DOCKET NO. **SA- 516**

EXHIBIT NO. **13E**

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C

STUDY OF RADAR DATA FROM UNITED STATES AIR FORCE'S 84TH RADAR EVALUATION SQUADRON

(19 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, DC

June 22, 2000

Study of Radar Data from United States Air Force's 84th Radar Evaluation Squadron

Specialist's Report of Investigation
by John E. Schade

DCA96MA070

A. ACCIDENT

Location	:	East Moriches, NY
Date	:	07/17/96
Time	:	2031 local standard time
Aircraft	:	B747-131, N93119

B. GROUP

Not Applicable

C. SUMMARY

On July 17, 1996, about 2031 eastern daylight time, a Boeing 747-131, N93119, operated as Trans World Airlines Flight 800 (TWA800), crashed into the Atlantic Ocean, about 8 miles south of East Moriches, New York, after taking off from John F. Kennedy International Airport (JFK), Jamaica, New York. All 230 people aboard the airplane were killed. The airplane, which was operated under Title 14 Code of Federal Regulations (CFR) Part 121, was bound for Charles De Gaulle International Airport (CDG), Paris France.

D. DETAILS OF INVESTIGATION

Air Route Surveillance Radars (ARSRs) are long range (250 NM) radars used to track aircraft cruising between terminal airspaces. ARSR antennas rotate at 5 to 6 revolutions per minute (RPM), resulting in a radar return every 10 to 12 seconds. A block of airspace may be covered by more than one ARSR antenna, and data from these antennas are fed to an FAA central computer where the returns are sorted and the data converted to latitude, longitude, and altitude information. Along the

perimeter of the United States, ARSRs used by the FAA to provide air traffic control services are also used by the United States Air Force (USAF) for air sovereignty mission purposes. The USAF 84th Radar Evaluation Squadron (84 RADES) monitors the returns from these ARSRs and records the raw data generated by each. RADES uses its own software to compile and interpret the returns.

In the days immediately following the accident, recorded radar data from 84 RADES[1] were sent to the National Transportation Safety Board (NTSB) for review. Initial review of 84 RADES radar data indicated they were essentially identical to the FAA radar data. However, in November of 1999 Safety Board staff became aware of additional altitude data that had not been previously evaluated. In addition to the primary/secondary/reinforced[2] formats recorded by the FAA, the RADES system also has the capability to estimate the altitude of primary targets with a certain degree of accuracy. This capability is only available from antennas that have been specially modified for this purpose. According to 84 RADES staff, at the time of the TWA800 accident, the radar antenna at North Truro, Massachusetts (NOR), was equipped to estimate the altitude of primary targets. NOR was the only radar facility within range of TWA800 that had altitude sensing capability for primaries. All of the radar data presented in this report are from the NOR radar facility.

The published[3] root-mean square accuracy of the height estimated by the radar system is +/- 3000 feet. However, the error can increase significantly when the range of the radar target increases beyond 100 nautical miles. As indicated in attachment I-1, the closest range of the radar returns presented in this report is 136 miles, and so the mean error of the height estimates probably exceeds the published 3000-foot value. In addition, the radar system is sometimes unable to estimate an altitude from a primary return signal, even though the range and azimuth of the return are determined. In these cases, the system will report an altitude value of 102,000 feet, which serves as a flag to indicate that no valid altitude estimate exists for that return.

According to 84 RADES, at the time of the accident the height estimations of higher targets (i.e. 20,000 feet and above) were more accurate than the height estimations of targets near the altitude of TWA800 (i.e. approximately 14,000 feet). This can be verified by observing the Navy P-3 track line, which has consistent radar

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[1] Refer to Exhibit 13A, Airplane Performance Study, for additional evaluation of the radar data available in this case. Radar data compiled by 84 RADES are identified as "NORAD data" in Exhibit 13A.

[2] A "primary" only target is received as a reflection of radar energy only. A "secondary" only target is recorded as a response of the aircraft's transponder to interrogation by the radar system. A "reinforced" target is recorded by the radar system in lieu of a primary or secondary target when transponder information is coincident with and reinforces a reflection of radar energy. Generally, secondary and reinforced returns are referred to as "secondary" targets.

[3] Both the FAA and 84 RADES have documented the capabilities of the radar sensing antennas in their respective technical manuals.

sensed altitude measurements near 20,000 feet. In contrast, the TWA800 radar sensed altitude is much more erratic and contains many more 102000 values.

Attachments I-1 and 2 contain tables of radar returns recorded by the NOR antenna site and processed by 84 RADES.

Attachment I-1 provides primary returns in the vicinity of TWA800 before the explosion occurred. The returns in attachment I-1 include all primary returns within 10 nautical miles of the TWA800 track line (excluding those that have been associated by the radar system with a secondary target) up until the time of the last secondary return from TWA800. These primary returns may be associated with other aircraft or surface vehicles, may be false returns, or may be the result of other circumstances as described in Exhibit 13A.

Attachment I-2 provides primary returns in the vicinity of TWA800 after the explosion, along with the secondary returns for TWA800 recorded by the NOR antenna. The primary returns in attachment I-2 encompass a time frame beginning after the last secondary return and lasting approximately three minutes. All primaries in the vicinity within the timeframe are included, except those associated with the Navy P-3 aircraft. The primary returns in attachment I-2 are consistent with the breakup of TWA800 and could not be associated with any other aircraft. Attachments I-3 and I-4 contain tables of the radar returns in North/East coordinates that correspond to the range/azimuth and latitude/longitude data tables in attachments I-1 and I-2, respectively.

Attachment I-5 displays a plot of North vs. East range data, for a time period up to the last recorded secondary for TWA800. This plot includes all primary only targets within 10 nautical miles of the TWA800 trackline within the specified timeframe as recorded by the NOR antenna. The secondary returns for TWA800 are included on the plot for reference.

Attachments I-6, I-7, and I-8 show North vs. East range plots of the primary targets following the last secondary return and consistent with the breakup of TWA800. All North vs. East plots are in nautical miles from the Islip[4] radar antenna. The secondary returns for TWA800 are included on the plots for reference.

Attachments I-9 and I-10 are plots of recorded altitude vs. elapsed time for the NOR antenna from the time of the first TWA800 secondary recorded by the antenna to approximately three minutes after the last beacon signal was received from the accident aircraft. Both mode C altitudes and radar sensed altitudes for TWA800 are

[4]To be consistent with other NTSB radar plots the origin for these North/East plots was chosen to be the Islip radar antenna. To obtain the range of each return to the NOR antenna refer to the tabular data in attachment I-1 and 2.

included on the plots. Attachment I-9 shows altitudes from 0 to 102000 feet while attachment I-10 shows altitudes from 10000 to 30000 feet.

Attachments I-11 and 12 provide plots of North Range vs. time for the TWA800 secondary returns and the primary targets associated with the breakup. Attachments I-13 and I-14 provide plots of East Range vs. time for the TWA800 secondary returns and the primary targets associated with the breakup.

One primary target was recorded by the North Truro Radar antenna following the end of transponder returns from TWA800 that is in the general area of the simulated flightpath of TWA800 after the explosion. The recorded altitude associated with this primary target was 14,400 feet at 0031:16.56 Coordinated Universal Time (UTC). However, the radar sensed altitude data for primary targets is not of sufficient fidelity to be used in determining the altitude profile of the aircraft after the nose separated.

John Schade
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Vehicle Performance Division

NOR Radar Data: Primary Returns Occurring Before Last NOR TWA800 Secondary Return (00:31:04.460)

Antenna ID	Time	Correlated Time	Return Type	Range (NM)	Azimuth (deg)	Radar Sensed Alt	Mode C Alt	Beacon Code	Latitude	Longitude	Date	Run Length
NOR	25:13.1	00:26:28.860	Primary	168.625	237.217	22800	n/a	n/a	40 28 14.241 N	073 08 53.991 W	18-Jul-96	4
NOR	25:25.1	00:26:40.795	Primary	142.25	238.799	16800	n/a	n/a	40 46 29.494 N	072 43 20.306 W	18-Jul-96	4
NOR	25:25.1	00:26:40.805	Primary	160	238.799	56800	n/a	n/a	40 37 01.129 N	073 02 27.206 W	18-Jul-96	12
NOR	25:37.1	00:26:52.845	Primary	142.25	238.887	14800	n/a	n/a	40 46 40.067 N	072 43 30.508 W	18-Jul-96	4
NOR	25:37.1	00:26:52.850	Primary	165.125	239.766	19200	n/a	n/a	40 36 20.504 N	073 10 28.855 W	18-Jul-96	8
NOR	25:37.1	00:26:52.860	Primary	159.875	238.799	24000	n/a	n/a	40 36 53.777 N	073 02 41.902 W	18-Jul-96	16
NOR	25:37.1	00:26:52.860	Primary	169.25	239.414	24800	n/a	n/a	40 33 16.933 N	073 14 16.694 W	18-Jul-96	12
NOR	25:49.0	00:27:04.695	Primary	159.875	238.271	20000	n/a	n/a	40 35 39.133 N	073 01 40.074 W	18-Jul-96	4
NOR	26:13.2	00:27:28.890	Primary	136.125	236.338	31200	n/a	n/a	40 45 02.965 N	072 32 08.040 W	18-Jul-96	24
NOR	26:13.2	00:27:28.890	Primary	168.5	237.217	23600	n/a	n/a	40 28 18.739 N	073 08 45.525 W	18-Jul-96	16
NOR	26:13.2	00:27:28.905	Primary	142.125	238.799	102000	n/a	n/a	40 46 42.101 N	072 42 54.781 W	18-Jul-96	12
NOR	26:25.1	00:27:40.840	Primary	142.125	238.711	102000	n/a	n/a	40 46 31.153 N	072 42 45.427 W	18-Jul-96	0
NOR	26:25.1	00:27:40.850	Primary	168.5	237.129	21200	n/a	n/a	40 28 05.392 N	073 08 35.095 W	18-Jul-96	20
NOR	26:37.2	00:27:52.890	Primary	142	238.799	16800	n/a	n/a	40 46 37.661 N	072 43 03.741 W	18-Jul-96	4
NOR	26:49.1	00:28:04.845	Primary	142	238.711	16000	n/a	n/a	40 46 26.533 N	072 42 54.720 W	18-Jul-96	12
NOR	27:01.0	00:28:16.685	Primary	148	232.559	16000	n/a	n/a	40 30 20.188 N	072 37 14.305 W	18-Jul-96	20
NOR	27:01.2	00:28:16.890	Primary	142	238.711	14000	n/a	n/a	40 46 26.125 N	072 42 55.541 W	18-Jul-96	8
NOR	27:01.3	00:28:17.005	Primary	147.375	238.447	17200	n/a	n/a	40 42 56.623 N	072 48 20.431 W	18-Jul-96	16
NOR	27:13.2	00:28:28.935	Primary	141.875	238.711	16400	n/a	n/a	40 46 30.710 N	072 42 46.275 W	18-Jul-96	4
NOR	27:13.2	00:28:28.950	Primary	147.375	238.447	16000	n/a	n/a	40 42 56.364 N	072 48 20.947 W	18-Jul-96	8
NOR	27:25.2	00:28:40.885	Primary	141.875	238.711	14800	n/a	n/a	40 46 30.378 N	072 42 46.944 W	18-Jul-96	8
NOR	27:25.2	00:28:40.895	Primary	166.125	238.271	20800	n/a	n/a	40 32 10.966 N	073 08 28.919 W	18-Jul-96	12
NOR	27:25.3	00:28:40.990	Primary	168.375	236.953	28400	n/a	n/a	40 27 46.290 N	073 08 00.084 W	18-Jul-96	12
NOR	27:49.1	00:29:04.775	Primary	136	235.986	18800	n/a	n/a	40 44 23.013 N	072 31 28.318 W	18-Jul-96	28
NOR	27:49.1	00:29:04.785	Primary	147.25	238.271	16000	n/a	n/a	40 42 37.880 N	072 47 53.074 W	18-Jul-96	20
NOR	28:01.1	00:29:16.825	Primary	137.125	235.898	18400	n/a	n/a	40 43 33.301 N	072 32 30.964 W	18-Jul-96	28
NOR	28:01.1	00:29:16.825	Primary	166	238.096	20400	n/a	n/a	40 31 49.670 N	073 07 58.630 W	18-Jul-96	16
NOR	28:01.1	00:29:16.840	Primary	141.75	238.623	102000	n/a	n/a	40 46 32.527 N	072 42 11.239 W	18-Jul-96	12
NOR	28:13.0	00:29:28.675	Primary	138.125	235.723	21600	n/a	n/a	40 42 38.428 N	072 33 13.977 W	18-Jul-96	28
NOR	28:24.9	00:29:40.620	Primary	139.125	235.547	21600	n/a	n/a	40 41 42.489 N	072 33 58.072 W	18-Jul-96	28
NOR	28:25.2	00:29:40.940	Primary	162.125	238.887	18800	n/a	n/a	40 35 51.047 N	073 05 23.468 W	18-Jul-96	28
NOR	28:37.0	00:29:52.675	Primary	140.25	235.547	20000	n/a	n/a	40 41 02.259 N	072 35 10.495 W	18-Jul-96	28
NOR	28:37.3	00:29:52.980	Primary	141.625	238.535	14800	n/a	n/a	40 46 16.733 N	072 42 11.652 W	18-Jul-96	12
NOR	28:37.3	00:29:52.980	Primary	172.875	239.062	20800	n/a	n/a	40 30 24.909 N	073 17 33.471 W	18-Jul-96	4
NOR	28:37.3	00:29:52.990	Primary	165.875	238.096	19600	n/a	n/a	40 31 53.667 N	073 07 50.845 W	18-Jul-96	16
NOR	28:49.1	00:30:04.830	Primary	141.375	235.547	17600	n/a	n/a	40 40 21.841 N	072 36 23.207 W	18-Jul-96	28
NOR	29:01.1	00:30:16.775	Primary	142.375	235.547	20400	n/a	n/a	40 39 47.121 N	072 37 25.637 W	18-Jul-96	28
NOR	29:12.8	00:30:28.505	Primary	143.5	235.459	20000	n/a	n/a	40 38 56.514 N	072 38 27.189 W	18-Jul-96	28
NOR	29:13.1	00:30:28.815	Primary	165.75	238.008	102000	n/a	n/a	40 31 55.034 N	073 07 12.494 W	18-Jul-96	24
NOR	29:24.9	00:30:40.655	Primary	144.5	235.459	18000	n/a	n/a	40 38 20.512 N	072 39 31.633 W	18-Jul-96	28
NOR	29:24.9	00:30:40.665	Primary	169.375	236.074	29200	n/a	n/a	40 25 05.226 N	073 07 05.525 W	18-Jul-96	4
NOR	29:25.2	00:30:40.880	Primary	165.75	237.832	18800	n/a	n/a	40 31 19.761 N	073 07 09.467 W	18-Jul-96	16
NOR	29:37.1	00:30:52.810	Primary	145.5	235.459	20800	n/a	n/a	40 37 45.698 N	072 40 33.922 W	18-Jul-96	28
NOR	29:37.1	00:30:52.815	Primary	165.625	237.92	102000	n/a	n/a	40 31 46.630 N	073 06 53.172 W	18-Jul-96	8
NOR	29:37.1	00:30:52.825	Primary	154.125	237.92	20400	n/a	n/a	40 38 03.424 N	072 54 41.357 W	18-Jul-96	28

Notes:
Correlated Time = Time+75.715 seconds as per correlation in Aircraft Performance Study (Exhibit 13A)
Run Length value is a measure of the strength of the radar return for primary targets only.

NOR Primary & Secondary Returns (00:26:28.860 – 00:34:04.660)

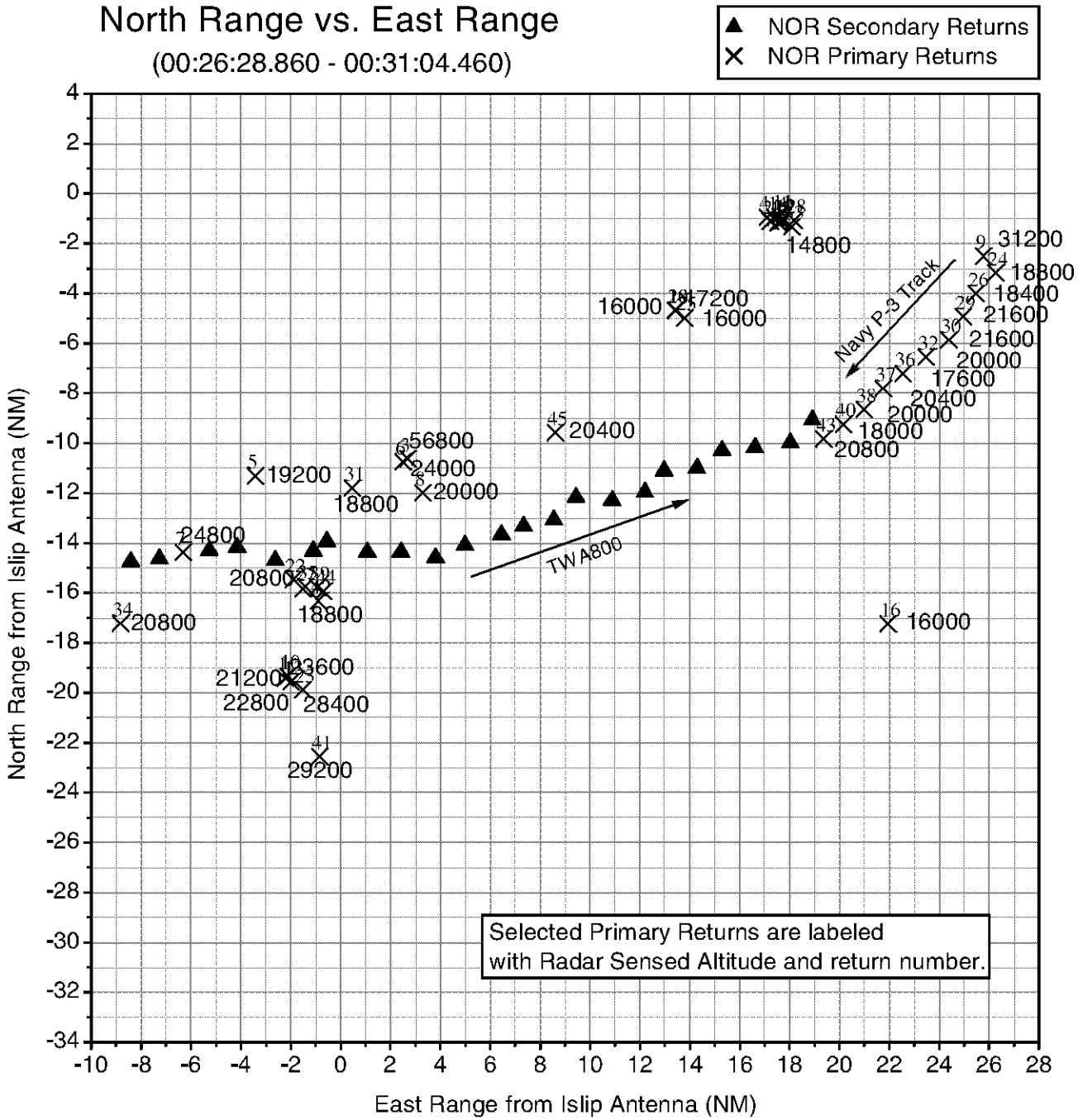
Antenna ID	Time	Correlated Time	Return Type	Range (NM)	Azimuth (deg)	Radar Sensed Alt	Mode C Alt	Beacon Code	Latitude	Longitude	Date	Run Length
NOR	25:13.1	00:26:28.860	Secondary	171.125	239.678		10800	2633	40 32 52.805 N	073 17 00.592 W	18-Jul-96	
NOR	25:25.1	00:26:40.860	Secondary	170.125	239.502		11400	2633	40 32 58.729 N	073 15 31.854 W	18-Jul-96	
NOR	25:49.1	00:27:04.860	Secondary	168.25	239.238	102000	12000	2633	40 33 20.418 N	073 12 54.342 W	18-Jul-96	
NOR	26:01.2	00:27:16.960	Secondary	167.25	239.062	102000	12100	2633	40 33 27.158 N	073 11 26.219 W	18-Jul-96	
NOR	26:13.1	00:27:28.860	Secondary	166.25	238.623	22400	12200	2633	40 32 55.870 N	073 09 25.211 W	18-Jul-96	
NOR	26:25.0	00:27:40.760	Secondary	165.125	238.447	102000	12300	2633	40 33 19.051 N	073 07 27.005 W	18-Jul-96	
NOR	26:37.1	00:27:52.860	Secondary	164.125	238.447	102000	12400	2633	40 33 40.972 N	073 06 43.633 W	18-Jul-96	
NOR	26:49.1	00:28:04.860	Secondary	163	238.008	102000	12600	2633	40 33 16.005 N	073 04 35.072 W	18-Jul-96	
NOR	27:01.2	00:28:16.960	Secondary	161.875	237.744	102000	12700	2633	40 33 16.768 N	073 02 48.733 W	18-Jul-96	
NOR	27:13.1	00:28:28.860	Secondary	160.875	237.393	102000	12700	2633	40 33 01.665 N	073 00 59.779 W	18-Jul-96	
NOR	27:25.2	00:28:40.960	Secondary	159.625	237.305	102000	12800	2633	40 33 32.161 N	072 59 27.763 W	18-Jul-96	
NOR	27:37.0	00:28:52.760	Secondary	158.5	237.129	102000	13000	2633	40 33 57.797 N	072 57 31.953 W	18-Jul-96	
NOR	27:49.1	00:29:04.860	Secondary	157.25	237.041	18800	12900	2633	40 34 17.515 N	072 56 21.390 W	18-Jul-96	
NOR	28:01.0	00:29:16.760	Secondary	156.125	236.865	24400	12900	2633	40 34 32.560 N	072 54 47.111 W	18-Jul-96	
NOR	28:12.8	00:29:28.560	Secondary	154.875	236.953		12700	2633	40 35 27.265 N	072 53 37.282 W	18-Jul-96	
NOR	28:24.8	00:29:40.560	Secondary	153.75	236.602	17200	12700	2633	40 35 19.604 N	072 51 41.942 W	18-Jul-96	
NOR	28:36.9	00:29:52.660	Secondary	152.5	236.426		12700	2633	40 35 40.010 N	072 50 00.239 W	18-Jul-96	
NOR	28:49.0	00:30:04.760	Secondary	151.375	236.514	21600	12900	2633	40 36 30.545 N	072 48 58.510 W	18-Jul-96	
NOR	29:00.9	00:30:16.660	Secondary	150.25	236.25	17600	12800	2633	40 36 35.754 N	072 47 14.655 W	18-Jul-96	
NOR	29:13.0	00:30:28.760	Secondary	149	236.25	16000	12900	2633	40 37 19.407 N	072 45 54.486 W	18-Jul-96	
NOR	29:24.8	00:30:40.560	Secondary	147.875	235.986	15200	13100	2633	40 37 25.529 N	072 44 11.028 W	18-Jul-96	
NOR	29:36.9	00:30:52.660	Secondary	146.625	235.723	18000	13200	2633	40 37 36.632 N	072 42 19.914 W	18-Jul-96	
NOR	29:48.7	00:31:04.460	Secondary	145.375	235.811	102000	13500	2633	40 38 31.659 N	072 41 10.442 W	18-Jul-96	
NOR	*30:00.7*	*00:31:16.460*	*Primary*	*144.25*	*235.107*	*17600*			*40 37 46.573 N*	*072 38 34.526 W*	*18-Jul-96*	28
NOR	30:00.8	00:31:16.560	Primary	144.375	235.723	14400			40 38 56.320 N	072 39 56.019 W	18-Jul-96	28
NOR	30:01.1	00:31:16.860	Primary	144.25	236.25	102000			40 40 14.973 N	072 40 31.532 W	18-Jul-96	24
NOR	30:12.8	00:31:28.560	Primary	143.875	235.547	102000			40 39 02.318 N	072 38 46.182 W	18-Jul-96	12
NOR	30:12.8	00:31:28.560	Primary	144.375	235.723	14800			40 38 56.407 N	072 39 55.863 W	18-Jul-96	12
NOR	30:12.8	00:31:28.560	Primary	143.875	236.25	14400			40 40 18.452 N	072 40 25.071 W	18-Jul-96	4
NOR	30:12.8	00:31:28.560	Primary	144	235.371	14400			40 38 26.759 N	072 38 51.028 W	18-Jul-96	20
NOR	30:24.9	00:31:40.660	Primary	142.625	235.547	102000			40 39 46.618 N	072 37 26.581 W	18-Jul-96	20
NOR	30:24.9	00:31:40.660	Primary	144	235.371	102000			40 38 36.553 N	072 38 33.601 W	18-Jul-96	16
NOR	30:24.9	00:31:40.660	Primary	143.125	235.459	14800			40 39 08.592 N	072 38 05.551 W	18-Jul-96	16
NOR	30:24.9	00:31:40.660	Primary	144.375	235.635	102000			40 38 55.305 N	072 39 28.280 W	18-Jul-96	28
NOR	30:36.7	00:31:52.460	Primary	142.875	235.371	14400			40 39 06.780 N	072 37 39.594 W	18-Jul-96	24
NOR	30:36.7	00:31:52.460	Primary	143	235.371	14800			40 39 02.421 N	072 37 47.377 W	18-Jul-96	12
NOR	30:36.7	00:31:52.460	Primary	144.125	235.371	14800			40 38 22.400 N	072 38 58.808 W	18-Jul-96	20
NOR	30:36.8	00:31:52.560	Primary	143.25	235.371	102000			40 39 03.245 N	072 37 45.955 W	18-Jul-96	20
NOR	30:36.8	00:31:52.560	Primary	144.375	235.547	102000			40 38 44.594 N	072 39 18.014 W	18-Jul-96	24
NOR	30:37.2	00:31:52.960	Primary	144	235.986	102000			40 39 51.426 N	072 39 45.128 W	18-Jul-96	8
NOR	30:48.8	00:32:04.560	Primary	144.375	235.723	102000			40 39 06.029 N	072 39 38.525 W	18-Jul-96	28
NOR	30:48.8	00:32:04.560	Primary	144.125	235.195	14800			40 38 01.055 N	072 38 38.129 W	18-Jul-96	28
NOR	31:00.9	00:32:16.660	Primary	144.125	235.459	102000			40 38 42.774 N	072 38 51.830 W	18-Jul-96	28
NOR	32:24.9	00:33:40.660	Primary	144.25	235.459	102000			40 38 38.334 N	072 38 59.779 W	18-Jul-96	0
NOR	32:36.9	00:33:52.660	Primary	142.25	235.283	102000			40 39 28.304 N	072 36 32.238 W	18-Jul-96	4
NOR	32:48.9	00:34:04.660	Primary	142.75	235.635	102000			40 39 52.782 N	072 37 44.691 W	18-Jul-96	12

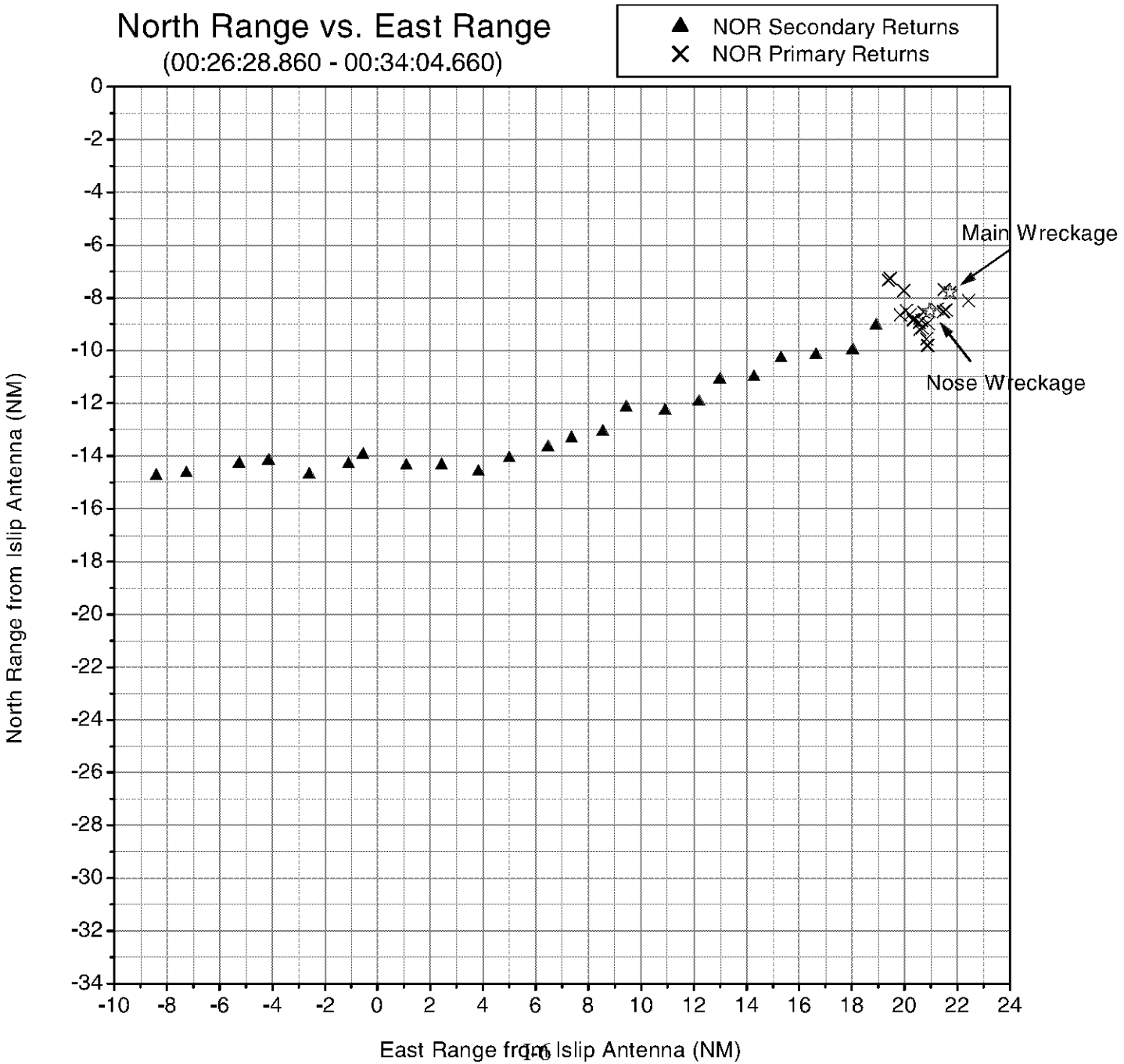
Notes: See Previous Page

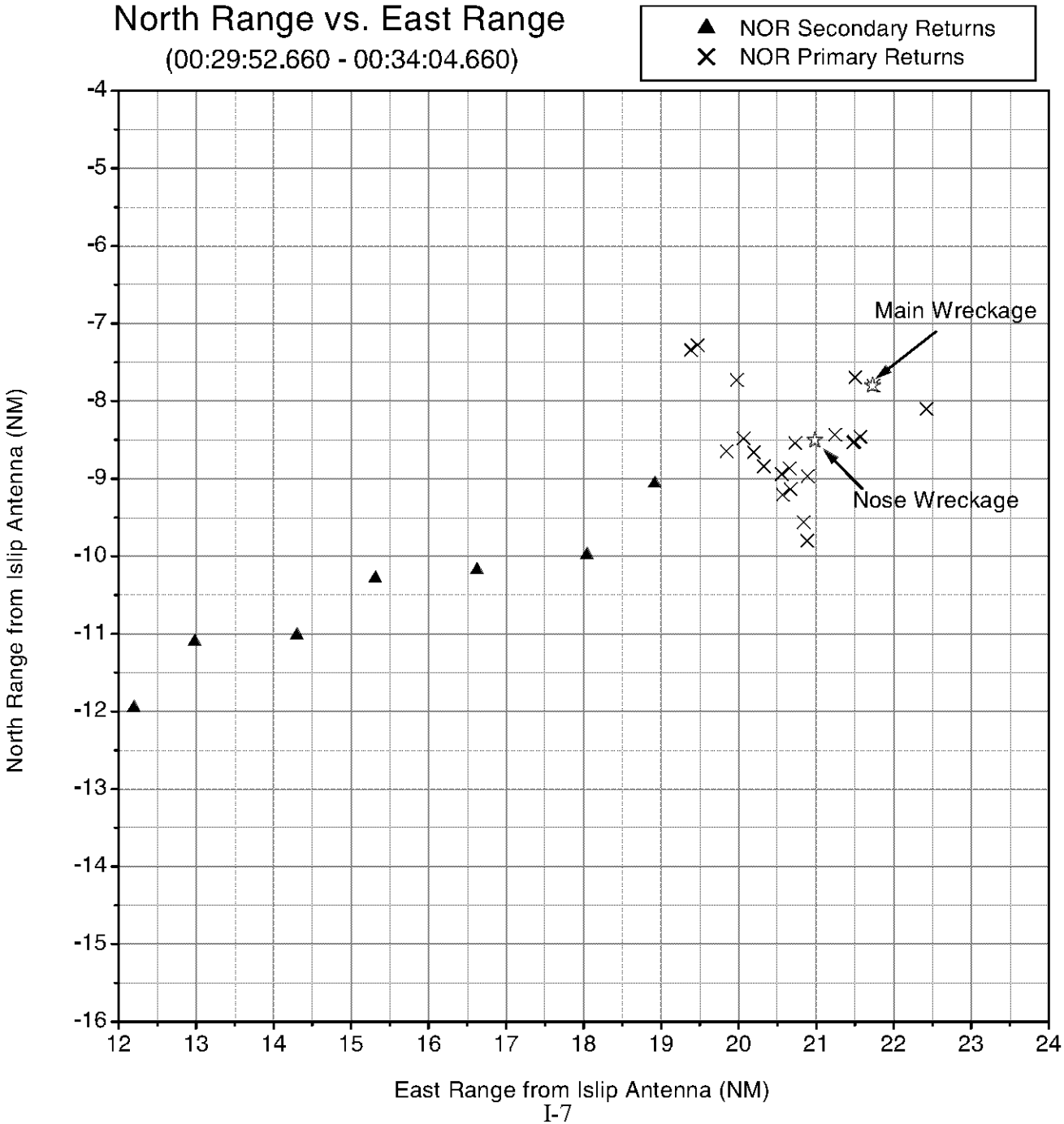
Additional NOR Primary Returns					
Elapsed Time,	Correlated Time	North Range	East Range	Radar Sensed	Return Label
seconds	HH:MM:SS	from ISP, NM	from ISP, NM	Altitude, ft.	Number
0.0	00:26:28.860	-19.40739	-2.20917	22800	1
11.9	00:26:40.795	-1.10817	17.23646	16800	2
11.9	00:26:40.805	-10.63905	2.71447	56800	3
24.0	00:26:52.845	-0.93239	17.10480	14800	4
24.0	00:26:52.850	-11.29668	-3.40967	19200	5
24.0	00:26:52.860	-10.74510	2.52358	24000	6
24.0	00:26:52.860	-14.35736	-6.31104	24800	7
35.8	00:27:04.695	-11.98693	3.30962	20000	8
60.0	00:27:28.890	-2.50649	25.78224	31200	9
60.0	00:27:28.890	-19.33319	-2.10141	23600	10
60.0	00:27:28.905	-0.90027	17.63032	102000	11
72.0	00:27:40.840	-1.08299	17.75014	102000	12
72.0	00:27:40.850	-19.55357	-1.96848	21200	13
84.0	00:27:52.890	-0.97112	17.44578	16800	14
96.0	00:28:04.845	-1.15607	17.56023	16000	15
107.8	00:28:16.685	-17.24231	21.96193	16000	16
108.0	00:28:16.890	-1.16281	17.54819	14000	17
108.1	00:28:17.005	-4.67128	13.44550	17200	18
120.1	00:28:28.935	-1.08600	17.66727	16400	19
120.1	00:28:28.950	-4.67535	13.43820	16000	20
132.0	00:28:40.885	-1.09148	17.65747	14800	21
132.0	00:28:40.895	-15.45895	-1.88788	20800	22
132.1	00:28:40.990	-19.87909	-1.52332	28400	23
155.9	00:29:04.775	-3.16776	26.27495	18800	24
155.9	00:29:04.785	-4.98225	13.79278	16000	25
168.0	00:29:16.825	-4.00156	25.48544	18400	26
168.0	00:29:16.825	-15.81387	-1.50271	20400	27
168.0	00:29:16.840	-1.05804	18.18502	102000	28
179.8	00:29:28.675	-4.92050	24.94947	21600	29
191.8	00:29:40.620	-5.85662	24.39574	21600	30
192.1	00:29:40.940	-11.78896	0.47057	18800	31
203.8	00:29:52.675	-6.53237	23.47886	20000	32
204.1	00:29:52.980	-1.31692	18.10568	14800	33
204.1	00:29:52.980	-17.21794	-8.81842	20800	34
204.1	00:29:52.990	-15.74666	-1.40360	19600	35
216.0	00:30:04.830	-7.21068	22.55730	17600	36
227.9	00:30:16.775	-7.79488	21.77101	20400	37
239.6	00:30:28.505	-8.64261	20.99362	20000	38
240.0	00:30:28.815	-15.78602	-0.91937	102000	39
251.8	00:30:40.655	-9.24614	20.17643	18000	40
251.8	00:30:40.665	-22.56641	-0.82891	29200	41
252.0	00:30:40.880	-16.31145	-0.87736	18800	42
264.0	00:30:52.810	-9.83171	19.39086	20800	43
264.0	00:30:52.815	-15.92673	-0.67265	102000	44
264.0	00:30:52.825	-9.57359	8.62585	20400	45

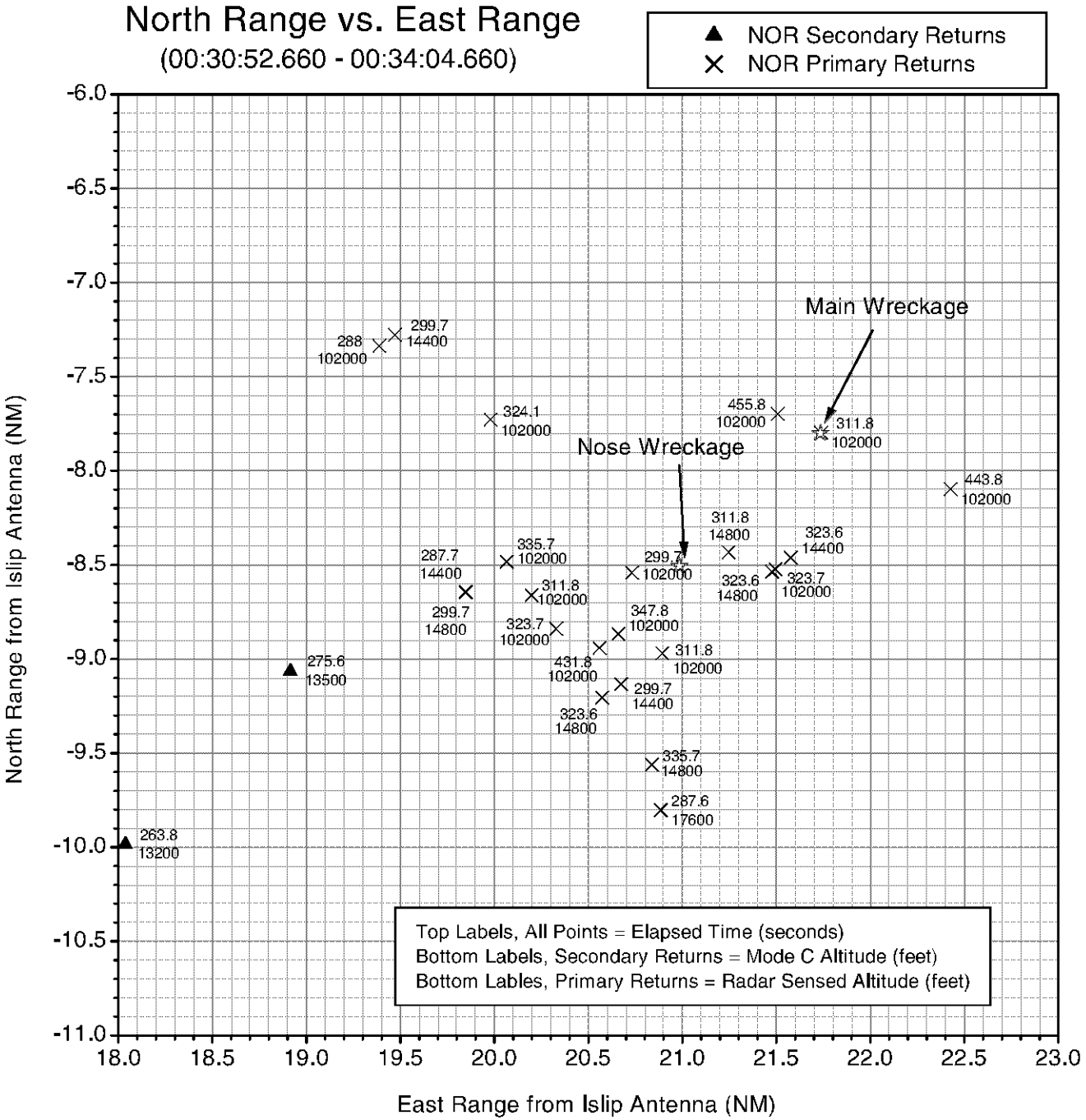
		NOR Secondary Returns			
Elapsed Time,	Correlated Time	North Range	East Range	Mode C	Radar Sensed
seconds	HH:MM:SS	from ISP, NM	from ISP, NM	Altitude, ft.	Altitude, ft.
0	00:26:28.860	-14.74767	-8.39087	10800	
12	00:26:40.860	-14.65157	-7.26289	11400	
36	00:27:04.860	-14.29366	-5.26033	12000	102000
48.1	00:27:16.960	-14.18272	-4.1401	12100	102000
60	00:27:28.860	-14.70551	-2.60236	12200	22400
71.9	00:27:40.760	-14.31995	-1.09958	12300	102000
84	00:27:52.860	-13.9548	-0.54823	12400	102000
96	00:28:04.860	-14.37092	1.08592	12600	102000
108.1	00:28:16.960	-14.35768	2.43766	12700	102000
120	00:28:28.860	-14.60831	3.82288	12700	102000
132.1	00:28:40.960	-14.09884	4.99201	12800	102000
143.9	00:28:52.760	-13.66962	6.46342	13000	102000
156	00:29:04.860	-13.33939	7.35961	12900	18800
167.9	00:29:16.760	-13.08627	8.55721	12900	24400
179.7	00:29:28.560	-12.17245	9.44233	12700	
191.7	00:29:40.560	-12.29641	10.90803	12700	17200
203.8	00:29:52.660	-11.9526	12.19913	12700	
215.9	00:30:04.760	-11.10803	12.98072	12900	21600
227.8	00:30:16.660	-11.01668	14.29944	12800	17600
239.9	00:30:28.760	-10.28544	15.31495	12900	16000
251.7	00:30:40.560	-10.17828	16.62847	13100	15200
263.8	00:30:52.660	-9.98718	18.03869	13200	18000
275.6	00:31:04.460	-9.06615	18.91678	13500	102000

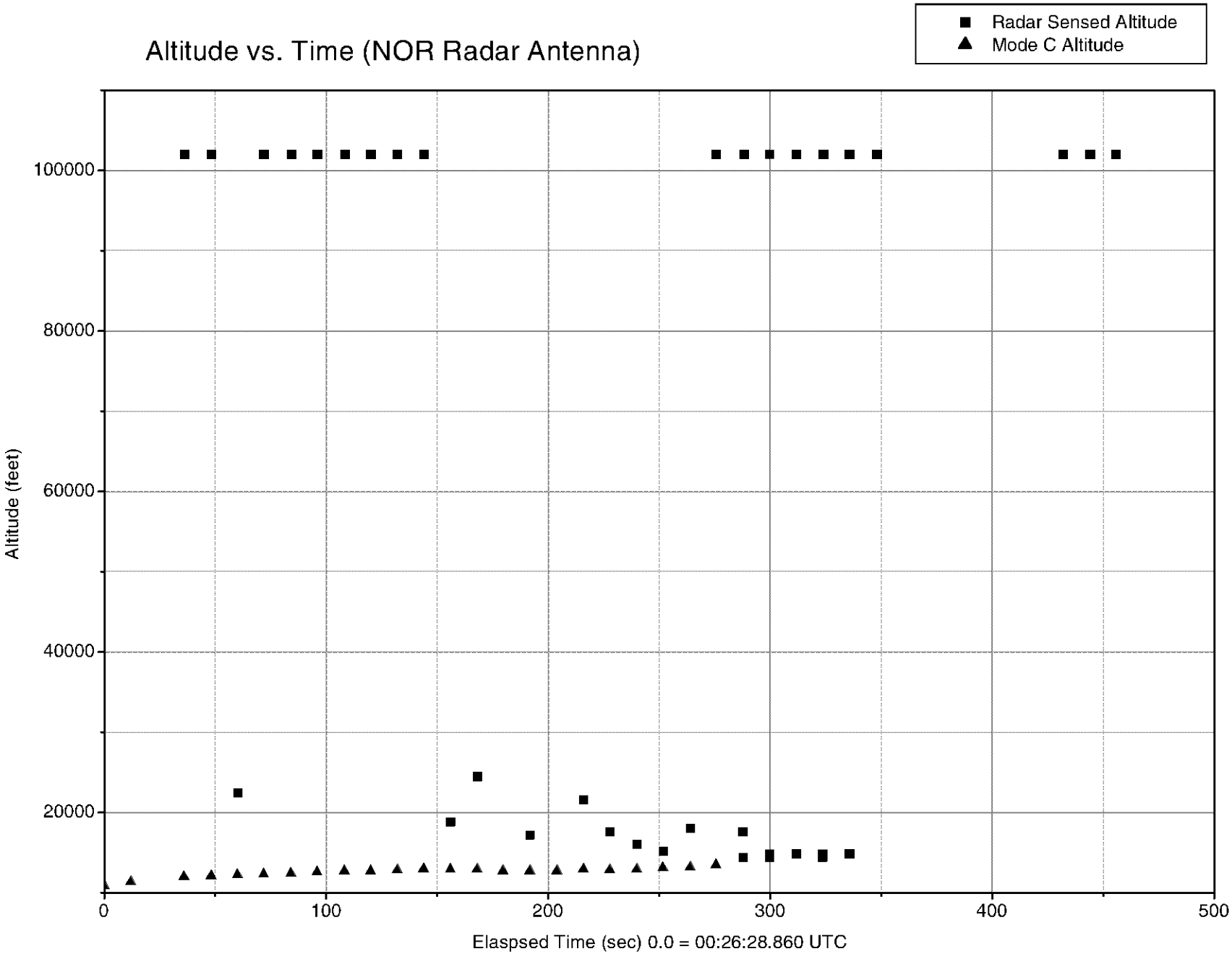
NOR Primary Radar Returns				
Elapsed Time,	UTC Time,	North Range	East Range	Radar Sensed
seconds	HH:MM:SS	from ISP, NM	from ISP, NM	Altitude, ft.
287.6	00:31:16.460	-9.8014	20.8866	17600
287.7	00:31:16.560	-8.64497	19.84676	14400
288	00:31:16.860	-7.33715	19.3899	102000
299.7	00:31:28.560	-8.54058	20.73216	102000
299.7	00:31:28.560	-8.64351	19.84873	14800
299.7	00:31:28.560	-7.27881	19.47155	14400
299.7	00:31:28.560	-9.13316	20.67375	14400
311.8	00:31:40.660	-7.79738	21.73791	102000
311.8	00:31:40.660	-8.96889	20.894	102000
311.8	00:31:40.660	-8.43338	21.24702	14800
311.8	00:31:40.660	-8.66012	20.19873	102000
323.6	00:31:52.460	-8.4618	21.57645	14400
323.6	00:31:52.460	-8.53493	21.47811	14800
323.6	00:31:52.460	-9.20627	20.57542	14800
323.7	00:31:52.560	-8.52111	21.49607	102000
323.7	00:31:52.560	-8.83786	20.32986	102000
324.1	00:31:52.960	-7.72645	19.98033	102000
335.7	00:32:04.560	-8.48215	20.06787	102000
335.7	00:32:04.560	-9.56043	20.83963	14800
347.8	00:32:16.660	-8.86647	20.6622	102000
431.8	00:33:40.660	-8.94094	20.56173	102000
443.8	00:33:52.660	-8.09861	22.42884	102000
455.8	00:34:04.660	-7.69595	21.50767	102000

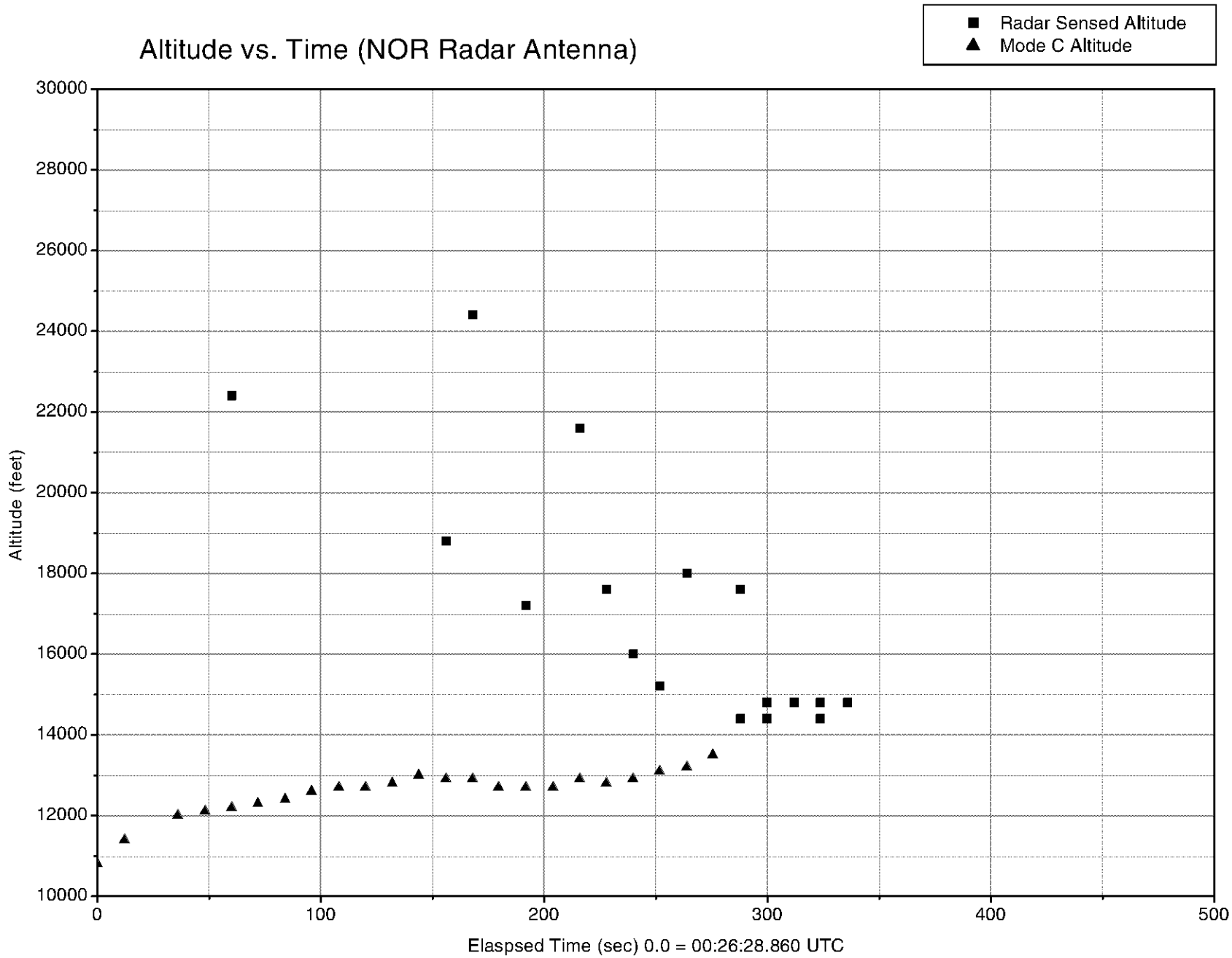

North Range vs. East Range
(00:26:28.860 - 00:31:04.460)
NOR Secondary Returns
NOR Primary Returns
North Range from Islip Antenna (NM)
East Range from Islip Antenna (NM)
Navy P-3 Track
TWA800
Selected Primary Returns are labeled
with Radar Sensed Altitude and return number.
14800
31200
18800
18400
21600
21600
20000
17600
20400
20000
18000
20800
16000
16000
45 20400
56800
24000
20000
5 19200
31 18800
24800
20800
18800
34 20800
16 16000
23600
21200
22800
28400
41
29200

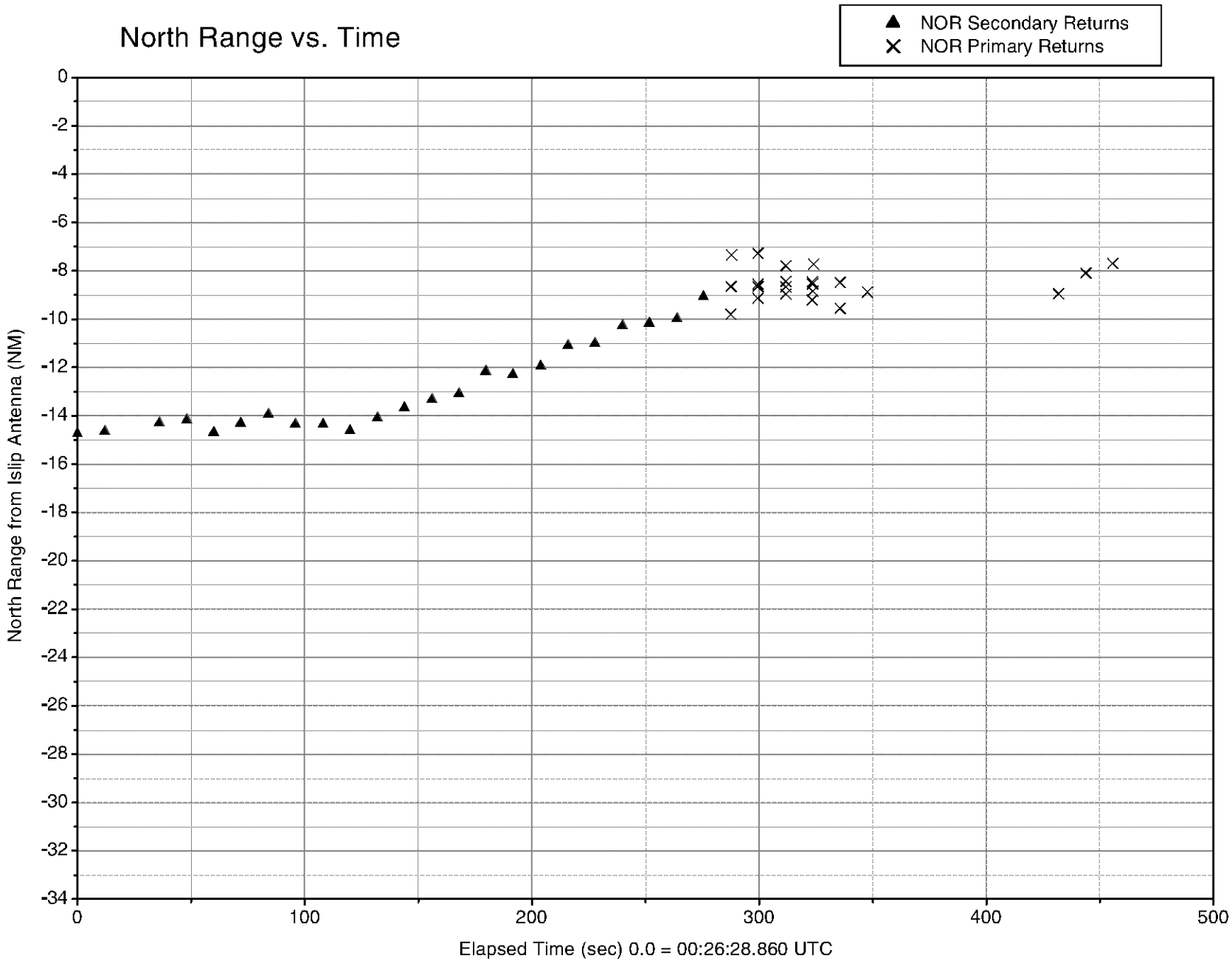

North Range vs. East Range
(00:26:28.860 - 00:34:04.660)
NOR Secondary Returns
NOR Primary Returns
Main Wreckage
Nose Wreckage
North Range from Islip Antenna (NM)
East Range from Islip Antenna (NM)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-10
-8
-6
-4
-2
0
2
4
6
8
10
12
14
16
18
20
22
24

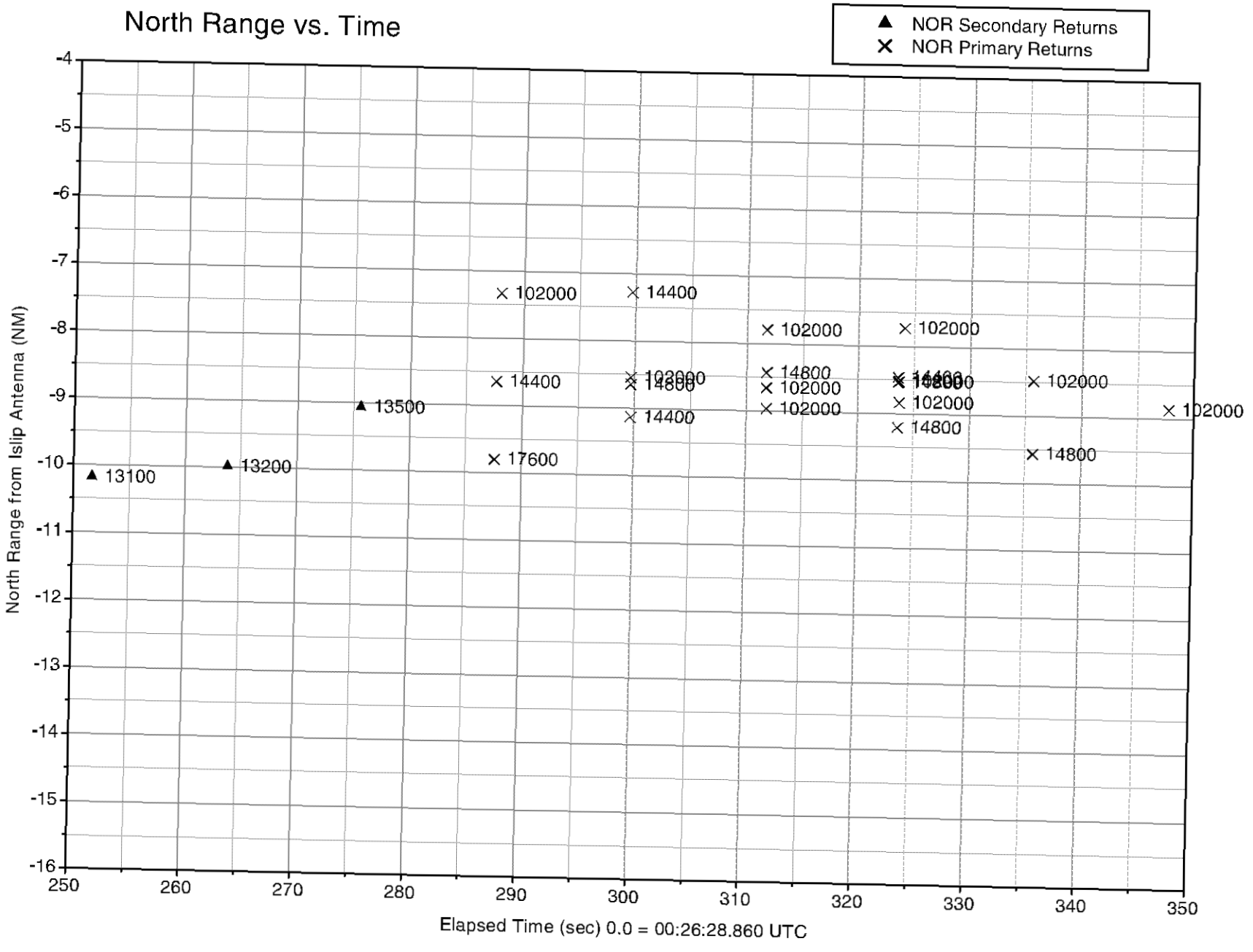

North Range vs. East Range
(00:29:52.660 - 00:34:04.660)
NOR Secondary Returns
NOR Primary Returns
Main Wreckage
Nose Wreckage
North Range from Islip Antenna (NM)
East Range from Islip Antenna (NM)
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
12
13
14
15
16
17
18
19
20
21
22
23
24

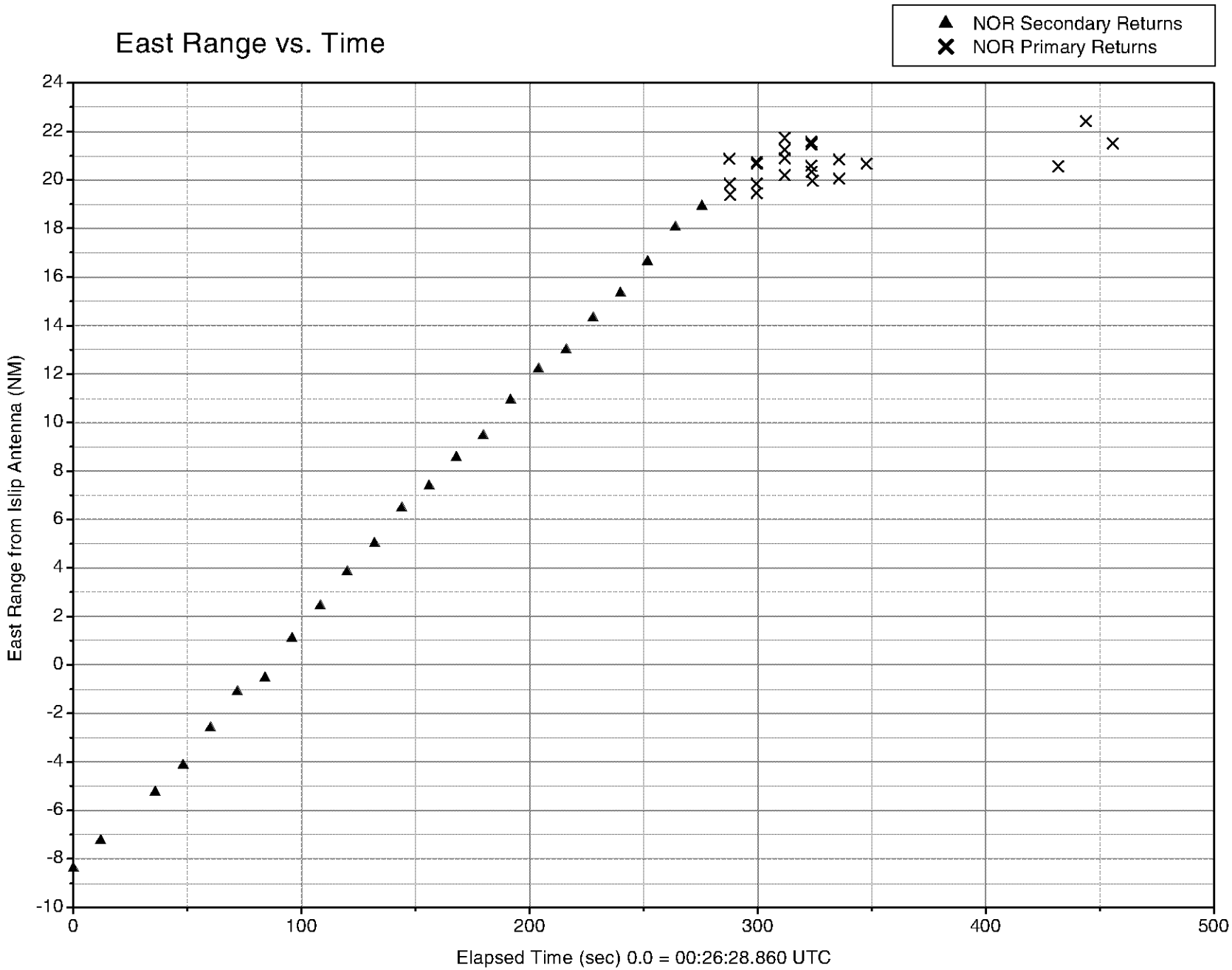

North Range vs. East Range
(00:30:52.660 - 00:34:04.660)
NOR Secondary Returns
NOR Primary Returns
Main Wreckage
Nose Wreckage
North Range from Islip Antenna (NM)
East Range from Islip Antenna (NM)
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
-11.0
18.0
18.5
19.0
19.5
20.0
20.5
21.0
21.5
22.0
22.5
23.0
288
102000
299.7
14400
324.1
102000
455.8
102000
311.8
102000
443.8
102000
311.8
14800
323.6
14400
287.7
14400
335.7
102000
299.7
102000
323.6
14800
323.7
102000
299.7
14800
311.8
102000
347.8
102000
323.7
102000
275.6
13500
431.8
102000
311.8
102000
299.7
14400
323.6
14800
335.7
14800
287.6
17600
263.8
13200
Top Labels, All Points = Elapsed Time (seconds)
Bottom Labels, Secondary Returns = Mode C Altitude (feet)
Bottom Lables, Primary Returns = Radar Sensed Altitude (feet)

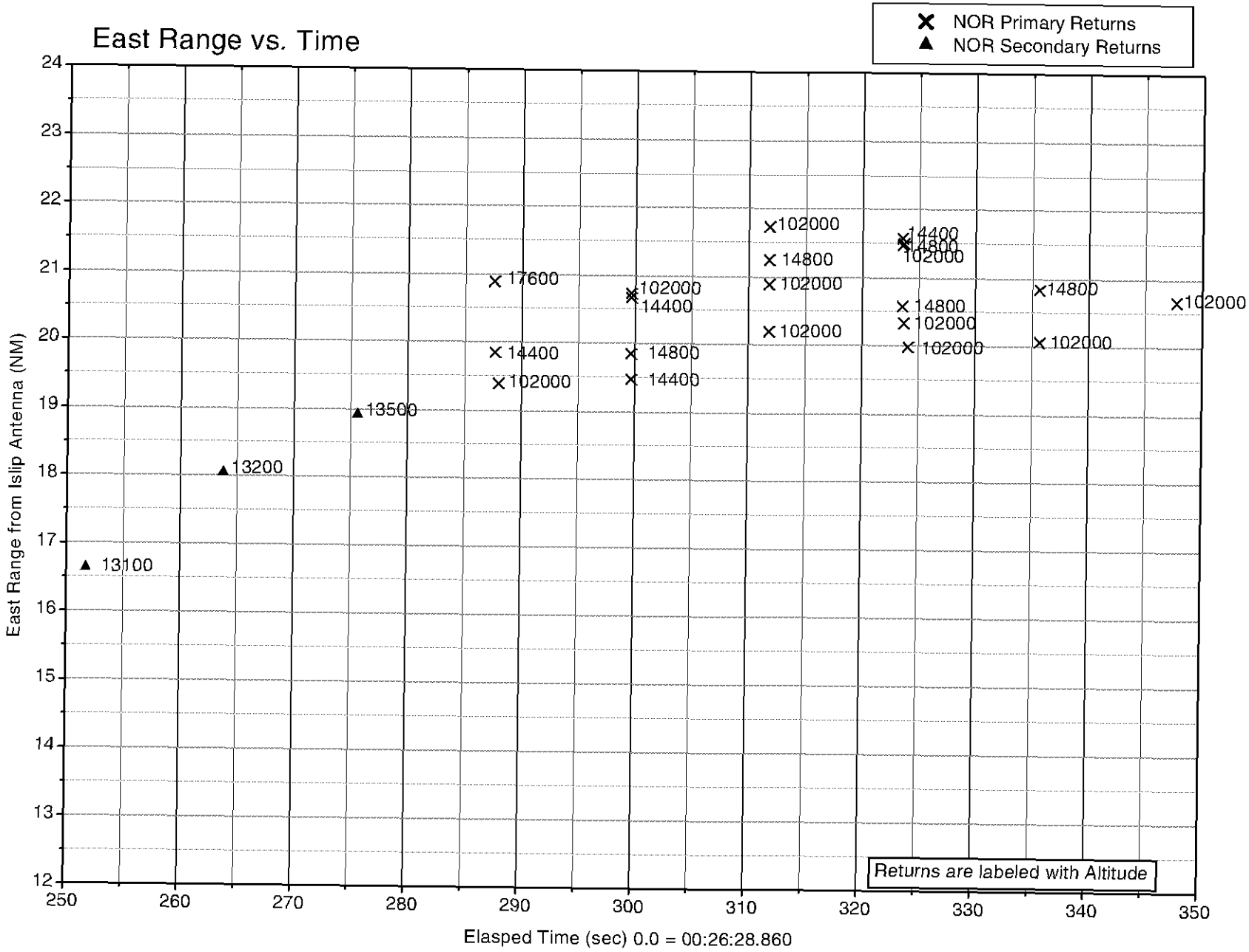

Altitude vs. Time (NOR Radar Antenna)
Radar Sensed Altitude
Mode C Altitude
Altitude (feet)
100000
80000
60000
40000
20000
0
100
200
300
400
500
Elaspsed Time (sec) 0.0 = 00:26:28.860 UTC


Altitude vs. Time (NOR Radar Antenna)
Radar Sensed Altitude
Mode C Altitude
Altitude (feet)
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
0
100
200
300
400
500
Elaspsed Time (sec) 0.0 = 00:26:28.860 UTC


North Range vs. Time
NOR Secondary Returns
NOR Primary Returns
North Range from Islip Antenna (NM)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
0
100
200
300
400
500
Elapsed Time (sec) 0.0 = 00:26:28.860 UTC


North Range vs. Time
NOR Secondary Returns
NOR Primary Returns
North Range from Islip Antenna (NM)
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
250
260
270
280
290
300
310
320
330
340
350
Elapsed Time (sec) 0.0 = 00:26:28.860 UTC
13100
13200
13500
17600
14400
102000
14800


East Range vs. Time
NOR Secondary Returns
NOR Primary Returns
East Range from Islip Antenna (NM)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
100
200
300
400
500
Elapsed Time (sec) 0.0 = 00:26:28.860 UTC


East Range vs. Time
NOR Primary Returns
NOR Secondary Returns
East Range from Islip Antenna (NM)
Elasped Time (sec) 0.0 = 00:26:28.860
Returns are labeled with Altitude
13100
13200
13500
17600
14400
14800
102000