MONSOON/Torrent Software

Adding automation to detector controller configuration and startup

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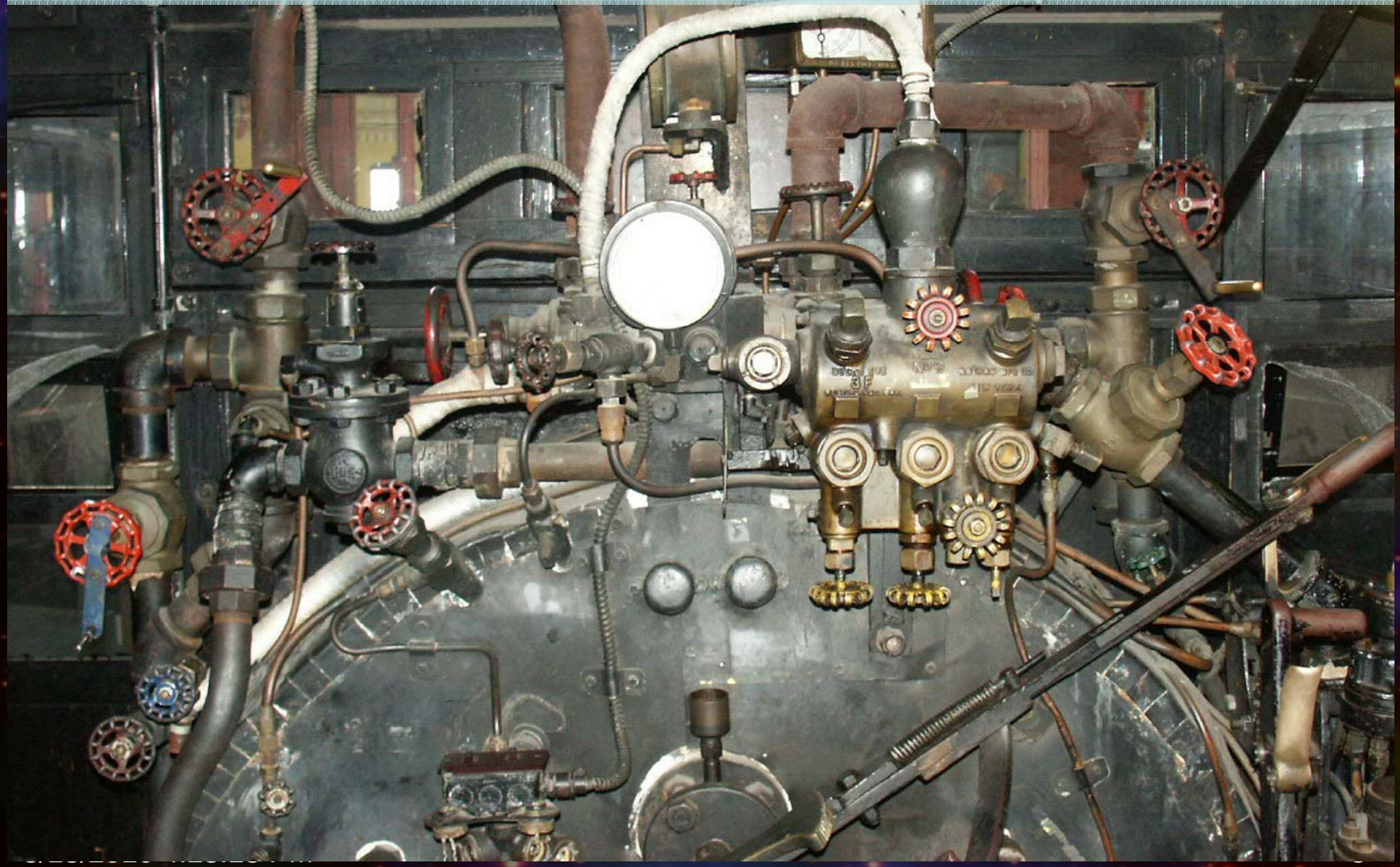
Where are we now

Baseline Information

- Torrent Systems are being run with “orange” software now. We could continue to configure Torrent systems by hand.
- **None** of the software being presented here is ***required*** to run Torrent hardware.
- This software will make Torrent systems safer, easier to use and simpler to configure, maintain and document.

Torrent Software Goals

to move from “orange” Configuration Tools like this:



To Torrent Configuration tools more like this:

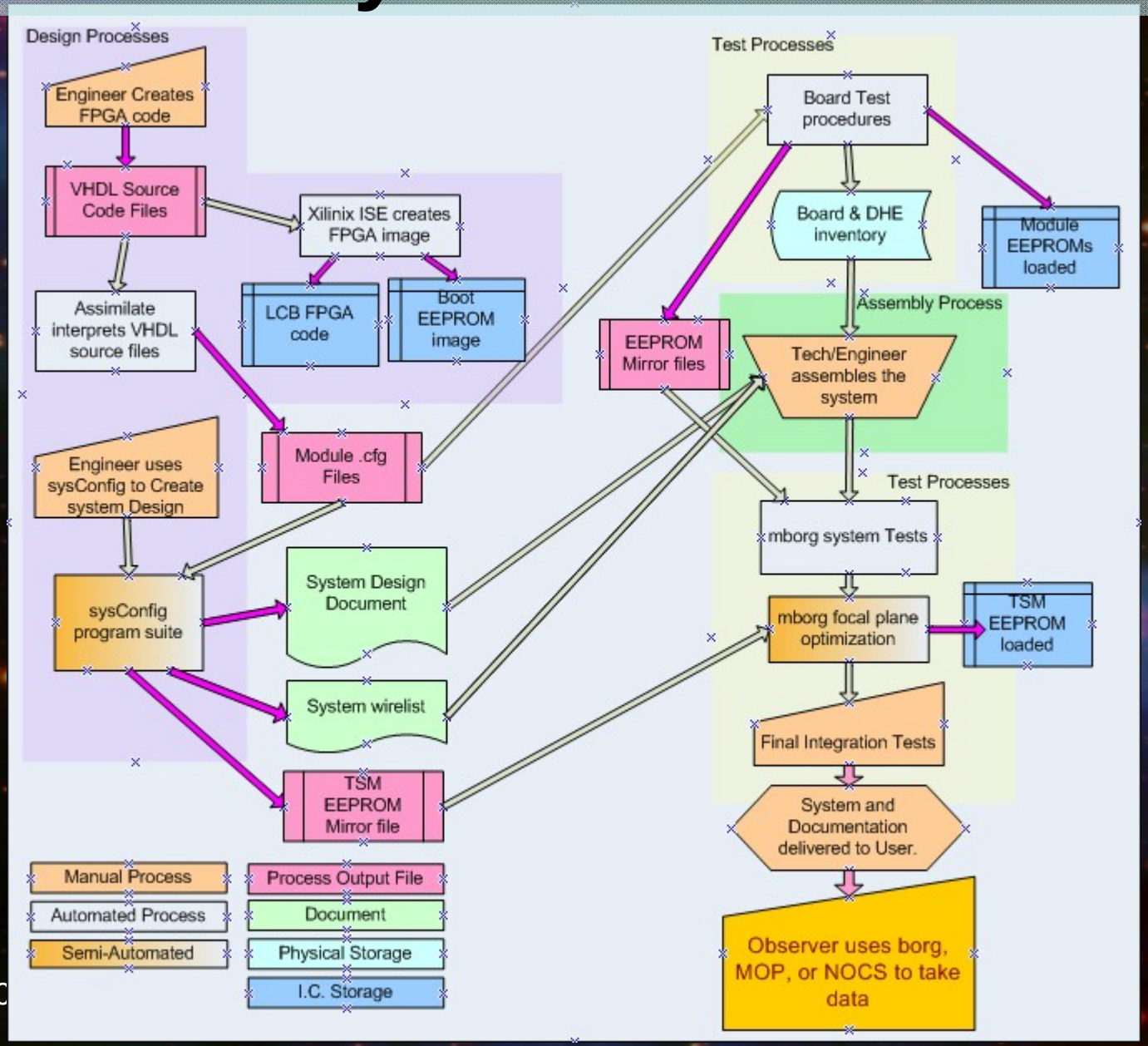
Torrent Software Goals

1. Support the hardware in providing detector limited performance for image acquisition.
2. Use the same PAN & User software as MONSOON “orange” systems.
3. Minimize image acquisition process overheads.
4. Store the board calibration values in the DHE not on external media.
5. Store the focal plane attribute default values with the Dewar not on external media.
6. Automate the configuration, testing, calibration & optimization of Torrent focal planes.

Torrent software Goals (cont)

7. To provide tools to:
   - Automate the description of the hardware/ firmware attributes/registers/functions and the connection of the user attribute-value pairs to the hardware functions.
   - Automate the design & specification of Torrent controller configurations and documentation of Torrent controller configurations.
   - Automate the startup & initialization of the MONSOON software when used with Torrent systems.

Torrent System Process Flow



Achieving the Goals

1. **Support detector limited observing** ☑
   - Readout speed determined by the science.
   - Detector clock and bias voltage can be changed at readout clock speeds (subject to electrical filter settling).
   - Readout sequences and exposure time can overlap data transfer to DHS.
   - Detector library can be custom designed to support complex operations required by detector or science

Achieving the Goals (cont)

2. Use the same software as the "orange" MONSOON ☑

- Pan processes and libraries used essentially unchanged. Two new gpx/ppx commands added to support hardware EEPROMs in Torrent.
- Currently running (E2V 4482) prototype systems, reviewCCD and basicCCD systems with the modified "orange" software.

Achieving the Goals (cont)

3. Minimize image acquisition overheads. ☑

- Can allow overlap of instrument configuration and Integration time with the data transfer to DHS.
- Setup times for complete change in observation parameters less than 2 secs. startExp command to integration start on order .25 secs.
- Data transfer DHE to PAN 1.25 secs for 4kx4k detector (32bit Pixels @ 50MBytes/sec) with no allowance for ADC and clocking delays.Total readout time for 4 output 4kx4k detector @ 150 kPix/sec <25 secs.

Achieving the Goals (cont)

4. **Store the board calibration values in the DHE not on external media.** !
   - EEPROMs on AFE, LCB and PSM boards are loaded with calibration values during board testing.
   - Torrent program "***`collector`***" reads configuration files and EEPROMs and constructs the system '.csv' file from this data.
   - Faulty EEPROM values caught through CRC check on entire EEPROM. Additional error checking/correction could be added if deemed necessary.
   - Allows swapping out a failed DHE controller and achieving identical performance from the new DHE controller.

Achieving the Goals (cont)

5. **Store the attribute default values with the Dewar not on external media. !**
   - EEPROM on Transition module utility board is loaded with operating values during detector optimization
   - "***collector***" reads TSM configuration file and EEPROM and constructs a DefaultSetup.mod file and a system SetVoltages.mod file
   - Faulty EEPROM values caught through CRC check on entire EEPROM. Correct values can be obtained from a database if EEPROM not available.

Achieving the Goals (cont)

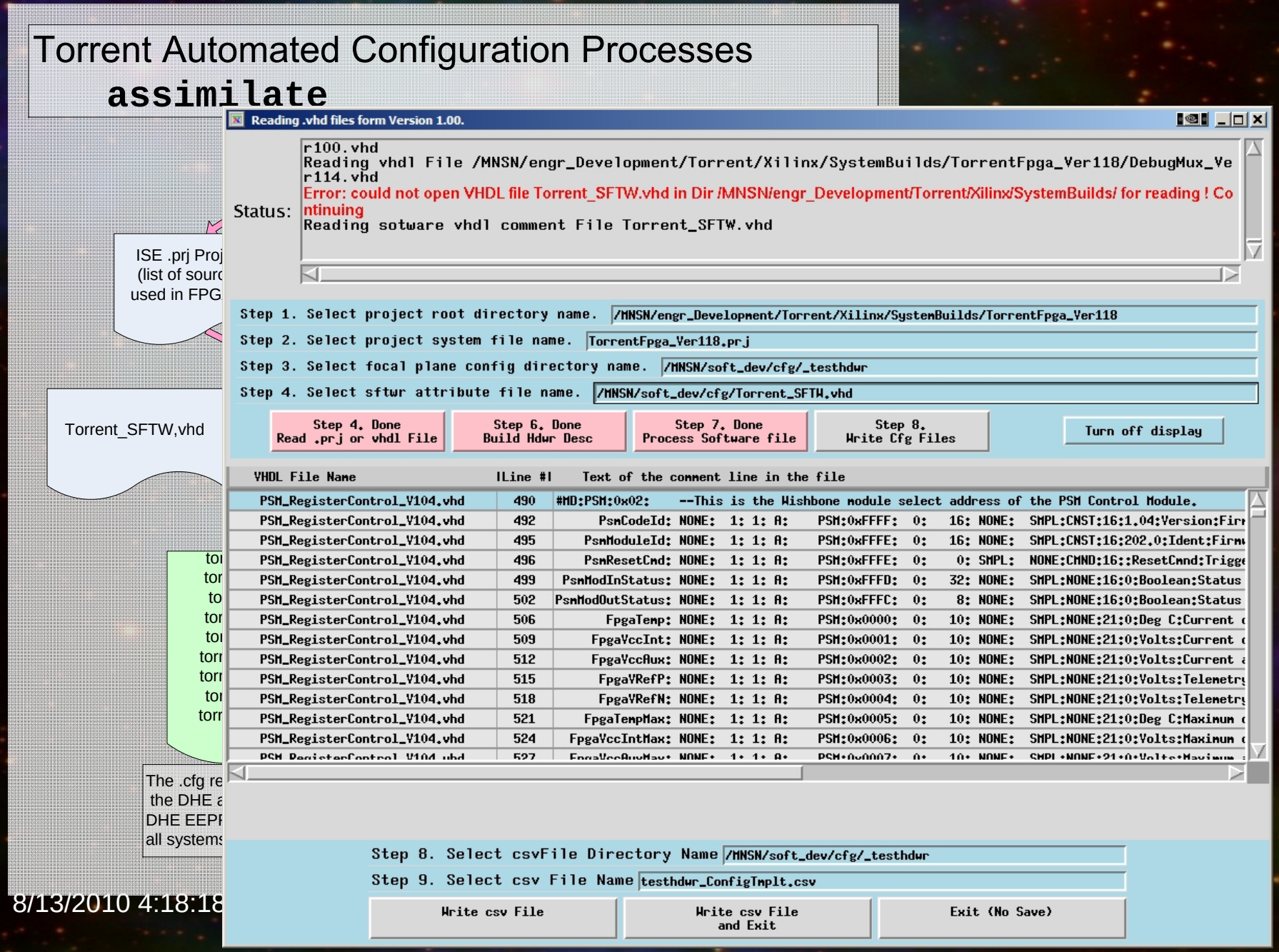
6. **Automate the configuration, testing, calibration and optimization of Torrent systems.** !
   - Provide "**`sysConfig`**" tools to the system or detector engineer/scientist.
   - Provide **`mborg`** test and focal plane optimization routines to do testing and calibration of boards and detector optimization.
   - Keep track of , document configuration decisions and test & optimization results automatically.

7. Providing Automation Tools

- **Automate the description of the hardware & firmware attributes, registers, functions.** ☑
  - "***`assimilate`***" an OO python program to read the VHDL source code files and produce system configuration files.
  - Assigns attributes to locations in module EEPROM memory space as needed.
  - Produces a template Config.csv file for testing.
  - Needs to be run once for each version of the FPGA firmware.

Torrent Automated Configuration Processes

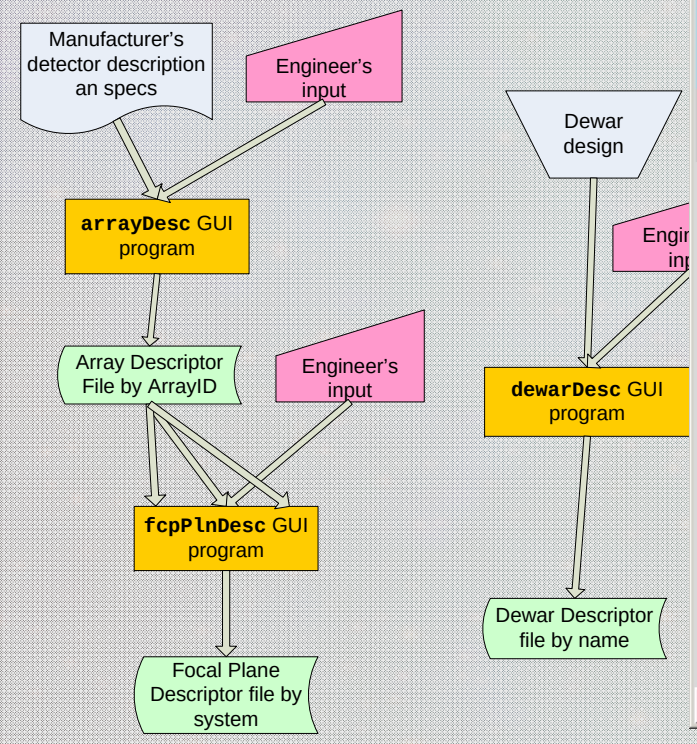
assimilate

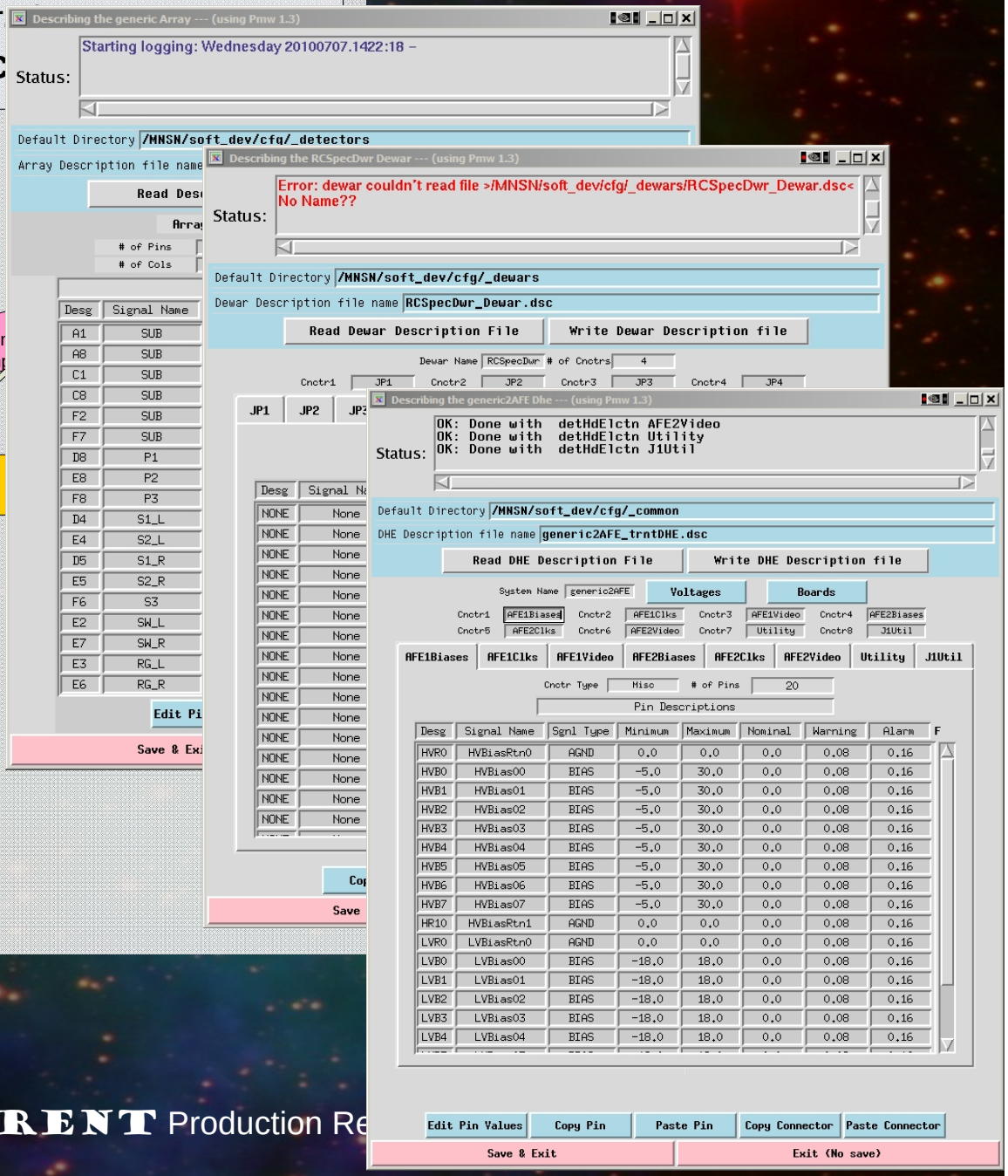


7. Providing Automation Tools

- **Automate the design & specification of Torrent controller configurations.** ☑
  - "***sysConfig***" tools – ***arrayDesc, fclPlnDesc, dewarDesc, dheDesc*** and ***sysConfig***
  - Run once while designing a focal plane system. Produces "System Configuration Document".
  - Run again if something is changed, i.e. a new array is installed, a new firmware version is released.
  - Can be used to track and document changes to default value settings.
  - Can create modified GUI display for borg & mborg.

Torrent System Design and Configur
sysConfig and its anc

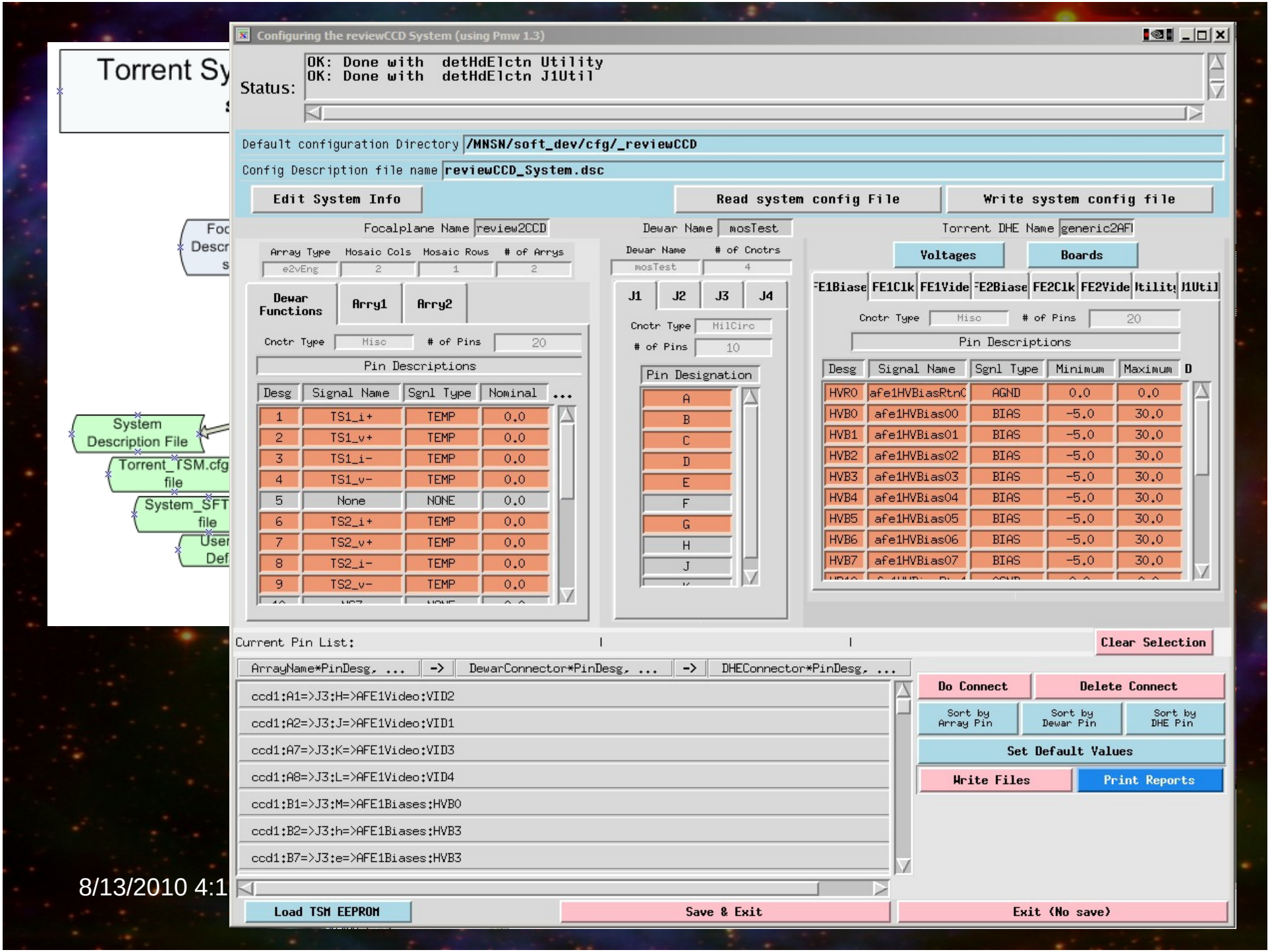




sysConfig Tools

These tools are used to define, document and track:

- arrayDesc – Gui based tool to describe an detector. ☑
  - Signal Names and Signal types for pins by designation. Signal nominal, min and max safe values.
- fclPlnDesc - Gui based tool to describe a focal plane. ☑
  - Number, type, unique Identifier and position in focal plane for each detector in focal plane. Connection points for focal plane functions, temperature Sensors, heaters, etc.
- dewarDesc – Gui tool to describe a Dewar. ☑
  - Number and type of Connectors. Number of Pins in each connector. Name of each connector and pin.
- dheDesc - Gui tool to describe a DHE. ☑
  - Number, type and serial number of boards. Voltage settings for vHv+, vHv-, vCb+,vCb-, vAna+, vAna-, vBb for system. Names of connections for AFE signals and TSM utility board signals.


Torrent Sy
System Description File
Torrent_TSM.cfg file
System_SFT file
Configuring the reviewCCD System (using Pmw 1.3)
Status:
OK: Done with detHdElctn Utility
OK: Done with detHdElctn J1Util
Default configuration Directory
/MNSN/soft_dev/cfg/_reviewCCD
Config Description file name
reviewCCD_System.dsc
Edit System Info
Read system config File
Write system config file
Focalplane Name
review2CCD
Array Type
Mosaic Cols
Mosaic Rows
# of Arrys
e2vEng
2
1
2
Dewar Functions
Arry1
Arry2
Cnctr Type
Misc
# of Pins
20
Pin Descriptions
Desg
Signal Name
Sgnl Type
Nominal
1 TS1_i+ TEMP 0.0
2 TS1_v+ TEMP 0.0
3 TS1_i- TEMP 0.0
4 TS1_v- TEMP 0.0
5 None NONE 0.0
6 TS2_i+ TEMP 0.0
7 TS2_v+ TEMP 0.0
8 TS2_i- TEMP 0.0
9 TS2_v- TEMP 0.0
Dewar Name
mosTest
# of Cnctrs
4
J1
J2
J3
J4
Cnctr Type
MilCirc
# of Pins
10
Pin Designation
A
B
C
D
E
F
G
H
J
Torrent DHE Name
generic2AFI
Voltages
Boards
FE1Biase
FE1Clk
FE1Vide
FE2Biase
FE2Clk
FE2Vide
Misc
# of Pins
20
Pin Descriptions
Desg
Signal Name
Sgnl Type
Minimum
Maximum
HVR0 afe1HVBiasRtnC AGND 0.0 0.0
HVB0 afe1HVBias00 BIAS -5.0 30.0
HVB1 afe1HVBias01 BIAS -5.0 30.0
HVB2 afe1HVBias02 BIAS -5.0 30.0
HVB3 afe1HVBias03 BIAS -5.0 30.0
HVB4 afe1HVBias04 BIAS -5.0 30.0
HVB5 afe1HVBias05 BIAS -5.0 30.0
HVB6 afe1HVBias06 BIAS -5.0 30.0
HVB7 afe1HVBias07 BIAS -5.0 30.0
Current Pin List:
Clear Selection
ArrayName*PinDesg, ...
->
DewarConnector*PinDesg, ...
->
DHEConnector*PinDesg, ...
ccd1:A1=>J3:H=>AFE1Video:VID2
ccd1:A2=>J3:J=>AFE1Video:VID1
ccd1:A7=>J3:K=>AFE1Video:VID3
ccd1:A8=>J3:L=>AFE1Video:VID4
ccd1:B1=>J3:M=>AFE1Biases:HVB0
ccd1:B2=>J3:h=>AFE1Biases:HVB3
ccd1:B7=>J3:e=>AFE1Biases:HVB3
Do Connect
Delete Connect
Sort by Array Pin
Sort by Dewar Pin
Sort by DHE Pin
Set Default Values
Write Files
Print Reports
Load TSM EEPROM
Save & Exit
Exit (No save)
8/13/2010 4:1

Pulling it all together

- "***sysConfig***" – a GUI engineer's assistant. !
  The engineer:
  - Selects the Focal plane, Dewar and DHE for system.
  - Connects the focal plane signals to Dewar connectors and then to DHE signals.
  - Selects default settings for focal plane attributes.
  - Prints a wire list for the 'tech' assembling the system.
  - Prints and stores the System documentation records.
  - Prints and stores a attribute default values Document.
  - Stores an TSM EEPROM mirror file
  - Creates a ucode sequencer source code template.
  - Can creates a GUI display file for borg or mborg

7. Providing Automation Tools

- Automate the connection of the user attribute-value pairs to the hardware descriptions. ☑
  - "***sysConfig***" creates a system software.cfg file that is used by ***collector*** to assign user names to the hardware attributes.
  - "***sysConfig***" creates a system ucode Template to connect dhe signals to bits in the ucode.
  - "***sysConfig***" creates a system defaults file relating user attribute names to default values.
  - "***sysConfig***" creates a system ".ini" file to handle startup issues
- At this point there is sufficient information to start a system for checkout. ☑

7. Providing Automation Tools

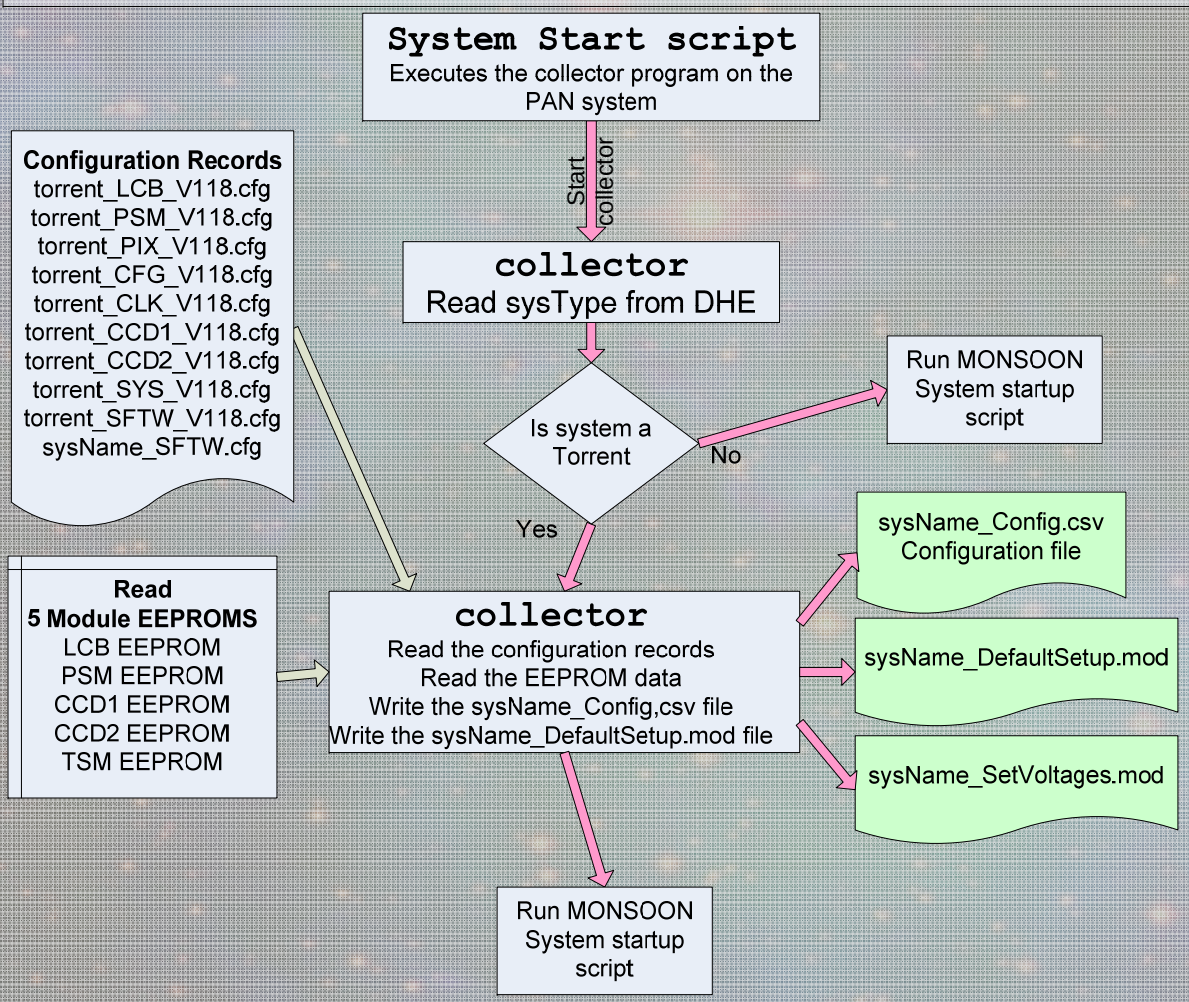
- Automate the documentation of Torrent controller configurations. ☑
  - "***sysConfig***" tracks and stores the system configuration document.
  - "***sysConfig***" allows printing a formatted document for the system documentation package.
  - "***sysConfig***" allows the user to modify the configuration if a detector or board is changed out.

7. Providing Automation Tools

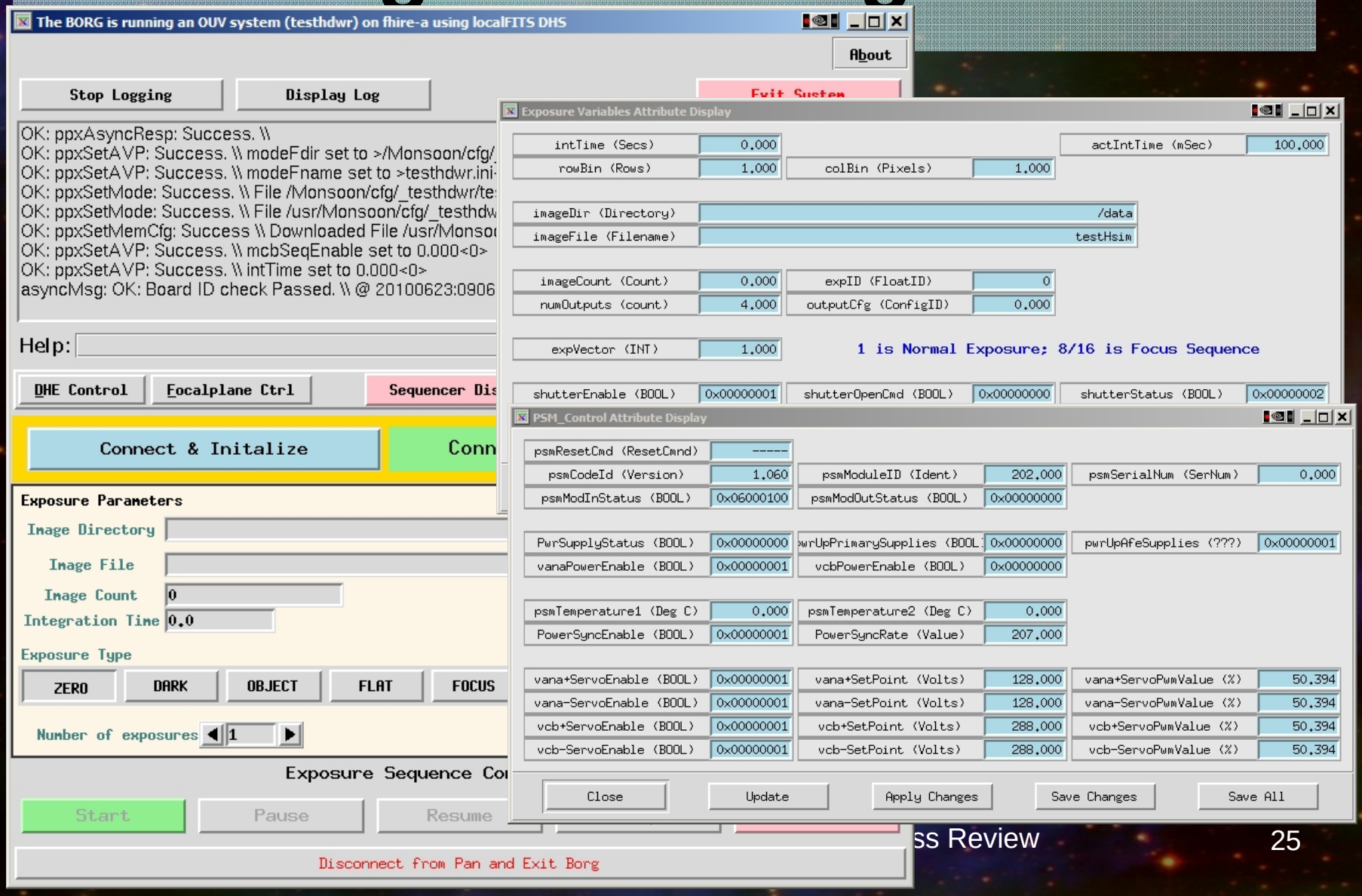
- Automate the startup & initialization of the PAN software when used with Torrent systems. !
  - "***collector***" – run before the standard MONSOON startup script for the system.
    - Reads the FPGA .cfg files,
    - Reads the EEPROMs in the DHE
    - And Creates
      - a sysName_Config.csv file,
      - a sysName_DefaultSetup.mod and
      - a sysName_SetVoltages.mod file from the EEPROM data.
    - Starts the Execution of the standard MONSOON startup script for the system.

Torrent Automated Configuration Processes

`collector` - System Startup



borg and mborg GUI



Mborg Optimization Tools

- pteTest – a test to determine the serial and parallel photon transfer efficiency for a CCD. !
- noiseTest - a test to determine the system noise for a CCD or IR system. !
- features - a test to determine the location and extent of “hot” and “bad” pixels, rows, columns. !
- optimize – a series of sequences to ease the task of optimizing a focal plane or detector TBD !
- eepEdit –this tool allows the engineer to write the optimization voltage values to the TSM EEPROM and/or edit the EEPROM values by hand !
  - Done after engineer is satisfied with optimization results
  - Hand editing is “possible but not recommended.”

Mborg Diagnostic tools

- Provide software to automate the diagnostic testing of Torrent Boards at the Telescope.
  - *lcbTest* – tests the functionality of an LCB board !
  - *afeTest* – tests the functionality of each AFE !
    - *recalibrate* will run a calibration test on the clock rails, high and low voltage biases
  - *preAmpTest* – tests the functionality of a transition module preAmp board. !
  - *utilTest* - tests the functionality of a transition module utility board !
  - *psmTest* – tests the functionality of the PSM !

Runtime Failure Mode Analysis

- "***collector***" cannot connect to DHE !
  - System in [SIM] mode.
  - Informs user and suggests corrective actions.
  - Sends report to responsible maintenance tech/engineer.
- "***collector***" detects a "not Torrent" DHE !
  - Executes the normal MONSOON startup script for the system and exits.
- "***collector***" detects a "bad" EEPROM on LCB,PSM or AFE !
  - Collector checks that power supply voltages are in range.
  - Checks for an existing set of ".ini", ".csv" and ".mod" files.
  - Request that the user contact maintenance.
  - Asks maintenance for permission to use the existing files.
    - If answer is "YES" execute the normal startup script and exit.
    - If answer is "NO" exit.
  - Sends report to responsible maintenance tech/engineer.

Runtime Failure Mode Analysis (cont)

- "***collector***" detects a "bad" EEPROM on TSM !
  - Request user to contact maintenance.
  - Asks maintenance if correct system is connected.
  - If a previous sysName_setVoltages.mod file exist.
    - Yes; Asks for maintenance permission to startup using previous file.
    - If No exits without starting system
  - Sends report to responsible maintenance tech/engineer.
- PAN processes fail to connect to DHE ☑
  - PAN goes into [SIM] mode
  - "client' software informs user of problem and suggests corrective action.
  - Suggest user contact maintenance.
- PAN processes connect & get errors during operations ☑
  - "client' software informs user of problem and suggests corrective action.
  - Suggest user contact maintenance.

Runtime Failure Mode Analysis (cont)

- A “client” system (borg, NOCS, MOP) finds voltages have been incorrectly set before detector powerOn sequence. !
  - During Initialization “client” Informs user of failure.
  - Requests that the user contact maintenance.
  - Sends report to responsible maintenance tech/engineer
- A “client” system finds some voltages have been incorrectly set after detector powerOn sequence. !
  - During Initialization “client”
    - executes detector powerOff sequence.
    - Informs user of failure.
    - Requests that the user contact maintenance.
  - During normal operations “client”.
    - Postpones start Exposure command
    - Informs user of failure. Asks if user wishes to continue.
    - In user “client” programs that can use it the ‘alarm’ level will execute a detector powerOff sequence
    - Requests that user contact maintenance.
  - Sends report to responsible maintenance tech/engineer.

Conclusion

- Questions?
- Answers!
  - 42 ☑
  - NCC-1701-E
  - The Dumbbell Nebula
  - It's a hardware problem