Change Notes:
V1.0 New Document 25 June 2003
V1.1 Renamed failures to bring inline with proposed anomaly handling SPIRE-RAL-PRJ-001855
V1.2 Add DPU Power Failures to list, morphed OBS failures into main tables.

0 Introduction

This note contains the Hardware Software Interaction Analysis (HSIA) worksheets for the SPIRE instrument operations during flight operations. The worksheets follow (more or less) the formalism proposed in ECSS-Q-30-02A, however rather than a single worksheet per failure we use tables with the following columns:

Anomaly – possible problem that might occur within the hardware or software that leads to an error in the operation of the SPIRE instrument. As we do not have an applicable FMECA, we have generated a list of problems that might occur specifically for the present exercise. For the purposes of this exercise we define a UNIT as one of the DPU; DCU; MCU; SCU or PSU – i.e. the units that make up the SPIRE warm electronics system and a SUB-SYSTEM as one of the sub-systems within the SPIRE FPU and/or JFETs. See the SPIRE block diagram SPIRE-RAL-DWG-000646.

Detection – identified method by which the SPIRE OBS will recognise that a problem has occurred. This is either by a known housekeeping parameter going out of limits appropriate for the known operating mode of the instrument (to be defined as part of the MIB definition – see also Failure Detection Isolation and Recovery Policy in the SPIRE Instrument SPIRE-RAL-PRJ-001128) or by an error flag being raised in the OBS because an OBS anomaly has occurred – see table XXX.

Isolation – a comment as to whether a) the problem and its detection will isolate the problem or whether it is indicative of a more general systemic problem and b) the action taken by the OBS in response to the failure detection will isolate the problem to a single unit/sub-system or whether the instrument must be shut down as the problem cannot be uniquely isolated.

Failure – name of the failure to be used in the OBS; event packets and subsequent problem analysis.

Autonomous Recovery – the action that will be taken by the OBS to isolate the failure and/or attempt to recover as much operational ability as is safe to carry on SPIRE operations without ground contact. This section effectively outlines the specification for the OBS autonomy functions.

Operations Recovery – indicative (only) actions that might be taken when the S/C is in ground contact in an attempt to identify the cause of the problem and initiate full recovery of the instrument.

The note is broken into five sections:

1 DRCU/FPU Failures
2 DPU/DRCU Low Speed Interface Failures
3 DPU/DRCU High Speed Interface Failures
4 CDMS/DPU Interface

1 DRCU/FPU Failures

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.1 DRCU Power Rails 1. Any or all of the power rails in the units fails	One or all of the following out of hard limits: ScuCHTp05 ScuCHTp09 ScuCHTn09 ScuCHTp25 P5V P15V M15V P13V M13V BDAQ_P5 BDAQ_P9 BDAQ_N9 LIAP_P5 LIAP_P9 LIAP_N9 LIAS_P5 LIAS_P9 LIAS_N9 DPUP5V DPUP15V DPUM15V DPUP25V	Uncertain - switch instrument to SAFE and investigate to isolate failure	POWER_FAILURE(SCUP5V) POWER_FAILURE(SCUP9V) POWER_FAILURE(SCUN9V) POWER_FAILURE(SCUP25V) POWER_FAILURE(MCUP5V) POWER_FAILURE(MCUP15V) POWER_FAILURE(MCUN15V) POWER_FAILURE(MCUP13V) POWER_FAILURE(MCUN13V) POWER_FAILURE(BIASP5V) POWER_FAILURE(BIASP9V) POWER_FAILURE(BIASN9V) POWER_FAILURE(PLIAP5V) POWER_FAILURE(PLIAP9V) POWER_FAILURE(PLIAN9V) POWER_FAILURE(SLIAP5V) POWER_FAILURE(SLIAP9V) POWER_FAILURE(SLIAN9V) POWER_FAILURE(DPUP5V) POWER_FAILURE(DPUP15V) POWER_FAILURE(DPUM15V) POWER_FAILURE(DPUP25V)	In all cases of DRCU power failure switch instrument to SAFE *(We cannot trust that this is a sensing (i.e. digitization or read circuit) failure. Any failure of a power line may indicate serious systemic problems)* In all cases of DPU power failure attempt to switch instrument to SAFE then switch SPIRE to OFF	Switch affected unit on stand alone. Switch on sub-systems in turn monitoring total current drawn on 28V line at same time to attempt to identify cause of problem. For DPU power failure attempt to switch instrument back on with anomaly detection disabled in order to prevent DPU automatically demanding the S/C to switch off again! A test to see if problem is with sensor or really voltage OOL is needed. If problem persists and is real voltage error then switch to redundant side.

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.2 DRCU Board Temperatures 1. Any or all of the electronics cards in the units overheats	One or all of the following out of hard limits:				Analysis of other housekeeping to identify cause of failure. Conditioned switch on sequence under ground contact may also be necessary to identify problematic sub-system. If problem is within the electronics then switch to redundant side or, if LIA card, inhibit further use of that unit. If problem is within redundant FPU sub-system switch to redundant. If problem is within non-redundant FPU sub-system, inhibit further use of that sub-system. For DPU board temperature problem attempt to switch instrument back on with anomaly detection disabled in order to prevent DPU automatically demanding the S/C to switch off again. May have to wait for the error to recur before diagnosis is possible.
	CcuTempRd TcuTempRd	Uncertain – switch instrument to SAFE and investigate to isolate failure	BTEMP_FAILURE(CCUTEMP) BTEMP_FAILURE(TCUTEMP)	Switch to SAFE mode *This appears to be the only option?*	
	PsuTemp1Rd PsuTemp2Rd	*Ditto*	BTEMP_FAILURE(PSUTEMP1) BTEMP_FAILURE(PSUTEMP2)	Switch to SAFE mode (*Cannot be sure this isn't a systemic problem)*	
	MACTemp SMECTemp BSMTemp	Yes – failure isolated to MCU by switching unit off	BTEMP_FAILURE(MCUMACTEMP) BTEMP_FAILURE(MCUSMECTEMP) BTEMP_FAILURE(MCUBSMTEMP)	Switch MCU off and inhibit further MCU commands	
	DAQ_IF_TEMP BIAS_TEMP	Yes - failure isolated to DCU by switching unit off	BTEMP_FAILURE(DAQIFTEMP) BTEMP_FAILURE(BIASTEMP)	Switch DCU off and inhibit further DCU commands (*Actually might as well SAFE the instrument!)*	
	LIA_B1_TEMP LIA_B2_TEMP LIA_B3_TEMP LIA_B4_TEMP LIA_B5_TEMP LIA_B6_TEMP LIA_B7_TEMP LIA_B8_TEMP LIA_B9_TEMP LIA_B10_TEMP LIA_B11_TEMP LIA_B12_TEMP	Yes - failure isolated to individual LIA board by switching board off	BTEMP_FAILURE(LIA01TEMP) BTEMP_FAILURE(LIA02TEMP) BTEMP_FAILURE(LIA03TEMP) BTEMP_FAILURE(LIA04TEMP) BTEMP_FAILURE(LIA05TEMP) BTEMP_FAILURE(LIA06TEMP) BTEMP_FAILURE(LIA07TEMP) BTEMP_FAILURE(LIA08TEMP) BTEMP_FAILURE(LIA09TEMP) BTEMP_FAILURE(LIA10TEMP) BTEMP_FAILURE(LIA11TEMP) BTEMP_FAILURE(LIA12TEMP)	Switch off LIA board with the OOL and continue operations	
	DPUTEMP	No – problem in the DPU will mean SPIRE operation is no longer possible	BTEMP_FAILURE(DPUTEMP)	In case of DPU temperature failure attempt to switch instrument to SAFE then switch SPIRE to OFF	

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.3 SCU DC Thermistors 2. R goes Open Circuit 3. R(T) changes 4. Faulty connecton on I leads 5. Faulty connection on V leads 6. Short on I leads 7. Short on V leads 8. Voltage supply fails 9. Error in Digitisation chain	SingleThermistor OOL SingleThermistor OOL SingleThermistor OOL SingleThermistor OOL SingleThermistor OOL MultipleThermistors OOL MultipleThermistors OOL MultipleThermistors OOL	Yes – any problem with a single thermistor can be isolated by switching thermistor off.	THERM_FAILURE(PUMPHTRTEMP) THERM_FAILURE(PUMPHSTEMP) THERM_FAILURE(EVAPHSTEMP) THERM_FAILURE(SHUNTTEMP) THERM_FAILURE(SOBTEMP) THERM_FAILURE(SL0TEMP) THERM_FAILURE(PL0TEMP) THERM_FAILURE(OPTTEMP) THERM_FAILURE(BAFTEMP) THERM_FAILURE(BSMIFTEMP) THERM_FAILURE(SCAL2TEMP) THERM_FAILURE(SCAL4TEMP) THERM_FAILURE(SCALTEMP) THERM_FAILURE(SMECIFTEMP) THERM_FAILURE(SMECTEMP) THERM_FAILURE(BSMTEMP)	Switch Thermistor N off If N=SCAL turn off SCAL control If (N=CP, CPHP, CPHS, CEHS or CSHT(AND (in CREC Mode) Switch off Cooler Recycling	**For single failure:** 1. implement bitmask in OBS plus command parameter check before issuing thermistor command 2. Change all thermistor commands in flight procedures and observations **For multiple failures:** May be genuine increase in temperatre – if so we are at the end of the mission or something has gone wrong with the thermal system! If not then: Diagnostic: switch on each thermistor in turn to see which one(s) have failed. If multiple thermistors failed switch to redundant system or use a backup mode of operations for all heater control
1.4 SCU Heaters **(Cooler and Thermal control Heaters)**	One of the following will go out of hard limits				Check for multiple SCU HSK failures. If so it is likely to be a digitization failure. If so use backup control mode(s) Otherwise:
1. R goes Open Circuit 2. R(T) changes 3. Faulty connecton on I leads 4. Faulty connection on V leads	EVHSHeatVolt SPHeaterVolt	Yes – individual power supplies for each heater - switching off isolates failure.	HEATER_FAILURE(EVHSV) HEATER_FAILURE(SPHTRV)	If in CREC Mode: Stop Cooler Recycle	For single failure: Switch to redundant system
5. Short on I leads 6. Short on V leads 7. Voltage supply fails 8. Error in D to A conversion 9. Error in Digitisation chain	SPHSHeatVolt		HEATER_FAILURE(SPHSV)	If in CREC Mode: Stop Cooler Recycle Else Set current to 0	Switch to redundant system
	TCHeaterVolt		HEATER_FAILURE(TCHTRV)	Set current to 0	Do not use Thermal Control or Switch to redundant system

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.5 SCU Heaters (Calibrators) 1. R goes Open Circuit 2. R(T) changes 3. Faulty connecton on I leads 4. Faulty connection on V leads 5. Short on I leads 6. Short on V leads 7. Voltage supply fails 8. Error in D to A conversion 9. Error in Digitisation chain	One of the following will go out of hard limits PhCalVolt SCal4Volt SCal2Volt	Yes – individual power supplies for each heater – switching off isolates failure.	HEATER_FAILURE(PCALV) HEATER_FAILURE(SCAL4V) HEATER_FAILURE(SCAL2V)	Switch off PCAL. Inhibit further commands to PCAL If SCAL4 is in thermal control switch off control loop. Switch off SCAL4 Inhibit further commands to SCAL4 If SCAL2 is in thermal control switch off control loop. Switch off SCAL2 Inhibit further commands to SCAL2	Check for multiple SCU HSK failures. If so it is likely to be a digitization failure and switch to redundant side. Otherwise: Can choose not to use PCAL and rely on other means of calibration. Else switch to redundant system Can choose no to use SCAL4 and rely only on SCAL2 Else switch to redundant system Can choose no to use SCAL2 and rely only on SCAL4 Else switch to redundant system
1.6 SCU AC Thermistor 1. R goes Open Circuit 2. R(T) changes 3. Faulty connecton on I leads 4. Faulty connection on V leads 5. Short on I leads 6. Short on V leads 7. Voltage supply fails 8. Error in D to A conversion 9. Error in Digitisation chain	SubKTemp OOL	Yes – supply is specific to this thermistor – switching off isolates failure.	THERM_FAILURE(SUBKTEMP)	Switch SubKTemp off	Check other temperatures (detectors) to see if it is a real increase in temperature – if so the cooler ran out! Check for multiple SCU HSK failures. If so it is likely to be a digitization failure and may require change to redundant side Otherwise ignore and use detector thermistors to monitor sub-K temperatures.

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.7 MCU SMEC 1. Motor goes open circuit 2. Optical encoder position derivation fails 3. LVDT position derivation fails 4. Mean speed is not within hard limits 5. Position error is not within hard limits 6. Loss of one optical encoder raw signal 7. Loss of LVDT raw signal 8. Demand current is not within hard limits (mechanism jammed) 9. Error in digitization of position sensors	SMECStatus bit 15 is set high	Yes – indicator is only for failure in SMEC – switching off SMEC will ensure isolation.	MCU_FATALERROR(SMECSTAT)	Switch SMEC off Inhibit further SMEC commands	Check for general digitization or power supply failure – if either of these swap to redundant – if these o.k. then do the following Check signals from optical encoder position sensors – if signal has failed on single Optical Encoder channel then switch to alternative for position derivation If all signals failed on optical encoder increase power to LED and check for signal – if this is cause use increase LED power Else swap to redundant side and check for signals – if none then switch to backup operational mode Check for signal from LVDT – if none swap to operational mode without use of LVDT position – i.e. ignore LVDT Check back e.m.f. is present when mechanism is moved. If not motor has failed switch to redundant. Check optical fine and coarse position increments correctly during scan – if jittery or lots of steps missing check encoder signal quality – if poor increase LED or swap to alternative signal. If LVDT; optical encoder position; back e.m.f and demand current are jittery/non-linear there is a problem with the mechanism requiring further detailed investigation.

Unit/Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
1.8 MCU BSM (both axes) 1. Motor goes open circuit 2. Position derivation fails 3. Demand current is not within hard limits (mechanism jammed) 4. Position error is not within hard limits 5. Position sensor raw signal fails 6. Error in digitization of position sensors	CHOPStatus bit 15 high And/or JIGStatus bit 15 high	Yes – indicator is only for failure in one axis of BSM – switching off BSM will ensure isolation and prevent any propagation to other axis.	MCU_FATALERROR(CHOPSTAT) And/or MCU_FATALERROR(JIGGSTAT)	Switch off BSM Inhibit further BSM commands	Check for general digitization or power supply failure – if either of these swap to redundant – if these o.k. then do the following for the axis(es) that show the error Check signals from position sensors – if signal has failed then … *what – can we increase the volts to recover or just swap to redundant?* Else swap to redundant side and check for signals – if none then switch to backup operational mode Check back e.m.f. is present when mechanism is moved. If not motor has failed switch to redundant. Check position increments correctly during movement – if jittery check position sensor signal quality – if poor ... … *what?* If back e.m.f/demand current also jittery/non-linear there is a problem with the mechanism requiring further detailed investigation.
1.9 MCU DSP BOOT 1. Fails to boot following switch on 2. Error in boot from PROM 3. *Any other error during operations? – How would these be flagged?*	10 seconds after MCU powered on the Bootstatusregister bit 0 !=1 And/or Bootstatusregister bits 8-15 !=0	Yes – further use of MCU not possible	CONFIG_ERROR(MCUBOOTED) CONFIG_ERROR(MCUON)	Switch MCU off Inhibit further MCU commands	Check for general PSU failure If not PSU failure attempt boot again *If boot fails continuously – what then?*
1.10 DCU 1. *The only housekeeping available is either commanded values (not much use); power rails (see above) or board temps (see above)*					

2 DPU/DRCU Low Speed Interface Failures

Anomaly	Detection	Isolation	Failure(s) (see Table xxx)	Autonomous Recovery	Operations Recovery
2.1 Interface Hardware Failure 1. Unit not switched on 2. Unit has failed 3. Unit interface hardware failure 4. DPU interface hardware failure	Timeout waiting for CMD Response Word from DRCU Unit	Uncertain – this could be indicative of general DPU interface failure – switch instrument to SAFE and investigate	ERROR_NO_DCU_RESPONSE ERROR_NO_MCU_RESPONSE ERROR_NO_SCU_RESPONSE *Note these are a refinement of the ERROR_NO_DRCU_RESPONSE identified in the DPU FDIR to allow us to see which DRCU unit has failed.*	If DCU should be operating in given instrument mode the switch instrument to SAFE mode *ditto* for MCU *ditto* for SCU	Switch instrument on and try switching unit up again – it could just be a latchup. If unsuccessful then switch to redundant side.
2.2 Command Failure 1. Unit fails to execute command properly 2. Failure in unit interface causes change in command or parameter bit pattern 3. Failure in DPU interface or transmission causes change in command or parameter bit pattern	Parameter field in CMD Response Word is not an echo of the CMD parameter sent for a Set CMD Command Identifier field in CMD Response Word is not an echo of the Command Identifier send	Uncertain - depends whether resend of command to unit either successful or not – if consistent failure could be generic problem and instrument must be SAFE'd	ERROR_LS_DCU_RX ERROR_LS_MCU_RX ERROR_LS_SCU_RX *Note these are a refinement of the ERROR_LS_DRCU_RX identified in the DPU FDIR to allow us to see which DRCU unit has failed*	Resend command up to N times re-inserting correct parameter After N resend and still failure inhibit further commands to unit and attempt to switch unit off. If unsuccessful in switching unit off, set instrument to SAFE	Switch instrument on and try again – it could just be a latchup. Investigate possible OBS error If unsuccessful then switch to redundant side
2.3 Incorrect Command 1. DPU sends a command unknown to the DRCU 2. DPU sends a command forbidden by the unit	ACK field in CMD Response Word = 1 ACK field in CMD Response Word = 2	Uncertain – could be indicative of general interface or communications failure.	ERROR_LS_CID_UNKNOWN ERROR_LS_CID_FORBIDDEN	Resend command N times? If continuous failure then attempt to switch off unit and inhibit further commanding If another command fails switch instrument to SAFE mode.	Switch instrument on and try again – it could just be a latchup. Investigate possible OBS error If unsuccessful then switch to redundant side

Anomaly	Detection	Isolation	Failure(s) (see Table xxx)	Autonomous Recovery	Operations Recovery
2.4 Command Failure 1. Unit fails to execute command properly 2. Sub-system does not respond to command	ACK field in CMD Response Word = 3	Uncertain – could be indicative of general interface or communications failure.	ERROR_SS_TIMEOUT *This is used ONLY for the ACK=3 error*	Resend command N times? If continuous failure then attempt to switch off unit and inhibit further commanding If another command fails switch instrument to SAFE mode.	Switch instrument on and try again – it could just be a latchup. Investigate possible OBS error If unsuccessful then switch to redundant side

3 DPU/DRCU High Speed Interface Failures

Anomaly	Detection	Isolation	Failure(s) (see Table xxx)	Autonomous Recovery	Operations Recovery
3.1 Interface Hardware Failure 1. Unit not switched on 2. Unit has failed 3. Unit interface hardware failure 4. DPU interface hardware failure	When a request for data is sent to a unit a flag is set in the OBS. If this flag is set the amount of data in the FIFO should be seen to be increasing after some reasonable (TBD) interval – if it is not then there is an error *A method of keeping track of the contents of the FIFO needs to be implemented*	Yes – other errors will indicate whether there is a general commanding or LS interface failure. Detection and correction is confined to the unit HS interface.	ERROR_DCU_SCI_RX ERROR_MCU_SCI_RX ERROR_SCU_SCI_RX	Inhibit data stream from affected unit Reset DPU FIFO Restart data stream from affected unit If problem repeats then inhibit data stream from affected unit	Switch instrument on and try again – it could just be a latchup. If unsuccessful then switch to redundant side.
3.2 Transmission or Synchronisation Failure 1. Unit transmission and DPU receipt become out or synch leading to misinterpretation of frame contents 2. Failure on unit interface leads to bit errors in science frames 3. Failure in DPU FIFO leads to bits errors in science frame 4. Other hardware/software failure in DPU leads to misinterpretation of frame contents	Unit frame ID is not valid Unit frame length is not valid Unit frame checksum failre	Yes – starting and stopping individual unit frame transmission either clears problem or not. Either way the failure is isolated to the unit in question and only affects data.	One of: ERROR_SCU_FIFO_FID ERROR_DCU_FIFO_FID ERROR_MCU_FIFO_FID ERROR_SCU_FIFO_FLEN ERROR_DCU_FIFO_FLEN ERROR_MCU_FIFO_FLEN ERROR_SCU_FIFO_CRC ERROR_DCU_FIFO_CRC ERROR_MCU_FIFO_CRC	Stop telemetry generation from affected unit Clear affected FIFO and restart If problem persists switch to transparent data mode (TBD) for this unit.	Analyse data/housekeeping to identify where problem has arisen Could be a latchup problem so switch unit off then on and try again If problem undiagnosed or identified as hardware fault then switch to redundant

4 CDMS/DPU Interface

This section deals with errors on the CDMS to DPU detected by SPIRE only – not those detected by the S/C.

Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
4.1 CDMS Temporary Interrupt Failure 1. Glitch or temporary interrupt on CDMS BUS - 1 second or less 2. Temporary interrupt on CDMS BUS – 10 seconds or less 3. Interface hardware problem causes timing signal to be undetected for <10 seconds	No timing signal (normally comes 1/second) for 1 second	Uncertain – if just loss of one timing signal then probably o.k. but there is no way for SPIRE to know if a command packet went missing – S/C must deal with this	NO_CDMS_TIME *New error code required for OBS*	None required – set flag to indicate that timing signal has been lost once Count number of these errors we get. If number reaches 10 stop telemetry to S/C (memory errors may occur anyway see table XXX)	None for SPIRE – S/C problem
4.2 CDMS Bus Failure 1. Permanent loss of CDMS BUS 2. Permanent interface hardware problem means timing signal cannot be detected.	No timing signal DPU memory errors occur as buffers fill up	No – SPIRE cannot be switched off if we cannot communicate with the S/C. S/C must deal with this situation.	NO_CDMS_TIME > 100 (TBD)	Inhibit all SPIRE operations currently taking place Switch off as many SPIRE sub-systems as possible (This is SPIRE_SAFE mode) Store minimum HK in DPU memory (TBD?)	None for SPIRE – S/C problem
4.3 TX Interface Failure 1. DPU Hardware Failure causes TX problem 2. DPU and CDMS get out of synch. (CDMS doesn't collect packets)	Telemetry cannot be sent to CDMS - DPU memory errors occur as buffers fill up	No – SPIRE cannot be switched off if we cannot communicate with the S/C. S/C must detect and deal with this situation.	A memory error – probably ERROR_DPU_POOL_FULL	Stop telemetry generation from DRCU Stop current SPIRE operations Clear affected DPU memory Try to restart CDMS handshake (see Table XXX) Request CDMS to suspend current observation – wait until next observation to restart Put SPIRE to PHOT_STBY If problem persists during next observation switch to SPIRE_SAFE	Check for S/C side problem. Restart SPIRE to check for a latch up If this doesn't clear the problem then switch to redundant side.
4.4 RX Interface Failure 1. DPU Hardware Failure causes RX problem (no command packets received) 2. Problem on S/C side with command packet transmission to SPIRE	None on SPIRE side. S/C must detect no response from SPIRE when commands sent	Not on SPIRE side	No SPIRE error generated	S/C error should be raised and SPIRE switched OFF	Check for S/C side problem Restart SPIRE to sheck for latch up If this doesn't clear the problem then switch to redundant side.

5 OBS Errors

Anomaly	Detection	Isolation	Failure(s)	Autonomous Recovery	Operations Recovery
5.1 Virtual Machine Execution Error 1. Execution error causes memory to be blocked	DPU memory buffers and/or transfer FIFOs fill up	Yes – stopping SPIRE operations will isolate problem	One or all of the following: ERROR_DPU_POOL_FULL BLOCK_NOT_ALLOCATED ERROR_LS_OVERFLOW	See error 4.3 above Stop telemetry generation from DRCU Stop current SPIRE operations Clear affected DPU memory Request CDMS to suspend current observation – wait until next observation to restart Put SPIRE to PHOT_STBY If problem persists during next observation switch to SPIRE_SAFE	Investigate VM code execution and correct as necessary Upload new OBS.