Goldstone High Power Radiation Control

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The airspace near Goldstone is shared by many users in carrying out their respective missions. Coordination of Goldstone High Power Transmitter Radiation activity with mutual airspace users near Goldstone is an effective method to prevent aircraft from being exposed to radiation levels greater than 10 mW/cm^2, to allow Goldstone to transmit high power levels for Planetary Radar experiments and to provide the necessary information to both civil and military aircraft users to enable them to perform their necessary activities.

I. Introduction

The Goldstone Deep Space Communications Complex (GDSCC), the Department of Defense (DOD), and the Federal Aviation Administration (FAA) use the airspace near Goldstone to carry out their respective missions. Whenever Goldstone activates high power emitters the airspace near the antenna beam could be hazardous to air operations. To prevent aircraft from being exposed to levels of radiation greater than 10 mW/cm^2 Goldstone has two choices: operate in conjunction with a local surveillance radar to detect aircraft within the proximity of the transmitted beam or operate within a set of parameters mutually acceptable to airspace users. Goldstone has elected the latter of the two choices. The intent of this article is to provide information regarding the internal high power radiation policies, high power radiation constraints, agreements with external agencies, and the actions required to fulfill high power radiation agreements.

II. Internal High Power Radiation Policies

The following policies are adhered to by all high power transmitter users. Any changes to these policies must be approved by the Goldstone Radio Spectrum Coordinator and the JPL Operations Support Group (OSG).

A. Long Range Scheduling Information

The Mission Coordination Group shall provide an annual prediction of radio astronomy and special activities to the OSG and the Goldstone Radio Spectrum Coordinator for planning and coordination of high power emissions. These predictions should include any object which may be desired to be tracked, and the date, time, power and band of emission.

B. Midrange Scheduling Information

The OSG shall enter a 12-week advance high power transmitter projection into the Univac 1100/81F data base on a weekly basis. This projection will include the year, week, day of year, calibration information, power of emission, and the source that will be tracked. The Goldstone Radio Spectrum Coordinator will query the data base (Fig. 1) each week to update the Goldstone schedule (Fig. 2).

C. Published 7-Day Schedule

The OSG shall notify the Goldstone Radio Spectrum Coordinator of any scheduled radiation greater than 20 kW

originating from the GDSCC. The OSG shall transmit, via teletype (Fig. 3) by Tuesday, the high power radiation schedule for the following week. This message will include the project, Deep Space Station (DSS) number, power and band of emission, the day of year, track times in 30-minute intervals, azimuth, elevation, declination, and the zenith crossing time.

D. Real-Time High Power Activation (Spacecraft Emergency)

Any high power activity (100 kW or greater) not appearing in the published 7-day schedule will be handled in real-time. The Goldstone Radio Spectrum Coordinator will take appropriate action during normal working hours. Outside normal working hours the OSG is responsible for informing the Federal Aviation Administration (Los Angeles Center) and the Edwards AFB Radar Approach Control (RAPCON) of any emergency high power radiation. After proper notification the JPL Network Operations Chief (NOC) may authorize the station to radiate at high power. This is not a standard mode of operation – it applies to spacecraft emergency only.

E. Real-Time High Power Termination

In the event of an air emergency or personnel emergency in or adjacent to Goldstone the DSN may be requested to terminate any high power radiation (100 kW or greater). During normal working hours the Goldstone Radio Spectrum Coordinator will make the decision to terminate any high power emission. After normal working hours the OSG will make this decision according to the inputs received. These inputs may come from the DSN stations, RAPCON, CCF, FAA, or local land and airspace users.

III. High Power Radiation Constraints

The majority of the DSN high power targets are within a specific tracking window. The following constraints were approved by the DSN, DOD, and FAA after examining our normal tracking targets. These constraints apply to all high power emissions of 100 kW or greater.

A. Elevation Restriction

There will be no high power emission below 15 degrees elevation.

B. Declination Restrictions

All high power emissions shall fall between ±25 degrees declination.

C. Minimum Time Notifications

There will be a minimum of one week notification on high power emissions, except for maintenance at zenith. If high power transmitter usage exceeds 2 days of any week a minimum of 3 weeks notification is required.

D. Exceptions

Any exceptions to the restrictions in pointing angles or notification will be handled by the Goldstone Radio Spectrum Coordinator on a case-by-case basis. Additional external coordination may be required to determine if the activity will impact local airspace users.

IV. Agreements With External Agencies

Goldstone has agreed to minimize airspace usage by managing the GDSCC high power radiation program. GDSCC provides sector information to the Central Coordinating Facility (CCF) at Edwards AFB for dissemination to other agencies.

A. Annual and Semiannual Projection of High Power

GDSCC and the R2508 Complex Control Board members review the long range schedule to ensure compatibility with their scheduled activities. To date, this action has not caused any cancellations of DSN high power transmissions, and it has created a spirit of cooperation.

B. Advance Notification of High Power Emissions

GDSCC must provide a minimum of three working days notification to the CCF and Fort Irwin. Subsequent to this, CCF will notify FAA (Los Angeles Center) when the restricted areas are closed or when the Goldstone VFR Avoidance Zone is activated. CCF will also notify all military airspace users, with the exception of Fort Irwin, of the avoidance sectors. Goldstone will notify the Fort Irwin Frequency Manager of Goldstone High Power Activation. The NTC Frequency Manager will notify NTC air operations for the safety of NTC small, fixed-wing aircraft and helicopters.

C. CCF Notification Responsibility

The CCF is responsible for notifying all users of the R-2508 including the FAA Los Angeles Center of all Goldstone high power radiation. Normally CCF will provide specific avoidance sectors to the military sponsors and will retain control of restricted areas to simplify general aviation avoidance. A 12-nautical-mile VFR avoidance zone centered at DSS 14 will be in effect whenever Goldstone is radiating high power.

V. Specific Actions Required to Fulfill High Power Agreements

The Goldstone Radio Spectrum Office is responsible for policing the Goldstone High Power Radiation Control program and taking the necessary action to fulfill the written or verbal agreements with external agencies. To assist in this activity a computer program has been developed for the 9825A calculator which inputs the date, day of year, planet/mission, declination, emission power, band, start time of track, stop time of track, and the zenith crossing time. Figure 1 shows a sample computer printout depicting the input data, the NASA Goldstone High Power Avoidance Zones, the action required by the Radio Spectrum Office, the station authorization, and the required distribution. In the event the transmitter on/off times are not above the 15-degree elevation point a caution would be printed to alert the Goldstone Operations Supervisor.

A. External Notification

After providing a Goldstone high power printout, the Avoidance Zone information is transferred to a map (Fig. 4) which depicts the transmitted beam avoidance zones and the time the beam remains in each sector. This information is then passed to the Central Coordinating Facility at Edwards AFB, and to the Spectrum Management Office at Fort Irwin.

B. Internal Notification

After external notification is accomplished it is necessary to issue a signed authorization to transmit. This authorization is specific as to power and band of transmission, the JPL scheduling message authorizing the transmission, restrictions or exceptions, the Spectrum Coordinator's signature, and the date authorized (Fig. 5).

VI. Summary

From the implementation of this High Power Radiation Control program in January 1980, until August 1981, there have been a total of 78 high power transmitter operations. All of these were conducted successfully by advance coordination with the military and the FAA.

The Goldstone High Power Radiation Control program has been operating smoothly and has proved that coordination is preferable to an aircraft tracking radar system. The military organizations have upheld their end of the agreement, and Goldstone has policed internal policies to prevent any conflicts between organizations. As long as this spirit of cooperation continues the Goldstone High Power Radiation Control program will be a success.

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HIGH POWER TRANSMISSION SCHEDULE
FOR WEEKS 23 THRU 42
06/03/81

YEAR	WEEK	DOY	TIME	CAL	POWER		SOURCE
81	23	158	1335-0145	D A	X-BAND 400KW		MERCURY
81	24	161	1515-0245	D A	X-BAND 400KW		MERCURY
81	24	165	1245-1815	D A	S-BAND 400KW	(BISTATIC)	MERCURY
81	25	169	1230-2210	C A	X-BAND 400KW		MERCURY
81	25	171	1220-0055	D A	S-BAND 400KW	(BISTATIC)	MERCURY
81	26	174	1710-0145	D A	X-BAND 400KW		MERCURY
81	27	182	1740-0110	D A	S-BAND 400KW	(BISTATIC)	MERCURY
81	28	189	1100-1730	D A	X-BAND 400KW		MERCURY
81	28	190	1640-0040	D A	X-BAND 400KW		MERCURY
81	29	198	1645-0015	D A	X-BAND 400KW		MERCURY
81	30	207	1545-2345	D A	X-BAND 400KW		MERCURY
81	31	NOTHING SCHEDULED					
81	32	NOTHING SCHEDULED					
81	33	NOTHING SCHEDULED					
81	34	NOTHING SCHEDULED					
81	35	NOTHING SCHEDULED					
81	36	NOTHING SCHEDULED					
81	37	NOTHING SCHEDULED					
81	38	NOTHING SCHEDULED					
81	39	NOTHING SCHEDULED					
81	40	NOTHING SCHEDULED					

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END OF REPORT

Fig. 1. High power transmission schedule

1981 DUAL, BI, and TRI-STATIC High Power Transmitter Projection

DATE	DOY	TIME (Z)	BAND /PWR	MISSION /PLANET	ZENITH TIME (Z)	15 DEGREE RISE	15 DEGREE SET	DEC ANGLE
Mar 02	061	0800-1305	X200	SATURN	0940	0500	1430	001
Mar 07	066	0900-1330	X200	SATURN	0920	0434	1408	001
Mar 09	068	0630-1100	X400	SATURN	0912	0426	1400	001
Mar 14	073	0630-1100	X200	SATURN	0851	0404	1339	001
Mar 20	079	0755-1225	X200	SATURN	0826	0339	1314	000
Apr 07	097	0525-1245	X200	SATURN	0710	0221	1200	000
Apr 16	106	0205-1145	X400	Mon-St JUP	0633	0150	1125	000
Apr 27	117	0000-1030	X400	Mon-St JUP C	0543	0056	1038	001
Apr 28	119	0000-1030	X400	Mon-St JUP C	0540	0048	1030	001
Apr 30	120	2250-1030	X400	Mon-St JUP E	0540	0043	1026	001
May 17	137	1715-0300	X400	Mon-St MERC	2115	1515	0310	025
May 28	148	1615-0310	X400	Mon-St MERC	2120	1530	0315	024
Jun 07	158	1335-0145	X400	Mon-St MERC	2100	1515	0205	023
Jun 10	161	1515-0245	X400	Mon-St MERC	2055	1510	0245	022
Jun 14	165	1245-1815	S400	Bi-St MERC	2027	1450	0215	021
Jun 18	169	1220-2210	X400	Mon-St MERC	2000	1420	0145	020
Jun 20	171	1220-2250	S400	Bi-St MERC	2000	1420	0145	020
Jun 23	174	1710-0145	X400	Mon-St MERC	1945	1400	0115	020
Jul 01	182	1740-0110	S400	Bi-St MERC	1900	1325	0040	019
Jul 08	189	1100-1730	S400	Mon-St MERC	1840	1300	0020	019
Jul 09	190	1640-0040	X400	Mon-St MERC	1815	1245	0010	020
Jul 17	198	1645-0015	X400	Mon-St MERC	1758	1218	2338	021
Jul 26	207	1545-2345	X400	Mon-St MERC	1720	1145	2300	022
Sep 20	263	1700-0135	X400	Mon-St MERC	2115	1700	0135	349
Sep 30	273	1710-0100	X400	Mon-St MERC	2115	1710	0100	345
Oct 30	303	1400-2250	X400	Mon-St MERC	1825	1400	2250	354

Fig. 2. 1981 high power transmitter projections

GJG038A
RR JGLD JGTS JOCC
DE JJPL 042A
07/2055Z
FM DSN SCHEDULING
TO JGLD/GOLDSTONE RADIO SPECTRUM COORDINATOR
INFO JGLD/E JACKSON/GOLDSTONE RFI COORD R CUSHMAN
JGTS/STADIR/STAOPS
JOCC/NOC
DLD/D ENARI/G M REED/J R HALL/J NASH/R SATTERLEE/R DURHAM/N LACY/
M HALAL/L LAPRADE

SUBJECT: DEEP SPACE NETWORK RADIATION SCHEDULE FOR GOLDSTONE DURING
WEEK 29, DATES: 13 JULY - 19 JULY 81
PROJECT: MERCURY RADAR MAPPING DSS 14 RADIATING AT 400 KW,
IN X-BAND

D.O.Y.	G.M.T.	AZ	EL	DEC
198	1645	0	90	
	1745	0	90	
	1845	198.5	75.5	21.39
	1915	221.3	72.4	
	1945	236.8	67.8	
	2015	247.3	62.3	
	2045	255.0	56.5	
	2115	261.0	50.6	
	2145	266.1	44.5	
	2215	270.6	38.4	
	2245	274.7	32.2	
	2315	278.6	26.2	
	2345	282.5	20.2	21.43
	0015	0	90	

07/2102Z JUL 81 JJPL

Fig. 3. Goldstone weekly radiation schedule

DATE	TIME (Z)	A SECTOR					B SECTOR					C SECTOR	D SECTOR
		W1W2*	NW	NE	SE	SW	NW	NE	SE	SW	E1E2*		
							000-400	000-400			200-400		
							000-400	200-400					
							000-400		300-400	400-500			
7/17/81	1845-2128			000-400	400-500	400-500	000-400						
7/17/81	2128-2238		200-400	000-400			000-200						
7/17/81	2238-2338	200-400	000-400	000-200			000-200						

*NOTE: W1W2 IS AN EXTENSION OF A SECTOR AND E1E2 IS AN EXTENSION OF B SECTOR

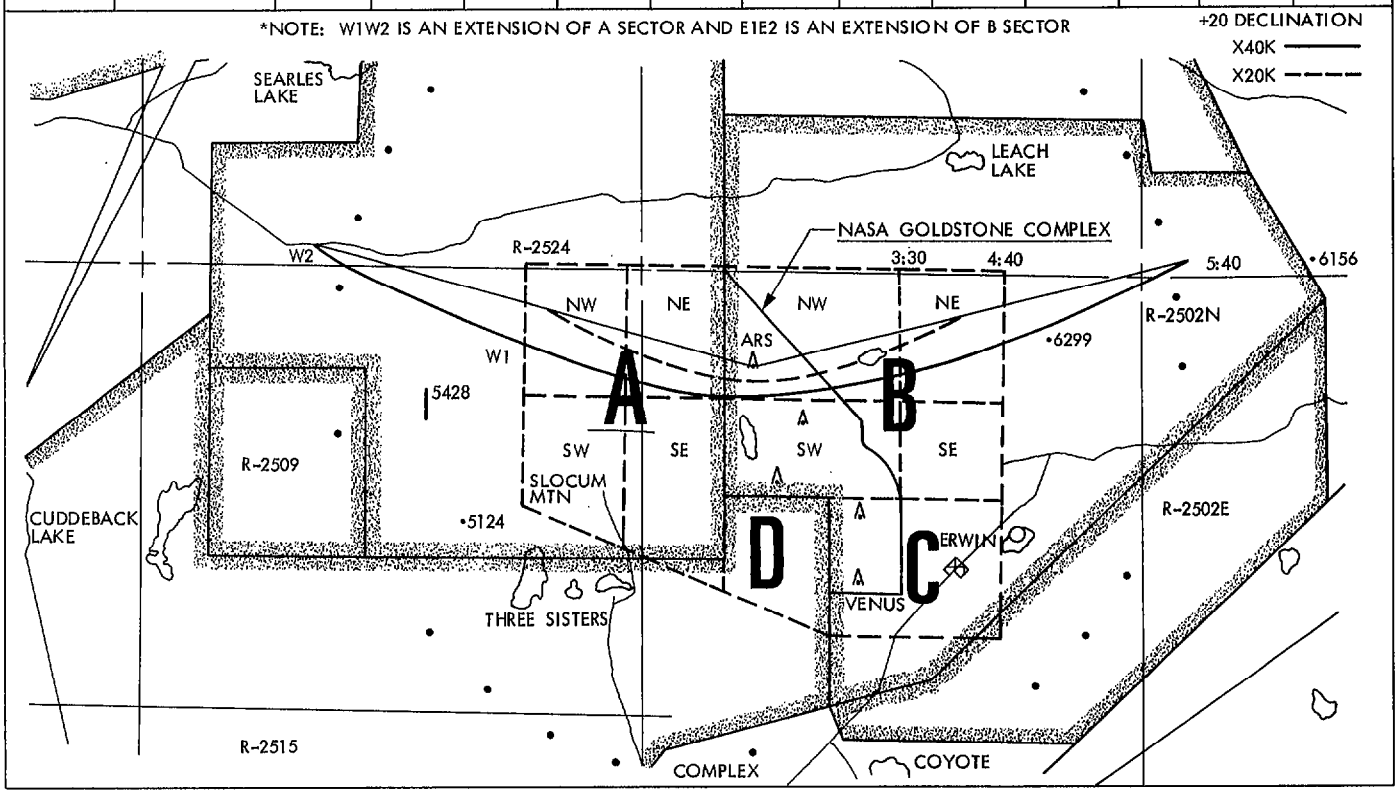

Fig. 4. Goldstone high power avoidance zone

GOLDSTONE HIGH POWER TRANSMISSION AUTHORIZATION

Date	Day	Planet/ Mission	Dec.	Pwr/ Band	Start Time GMT	Stop Time GMT	Zenith Crossing
7/17/81	198	Mercury	20	400X	18:45	23:45	17:58

NASA GOLDSTONE HIGH POWER AVOIDANCE ZONES

			A Sector					B Sector					C	D
	DATE.		W1W2	NW	NE	SE	SW	NW	NE	SE	SW	E1E2	Sec	Sec
(4)	7/17/81	18:45-21:28			0-4			0-4						
(5)	7/17/81	21:28-22:38		2-4	0-4			0-2						
(6)	7/17/81	22:38-23:38	2-4	0-4	0-4			0-2						

*** ACTION ***

(A) Notify CCF of High Power Avoidance Zones.
(B) Notify Ft. Irwin of High Power Avoidance Zones.
(C) Issue STATION AUTHORIZATION to transmit.

STATION AUTHORIZATION GRANTED FOR - 400KW X-BAND
PER JJPL 042A DTG 07/2055Z JUL 81

Signature Date

CAUTION: Transmitter on/off times are not within the 15 degree tracking window. The transmitter may be tested at zenith during the following times:
(b) 7/17/81 23:38-23:45

cc: R. Blanchard
L. Butcher
R. Kelley

Fig. 5. Goldstone high power transmission authority