supply in order to characterize all aspects of the performance in an unambiguous manner.

2) POWER SUPPLY TESTING:

The converter module will be next tested in the larger Power Supply context. The Converter Modules will be plugged into the Backplane and the Shunt Regulator and other associated circuits.

This tests their performance in the Stack and their interaction with each other and with the Shunt Regulator and the Test Load.

The start-up cycling will be performed "informally" many times, but the engineering data should be routinely logged any time that it is possible.

Formal testing of the start-up cycle will focus attention on all relevant aspects of performance, with active pursuit of any unexpected or unusual data.

3) ALOHA OBSERVATORY POWER SYSTEM TESTING:

The same range of tests as in (2) above need to be carried out with the Observatory as the load on the Power Supply.

This testing also falls naturally into "informal" and "formal" testing. We will run the Observatory on the Power Supply rather than on a bench supply so that we log maximum time on the whole system working together in a configuration that is close to the deployed system.

Special Test Equipment for Aloha Power System:

1) Spellman High Voltage Power Supply, Model SA-4
   0 – 2000 Volts, 0 – 2.0 Amps

2) Insulation Breakdown Test Set Model MD-1 (Air Force)
   0 – 1.5kV
   0 – 15kV
   0 – 500μA
   0 – 100μA
   * ESF Custom Partial Breakdown RF Detector
   (Uncalibrated, but extends *partial breakdown* detection *sensitivity* by 2 or 3 orders of magnitude.)

3) ESF Test Load
   This is a custom test load that uses a pseudo-random bit generator to switch DC-DC converter loads. (Both primary and secondary side switching.)

4) HP 3562A Dynamic Signal Analyzer
   Spectral content of ripple and noise will be tested.