JACOBS SVERDRUP

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To: Laura Hood
NASA/JSC/EV711

Via: Y. C. Loh AAA for
ESCG/6WB

From: Bryan Rhodes
ESCG/6WA

Alan Chu
ESCG/6WA

Subject: STS-115 COMMUNICATION, NAVIGATION, AND TRACKING SYSTEMS COORDINATION CRITERIA FOR LAUNCH, ASCENT, AND LANDING

This report documents the Space Transportation System Flight 115 (STS-115) Communication, Navigation, and Tracking Systems coordination criteria necessary to protect these systems from harmful Radio Frequency Interference (RFI) during launch, ascent, and landing mission phases. The information contained in this is report is exempt from release outside the Federal Government in accordance with the provisions of the Freedom of Information Act, 5 U.S.C. Paragraph 552 as amended, and therefore requires special handling.

Bryan A. Rhodes
Avionic Systems Analysis Section

Alan H. Chu
Avionic Systems Analysis Section

CC: NASA
EV141/Cordelia Foster W/O Attachment
EV711/C. Sham
Q. D. Kroll

ESCG
JE22/Paul Wheat W/O Attachment
Don Cravey
6WB/Y.C. Loh
6WA/B. A. Rhodes
A. H. Chu
A. A. Adkins

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COMMUNICATIONS AND TRACKING SYSTEMS ANALYSIS TASK

STS-115 COMMUNICATION, NAVIGATION, AND TRACKING SYSTEMS COORDINATION CRITERIA FOR LAUNCH, ASCENT, AND LANDING

Engineering and Science Contract
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Prepared
By

Bryan Rhodes
ESCG

Alan Chu
ESCG

Catherine Sham
JSC/EV711

Approved
By

Y. C. Loh
ESCG

Avionics Systems Analysis
Engineering Science Contract Group

For

Systems Analysis & Verification Branch
Avionic Systems Division

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058-3696

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Backup Data
Freedom of Information Act Exempt

STS-115 Launch and Ascent Radio Frequency Protection Criteria

SYSTEM NAME	Transmit Center Frequency MHz	Protection Bandwidth (+/- center freq)	Requested Freq Range of Protection [1] MHz	Protection Window Around T0 Time (liftoff = T0)	Rationale
UHF Voice	259.7	30 kHz	259.67 - 259.73	T0-4 hours, T0+90 minutes (60 miles of launch site)	Protect for pre-launch for voice check with crew (after ingress @ ~ T0-4 hours) and for certified abort modes - RTLS and AOA
	296.8	30 kHz	296.77 - 296.83	T0-4 hours, T0+90 minutes (60 miles of launch site)	
UHF ATC (Guard)	243.0	Std ops	Std ops	N/A	Operationally required for emergency landing support. No protection required - shared frequency.
Range Safety	416.5	3 MHz	413.5 - 419.5	T0-1 hour, T0+3 minutes (60 miles of launch site)	Requirement for safety of the general population.
S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2041.9479 (primary)	10 MHz	2031.9479 - 2051.9479	T0-27 hours, T0-24 hours and T0-15 hours, T0+90 minutes (60 miles of launch site)	T0-27 to T0-24 hours for comm activation checkout with MILA . T0-15 hours prior to launch for commanding activities to vehicle for day of launch design and weather compensation. T0+90 minutes to protect RTLS and AOA abort scenarios. Starting from T0-4 hours, this is the prime link to communicate with the crew while the crew is in the vehicle.
	2106.4063 (backup)	10 MHz	2096.4063 - 2116.4063		
	2217.5 (primary)	10 MHz	2207.5 - 2227.5		
	2287.5 (backup)	10 MHz	2277.5 - 2290.0		
	2250 (FM)	10 MHz	2240.0 - 2260.0	T0-1hour, T0+30 minutes (60 miles of launch site)	Downlink of SSME data during ascent.
ET Camera (ascent video for debris detection, cut off at 15 min MET)	2272.5 (S-band)	17.5 MHz	2255.0 - 2290.0	T0, T0+15 minutes (60 miles of ground stations - MILA, PDL, JDMTA, WLP)	ET Camera used for debris observation during ascent (liftoff though latest ET separation).
TDRSS Link	2041.9479 (S-band)	20 MHz	2021.9479 - 2061.9479	T0, T0+90 minutes (60 miles of launch site)	Required after airborne, primary after 7:30 MET, 90 minutes protects for AOA.
	2106.4063 (S-band)	20 MHz	2086.4063 - 2126.4063		
	2217.5 (S-band)	10 MHz	2207.5 - 2227.5		
	2287.5 (S-band)	10 MHz	2277.5 - 2290.0		
Radar Altimeter (protect for launch coutdown) (protect for abort landing support)	Std ops	Std ops	Std ops	T0-3 hours, T0+90 minutes (60 miles of launch site, prior to liftoff) (300 nmi of landing site for abort cases)	Operationally required for Launch Commit Criteria (LCC) monitoring beginning T0-3 hours through T0+90 minutes for RTLS and AOA scenarios. Also required for landing in an abort scenario (see landing table).
SRB Tracking Radar	5690.0	10 MHz	5680.0 - 5700.0 MHz	T0, T0+10 minutes (60 miles of launch site)	Frequency deconfliction per standard procedure for radars.
	5765.0	10 MHz	5755.0 - 5775.0 MHz		

STS-115 Launch and Ascent Radio Frequency Protection Criteria

SYSTEM NAME	Transmit Center Frequency MHz	Protection Bandwidth (+/- center freq)	Requested Freq Range of Protection [1] MHz	Protection Window Around T0 Time (liftoff = T0)	Rationale
MSBLS (protect for abort landing support)	15460	Std ops	Std ops	T0+10 minutes, T0+90 minutes for abort protection. Within 60 miles of Kennedy Space Center during launch and landing and/or Edwards AFB (Dryden) CA or White Sands Space Harbor. **Protection for MSBLS CH 6 (15568 MHZ) is required for landings at Zaragoza AB and Moron AB, Spain and Le Tube, France.	Manually activited by crew for abort landing support at T0+10 minutes until T0+90 minutes for RTLS & AOA.
	15568 (ch 6)	Std ops	Std ops		
	15616 (ch 8)	Std ops	Std ops		
TACAN (protect for launch coutdown) (protect for abort landing support)	1146 (TTS59Y)	Std ops ground reply	Std ops at KSC: TTS59Y is primary. COF97 is secondary. LAL107 is secondary.	T0-3 hours, T0+90 minutes (60 miles of launch site, prior to liftoff) (300 nmi of landing site for abort cases)	Operationally required for Launch Commit Criteria (LCC) monitoring beginning T0-3 hours through T0+90 minutes for RTLS and AOA scenarios. TACAN is required at 300 nautical miles of landing site to safely navigate the orbiter to the landing site.
	1083 (TTS59Y)	Std ops airborne interrog			
	1184 (COF97)	Std ops ground reply			
	1121 (COF97)	Std ops airborne interrog			
	1194 (LAL107)	Std ops ground reply			
	1131 (LAL107)	Std ops airborne interrog			
	1198 (EDW111)	Std ops ground reply	Std ops at Edwards: EDW111 is primary. LHS21 is secondary		
	1135 (EDW111)	Std ops airborne interrog			
	982 (LHS21)	Std ops ground reply			
	1045 (LHS21)	Std ops airborne interrog			
	1082 (SNG121Y)	Std ops ground reply	Std ops at WSSH: SNG121Y is primary. HMN92 is secondary		
	1145 (SNG121Y)	Std ops airborne interrog			
	1179 (HMN92)	Std ops ground reply			
	1116 (HMN92)	Std ops airborne interrog			
GPS (protect for abort landing support)	1575.42 (L1)	15 MHz	1560.42 - 1590.42 MHz	T0-3 hours, T0+90 minutes (300 nmi of landing site)	GPS is required at 300 nautical miles of landing site to safely navigate the orbiter to the landing site for RTLS and AOA scenarios.
	1227.6 (L2)	15 MHz	1212.6 - 1242.6 MHz		
Ku-band	13775.0/15003.4	N/A	N/A	N/A	Not operationally used during launch and landing. Antenna is physically stowed.
Wing Leading Edge	916.5	N/A	N/A	N/A	Operationally used between T0 and T0+10 minutes BUT no protection required.

NOTE (1) - Center frequency of the potential "offending" system SHALL fall OUTSIDE of this requested protection range.
NOTE (2) - Ground station receiver antenna locations are in the UHF & S-band GS Location tab.

STS-115 Landing Radio Frequency Protection Criteria

SYSTEM NAME	Transmit Center Frequency MHz	Protection Bandwidth (+/- center freq)	Requested Freq Range of Protection [1] MHz	Protection Window Around L0 Time (Touch Down time = L0)	Rational
UHF Voice	259.7	30 kHz	259.67 - 259.73	L0-30 minutes, L0+4 hour (60 miles of landing site)	Post landing voice and RF links are required to support vehicle safing activities and crew egress.
	296.8	30 kHz	296.77 - 296.83		
UHF ATC (Guard)	243.0	Std ops	Std ops	Std ops	Opertionally required for emergency landing support. No protection required - shared frequency.
S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2041.9479 (primary)	10 MHz	2031.9479 - 2051.9479	L0-2 hours, L0+18 hours (60 miles of landing site)	L0-2 hours is required to protect landing site RF environment and L0+18 hours is required to support vehicle safing activities and crew egress, per Operation and Maintenance Instruction (OMI) S0028, Shuttle Landing-Post Landing Convoy Ops
	2106.4063 (backup)	10 MHz	2096.4063 - 2116.4063		
	2217.5 (primary)	10 MHz	2207.5 - 2227.5		
	2287.5 (backup)	10 MHz	2277.5 - 2290.0		
	2250 (FM)	10 MHz	2240.0 - 2260.0	L0-30 minutes, L0+1 hour (60 miles of landing site)	Post landing recorder playback and video dump.
TDRSS Link	2041.9479 (S-band)	20 MHz	2021.9479 - 2061.9479	L0-2 hours, L0+18 hours (60 miles of landing site)	L0-2 hours is required to protect landing site RF environment and L0+18 hours is required to support vehicle safing activities and crew egress, per Operation and Maintenance Instruction (OMI) S0028, Shuttle Landing-Post Landing Convoy Ops
	2106.4063 (S-band)	20 MHz	2086.4063 - 2126.4063		
	2217.5 (S-band)	10 MHz	2207.5 - 2227.5		
	2287.5 (S-band)	10 MHz	2277.5 - 2290.0		
MSBLS	15460	Std ops	Std ops	L0-10 minutes, L0. Within 60 miles of Kennedy Space Center during launch and landing and/or Edwards AFB (Dryden) CA or White Sands Space Harbor. **Protection for MSBLS CH 6 (15568 MHZ) is required for landings at Zaragoza AB and Moron AB, Spain and Le Tube, France.	System required to navigate the orbiter to the runway safely during the specified protection timeframe and protection distance.
	15568 (ch 6)	Std ops	Std ops		
	15616 (ch 8)	Std ops	Std ops		

STS-115 Landing Radio Frequency Protection Criteria

SYSTEM NAME	Transmit Center Frequency MHz	Protection Bandwidth (+/- center freq)	Requested Freq Range of Protection (1) MHz	Protection Window Around L0 Time (Touch Down time = L0)	Rational
TACAN (acq @ 140,000 ft)	1146 (TTS59Y)	Std ops ground reply	Std ops at KSC: TTS59Y is primary. COF97 is secondary. LAL107 is secondary.	L0-30 minutes, L0 (300 nmi from landing site)	TACAN is required at 300 nautical miles of the landing sites to safely navigate the Orbiter to the landing site.
	1083 (TTS59Y)	Std ops airborne interrog			
	1184 (COF97)	Std ops ground reply			
	1121 (COF97)	Std ops airborne interrog			
	1194 (LAL107)	Std ops ground reply			
	1131 (LAL107)	Std ops airborne interrog			
	1198 (EDW111)	Std ops ground reply	Std ops at Edwards: EDW111 is primary. LHS21 is secondary		
	1135 (EDW111)	Std ops airborne interrog			
	982 (LHS21)	Std ops ground reply			
	1045 (LHS21)	Std ops airborne interrog			
	1082 (SNG121Y)	Std ops ground reply	Std ops at WSSH: SNG121Y is primary. HMN92 is secondary		
	1145 (SNG121Y)	Std ops airborne interrog			
	1179 (HMN92)	Std ops ground reply			
	1116 (HMN92)	Std ops airborne interrog			
Radar Altimeter	Std ops	Std ops	Std ops	L0-5 minutes, L0 (60 miles of landing site)	System required to navigate the orbiter to the runway safely during the specified protection timeframe.
Ku Band	13775.0/15003.4	NA	NA	NA	Not operational during launch and landing. Antenna is physically stowed.
GPS	1575.42 (L1)	15 MHz	1560.42 - 1590.42 MHz	L0-30 minutes, L0 (300 nmi from landing site)	GPS is required at 300 nautical miles of landing site to safely navigate the orbiter to the landing site.
	1227.6 (L2)	15 MHz	1212.6 - 1242.6 MHz		

NOTE (1) - Center frequency of the potential "offending" system SHALL fall OUTSIDE of this requested protection range.
NOTE (2) - Ground station receiver antenna locations and runway locations are in the UHF & S-band GS Location tab.

UHF & S-Band Ground Receiver Locations

Receiver Location	Latitude (ddmmss)	Longitude (dddmmss)	Link Supported	Frequencies Supported (MHz)
KSC	283658N	0804125W	UHF ATC (Guard)	243
	283653N	0804141W	S-band Links (SSME FM)	2250 (FM)
Merritt Island	283030N	0804136W	UHF Voice	259.7
				296.8
	283030N	0804137W	S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2217.5
				2287.5
				2250 (FM)
	282128N	0804212W	ET Camera (ascent video for debris detection, cut off at 15 min MET)	2272.5 (S-band)
Wallops Island	375159N	0753018W	UHF Voice	259.7
				296.8
	375538N	0752831W	S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2217.5
				2287.5
				2250 (FM)
	375600N	0752800W	ET Camera (ascent video for debris detection, cut off at 15 min MET)	2272.5 (S-band)
PDL	290400N	0805447W	S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2217.5
				2287.5
				2250 (FM)
	290400N	0805500W	ET Camera (ascent video for debris detection, cut off at 15 min MET)	2272.5 (S-band)
JDMTA	265902N	0800631W	S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2217.5
				2287.5
				2250 (FM)
			ET Camera (ascent video for debris detection, cut off at 15 min MET)	2272.5 (S-band)
Edwards AFB	345659N	1175911W	UHF Voice	259.7
				296.8
			UHF ATC (Guard)	243.0
	345729N	1175442W	S-band Links (primary vs. backup designation to mitigate potential RFI to ET Camera at 2272.5 MHz)	2217.5
				2287.5
				2250 (FM)
White Sands	325200N	1062422W	UHF Voice	259.7
				296.8
			UHF ATC (Guard)	243.0

NOTE: Merritt Island, Wallops Island, PDL, and JDMTA are used to support KSC launch and landing

End Of Mission CONUS Landing Sites & Runways

Landing Site	Runway No	Latitude (ddmmss.ssss)	Longitude (dddmmss.ssss)
KSC	15	283757.9276N	0804221.8293W
	33	283549.3125N	0804057.6571W
Edwards	04	345345.6576N	1175407.7732W
	22	345458.6296N	1175144.73W
White Sands	17	325737.13089N	1062502.61943W
	35	325509.9373N	1062524.79680W
	23	325702.4637N	1062412.0432W
	05	325558.4845N	1062650.8351W