



# **STS-134 / ISS-ULF6 MOD Flight Readiness Review**

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***JSC Mission Operations Directorate  
Flight Director Office***

***DA8/Emily Nelson***

***DA8/Richard Jones***

***DA8/Gary Horlacher***

***DA8/Derek Hassmann***

***DA8/Tony Ceccacci***

***10 March 2011***

# Agenda



- **DA8 COFR Requirements/Endorsements**
  - COFR Requirements/Endorsements Summary
  - New Operations – A/E Topics, Shuttle, ISS, MCC
  - Safety Status Review
  - Flight Rules (Generic Volumes A, B, C, D, E; STS-134/ULF6 Annex)
  - FDF/ODF/SODF
  - Mission Staffing: Training/Certification/Work Guidelines Compliance
  - Non-Critical Processors/Applications (backup)
  - Emergency Mission Control Center (EMCC)/Backup Control Center (BCC) (backup)
  - Command Procedures (backup)
  - Contingency Shuttle Crew Support/Rescue Flight: STS-135 (LON vehicle) (backup)
  - Flight Techniques & Joint Operations Panels (backup)
  - Level II Actions/Shuttle IFAs
- **Standard Open Work (backup)**
- **Non-Standard Open Work**
- **Exceptions**
- **Items of Interest**
- **Flight Readiness Statement**



# DA8 COFR Requirements/Endorsements



REQUIREMENT (SHUTTLE)	FD	PI	Safety	SPAN	SMG	Team 4
Non-Crit Processors/Applications	G				G	
EMCC	G				G	G
Certified Flight Controllers	G			G	G	G
Flight Rules	G					
FDF	G	G				
FTP - New Ops	G					
Flight Anomaly Resolution	Y			G		
Anomaly - Procedure	G					
Exceptions/Action Items From Prior Readiness Reviews	G	G	G	G	G	G
CIL/Hazards	G		G			
No Constraints	G	G				
Level II (Program) Actions	G	G				
Mission Requirements	G					
Exception/Resolution	G	G				
Command Procedures	G					
Flt Prep Process Plan Requirements Met		G				
Contractor Process Insight		G				



Ready to Support Flight/Only Standard Open work



Non Standard Open work with expected resolution prior to flight.



Open work without expected resolution without assistance, prior to flight, or unavoidable constraint violation.



N/A



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# DA8 COFR Requirements/Endorsements



REQUIREMENT (STATION)	FD	PI	Safety	SPAN	Team 4
Non-Crit Processors/Applications	G				
BCC	G				G
Certified Flight Controllers	G			G	G
Flight Rules	G				
ODF/SODF	G	G			
JOP - New Ops	G				
Flight Anomaly Resolution	G			G	
Anomaly - Procedure	G				
Exceptions/Action Items From Prior Readiness Reviews	G	G	G	G	G
CIL/Hazards	G		G		
No Constraints	G	G			
Level II (Program) Actions	G	G			
Flight/Increment Planning (Mission Requirements)	G				
Exception/Resolution	G	G			
Command Procedures	G				
Contractor Process Insight		G			

G

Ready to Support Flight/Only Standard Open work

Y

Non Standard Open work with expected resolution prior to flight.

R

Open work without expected resolution without assistance, prior to flight, or unavoidable constraint violation.



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# Ascent/Entry Topics



Preliminary Launch Window Times for STS-134/ULF6

KSC Day Window Open	KSC Date	RNDZ Day	ET Photo Umbilical	ET Photo Handheld	Open (EDT)	Open (GMT)	In-Plane (GMT)	FD3 Close (GMT)	FD4 Close (GMT)
Tuesday	19-Apr	FD3	Daylight	Dark	19:43:41	23:43:41	23:48:41	23:53:41	
Wednesday	20-Apr	FD3/FD4	Daylight	Dark	19:26:22	23:26:22	23:23:00	23:28:00	23:31:12
Thursday	21-Apr	FD3	Daylight	Daylight	18:55:27	22:55:27	23:00:27	23:05:27	
Friday	22-Apr	FD4	Daylight	Daylight	18:32:58	22:32:58	22:37:58		22:42:58
Saturday	23-Apr	FD3	Daylight	Daylight	18:07:13	22:07:13	22:12:13	22:17:13	
Sunday	24-Apr	FD4	Daylight	Daylight	17:44:43	21:44:43	21:49:43		21:54:43
Monday	25-Apr	FD3	Daylight	Daylight	17:18:59	21:18:59	21:23:59	21:28:59	
Tuesday	26-Apr	FD3	Daylight	Daylight	16:56:29	20:56:29	21:01:29	21:00:16	
Wednesday	27-Apr	FD3/FD4	Daylight	Daylight	16:30:46	20:30:46	20:35:46	20:40:46	20:44:01
Thursday	28-Apr	FD3	Daylight	Daylight	16:08:15	20:08:15	20:13:15	20:16:50	
Friday	29-Apr	FD3/FD4	Daylight	Daylight	15:42:32	19:42:32	19:47:32	19:52:32	19:55:47
Saturday	30-Apr	FD3	Daylight	Daylight	15:20:00	19:20:00	19:25:00	19:30:00	
Sunday	1-May	FD3/FD4	Daylight	Daylight	14:54:18	18:54:18	18:59:18	19:04:18	19:07:32
Monday	2-May	FD3	Daylight	Daylight	14:31:47	18:31:47	18:36:47	18:41:47	

## NOTES:

- 1) Assumes 3.6 m/s ISS reboost on March 18
- 2) Flight Day 3 launch window times prior to the inplane time on Apr 20 may not be available due to small phase angle limitations
- 3) Flight Day 3 launch window close times on Apr 26 & 28 may be limited by large phase angle constraints
- 4) ET Umbilical camera flash is available and +X manuever will be performed on all days
- 5) FD3/FD4 are days where both a FD3 and a FD4 pane may be utilized to extend the launch window



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# Ascent/Entry Topics – con't



- **Boundary Layer Transition DTO**
  - 5<sup>th</sup> flight of Boundary Layer DTO
  - 1<sup>st</sup> flight of BLT DTO on Endeavour
  - Same characteristics as STS-133
    - Protuberance Height at 0.5 inches
    - Expected Boundary layer trip at Mach ~ 19.5
    - Crossrange limits avoid roll reversal during trip region (Mach ~ 19.5)
    - Additional crossrange limits calculated to avoid roll reversals prior Mach 16 to improve data gathering
  - Baselined at 6/24/10 PRCB (S062839)
- **APU Auto Shutdown Inhibit Management**
  - Hot restart failure mode could be catastrophic if APU Auto Shutdown switch positioned in Inhibit
  - Current flight rules do not account for this possibility when configuring the Auto Shutdown switch after a diagnostic restart
  - Fuel Isolation valve position may be used to diagnose hot restart failure mode
  - Annex flight rule update expected for PCN-1



# New Operations: Shuttle



- **STORRM (Sensor Test for Orion Rel-Nav Risk Mitigation)**
  - STORRM will be collecting data during rendezvous, prox ops, and docking.
  - Photographs of the STORRM targets will be captured at hatch opening and hatch closure for photogrammetry objectives.
  - The undock procedures (including flyaround) thru Sep 1 are standard like previous missions.
  - Sep 2 thru Sep 3 section of the undock procedures (including all the STORRM burns) are unique to accomplish the STORRM re-rendezvous objectives.



# New Operations: ISS



- **Express Logistics Carrier 3 (ELC 3)**
  - Installed on UCCAS-1 on FD3 and flies with the following spares: ATA, HPGT, SASA x 2, CTS with ten RPCMs, and SPDM arm
- **Alpha Magnetic Spectrometer (AMS)**
  - Installed on PAS-2 on FD4
  - AMS “FCR” team will be located in the Payload Operations Control Center (30S/3301) and will be the primary interface with ACO and MSFC POD
    - Additional AMS personnel located in BFCR and Gilruth
  - AMS team supports at JSC from launch through 3 months post-flight, then relocates to remote POCC





# New Operations: ISS (cont)



- **2B PVTCS fill**
  - 2B PVTCS has a slow ammonia leak that will eventually result in loss of 2B cooling
  - Tasks on EVA 1 and EVA 2 configure cooling systems (ETCS/EETCS/PVTCS) to fill the 2B PVTCS using ammonia from the Loop B ATA
    - EVA 1 configures jumpers and vents nitrogen; no ammonia ops on EVA 1
    - EVA 2 configures valves and QDs to execute the PVTCS fill, vents ammonia from jumpers after the fill, and stows jumpers
  - 2B PVTCS remains operational during the fill



# New Operations: ISS (cont)



- **In-Suit Light Exercise (ISLE) EVA Pre-Breathe Protocol**
  - New pre-breathe protocol that will be used for the first time on EVA 3
    - Evaluate ISLE operations and crew health post EVA 3 and determine whether ISLE will be used on EVA 4
  - ISLE protocol does not require overnight campout in the ISS airlock or CEVIS exercise and is expected to use less O<sub>2</sub> than campout or CEVIS exercise
    - 60 minute mask pre-breathe, depress Airlock to 10.2 psia
    - Perform suit donning at 10.2 psia, then standard EMU purge & repress to ISS ambient
    - New: 100 minute in-suit pre-breathe
      - 50 minutes of light in-suit exercise
        - » Trained at NBL to limit crew exertion and minimize cycling on suit
      - 50 minutes of resting (nominal) in-suit pre-breathe



# New Operations: ISS Stage Ops



- None



# Shuttle: Items of Interest



- None



# ISS: Items of Interest



- **ELC 3 Installation Contingencies**

- Nominal plan is to install ELC 3 on UCCAS-1 on FD3
- If no joy on UCCAS-1 due to mechanism failure then ELC-3 will be installed on the MCAS prior to crew sleep
  - MT would then be translated (WS7 to WS2) with ELC-3 to support nominal AMS install on FD4
- If UCCAS-1 failure is resolved via EVA or ground troubleshooting then consider ELC-3 install later in the docked mission

- **AMS Installation Contingencies**

- Nominal plan is to install AMS on PAS-2 on FD4
- If no joy on PAS-2 due to mechanism or power/data failure then AMS remains on SSRMS with survival heater applied
  - AMS installation on MCAS is not an option because MCAS cannot provide enough power to keep AMS alive
  - IF PAS issue is a power/data failure that affected capture claw or IMCA then work around failure with EVA crew and install during EVA 1
- IF PAS issue cannot be resolved via EVA or ground troubleshooting then AMS must be returned to the PLB so that the SSRMS can support OBSS H/O on FD6 followed by SPDM LEE lube on FD7



# ISS: Items of Interest



- **EVA 1**

- ISS UHF radio must be powered down for approximately 15 minutes as an inhibit during Lab EWC install
  - Conservative analysis shows a potential loss of comm with the EV crew while they are at the antenna worksite, however, ISS experience indicates continuous comm; crew and ground teams will be prepared to deal with a loss of comm if it does occur
- At the conclusion of EVA 1 the 16 ft P3/P4 jumper is temp stowed on P4 so no constraints on SARJ rotation
  - If EVA 1 is terminated or aborted early then the P3/P4 jumper may be left installed resulting in no SARJ rotation until jumper is removed



# Joint Items of Interest



- **ELC 3 must be unberthed prior to AMS:**
  - Constraint required for Orbiter center of gravity (CG) control at End of Mission (EOM) and for any time deorbit capability (program requirement)
  - If ELC3 unberth is unsuccessful, both ELC and AMS will be round-tripped:
    - Considered an accepted risk by the ISS program during mission design phase to maximize upmass capability on remaining Shuttle flights
    - Constraint documented in Annex Flight Rule (ULF6\_C2-79)
- **OBSS will be transferred and left on ISS**
  - Requirement documented in Annex Flight Rule (ULF6\_C2-11)
  - This requires a nominal docked late inspection (DLI) be performed as late as possible to buy down MMOD risk.
  - The DLI arm trajectory will be the same as flown during STS131 DLI due to the in-flight shuttle Ku-band failure.
  - The procedures have been updated from STS131 to improve some camera views for clearance purposes, but all else remains the same.



# Flight Rules



- **All required generic volume A, B, C, D, and E flight rules have been developed, reviewed, and approved by the appropriate Flight Techniques Panels, Joint Operations Panels, and the Flight Rules Control Board**
- **The following generic publications are applicable for STS-134/ISS-ULF6**
  - Volume A (STS), Final, PCN-10 dated 5/21/09
  - Volume B (ISS), Final, PCN-1 dated 2/25/11
  - Volume C (Joint), Final, PCN-5 dated 5/18/09
  - Volume D (Soyuz/Progress), Final, PCN-6, dated 5/4/09
  - Volume E (ATV), Final, Rev A, PCN-1 dated 2/8/11
- **STS-134/ISS-ULF6 flight rules annex**
  - Basic Rev-A dated 3/31/2010
  - Final, planned for JPRCB review on 3/21/11
    - 103 flight rule CRs included
  - PCN-1, planned for JPRCB review on 4/11/11
    - Expecting ~15 flight rule CRs (mission priorities, docked loads, etc)





# FDF/ODF/SODF



- **DA8 has participated in FDF/ODF/SODF processes and procedure reviews as required**
- **FDF/ODF will be ready to support STS-134/ISS-ULF6**
- **New procedures are primarily for:**
  - STORRM unique procedures
  - GNC (DAP table mods for Draper loads analysis)
  - EVA and Robotics activities
  - Assembly Ops (AMS activities, payload activities)



# Flight Director Mission Staffing



- **STS-134/ISS-ULF Flight Directors are certified per Flight Director Certification Guide (DA8-00010), Final, dated May 22, 2009**
- **Additional certified Flight Directors are available to support mission staffing, Team 4, EMCC, and STS-135/LON flight, as required**
- **MOD Work Guidelines are met**
- **Flight-specific certifications are expected to be complete by April 5, 2011**

Shuttle Flight Directors		ISS Flight Directors	
Gary Horlacher	Lead/Orbit 1	Dana Weigel	Orbit 1
Paul Dye	Orbit 2	Derek Hassmann	Lead/Orbit 2
Kwatsi Alibaruho	Planning	Dina Contella	Orbit 3
Richard Jones	Ascent		
Tony Ceccacci	Entry	Emily Nelson	Increment Lead



# Spaceflight Meteorology Group



- All forecasters required to support STS-134 meet requirements listed in SMG Training & Certification plan.
- AWIPS
  - National Weather Service (NWS) required installation of AWIPS-II workstation may occur before STS-134
  - FDOC decision on SR expected March 10<sup>th</sup>
- Moron Wx Team not able to dial in upper air balloons or surface observations
  - Problem occurred for both Nov and Feb launch attempts for STS-133
  - Moron observer sent all balloon files to SMG via e-mail for STS-133
- Moron radar data possibly intermittent
  - Monitoring Spanish Weather Service (AEMET) progress on restoring UPS for radar at Sevilla. AEMET hopes to have UPS installed prior to STS-134.

The undersigned certifies that the Spaceflight Meteorology Group is ready to support the STS-134 flight.

/s/ Frank C. Brody

Frank C. Brody

Chief, Spaceflight Meteorology Group



**Mission Operations Directorate**  
**Flight Director Office**

DA8/Nelson/Jones/Horlacher/Hassmann/Ceccacci 134/ULF6 MOD FRR 3/10/11

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# Level II Actions and Exceptions



- **Level II Actions:**            **None**
- **Exceptions:**                **None**



# Safety Open Work



- **Potential Thermal issue for High Pressure Gas Tank (HPGT) on ELC-3 (New issue ECD: TBD)**
  - Attitude restrictions being proposed



# Non-Standard Open Work



- **STS-134/ISS-ULF6 Soyuz Flyabout**
  - Supporting both programs on assessing a possible Soyuz Flyabout during the mission
  - ECD: TBD
- **STS-133/ULF5 MCC AR 107147, SYSE ERROR ON BACKUP CMD SVR**
  - SSP command server out of sync error was caused by a 17 second delay in the prime command server processing a single, two-stage, command.
  - Nominal processing of commands by the command server occurs in .4 seconds or less.
  - The command was successfully uplinked, and no other commands have been or were delayed as confirmed by a review of all STS-133 command system logs.
  - The Engineering team setup a test bed in their development environment over the weekend to attempt to recreate the issue. Engineers have also pulled STS-131 data to determine if there have been past occurrences of this issue.
  - Investigation continues. (ECD=TBD)



# Flight Readiness Statement



- Pending completion of all standard and non-standard open work, the Flight Director Office and Space Flight Meteorology Group are ready to support the STS-134/ISS-ULF6 mission and ISS-ULF6 stage
- All standard/non-standard open work will be closed out or have a closure plan prior to SSP FRR (3/31/11) with no exceptions
- ISSP SORR will be conducted on 3/24/11; closeout for non-standard open work will be reported to ISSP prior to SOMD Level 1 FRR (4/7/11)





# BACKUP





# ISS Open Hazard Reports



- **ISS-OSE-IBA-MCH-0109-AC** Inability to gain / maintain structural integrity using attachment mechanisms. (ECD 3/25/11)
- **ISS-MCH-0109-ULF6** Inability to gain/maintain structural integrity using attachment mechanisms (ECD 3/25/11)
- **ISS-COL-1002-ULF6** ISS Collision (ECD 3/25/11)
- **ISS-TCS-1210-ULF6** Over Pressurization of an External Ammonia System Component or ORU Prior to Vent Operations (ECD 3/10/11)
- **HR-EIBA-002** Inability to Gain/Maintain Structural Integrity (ECD 3/25/11)



# ISS OPEN NCRs



- **NCR-ISS-259** Lack of Fault Tolerance for Isolated Line Segments due to Leak Response (3/25/11)
- **NCR-ISS-232E** Lack of Two-fault Tolerance to EVA Crew Shock in the Low Earth Orbit Plasma Environment (3/15/11)
- **NCR-ISS-229** US Lab Integrated Acoustic Non-Compliance (3/10/11)
- **NCR-ISS-TBD** Close SRMS payload clearance with OBSS (3/25/11)



# Payload Open Hazard Reports



- **STS**
  - None
- **ISS**
  - CSI-05 Series/Reflight Assessment (ECD 3/25/11)
  - MISSE-F31, Exposure of ISS to EMI Radiation (ECD 3/11/11)
  - Robo-6-ULF6 (ECD 3/11/11)
  - VCAM-MHA-01 Maintenance Hazard (ECD 3/11/11)



# Open NASA OCADs

(as of 3/4/11)



- **OSO (7 flight, 32 stage)**
  - ELC3 Berthing\*
  - OGA Water & Pump ORU IFM
  - OGS Recirc Loop Sampling
- **EVA (~10 flight)**
  - Binding/ jamming during IBA ops\*
  - Tie-down plans\*
- **THOR/EVA (1 flight)**
  - Matrix of control for PVTCS fill\*

\* Not submitted yet



# Non-Critical Processors/Applications



- **No changes to Flight Director MCC software applications for STS-134/ISS-ULF6**



# EMCC/BCC



- **No changes to EMCC procedures from STS-133/ULF5 plan**
  - Personnel are identified to support EMCC, if required
- **Backup Control Center (BCC)**
  - BCC-HOSC is prime for BCC/BAT.
  - Facilities and personnel are readying to support.
  - March 30-31, 2010, BCC-HOSC checkout successful and included HOSC, POIC, JAXA, ESA and MCC-M
    - 2011 checkout scheduled for week of 5/23/11
  - June 7, 2010, BAT hotel checkout successful
    - 2011 checkout scheduled for week of 5/30/11



# Command Procedures



- Personnel are prepared and ready to execute the command procedures as documented per MOD Command Policy/Flight Rules



# CSCS Support/LON



- Contingency Shuttle Crew Support (CSCS) /Rescue Flight Resource Book is located at [http://mod.jsc.nasa.gov/da8/rules/CSCS\\_Rescue\\_Flight\\_Resource\\_Book/cover.htm](http://mod.jsc.nasa.gov/da8/rules/CSCS_Rescue_Flight_Resource_Book/cover.htm)
- STS-134 Ascent/Entry Team will support STS-135/LON mission
- Personnel are available to support orbit operations as required





# Remaining STS-134/ULF6 Integrated Sims



- **Ascent/Entry (as of 3/10/11)**
  - 03/16: D/O Prep
  - 03/28: Post Insertion
  - 03/29: Asc #3
  - 04/01: TCDT
  - 04/11: Ent #3
  - 04/12: Asc #4
- **Orbit**
  - 03/22: Undock/Flyaround/STORRM Re-rendezvous
- **ISS**
  - 03/21: EVA Prep Mini-Sim



# Standard Open Work



- **STS-134/ISS-ULF6 Flight Rules Annex**
  - Final: targeted for JPRCB on 3/21/11
  - PCN-1: targeted for JPRCB on 4/11/11
- **FDF/SODF**
  - Final cut-off 3/14/11
  - Final crew review 4/4/11
  - Final errata, L-1 days
- **Training**
  - Complete STS-134 Ascent/Entry simulations (L-7 days)
  - Complete Flight Director flight specific certifications (ECD 4/5/11)
- **Independent Safety Verification Review**
  - ISS ISVR Report (ECD: L-2 wk)



# Standard Open Work



- **Water transfer plan and Pressure profile**
  - Complete coordination with MCC-M (ECD L- 8 days)
- **Finalize solar array constraints and power profile plan for docked mission**
  - SACM (L-2 weeks)
  - Power Analysis (ECD L-2 weeks)
  - Longeron Shadowing Response
- **Complete “Road To” Items and Prepack**



# Shuttle Waste Management



- **Shuttle Waste Management**

- Urine/waste water dumps not allowed during mated operations
- Plan for 4 Shuttle crew members to use ISS WHC during docked mission to reduce Shuttle waste tank input and support ISS regen water processing
- Crew/Ground Plan:
  - For nominal mission do not expect to offload waste tank into CWC
  - Worst case – may require offload of waste tank into 1 CWC (due to ISS WHC/Regen ECLSS failure, etc)
  - Waste tank dump targeted for afternoon of FD13 (Undock and STORRM re-rendezvous day) followed by CWC dump (only if required)



# SMG Systems



- System Changes:
  - MIDDS
    - No releases planned for MIDDS
    - Contact GA for any detailed questions on WDS changes
  - AWIPS
    - National Weather Service (NWS) required installation of AWIPS-II workstation may occur before STS-134
    - FDOC decision on SR expected March 10<sup>th</sup>
    - No impact to operations if installation occurs either before or after STS-134
    - However, NWS requests this installation by March 31<sup>st</sup>
  - NOAAPort Weather Data Broadcast
    - Broadcast transitioning to a higher bandwidth requiring new receiver installations on both MIDDS and AWIPS by May 17<sup>th</sup>
    - FDOC wants to install MIDDS receiver prior to STS-134 hardware lockout, if new receiver arrives in time
    - NWS has not yet provided installation date for AWIPS receiver
    - No impacts expected on either MIDDS or AWIPS if new receivers installed before transition to higher bandwidth
    - Loss of weather data broadcast after May 17<sup>th</sup> if new receivers are not installed



# MORON Communications Issue



- **Moron Weather Team not able to dial in upper air balloons or surface observations**
  - Problem occurred for both Nov and Feb launch attempts for STS-133
  - Upper Air Balloon is most significant concern
    - Moron observer sent all balloon files to SMG via e-mail for STS-133. TAL forecaster then manually moved files to MIDDS via Internet for use by Winds Coordinators
    - Loss of Internet or e-mail at either Moron or SMG may result in loss of data
    - Lack of a balloon within L-4 hours may No-Go a site
  - Impact for Surface Observations considered minimal
    - Surface observations are not currently sent in via MIDDS modem
    - SMG requested that observers from all 3 TAL sites send surface observations via USAF web-based system (JAAWIN) several missions ago to mitigate poor performance of MIDDS modems
    - This method has worked very well for surface observations and SMG prefers this more reliable “backup” method
    - Loss of a surface observation will not No-Go site, but does impact ability of SMG to evaluate weather flight rules



# TAL Radar Systems Status



- **Moron radar data possibly intermittent**
  - It has happened in the past, and it may happen again. This time it's due to broken Uninterruptible Power Supply (UPS).
  - Monitoring Spanish Weather Service (AEMET) progress on restoring UPS for radar at Sevilla. AEMET hopes to have UPS installed prior to STS-134.
  - However, AEMET may bring up radar in support of STS-134 if UPS not restored by launch date. They did this for STS-133.
  - SMG would apply the same mitigation strategy for loss of radar data as in previous missions
    - Alternate radars from Rota, Spain and Portugal (available only via web) provide some coverage at Moron.
    - May impact ability to evaluate TAL precipitation flight rules and use rain shower allowance at Moron

