POWER-UP ISSUE WITH APIU

TABLE 1: DOCUMENT HISTORY

Revision	Date	Document Name	Editor	Comments
1.0	13-Mar-18	AAVSAPIUPowerUp_V1.0_20180313	Dave Emrich	Draft
1.1	13-Mar-18	AAVS_APIUPowerUp_V1.1_2018-03-13	Mia Walker	Minor edits

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1. Introduction

1.1 Purpose and Context of Document

This document discusses an issue discovered with the APIU as installed at the AAVS1.1 antenna station, and proposes actions to remedy this issue.

1.2 Scope of Document

This document applies to at least the APIU installed at AAVS1.1 but may extend to all APIUs of the same version installed on the MRO site.

FIGURE 1: NORTH FACE OF APIU ON AAVS1.1 ANTENNA ARRAY

2. References

The following documents are applicable to the extent stated herein.

TABLE 2: KEY DOCUMENTS

ID	Title	Code	Issue

3. Restoring APIU power after an up-stream power cycle

3.1 General description

The central issue is that there is a high likelihood that the APIU will not automatically return to operational status after mains power is removed and restored anywhere up-line from the APIU field distribution sub-system. The superficial cause of this is that one or more circuit breakers “trip” when the mains power is restored, and the process of resetting the breakers is complicated.

This issue has been noted at times where there have been as few as one, or as many as 254, of the possible 256 antennas connected, indicating that the output load on the power supply has little bearing on the problem.

Without detailed electrical systems engineering knowledge, CIRA personnel can only conjecture that the root cause of this problem is in-rush surge current on initial power up.

3.2 Pre-conditions

The starting state for inducing the fault is that site-wide power is up, all breakers are “on” and the APIU is operational and has been for “some time”. The system appears to be reasonably stable under these conditions and has been known to be operational like this for two or more months continuously.

The details of the (single phase) circuit breakers in the chain are:

MWA Field transformer kiosk: DIN-T10 C32, 10kA breaking capacity, "C" curve, 32A breaker.

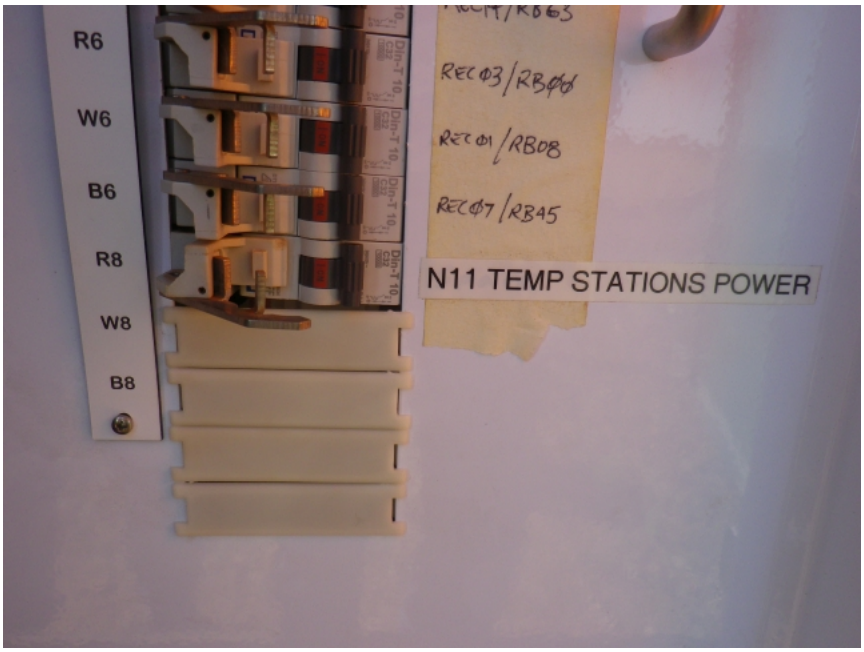

FIGURE 2: MWA FIELD TRANSFORMER KIOSK SHOWING AAVS BREAKER “N11…”

AAVS power distribution sub-board: RCDMCB10I-C10 => 6kA breaking capacity, "C" curve, 10A breaker, 30mA RCD combo.

FIGURE 3: AAVS1 POWER DISTRIBUTION SUB-BOARD BREAKER PANEL SHOWING BREAKER "3"

APIU internal breaker: HPM HE4110 => 4.5kA breaking capacity, "C" curve, 10A breaker.

FIGURE 4: APIU INTERNAL SUB-BOARD SHOWING BREAKER AND SURGE PROTECTORS

3.3 Observed behaviour as of 2018-03-13

Site wide power had been interrupted at least a week prior to our arrival on site and CSIRO staff had restored the main breaker and individual circuit breakers in the MWA Transformer kiosk (these had been deliberately turned off at the commencement of the power outage, to prevent “bounces” on restoration of site-wide power from affecting MWA/AAVS end-point loads).

The observed states of the relevant breakers before any recovery actions were taken were:

- Kiosk breaker: ON
- Sub-board breaker: ON
- APIU breaker: OFF

Attempting to turn on the APIU breaker failed (it tripped out immediately), and further caused the sub-board breaker to trip.

While the sub-board breaker was tripped out, the APIU breaker was re-set, and it stayed ON.

Attempting to turn on the sub-board breaker caused both to trip out again.

Again, while the sub-board breaker was tripped out, the APIU breaker was re-set, and it stayed ON.

And again, attempting to turn on the sub-board breaker caused both to trip out again.

For the last time, the APIU breaker was re-set (and stayed) and this time when the sub-board breaker was re-set, it also stayed on, and the APIU appeared to power up (a slight hum was audible).

While CIRA does not possess accurate chronological detailed records of previous occurrences, very similar behaviour has been observed previously with this APIU as well as at least one other, and apparently without regard to how many (if any at all) of the antenna loads were connected.

It is not clear whether the surge protection devices in the APIU have any effect on this recovery behaviour, and CIRA staff do not possess the necessary qualifications to isolate these devices in order to test any effect they may have.

4. Recommendations for remediation

4.1 Actions by Balance Utility Solutions

Balance Utility Solutions (“Balance”) are best placed to analyse the above results/behaviours and recommend a suitable course of action to modify the installation to better handle up-stream power cycle operations without requiring complex re-start procedures.

In the ideal circumstance, no on-site activity should be required once the mains power is restored; the APIU should start up cleanly, even with all 256 antenna loads connected.

Balance will specify any further testing/diagnosis actions required in order to understand the problem and offer a solution for remediation. Further, Balance will provide full documentation that can be passed on to suitable contractors to perform the work, including what documentation contractors will need to provide in order that Balance can provide CIRA with updated “as-built” documents. And finally, Balance will co-ordinate the provision to CIRA, of these updated “as-built” drawings of the installation.

4.2 Actions by CIRA

If further diagnoses are recommended by Balance, then CIRA staff will undertake those diagnoses, or engage licensed contractors to undertake them where required.

Once Balance has identified suitable remedial work/parts/actions, CIRA will engage suitably licensed contractors to carry out the work required to improve the performance of the APIU. Those contractors will be given clear instructions as to the works required, and any documentation that will be needed by Balance to provide CIRA with updated “as-built” drawings, as described above in section 4.1