

# **HARMONIZATION: THE WESTERN RANGE, ITS USERS, AND START**

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## **ABSTRACT**

The Strategic Arms Reduction Treaty (START) introduces an important new element into the Mission planning and operation processes of the Western Range and its users. In the past, safe and successful completion of a ballistic or space operation was the primary mission of the Range. Under START, the Western Range has the added responsibility of playing a major role in the verification process necessary for a safe reduction of the world's ballistic nuclear weapons. This paper describes the impact of the Treaty on both the Western Range and its users while outlining how the Range has adapted to meet the challenges introduced by the Treaty.

## **KEYWORDS**

Arms Control, Range Operations, START, Telemetry

## **INTRODUCTION**

The United States Air Force (USAF) faced with the challenges of implementing and complying with the provisions of the START Treaty completed a series of dry runs and procedural analyses that resulted in the compilation of a START Telemetry (TM) Compliance plan. This plan outlines the procedures and checks required to ensure the Air Force fully complies with all telemetry aspects of the Treaty. This paper follows the Treaty compliance and implementation process for a typical START-accountable launch from Vandenberg Air Force Base. The process is described from Range program introduction through delivery of the end data products to the Former Soviet Union (FSU).

## **PROGRAM INTRODUCTION**

A Range START Telemetry Office (STO) was created to work with the Air Staff to help ensure all Air Force telemetry obligations under the Treaty are fulfilled. The Range STO serves as a central clearinghouse for Treaty TM information and deliverables for each flight. The Range STO reviews all START TM deliverables and notifications for proper form and technical content.

The Range STO works interactively with a Missile Program Office (MPO) from Program introduction to months beyond the flight to ensure all telemetry notifications, demonstrations, and products are properly made and on schedule. The MPO must provide a point of contact (POC) for START telemetry issues, at least one year prior to flight, to work with the Range. This POC must have the resources and authority available to ensure all MPO Treaty telemetry obligations will be satisfied.

## **MISSION PLANNING**

The Range works interactively with the MPOs to develop the operational plan for a particular mission. The Range inputs to the operational plan weigh safety, cost, and schedule against the support required to meet Mission objectives and Range services required to meet Program objectives. The Range STO ensures all START telemetry requirements are properly documented in the Universal Documentation System (UDS). The UDS is a series of itemized requirement listings used by Ranges to ensure all Mission requirements are identified, understood, and completed.

The Air Force must record all telemetry broadcast during flight to satisfy START requirements. Therefore, some flights will have TM and Metric coverage in addition to that required by Range Safety and the MPO. The USAF must provide three chief products for each flight: an acceleration profile, interpretive data for the booster and post boost vehicle (PBV), and a complete set of telemetry tapes. In addition to these products, several notifications and a demonstration of any new equipment needed to playback the provided telemetry tapes are required.

## **PREFLIGHT INFORMATION FLOW, COORDINATIONS, AND DEMONSTRATIONS**

The USAF START TM Compliance Plan was written to ensure all Air Force launches are fully compliant with the TM aspects of the Treaty. The checks and

balances developed as the result of over 18 months of planning and dry runs are comprehensive, logical, and straight forward.

The Range STO evaluates Mission and Program TM requirements for START and Range impacts. The Range STO, working in conjunction with Air Staff and the MPO, verifies all preflight coordinations and demonstrations have occurred and preparations to satisfy all flight and post flight requirements are in place. When faced with a new or unique requirement, the Range STO provides technical recommendations to Air Staff and the MPO. Air Staff will provide managerial guidance and Treaty interpretation, as needed. The process and schedule used by the USAF to ensure compliance are expanded on in the Scheduled Actions section of this paper.

## **THE LAUNCH**

The Range will obtain and provide all the Mission requirements to include those required by START and Safety. TM and Metric data, previously planned in the UDS, will be received and recorded for the duration of the Mission. For the vast majority of flights, Range sensor reliability and redundancy will be able to provide complete coverage from launch to splashdown. In the unlikely event of a last minute collection site failure that may cause a gap in coverage, the flight will not be postponed for START. Any resulting periods of missing or inferior quality TM recordings will be annotated on the appropriate tape summary in accordance with the Telemetry Protocol of the Treaty.

## **TAPE COLLECTION, DATA PRODUCTION, AND ANALYSIS**

The data production processes needed for START TM compliance begin as soon as a flight ends. A large number of data items must be produced, quality controlled, and delivered. A major task is gathering a copy of all telemetry tapes made during a flight. Some flights will require the collection of as many as fifty tapes. For a typical flight this involves several weeks as tapes must be delivered not only from nearby Vandenberg and Pillar Point Telemetry Receiving Stations located in California but also from sites located in Hawaii and the South Pacific's Marshall Islands.

After delivery to Vandenberg, the quality of all tapes made during the flight are thoroughly analyzed to determine: signal to noise ratios, bit error rates, and periods of inferior quality or missing recordings. All tapes recorded must be examined before a decision can be made which tracks represent the best recording of a link at each site. The best tracks are then copied to new tapes. When none of the tracks made during a flight contain a usable recording of a

link for a period of time, that period of time is identified and an explanation is provided on the appropriate START tape summary. The START tape summary required for each delivered tape also includes a variety of additional information about the telemetry links and their associated recordings. Illustrative tape summaries for predetection and video tapes are included on pages A-1 and A-2, respectively.

Data required to generate a tabular acceleration profile is extracted from the booster/PBV TM and Metric data tapes as they become available. The primary purpose of the acceleration profile is to roughly characterize booster performance to facilitate detection of the use of new or changed boosters. Page A-3 contains an illustrative tabular acceleration profile in the START format. The profile is provided at 5 samples per second, to a 0.05 meter per second resolution, and in an Earth Centered Inertial (ECI) coordinate frame. The Treaty requires no correlation between this tabular acceleration profile and the profile the FSU may create using information in the Interpretive Data though a rough check of accuracy is possible by comparing magnitudes of the accelerations at any given time.

## **DATA DELIVERY AND FOLLOW ON SUPPORT**

Due to their extreme importance, all Treaty required data products would be examined by and coordinated with the Range's START Telemetry Office and the Air Staff prior to delivery to the State Department. The data products must be delivered to the FSU within fifty days after a launch.

Many questions from the FSU concerning the deliverables and their format are anticipated. Prior to Treaty Entry Into Force (EIF) much discussion concerning the products occurred. Illustrative examples and demonstrations between the sides answered many of the initial technical questions but potential problems remain. After EIF, when both sides take delivery of products containing actual data, the products will not only be compared to that anticipated but will also be subject to validity checks by in-depth engineering analyses and National Technical Means (NTM).

## **SCHEDULED ACTIONS**

The following is a summary of the timetable of events that the Air Force will use to ensure full compliance with all telemetry aspects of the Treaty.

<b><u>Deadline</u></b>	<b><u>Action</u></b>
before occurrence	MPO receives approval from HQ USAF/XOXI prior to transfer of any USAF START-accountable boosters to another government or private agency.
1 year prior to flight	MPO provides Range a START TM POC
1 year prior to flight	Range provides 1 year schedule of launches to HQ USAF/XOXI. Schedule includes any intentions for encryption and/or encapsulation.
1 Year prior to flight	Range/MPO notifies HQ USAF/XOXI if any anticipated recordings will require new playback equipment.
180 days prior to flight prior	MPO coordinates with HQ USAF/XOXI to use of encapsulated TM recordings.
90 days prior to flight	Range reviews TDD and provides acceptability statements to HQ USAF /XOXI.
75 days prior to flight	Range/POC notifies HQ USAF/XOXI if using a new TM recording format.
30 days prior to flight	Range or MPO provides a demonstration to the FSU if any new equipment is required to playback delivered TM tapes.
30 days prior to flight	Range provides an outline of planned TM coverage to HQ USAF/XOXI. Coverage for all TM broadcast must be planned.

30 days prior to flight	MPO provides a complete list of all TM recordings it will make during flight to the Range.
5 days prior to flight	MPO provides a complete list of all TM broadcast frequencies, modulation types, and a whether any encryption and/or encapsulation will be used during the flight to the Range.
5 days prior to flight	MPO provides the Range and HQ USAF/XOXI a written notification that states all preflight START TM compliance requirements have been fully satisfied and provisions have been made to ensure all MPO START telemetry responsibilities will be met.
24 Hours prior to flight	Range sends flight notification to HQ USAF/XOXI that contains all TM broadcast frequencies, modulation types, and whether the flight includes encryption and/or encapsulation .
24 Hours prior to flight	Nuclear Risk Reduction Center (NRRC) in Washington D.C. sends to the Russian NRRC a launch notification which also contains all TM broadcast frequencies, modulation types, and whether the flight includes encryption and/or encapsulation.
during flight	Range/MPO record all TM broadcast.
1 - 15 days after flight	Recording sites deliver TM tapes to Range.

1 -39 days after flight	Range/MPO produce and review START deliverables.
40 days after flight	Range delivers of all START products to HQ USAF/XOXI.
40-49 days after flight	Washington reviews START deliverables.
50 days after flight	Washington delivers START products to FSU.
50 + days after flight	Range/MPO provide ongoing production and technical support to respond to any questions raised by FSU concerning delivered products.

## **CONCLUSION**

START has changed the nature of the United State's missile and space program at the Western Range. The Air Force's START Telemetry program is playing a major role in fostering trust, confidence, and facilitating a verification regime between the United States and the Former Soviet Union, permitting a safe and verifiable reduction of both side's nuclear arsenals.

### **Illustrative START Predetection Tape Summary**

1. **Missile:** Minuteman III, W1234
2. **Date of Flight:** 25 Jun 1999
3. **Tape Number:** 1 of 8
4. **Recorder Type:** Metrum 97 compatible
5. **Recording Speed:** 120 ips
6. **Track Information:**

<b>Track</b>	<b>1 =</b>	Blank
<b>Track</b>	<b>2 =</b>	Site A
<b>Track</b>	<b>3 =</b>	Site A - Timing (IRIG A)
<b>Track</b>	<b>4 =</b>	Blank
<b>Track</b>	<b>5 =</b>	Site B
<b>Track</b>	<b>6 =</b>	Site B - Timing (IRIG A)
<b>Track</b>	<b>7 =</b>	Tape Servo
<b>Track</b>	<b>8 =</b>	Blank
<b>Track</b>	<b>9 =</b>	Site C
<b>Track</b>	<b>10 =</b>	Site C - Timing (IRIG B)

Track 11 = Blank  
Track 12 = Blank  
Track 13 = Blank  
Track 14 = Blank

7. Record Period: 23:30.2 - 23:42.8 UTC
8. Record Mode: Direct
9. Broadcast Frequency: 2205.5 MHz
10. Encoding Method: N/A
11. Recording Format: N/A
12. Explanations of Periods of No or Poor Quality Recordings: N/A

### Illustrative START Video Tape Summary

1. Missile: Minuteman III, W1234
2. Date of Flight: 25 Jun 1996
3. Tape Number: 8 of 8
4. Recorder Type: Super VHS
5. Recording Speed: SP
6. Track Information:

Track 1 (Left Audio)	= Site D - Timing (IRIG B)
Track 2 (Right Audio)	= Site D - Timing (IRIG B)
Track 3 (Video)	= Site D
Track 4 (Left Hi-Fi Audio)	= Blank
Track 5 (Right Hi-Fi Audio)	= Blank
Track 6 (Control Track)	= Tape Servo

7. Record Period: 23:31.8 - 23:36.6 (UTC)
8. Record Mode: Super VHS/SP
9. Broadcast Frequency: 2275.5 MHz
10. Encoding Method: N/A
11. Recording Format: Super VHS
12. Explanations of Periods of No or Poor Quality Recordings: N/A

### Illustrative START Acceleration Profile

1. Missile: Minuteman III, W1234
2. Date of Flight: 25 Jun 1996
3. Profile Duration: 23:30.2 - 23:36.2
4. Profile Type: Sensed
5. Coordinate System: Earth Centered Inertial
6. Units of Acceleration: Meters/Second/Second



## 7. Profile:

<u>T Plus Time (sec)</u>	<u>EC1</u>	<u>EC2</u>	<u>EC3</u>
0.0	1.45	2.60	3.65
0.2	1.60	4.15	5.30
0.4	1.45	3.85	7.20
0.6	1.50	2.60	8.95
0.8	1.55	2.20	9.10
1.0	1.45	1.80	10.25
1.2	1.35	1.25	11.75
1.4	1.25	1.10	12.10
1.6	1.10	0.75	13.25
1.8	1.05	0.50	14.10
2.0	1.10	0.25	14.50
2.2	1.20	0.10	14.60
2.4	1.15	-0.15	15.05
2.6	1.25	-0.25	15.45
2.8	1.30	-0.35	15.75
3.0	1.35	-0.45	16.00
3.2	1.45	-0.55	16.05
3.4	1.35	-0.65	16.05
3.6	1.40	-0.65	15.45
3.8	1.50	-0.50	14.75
4.0	1.65	-0.20	14.05
4.2	1.60	0.15	12.35
4.4	1.55	0.15	10.75
4.6	1.55	0.10	9.80
4.8	1.50	0.05	9.55
5.0	1.45	0.00	9.10
5.2	1.40	-0.05	8.65
5.4	1.45	0.00	8.45
5.6	1.40	0.05	8.50
5.8	1.40	0.10	8.40
6.0	1.40	0.00	8.45