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NATIONAL LAUNCH SYSTEM CYCLE I LOADS AND MODELS DATA BOOK

By F. Bugg, J. Brunty, G. Ernsberger, D. McGhee,
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Structures and Dynamics Laboratory
Science and Engineering Directorate

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This document contains preliminary cycle 1 loads for the National Launch System NLS 1 and NLS 2 vehicles. The loads provided and recommended as design loads represent the maximum loads expected during prelaunch and flight regimes, i.e., limit loads, except that propellant tank ullage pressure has not been included. Ullage pressure should be added to the loads book values for cases where the addition results in higher loads. The loads must be multiplied by the appropriate factors of safety to determine the ultimate loads for which the structure must be capable.

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DEFINITION OF SYMBOLS

ASRB	Advanced Solid Rocket Booster
ASRM	Advanced Solid Rocket Motor
CCS	Common Core Stage
CTV	Cargo Transfer Vehicle
FORMA	FORTRAN Matrix Analysis Computer Code
FPM	Forward Propulsion Module
FRF	Flight Readiness Firing
F_x	Force in the X-Direction
F_y	Force in the Y-Direction
F_z	Force in the Z-Direction
HLLV	Heavy Lift Launch Vehicle
KSC	Kennedy Space Center
K_v	Uncertainty factor
LH_2	Liquid Hydrogen
lox	Liquid Oxygen
MLP	Mobile Launch Platform
M_y	Moment About Y-Axis
M_z	Moment About Z-Axis
NASTRAN	NASA Structural Analysis Finite Element Computer Code
NLS 1	National Launch System 100 klb Payload Launch Vehicle
NLS 2	National Launch System 50 klb Payload Launch Vehicle
NSTS	National Space Transportation System
N_x	Load in the X-Direction Per Inch of Vehicle Circumference
N_v	Combined Load in the Y-Z Plane Per Inch of Vehicle Circumference
P	Axial Load
P_{eq}	Total Axial Load, Including Moment Effects
Q	Dynamic Pressure
R	Radius
RSS	Root Sum Squared
SRB	Solid Rocket Booster
STME	Space Transportation Main Engine
STS	Space Transportation System
V	Y-Z Load
V_{eq}	Total Y-Z Load, Including the Effect of Torsion
VAB	Vehicle Assembly Building

TECHNICAL MEMORANDUM

NATIONAL LAUNCH SYSTEM LOADS AND MODELS DATA BOOK

I. INTRODUCTION

The National Launch System (NLS) Reference Launch Vehicles Definition document was published in May 1991[1] and contained the basic design criteria and guidelines for a series of launch vehicles designated NLS 1 (heavy lift launch vehicle or HLLV) and NLS 2 (stage 1.5). The use of existing National Space Transportation System (NSTS) hardware, tooling, and methodology was emphasized as a means of minimizing the overall cost.

The design reference missions require that NLS 1 and NLS 2 launch vehicles be capable of placing nominal 100-kip (1 kip = 1,000 lb) and 50-kip payloads, respectively, in low-Earth orbit (LEO). The payloads may be composed of single or multiple payload elements. Both vehicles were to be capable of accomplishing their design reference missions with one liquid booster engine inoperative. In this study, it was assumed that the nominal vehicle was one which had all engines burning.

The NSTS advanced solid rocket boosters (ASRB's) with a lift-off thrust of approximately 3,350 kips thrust (sea level) and space transportation main engines (STME's) with a 580-kip vacuum thrust were selected as the basic propulsion systems for the two configurations. The NSTS external tank (ET) was defined to be the basis for modification to upgrade to a common core stage (CCS). The modifications were to be those required to permit the CCS to support a payload/payload shroud at the forward end of the liquid oxygen (lox) tank, a thrust structure, and up to six STME's positioned at the aft end of the liquid hydrogen (LH_2) tank.

The NLS 2 payload shroud was further defined to be a Titan IV derived structure to make use of currently available tooling.

The cargo transfer vehicle (CTV) is provided for additional orbital transfer capability for NLS 1 payloads. A forward propulsion module (FPM) would also be provided in conjunction with the CTV for final payload positioning.

A payload adapter would be provided for both configurations for mounting the payloads, and a transition section would provide a transition from the nominal 220-in payload shroud diameter to the 331-in CCS.

A modified NSTS mobile launch platform (MLP) or a platform constructed specifically for the NLS would be used to carry the launch vehicle from the vehicle assembly building (VAB) to the launch site.

Using the guidelines contained in reference 1, an analysis of the vehicle loads and dynamic response characteristics was performed. The ultimate use of the resulting data was to provide sufficient definition to the structural loading so as to facilitate detailed design of the overall structure during the next design cycle (cycle 2).

II. CONFIGURATION DESCRIPTIONS

The NLS 1 vehicle was composed of two ASRB's, CCS, CTV, FPM, payload shroud, payload adapter, transition section, and a nominal payload of 100 kips. The aft end of the CCS accommodates four liquid STME's rated at a nominal vacuum thrust level of 580 kips. The NLS 1 vehicle is propelled by the four liquid STME's and the two ASRB's. The NLS 1 vehicle was assumed to be constrained in three directions at each of eight holddown locations on the two ASRM's.

The NLS 2 vehicle was composed of the CCS, a Titan IV derived payload shroud, payload adapter, transition section, and a nominal payload of 50 kips. The NLS 2 vehicle is propelled by six STME's with four engines to be jettisoned in flight and two engines remaining to position the vehicle in the proper orbit. The launch vehicle was assumed to be constrained in three directions at each of four holddown locations at the base of the CCS thrust structure.

For purposes of interpreting the results of this analysis, a compressive load is defined as a positive value, and a tension load is defined by a negative value. An exception to this convention is the notation for the on-pad interface loads. When interpreting on-pad interface loads, a compressive load is defined as a negative value, and a tension load is defined as a positive value. All accelerations are shown in terms of absolute value. A diagram depicting the sign convention used in this analysis is shown in figure 1.

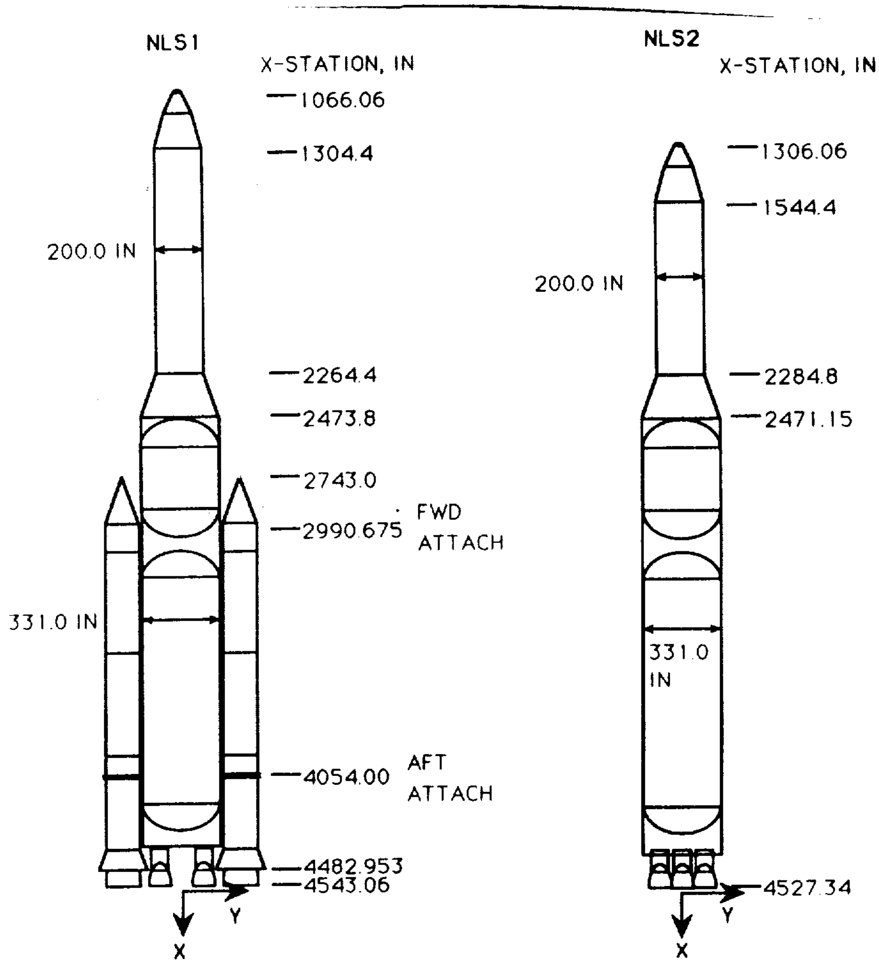

Figure 1. NLS 1 and NLS 2 reference vehicle.

III. COMMON CORE DESIGN LOADS SUMMARY

This section contains the recommended design loads for the CCS and shroud. In section A, the overall CCS line loads for both vehicles during all events are compared. Section B contains the overall maximum interface loads for the NLS 1 vehicle for all events. The shroud design loads are in section C. Finally, the cycle 1 line loads are compared to cycle 0 line loads in section D. It is recommended that the cycle 1 line loads in conjunction with the interface loads and transverse shears be used for the CCS design.

A. NLS 1 and NLS 2 Overall Line Loads

Comparisons of the prelaunch buildup and shutdown (BUSD) line loads, lift-off line loads, and ascent CCS line loads for both NLS 1 and NLS 2 vehicles were made. This was accomplished by superimposing plots of the line loads for the various conditions in figures 2 through 5. The data is plotted versus the X-station of the CCS. Several comparisons were made using the line load data, since the line load data were separated for nominal and engine out. Shown in figures 2 through 5 are the plots of the prelaunch and lift-off comparisons. NLS 1 maximum and minimum line loads during prelaunch events of buildup and shutdown envelope those of lift-off. This can be observed in figures 2 and 5. Similarly, figures 4 and 5 show that the highest line loads occur during the NLS 2 lift-off event.

The ascent line loads are added to prelaunch and lift-off line loads in figures 6 through 8 for both the nominal vehicle and engine-out condition. Note that the ascent analysis for the NLS 1 vehicle for STME out condition was not analyzed because the dominating thrust for the NLS 1 vehicle is produced by the ASRB's, and other engines (STME's) would be throttled up to 100-percent thrust for the engine out condition. Therefore, the "engine out" case is essentially the same as the "nominal" case for the NLS 1 ascent. The max-q ascent line loads envelope the prelaunch and lift-off line loads for all forward sections of the NLS 1 and NLS 2 vehicles. The lift-off line loads for the NLS 1 and NLS 2 vehicles envelope sections of the aft structure.

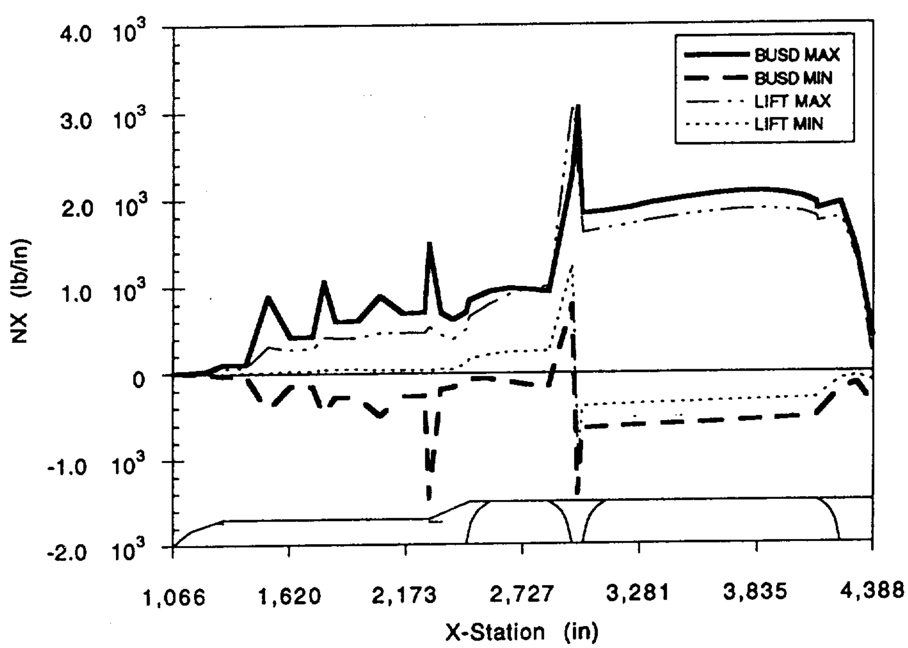

Figure 2. NLS 1 with STME out N_x max/min versus X-station.

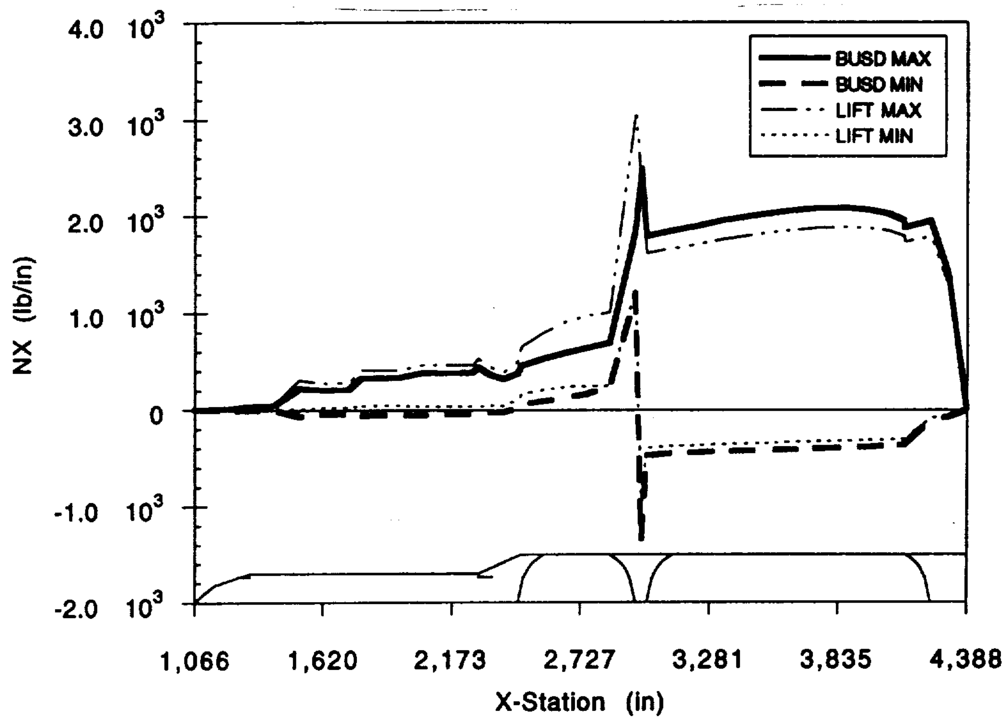

Figure 3. NLS 1 without STME out N_x max/min versus X-station.

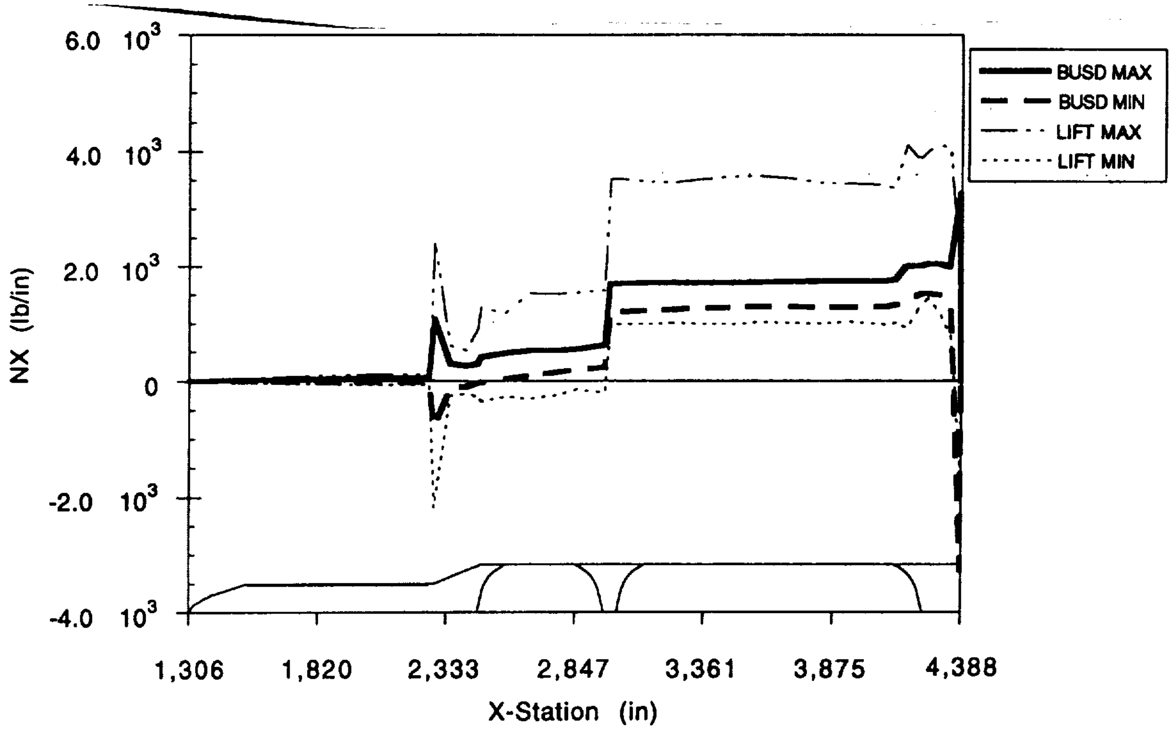

Figure 4. NLS 2 with STME out N_x max/min versus X-station.

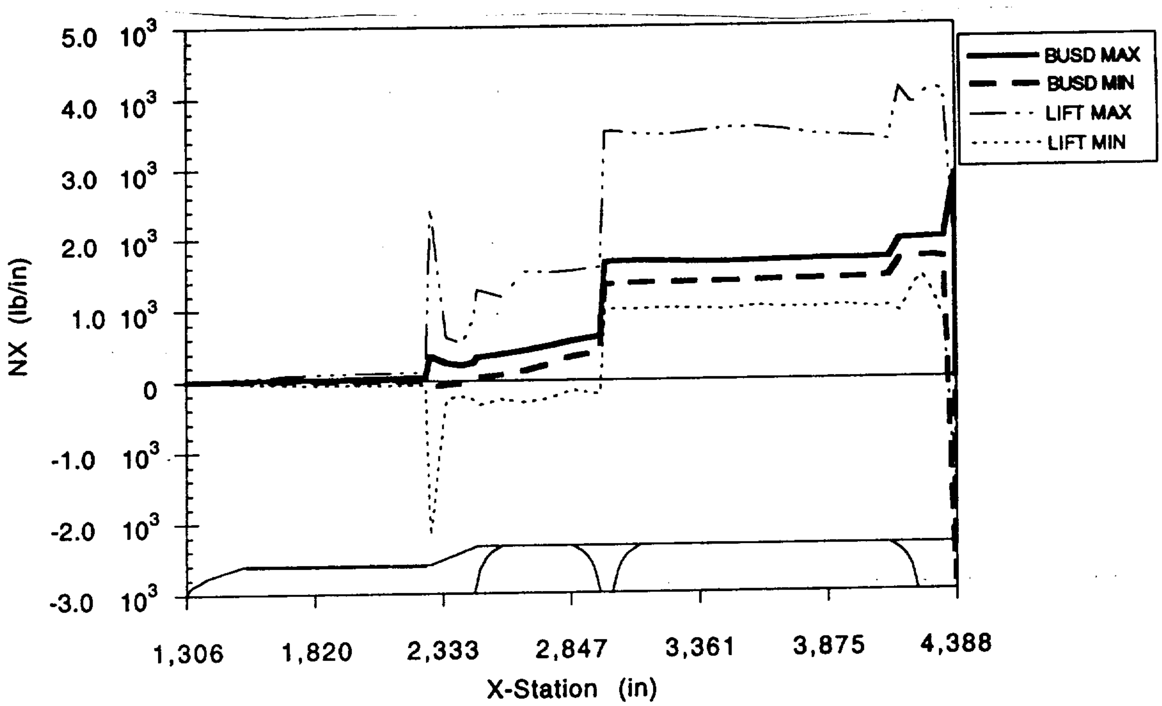

Figure 5. NLS 2 without STME out N_x max/min versus X-station.

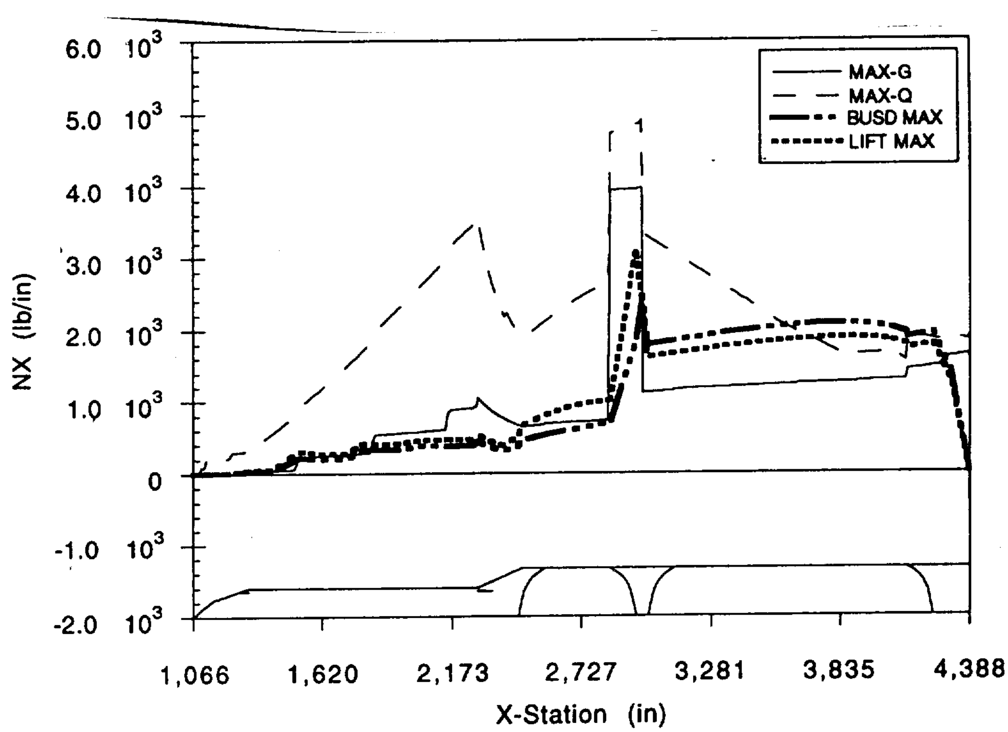

Figure 6. NLS 1 core without STME out N_x event comparison versus X-station.

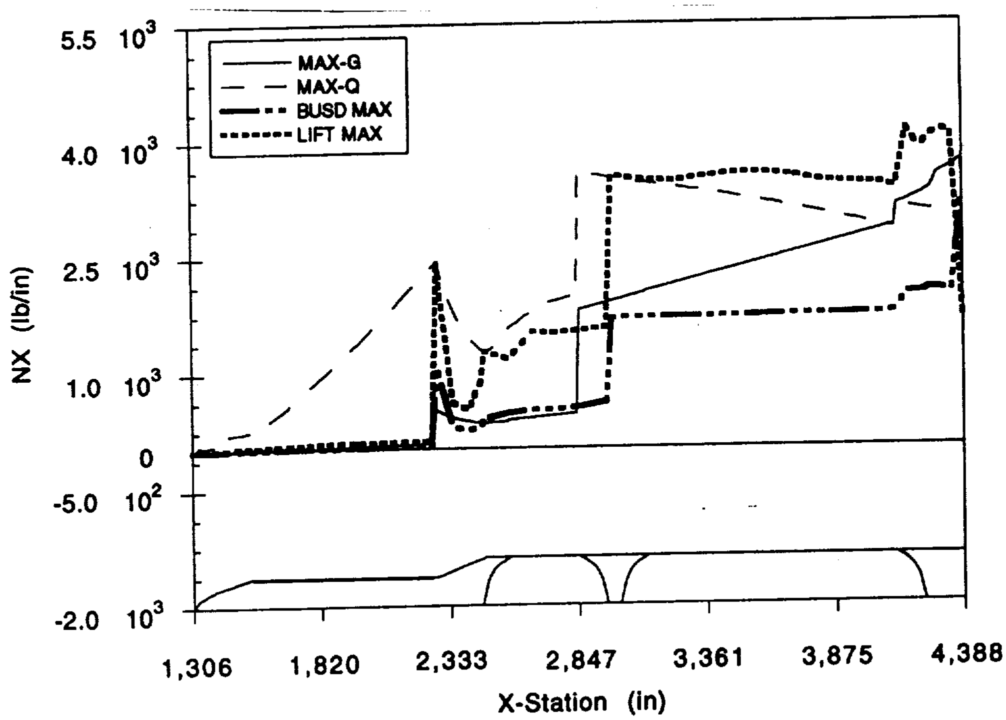

Figure 7. NLS 2 with STME out N_x event comparison versus X-station.

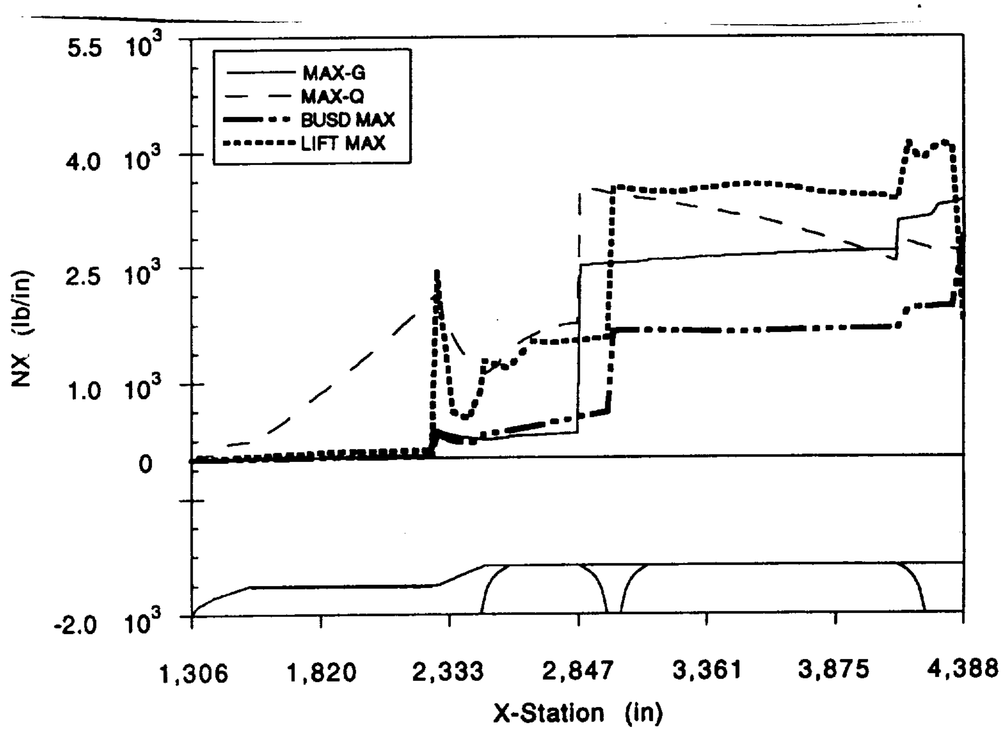

Figure 8. NLS 2 without STME out N_x event comparison versus X-station.

Next, the overall maximum line loads are plotted in figures 9 through 11. These values are tabulated in tables 1 through 3. The NLS 1 maximum line load values and the flight events which produced these maximums are given in table 1. NLS 2 maximum line load values are provided in table 2. The overall maximum line loads for both vehicles are tabulated in table 3 including the overall maximum design line loads for the CCS. This table further indicates the vehicle configuration and flight events corresponding to the maximum loading. Note that the NLS 1 vehicle "nominal" is the same as "engine out" for ascent flight events, therefore this condition was not analyzed. The CCS forward section has the highest line loads during max-q (NLS 1), while the CCS mid- to aft-section line loads are enveloped by lift-off and the static 180-day wind load case (NLS 2). The highest line load for the very aft section occurred during static 180-day wind load for the NLS 2 vehicle.

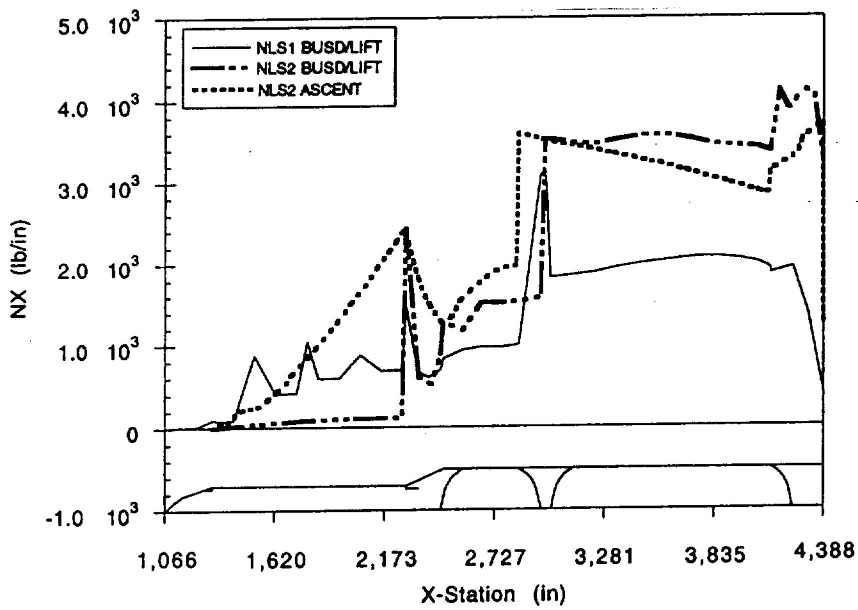

Figure 9. NLS 1 and NLS 2 with STME out N_x event comparison versus X-station.

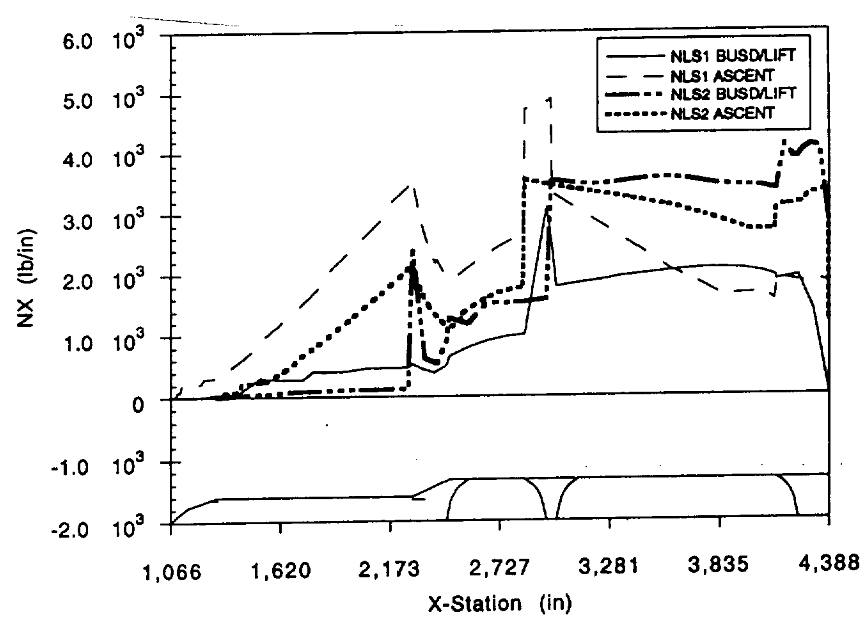

Figure 10. NLS 1 and NLS 2 without STME out N_x event comparison versus X-station.

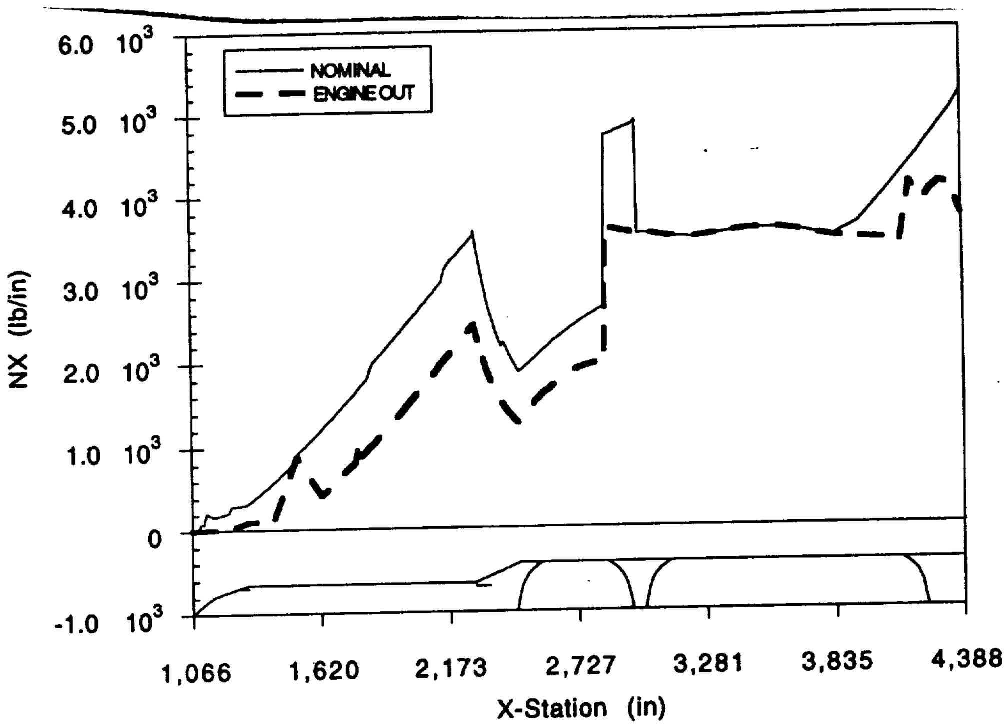

Figure 11. Overall NLS 1 and NLS 2 N_x line load comparison versus X-station.

The overall maximum and minimum design shear loads are provided in table 4 and are illustrated in figure 12.

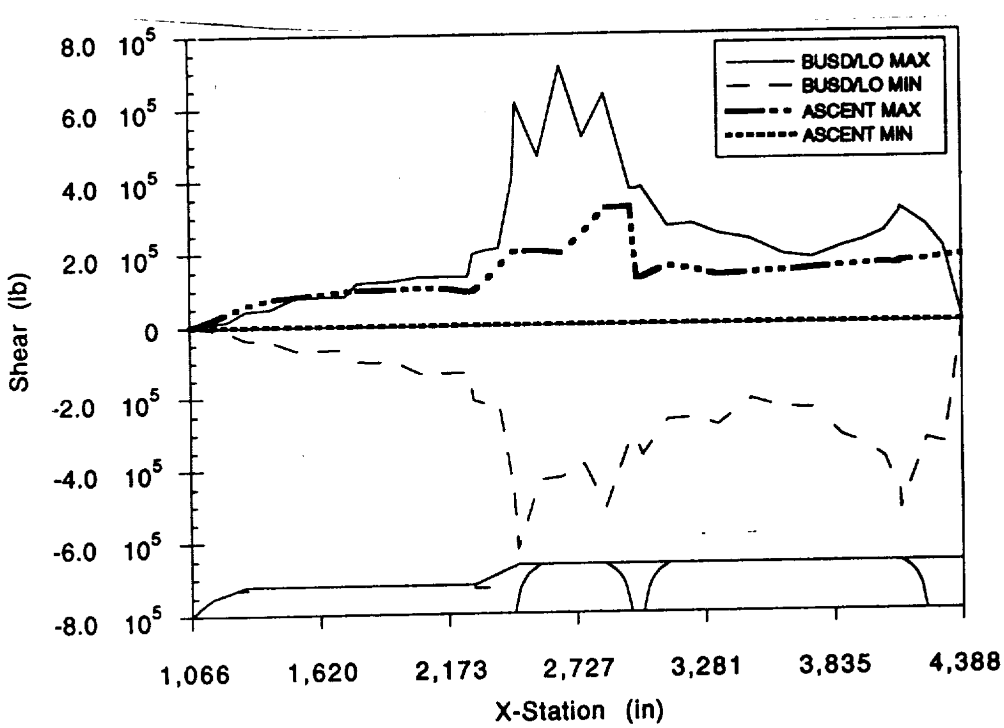

Figure 12. NLS 1 and NLS 2 maximum composite shear versus X-station.

Table 1. NLS 1 maximum line loads N_x (lb/in).

X-Station (in)	Max Value	Flight Condition
1,066.06	0	
1,110.6	84	MAX-Q
1,155.1	176	MAX-Q
1,229.75	292	MAX-Q
1,304.4	329	MAX-Q
1,411	578	MAX-Q
1,518	929	MAX-Q
1,625	1,120	MAX-Q
1,732	1,540	MAX-Q
1,784.4	1,700	MAX-Q
1,839	1,910	MAX-Q
1,946	2,290	MAX-Q
2,050.8	2,640	MAX-Q
2,160	3,100	MAX-Q
2,264.4	3,450	MAX-Q
2,284.8	3,570	MAX-Q
2,340.68	2,740	MAX-Q
2,396.57	2,180	MAX-Q
2,459.17	1,940	MAX-Q
2,473.8	1,870	MAX-Q
2,569.8	2,110	MAX-Q
2,664.13	2,320	MAX-Q
2,758.47	2,510	MAX-Q
2,852.8	4,730	MAX-Q
2,963.42	4,850	MAX-Q
2,990.67	3,320	MAX-Q
3,012.52	3,280	MAX-Q
3,123.15	3,050	MAX-Q
3,233.63	2,810	MAX-Q
3,337.35	2,600	MAX-Q
3,480.57	2,300	MAX-Q
3,623.8	2,046	BUILDUP/SHUTDOWN
3,747.4	2,073	BUILDUP/SHUTDOWN
3,871	2,077	BUILDUP/SHUTDOWN
3,964.5	2,058	BUILDUP/SHUTDOWN
4,054	2,014	BUILDUP/SHUTDOWN
4,118.65	1,944	BUILDUP/SHUTDOWN
4,122.65	1,910	MAX-Q
4,233.27	1,947	BUILDUP/SHUTDOWN
4,309.4	1,890	MAX-Q
4,385.5	1,900	MAX-Q

Table 2. NLS 2 maximum line loads N_x (lb/in).

X-Station (in)	Max Value	Flight Condition
1,306.1	0	
1,395.1	84.6	MAX-Q*
1,444.9	214	MAX-Q*
1,494.6	238	MAX-Q*
1,544.4	261	MAX-Q*
1,624.4	430	MAX-Q*
1,704.4	633	MAX-Q*
1,784.4	850	MAX-Q*
1,864.4	1,090	MAX-Q*
1,944.4	1,310	MAX-Q*
2,024.4	1,580	MAX-Q*
2,104.4	1,850	MAX-Q*
2,184.4	2,100	MAX-Q*
2,264.4	2,380	MAX-Q*
2,284.8	2,440	LIFT-OFF*
2,347.8	1,800	MAX-Q*
2,410.8	1,470	MAX-Q*
2,459.2	1,300	MAX-Q*
2,471.1	1,278	LIFT-OFF*
2,569.8	1,580	MAX-Q*
2,664.1	1,790	MAX-Q*
2,758.5	1,930	MAX-Q*
2,852.8	3,600	MAX-Q*
2,963.4	3,530	MAX-Q*
2,985.7	3,520	MAX-Q*
3,012.5	3,531	LIFT-OFF*
3,123.1	3,483	LIFT-OFF*
3,240	3,469	LIFT-OFF*
3,356.9	3,521	LIFT-OFF*
3,473.7	3,566	LIFT-OFF*
3,590.6	3,573	LIFT-OFF*
3,707.4	3,536	LIFT-OFF*
3,824.3	3,463	LIFT-OFF*
3,941.1	3,633.6	Static/180
4,058	3,995.2	Static/180
4,090.3	4,100.8	Static/180
4,122.6	4,207.6	Static/180
4,166.6	4,359.9	Static/180
4,210.3	4,514	Static/180
4,227.4	4,583.8	Static/180
4,254	4,683.2	Static/180
4,297.8	4,841.8	Static/180
4,341.6	5,002.7	Static/180
4,385.5	5,212.7	Static/180

* Engine out

Table 3. NLS overall maximum line loads N_x (lb/in).

X-Station (in)	Max Value	Vehicle	Flight Condition
1,066.1	0		
1,114.1	84	NLS 1	MAX-Q
1,155.1	176	NLS 1	MAX-Q
1,234.1	292	NLS 1	MAX-Q
1,304.4	329	NLS 1	MAX-Q
1,414.1	578	NLS 1	MAX-Q
1,522.1	929	NLS 1	MAX-Q
1,630.1	1,220	NLS 1	MAX-Q
1,738.1	1,540	NLS 1	MAX-Q
1,786.1	1,700	NLS 1	MAX-Q
1,834.1	1,910	NLS 1	MAX-Q
1,942.1	2,290	NLS 1	MAX-Q
2,050.1	2,640	NLS 1	MAX-Q
2,158.1	3,100	NLS 1	MAX-Q
2,264.4	3,450	NLS 1	MAX-Q
2,284.4	3,570	NLS 1	MAX-Q
2,338.1	2,740	NLS 1	MAX-Q
2,398.1	2,180	NLS 1	MAX-Q
2,459.4	1,940	NLS 1	MAX-Q
2,473.8	1,870	NLS 1	MAX-Q
2,569.8	2,110	NLS 1	MAX-Q
2,662.1	2,320	NLS 1	MAX-Q
2,758.1	2,510	NLS 1	MAX-Q
2,852.8	4,730	NLS 1	MAX-Q
2,963.2	4,850	NLS 1	MAX-Q
3,012.5	3,531	NLS 2	LIFT-OFF*
3,123.1	3,483	NLS 2	LIFT-OFF*
3,240	3,469	NLS 2	LIFT-OFF*
3,356.9	3,521	NLS 2	LIFT-OFF*
3,473.7	3,566	NLS 2	LIFT-OFF*
3,590.6	3,573	NLS 2	LIFT-OFF*
3,707.4	3,536	NLS 2	LIFT-OFF*
3,824.3	3,463	NLS 2	LIFT-OFF*
3,941.1	3,633.6	NLS 2	Static/180
4,058	3,995.2	NLS 2	Static/180
4,090.3	4,100.8	NLS 2	Static/180
4,122.6	4,207.6	NLS 2	Static/180
4,166.6	4,359.9	NLS 2	Static/180
4,210.3	4,514	NLS 2	Static/180
4,227.4	4,583.8	NLS 2	Static/180
4,254	4,683.2	NLS 2	Static/180
4,297.8	4,841.8	NLS 2	Static/180
4,341.6	5,002.7	NLS 2	Static/180
4,385.5	5,212.7	NLS 2	Static/180

* Engine out

Table 4. NLS overall max/min shear loads (lb).

X-Station (in)	Max Value	Vehicle	Flight Condition		X-Station (in)	Min Value	Vehicle	Flight Condition
1,066.06	384.8	NLS 1	MAX-Q		1,066.06	–235.7	NLS 1	BUSD
1,110.6	7,490	NLS 1	MAX-Q		1,110.6	–3,069	NLS 1	BUSD
1,155.1	18,700	NLS 1	MAX-Q		1,155.1	–7,452	NLS 1	BUSD
1,229.75	37,800	NLS 1	MAX-Q		1,229.75	–3,540	NLS 1	BUSD
1,304.4	57,800	NLS 1	MAX-Q		1,304.4	–37,510	NLS 1	BUSD
1,411	75,700	NLS 1	MAX-Q	S	1,411	–40,660	NLS 1	BUSD
1,518	81,600	NLS 1	MAX-Q	H	1,518	–67,650	NLS 1	BUSD
1,625	88,300	NLS 1	MAX-Q	R	1,625	–67,660	NLS 1	BUSD
1,732	95,600	NLS 1	MAX-Q	O	1,732	–65,200	NLS 1	BUSD
1,784.4	116,700	NLS 1	BUSD	U	1,784.4	–99,170	NLS 1	BUSD
1,839	120,400	NLS 1	BUSD	D	1,839	–100,900	NLS 1	BUSD
1,946	122,500	NLS 1	BUSD		1,946	–100,300	NLS 1	BUSD
2,050.8	133,700	NLS 1	BUSD		2,050.8	–134,500	NLS 1	BUSD
2,160	133,700	NLS 1	BUSD		2,160	–134,500	NLS 1	BUSD
2,264.4	133,000	NLS 1	BUSD		2,264.4	–133,700	NLS 1	BUSD
2,284.8	195,300	NLS 2	LIFT-OFF		2,284.8	–211,100	NLS 2	LIFT-OFF
2,340.68	204,800	NLS 2	LIFT-OFF		2,340.68	–222,400	NLS 2	LIFT-OFF
2,396.57	209,400	NLS 2	LIFT-OFF		2,396.57	–228,000	NLS 2	LIFT-OFF
2,459.17	404,600	NLS 2	LIFT-OFF		2,459.17	–468,400	NLS 2	LIFT-OFF
2,473.8	612,500	NLS 2	LIFT-OFF		2,473.8	–625,100	NLS 2	LIFT-OFF
2,569.8	461,400	NLS 2	LIFT-OFF		2,569.8	–433,600	NLS 2	LIFT-OFF
2,664.13	711,300	NLS 2	LIFT-OFF		2,664.13	–425,700	NLS 2	LIFT-OFF
2,758.47	515,000	NLS 2	LIFT-OFF		2,758.47	–390,400	NLS 2	LIFT-OFF
2,852.8	634,100	NLS 2	LIFT-OFF	C	2,852.8	–511,500	NLS 2	LIFT-OFF
2,963.42	370,800	NLS 2	LIFT-OFF	O	2,963.42	–312,800	NLS 2	LIFT-OFF
2,990.67	370,500	NLS 2	LIFT-OFF	M	2,990.67	–334,500	NLS 1	BUSD
3,012.52	375,900	NLS 2	LIFT-OFF	M	3,012.52	–367,100	NLS 2	LIFT-OFF
3,123.15	267,800	NLS 2	LIFT-OFF	O	3,123.15	–269,300	NLS 1	BUSD
3,233.63	272,800	NLS 2	LIFT-OFF	N	3,233.63	–265,400	NLS 2	LIFT-OFF
3,337.35	245,800	NLS 2	LIFT-OFF		3,337.35	–285,000	NLS 2	LIFT-OFF
3,480.57	227,500	NLS 2	LIFT-OFF	C	3,480.57	–214,600	NLS 1	BUSD
3,623.8	185,000	NLS 2	LIFT-OFF	O	3,623.8	–238,800	NLS 2	LIFT-OFF
3,747.4	175,800	NLS 1	BUSD	R	3,747.4	–242,300	NLS 2	LIFT-OFF
3,871	204,900	NLS 1	BUSD	E	3,871	–317,900	NLS 2	LIFT-OFF
3,964.5	222,000	NLS 1	BUSD		3,964.5	–339,600	NLS 2	LIFT-OFF
4,054	246,700	NLS 1	BUSD		4,054	–379,400	NLS 2	LIFT-OFF
4,118.65	298,100	NLS 2	LIFT-OFF		4,118.65	–473,800	NLS 2	LIFT-OFF
4,122.65	312,500	NLS 2	LIFT-OFF		4,122.65	–522,500	NLS 2	LIFT-OFF
4,233.27	263,000	NLS 2	LIFT-OFF		4,233.27	–329,300	NLS 2	LIFT-OFF
4,341.57	213,591	NLS 2	Static/180		4,309.4	–341,600	NLS 2	LIFT-OFF
4,385.5	215,157	NLS 2	Static/180		4,385.5	–12,430	NLS 1	BUSD

B. Interface Design Loads Summary

The overall maximum interface loads for the NLS 1 and NLS 2 vehicles are given in this section. Table 5 contains the overall maximum and minimum interface loads between the NLS 1 vehicle and the ASRB's. The locations and load directions for the interface loads and members are shown in figures 1 and 27. The NSTS limits are exceeded at the forward ASRB/CCS interface in the x and y directions and at the aft ASRB/CCS interface in the aft ASRB/CCS interface in the y direction. Table 6 contains the overall maximum and minimum interface loads between the NLS 2 and launch pad. These values along with the overall maximum line loads and overall max/min shear loadings comprise the CCS design loads.

Table 5. NLS 1 interface loads summary.

Member	Max Load (kips)	Min Load (kips)	NSTS Upper Limit	NSTS Lower Limit	Flight Condition
FTB1	59	–128	212	–190	Prelaunch
FTB2	64	–129	214	–206	Prelaunch
FTB3	211	–147	212	–95	Lift-off/Pre
FTB4	142	–229	86	–219	Pre/Lift-off
FTB5	419	–1,332	178	–1,672	Prelaunch
FTB6	254	–1,348	156	–1,672	Ascent/Pre
FTB7	85	–71	247	–233	Prelaunch
FTB8	80	–71	263	–224	Prelaunch
FTB9U	104	–113	295	–256	Pre/Lift-off
FTB10U	111	–102	277	–293	Lift-off/Pre
FTBA	121	–122	127	–267	Pre/Lift-off
FTBB	115	–126	277	–121	Lift-off/Pre
P(08)	66	–21	271	264	Ascent
P(09)	67	–24	358	–291	Ascent
P(10)	41	–38	233	–274	Ascent
P(11)	66	–21	265	–299	Ascent
P(12)	67	–24	296	–274	Ascent
P(13)	41	–38	244	–258	Ascent
MTBLS	9,235	–9,000	11,800	–11.800	Ascent
MTBRS	8,994	–9,238	11,800	–11,800	Ascent

Table 6. NLS 2 interface loads summary.

Pad Number	Max Load (kips) X–dir	Y–dir	Z–dir	Min Load (kips) X–dir	Y–dir	Z–dir
M1	320	95	30	–975	–65	–65
M2	709	68	21	–587	–81	–35
M3	718	38	21	–597	–65	–61
M4	284	46	59	–942	–44	–28

The overall maximum and minimum ASRB to launch pad loads are provided in table 7. These values should be checked against current ASRB aft skirt design. The pad locations are shown in figure 13.

Table 7. ASRB to launch pad loads summary.

Pad Number	Max Load (kips) X-dir	Y-dir	Z-dir	Min Loads (kips) X-dir	Y-dir	Z-dir
M1	1,243	219	190	–1,015	–301	–227
M2	1,452	394	304	–1,274	–261	–326
M3	237	124	207	–697	–92	–6
M4	894	135	317	–1,008	–163	–299
M5	1,243	300	189	–1,021	–221	–225
M6	1,453	265	212	–1,296	–394	–318
M7	490	91	213	–697	–124	–164
M8	181	163	307	–957	–96	–108

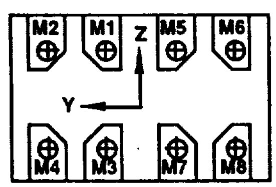

Figure 13. MLP locations for holddown pad loads.

The maximum LO_2 and LH_2 slosh mass accelerations were computed for both prelaunch (buildup and shutdown) and lift-off. From these values, a maximum aft bulk head pressure was computed using the ullage pressures of 20 lb/in^2 gauge for LO_2 and 32 lb/in^2 gauge for LH_2. The maximum aft bulk head pressures are:

Tank	Pressure	Vehicle	Event
LO_2	54.0 lb/in^2	NLS 2	Prelaunch
LH_2	49.3 lb/in^2	NLS 2	Lift-off

The overall payload accelerations for the NLS 1 and NLS 2 vehicles are provided in the tables below:

NLS 1 30/40/30K Payload Maximum Accelerations

Direction	Value (±G's)	Flight Condition
X	5.1	Buildup/Shutdown*
Y	2.3	Buildup/Shutdown*
Z	2.7	Buildup/Shutdown*

* Engine Out case

NLS 2 50K Payload Maximum Accelerations

Direction	Value (±G's)	Flight Condition
X	6.2	Lift-off
Y	3.2	Lift-off
Z	2.5	Lift-off

C. NLS 2 Modified Titan IV Shroud Design Loads

As may be noted from figures 14 through 17, the Titan IV shroud capability as expressed as both a P_{eq} and V_{eq} load was considerably exceeded. Titan IV shroud capability was taken from reference 19. A substantial reduction in q-α and/or q-β is needed to maintain an adequate structural margin.

The q-α and q-β terms are the products of dynamic pressure and angle-of-attack and dynamic pressure and angle-of-sideslip, respectively.

In order to understand the problems with the Titan IV shroud, the P_{eq} results were used to develop the shroud capability in terms of the maximum allowable q-α or q-β. The results showed that even with the use of a load relief control system, the nominal vehicle would exceed the allowable limits. It is therefore recommended that the shroud be structurally reinforced or redesigned to meet the ascent loads environment.

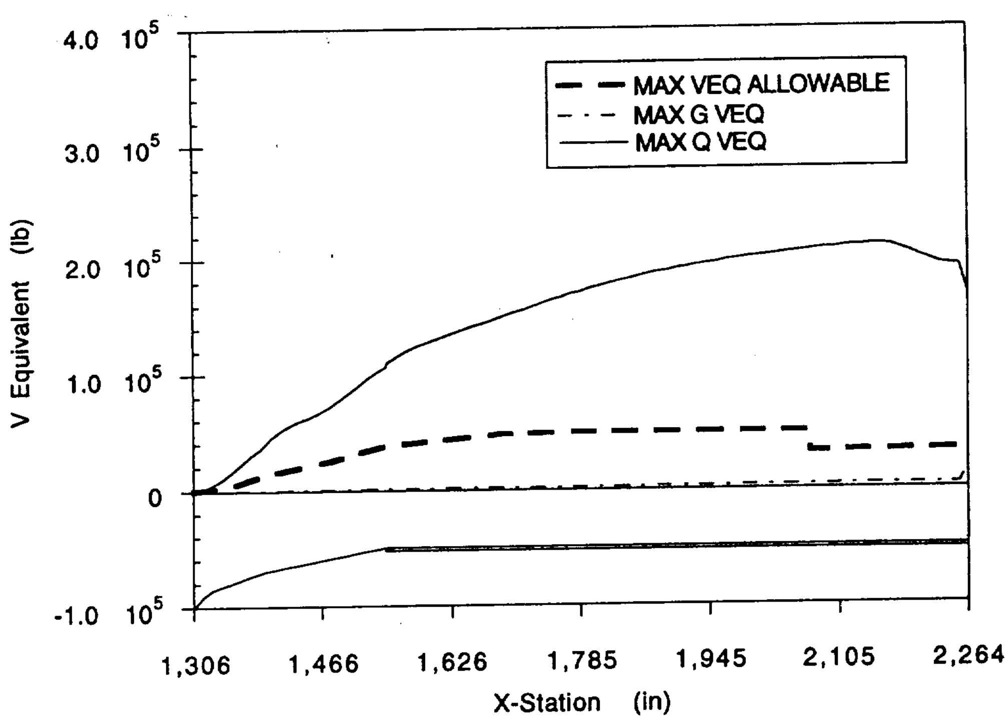

Figure 14. NLS 2 core ascent engine out overall max V_{eq} versus X-station.

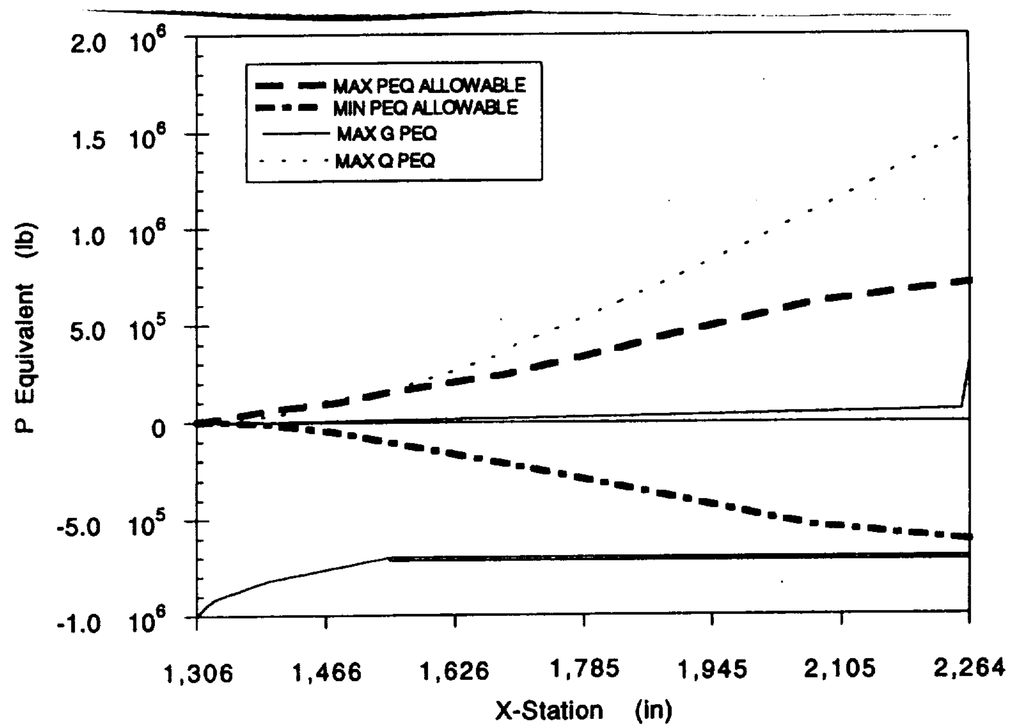

Figure 15. NLS 2 core ascent engine out overall max P_{eq} versus X-station.

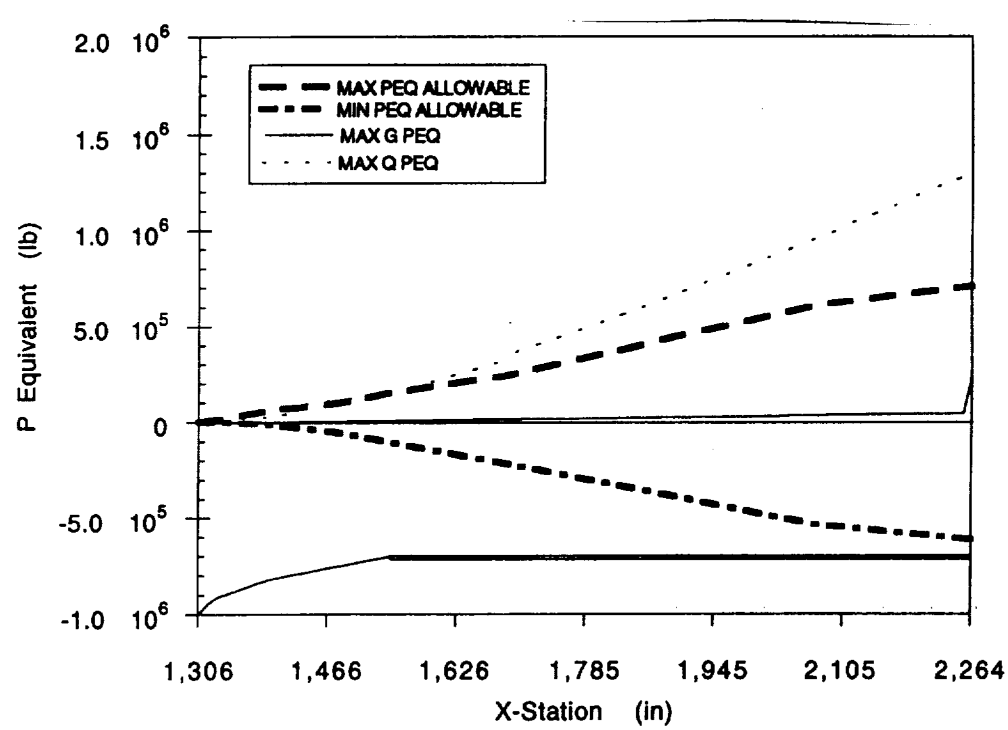

Figure 16. NLS 2 core ascent overall maximum P_{eq} versus X-station.

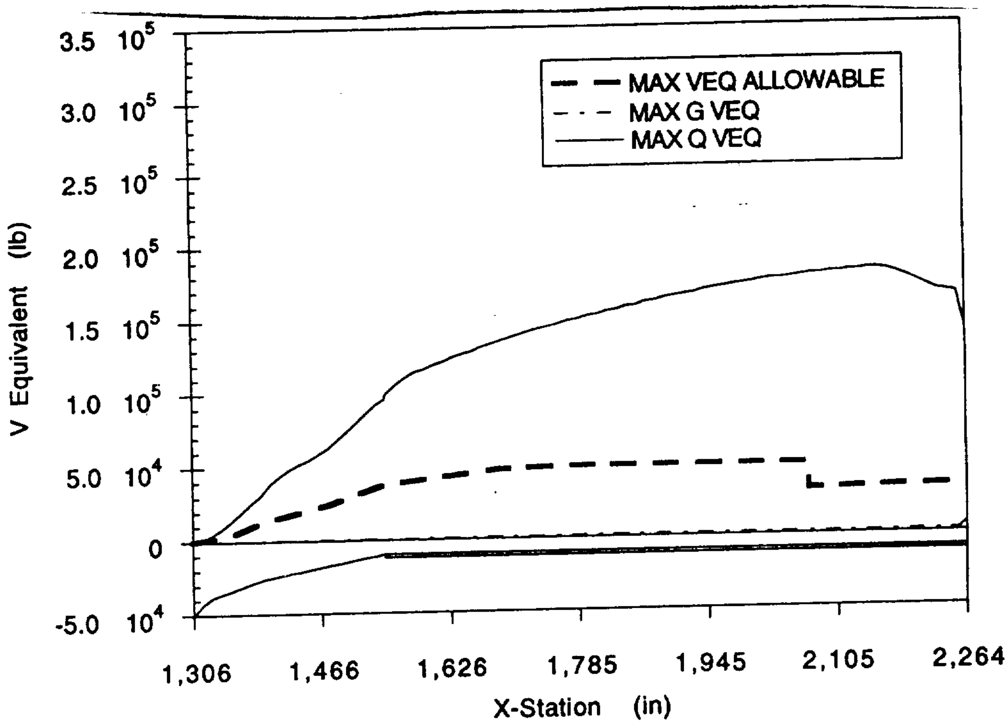

Figure 17. NLS 2 core ascent overall maximum V_{eq} versus X-station.

D. Comparison With Cycle 0 Baseline Loads

The cycle 1 results, obtained in this analysis, were compared to those results obtained in cycle 0 for like regimes of the NLS 1 and NLS 2 models. Figures 18 through 23 contain the comparisons between cycle 1 and cycle 0. The cycle 0 design case was rerun to eliminate tank pressures and is presented herein as a limit rather than ultimate load.

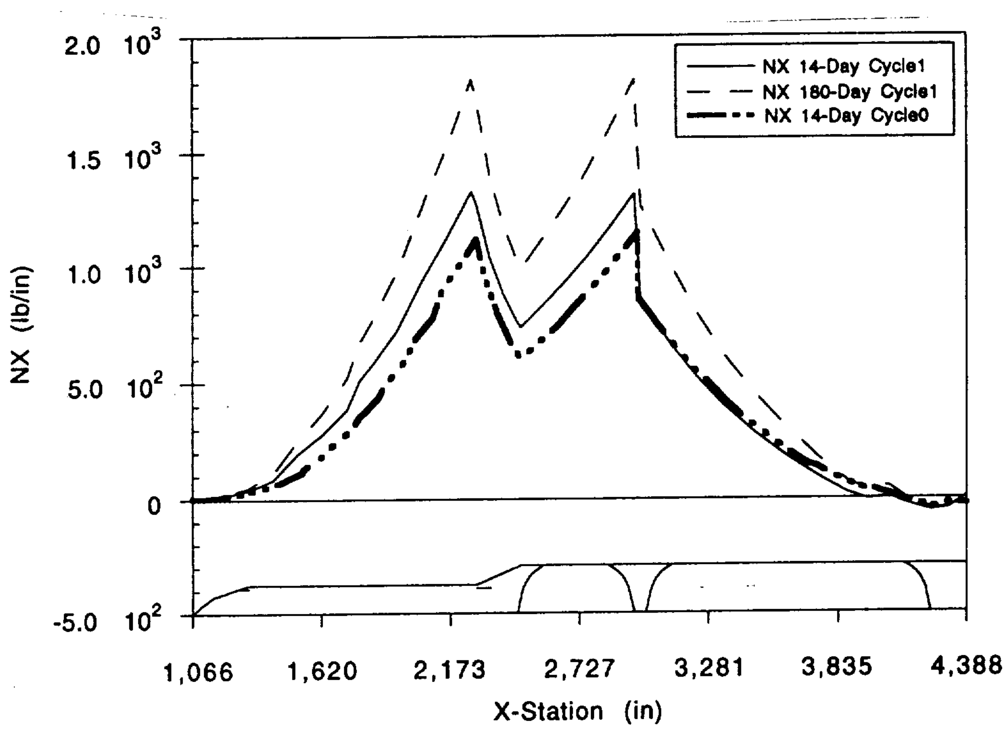

Figure 18. NLS 1 core prelaunch cycle 1 and cycle 0 static N_x comparison versus X-station.

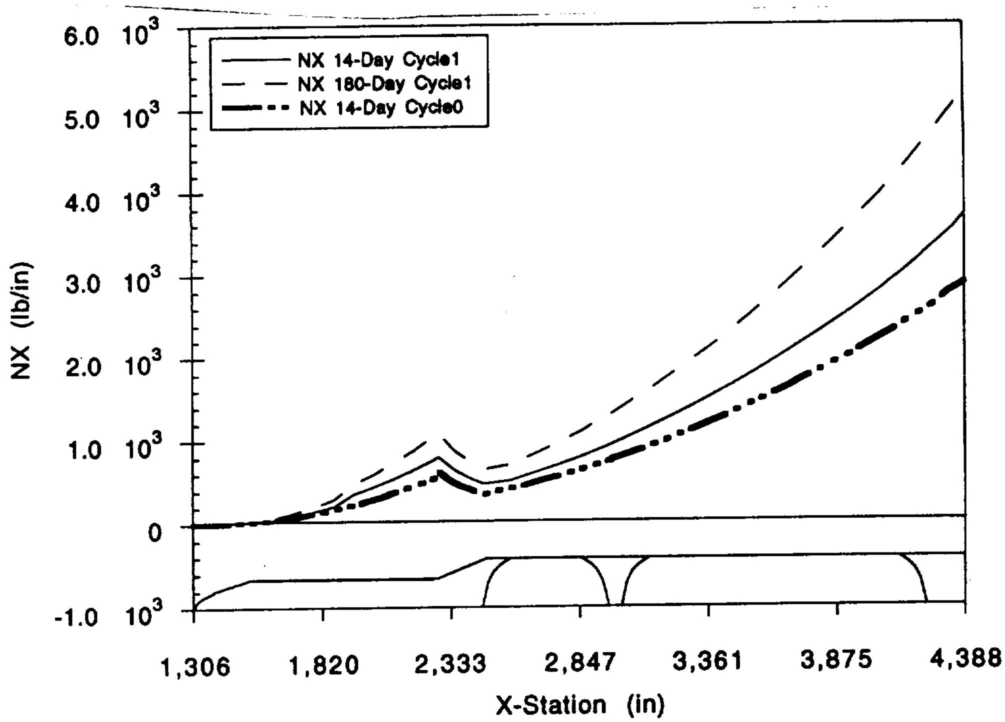

Figure 19. NLS 2 core prelaunch cycle 1 and cycle 0 static N_x comparison versus X-station.

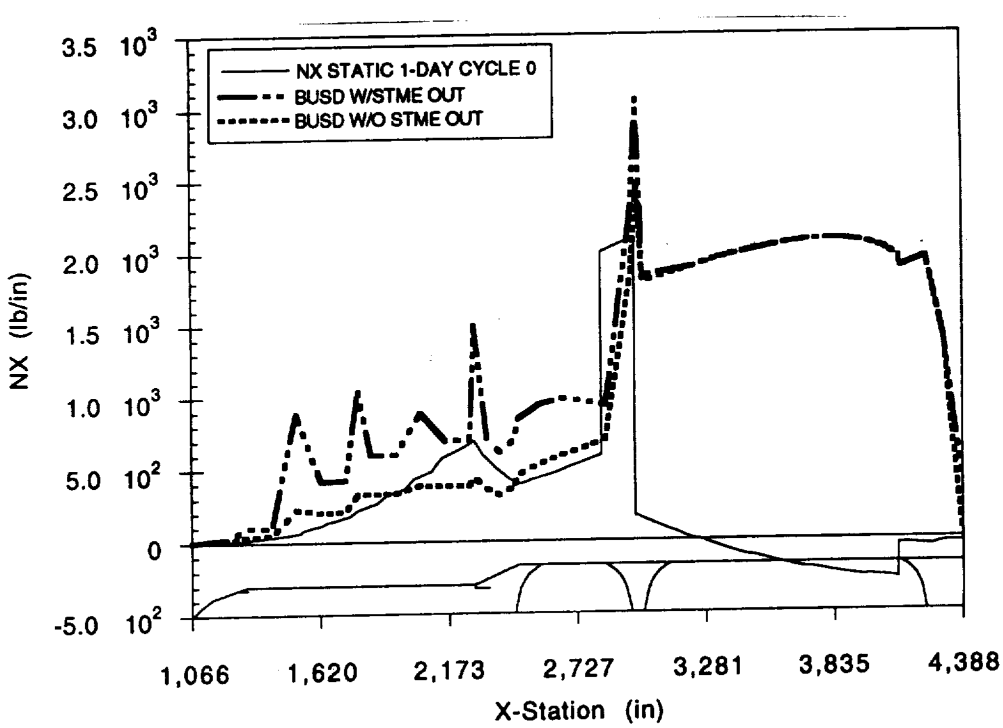

Figure 20. NLS 1 core prelaunch cycle 1 and cycle 0 N_x comparison versus X-station.

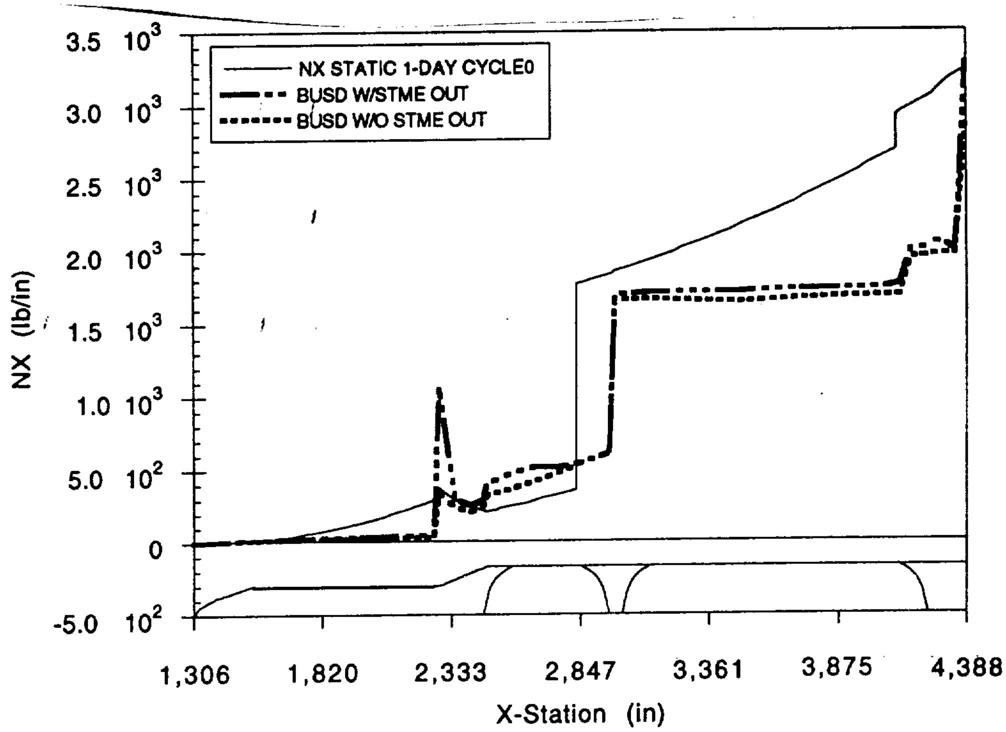

Figure 21. NLS 2 core prelaunch cycle 1 and cycle 0 N_x comparison versus X-station.

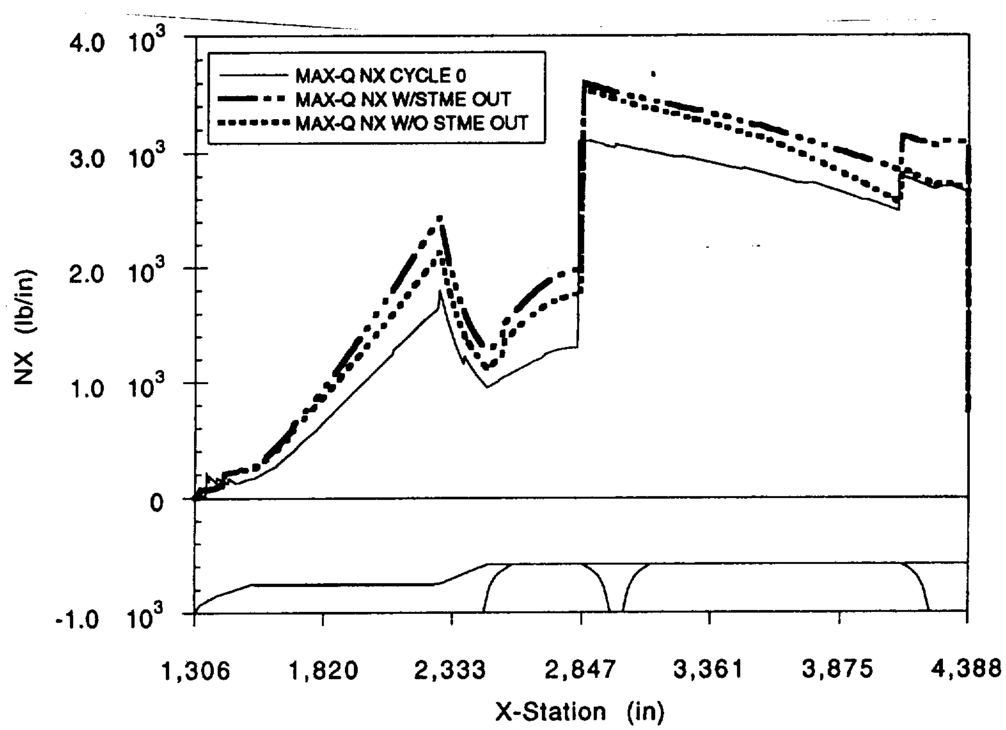

Figure 22. NLS core 2 max-q cycle 1 and cycle 0 N_x comparison versus X-station.

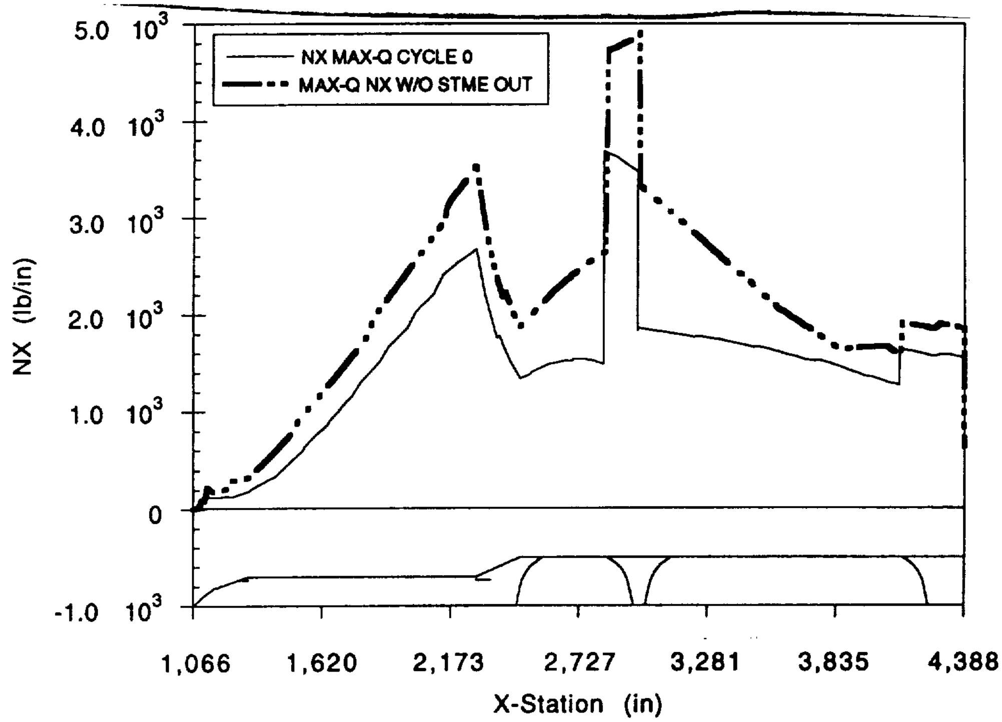

Figure 23. NLS 1 core max-q cycle 1 and cycle 0 N_x comparison versus X-station.

The following exceedances were noted for the max-q, buildup/shutdown, and prelaunch static regimes:

1. NLS 1 max-q results for cycle 1 runs envelope that of cycle 0 results.

2. NLS 1 prelaunch results from buildup and shutdown cases with engine out envelope those of cycle 0 except at the aft end of the LO_2 tank.

3. NLS 1 prelaunch static results for cycle 1 14-day winds envelope those of cycle 0 14-day winds for the LO_2 tank and above. The 180-day winds data obtained in cycle 1 exceed the other values throughout the entire vehicle.

4. NLS 2 max-q results for cycle 1 exceed those of cycle 0 throughout the vehicle except for the vehicle nose cap area.

5. NLS 2 prelaunch results for cycle 0 data exceed that of the cycle 1 except in an area extending from the payload adapter to the aft portion of the LO_2 tank.

6. NLS 2 prelaunch static results for 14-day winds show that cycle 1 exceeds those obtained in cycle 0 throughout the entire vehicle. The cycle 1 data for 180-day winds encompass both of these cases.

In general, the results obtained in cycle 1 encompass those from cycle 0. The exceedance noted for the NLS 1 model in cycle 0 is probably due to the lumping of the majority of the x-direction fuel weight at the bottom of the LO_2 tank for cycle 1 which shifted the cycle 1 results back. The only areas where cycle 0 exceeded those of cycle 1 were for the dynamic prelaunch cases in NLS 2 and a small area of exceedance in the nose cap area of the NLS 2 vehicle for the max-q results.

IV. STRUCTURAL DYNAMICS AND LOADS MODELS

A. Data Sources

1. Reference Configuration Drawings

The vehicle geometry of reference 1 was developed into detailed drawings and sketches of the NLS 1 and NLS 2 configurations in reference 2. All analyses herein are based on these vehicle locations. Figure 1 illustrates the NLS 1 and NLS 2 vehicle configurations.

2. Mass Properties

The NLS 1 and NLS 2 mass properties of reference 1 were incorporated in a set of detailed mass properties versus flight time for the NLS configurations in reference 4.

B. FORTRAN/NASTRAN Model Bulk Data

The NLS 1 and NLS 2 prelaunch and lift-off analyses were performed using various in-house developed finite element models and by also utilizing pre-existing finite element models. Ascent loads were developed utilizing a rigid-body approach with a combination of discrete and distributed aerodynamic and mass properties.

The prelaunch and lift-off finite element models were developed using NASTRAN and FORMA. The various models are as follows:

1. An in-house CCS vehicle flexible body (beam) model used for NLS 1 (HLLV) and NLS 2 (stage 1.5).

2. An NSTS mobile launch platform (MLP) flexible body model.

3. NSTS ASRB flexible body model used for boosters (nominal temperature only).

In order to accomplish the vehicle modeling and analysis in a minimum amount of time and to facilitate the start of the cycle 2 design stage, a number of assumptions and simplifications were made:

1. Lumped mass representation for payloads, FPM, and CTV.

   (a) NLS 1 payload was assumed to be three lumped masses (two 30-klb masses and one 40-klb mass) rigidly mounted to the payload shroud with their c.g. at center of shroud.

   (b) NLS 2 payload assumed a lumped mass rigidly mounted to payload adapter with the c.g. located at station X-1,997.58 inches.

2. NSTS external tank (ET) stiffness assumed for CCS.

3. Titan IV stiffness properties used for NLS 2 shroud flexible model.

4. NLS 1 ASRB/CCS vehicle interfaces assumed same as NSTS.

5. Slosh mass properties were approximated using single spring-mass systems to represent both the LO_2 and LH_2 fluid in the axial direction. The spring-mass systems were modeled using reference 18.

The NLS 2 model required that the thrust structure be modeled more accurately to appropriately represent the load paths in the vehicle. Reference 2 was used as a basis in modeling the thrust structure area. The thrust structure was tied into the stick vehicle model through rigid links. Figure 24 shows a close-up view of the thrust structure while figure 25 displays the overall representation of the NLS 2 vehicle.

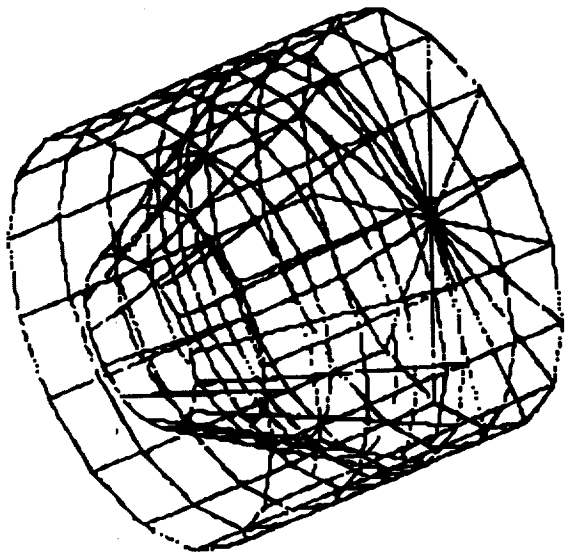

Figure 24. Thrust structure model representation.

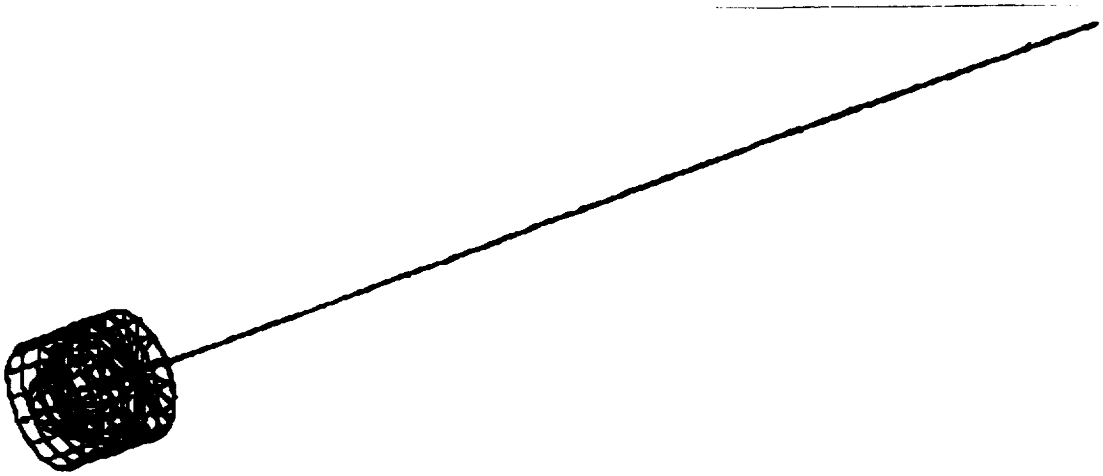

Figure 25. NLS 2 overall vehicle model.

Detailed mass properties are provided for the core stage in the appendix. Copies of the NASTRAN bulk data decks can also be found in the appendix.

C. Prelaunch and Lift-Off Model Modes and Frequencies

The mass and stiffness matrices for the prelaunch and lift-off configurations were reduced using standard reduction techniques and coupled together to give standard Craig-Bampton models.[15] These models were then analyzed to determine the vehicle characteristics as a function of mode shapes and frequencies of the uncoupled system of equations.

The vehicle prelaunch and lift-off frequencies, respectively, for the predominant selected modes below a cutoff frequency of 20 Hz are provided in tabulated form in the appendix.

V. LOADING EVENTS

The prelaunch (on pad) and lift-off loading conditions were selected to include requirements defined and implied in reference 1. All conditions which were known or suspected to define limit loads were assessed in the various analyses. These analyses included ground wind loads for appropriate on-pad stay times defined by reference 1. The loading conditions analyzed are defined and developed in the following paragraphs.

A. On-Pad (Ground Winds, STME Buildup/Shutdown)

Prelaunch loads include ground winds for appropriate on-pad stay times. For a free-standing launch vehicle, the wind loading is the only forcing function acting on the vehicle other than gravity. Additional prelaunch cases include STME thrust buildup and shutdown in a simulated flight readiness firing (FRF) or on-pad abort and one STME engine out prior to launch commit resulting in an on-pad abort.

1. Methodology/Assumptions

The methodology used for prelaunch analysis was essentially the same as that used in the lift-off analysis with the exception of releasing the vehicle from the launch pad. The vehicle dynamic responses were computed by integrating the uncoupled equations of motion with the appropriate forcing functions. The resulting response time histories were then used in conjunction with appropriate load transformation equation matrices to provide the load time histories. Maximum and minimum values of the vehicle responses including loads and body accelerations were stored on magnetic disk for later processing. Reference 16 describes the methodology in more detail and will not be repeated here for brevity.

The following assumptions were made in the analysis:

1. Simultaneous ignition command to all STME's.

2. One STME engine-out analysis performed for worst engine at worst time.

3. Vehicle parameter dispersions were utilized in a 2-σ worst-on-worst combination.

4. An uncertainty factor K_v of 1.5 was applied to the dynamic response loads to account for the lack of design/model maturity.

5. Damping of all flexible body modes was assumed to be 1 percent of critical in the analyses.

2. Input Data Requirements and Sources

a. Ground Winds Criteria

All ground wind speeds were selected from reference 5 to satisfy the requirements of reference 1. The following wind speeds and corresponding probability levels were selected to meet the pad stay time requirements. All wind speeds were taken at the 99-percent probability level. The following wind criteria were selected to satisfy design requirements:

1. 180-day exposure—74.5 knot peak ground wind speed (unpressurized vehicle).

2. 14-day exposure—60.4 knot peak ground wind speed (unpressurized vehicle).

3. One-day exposure—47.0 knot peak ground wind speed (pressurized vehicle).

All wind speeds were referenced to the Kennedy Space Center (KSC) 60-foot pad light pole reference level. The wind loading was divided into two parts—the drag load and the vortex shedding load. The drag load was assumed to act parallel to the wind vector, and the vortex shedding was assumed to act normally to the wind vector. The wind loads were computed using a drag coefficient C_d of 1.0 for a simple cylinder (NLS 2) and a C_d of 1.5 for the multicylinder arrangement (NLS 1). An uncertainty factor of K_v of 1.5 was applied to the design wind loads to account for vortex shedding.

b. Forcing Functions/STME's

Forcing functions, which are the applied forces on the vehicles, were developed using the data provided in reference 14. Variations in the STME thrust profiles in conjunction with the ground winds provided the forcing functions used to assess the FRF and on-pad abort loads. A simultaneous ignition command was assumed applied to all STME's for the rebound analysis (FRF or on-pad abort). The STME thrust time history profiles are provided in the appendix. A total of 17 prelaunch forcing function cases for NLS 1 and 8 prelaunch forcing function cases for NLS 2 were developed using the STME thrust and applied wind data. Tables in the appendix give full details of each forcing function and which parameters were varied. These parameters include STME thrust levels, STME thrust misalignment, wind directions and speeds, and time of STME out conditions.

3. Loads Results for NLS 2

The NLS 2 vehicle was analyzed for prelaunch using the eight forcing functions listed in the appendix along with the static on-pad wind conditions listed in section 2.a. Results from the analyses include accelerations of the payload c.g. and the slosh masses of LO_2 and LH_2. Shear and moment body loads of the NLS 2 vehicle were also recovered along with the vehicle line loads (N_x). The line load is defined as:

$$N_x = F_x/(2\pi R) \pm (M_y^2 + M_z^2)^{1/2}/(\pi R^2) \text{ (lb/in)} ,$$

where R is the radius of the vehicle, M_y and M_z are the moments of the vehicle, and F_x is the axial shear. Interface loads of the CCS to the pad were also computed.

a. Interface Loads/Accelerations

The NLS 2 holddown pad loads were computed for the CCS-to-pad interface. The composite maximum and minimum pad forces are tabulated and are given in the appendix. The largest values occur during the rebound of an abort condition with one STME out. The values for the maximum loaded hold-down location are:

$$F_x = -975 \text{ kips (compression)}$$

$$F_y = 95 \text{ kips}$$

$$F_z = 59 \text{ kips} \ .$$

Composite maximum and minimum net c.g. accelerations for the 50-kips payload and the slosh masses of LO_2 and LH_2 were also computed and are tabulated in the appendix. Maximum acceleration values for the 50-kips payload occurred during rebound with an STME out condition. The maximum values are: 3.95 g's in the x direction and 0.9 g's in both the y and z directions. All tabulated composite results in the appendix are separated according to nominal and engine-out conditions.

b. Distributed Body Loads

The distributed body loads for NLS 2 CCS have been computed. The distributed body loads include the shear, moment, and line loads. Composite maximum and minimum values of the distributed loads are tabulated and plotted versus the NLS 2 CCS axial (X) stations in the appendix. The tables and plots of the distributed loads are for nominal and engine-out conditions. Distributed loads for on-pad static cases were also computed. These include the 180-day and 14-day winds. The distributed loads for these cases are tabulated and are given in the appendix.

The peak loads for the NLS 2 occur during the event of STME out and the static wind case with 180-day winds. For the on-pad conditions analyzed, the maximum distributed loads for the CCS are:

max. shear = 215.0 kips (180-day winds)

max. moment = 302.4 million in-lb (180-day winds).

These values occur at the station X-4,385.5, i.e., the base of the NLS 2 vehicle. Line loads for the NLS 2 vehicle are in the appendix in both tables and plotted versus X-station. The peak line load value for NLS 2 occurs at station X-4,385.5 and has a value of 3,276 lb/in. The line loads are recommended for the cycle 1 design.

4. Loads Results for NLS 1

The NLS 1 vehicle was analyzed for prelaunch using the 17 forcing functions listed in the appendix. Results from the analyses include net c.g. accelerations of the three payloads, the CTV, the FPM, and the slosh masses of LO_2 and LH_2. Distributed body loads of the CCS were also recovered which include axial and transverse shear, torsion, and moments. Line loads (N_x) for the CCS were also recovered. Line loads were computed as defined in section A.3. All results were computed nominal and engine-out conditions. Interface loads of the ASRB's to pad and ASRB's to CCS were also computed.

a. **Interface Loads/Accelerations**

Composite maximum and minimum interface loads of the ASRB to pad and ASRB to CCS are tabulated in the appendix. The interfaces are tabulated for nominal and engine-out conditions. The maximum holddown pad loads occurred during a rebound case with an STME out condition. Values for the maximum loaded aft skirt holddown location are:

$$F_x = -1{,}296 \text{ kips (compression)}$$

$$F_y = 264 \text{ kips}$$

$$F_z = 326 \text{ kips} \quad .$$

NLS 1 prelaunch composite maximum and minimum interface loads for the CCS to ASRB are tabulated in the appendix. Figure 26 illustrates the attach point locations and the interface load component directions. Some of the interface loads are higher than design values given for NSTS. NSTS design loads are exceeded in the x and y directions at the forward ASRB/CCS attach and in the y direction at the aft attach. Once again, the highest values occurred during a rebound case with STME out condition.

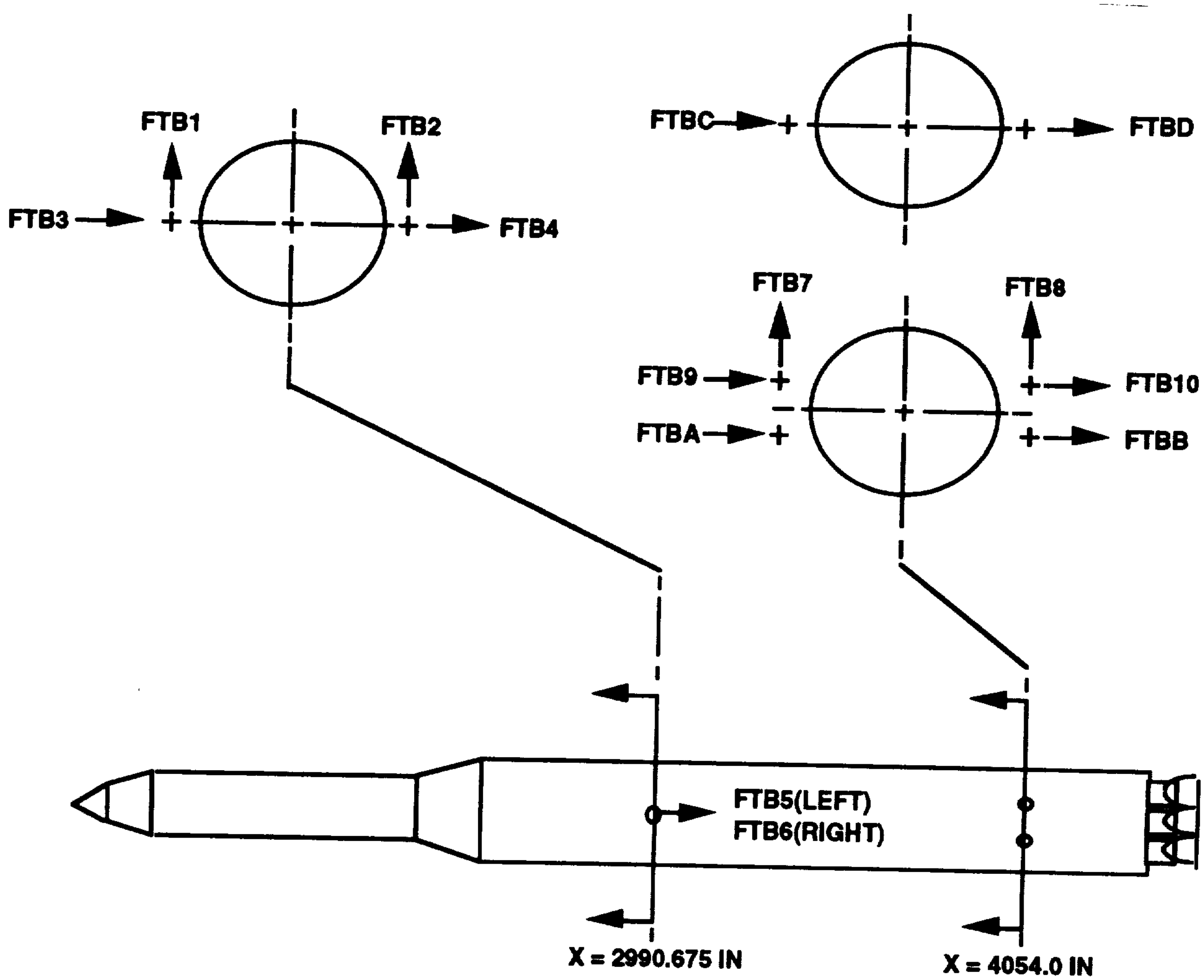

Figure 26. NLS 1 interface loads and directions.

The composite maximum and minimum net c.g. accelerations of the three payloads, along with the CTV, FPM, and slosh masses for LO_2 and LH_2, are provided in tabular form in the appendix. Of the three payloads, the forward 30-kip payload received the highest accelerations during a rebound condition with an STME out. Maximum accelerations for the CTV, FPM, and the forward payload were as follows:

	X-dir	Y-dir	Z-dir
CTV	3.8 g's	1.3 g's	1.8 g's
FPM	5.6 g's	4.7 g's	5.0 g's
30 k Payload	5.1 g's	1.7 g's	1.8 g's

b. Core Vehicle Distributed Body Loads

The distributed body loads for NLS 1 CCS have been computed. These include the axial and transverse shears, torsion and bending moments, and the line loads. Composite maximum and minimum values of the distributed loads are tabulated and plotted versus the NLS 1 CCS X-station in the appendix. The composites are separated according to nominal and engine-out conditions. The static shear and moment values for the CCS were also computed and are tabulated in the appendix. The peak distributed load for the NLS 1 vehicle occurs during a rebound condition with an STME out. The maximum transverse shear and moment recovered are:

Shear = 521 kips (z-dir, station X-2,473.8)
Moment = 113 million in-lb (y-dir, station X-2,758.47).

Line loads for the NLS 1 vehicle are in the appendix in tables and plotted versus X-station. Peak line load values for NLS 1 occur at station X-2,990.67 and have the value of 3,056 lb/in. The line loads are recommended for the cycle 1 design.

5. On-Pad Prelaunch Loads Summary

The overall peak dynamic loads occur during the on-pad event of rebound (FRF) with an STME out abort condition. Only the NLS 2 vehicle has higher bending moments during the static 180-day wind load case (302.4 million in-lb). Some of the NLS 1 vehicle interface loads for the CCS to ASRB's were higher than NSTS allowables. The interface loads which are higher need to be considered for local interface design of the CCS. It is recommended that the N_x line loads be used for design of the CCS.

The NLS 1 vehicle experienced the highest payload accelerations of the on-pad conditions analyzed.

B. Lift-Off

In this section, the methodology and assumptions used to perform the lift-off analysis along with the forcing function cases that were derived will be described. Results from the analyses will be presented next, followed by a summary of the results for both NLS 1 and NLS 2 vehicles.

1. Methodology/Assumptions

A point-by-point release lift-off analysis was performed on both the NLS 1 and NLS 2 vehicles. The analysis used a power series approximation of the pad-to-vehicle interface forces. This allowed the equations of motion of the pad and vehicle to be solved separately with unknown coefficients at the end of each time step. The unknown coefficients were then obtained by enforcing the interface compatibility conditions between the two structures. Once the unknown coefficients were determined, the total response for that time step was computed. A check during each time step of the interface forces allows the analyst to simulate a point-by-point fly-away analysis by modifying the compatibility equations for those points that are released and go from a state of compression to tension. Reference 16 describes the methodology in more detail and, for brevity, will not be repeated here. The resulting response time histories were used in conjunction with appropriate load transformation equation matrices to provide the load time histories. Maximum and minimum values of the vehicle responses were stored on magnetic disk for later processing.

The following loading conditions were examined during the lift-off analysis:

1. STME thrust buildup.

2. One STME engine out.

3. Cryogenic loading (NLS 1).

4. ASRB thrust buildup.

5. ASRB overpressure loads.

The following assumptions were made in the analysis:

1. Simultaneous ignition command to all STME's.

2. Point-by-point fly-away from the MLP with no slow release mechanism.

3. Holddown bolts blown at 100-percent STME thrust level. Some cases were run with bolts blown at 90-percent thrust.

4. STME engine-out analysis performed for worst engine at worst time.

5. No vehicle flight control system (i.e., no engine gimbaling during lift-off transient).

6. Vehicle parameter dispersions were utilized in a 2-σ worst-on-worst combination.

7. An uncertainty factor K_v of 1.5 was applied to the dynamic response loads to account for the lack of design/model maturity.

2. Input Data Requirements and Sources

a. Ground Winds Criteria

The following conditions were examined in the lift-off analysis for the fully loaded vehicle with ground wind/wind shear and no gust.

1. One hour exposure, vehicle pressurized.

2. One STME engine out.

All ground wind-speed speeds were selected from reference 5 to satisfy the requirements of reference 1. The wind-speed speed for a 1-hour exposure time was 34.4 knots (peak) at the 95-percent probability level, as measured at the KSC 60-ft pad light pole reference level.

b. Forcing Functions

Forcing functions were developed using the data provided in references 12, 13, and 14. Variations in the applied thrust profiles (ASRB's and STME's) in conjunction with the ground winds provided the forcing functions used to assess the lift-off loads. A simultaneous ignition command was assumed applied to all STME's and ASRB's for the lift-off analysis. The STME thrust time history profiles are provided in the appendix. ASRB thrust and pressure profiles from reference 12 are also provided in the appendix. ASRB overpressure forces per model node number are plotted and given in the appendix (only applies to NLS 1).

A total of 17 lift-off forcing function cases for NLS 1 and 9 lift-off forcing function cases for NLS 2 were developed using the STME thrust, ASRB thrust/pressure (NLS 1), and applied wind data. Tables in the appendix give full details of each forcing function and which force parameters were varied. The parameters were varied $\pm 2\sigma$ with the various combinations. These parameters include:

1. ASRB ignition timing.
2. ASRB thrust rise rate.
3. ASRB thrust level.
4. ASRB ignition interval.
5. ASRB thrust mismatch.
6. ASRB ignition overpressure.
7. ASRB growth.
8. STME thrust levels.
9. STME thrust misalignment.
10. Ground wind directions.
11. Time of STME out conditions.
12. Cryogenic loading.

Cryogenic loading for the NLS 1 vehicle was included in the applied loading as statically applied forces superimposed at the CCS to ASRB interfaces.

3. Loads Results for NLS 2

The NLS 2 vehicle lift-off loads were assessed using the forcing functions described in section B.2.b. Results from the analyses include the payload c.g. accelerations and the LO_2 and LH_2 slosh mass accelerations. Vehicle shears and moments and interface loads of the CCS to the pad were also recovered. Line loads (N_x), as defined in section A.3, were also computed.

a. Interface Loads/Accelerations

The composite maximum and minimum interface loads for the CCS to pad interface are tabulated in the appendix. The peak values for one holddown location are:

$$F_x = -746.0 \text{ kips (compression)}$$

$$F_y = 65.3 \text{ kips}$$

$$F_z = 28.0 \text{ kips} \ .$$

Composite maximum and minimum accelerations for the 50-kip payload and the slosh masses of LO_2 and LH_2 are also tabulated in the appendix. The peak values for the payload are as follows:

	X-dir	Y-dir	Z-dir
50 k Payload	±6.2 g's	±3.2 g's	±2.5 g's

All tabulated composite results in the appendix are separated according to with and without STME out conditions. There was no difference between the maximum payload accelerations for the nominal and STME out conditions.

b. Distributed Body Loads

The distributed body loads for CCS were computed and include shears, moments, and line loads. Composite maximum and minimum values of the distributed loads were tabulated and plotted versus the CCS X-station in the appendix. The tables and plots of the distributed loads are for the nominal and STME out conditions.

The peak distributed loads for NLS 2 are approximately the same for both the nominal and STME out events. The maximum distributed loads for the CCS were:

Maximum shear = 711 kips

Maximum moment = 142 million in-lb.

These values occur at the station X-4,385.5, i.e., the base of the NLS 2 vehicle. Vehicle line loads are contained in the appendix in both tabular and plotted form. The peak line load value occurred at station X-4,297.8 and had a value of 4,113 lb/in.

4. Loads Results for NLS 1

The NLS 1 vehicle was analyzed for lift-off using the forcing functions described in section B.2.b. Results from the analyses include net c.g. accelerations of the three payloads, the CTV, the FPM, and the slosh masses of LO_2 and LH_2. Distributed body loads of the CCS were also recovered including axial and transverse shears, torsion, and moments. Line loads (N_x) for the CCS were also recovered. Line load computation is defined in section A.3. All results were computed for the nominal and STME out conditions. Interface loads of the ASRB's to pad and ASRB's to CCS were also computed. Only one STME out condition was assessed in this analysis cycle due to time constraints.

a. Interface Loads/Accelerations

Composite maximum and minimum interface loads of the ASRB to pad and ASRB to CCS are tabulated in the appendix. The interface loads are tabulated for both the nominal and STME out conditions. Because only one STME out condition was analyzed, the composite maximum and minimum holddown pad loads are essentially the same as those for the nominal case. Values for the maximum loaded aft skirt holddown location are:

$$F_x = -833.3 \text{ kips (compression)}$$

$$F_y = 127 \text{ kips}$$

$$F_z = 277 \text{ kips.}$$

NLS 1 lift-off composite maximum and minimum interface loads for the CCS to ASRB are tabulated in the appendix. Some of the interface loads are higher than design values given for NSTS. NSTS design loads are exceeded in the x and y directions at the forward ASRB/CCS attachment and in the y direction at the aft attach. Once again, the highest values occurred during the nominal and the STME out conditions.

The composite maximum and minimum net c.g. accelerations of the three payloads, along with the CTV, FPM, and LO_2 and LH_2 slosh masses, are provided in tabular form in the appendix. Of the three payloads, the forward 30-kip payload experienced the highest accelerations. The maximum accelerations of the CTV, FPM, and the forward payload were:

	X-dir	Y-dir	Z-dir
CTV	±1.9 g's	±0.2 g's	±0.4 g's
FPM	±1.9 g's	±1.4 g's	±1.4 g's
30 k Payload	±1.8 g's	±0.9 g's	±0.93 g's

b. Core Vehicle Distributed Body Loads

The distributed body loads for the NLS 1 CCS were computed and include the axial and transverse shears, torsion and bending moments, as well as the line loads. Composite maximum and minimum values of the distributed loads are tabulated and plotted versus the CCS X-station in the appendix. The composite loads were presented separately for the nominal and STME out conditions.

Line loads for the NLS 1 vehicle are given in the appendix in tables and are plotted versus X-station. The peak line load value of 3,096 lb/in occurred at station X-2,963.42.

5. Lift-Off Loads Summary

The NLS 2 vehicle results exhibited the largest CCS distributed body loads. The shear, moment, and line body loads were all higher than those contained in the NLS 1 data. No significant differences were observed for the NLS 1 vehicle loads between the nominal and STME out conditions since only one STME out condition was analyzed. It is assumed that analysis of additional STME out cases would likely result in higher body and interface loadings for the NLS 1 vehicle.

The NLS 2 vehicle experienced the maximum payload accelerations as seen from the results.

C. Ascent

1. Methodology/Assumptions

The ascent loads environment was assessed using the squatcheloid approach and a rigid-body model. The time histories of vehicle wind responses were generated by applying the wind shear and gust to the wind envelope at the altitude of interest. The vehicle responses to the design winds were generated by the controls group at discrete altitude intervals (i.e., 8, 10, or 12 km) and at 12 clockwise intervals. The resulting responses were assessed at the point of maximum aerodynamic loading.

The point of maximum aerodynamic loading was determined from experience to be the point at which the RSS value of q-alpha and q-beta were at a relative maximum or minimum. Q-alpha (q-α) is the dynamic pressure (q) and angle-of-attack (α) product and q-beta (q-β) is the dynamic pressure and angle-of-sideslip (β) product. Summary tables of the q, $q-\alpha$, q-β, Mach number, altitude, and translational and rotational accelerations were generated by the controls group for each altitude region.

The resulting data for each point in the table were plotted as q-α versus q-β, and the resulting figure is approximately elliptical and is called a squatcheloid (i.e., a squashed ellipsoid). Each point on the squatcheloid represents the maximum loading due to a head, tail, quartering, etc., wind at the discrete altitude (or Mach number) being examined. An incremental value q-α/q-β of 500 lb/ft$^{2\circ}$ was added proportionately to all squatcheloids to account for parameter effects on the control trajectories.

Time consistent loads were then computed for each squatcheloid using a combination of discrete and distributed airloads acting on the body. For all squatcheloid cases, a detailed assessment of core vehicle loads was performed to include normal and axial shears, moments, line loads, and P-equivalent loads. Loads were developed for the attach members and attach fittings for the NLS 1 configuration. The interface locations and designations are shown in figure 26, and the attach member loads designations are shown in figure 27. The NLS 1 core stage loads were developed for the point of maximum combined bending load, while the NLS 2 approach assumed all vehicle loads to lie in the plane of the wind.

The various combined loads presented in the results were computed as follows:

$$P_{eq} = P\text{-equivalent load}$$

$$= P \pm \frac{2M}{R}$$

$$N_v = \text{line load for combined normal shear and torsion}$$

$$= \frac{V}{2\pi R} \pm \frac{T}{\pi R^2}$$

where,

V = normal shear load

T = torsional moment

V_{eq} = shear-equivalent load = $2P \pm \frac{V}{R}$

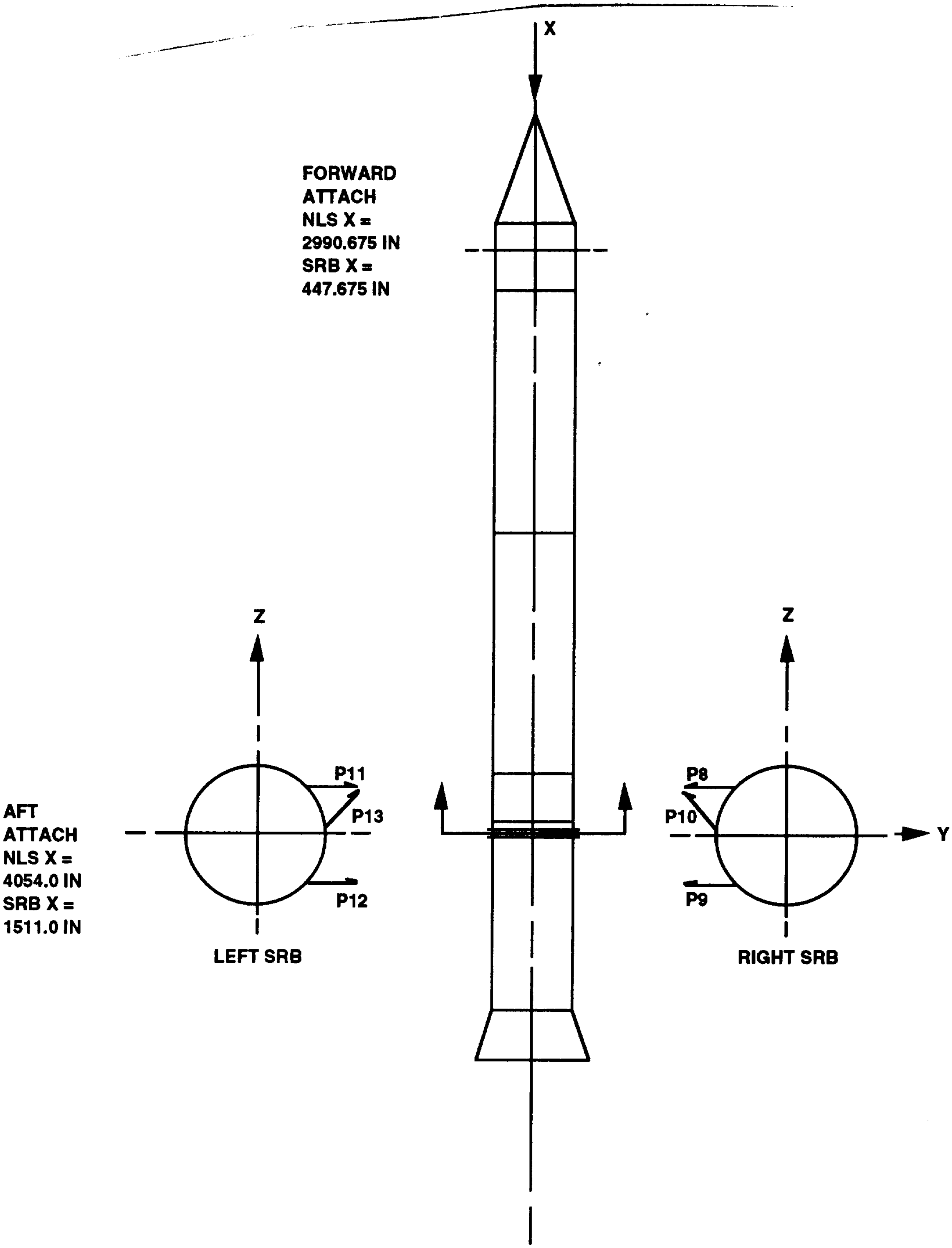

Figure 27. ASRB interface loads locations and directions.

N_x line loads were defined in section A.3. The flight conditions analyzed included the following conditions:

1. Maximum dynamic pressure (max-q)

2. Maximum acceleration (max-g)

3. ASRB separation (NLS 1 only)

4. STME engine-out cases (NLS 1 and NLS 2).

The following assumptions were utilized in the analysis:

1. ASRB separation loads were computed assuming a 200-kip variation on the tailoff thrust (i.e., one engine at zero thrust and one engine at 200-kips thrust).

2. Uncertainty factor of $k_v = 1.05$ was applied to axial loads to account for thrust oscillations during max-g flight regimes.

3. Vehicle parameter dispersions were utilized in a 3-σ RSS combination including (a) ±25 percent on aerodynamic data and (b) ±3 percent on STME and ASRB thrust levels.

For purposes of this analysis, the vehicle mass and c.g. were assumed to be the nominal values. Elastic body loads were not included in the analysis. Conservatism in the wind criteria and the large uncertainty represented by the aerodynamic tolerances should envelope the dynamic loads.

2. Input Data Requirements and Sources

a. Vehicle Aerodynamics

Vehicle aerodynamic data were furnished by the aerodynamics group as separate data bases for the two configurations.[9 10 11] For the NLS 1 configuration, data were provided as discrete or point loads and as distributed loads. The discrete loads were provided over the range of interest (Mach 0.6 to 5.0) for the left and right ASRM's and the CCS. The loads on each body were further broken down into smaller increments for key vehicle segments such as the nose cap assembly, shroud, etc. The discrete data included normal and side force, axial force, and pitching, yawing, and rolling moment coefficient data. A base force increment for each body was also provided as a function of altitude.

Distributed aerodynamic coefficient data were provided for the core stage as a function of x/D at four selected Mach numbers—Mach 0.9, 1.25, 1.46, and 2.0. The data base included separate data for the side force and normal force distributions due to the interference effects of the ASRM's on the side force distributions. Other Mach regimes were obtained by extrapolation or interpolation. The base force increment was applied to the CCS base as a discrete load. Since the ASRM's were already designed, this study assumed that only the core stage required a detailed loads assessment. The boosters were modeled using discrete aerodynamic loads data.

For the NLS 2 configuration, discrete and distributed aerodynamic data bases were provided over the same Mach ranges as for NLS 1. The discrete data contained the normal force, axial force, and pitching moment coefficient data as well as a base force increment. The distributed data included distributed normal force and axial force data. The same base force increment data were applied in a discrete fashion to the base region. All loads were assumed to lie in the plane of the wind to simplify the loads calculation.

b. Winds Criteria

All high altitude wind-speed speeds were selected from reference 6. The following criteria were selected to satisfy design requirements:

1. 95-percent annual wind speed envelope
2. 99-percent scalar shears and gust reduced 15 percent.

The wind speed was varied at 12 clockwise azimuth increments and at constant altitude levels ranging from 3 to 15 km.

c. Control System Data

The squatcheloid data were developed using a rigid body vehicle model and a simple altitude and altitude rate (i.e., no load relief) control system. A few squatcheloids were generated for a load relief control system and were assessed to give an indication of the load reduction which could be achieved.

A simplified engine mixing logic was assumed for the analysis. All engines were assumed to act equally in pitch and yaw for both configurations. Roll control was assumed as follows for purposes of the loads analysis:

1. NLS 1 roll control provided by ASRB's
2. NLS 2 roll control provided by two center engines.

The A-factor approach was used to obtain the RSS control response trajectory. The data variations were scaled proportionately to the A-factor and were applied in the direction indicated to maximize the vehicle loads. The trajectory variation amounted to a delta load of 500 lb/ft^2° in the worst direction. This delta was added to the squatcheloid data prior to the loads computation. Vehicle distributed loads were assessed for nominal aerodynamic distribution with a ±25-percent aerodynamic variation included.

d. Trajectory Data

The design reference trajectories of references 7 and 8 were utilized by the control group to develop the control system response trajectories required in the analysis. The basic trajectories selected for loads assessment included the following conditions:

1. NLS 1 vehicle with one STME engine out at lift-off and 100-kip payload to orbit.
2. NLS 1 vehicle with no STME engine out and 100-kip payload to orbit.
3. NLS 2 vehicle with one STME engine out at lift-off and 50-kip payload to orbit.
4. NLS 2 vehicle with no STME engine out.

For the NLS 1 nominal trajectory, the maximum acceleration (max-g) was limited to 4.0 g's. The dynamic pressure was also constrained to the STME engine-out case maximum value in shaping the trajectory. The NLS 2 nominal trajectory maximum acceleration (max-g) was limited to 4.5 g's, and the dynamic pressure was constrained to NLS 2 engine-out trajectory maximum value.

e. Engine-Out Conditions

Since the NLS vehicles are designed to perform their missions with one liquid engine out, a separate analysis was performed to assess the resulting loads. Both the NLS 1 and NLS 2 configurations used throttling of the liquid engines to reduce the maximum dynamic pressure during the atmospheric portion of flight. The nominal throttle setting of the STME's was established at the 75-percent power level. In the event of an engine out, the remaining STME's would be throttled up to 100-percent power level. Throttling was also used during vacuum flight to maintain the maximum acceleration requirements.

For the NLS 1 configuration, it was assumed that the thrust level would be approximately the same for engine-out condition due to throttling up. Therefore, the control responses were assumed to be the same as for all engines burning.

For the NLS 2 configuration, two basic engine-out conditions were examined:

1. Engine out at lift-off

2. One engine out during max-q.

The engine out at lift-off case was characterized by engine No. 2 thrust going to zero at 1 second after ignition. The engine out during the max-q flight regime was simulated by phasing the wind gust and the time of engine out so that vehicle loads were maximized. This configuration was bounded by engine No. 5 out during head and cross wind cases and by engine No. 4 out during the tail wind case. These combinations represented the worst case scenarios for an engine failure occurring at the time of maximum wind gust.

3. Loads Results for NLS 2

a. Interface Loads

There were no interfaces to be considered in the NLS 2 loads other than the interfaces between the payloads and payload adapter. These data are presented as c.g. acceleration loads in a later section.

b. Distributed Body Loads

For nominal vehicle (no engine out), distributed body loads were calculated for nine squatcheloids generated at the altitudes described in section C.1 plus two maximum acceleration (max-g) cases.

Distributed loads were calculated using six squatcheloids for the STME engine out at lift-off condition. Distributed loads were also calculated for eight individual load cases for the engine out at max-q and for two cases at max-g.

The following body loads were computed for each load case:

1. N_x line loads

2. N_v line shears

3. P-equivalent loads

4. V-equivalent loads

5. Axial (X), Y, and Z direction shears

6. Y and Z direction bending moments.

These loads were computed for each station along the vehicle for each point on the given squatcheloids. The maximums and minimums for each load were then recovered case and station consistently. The plots showing the maximum and minimum loads for each squatcheloid, or altitude, versus X-station are shown in the appendix for the nominal (no engine out) vehicle and for one STME engine out. These plots show the maximum absolute or minimum absolute load for each station plotted with its correct sign. Thus, the shear diagrams may not necessarily show at what axial (X) station the shear changes sign.

The N_x, N_v, P-equivalent, and V-equivalent loads were computed by the formulas in section C.1 and by assuming the structure could be represented as a thin-walled cylinder.

4. Loads Results for NLS 1

a. Interface Loads

For the nominal case (i.e., all engines burning), interface and member loads were computed for the CCS/ASRM interfaces as shown in the appendix. The NLS 1 interfaces are assumed to be similar to the STS interfaces, although the aft strut geometry differs slightly from STS due to the larger diameter ASRM's. These loads included max-q, max-g, and separation of the ASRM from the CCS. These loads represent the overall maximums for all squatcheloid cases and all wind angles. Perturbation cases were generated for the max-q condition and included aerodynamic, thrust, and angular acceleration variations. These cases were combined to provide the load increase or decrease as an RSS increment. The load increments did not significantly increase any of the interface or member loads. Therefore, all ascent loads are presented as nominal values. However, the max-g and separation loads include angular acceleration variations.

All loads were compared to NSTS derived loads and were found to be generally less than the NSTS limits, except for the forward attach axial (X) loads FTB5 and FTB6. The forward attach loads exceeded the NSTS derived data at ASRM separation by 40 to 60 percent. This loading represents the bolt tension load in the forward attach joint and not an overload of the major structure.

The resulting interface loads were merged with the prelaunch and lift-off loads in section III.B and are contained in four tables in the appendix. The ascent loads were generally enveloped by the prelaunch and lift-off events. It is recommended that the NLS interface load increases be combined with the NSTS derived attach fitting and member loads for use in the cycle 2 design.

b. Core Vehicle Distributed Body Loads

Distributed body loads were calculated for 10 squatcheloids, or altitudes, as described in section C.1 plus 2 maximum acceleration (max-g) cases. The same body loads were computed for each load case as shown in section C.3.a.

These loads were computed for each station along the vehicle for each point on the given squatcheloids. The maximums and minimums for each load were then recovered case and station consistently. The plots showing the maximum and minimum loads for each squatcheloid, or altitude, versus axial (X) station are shown in the appendix. These plots show the maximum absolute or minimum absolute for each station plotted with its correct sign. Thus, the shear diagrams may not necessarily show at what X station the shear changes sign.

The N_x, N_v, P-equivalent, and V-equivalent loads were computed by the formulas discussed in section C.4.b assuming a thin-walled cylinder.

5. Maximum/Minimum Loads Summary

The NLS 2 distributed body loads discussed in section C.3.b were searched for the overall maximums and minimums. The results are contained in the appendix as plots of the maximum envelope values with separate curves for max-q and max-g. As noted previously, the Titan shroud capability was exceeded. Figures 14 through 17 show the shroud P-equivalent and V-equivalent loads versus the Titan IV allowables.

NLS 2 component accelerations were searched for the payloads and the results are:

	X-dir	Y-dir	Z-dir	Flight Condition
Payload	–2.1 g's	±1.3 g's	±1.3 g's	max-q
	–4.7 g's	±0.2 g's	±0.2 g's	max-g

The results for the NLS 1 ascent interface and member loads are tabulated in the appendix for the max-q loads and for the combined max-q, max-g, and separation loads. The load results are presented as maximum and minimum (max/min) summaries with general information identifying the squatcheloid case (i.e., altitude) and clock angle at which the extreme values occurred. Separate tables compare the max/min loads with the NSTS derived limits and compute an allowable vehicle margin where:

$$M_A = \text{margin allowable} = \frac{L-L_A}{L_A}\,100 \text{ percent}$$

and where,

L = maximum or minimum limit load

L_A = NSTS derived allowable load limit .

All of the loads were generally lower than the NSTS design loads except the separation load exceedances in interface loads FT05 and FT06 (axial loads) as previously noted. These interface loads were in turn enveloped by the lift-off loads. Therefore, any solution to the lift-off exceedance will probably accommodate the separation overload.

The NLS 1 distributed body loads discussed in section C.4.b were then searched for the overall maximums and minimums. Figures 6 through 10 show plots of the maximums with separate curves for max-q and max-g.

NLS 1 component accelerations were searched for the payloads, FPM, and CTV and the results are as follows:

	X-dir	Y-dir	Z-dir	Flight Condition
CTV	–2.3 g's	±0.8 g's	±0.7 g's	max-q
	–4.2 g's	±0.1 g's	±0.1 g's	max-g
FPM	–2.3 g's	±1.3 g's	±1.2 g's	max-q
	–4.2 g's	±0.2 g's	±0.2 g's	max-g
Payload	–2.5 g's	±1.3 g's	±1.2 g's	max-q
	–4.2 g's	±0.2 g's	±0.2 g's	max-g

Since no elastic transient analysis was performed for NLS 1 or for NLS 2, an allowance was included for bending and thrust oscillation in the acceleration results.

REFERENCES

1. National Launch System (NLS) Reference Launch Vehicles Definition Document, May 1991.

2. Working drawings and sketches of the NLS 1 and NLS 2 configurations.

3. ED53-31-91, "National Launch System (NLS) Reference Document Coordinate System and External Configuration," July 1, 1991.

4. NLS 1 and NLS 2 Mass Properties Versus Flight Time. Working papers from EL42 including magnetic disk files, 1991.

5. "Terrestrial Environment (Climatic) Criteria for Use in Aerospace Vehicle Development," NASA TM 82473, 1982 Revision.

6. "The Documentation of the Natural Environment Currently in Use for NLS Design, ES44-243-91, December 3, 1991.

7. "National Launch System Heavy Lift Launch Vehicle (HLLV) Nominal and Engine-Out Reference Mission Trajectories," EP55-91-99, August 29, 1991.

8. "National Launch System Stage 1.5 Vehicle Ascent Trajectory Performance Analyses for Engine-Out and Nominal Trajectories," EP55-91-102, August 7, 1991.

9. "Aerodynamic Data Base for the One and One-Half Stage (1.5-RV10603) and the Heavy Lift Launch Vehicle (HLV-RV10607) Configurations for the National Launch System," ED35-25-91, July 1, 1991.

10. "Distributed Loads on the National Launch System One and One-Half Stage Launch Vehicle," ED35-88-91, September 18, 1991.

11. "Distributed Loads on the National Launch System Heavy Lift Launch Vehicle Core Element," ED35-134-91, December 31, 1991.

12. "ASRM Lift-Off Cases to Support Cycle 1 NLS Lift-Off Loads Analysis," EP55-91-143, November 25, 1991.

13. "NLS Cycle 1 Ignition Overpressure Environments," ED33-103-91, October 2, 1991.

14. EP55 working papers, STME thrust data for NLS Cycle 1 loads analysis.

15. Craig, R.R. Jr., and Bampton, M.C.C.: "Coupling of Substructures for Dynamic Analysis." AIAA Journal, vol. 6, July 1968, pp. 1313–1319.

16. "A Transient Response Method for Linear Coupled Substructures," NASA TP 2926, December 1989.

17. "National Launch System (NLS) Cycle 1 Ascent Control Squatcheloids," ED13-07-92, February 1992.

18. "Longitudinal Mass-Spring Modeling of Launch Vehicles," NASA TN D-5371, August 1969.

19. McDonnell Douglas: "Prime Item Development Specification for Titan IV Payload Fairing Configuration Item No. DA200-1." Rev. A, October 2, 1989.

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NLS 2 CORE – 13 km ENGINE OUT

NLS 2 CORE – 14 km ENGINE OUT

MATH MODEL DATA

NLS1 CORE STICK MODEL MASS PROPERTIES

NODE	DESCRIPTION	X - STATION	Structural Wt. (lbs)	Propellant Wt. (lbs)	Payload Wt (lbs)	Total Wt per Node Fueled	Total Wt per Node Unfueled
1	Nose Cone	1066.06	20.00			20.00	20.00
2	Nose Cone	1110.60	277.80			277.80	277.80
3	Nose Cone	1155.10	507.70			507.70	507.70
4	Nose Cone	1229.75	995.50			995.50	995.50
45	Forward propulsion module	1274.00	3429.00			3429.00	3429.00
5	Shroud	1304.40	1430.17			1430.17	1430.17
6	Shroud	1411.00	1430.17			1430.17	1430.17
7	Payload #1 and Shroud	1518.00	1430.17		30000.00	31430.17	31430.17
8	Shroud	1625.00	1430.17			1430.17	1430.17
9	Shroud	1732.00	1430.17			1430.17	1430.17
90	Payload #2 and Shroud	1784.40	1430.17		40000.00	41430.17	41430.17
10	Shroud	1839.00	1430.17			1430.17	1430.17
11	Shroud	1946.00	1430.17			1430.17	1430.17
12	Payload #3 and Shroud	2050.80	1430.17		30000.00	31430.17	31430.17
13	Shroud	2160.00	1430.17			1430.17	1430.17
14	Shroud	2264.40	1430.17			1430.17	1430.17
15	Shroud + Adapter	2284.80	8565.17			8565.17	8565.17
16	Transition Section	2340.68	1128.00			1128.00	1128.00
46	Cargo Transfer Vehicle	2342.00	21554.00			21554.00	21554.00
17	Transition Section	2396.57	1128.00			1128.00	1128.00
18	Transition Secton and Top of LO2	2459.75	3135.86	205549.33		208685.19	3135.86
19	LO2 Tank & Prop.	2473.80	2007.86	205549.33		207557.19	2007.86
20	LO2 Tank & Prop.	2569.80	2007.86	205549.33		207557.19	2007.86
21	LO2 Tank & Prop.	2664.13	2007.86	205549.33		207557.19	2007.86
22	LO2 Tank & Prop.	2758.47	2007.86	205549.33		207557.19	2007.86
23	LO2 Tank & Prop. top Inner Skirt	2852.80	5327.86	205549.33		210877.19	5327.86
24	Bottom LO2 Tank + Inner Skirt	2963.43	5327.86	205549.33		210877.19	5327.86
25	Inner Skirt	2985.68	3320.00	583.33		3903.33	3320.00
26	Inner Skirt + top LH2 Tank+Prop	3012.53	6127.92	20099.03		26226.95	6127.92
27	Bottom of Inner Skirt + LH2	3123.15	6127.92	20099.03		26226.95	6127.92
28	LH2 + Prop.	3233.63	2807.92	20099.03		22906.95	2807.92
29	LH2 + Prop.	3337.35	2807.92	20099.03		22906.95	2807.92
30	LH2 + Prop.	3480.58	2807.92	20099.03		22906.95	2807.92
31	LH2 + Prop.	3623.80	2807.92	20099.03		22906.95	2807.92
32	LH2 + Prop.	3747.40	2807.92	20099.03		22906.95	2807.92
33	LH2 + Prop.	3871.00	2807.92	20099.03		22906.95	2807.92
34	LH2 + Prop.	3964.50	2807.92	20099.03		22906.95	2807.92
35	LH2 + Prop.	4058.00	2807.92	20099.03		22906.95	2807.92
36	LH2 + Prop.+ top aft skirt	4118.65	3469.26	20099.03		23568.28	3469.26
37	LH2 + Prop+ aft skirt	4122.65	3469.26	20099.03		23568.28	3469.26
38	Bottom LH2 +Prop+ aft skirt	4233.28	3469.26	20099.03		23568.28	3469.26
39	aft skirt	4309.40	25013.00	4187.50		29200.50	25013.00
40	aft end of structure	4385.50	25013.00	4187.50		29200.50	25013.00
41	engine	4388.28	8004.00			8004.00	8004.00
42	engine	4388.28	8004.00			8004.00	8004.00
43	engine	4388.28	8004.00			8004.00	8004.00
44	engine	4388.28	8004.00			8004.00	8004.00
	6 attach pts (50 lb each)	n/a	300.00			300.00	300.00
	TOTALS		205949.00	1709091.00	100000.00	2015040.00	305949.00

NLS2 CORE STICK MODEL MASS PROPERTIES

NODE	DESCRIPTION	X-STATION	STRUCTURAL WT. (LBS)	PROPELLANT WT. (LBS)	PAYLOAD WT (LBS)	TOTAL WT PER NODE FUELED	TOTAL WT PER NODE UNFUELED
1	Nose Cone	1306.06	20.0			20.0	20.0
2	Nose Cone	1395.10	300.0			300.0	300.0
3	Nose Cone	1444.87	548.0			548.0	548.0
4	Nose Cone	1494.64	1076.0			1076.0	1076.0
5	Shroud	1544.40	720.0			720.0	720.0
6	Shroud	1624.40	720.0			720.0	720.0
7	Shroud	1704.40	720.0			720.0	720.0
8	Shroud	1784.40	720.0			720.0	720.0
9	Shroud	1864.40	720.0			720.0	720.0
10	Shroud	1944.40	720.0			720.0	720.0
999	Payload C.G.	1997.58			50000.0	50000.0	50000.0
11	Shroud	2024.40	720.0			720.0	720.0
12	Shroud	2104.40	720.0			720.0	720.0
13	Shroud	2184.40	720.0			720.0	720.0
14	Shroud	2264.40	720.0			720.0	720.0
15	Shroud & Payload Adapter	2284.80	5078.0			5078.0	5078.0
16	Transition Section	2347.80	1128.0			1128.0	1128.0
17	Transition Section	2410.80	1128.0			1128.0	1128.0
18	Transition Section & Top of LO2	2459.18	3135.9	204977.9		208113.8	3135.9
19	LO2 Tank & Prop.	2471.15	2007.9	204977.9		206985.8	2007.9
20	LO2 Tank & Prop.	2569.80	2007.9	204977.9		206985.8	2007.9
21	LO2 Tank & Prop.	2664.13	2007.9	204977.9		206985.8	2007.9
22	LO2 Tank & Prop.	2758.47	2007.9	204977.9		206985.8	2007.9
23	LO2 Tank & Prop. top Inner Skirt	2852.80	4824.9	204977.9		209802.8	4824.9
24	Bottom LO2 Tank & Inner Skirt	2963.43	4824.9	204977.9		209802.8	4824.9
25	Inner Skirt	2985.68	2817.0	583.3		3400.3	2817.0
26	Inner Skirt & top LH2 Tank & Prop.	3012.53	5624.9	20032.2		25657.1	5624.9
27	Bottom of Inner Skirt & LH2	3123.15	5624.9	20032.2		25657.1	5624.9
28	LH2 & Prop.	3240.01	2807.9	20032.2		22840.1	2807.9
29	LH2 & Prop.	3356.86	2807.9	20032.2		22840.1	2807.9
30	LH2 & Prop.	3473.72	2807.9	20032.2		22840.1	2807.9
31	LH2 & Prop.	3590.58	2807.9	20032.2		22840.1	2807.9
32	LH2 & Prop.	3707.43	2807.9	20032.2		22840.1	2807.9
33	LH2 & Prop.	3824.29	2807.9	20032.2		22840.1	2807.9
34	LH2 & Prop.	3941.14	2807.9	20032.2		22840.1	2807.9
35	LH2 & Prop.	4058.00	2807.9	20032.2		22840.1	2807.9
36	LH2 & Prop. & top aft skirt	4090.33	3469.3	20032.2		23501.5	3469.3
37	LH2 & Prop. & aft skirt	4122.65	3469.3	20032.2		23501.5	3469.3
38	Bottom LH2 & Prop. & aft skirt	4233.28	3469.3	20032.2		23501.5	3469.3
803	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
807	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
811	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
815	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
851	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
859	STME Engine	4385.50	8004.0	729.1		8733.1	8004.0
	Thrust Structure		69668.3	4000.0		73668.3	69668.3
	TOTALS		201925.5	1704222.0	50000.0	1956147.5	251925.5

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*******************************************************************************************
*  J. A. BRUNTY        *       MARSHALL SPACE FLIGHT CENTER        *                        *
*                      *        SYSTEMS DYNAMICS DIVISION          * MAP NAME    HLLV       *
*       10/16/91       * CYCLE I STUDY                             * MODEL NO.     BASELINE *
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DOFS = 608 BND DOFS = 14 INT DOFS = 594

NODE	DESCRIPTION	X COORD	Y COORD	Z COORD	ROW/COL OF MATRIX X	Y	Z	RX	RY	RZ
1	HLLV	1066.060	0.000	0.000	1	2	3	4	5	6
2	HLLV	1110.600	0.000	0.000	7	8	9	10	11	12
3	HLLV	1155.100	0.000	0.000	13	14	15	16	17	18
4	HLLV	1229.750	0.000	0.000	19	20	21	22	23	24
45	FORWARD PROP MOD	1274.000	0.000	0.000	25	26	27	28	29	30
5	HLLV	1304.400	0.000	0.000	31	32	33	34	35	36
6	HLLV	1411.000	0.000	0.000	37	38	39	40	41	42
7	PAYLOAD #1 30K	1518.000	0.000	0.000	43	44	45	46	47	48
8	HLLV	1625.000	0.000	0.000	49	50	51	52	53	54
9	HLLV	1732.000	0.000	0.000	55	56	57	58	59	60
90	PAYLOAD #2 40K	1784.400	0.000	0.000	61	62	63	64	65	66
10	HLLV	1839.000	0.000	0.000	67	68	69	70	71	72
11	HLLV	1946.000	0.000	0.000	73	74	75	76	77	78
12	PAYLOAD #3 30K	2050.800	0.000	0.000	79	80	81	82	83	84
13	HLLV	2160.000	0.000	0.000	85	86	87	88	89	90
14	HLLV	2264.400	0.000	0.000	91	92	93	94	95	96
46	CTV	2342.000	0.000	0.000	97	98	99	100	101	102
15	HLLV	2284.800	0.000	0.000	103	104	105	106	107	108
16	HLLV	2340.680	0.000	0.000	109	110	111	112	113	114
17	HLLV	2396.570	0.000	0.000	115	116	117	118	119	120
18	HLLV	2459.170	0.000	0.000	121	122	123	124	125	126
19	HLLV	2473.800	0.000	0.000	127	128	129	130	131	132
20	HLLV	2569.800	0.000	0.000	133	134	135	136	137	138
21	HLLV	2664.130	0.000	0.000	139	140	141	142	143	144
22	HLLV	2758.470	0.000	0.000	145	146	147	148	149	150
23	HLLV	2852.800	0.000	0.000	151	152	153	154	155	156
70	FWD ATTACH ASRM +Y	2990.675	165.600	0.000	595	596	597	0	0	0
24	HLLV	2963.420	0.000	0.000	157	158	159	160	161	162
60	HLLV	2990.670	165.600	0.000	163	164	165	166	167	168
80	LO2 SLOSH	2963.420	0.001	0.000	169	0	0	0	0	0

25	HLLV	2990.670	0.000	0.000	170	171	172	173	174	175
26	HLLV	3012.520	0.000	0.000	176	177	178	179	180	181
61	HLLV	2990.670	-165.600	0.000	182	183	184	185	186	187
27	HLLV	3123.150	0.000	0.000	188	189	190	191	192	193
71	FWD ATTACH ASRM -Y	2990.675	-165.600	0.000	598	599	600	0	0	0
28	HLLV	3233.630	0.000	0.000	194	195	196	197	198	199
29	HLLV	3337.350	0.000	0.000	200	201	202	203	204	205
30	HLLV	3480.570	0.000	0.000	206	207	208	209	210	211
31	HLLV	3623.800	0.000	0.000	212	213	214	215	216	217
32	HLLV	3747.400	0.000	0.000	218	219	220	221	222	223
33	HLLV	3871.000	0.000	0.000	224	225	226	227	228	229
72	AFT ATTACH +Y (UPR)	4054.000	161.751	57.000	0	601	602	0	0	0
74	AFT ATTACH +Y (LWR)	4054.000	161.751	-57.000	0	603	604	0	0	0
34	HLLV	3964.500	0.000	0.000	230	231	232	233	234	235
62	HLLV	4054.000	161.750	57.000	236	237	238	239	240	241
64	HLLV	4054.000	161.750	-57.000	242	243	244	245	246	247
35	HLLV	4054.000	0.000	0.000	248	249	250	251	252	253
36	HLLV	4118.650	0.000	0.000	254	255	256	257	258	259
63	HLLV	4054.000	-161.750	57.000	260	261	262	263	264	265
65	HLLV	4054.000	-161.750	-57.000	266	267	268	269	270	271
37	HLLV	4122.650	0.000	0.000	272	273	274	275	276	277
73	AFT ATTACH -Y (UPR)	4054.000	-161.751	57.000	0	605	606	0	0	0
75	AFT ATTACH -Y (LWR)	4054.000	-161.751	-57.000	0	607	608	0	0	0
38	HLLV	4233.270	0.000	0.000	278	279	280	281	282	283
81	LH2 SLOSH	4233.270	0.001	0.000	284	0	0	0	0	0
39	HLLV	4309.400	0.000	0.000	285	286	287	288	289	290
43	HLLV	4388.280	-117.097	117.097	291	292	293	294	295	296
40	HLLV	4385.500	0.000	0.000	297	298	299	300	301	302
41	HLLV	4388.280	-117.097	-117.097	303	304	305	306	307	308
42	HLLV	4388.280	117.097	-117.097	309	310	311	312	313	314
44	HLLV	4388.280	117.097	117.097	315	316	317	318	319	320
999999	CANTILEVER MODES	0.000	0.000	0.000	321	322	323	324	325	326
999999	CANTILEVER MODES	0.000	0.000	0.000	327	328	329	330	331	332
999999	CANTILEVER MODES	0.000	0.000	0.000	333	334	335	336	337	338
999999	CANTILEVER MODES	0.000	0.000	0.000	339	340	341	342	343	344
999999	CANTILEVER MODES	0.000	0.000	0.000	345	346	347	348	349	350
999999	CANTILEVER MODES	0.000	0.000	0.000	351	352	353	354	355	356
999999	CANTILEVER MODES	0.000	0.000	0.000	357	358	359	360	361	362
999999	CANTILEVER MODES	0.000	0.000	0.000	363	364	365	366	367	368
999999	CANTILEVER MODES	0.000	0.000	0.000	369	370	371	372	373	374

999999	CANTILEVER MODES	0.000	0.000	0.000	375	376	377	378	379	380
999999	CANTILEVER MODES	0.000	0.000	0.000	381	382	383	384	385	386
999999	CANTILEVER MODES	0.000	0.000	0.000	387	388	389	390	391	392
999999	CANTILEVER MODES	0.000	0.000	0.000	393	394	395	396	397	398
999999	CANTILEVER MODES	0.000	0.000	0.000	399	400	401	402	403	404
999999	CANTILEVER MODES	0.000	0.000	0.000	405	406	407	408	409	0
1903	FRUSTUM (302)	2873.000	240.350	0.000	0	410	411	0	0	0
1904	FWD PRESS PT. 20409	3074.980	315.100	0.000	412	0	0	0	0	0
1904	FWD PRESS PT. 20413	3074.980	240.350	-74.750	413	0	0	0	0	0
1904	FWD PRESS PT. 20405	3074.980	240.350	74.750	414	0	0	0	0	0
1904	FWD PRESS PT. 20401	3074.980	165.600	0.000	415	0	0	0	0	0
1909	STA. X = 851.48 UPR	3394.480	240.350	74.750	0	0	416	0	0	0
1907	STA. X = 851.48 INB	3394.480	165.600	0.000	0	417	0	0	0	0
1911	STA. X =1385.46 INB	3928.460	315.100	0.000	0	418	0	0	0	0
1913	STA. X =1385.46 UPR	3928.460	240.350	74.750	0	0	419	0	0	0
1917	STA. X =1830.00 UPR	4373.000	240.350	73.620	0	0	420	0	0	0
1915	STA. X =1830.00 INB	4373.000	166.730	0.000	0	421	0	0	0	0
1922	AFT PRESS PT. 51613	4416.520	240.350	-51.750	422	0	0	0	0	0
1922	AFT PRESS PT. 51609	4416.520	292.100	0.000	423	0	0	0	0	0
1922	AFT PRESS PT. 51605	4416.520	240.350	51.750	424	0	0	0	0	0
1922	AFT PRESS PT. 51601	4416.520	188.600	0.000	425	0	0	0	0	0
1919	NOZZLE MOTOR 51600	4406.060	240.354	0.000	426	427	428	0	0	0
1919	NOZZLE FLEX 51599	4406.060	240.355	0.000	429	430	431	0	0	0
1920	NOZZLE C.G.	4417.260	240.350	0.000	0	432	433	0	0	0
1940	SRB LAUNCH PAD POST 4	4482.953	304.300	-93.184	434	435	436	437	438	439
1941	SRB LAUNCH PAD POST 3	4482.953	196.700	-93.184	440	441	442	443	444	445
1942	SRB LAUNCH PAD POST 1	4482.953	196.700	93.184	446	447	448	449	450	451
1943	SRB LAUNCH PAD POST 2	4482.953	304.300	93.184	452	453	454	455	456	457
999999	CANTILEVER MODES	0.000	0.000	0.000	458	459	460	461	462	463
999999	CANTILEVER MODES	0.000	0.000	0.000	464	465	466	467	468	469
999999	CANTILEVER MODES	0.000	0.000	0.000	470	471	472	473	474	475
999999	CANTILEVER MODES	0.000	0.000	0.000	476	477	478	479	480	481
999999	CANTILEVER MODES	0.000	0.000	0.000	482	483	484	485	486	487
999999	CANTILEVER MODES	0.000	0.000	0.000	488	489	490	491	492	493
999999	CANTILEVER MODES	0.000	0.000	0.000	494	495	496	497	498	499
999999	CANTILEVER MODES	0.000	0.000	0.000	500	501	502	503	504	505
999999	CANTILEVER MODES	0.000	0.000	0.000	506	507	508	509	510	511
999999	CANTILEVER MODES	0.000	0.000	0.000	512	513	514	515	516	517
999999	CANTILEVER MODES	0.000	0.000	0.000	518	519	520	521	522	523
999999	CANTILEVER MODES	0.000	0.000	0.000	524	525	526	527	528	529

999999	CANTILEVER MODES	0.000	0.000	0.000	530	531	532	533	534	535
999999	CANTILEVER MODES	0.000	0.000	0.000	536	537	538	539	540	541
999999	CANTILEVER MODES	0.000	0.000	0.000	542	543	544	545	546	0
1953	FRUSTUM	2873.000	-240.351	0.000	0	547	548	0	0	0
1954	FWD PRESS PT. 20409	3074.980	-315.100	0.001	549	0	0	0	0	0
1954	FWD PRESS PT. 20413	3074.980	-240.351	-74.750	550	0	0	0	0	0
1954	FWD PRESS PT. 20405	3074.980	-240.351	74.750	551	0	0	0	0	0
1954	FWD PRESS PT. 20401	3074.980	-165.600	0.001	552	0	0	0	0	0
1959	STA. X = 851.48 UPR	3394.480	-240.351	74.750	0	0	553	0	0	0
1957	STA. X = 851.48 INB	3394.480	-165.600	0.000	0	554	0	0	0	0
1961	STA. X =1385.46 INB	3928.460	-315.100	0.000	0	555	0	0	0	0
1963	STA. X =1385.46 UPR	3928.460	-240.351	74.750	0	0	556	0	0	0
1967	STA. X =1823.85 UPR	4373.000	-240.351	73.620	0	0	557	0	0	0
1965	STA. X =1823.85 INB	4373.000	-166.730	0.000	0	558	0	0	0	0
1972	AFT PRESS PT. 51613	4416.520	-240.351	-51.750	559	0	0	0	0	0
1972	AFT PRESS PT. 51609	4416.520	-292.100	0.001	560	0	0	0	0	0
1972	AFT PRESS PT. 51605	4416.520	-240.351	51.750	561	0	0	0	0	0
1972	AFT PRESS PT. 51601	4416.520	-188.600	0.001	562	0	0	0	0	0
1969	NOZZLE MOTOR 51600	4406.060	-240.351	0.000	563	564	565	0	0	0
1969	NOZZLE FLEX 51599	4406.060	-240.352	0.000	566	567	568	0	0	0
1970	NOZZLE C.G.	4417.260	-240.353	0.000	0	569	570	0	0	0
1990	SRB LAUNCH PAD POAT 8	4482.953	-304.300	-93.184	571	572	573	574	575	576
1991	SRB LAUNCH PAD POST 7	4482.953	-196.700	-93.184	577	578	579	580	581	582
1992	SRB LAUNCH PAD POST 5	4482.953	-196.700	93.184	583	584	585	586	587	588
1993	SRB LAUNCH PAD POST 6	4482.953	-304.300	93.184	589	590	591	592	593	594

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$  HLLV MODEL 9/11/91
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CELAS2  301     1.73E+6 60      1       70      1
CELAS2  302     2.34E+6 60      2       70      2
CELAS2  303     1.12E+4 60      3       70      3
CELAS2  304     1.73E+6 61      1       71      1
CELAS2  305     2.34E+6 61      2       71      2
CELAS2  306     1.12E+4 61      3       71      3
CELAS2  307     8.08E+5 62      2       72      2
CELAS2  308     7.65E+4 62      3       72      3
CELAS2  309     8.08E+5 63      2       73      2
CELAS2  310     7.65E+4 63      3       73      3
CELAS2  311     8.08E+5 64      2       74      2
CELAS2  312     7.65E+4 64      3       74      3
CELAS2  313     8.08E+5 65      2       75      2
CELAS2  314     7.65E+4 65      3       75      3
$CELAS2  315     9.99E+9 90      1       89      1
$CELAS2  316     9.99E+9 90      2       89      2
$CELAS2  317     9.99E+9 90      3       89      3
$CELAS2  318     9.99E+9 90      4       89      4
$CELAS2  319     9.99E+9 90      5       89      5
$CELAS2  320     9.99E+9 90      6       89      6
CELAS2  321     1.12E+6 24      1       80      1
CELAS2  322     5.13E+5 38      1       81      1
CBAR    101      100    1       2       99                                      2
CBAR    102      101    2       3       99                                      2
CBAR    103      102    3       4       99                                      2
CBAR    104      103    4       5       99                                      2
CBAR    105     1001    5       6       99                                      2
CBAR    106     1001    6       7       99                                      2
CBAR    107     1001    7       8       99                                      2
CBAR    108     1001    8       9       99                                      2
CBAR    109     1001    9       90      99                                      2
CBAR    110     1001    90      10      99                                      2
CBAR    111     1001    10      11      99                                      2
CBAR    112     1001    11      12      99                                      2
CBAR    113     1001    12      13      99                                      2
CBAR    114     1001    13      14      99                                      2
CBAR    115     1002    14      15      99                                      2
CBAR    116     1002    15      16      99                                      2
CBAR    117     1002    16      17      99                                      2
CBAR    118     1002    17      18      99                                      2
CBAR    119     1002    18      19      99                                      2
CBAR    120     1003    19      20      99                                      2
CBAR    121     1004    20      21      99                                      2
CBAR    122     1004    21      22      99                                      2
CBAR    123     1003    22      23      99                                      2
CBAR    124     1002    23      24      99                                      2
CBAR    125     1005    24      25      99                                      2
CBAR    126     1006    25      26      99                                      2
CBAR    127     1012    26      27      99                                      2
CBAR    128     1012    27      28      99                                      2
CBAR    129     1012    28      29      99                                      2
CBAR    130     1013    29      30      99                                      2
CBAR    131     1013    30      31      99                                      2
CBAR    132     1014    31      32      99                                      2
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CBAR     133      1014     32      33      99                              2
CBAR     134      1015     33      34      99                              2
CBAR     135      1015     34      35      99                              2
CBAR     136      1015     35      36      99                              2
CBAR     137      1015     36      37      99                              2
CBAR     138      1015     37      38      99                              2
CBAR     139      1015     38      39      99                              2
CBAR     140      1015     39      40      99                              2
CBAR     141      1020     40      41      1                               2
CBAR     142      1020     40      42      1                               2
CBAR     143      1020     40      43      1                               2
CBAR     144      1020     40      44      1                               2
CBAR     200      1020     25      60      1                               2
CBAR     201      1020     25      61      1                               2
CBAR     202      1020     35      62      1                               2
CBAR     203      1020     35      63      1                               2
CBAR     204      1020     35      64      1                               2
CBAR     205      1020     35      65      1                               2
CBAR     301      1020     5       45      99                              2
CBAR     302      1020     15      46      99                              2
$
$ STRUCTURE WTS.
$
CONM2    3001     1                20.000                                          AA1
+A1      3.6+06
CONM2    3002     2                277.80                                          AA2
+A2      3.6+06
CONM2    3003     3                507.70                                          AA3
+A3      3.6+06
CONM2    3004     4                995.50                                          AA4
+A4      3.6+06
CONM2    3005     5                1734.3                                          AA5
+A5      1.25+07
CONM2    3006     6                1734.3                                          AA6
+A6      1.25+07
$CONM2    3007     7                1734.3                                          AA7
CONM2    3008     8                1734.3                                          AA8
+A8      1.25+07
CONM2    3009     9                1734.3                                          AA9
+A9      1.25+07
$CONM2    3090     90               1734.3                                          AA90
CONM2    3010     10               1734.3                                          AA10
+A10     1.25+07
CONM2    3011     11               1734.3                                          AA11
+A11     1.25+07
$CONM2    3012     12               1734.3                                          AA12
CONM2    3013     13               1734.3                                          AA13
+A13     1.25+07
CONM2    3014     14               1734.3                                          AA14
+A14     1.25+07
CONM2    3015     15               8869.3                                          AA15
+A15     9.31+07
CONM2    3016     16               1128.0                                          AA16
+A16     2.31+07
CONM2    3017     17               1128.0                                          AA17
+A17     2.31+07
$
```

```
$  LH2 AND LO2 LUMPED MASSES FOR THE X-DIR (AXIAL SLOSH)
$
CONM1   3080    80                      1048918.
CONM1   3081    81                      210858.9
$
$  LO2 TANK MASSES IN Y,Z DIRECTIONS WITH PARTIAL X-DIR
$
CONM1   3018    18                      58839.8         208685.2                A18
+18     208685.2                                6.77+07
CONM1   3019    19                      57711.7         207557.2                A19
+19     207557.2                                4.46+07
CONM1   3020    20                      57711.7         207557.2                A20
+20     207557.2                                4.46+07
CONM1   3021    21                      57711.7         207557.2                A21
+21     207557.2                                4.46+07
CONM1   3022    22                      57711.7         207557.2                A22
+22     207557.2                                4.46+07
CONM1   3023    23                      61031.8         210877.2                A23
+23     210877.2                                11.2+07
CONM1   3024    24                      61031.8         210877.2                A24
+24     210877.2                                11.2+07
$
$  INNER TANK
CONM2   3025    25                      3903.33                                 AA25
+A25    6.72+07
$
$  LH2 TANK MASSES IN Y,Z DIRECTIONS WITH PARTIAL X-DIR
$
CONM1   3026    26                      10007.0         26226.9                 A26
+26     26226.9                                 1.4+08
CONM1   3027    27                      10007.0         26226.9                 A27
+27     26226.9                                 1.4+08
CONM1   3028    28                      6687.0          22906.9                 A28
+28     22906.9                                 7.28+07
CONM1   3029    29                      6687.0          22906.9                 A29
+29     22906.9                                 7.28+07
CONM1   3030    30                      6687.0          22906.9                 A30
+30     22906.9                                 7.28+07
CONM1   3031    31                      6687.0          22906.9                 A31
+31     22906.9                                 7.28+07
CONM1   3032    32                      6687.0          22906.9                 A32
+32     22906.9                                 7.28+07
CONM1   3033    33                      6687.0          22906.9                 A33
+33     22906.9                                 7.28+07
CONM1   3034    34                      6687.0          22906.9                 A34
+34     22906.9                                 7.28+07
CONM1   3035    35                      6687.0          22906.9                 A35
+35     22906.9                                 7.28+07
CONM1   3036    36                      7348.4          23568.3                 A36
+36     23568.3                                 9.46+07
CONM1   3037    37                      7348.4          23568.3                 A37
+37     23568.3                                 9.46+07
CONM1   3038    38                      7348.4          23568.3                 A38
+38     23568.3                                 9.46+07
$
$  ENGINES AND AFT STRUCTURE
$
```

```
CONM2    3039    39                29200.5                                      AB39
+B39     2.18+07
CONM2    3040    40                29200.5                                      AB40
+B40     2.18+07
CONM2    3041    41                8004.0                                       AB1
+B1      7.06+6          1.95+7                      1.98+7
CONM2    3042    42                8004.0                                       AB2
+B2      7.06+6          1.95+7                      1.98+7
CONM2    3043    43                8004.0                                       AB3
+B3      7.06+6          1.95+7                      1.98+7
CONM2    3044    44                8004.0                                       AB4
+B4      7.06+6          1.95+7                      1.98+7
CONM2    3060    60                50.
CONM2    3061    61                50.
CONM2    3062    62                50.
CONM2    3063    63                50.
CONM2    3064    64                50.
CONM2    3065    65                50.
CONM2    3070    70                1.0
CONM2    3071    71                1.0
CONM2    3072    72                1.0
CONM2    3073    73                1.0
CONM2    3074    74                1.0
CONM2    3075    75                1.0
$
$  FORWARD PROPULSION MODULE (FPM)
$
CONM2    3045    45                3429.0                                       AB5
+B5      3.09+6          3.09+6                      3.09+6
$
$  CARGO TRANSFER VEHICLE (CTV)
$
CONM2    3046    46                17905.0                                      AB6
+B6      4.02+7          2.8+09                      2.8+09
$
$  PAYLOAD WT.
$
CONM2    3007     7                 31734.3                                     AB7
+B7      9.39+7          6.66+8                      6.75+8
CONM2    3090    90                 41734.3                                     AB90
+B90     9.39+7          6.66+8                      6.75+8
CONM2    3012    12                 31734.3                                     AB12
+B12     9.39+7          6.66+8                      6.75+8
EIGR     40      FEER    0.1                         15              1.-4      +EIG1
+EIG1    MAX
EIGR     42      INV     0.0     100.    60          8               1.-5      +EIG2
+EIG2    MAX
EIGR     41      GIV                                 12              1.-4      +EIGR
+EIGR    MAX
GRID     1               1066.06 0.0     0.0
GRID     2               1110.6  0.0     0.0
GRID     3               1155.10 0.0     0.0
GRID     4               1229.75 0.0     0.0
GRID     5               1304.4  0.0     0.0
GRID     6               1411.0  0.0     0.0
GRID     7               1518.0  0.0     0.0
GRID     8               1625.0  0.0     0.0
```

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GRID    9               1732.0  0.0     0.0
GRID    10              1839.0  0.0     0.0
GRID    11              1946.0  0.0     0.0
GRID    12              2050.8  0.0     0.0
GRID    13              2160.0  0.0     0.0
GRID    14              2264.4  0.0     0.0
GRID    15              2284.8  0.0     0.0
GRID    16              2340.68 0.0     0.0
GRID    17              2396.57 0.0     0.0
GRID    18              2459.1750.0     0.0
GRID    19              2473.8  0.0     0.0
GRID    20              2569.8  0.0     0.0
GRID    21              2664.1330.0     0.0
GRID    22              2758.4670.0     0.0
GRID    23              2852.8  0.0     0.0
GRID    24              2963.4250.0     0.0
GRID    25              2990.6750.0     0.0
GRID    26              3012.5250.0     0.0
GRID    27              3123.15 0.0     0.0
GRID    28              3233.6250.0     0.0
GRID    29              3337.35 0.0     0.0
GRID    30              3480.5750.0     0.0
GRID    31              3623.8  0.0     0.0
GRID    32              3747.4  0.0     0.0
GRID    33              3871.0  0.0     0.0
GRID    34              3964.5  0.0     0.0
GRID    35              4054.0  0.0     0.0
GRID    36              4118.65 0.0     0.0
GRID    37              4122.65 0.0     0.0
GRID    38              4233.2750.0     0.0
GRID    39              4309.4  0.0     0.0
GRID    40              4385.5  0.0     0.0
GRID    41              4388.28 -117.097-117.097
GRID    42              4388.28  117.097-117.097
GRID    43              4388.28 -117.097 117.097
GRID    44              4388.28  117.097 117.097
GRID    45              1274.00 0.0     0.0
GRID    46              2342.00 0.0     0.0
GRID    60              2990.675 165.60  0.0
GRID    61              2990.675-165.60  0.0
GRID    62              4054.0    161.75  57.0
GRID    63              4054.0   -161.75  57.0
GRID    64              4054.0    161.75 -57.0
GRID    65              4054.0   -161.75 -57.0
GRID    70              2990.675 165.60  0.0
GRID    71              2990.675-165.60  0.0
GRID    72              4054.0    161.75  57.0
GRID    73              4054.0   -161.75  57.0
GRID    74              4054.0    161.75 -57.0
GRID    75              4054.0   -161.75 -57.0
GRID    80              2963.4250.0     0.0
GRID    81              4233.2750.0     0.0
$GRID    89              1888.14    0.0     0.0
GRID    90              1784.4    0.0     0.0
GRID    99              4687.06 1.0     0.0                     123456
$
$ ALUMINUM MATERIAL
```

```
$
MAT1     2001     9.9+6            .33      0.0
PARAM    GRDPNT   0
$PARAM    AUTOSPC 1
PARAM    WTMASS   2.591E-3
$
$  CONE BAR PROPERTIES
$
PBAR      100     2001     17.9    3433.0   3433.0   6866.0
PBAR      101     2001     30.7    32566.   32566.   65132.
PBAR      102     2001     36.0    60000.   60000.   .12E+6
PBAR      103     2001     50.6    .214E+6  .214E+6  .43E+6
$
$  SHROUD BAR PROPERTIES
$
PBAR     1001     2001    170.5    1.05E+6  .656E+6  1.71E+6
$
$  LO2 TANK BAR PROPERTIES
$
PBAR     1002     2001    254.65   4.18E+6  2.79E+6  7.08E+6
PBAR     1003     2001    237.18   3.79E+6  2.69E+6  5.91E+6
PBAR     1004     2001    216.425  3.33E+6  2.60E+6  6.42E+6
PBAR     1005     2001    263.83   4.51E+6  2.72E+6  4.99E+6
PBAR     1006     2001    263.79   4.66E+6  2.41E+6  4.99E+6
$
$  LH2 TANK BAR PROPERTIES
$
PBAR     1012     2001    145.06   1.99E+6  1.99E+6  2.54E+6
PBAR     1013     2001    196.984  2.68E+6  2.71E+6  2.43E+6
PBAR     1014     2001    225.198  3.07E+6  3.096E+62.34E+6
PBAR     1015     2001    213.168  2.97E+6  2.87E+6  2.31E+6
PBAR     1020     2001    50.0     9.99E+9  9.99E+9  9.99E+9
$SPC1     100      123     42       43       44       45
SPC1     100      456     70       71       72       73
SPC1     100      456     74       75
SPC1     100      1       72       73       74       75
SPC1     100      23456   80       81
$SPC1     100      3       74       75
$$$$$$$$$$$$FIXED SRB'S $$$$$$$$$$$$$$
$SPC1     100      123     70       71
$SPC1     100      2       72       73       74       75
$SPC1     100      3       72       73
$
$  AXIS DIRECTION INDICATORS
$
$
GRID     50000             0.0      0.0      0.0               123456
GRID     50001             10.0     0.0      0.0               123456
GRID     50002             0.0      10.0     0.0               123456
GRID     50003             0.0      0.0      10.0              123456
PLOTEL   55001    50000    50001
PLOTEL   55002    50000    50002
PLOTEL   55003    50000    50003
```

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***************************************************************************************
*FRED HARRINGTON      *      MARSHALL SPACE FLIGHT CENTER       *                      *
*                     *        SYSTEMS DYNAMICS DIVISION        * MAP NAME   FULL1*5   *
*      12/03/91       * STAGE 1.5,FULL, LIFTOFF MODEL           * MODEL NO.     FULL1*5 *
***************************************************************************************
```

DOFS = 1388 BND DOFS = 0 INT DOFS = 0

NODE	DESCRIPTION	X COORD	Y COORD	Z COORD	ROW/COL OF MATRIX X	Y	Z	RX	RY	RZ
809	FULL1*5	4385.500	0.000	-165.463	1	2	3	4	5	6
810	FULL1*5	4385.500	-63.320	-152.868	7	8	9	10	11	12
811	FULL1*5	4385.500	-117.000	-117.000	13	14	15	16	17	18
808	FULL1*5	4385.500	63.320	-152.868	19	20	21	22	23	24
807	FULL1*5	4385.500	117.000	-117.000	25	26	27	28	29	30
812	FULL1*5	4385.500	-152.868	-63.320	31	32	33	34	35	36
813	FULL1*5	4385.500	-165.463	0.000	37	38	39	40	41	42
806	FULL1*5	4385.500	152.868	-63.320	43	44	45	46	47	48
814	FULL1*5	4385.500	-152.868	63.320	49	50	51	52	53	54
805	FULL1*5	4385.500	165.463	0.000	55	56	57	58	59	60
815	FULL1*5	4385.500	-117.000	117.000	61	62	63	64	65	66
804	FULL1*5	4385.500	152.868	63.320	67	68	69	70	71	72
816	FULL1*5	4385.500	-63.320	152.868	73	74	75	76	77	78
803	FULL1*5	4385.500	117.000	117.000	79	80	81	82	83	84
801	FULL1*5	4385.500	0.000	165.463	85	86	87	88	89	90
802	FULL1*5	4385.500	63.320	152.868	91	92	93	94	95	96
860	FULL1*5	4385.500	-26.405	-63.748	97	98	99	100	101	102
710	FULL1*5	4341.570	-63.320	-152.868	103	104	105	106	107	108
859	FULL1*5	4385.500	0.000	-69.000	109	110	111	112	113	114
709	FULL1*5	4341.570	0.000	-165.463	115	116	117	118	119	120
858	FULL1*5	4385.500	26.405	-63.748	121	122	123	124	125	126
708	FULL1*5	4341.570	63.320	-152.868	127	128	129	130	131	132
861	FULL1*5	4385.500	-48.791	-48.791	133	134	135	136	137	138
711	FULL1*5	4341.570	-117.000	-117.000	139	140	141	142	143	144
862	FULL1*5	4385.500	-63.748	-26.405	145	146	147	148	149	150
712	FULL1*5	4341.570	-152.868	-63.320	151	152	153	154	155	156
863	FULL1*5	4385.500	-69.000	0.000	157	158	159	160	161	162
864	FULL1*5	4385.500	-63.748	26.405	163	164	165	166	167	168
865	FULL1*5	4385.500	-48.791	48.791	169	170	171	172	173	174

866	FULL1*5	4385.500	-26.405	63.748	175	176	177	178	179	180
857	FULL1*5	4385.500	48.791	-48.791	181	182	183	184	185	186
707	FULL1*5	4341.570	117.000	-117.000	187	188	189	190	191	192
856	FULL1*5	4385.500	63.748	-26.405	193	194	195	196	197	198
706	FULL1*5	4341.570	152.868	-63.320	199	200	201	202	203	204
855	FULL1*5	4385.500	69.000	0.000	205	206	207	208	209	210
713	FULL1*5	4341.570	-165.463	0.000	211	212	213	214	215	216
714	FULL1*5	4341.570	-152.868	63.320	217	218	219	220	221	222
705	FULL1*5	4341.570	165.463	0.000	223	224	225	226	227	228
715	FULL1*5	4341.570	-117.000	117.000	229	230	231	232	233	234
704	FULL1*5	4341.570	152.868	63.320	235	236	237	238	239	240
716	FULL1*5	4341.570	-63.320	152.868	241	242	243	244	245	246
703	FULL1*5	4341.570	117.000	117.000	247	248	249	250	251	252
701	FULL1*5	4341.570	0.000	165.463	253	254	255	256	257	258
702	FULL1*5	4341.570	63.320	152.868	259	260	261	262	263	264
854	FULL1*5	4385.500	63.748	26.405	265	266	267	268	269	270
853	FULL1*5	4385.500	48.791	48.791	271	272	273	274	275	276
852	FULL1*5	4385.500	26.405	63.748	277	278	279	280	281	282
851	FULL1*5	4385.500	0.000	69.000	283	284	285	286	287	288
761	FULL1*5	4341.570	-65.894	-65.894	289	290	291	292	293	294
611	FULL1*5	4297.820	-117.000	-117.000	295	296	297	298	299	300
760	FULL1*5	4341.570	-35.662	-86.095	301	302	303	304	305	306
610	FULL1*5	4297.820	-63.320	-152.868	307	308	309	310	311	312
759	FULL1*5	4341.570	0.000	-93.188	313	314	315	316	317	318
609	FULL1*5	4297.820	0.000	-165.463	319	320	321	322	323	324
758	FULL1*5	4341.570	35.662	-86.095	325	326	327	328	329	330
608	FULL1*5	4297.820	63.320	-152.868	331	332	333	334	335	336
757	FULL1*5	4341.570	65.894	-65.894	337	338	339	340	341	342
607	FULL1*5	4297.820	117.000	-117.000	343	344	345	346	347	348
762	FULL1*5	4341.570	-86.095	-35.662	349	350	351	352	353	354
612	FULL1*5	4297.820	-152.868	-63.320	355	356	357	358	359	360
763	FULL1*5	4341.570	-93.188	0.000	361	362	363	364	365	366
613	FULL1*5	4297.820	-165.463	0.000	367	368	369	370	371	372
764	FULL1*5	4341.570	-86.095	35.662	373	374	375	376	377	378
765	FULL1*5	4341.570	-65.894	65.894	379	380	381	382	383	384
766	FULL1*5	4341.570	-35.662	86.095	385	386	387	388	389	390
756	FULL1*5	4341.570	86.095	-35.662	391	392	393	394	395	396
606	FULL1*5	4297.820	152.868	-63.320	397	398	399	400	401	402
755	FULL1*5	4341.570	93.188	0.000	403	404	405	406	407	408

605	FULL1*5	4297.820	165.463	0.000	409	410	411	412	413	414
754	FULL1*5	4341.570	86.095	35.662	415	416	417	418	419	420
614	FULL1*5	4297.820	-152.868	63.320	421	422	423	424	425	426
615	FULL1*5	4297.820	-117.000	117.000	427	428	429	430	431	432
604	FULL1*5	4297.820	152.868	63.320	433	434	435	436	437	438
616	FULL1*5	4297.820	-63.320	152.868	439	440	441	442	443	444
603	FULL1*5	4297.820	117.000	117.000	445	446	447	448	449	450
601	FULL1*5	4297.820	0.000	165.463	451	452	453	454	455	456
602	FULL1*5	4297.820	63.320	152.868	457	458	459	460	461	462
753	FULL1*5	4341.570	65.894	65.894	463	464	465	466	467	468
752	FULL1*5	4341.570	35.662	86.095	469	470	471	472	473	474
751	FULL1*5	4341.570	0.000	93.188	475	476	477	478	479	480
662	FULL1*5	4297.820	-108.352	-44.881	481	482	483	484	485	486
512	FULL1*5	4254.070	-152.868	-63.320	487	488	489	490	491	492
661	FULL1*5	4297.820	-82.929	-82.929	493	494	495	496	497	498
511	FULL1*5	4254.070	-117.000	-117.000	499	500	501	502	503	504
660	FULL1*5	4297.820	-44.881	-108.352	505	506	507	508	509	510
510	FULL1*5	4254.070	-63.320	-152.868	511	512	513	514	515	516
659	FULL1*5	4297.820	0.000	-117.280	517	518	519	520	521	522
509	FULL1*5	4254.070	0.000	-165.463	523	524	525	526	527	528
658	FULL1*5	4297.820	44.881	-108.352	529	530	531	532	533	534
508	FULL1*5	4254.070	63.320	-152.868	535	536	537	538	539	540
657	FULL1*5	4297.820	82.929	-82.929	541	542	543	544	545	546
507	FULL1*5	4254.070	117.000	-117.000	547	548	549	550	551	552
656	FULL1*5	4297.820	108.352	-44.881	553	554	555	556	557	558
506	FULL1*5	4254.070	152.868	-63.320	559	560	561	562	563	564
663	FULL1*5	4297.820	-117.280	0.000	565	566	567	568	569	570
513	FULL1*5	4254.070	-165.463	0.000	571	572	573	574	575	576
664	FULL1*5	4297.820	-108.352	44.881	577	578	579	580	581	582
514	FULL1*5	4254.070	-152.868	63.320	583	584	585	586	587	588
665	FULL1*5	4297.820	-82.929	82.929	589	590	591	592	593	594
666	FULL1*5	4297.820	-44.881	108.352	595	596	597	598	599	600
655	FULL1*5	4297.820	117.280	0.000	601	602	603	604	605	606
505	FULL1*5	4254.070	165.463	0.000	607	608	609	610	611	612
654	FULL1*5	4297.820	108.352	44.881	613	614	615	616	617	618
504	FULL1*5	4254.070	152.868	63.320	619	620	621	622	623	624
653	FULL1*5	4297.820	82.929	82.929	625	626	627	628	629	630
515	FULL1*5	4254.070	-117.000	117.000	631	632	633	634	635	636
516	FULL1*5	4254.070	-63.320	152.868	637	638	639	640	641	642

503	FULL1*5	4254.070	117.000	117.000	643	644	645	646	647	648
501	FULL1*5	4254.070	0.000	165.463	649	650	651	652	653	654
502	FULL1*5	4254.070	63.320	152.868	655	656	657	658	659	660
652	FULL1*5	4297.820	44.881	108.352	661	662	663	664	665	666
651	FULL1*5	4297.820	0.000	117.280	667	668	669	670	671	672
563	FULL1*5	4254.070	-141.371	0.000	673	674	675	676	677	678
413	FULL1*5	4227.370	-165.463	0.000	679	680	681	682	683	684
562	FULL1*5	4254.070	-130.610	-54.100	685	686	687	688	689	690
412	FULL1*5	4227.370	-152.868	-63.320	691	692	693	694	695	696
561	FULL1*5	4254.070	-99.965	-99.965	697	698	699	700	701	702
411	FULL1*5	4227.370	-117.000	-117.000	703	704	705	706	707	708
560	FULL1*5	4254.070	-54.100	-130.610	709	710	711	712	713	714
410	FULL1*5	4227.370	-63.320	-152.868	715	716	717	718	719	720
559	FULL1*5	4254.070	0.000	-141.371	721	722	723	724	725	726
409	FULL1*5	4227.370	0.000	-165.463	727	728	729	730	731	732
558	FULL1*5	4254.070	54.100	-130.610	733	734	735	736	737	738
408	FULL1*5	4227.370	63.320	-152.868	739	740	741	742	743	744
557	FULL1*5	4254.070	99.965	-99.965	745	746	747	748	749	750
407	FULL1*5	4227.370	117.000	-117.000	751	752	753	754	755	756
556	FULL1*5	4254.070	130.610	-54.100	757	758	759	760	761	762
406	FULL1*5	4227.370	152.868	-63.320	763	764	765	766	767	768
555	FULL1*5	4254.070	141.371	0.000	769	770	771	772	773	774
405	FULL1*5	4227.370	165.463	0.000	775	776	777	778	779	780
564	FULL1*5	4254.070	-130.610	54.100	781	782	783	784	785	786
414	FULL1*5	4227.370	-152.868	63.320	787	788	789	790	791	792
565	FULL1*5	4254.070	-99.965	99.965	793	794	795	796	797	798
415	FULL1*5	4227.370	-117.000	117.000	799	800	801	802	803	804
566	FULL1*5	4254.070	-54.100	130.610	805	806	807	808	809	810
554	FULL1*5	4254.070	130.610	54.100	811	812	813	814	815	816
404	FULL1*5	4227.370	152.868	63.320	817	818	819	820	821	822
553	FULL1*5	4254.070	99.965	99.965	823	824	825	826	827	828
403	FULL1*5	4227.370	117.000	117.000	829	830	831	832	833	834
552	FULL1*5	4254.070	54.100	130.610	835	836	837	838	839	840
416	FULL1*5	4227.370	-63.320	152.868	841	842	843	844	845	846
401	FULL1*5	4227.370	0.000	165.463	847	848	849	850	851	852
402	FULL1*5	4227.370	63.320	152.868	853	854	855	856	857	858
551	FULL1*5	4254.070	0.000	141.371	859	860	861	862	863	864
314	FULL1*5	4210.320	-152.868	63.320	865	866	867	868	869	870
313	FULL1*5	4210.320	-165.463	0.000	871	872	873	874	875	876

312	FULL1*5	4210.320	-152.868	-63.320	877 878 879 880 881 882
311	FULL1*5	4210.320	-117.000	-117.000	883 884 885 886 887 888
310	FULL1*5	4210.320	-63.320	-152.868	889 890 891 892 893 894
309	FULL1*5	4210.320	0.000	-165.463	895 896 897 898 899 900
308	FULL1*5	4210.320	63.320	-152.868	901 902 903 904 905 906
307	FULL1*5	4210.320	117.000	-117.000	907 908 909 910 911 912
306	FULL1*5	4210.320	152.868	-63.320	913 914 915 916 917 918
305	FULL1*5	4210.320	165.463	0.000	919 920 921 922 923 924
304	FULL1*5	4210.320	152.868	63.320	925 926 927 928 929 930
315	FULL1*5	4210.320	-117.000	117.000	931 932 933 934 935 936
316	FULL1*5	4210.320	-63.320	152.868	937 938 939 940 941 942
303	FULL1*5	4210.320	117.000	117.000	943 944 945 946 947 948
302	FULL1*5	4210.320	63.320	152.868	949 950 951 952 953 954
301	FULL1*5	4210.320	0.000	165.463	955 956 957 958 959 960
215	FULL1*5	4166.570	-117.000	117.000	961 962 963 964 965 966
214	FULL1*5	4166.570	-152.868	63.320	967 968 969 970 971 972
213	FULL1*5	4166.570	-165.463	0.000	973 974 975 976 977 978
212	FULL1*5	4166.570	-152.868	-63.320	979 980 981 982 983 984
211	FULL1*5	4166.570	-117.000	-117.000	985 986 987 988 989 990
210	FULL1*5	4166.570	-63.320	-152.868	991 992 993 994 995 996
209	FULL1*5	4166.570	0.000	-165.463	997 998 999100010011002
208	FULL1*5	4166.570	63.320	-152.868	100310041005100610071008
207	FULL1*5	4166.570	117.000	-117.000	100910101011101210131014
206	FULL1*5	4166.570	152.868	-63.320	101510161017101810191020
205	FULL1*5	4166.570	165.463	0.000	102110221023102410251026
204	FULL1*5	4166.570	152.868	63.320	102710281029103010311032
203	FULL1*5	4166.570	117.000	117.000	103310341035103610371038
216	FULL1*5	4166.570	-63.320	152.868	103910401041104210431044
201	FULL1*5	4166.570	0.000	165.463	104510461047104810491050
202	FULL1*5	4166.570	63.320	152.868	105110521053105410551056
116	FULL1*5	4122.650	-63.320	152.868	105710581059106010611062
115	FULL1*5	4122.650	-117.000	117.000	106310641065106610671068
114	FULL1*5	4122.650	-152.868	63.320	106910701071107210731074
113	FULL1*5	4122.650	-165.463	0.000	107510761077107810791080
112	FULL1*5	4122.650	-152.868	-63.320	108110821083108410851086
111	FULL1*5	4122.650	-117.000	-117.000	108710881089109010911092
110	FULL1*5	4122.650	-63.320	-152.868	109310941095109610971098
109	FULL1*5	4122.650	0.000	-165.463	109911001101110211031104
108	FULL1*5	4122.650	63.320	-152.868	110511061107110811091110

107	FULL1*5	4122.650	117.000	-117.000	111111121113111411151116
106	FULL1*5	4122.650	152.868	-63.320	111711181119112011211122
105	FULL1*5	4122.650	165.463	0.000	112311241125112611271128
104	FULL1*5	4122.650	152.868	63.320	112911301131113211331134
103	FULL1*5	4122.650	117.000	117.000	113511361137113811391140
102	FULL1*5	4122.650	63.320	152.868	114111421143114411451146
101	FULL1*5	4122.650	0.000	165.463	114711481149115011511152
37	FULL1*5	4122.650	0.000	0.000	115311541155115611571158
38	FULL1*5	4233.270	0.000	0.000	115911601161116211631164
36	FULL1*5	4090.320	0.000	0.000	116511661167116811691170
81	FULL1*5	4233.270	0.000	0.000	1171 0 0 0 0 0
35	FULL1*5	4058.000	0.000	0.000	117211731174117511761177
34	FULL1*5	3941.140	0.000	0.000	117811791180118111821183
33	FULL1*5	3824.290	0.000	0.000	118411851186118711881189
32	FULL1*5	3707.430	0.000	0.000	119011911192119311941195
31	FULL1*5	3590.570	0.000	0.000	119611971198119912001201
30	FULL1*5	3473.720	0.000	0.000	120212031204120512061207
29	FULL1*5	3356.860	0.000	0.000	120812091210121112121213
28	FULL1*5	3240.010	0.000	0.000	121412151216121712181219
27	FULL1*5	3123.150	0.000	0.000	122012211222122312241225
26	FULL1*5	3012.520	0.000	0.000	122612271228122912301231
25	FULL1*5	2985.670	0.000	0.000	123212331234123512361237
80	FULL1*5	2963.420	0.000	0.000	1238 0 0 0 0 0
24	FULL1*5	2963.420	0.000	0.000	123912401241124212431244
23	FULL1*5	2852.800	0.000	0.000	124512461247124812491250
22	FULL1*5	2758.470	0.000	0.000	125112521253125412551256
21	FULL1*5	2664.130	0.000	0.000	125712581259126012611262
20	FULL1*5	2569.800	0.000	0.000	126312641265126612671268
19	FULL1*5	2471.150	0.000	0.000	126912701271127212731274
18	FULL1*5	2459.170	0.000	0.000	127512761277127812791280
17	FULL1*5	2410.800	0.000	0.000	128112821283128412851286
16	FULL1*5	2347.800	0.000	0.000	128712881289129012911292
15	FULL1*5	2284.800	0.000	0.000	129312941295129612971298
999	FULL1*5	1997.580	0.000	0.000	129913001301130213031304
14	FULL1*5	2264.400	0.000	0.000	130513061307130813091310
13	FULL1*5	2184.400	0.000	0.000	131113121313131413151316
12	FULL1*5	2104.400	0.000	0.000	131713181319132013211322
11	FULL1*5	2024.400	0.000	0.000	132313241325132613271328
10	FULL1*5	1944.400	0.000	0.000	132913301331133213331334

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    9 FULL1*5              1864.400     0.000     0.000   133513361337133813391340
    8 FULL1*5              1784.400     0.000     0.000   134113421343134413451346
    7 FULL1*5              1704.400     0.000     0.000   134713481349135013511352
    6 FULL1*5              1624.400     0.000     0.000   135313541355135613571358
    5 FULL1*5              1544.400     0.000     0.000   135913601361136213631364
    4 FULL1*5              1494.640     0.000     0.000   136513661367136813691370
    3 FULL1*5              1444.870     0.000     0.000   137113721373137413751376
    2 FULL1*5              1395.100     0.000     0.000   137713781379138013811382
    1 FULL1*5              1306.060     0.000     0.000   138313841385138613871388
000000000000000
```

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*****************************************************************************************
* J.A. BRUNTY          *      MARSHALL SPACE FLIGHT CENTER       *                      *
*                      *        SYSTEMS DYNAMICS DIVISION        * MAP NAME   MLPHALF   *
*      06/20/91        *    1.5 STAGE VEHICLE                    * MODEL NO.     MLPHALF *
*****************************************************************************************
 DOFS =      83      BND DOFS =      12      INT DOFS =      71
```

NODE	DESCRIPTION	X COORD	Y COORD	Z COORD	ROW/COL OF MATRIX X	Y	Z	RX	RY	RZ
999999	CANTILEVER MODES	0.000	0.000	0.000	1	2	3	4	5	6
999999	CANTILEVER MODES	0.000	0.000	0.000	7	8	9	10	11	12
999999	CANTILEVER MODES	0.000	0.000	0.000	13	14	15	16	17	18
999999	CANTILEVER MODES	0.000	0.000	0.000	19	20	21	22	23	24
999999	CANTILEVER MODES	0.000	0.000	0.000	25	26	27	28	29	30
999999	CANTILEVER MODES	0.000	0.000	0.000	31	32	33	34	35	36
999999	CANTILEVER MODES	0.000	0.000	0.000	37	38	39	40	41	42
999999	CANTILEVER MODES	0.000	0.000	0.000	43	44	45	46	47	48
999999	CANTILEVER MODES	0.000	0.000	0.000	49	50	51	52	53	54
999999	CANTILEVER MODES	0.000	0.000	0.000	55	56	57	58	59	60
999999	CANTILEVER MODES	0.000	0.000	0.000	61	62	63	64	65	66
999999	CANTILEVER MODES	0.000	0.000	0.000	67	68	69	70	71	
351	SRB/MLP INTERFACE POST 3	1741.953	196.700	-29.684	81	82	83	0	0	0
352	SRB/MLP INTERFACE POST 1	1741.953	196.700	156.684	75	76	77	0	0	0
350	SRB/MLP INTERFACE POST 4	1741.953	304.300	-29.684	78	79	80	0	0	0
353	SRB/MLP INTERFACE POST 2	1741.953	304.300	156.684	72	73	74	0	0	0

0000000000000

NASTRAN BULK DATA DECK FOR NLS2

CELAS2	301	1.73E+6	24	1	80	1	
CELAS2	302	2.34E+6	38	1	81	1	
CBAR	101	1001	1	2	99		2
CBAR	102	1001	2	3	99		2
CBAR	103	1001	3	4	99		2
CBAR	104	1001	4	5	99		2
CBAR	105	1001	5	6	99		2
CBAR	106	1001	6	7	99		2
CBAR	107	1001	7	8	99		2
CBAR	108	1001	8	9	99		2
CBAR	109	1001	9	10	99		2
CBAR	110	1001	10	11	99		2
CBAR	111	1001	11	12	99		2
CBAR	112	1001	12	13	99		2
CBAR	113	1001	13	14	99		2
CBAR	114	1002	14	15	99		2
CBAR	115	1002	15	16	99		2
CBAR	116	1002	16	17	99		2
CBAR	117	1002	17	18	99		2
CBAR	118	1002	18	19	99		2
CBAR	119	1003	19	20	99		2
CBAR	120	1004	20	21	99		2
CBAR	121	1004	21	22	99		2
CBAR	122	1003	22	23	99		2
CBAR	123	1002	23	24	99		2
CBAR	124	1005	24	25	99		2
CBAR	125	1006	25	26	99		2
CBAR	126	1012	26	27	99		2
CBAR	127	1012	27	28	99		2
CBAR	128	1012	28	29	99		2
CBAR	129	1013	29	30	99		2
CBAR	130	1013	30	31	99		2
CBAR	131	1014	31	32	99		2
CBAR	999	1020	999	15	99		2
CBAR	132	1014	32	33	99		2
CBAR	133	1015	33	34	99		2
CBAR	134	1015	34	35	99		2
CBAR	135	1015	35	36	99		2
CBAR	136	1015	36	37	99		2
CBAR	137	1015	37	38	99		2
CBAR	149	1020	101	37	30		2
CBAR	150	1020	102	37	30		2
CBAR	151	1020	103	37	30		2
CBAR	152	1020	104	37	30		2
CBAR	153	1020	105	37	30		2
CBAR	154	1020	106	37	30		2
CBAR	155	1020	107	37	30		2
CBAR	156	1020	108	37	30		2
CBAR	157	1020	109	37	30		2
CBAR	158	1020	110	37	30		2
CBAR	159	1020	111	37	30		2

CBAR	160	1020	112	37	30	2
CBAR	161	1020	113	37	30	2
CBAR	162	1020	114	37	30	2
CBAR	163	1020	115	37	30	2
CBAR	164	1020	116	37	30	2
CBAR	201	2020	101	201	881	2
CBAR	202	2020	201	301	881	2
CBAR	203	2020	301	401	881	2
CBAR	204	2021	401	501	881	2
CBAR	205	2022	501	601	881	2
CBAR	206	2023	601	701	881	2
CBAR	207	2024	701	801	881	2
CBAR	208	2020	103	203	883	2
CBAR	209	2020	203	303	883	2
CBAR	210	2020	303	403	883	2
CBAR	211	2025	403	503	883	2
CBAR	212	2026	503	603	883	2
CBAR	213	2027	603	703	883	2
CBAR	214	2028	703	803	883	2
CBAR	215	2020	105	205	885	2
CBAR	216	2020	205	305	885	2
CBAR	217	2020	305	405	885	2
CBAR	218	2021	405	505	885	2
CBAR	219	2022	505	605	885	2
CBAR	220	2023	605	705	885	2
CBAR	221	2024	705	805	885	2
CBAR	222	2020	107	207	887	2
CBAR	223	2020	207	307	887	2
CBAR	224	2020	307	407	887	2
CBAR	225	2025	407	507	887	2
CBAR	226	2026	507	607	887	2
CBAR	227	2027	607	707	887	2
CBAR	228	2028	707	807	887	2
CBAR	229	2020	109	209	889	2
CBAR	230	2020	209	309	889	2
CBAR	231	2020	309	409	889	2
CBAR	232	2021	409	509	889	2
CBAR	233	2022	509	609	889	2
CBAR	234	2023	609	709	889	2
CBAR	235	2024	709	809	889	2
CBAR	236	2020	111	211	891	2
CBAR	237	2020	211	311	891	2
CBAR	238	2020	311	411	891	2
CBAR	239	2025	411	511	891	2
CBAR	240	2026	511	611	891	2
CBAR	241	2027	611	711	891	2
CBAR	242	2028	711	811	891	2
CBAR	243	2020	113	213	893	2
CBAR	244	2020	213	313	893	2
CBAR	245	2020	313	413	893	2
CBAR	246	2021	413	513	893	2
CBAR	247	2022	513	613	893	2
CBAR	248	2023	613	713	893	2
CBAR	249	2024	713	813	893	2

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CBAR    250     2020    115     215     895                             2
CBAR    251     2020    215     315     895                             2
CBAR    252     2020    315     415     895                             2
CBAR    253     2025    415     515     895                             2
CBAR    254     2026    515     615     895                             2
CBAR    255     2027    615     715     895                             2
CBAR    256     2028    715     815     895                             2
$
$  INNER CONE STRUCTURE BEAMS
$
CBAR    257     2031    301     551     881                             2
CBAR    258     2032    551     651     881                             2
CBAR    259     2033    651     751     881                             2
CBAR    260     2034    751     851     881                             2
CBAR    261     2031    309     559     889                             2
CBAR    262     2032    559     659     889                             2
CBAR    263     2033    659     759     889                             2
CBAR    264     2034    759     859     889                             2
$
$  RINGS FOR THRUST STRUCTURE
$
CBAR    265     1101    201     202     102                             2
CBAR    266     1101    202     203     103                             2
CBAR    267     1101    203     204     104                             2
CBAR    268     1101    204     205     105                             2
CBAR    269     1101    205     206     106                             2
CBAR    270     1101    206     207     107                             2
CBAR    271     1101    207     208     108                             2
CBAR    272     1101    208     209     109                             2
CBAR    273     1101    209     210     110                             2
CBAR    274     1101    210     211     111                             2
CBAR    275     1101    211     212     112                             2
CBAR    276     1101    212     213     113                             2
CBAR    277     1101    213     214     114                             2
CBAR    278     1101    214     215     115                             2
CBAR    279     1101    215     216     116                             2
CBAR    280     1101    216     201     101                             2
CBAR    281     1103    301     302     102                             2
CBAR    282     1103    302     303     103                             2
CBAR    283     1103    303     304     104                             2
CBAR    284     1103    304     305     105                             2
CBAR    285     1103    305     306     106                             2
CBAR    286     1103    306     307     107                             2
CBAR    287     1103    307     308     108                             2
CBAR    288     1103    308     309     109                             2
CBAR    289     1103    309     310     110                             2
CBAR    290     1103    310     311     111                             2
CBAR    291     1103    311     312     112                             2
CBAR    292     1103    312     313     113                             2
CBAR    293     1103    313     314     114                             2
CBAR    294     1103    314     315     115                             2
CBAR    295     1103    315     316     116                             2
CBAR    296     1103    316     301     101                             2
CBAR    297     1102    401     402     102                             2
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CBAR	298	1102	402	403	103	2
CBAR	299	1102	403	404	104	2
CBAR	300	1102	404	405	105	2
CBAR	301	1102	405	406	106	2
CBAR	302	1102	406	407	107	2
CBAR	303	1102	407	408	108	2
CBAR	304	1102	408	409	109	2
CBAR	305	1102	409	410	110	2
CBAR	306	1102	410	411	111	2
CBAR	307	1102	411	412	112	2
CBAR	308	1102	412	413	113	2
CBAR	309	1102	413	414	114	2
CBAR	310	1102	414	415	115	2
CBAR	311	1102	415	416	116	2
CBAR	312	1102	416	401	101	2
CBAR	313	1101	501	502	102	2
CBAR	314	1101	502	503	103	2
CBAR	315	1101	503	504	104	2
CBAR	316	1101	504	505	105	2
CBAR	317	1101	505	506	106	2
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CBAR	319	1101	507	508	108	2
CBAR	320	1101	508	509	109	2
CBAR	321	1101	509	510	110	2
CBAR	322	1101	510	511	111	2
CBAR	323	1101	511	512	112	2
CBAR	324	1101	512	513	113	2
CBAR	325	1101	513	514	114	2
CBAR	326	1101	514	515	115	2
CBAR	327	1101	515	516	116	2
CBAR	328	1101	516	501	101	2
CBAR	329	1101	601	602	102	2
CBAR	330	1101	602	603	103	2
CBAR	331	1101	603	604	104	2
CBAR	332	1101	604	605	105	2
CBAR	333	1101	605	606	106	2
CBAR	334	1101	606	607	107	2
CBAR	335	1101	607	608	108	2
CBAR	336	1101	608	609	109	2
CBAR	337	1101	609	610	110	2
CBAR	338	1101	610	611	111	2
CBAR	339	1101	611	612	112	2
CBAR	340	1101	612	613	113	2
CBAR	341	1101	613	614	114	2
CBAR	342	1101	614	615	115	2
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CBAR	345	1101	701	702	102	2
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CBAR	348	1101	704	705	105	2
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CBAR	352	1101	708	709	109	2
CBAR	353	1101	709	710	110	2
CBAR	354	1101	710	711	111	2
CBAR	355	1101	711	712	112	2
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CBAR	357	1101	713	714	114	2
CBAR	358	1101	714	715	115	2
CBAR	359	1101	715	716	116	2
CBAR	360	1101	716	701	101	2
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CBAR	363	1111	803	804	104	2
CBAR	364	1111	804	805	105	2
CBAR	365	1111	805	806	106	2
CBAR	366	1111	806	807	107	2
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CBAR	371	1111	811	812	112	2
CBAR	372	1111	812	813	113	2
CBAR	373	1111	813	814	114	2
CBAR	374	1111	814	815	115	2
CBAR	375	1111	815	816	116	2
CBAR	376	1111	816	801	101	2
CBAR	377	1105	551	552	302	2
CBAR	378	1105	552	553	303	2
CBAR	379	1105	553	554	304	2
CBAR	380	1105	554	555	305	2
CBAR	381	1105	555	556	306	2
CBAR	382	1105	556	557	307	2
CBAR	383	1105	557	558	308	2
CBAR	384	1105	558	559	309	2
CBAR	385	1105	559	560	310	2
CBAR	386	1105	560	561	311	2
CBAR	387	1105	561	562	312	2
CBAR	388	1105	562	563	313	2
CBAR	389	1105	563	564	314	2
CBAR	390	1105	564	565	315	2
CBAR	391	1105	565	566	316	2
CBAR	392	1105	566	551	301	2
CBAR	393	2020	651	652	302	2
CBAR	394	2020	652	653	303	2
CBAR	395	2020	653	654	304	2
CBAR	396	2020	654	655	305	2
CBAR	397	2020	655	656	306	2
CBAR	398	2020	656	657	307	2
CBAR	399	2020	657	658	308	2
CBAR	400	2020	658	659	309	2
CBAR	401	2020	659	660	310	2
CBAR	402	2020	660	661	311	2
CBAR	403	2020	661	662	312	2
CBAR	404	2020	662	663	313	2
CBAR	405	2020	663	664	314	2

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CBAR    406     2020    664     665     315                             2
CBAR    407     2020    665     666     316                             2
CBAR    408     2020    666     651     301                             2
CBAR    409     1105    751     752     302                             2
CBAR    410     1105    752     753     303                             2
CBAR    411     1105    753     754     304                             2
CBAR    412     1105    754     755     305                             2
CBAR    413     1105    755     756     306                             2
CBAR    414     1105    756     757     307                             2
CBAR    415     1105    757     758     308                             2
CBAR    416     1105    758     759     309                             2
CBAR    417     1105    759     760     310                             2
CBAR    418     1105    760     761     311                             2
CBAR    419     1105    761     762     312                             2
CBAR    420     1105    762     763     313                             2
CBAR    421     1105    763     764     314                             2
CBAR    422     1105    764     765     315                             2
CBAR    423     1105    765     766     316                             2
CBAR    424     1105    766     751     301                             2
CBAR    425     1104    851     852     302                             2
CBAR    426     1104    852     853     303                             2
CBAR    427     1104    853     854     304                             2
CBAR    428     1104    854     855     305                             2
CBAR    429     1104    855     856     306                             2
CBAR    430     1104    856     857     307                             2
CBAR    431     1104    857     858     308                             2
CBAR    432     1104    858     859     309                             2
CBAR    433     1104    859     860     310                             2
CBAR    434     1104    860     861     311                             2
CBAR    435     1104    861     862     312                             2
CBAR    436     1104    862     863     313                             2
CBAR    437     1104    863     864     314                             2
CBAR    438     1104    864     865     315                             2
CBAR    439     1104    865     866     316                             2
CBAR    440     1104    866     851     301                             2
CBAR    441     1020    101     102     902                             2
CBAR    442     1020    102     103     903                             2
CBAR    443     1020    103     104     904                             2
CBAR    444     1020    104     105     905                             2
CBAR    445     1020    105     106     906                             2
CBAR    446     1020    106     107     907                             2
CBAR    447     1020    107     108     908                             2
CBAR    448     1020    108     109     909                             2
CBAR    449     1020    109     110     910                             2
CBAR    450     1020    110     111     911                             2
CBAR    451     1020    111     112     912                             2
CBAR    452     1020    112     113     913                             2
CBAR    453     1020    113     114     914                             2
CBAR    454     1020    114     115     915                             2
CBAR    455     1020    115     116     916                             2
CBAR    456     1020    116     101     901                             2
$
$  QUAD ELEMENTS
$
```

CQUAD2	1001	9898	101	102	202	201
CQUAD2	1002	9898	201	202	302	301
CQUAD2	1003	9898	301	302	402	401
CQUAD2	1004	9898	401	402	502	501
CQUAD2	1005	9898	501	502	602	601
CQUAD2	1006	9898	601	602	702	701
CQUAD2	1007	9898	701	702	802	801
CQUAD2	1009	9898	102	103	203	202
CQUAD2	1010	9898	202	203	303	302
CQUAD2	1011	9898	302	303	403	402
CQUAD2	1012	9898	402	403	503	502
CQUAD2	1013	9898	502	503	603	602
CQUAD2	1014	9898	602	603	703	702
CQUAD2	1015	9898	702	703	803	802
CQUAD2	1017	9898	103	104	204	203
CQUAD2	1018	9898	203	204	304	303
CQUAD2	1019	9898	303	304	404	403
CQUAD2	1020	9898	403	404	504	503
CQUAD2	1021	9898	503	504	604	603
CQUAD2	1022	9898	603	604	704	703
CQUAD2	1023	9898	703	704	804	803
CQUAD2	1025	9898	104	105	205	204
CQUAD2	1026	9898	204	205	305	304
CQUAD2	1027	9898	304	305	405	404
CQUAD2	1028	9898	404	405	505	504
CQUAD2	1029	9898	504	505	605	604
CQUAD2	1030	9898	604	605	705	704
CQUAD2	1031	9898	704	705	805	804
CQUAD2	1033	9898	105	106	206	205
CQUAD2	1034	9898	205	206	306	305
CQUAD2	1035	9898	305	306	406	405
CQUAD2	1036	9898	405	406	506	505
CQUAD2	1037	9898	505	506	606	605
CQUAD2	1038	9898	605	606	706	705
CQUAD2	1039	9898	705	706	806	805
CQUAD2	1041	9898	106	107	207	206
CQUAD2	1042	9898	206	207	307	306
CQUAD2	1043	9898	306	307	407	406
CQUAD2	1044	9898	406	407	507	506
CQUAD2	1045	9898	506	507	607	606
CQUAD2	1046	9898	606	607	707	706
CQUAD2	1047	9898	706	707	807	806
CQUAD2	1049	9898	107	108	208	207
CQUAD2	1050	9898	207	208	308	307
CQUAD2	1051	9898	307	308	408	407
CQUAD2	1052	9898	407	408	508	507
CQUAD2	1053	9898	507	508	608	607
CQUAD2	1054	9898	607	608	708	707
CQUAD2	1055	9898	707	708	808	807
CQUAD2	1057	9898	108	109	209	208
CQUAD2	1058	9898	208	209	309	308
CQUAD2	1059	9898	308	309	409	408
CQUAD2	1060	9898	408	409	509	508
CQUAD2	1061	9898	508	509	609	608

CQUAD2	1062	9898	608	609	709	708
CQUAD2	1063	9898	708	709	809	808
CQUAD2	1065	9898	109	110	210	209
CQUAD2	1066	9898	209	210	310	309
CQUAD2	1067	9898	309	310	410	409
CQUAD2	1068	9898	409	410	510	509
CQUAD2	1069	9898	509	510	610	609
CQUAD2	1070	9898	609	610	710	709
CQUAD2	1071	9898	709	710	810	809
CQUAD2	1073	9898	110	111	211	210
CQUAD2	1074	9898	210	211	311	310
CQUAD2	1075	9898	310	311	411	410
CQUAD2	1076	9898	410	411	511	510
CQUAD2	1077	9898	510	511	611	610
CQUAD2	1078	9898	610	611	711	710
CQUAD2	1079	9898	710	711	811	810
CQUAD2	1081	9898	111	112	212	211
CQUAD2	1082	9898	211	212	312	311
CQUAD2	1083	9898	311	312	412	411
CQUAD2	1084	9898	411	412	512	511
CQUAD2	1085	9898	511	512	612	611
CQUAD2	1086	9898	611	612	712	711
CQUAD2	1087	9898	711	712	812	811
CQUAD2	1089	9898	112	113	213	212
CQUAD2	1090	9898	212	213	313	312
CQUAD2	1091	9898	312	313	413	412
CQUAD2	1092	9898	412	413	513	512
CQUAD2	1093	9898	512	513	613	612
CQUAD2	1094	9898	612	613	713	712
CQUAD2	1095	9898	712	713	813	812
CQUAD2	1097	9898	113	114	214	213
CQUAD2	1098	9898	213	214	314	313
CQUAD2	1099	9898	313	314	414	413
CQUAD2	1100	9898	413	414	514	513
CQUAD2	1101	9898	513	514	614	613
CQUAD2	1102	9898	613	614	714	713
CQUAD2	1103	9898	713	714	814	813
CQUAD2	1105	9898	114	115	215	214
CQUAD2	1106	9898	214	215	315	314
CQUAD2	1107	9898	314	315	415	414
CQUAD2	1108	9898	414	415	515	514
CQUAD2	1109	9898	514	515	615	614
CQUAD2	1110	9898	614	615	715	714
CQUAD2	1111	9898	714	715	815	814
CQUAD2	1113	9898	115	116	216	215
CQUAD2	1114	9898	215	216	316	315
CQUAD2	1115	9898	315	316	416	415
CQUAD2	1116	9898	415	416	516	515
CQUAD2	1117	9898	515	516	616	615
CQUAD2	1118	9898	615	616	716	715
CQUAD2	1119	9898	715	716	816	815
CQUAD2	1121	9898	116	101	201	216
CQUAD2	1122	9898	216	201	301	316
CQUAD2	1123	9898	316	301	401	416

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CQUAD2  1124    9898    416     401     501     516
CQUAD2  1125    9898    516     501     601     616
CQUAD2  1126    9898    616     601     701     716
CQUAD2  1127    9898    716     701     801     816
$
$  CONE SECTION QUADS
$
CQUAD2  1129    1100    301     302     552     551
CQUAD2  1130    1100    551     552     652     651
CQUAD2  1131    1100    651     652     752     751
CQUAD2  1132    1100    751     752     852     851
CQUAD2  1133    1100    302     303     553     552
CQUAD2  1134    1100    552     553     653     652
CQUAD2  1135    1100    652     653     753     752
CQUAD2  1136    1100    752     753     853     852
CQUAD2  1137    1100    303     304     554     553
CQUAD2  1138    1100    553     554     654     653
CQUAD2  1139    1100    653     654     754     753
CQUAD2  1140    1100    753     754     854     853
CQUAD2  1141    1100    304     305     555     554
CQUAD2  1142    1100    554     555     655     654
CQUAD2  1143    1100    654     655     755     754
CQUAD2  1144    1100    754     755     855     854
CQUAD2  1145    1100    305     306     556     555
CQUAD2  1146    1100    555     556     656     655
CQUAD2  1147    1100    655     656     756     755
CQUAD2  1148    1100    755     756     856     855
CQUAD2  1149    1100    306     307     557     556
CQUAD2  1150    1100    556     557     657     656
CQUAD2  1151    1100    656     657     757     756
CQUAD2  1152    1100    756     757     857     856
CQUAD2  1153    1100    307     308     558     557
CQUAD2  1154    1100    557     558     658     657
CQUAD2  1155    1100    657     658     758     757
CQUAD2  1156    1100    757     758     858     857
CQUAD2  1157    1100    308     309     559     558
CQUAD2  1158    1100    558     559     659     658
CQUAD2  1159    1100    658     659     759     758
CQUAD2  1160    1100    758     759     859     858
CQUAD2  1161    1100    309     310     560     559
CQUAD2  1162    1100    559     560     660     659
CQUAD2  1163    1100    659     660     760     759
CQUAD2  1164    1100    759     760     860     859
CQUAD2  1165    1100    310     311     561     560
CQUAD2  1166    1100    560     561     661     660
CQUAD2  1167    1100    660     661     761     760
CQUAD2  1168    1100    760     761     861     860
CQUAD2  1169    1100    311     312     562     561
CQUAD2  1170    1100    561     562     662     661
CQUAD2  1171    1100    661     662     762     761
CQUAD2  1172    1100    761     762     862     861
CQUAD2  1173    1100    312     313     563     562
CQUAD2  1174    1100    562     563     663     662
CQUAD2  1175    1100    662     663     763     762
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CQUAD2  1176    1100    762     763     863     862
CQUAD2  1177    1100    313     314     564     563
CQUAD2  1178    1100    563     564     664     663
CQUAD2  1179    1100    663     664     764     763
CQUAD2  1180    1100    763     764     864     863
CQUAD2  1181    1100    314     315     565     564
CQUAD2  1182    1100    564     565     665     664
CQUAD2  1183    1100    664     665     765     764
CQUAD2  1184    1100    764     765     865     864
CQUAD2  1185    1100    315     316     566     565
CQUAD2  1186    1100    565     566     666     665
CQUAD2  1187    1100    665     666     766     765
CQUAD2  1188    1100    765     766     866     865
$
$  LH2 AND LO2 LUMPED MASSES FOR THE X-DIR (AXIAL SLOSH)
$
CONM1   3050    80              1046002.
CONM1   3051    81              210158.
$
$  NOSE CONE, SHROUD, PAYLOAD MASSES
$
CONM2   3999    999             50000.                                  +C999
+C999   1.732+09        2.207+09                2.207+09
CONM2   3001    1               20.000                                  +C01
+C01    6.727+05
CONM2   3002    2               300.00                                  +C02
+C02    4.256+06
CONM2   3003    3               548.00                                  +C03
+C03    5.602+06
CONM2   3004    4               1076.0                                  +C04
+C04    1.207+07
CONM2   3005    5               720.00                                  +C05
+C05    1.045+08
CONM2   3006    6               720.00                                  +C06
+C06    6.673+07
CONM2   3007    7               720.00                                  +C07
+C07    3.822+07
CONM2   3008    8               720.00                                  +C08
+C08    1.891+07
CONM2   3009    9               720.00                                  +C09
+C09    8.828+06
CONM2   3010    10              720.00                                  +C10
+C10    7.958+06
CONM2   3011    11              720.00                                  +C11
+C11    1.630+07
CONM2   3012    12              720.00                                  +C12
+C12    3.387+07
CONM2   3013    13              720.00                                  +C13
+C13    6.064+07
CONM2   3014    14              720.00                                  +C14
+C14    9.664+07
CONM2   3015    15              5078.00                                 +C15
+C15    2.203+08
CONM2   3016    16              1128.0                                  +C16
```

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+C16    6.399+07
CONM2   3017    17              1128.0                                  +C17
+C17    4.411+07
$
$  LO2 TANK MASSES IN Y,Z DIRECTIONS WITH PARTIAL X-DIR
$
CONM1   3018    18              58684.9         208113.8                A18
+18     208113.8                        2.058+08
CONM1   3019    19              57556.9         206985.8                A19
+19     206985.8                        1.591+08
CONM1   3020    20              57556.9         206985.8                A20
+20     206985.8                        8.398+07
CONM1   3021    21              57556.9         206985.8                A21
+21     206985.8                        4.874+07
CONM1   3022    22              57556.9         206985.8                A22
+22     206985.8                        4.923+07
CONM1   3023    23              60373.9         209802.8                A23
+23     209802.8                        2.083+08
CONM1   3024    24              60373.9         209802.8                A24
+24     209802.8                        2.020+08
$
$  PART OF THE MASS OF THE INNER TANK
$
CONM2   3025    25              3400.3
$
$  LH2 TANK MASSES IN Y,Z DIRECTIONS WITH PARTIAL X-DIR
$
CONM1   3026    26              9491.1          25657.1                 A26
+26     25657.1                         1.192+09
CONM1   3027    27              9491.1          25657.1                 A27
+27     25657.1                         8.243+08
CONM1   3028    28              6674.1          22840.1                 A28
+28     22840.1                         4.847+08
CONM1   3029    29              6674.1          22840.1                 A29
+29     22840.1                         2.718+08
CONM1   3030    30              6674.1          22840.1                 A30
+30     22840.1                         1.354+08
CONM1   3031    31              6674.1          22840.1                 A31
+31     22840.1                         7.583+07
CONM1   3032    32              6674.1          22840.1                 A32
+32     22840.1                         9.289+07
CONM1   3033    33              6674.1          22840.1                 A33
+33     22840.1                         1.866+08
CONM1   3034    34              6674.1          22840.1                 A34
+34     22840.1                         3.571+08
CONM1   3035    35              6674.1          22840.1                 A35
+35     22840.1                         6.042+08
CONM1   3036    36              7335.5          23501.4                 A36
+36     23501.4                         7.064+08
CONM1   3037    37              7335.5          23501.4                 A37
+37     23501.4                         7.924+08
CONM1   3038    38              7335.5          23501.4                 A38
+38     23501.4                         1.142+09
$
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CONM2   3042    803             8004.                                   +C42
+C42    4.059+07        1.953+07                1.953+07
CONM2   3043    807             8004.                                   +C43
+C43    4.059+07        1.953+07                1.953+07
CONM2   3044    811             8004.                                   +C44
+C44    4.059+07        1.953+07                1.953+07
CONM2   3045    815             8004.                                   +C45
+C45    4.059+07        1.953+07                1.953+07
CONM2   3046    851             8004.                                   +C46
+C46    4.059+07        1.953+07                1.953+07
CONM2   3047    859             8004.                                   +C47
+C47    4.059+07        1.953+07                1.953+07
EIGR    40      FEER    1.00                    15              1.-4    +EIG1
+EIG1   MAX
EIGR    41      INV     0.0     10.     60      15              1.-5    +EIG2
+EIG2   MAX
EIGR    42      GIV                             15              1.-4    +EIGR
+EIGR   MAX
GRID    1               1306.06 0.0     0.0
GRID    2               1395.10 0.0     0.0
GRID    3               1444.87 0.0     0.0
GRID    4               1494.64 0.0     0.0
GRID    5               1544.40 0.0     0.0
GRID    6               1624.4  0.0     0.0
GRID    7               1704.4  0.0     0.0
GRID    8               1784.4  0.0     0.0
GRID    9               1864.4  0.0     0.0
GRID    10              1944.4  0.0     0.0
GRID    11              2024.4  0.0     0.0
GRID    12              2104.4  0.0     0.0
GRID    13              2184.4  0.0     0.0
GRID    14              2264.40 0.0     0.0
GRID    15              2284.80 0.0     0.0
GRID    16              2347.8  0.0     0.0
GRID    17              2410.8  0.0     0.0
GRID    18              2459.1750.0     0.0
GRID    19              2471.15 0.0     0.0
GRID    20              2569.8  0.0     0.0
GRID    21              2664.1330.0     0.0
GRID    22              2758.4670.0     0.0
GRID    23              2852.8  0.0     0.0
GRID    24              2963.4250.0     0.0
GRID    25              2985.6750.0     0.0
GRID    26              3012.5250.0     0.0
GRID    27              3123.15 0.0     0.0
GRID    28              3240.0060.0     0.0
GRID    29              3356.8630.0     0.0
GRID    30              3473.7190.0     0.0
GRID    31              3590.5750.0     0.0
GRID    32              3707.4310.0     0.0
GRID    33              3824.2880.0     0.0
GRID    34              3941.1440.0     0.0
GRID    35              4058.0  0.0     0.0
GRID    36              4090.3250.0     0.0
```

```
GRID    37              4122.65 0.0     0.0
$  THESE CARDS WHICH FOLLOW ARE THE OLD STICK METHOD
$
GRID    38              4233.2750.0     0.0
GRID    80              2963.4250.0     0.0             23456
GRID    81              4233.2750.0     0.0             23456
GRID    99              4687.06 1.0     0.0             123456
GRID    999             1997.58 0.0     0.0
$
$$THE FOLLOWING CARDS DESCRIBE THE NEW THRUST STRUCTURE
$
$
GRID    901             4000.0  0.0     165.463         123456
GRID    902             4000.0  63.32   152.868         123456
GRID    903             4000.0  117.0   117.0           123456
GRID    904             4000.0  152.868 63.32           123456
GRID    905             4000.0  165.463 0.0             123456
GRID    906             4000.0  152.868 -63.32          123456
GRID    907             4000.0  117.0   -117.0          123456
GRID    908             4000.0  63.32   -152.868        123456
GRID    909             4000.0  0.0     -165.463        123456
GRID    910             4000.0  -63.32  -152.868        123456
GRID    911             4000.0  -117.0  -117.0          123456
GRID    912             4000.0  -152.868-63.32          123456
GRID    913             4000.0  -165.463 0.0            123456
GRID    914             4000.0  -152.86863.32           123456
GRID    915             4000.0  -117.0  117.0           123456
GRID    916             4000.0  -63.32  152.868         123456
GRID    101             4122.65 0.0     165.463
GRID    102             4122.65 63.32   152.868
GRID    103             4122.65 117.0   117.0
GRID    104             4122.65 152.868 63.32
GRID    105             4122.65 165.463 0.0
GRID    106             4122.65 152.868 -63.32
GRID    107             4122.65 117.0   -117.0
GRID    108             4122.65 63.32   -152.868
GRID    109             4122.65 0.0     -165.463
GRID    110             4122.65 -63.32  -152.868
GRID    111             4122.65 -117.0  -117.0
GRID    112             4122.65 -152.868-63.32
GRID    113             4122.65 -165.463 0.0
GRID    114             4122.65 -152.86863.32
GRID    115             4122.65 -117.0  117.0
GRID    116             4122.65 -63.32  152.868
GRID    201             4166.5750.0     165.463
GRID    202             4166.57563.32   152.868
GRID    203             4166.575117.0   117.0
GRID    204             4166.575152.868 63.32
GRID    205             4166.575165.463 0.0
GRID    206             4166.575152.868 -63.32
GRID    207             4166.575117.0   -117.0
GRID    208             4166.57563.32   -152.868
GRID    209             4166.5750.0     -165.463
GRID    210             4166.575-63.32  -152.868
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GRID    211             4166.575-117.0  -117.0
GRID    212             4166.575-152.868-63.32
GRID    213             4166.575-165.463 0.0
GRID    214             4166.575-152.86863.32
GRID    215             4166.575-117.0  117.0
GRID    216             4166.575-63.32  152.868
GRID    301             4210.3250.0     165.463
GRID    302             4210.32563.32   152.868
GRID    303             4210.325117.0   117.0
GRID    304             4210.325152.868 63.32
GRID    305             4210.325165.463 0.0
GRID    306             4210.325152.868 -63.32
GRID    307             4210.325117.0   -117.0
GRID    308             4210.32563.32   -152.868
GRID    309             4210.3250.0     -165.463
GRID    310             4210.325-63.32  -152.868
GRID    311             4210.325-117.0  -117.0
GRID    312             4210.325-152.868-63.32
GRID    313             4210.325-165.463 0.0
GRID    314             4210.325-152.86863.32
GRID    315             4210.325-117.0  117.0
GRID    316             4210.325-63.32  152.868
GRID    401             4227.37 0.0     165.463
GRID    402             4227.37 63.32   152.868
GRID    403             4227.37 117.0   117.0
GRID    404             4227.37 152.868 63.32
GRID    405             4227.37 165.463 0.0
GRID    406             4227.37 152.868 -63.32
GRID    407             4227.37 117.0   -117.0
GRID    408             4227.37 63.32   -152.868
GRID    409             4227.37 0.0     -165.463
GRID    410             4227.37 -63.32  -152.868
GRID    411             4227.37 -117.0  -117.0
GRID    412             4227.37 -152.868-63.32
GRID    413             4227.37 -165.463 0.0
GRID    414             4227.37 -152.86863.32
GRID    415             4227.37 -117.0  117.0
GRID    416             4227.37 -63.32  152.868
GRID    501             4254.0750.0     165.463
GRID    502             4254.07563.32   152.868
GRID    503             4254.075117.0   117.0
GRID    504             4254.075152.868 63.32
GRID    505             4254.075165.463 0.0
GRID    506             4254.075152.868 -63.32
GRID    507             4254.075117.0   -117.0
GRID    508             4254.07563.32   -152.868
GRID    509             4254.0750.0     -165.463
GRID    510             4254.075-63.32  -152.868
GRID    511             4254.075-117.0  -117.0
GRID    512             4254.075-152.868-63.32
GRID    513             4254.075-165.463 0.0
GRID    514             4254.075-152.86863.32
GRID    515             4254.075-117.0  117.0
GRID    516             4254.075-63.32  152.868
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GRID    601             4297.8250.0     165.463
GRID    602             4297.82563.32   152.868
GRID    603             4297.825117.0   117.0
GRID    604             4297.825152.868 63.32
GRID    605             4297.825165.463 0.0
GRID    606             4297.825152.868 -63.32
GRID    607             4297.825117.0   -117.0
GRID    608             4297.82563.32   -152.868
GRID    609             4297.8250.0     -165.463
GRID    610             4297.825-63.32  -152.868
GRID    611             4297.825-117.0  -117.0
GRID    612             4297.825-152.868-63.32
GRID    613             4297.825-165.463 0.0
GRID    614             4297.825-152.86863.32
GRID    615             4297.825-117.0  117.0
GRID    616             4297.825-63.32  152.868
GRID    701             4341.5750.0     165.463
GRID    702             4341.57563.32   152.868
GRID    703             4341.575117.0   117.0
GRID    704             4341.575152.868 63.32
GRID    705             4341.575165.463 0.0
GRID    706             4341.575152.868 -63.32
GRID    707             4341.575117.0   -117.0
GRID    708             4341.57563.32   -152.868
GRID    709             4341.5750.0     -165.463
GRID    710             4341.575-63.32  -152.868
GRID    711             4341.575-117.0  -117.0
GRID    712             4341.575-152.868-63.32
GRID    713             4341.575-165.463 0.0
GRID    714             4341.575-152.86863.32
GRID    715             4341.575-117.0  117.0
GRID    716             4341.575-63.32  152.868
GRID    801             4385.5  0.0     165.463
GRID    802             4385.5  63.32   152.868
GRID    803             4385.5  117.0   117.0
GRID    804             4385.5  152.868 63.32
GRID    805             4385.5  165.463 0.0
GRID    806             4385.5  152.868 -63.32
GRID    807             4385.5  117.0   -117.0
GRID    808             4385.5  63.32   -152.868
GRID    809             4385.5  0.0     -165.463
GRID    810             4385.5  -63.32  -152.868
GRID    811             4385.5  -117.0  -117.0
GRID    812             4385.5  -152.868-63.32
GRID    813             4385.5  -165.463 0.0
GRID    814             4385.5  -152.86863.32
GRID    815             4385.5  -117.0  117.0
GRID    816             4385.5  -63.32  152.868
GRID    551             4254.0750.0     141.371
GRID    552             4254.07554.10   130.61
GRID    553             4254.07599.965  99.965
GRID    554             4254.075130.61  54.10
GRID    555             4254.075141.371 0.0
GRID    556             4254.075130.61  -54.10
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GRID    557             4254.07599.965  -99.965
GRID    558             4254.07554.10   -130.61
GRID    559             4254.0750.0     -141.371
GRID    560             4254.075-54.10  -130.61
GRID    561             4254.075-99.965 -99.965
GRID    562             4254.075-130.61 -54.10
GRID    563             4254.075-141.3710.0
GRID    564             4254.075-130.61 54.10
GRID    565             4254.075-99.965 99.965
GRID    566             4254.075-54.10  130.61
GRID    651             4297.8250.0     117.280
GRID    652             4297.82544.881  108.352
GRID    653             4297.82582.929  82.929
GRID    654             4297.825108.352 44.881
GRID    655             4297.825117.280 0.0
GRID    656             4297.825108.352 -44.881
GRID    657             4297.82582.929  -82.929
GRID    658             4297.82544.881  -108.352
GRID    659             4297.8250.0     -117.280
GRID    660             4297.825-44.881 -108.352
GRID    661             4297.825-82.929 -82.929
GRID    662             4297.825-108.352-44.881
GRID    663             4297.825-117.2800.0
GRID    664             4297.825-108.35244.881
GRID    665             4297.825-82.929 82.929
GRID    666             4297.825-44.881 108.352
GRID    751             4341.5750.0     93.188
GRID    752             4341.57535.662  86.095
GRID    753             4341.57565.894  65.894
GRID    754             4341.57586.095  35.662
GRID    755             4341.57593.188  0.0
GRID    756             4341.57586.095  -35.662
GRID    757             4341.57565.894  -65.894
GRID    758             4341.57535.662  -86.095
GRID    759             4341.5750.0     -93.188
GRID    760             4341.575-35.662 -86.095
GRID    761             4341.575-65.894 -65.894
GRID    762             4341.575-86.095 -35.662
GRID    763             4341.575-93.188 0.0
GRID    764             4341.575-86.095 35.662
GRID    765             4341.575-65.894 65.894
GRID    766             4341.575-35.662 86.095
GRID    851             4385.5  0.0     69.000
GRID    852             4385.5  26.405  63.748
GRID    853             4385.5  48.791  48.791
GRID    854             4385.5  63.748  26.405
GRID    855             4385.5  69.000  0.0
GRID    856             4385.5  63.748  -26.405
GRID    857             4385.5  48.791  -48.791
GRID    858             4385.5  26.405  -63.748
GRID    859             4385.5  0.0     -69.000
GRID    860             4385.5  -26.405 -63.748
GRID    861             4385.5  -48.791 -48.791
GRID    862             4385.5  -63.748 -26.405
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GRID    863             4385.5  -69.000 0.0
GRID    864             4385.5  -63.748 26.405
GRID    865             4385.5  -48.791 48.791
GRID    866             4385.5  -26.405 63.748
$
$  THE FOLLOWING GRIDS ARE FOR BAR ORIENTATION
$
GRID    881             5000.0  0.0     200.0           123456
GRID    883             5000.0  200.0   200.0           123456
GRID    885             5000.0  200.0   0.0             123456
GRID    887             5000.0  200.0   -200.0          123456
GRID    889             5000.0  0.0     -200.0          123456
GRID    891             5000.0  -200.0  -200.0          123456
GRID    893             5000.0  -200.0  0.0             123456
GRID    895             5000.0  -200.0  200.0           123456
$MAT1    2001    1.050+7 4.000+6 0.31250 5.000
MAT1    2001    1.050+7 4.000+6 0.31250
MAT1    2002    1.050+7 4.000+6 0.31250 0.208
PARAM   GRDPNT  0
PARAM   WTMASS  2.591E-3
PBAR    1001    2001    149.517 4.18E+6 2.79E+6 4.99E+6 0.0
PBAR    1002    2001    254.65  4.18E+6 2.79E+6 7.08E+6 0.0
PBAR    1003    2001    237.18  3.79E+6 2.69E+6 5.91E+6 0.0
PBAR    1004    2001    216.425 3.33E+6 2.60E+6 6.42E+6 0.0
PBAR    1005    2001    263.83  4.51E+6 2.72E+6 4.99E+6 0.0
PBAR    1006    2001    263.79  4.66E+6 2.41E+6 4.99E+6 0.0
PBAR    1007    2001    363.79  7.12E+6 2.84E+6 4.99E+6 0.0
PBAR    1008    2001    273.83  4.84E+6 2.66E+6 4.99E+6 0.0
PBAR    1009    2001    209.16  2.99E+6 2.63E+6 4.99E+6 0.0
PBAR    1010    2001    179.04  2.53E+6 2.37E+6 4.99E+6 0.0
PBAR    1011    2001    147.87  2.03E+6 2.03E+6 2.65E+6 0.0
PBAR    1012    2001    145.06  1.99E+6 1.99E+6 2.54E+6 0.0
PBAR    1013    2001    196.984 2.68E+6 2.71E+6 2.43E+6 0.0
PBAR    1014    2001    225.198 3.07E+6 3.096E+62.34E+6 0.0
PBAR    1015    2001    213.168 2.97E+6 2.87E+6 2.31E+6 0.0
PBAR    1016    2001    50.0    2.97E+3 2.87E+3 2.31E+3 0.0
PBAR    1020    2001    200.    9.99E+9 9.99E+9 9.99E+9 0.0
PBAR    1111    2002    55.30   920.00  26128.0 27048.0
PBAR    1101    2002    37.60   560.24  8360.00 8920.24
PBAR    1102    2002    7.56    17.448  180.248 197.696
PBAR    1103    2002    17.358  169.04  1596.0  1765.04
PBAR    1104    2002    20.000  170.4   2712.0  2882.4
PBAR    1105    2002    10.0    53.6    451.2   504.8
PBAR    2020    2002    2.0     4.0     4.0     8.000   0.0
PBAR    2021    2002    7.984   1.5104  258.79  260.3
PBAR    2022    2002    13.28   22.784  482.836 505.62
PBAR    2023    2002    19.85   114.122 761.083 875.205
PBAR    2024    2002    26.43   312.564 1039.9  1352.464
PBAR    2025    2002    6.971   0.16597 219.94  220.106
PBAR    2026    2002    9.879   4.5158  352.49  357.006
PBAR    2027    2002    13.49   29.338  517.116 546.454
PBAR    2028    2002    17.11   92.4519 682.078 774.530
PBAR    2031    2002    6.564   29.3878 239.174 268.562
PBAR    2032    2002    9.0399  25.5846 314.236 339.821
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PBAR    2033    2002    12.334  37.5201 464.362 501.882
PBAR    2034    2002    15.634  85.3905 614.791 700.182
PQUAD2  1100    2002    0.250   0.0
PQUAD2  9898    2002    0.195   0.0
SPC1    100     23456   80      81
$SPC1    100     123     801     805     809     813
$
$  AXIS DIRECTION INDICATORS
$
$
GRID    50000           0.0     0.0     0.0             123456
GRID    50001           10.0    0.0     0.0             123456
GRID    50002           0.0     10.0    0.0             123456
GRID    50003           0.0     0.0     10.0            123456
ENDDATA
```

NLS1 FREQUENCIES (Hz)

FIXED FREQUENCIES (Hz)

MODE	FREQUENCY	MODE	FREQUENCY	MODE	FREQUENCY
1	0.19	28	6.47	54	14.57
2	0.45	29	6.47	55	14.70
3	0.80	30	6.69	56	14.77
4	0.82	31	6.80	57	14.82
5	1.44	32	7.12	58	14.82
6	1.48	33	7.96	59	15.14
7	2.17	34	8.03	60	15.14
8	2.31	35	8.04	61	15.21
9	2.56	36	8.09	62	15.24
10	2.56	37	8.48	63	15.65
11	2.56	38	8.70	64	15.65
12	2.56	39	8.92	65	15.77
13	2.59	40	9.80	66	15.77
14	2.91	41	9.83	67	16.25
15	3.30	42	10.00	68	16.41
16	3.30	43	10.09	69	17.80
17	3.90	44	10.70	70	17.80
18	4.00	45	10.78	71	17.82
19	4.02	46	10.92	72	17.83
20	4.08	47	11.01	73	18.17
21	4.27	48	11.07	74	18.17
22	4.36	49	11.70	75	18.18
23	5.83	50	11.72	76	18.34
24	6.04	51	11.95	77	19.77
25	6.05	52	14.24	78	19.77
26	6.25	53	14.57	79	20.17
27	6.46				

FREE-FREE FREQUENCIES (Hz)

MODE	FREQUENCY	MODE	FREQUENCY	MODE	FREQUENCY
1	0.00	29	4.46	58	14.28
2	0.00	30	4.70	59	14.28
3	0.00	31	6.23	60	14.30
4	0.00	32	6.45	61	14.80
5	0.00	33	6.46	62	14.80
6	0.00	34	6.69	63	14.82
7	0.61	35	6.76	64	14.84
8	0.64	36	6.80	65	15.26
9	1.35	37	7.09	66	15.26
10	1.49	38	7.55	67	15.26
11	1.83	39	7.96	68	15.27
12	2.42	40	8.00	69	15.44
13	2.50	41	8.03	70	15.44
14	2.51	42	8.06	71	17.55
15	2.56	43	8.48	72	17.80
16	2.57	44	9.82	73	17.81
17	2.57	46	10.34	74	17.81
18	2.60	47	10.71	75	17.82
19	2.92	48	10.73	76	18.06
20	3.17	49	10.81	77	18.31
21	3.24	50	10.87	78	18.50
22	3.32	51	10.94	79	18.85
23	3.35	52	11.69	80	18.85
24	3.35	53	11.70	81	19.77
25	3.99	54	12.70	82	19.77
26	4.04	55	13.31	83	19.85
27	4.30	56	13.81	84	20.13
28	4.44	57	13.81		

NLS2 FREQUENCIES (Hz)

FIXED FREQUENCIES

MODE	FREQUENCY
1	0.31
2	0.31
3	2.48
4	2.56
5	2.72
6	3.46
7	7.05
8	7.35
9	7.58
10	8.96
11	10.45
12	11.44
13	11.80
14	12.86
15	13.13
16	13.38
17	15.31
18	16.08
19	16.65
20	17.15
21	18.19

FREE-FREE FREQUENCIES

MODE	FREQUENCY
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	2.53
8	2.68
9	4.95
10	5.11
11	7.15
12	7.84
13	8.10
14	11.37
15	11.80
16	12.57
17	13.01
18	13.41
19	15.02
20	15.49
21	15.63
22	16.74
23	19.87

FORCING FUNCTION DATA

ASRB THRUST AND PRESSURE CASE DESCRIPTION

CASE	FILENAME	DESCRIPTION
A1	NNMNMOL NNMNMOR	Nominal pair of motors
A2	AV2L AV2R	Nominal pair of motors with plus 2 sigma ignition timing
A3	NMXNMOL NMXNMOR	Nominal pair of motors with plus 2 sigma thrust rise rate
A4	NNMMXOL NNMMXOR	Nominal pair of motors with plus 2 sigma steady-state thrust level
A5	LNMNMOL LNMNMOR	Nominal pair of motors with plus 2 sigma ignition interval
A6	NNMNM2L NNMNM2R	Nominal pair of motors with plus 2 sigma ignition thrust differential
A11	AVM2L AVM2R	Nominal pair of motors with minus 2 sigma ignition timing
A12	NMNNMOL NMNNMOR	Nominal pair of motors with minus 2 sigma thrust rise rate
A13	NNMMNOL NNMMNOR	Nominal pair of motors with minus 2 sigma steady-state thrust level
A14	ENMNMOL ENMNMOR	Nominal pair of motors with minus 2 sigma ignition interval
A15	NNMNMM2L NNMNMM2R	Nominal pair of motors with minus 2 sigma ignition thrust differential
A20	EMXMX2L EMXMX2R	Pair of motors with plus 2 sigma for all motor parameters
A21	LMNMN2L LMNMN2R	Pair of motors with minus 2 sigma for all motor parameters

NLS1 BUILDUP/SHUTDOWN LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	BUSD01	BUSD02	BUSD03	BUSD04	BUSD05	BUSD06	BUSD07	BUSD08
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	NOM	MIN	MAX	NOM	NOM	MAX	MAX	MAX
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	0.0°	0.0°	0.0°	0.0°	0.0°	+0.4° ABOUT Z	+0.4° ABOUT Y	N/A
STME IGNITION SIDELOADS MAGNITUDES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	NONE	NONE	NONE	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR
SRB IGNITION TIMING	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST RISE RATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST LEVEL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION INTERVAL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST MISMATCH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST OFFSET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION OVERPRESSURE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IOP TIMING TOLERANCE (SECONDS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB GROWTH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+Y @ 4.75
TIME BETWEEN SRB IGNITION AND STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NLS1 BUILDUP/SHUTDOWN LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	BUSD09	BUSD10	BUSD11	BUSD12	BUSD13	BUSD14	`BUSD15	BUSD16	BUSD17
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	MAX	MAX	MAX	MAX*	MAX**	MAX*	MAX*	MAX*	MAX*
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	0.0°	+0.4° ABOUT Z	+0.4° ABOUT Y	0.0°	0.0°	0.0°	0.0°	+0.4° ABOUT Y	0.0°
STME IGNITION SIDELOADS MAGNITUDES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	Z-DIR	Y-DIR	Z-DIR	NONE	NONE	NONE	Z-DIR	Z-DIR	NONE
SRB IGNITION TIMING	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST RISE RATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST LEVEL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION INTERVAL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST MISMATCH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST OFFSET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION OVERPRESSURE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IOP TIMING TOLERANCE (SECONDS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB GROWTH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STME OUT	+Z @ 4.75	+Y @ 4.75	+Z @ 4.75	N/A	N/A	+Z @ 4.75	+Z @ 4.75	+Z @ 4.75	+Y @ 4.75
TIME BETWEEN SRB IGNITION AND STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* - SHUTDOWN OCCURS @ 4.75 SEC.

** - SHUTDOWN OCCRUS @ 4.75 SEC. WITH A .1 SEC. PLATEAU

NLS1 LIFTOFF LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	LC1001	LC1002	LC1003	LC1004	LC1005	LC1006	LC1007	LC1008
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STME IGNITION SIDELOADS MAGNITUDES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
SRB IGNITION TIMING	NOM	+2 SIGMA	NOM	NOM	NOM	NOM	-2 SIGMA	NOM
SRB THRUST RISE RATE	NOM	NOM	+2 SIGMA	NOM	NOM	NOM	NOM	-2 SIGMA
SRB THRUST LEVEL	NOM	NOM	NOM	+2 SIGMA	NOM	NOM	NOM	NOM
SRB IGNITION INTERVAL	NOM	NOM	NOM	NOM	+2 SIGMA	NOM	NOM	NOM
SRB THRUST MISMATCH	N/A	N/A	N/A	N/A	N/A	+2 SIGMA	N/A	N/A
SRB THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST OFFSET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION OVERPRESSURE	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM
SRB IOP TIMING TOLERANCE (SECONDS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB GROWTH	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TIME BETWEEN SRB IGNITION AND STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NLS1 LIFTOFF LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	LC1009	LC1010	LC1011	LC1012	LC1013	LC1014	LC1015	LC1016
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	NOM	NOM	NOM	NOM	NOM	MAX	MAX	MAX
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STME IGNITION SIDELOADS MAGNITUDES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	NONE	NONE	NONE	NONE	NONE	NONE	+Z DIR	+Y DIR
SRB IGNITION TIMING	NOM	NOM	NOM	+2 SIGMA	-2 SIGMA	+2 SIGMA	+2 SIGMA	+2 SIGMA
SRB THRUST RISE RATE	NOM	NOM	NOM	+2 SIGMA	-2 SIGMA	+2 SIGMA	+2 SIGMA	+2 SIGMA
SRB THRUST LEVEL	-2 SIGMA	NOM	NOM	+2 SIGMA	-2 SIGMA	+2 SIGMA	+2 SIGMA	+2 SIGMA
SRB IGNITION INTERVAL	NOM	-2 SIGMA	NOM	+2 SIGMA	-2 SIGMA	+2 SIGMA	+2 SIGMA	+2 SIGMA
SRB THRUST MISMATCH	N/A	N/A	-2 SIGMA	+2 SIGMA	-2 SIGMA	+2 SIGMA	+2 SIGMA	+2 SIGMA
SRB THRUST MISALIGNMENT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB THRUST OFFSET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB IGNITION OVERPRESSURE	NOM	NOM	NOM	NOM	NOM	+ 2SIGMA	+ 2SIGMA	+ 2SIGMA
SRB IOP TIMING TOLERANCE (SECONDS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SRB GROWTH	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TIME BETWEEN SRB IGNITION AND STME OUT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NLS1 LIFTOFF LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	LC1017	LC1018	LC1019	LC1020	LC1021	LC1022	LC1023	LC1024
STME 1 IGNITION STAGGER (SECONDS)	0.0							
STME 2 IGNITION STAGGER (SECONDS)	0.0							
STME 3 IGNITION STAGGER (SECONDS)	0.0							
STME 4 IGNITION STAGGER (SECONDS)	0.0							
STME THRUST BUILD-UP DESCRIPTION	MAX							
STME 1 IGNITION TIMING	0.0							
STME 2 IGNITION TIMING	0.0							
STME 3 IGNITION TIMING	0.0							
STME 4 IGNITION TIMING	0.0							
STME THRUST MISALIGNMENT	N/A							
STME IGNITION SIDELOADS MAGNITUDES	N/A							
WIND DIRECTION (NO DISPERSIONS)	+Z DIR							
SRB IGNITION TIMING	+2 SIGMA							
SRB THRUST RISE RATE	+2 SIGMA							
SRB THRUST LEVEL	+2 SIGMA							
SRB IGNITION INTERVAL	+2 SIGMA							
SRB THRUST MISMATCH	+2 SIGMA							
SRB THRUST MISALIGNMENT	N/A							
SRB THRUST OFFSET	N/A							
SRB IGNITION OVERPRESSURE	+2 SIGMA							
SRB IOP TIMING TOLERANCE (SECONDS)	N/A							
SRB GROWTH	NOM							
HOLDDOWN BOLT TIMING	NONE							
STRUCTURAL MISMATCH	NONE							
STME OUT	+Z ENGINE							
TIME BETWEEN SRB IGNITION AND STME OUT	0.0							

NLS2 1.5 STAGE LAUNCH VEHICLE

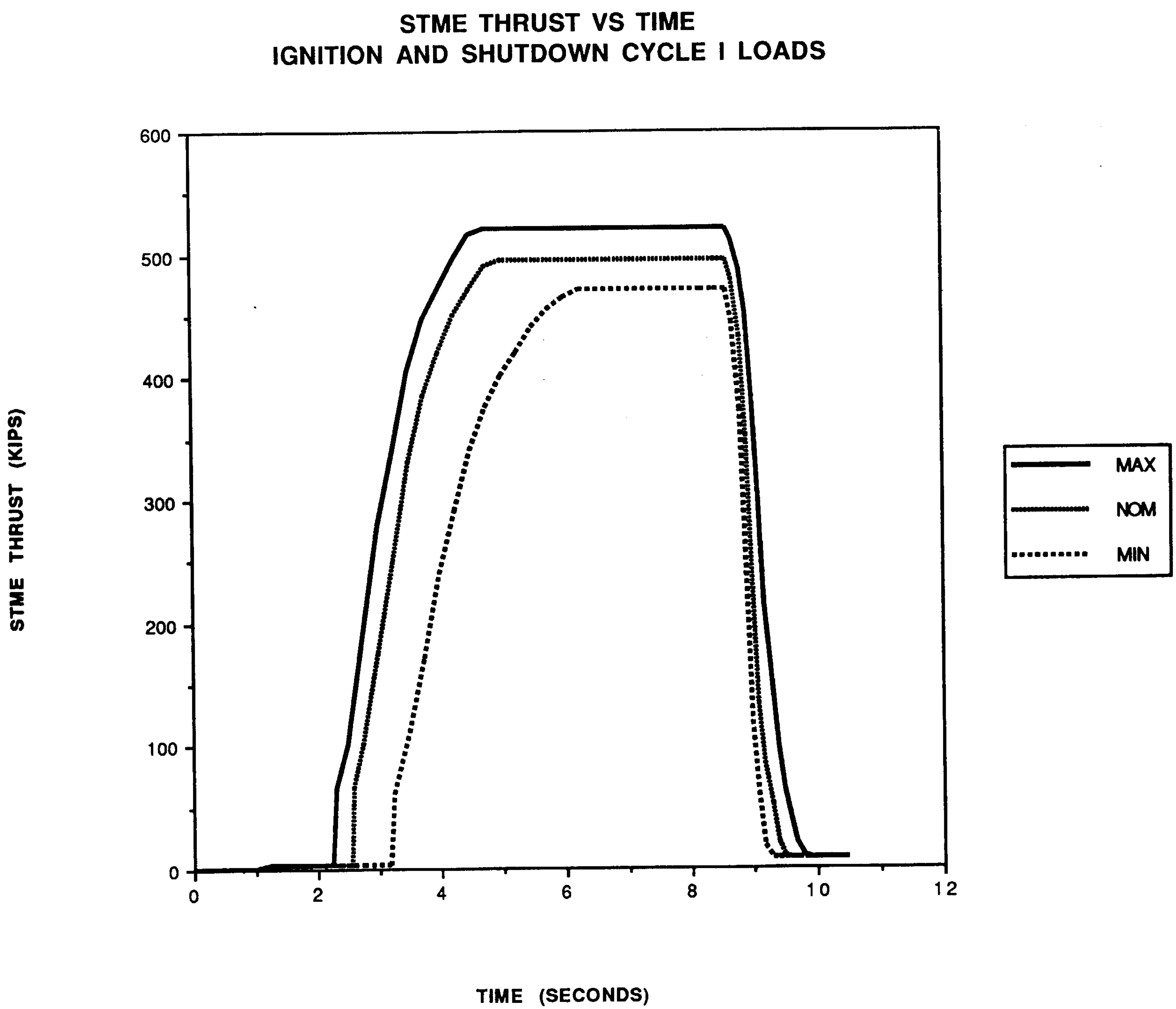
BUILDUP/SHUTDOWN LOAD CASES FOR CYCLE I DESIGN

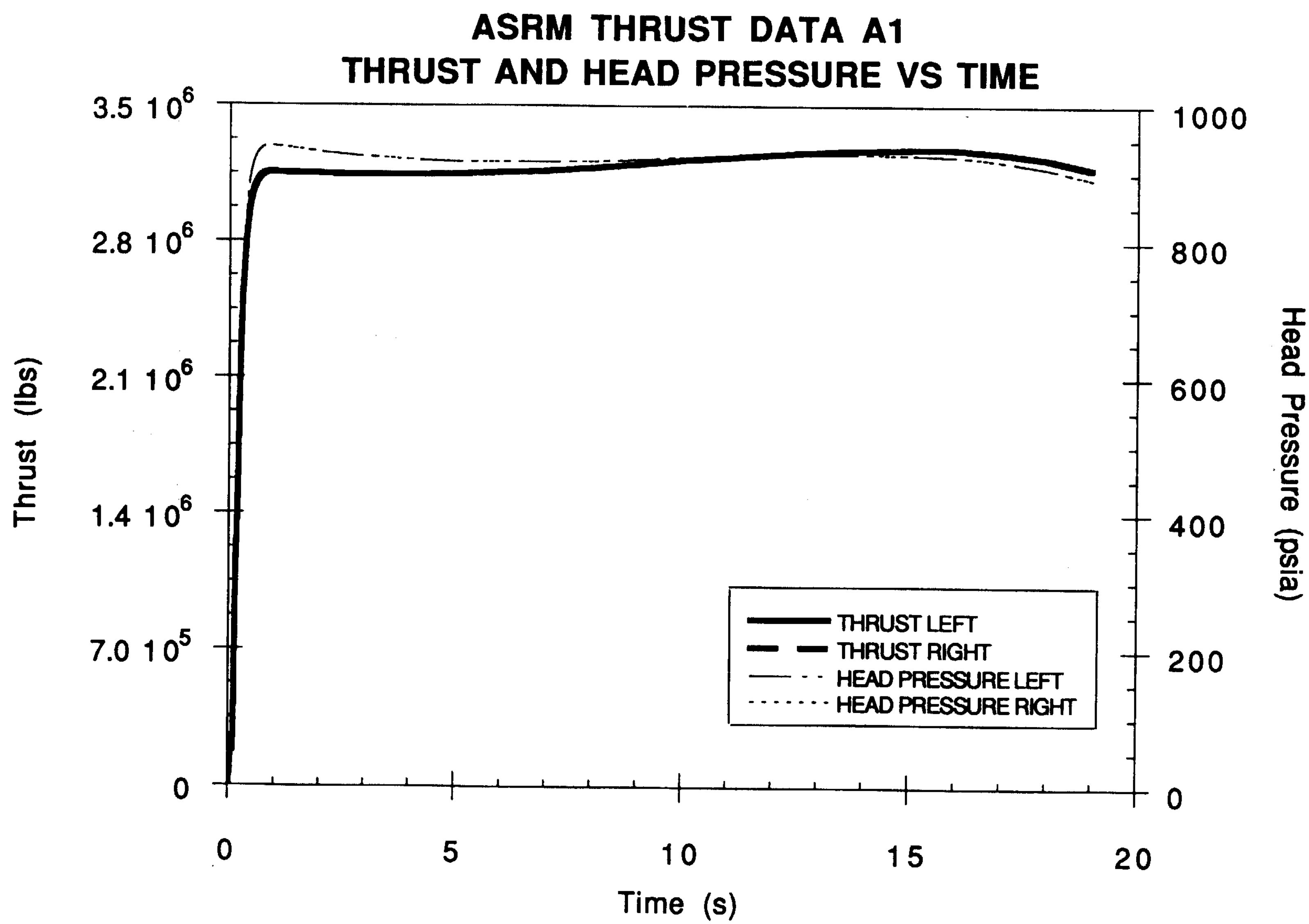
CASE NAME --->	BUSD01	BUSD02	BUSD03	BUSD04	BUSD05	BUSD06	BUSD07	BUSD17
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 5 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 6 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	NOM	MIN	MAX	MAX	MAX	MAX	MAX	MAX
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 5 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 6 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	0.0°	0.0°	0.0°	0.0°	0.0°	+.4° ABOUT Z	+.4° ABOUT Y	0.0°
STME IGNITION SIDELOADS MAGNITUDES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	NONE	NONE	NONE	Y-DIR	Z-DIR	Y-DIR	Z-DIR	NONE
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
RELEASE TIMING	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STME OUT	N/A	N/A	N/A	N/A	N/A	+Y @ 4.75	+Z @ 4.75	+Z @ 4.75

NLS2 1.5 STAGE LAUNCH VEHICLE

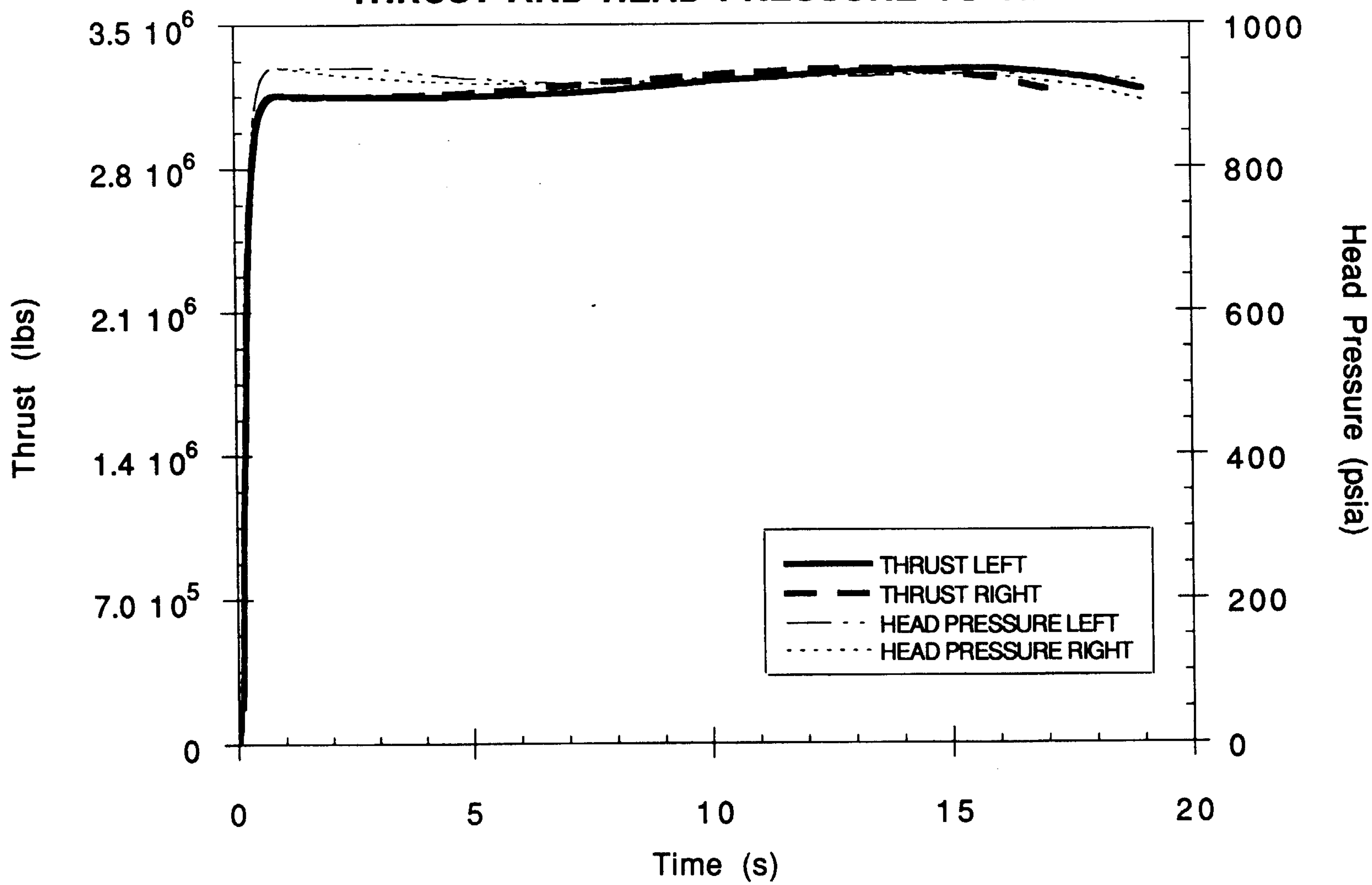
LIFTOFF LOAD CASES FOR CYCLE I DESIGN

CASE NAME --->	LC1001	LC1002	LC1003	LC1004	LC1005	LC1006	LC1007	LC1017	LC1003A
STME 1 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 5 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 6 IGNITION STAGGER (SECONDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST BUILD-UP DESCRIPTION	NOM	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX
STME 1 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 2 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 3 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 4 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 5 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME 6 IGNITION TIMING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STME THRUST MISALIGNMENT	0.0°	0.0°	0.0°	0.0°	0.0°	+.4° ABOUT Z	+.4° ABOUT Y	0.0°	0.0°
STME IGNITION SIDELOADS MAGNITUDE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WIND DIRECTION (NO DISPERSIONS)	NONE	NONE	NONE	Y-DIR	Z-DIR	Y-DIR	Z-DIR	NONE	NONE
HOLDDOWN BOLT TIMING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
STRUCTURAL MISMATCH	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
RELEASE TIMING	4.75 SEC	4.75 SEC	4.75 SEC	4.75 SEC	4.75 SEC	4.75 SEC	4.75 SEC	4.75 SEC	3.98 SEC
STME OUT	N/A	N/A	N/A	N/A	N/A	+Y @ 4.75	+Z @ 4.75	+Z @ 4.75	N/A

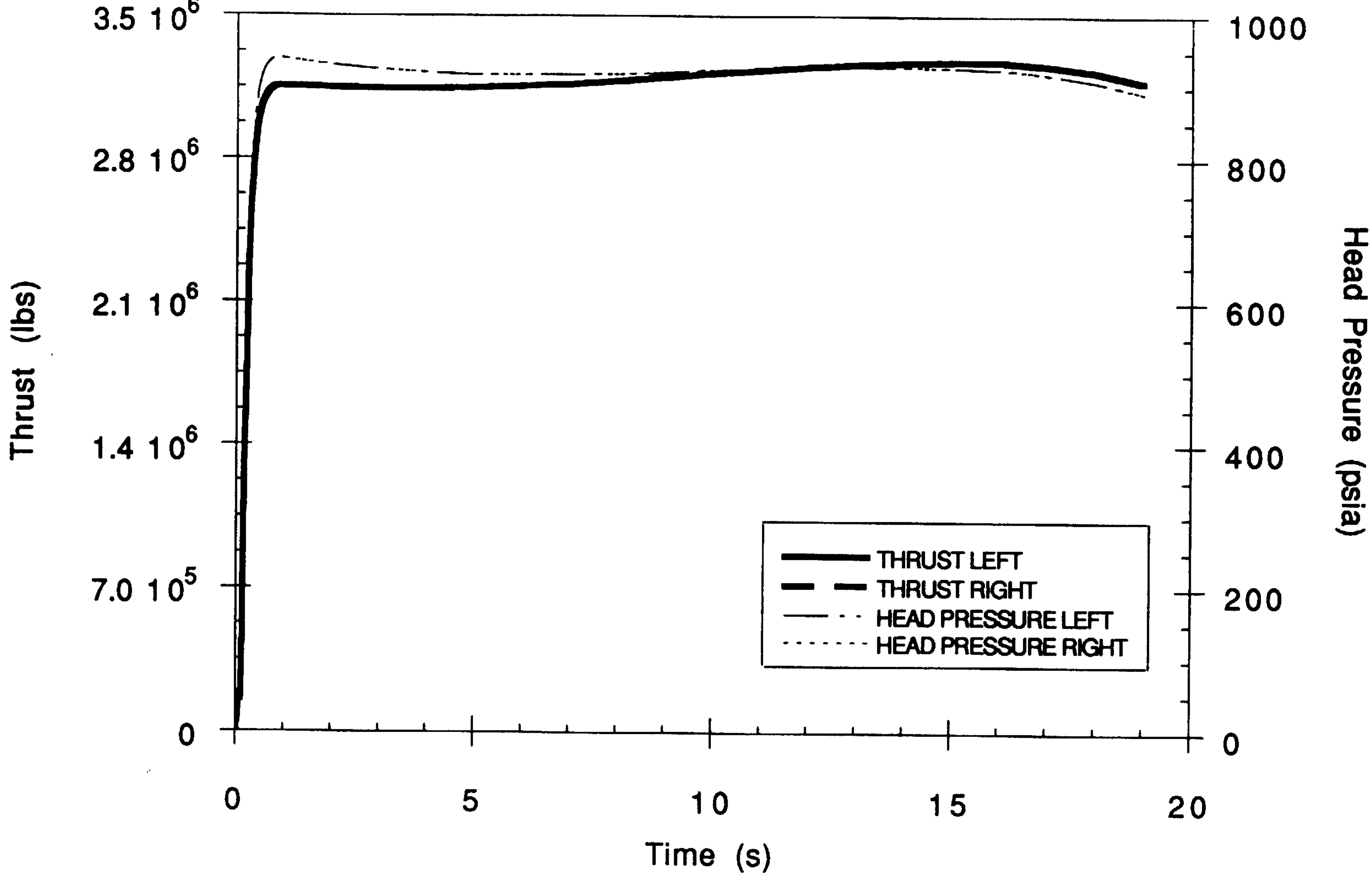

STME THRUST VS TIME
IGNITION AND SHUTDOWN CYCLE I LOADS
STME THRUST (KIPS)
0
100
200
300
400
500
600
0
2
4
6
8
10
12
TIME (SECONDS)
MAX
NOM
MIN

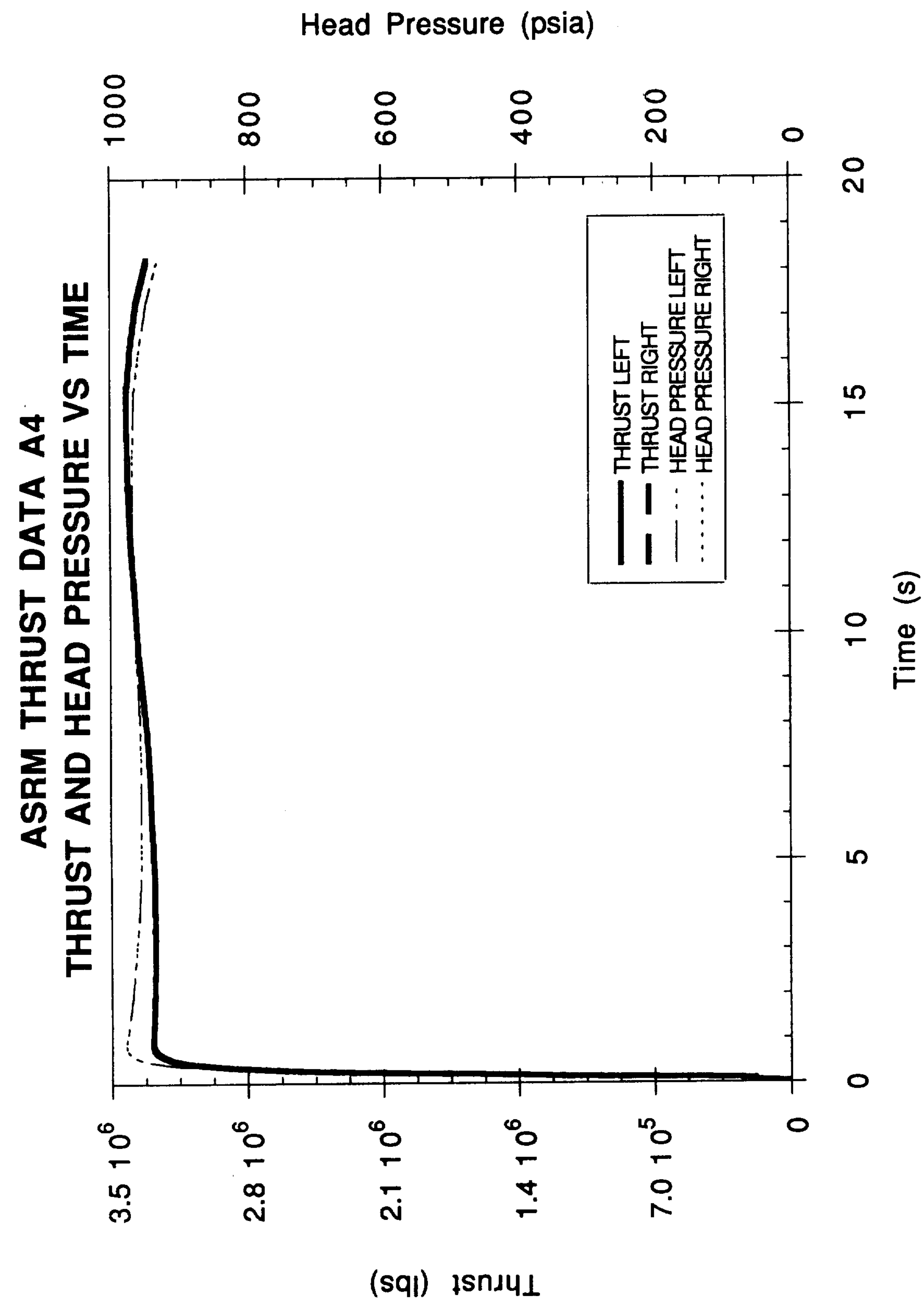

ASRM THRUST DATA A1
THRUST AND HEAD PRESSURE VS TIME
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Thrust (lbs)
1000
800
600
400
200
0
Head Pressure (psia)
0
5
10
15
20
Time (s)
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

ASRM THRUST DATA A2
THRUST AND HEAD PRESSURE VS TIME



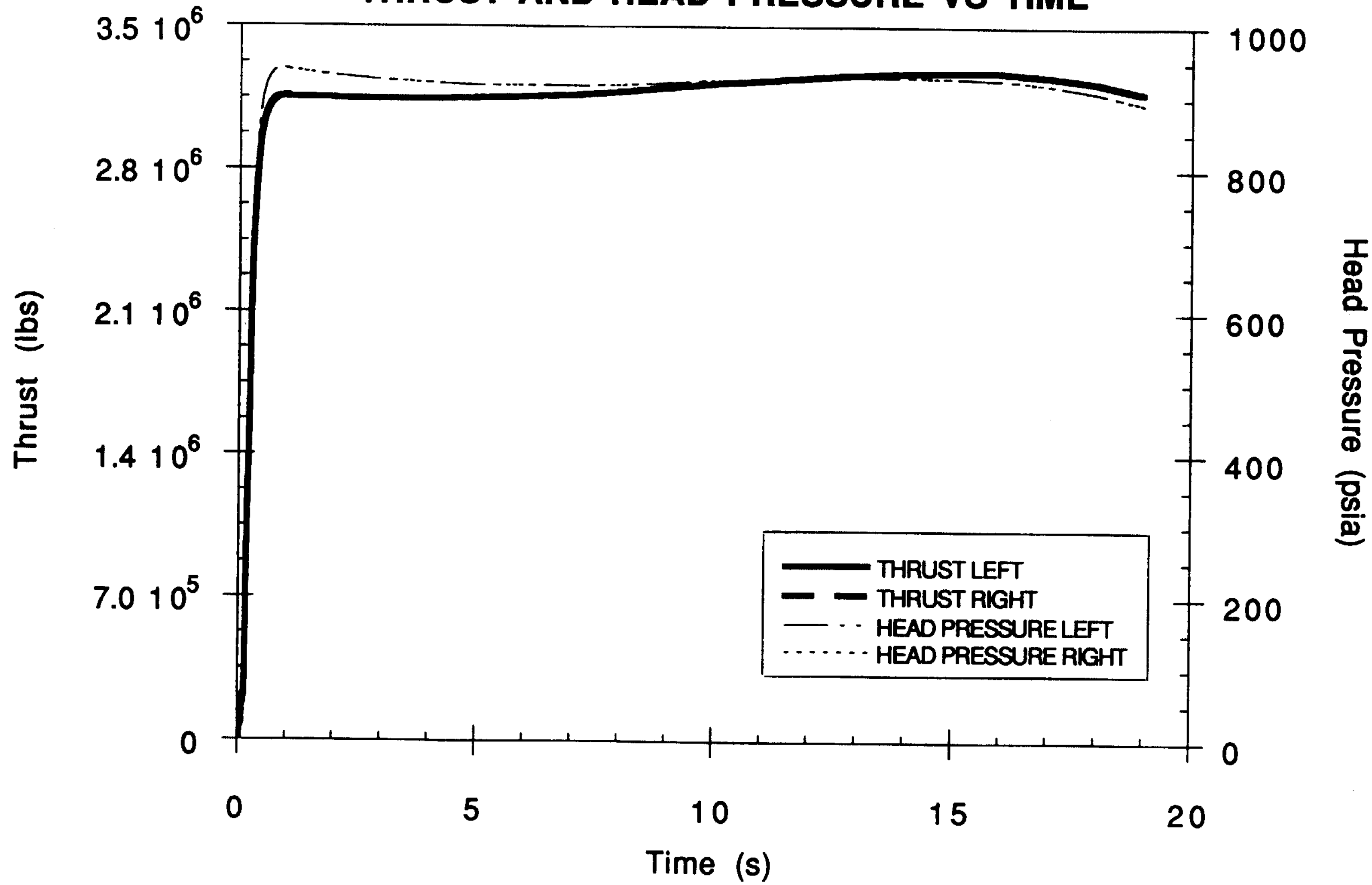
ASRM THRUST DATA A3
THRUST AND HEAD PRESSURE VS TIME



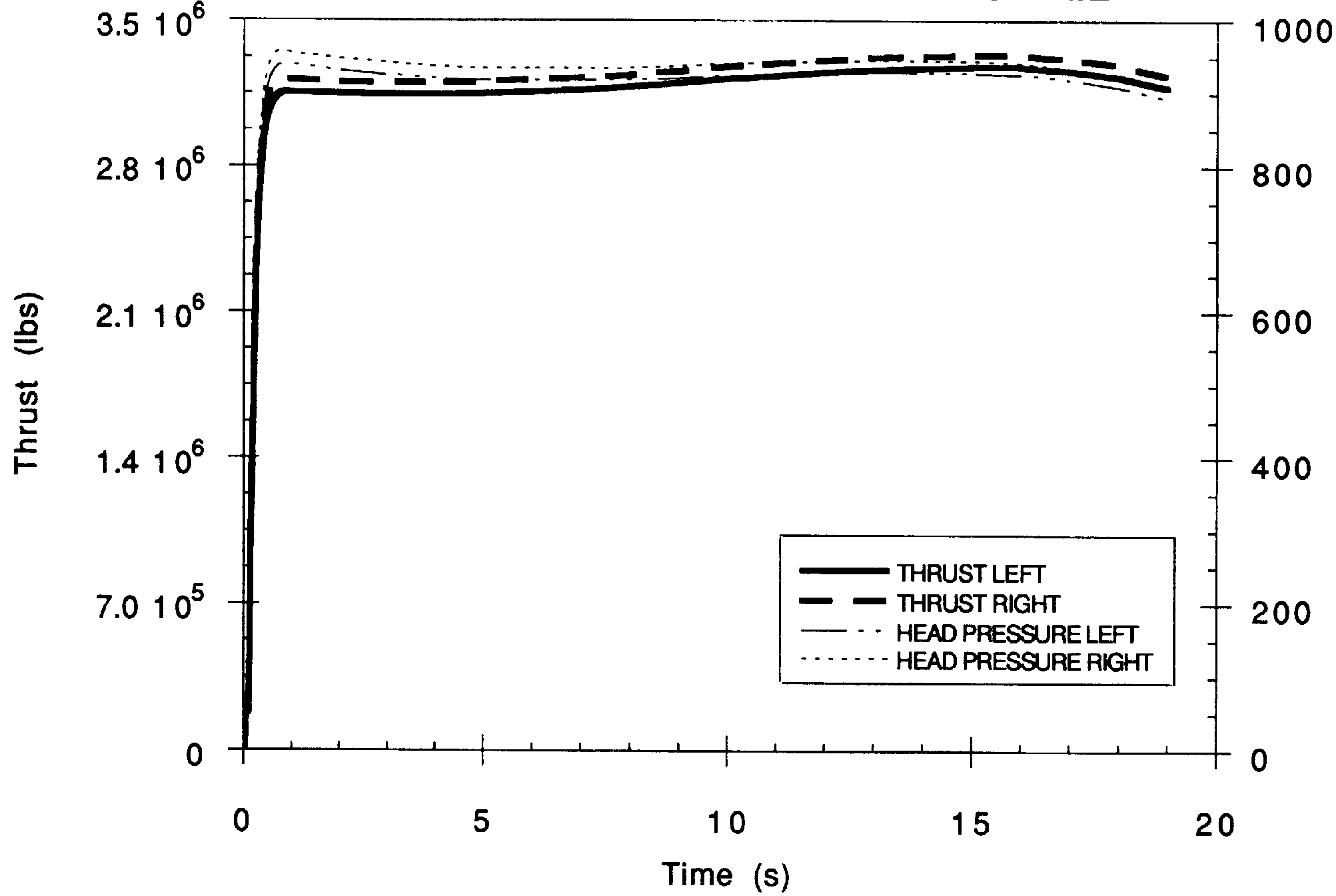


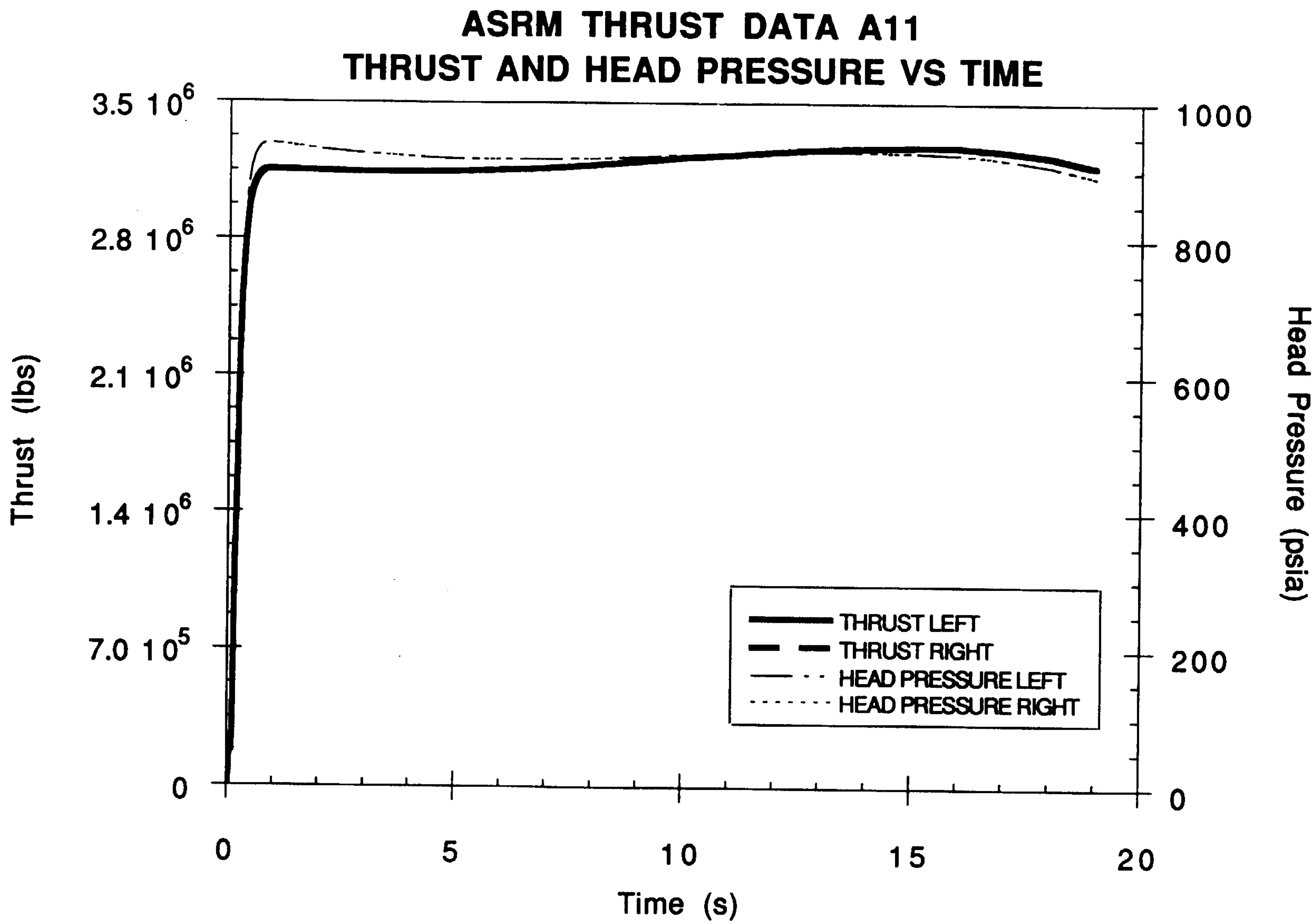
ASRM THRUST DATA A4
THRUST AND HEAD PRESSURE VS TIME
Head Pressure (psia)
1000
800
600
400
200
0
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Time (s)
0
5
10
15
20
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

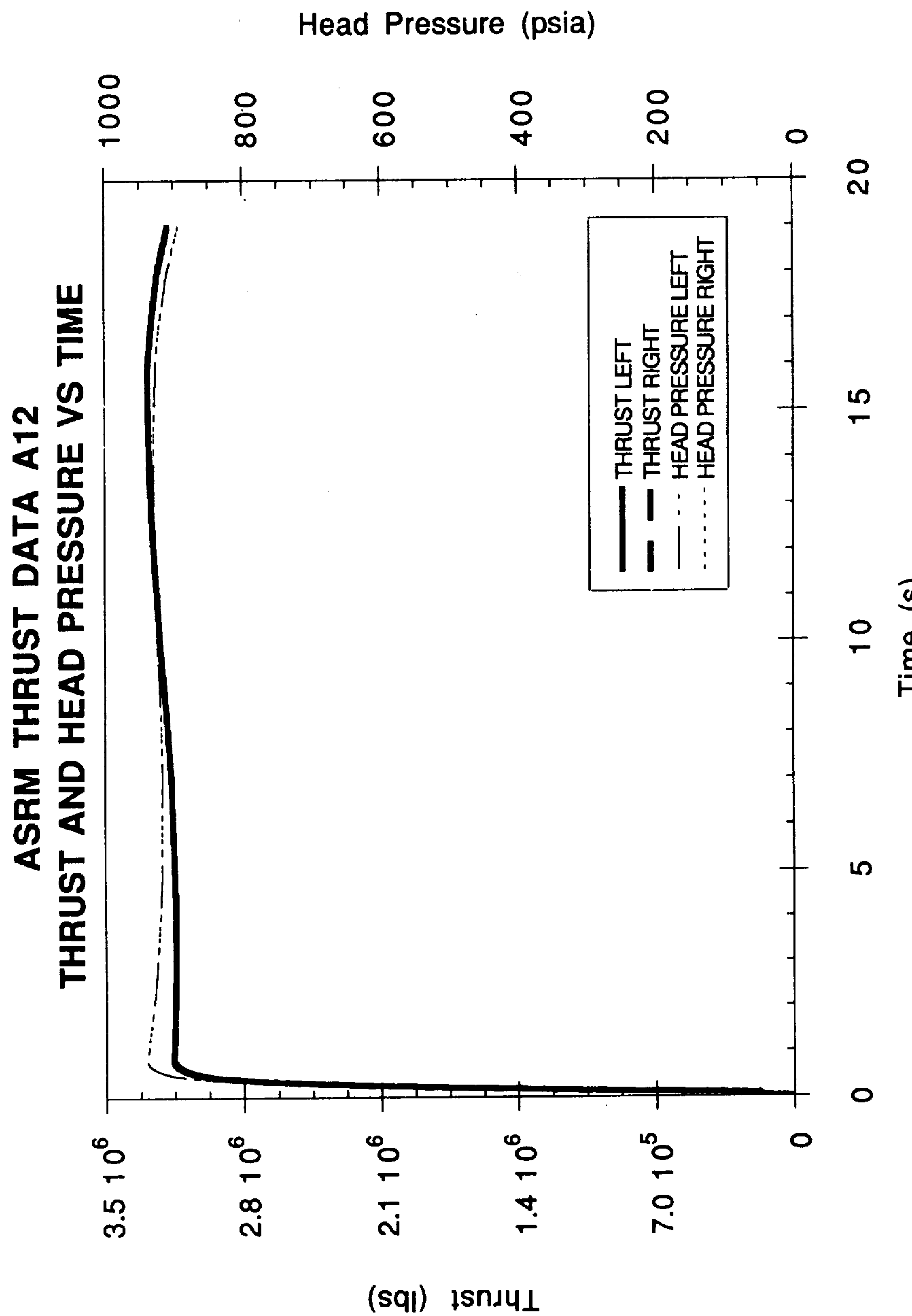
ASRM THRUST DATA A5
THRUST AND HEAD PRESSURE VS TIME



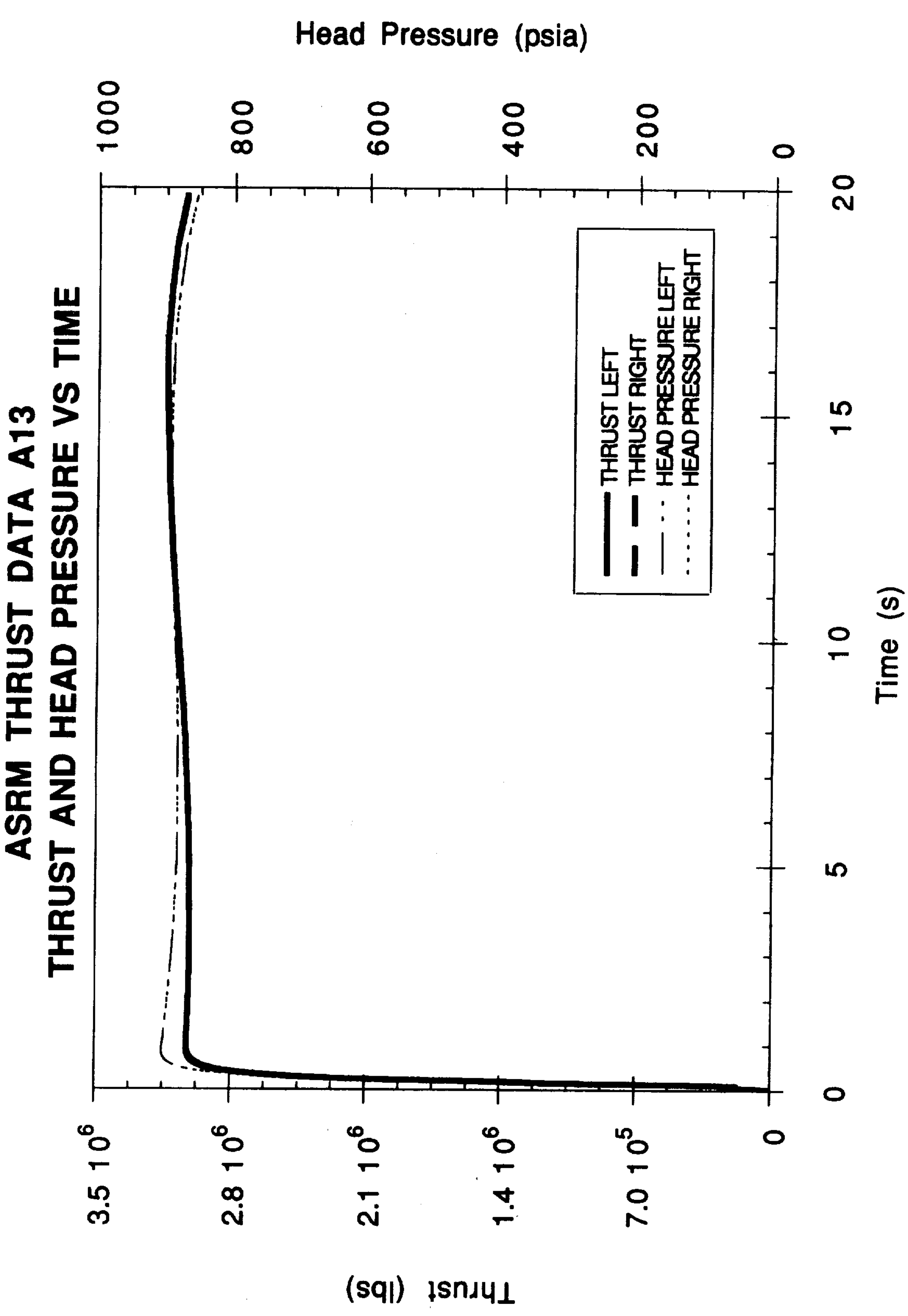
ASRM THRUST DATA A6
THRUST AND HEAD PRESSURE VS TIME




ASRM THRUST DATA A11
THRUST AND HEAD PRESSURE VS TIME
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Head Pressure (psia)
1000
800
600
400
200
0
0
5
10
15
20
Time (s)
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

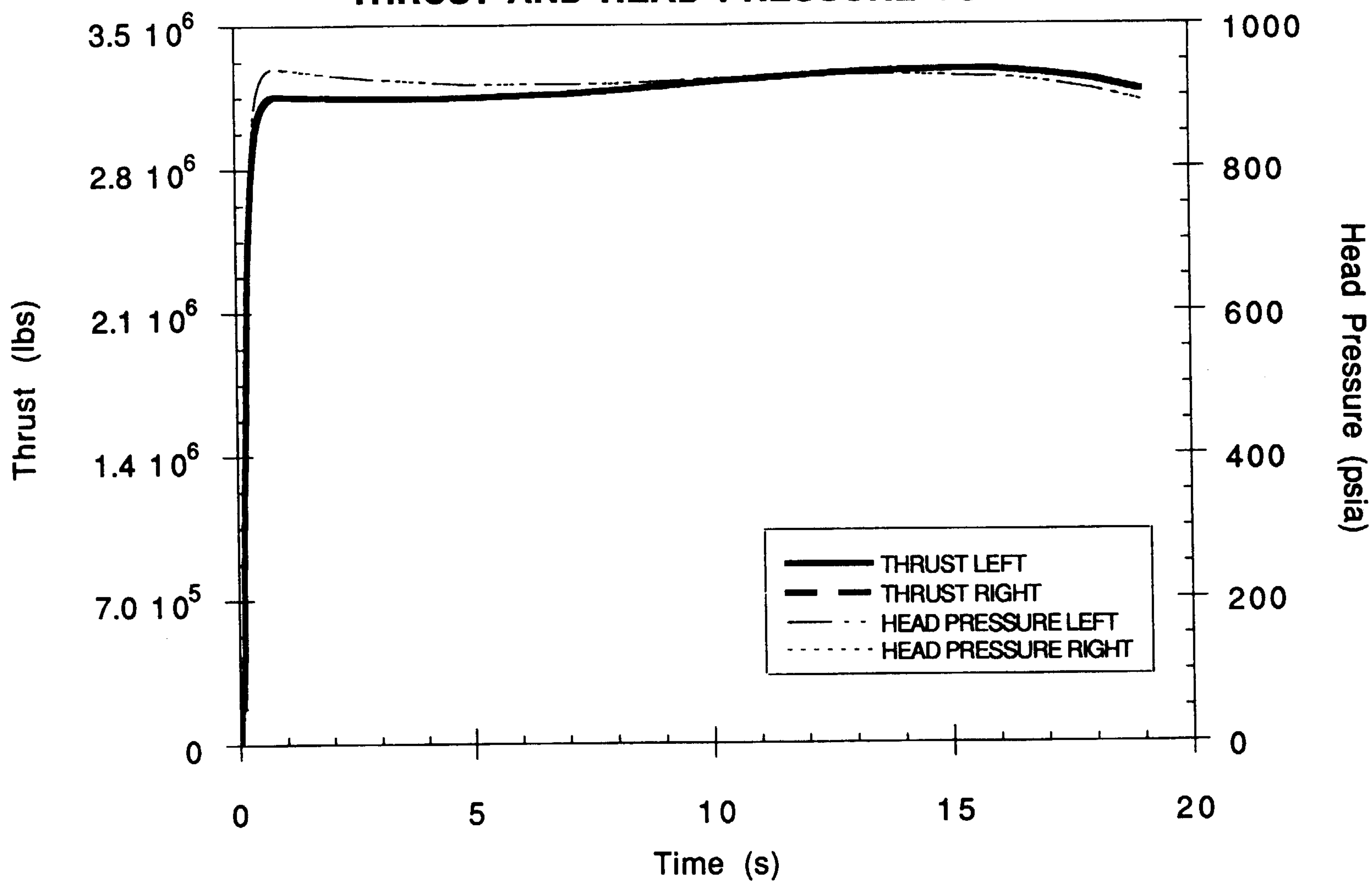


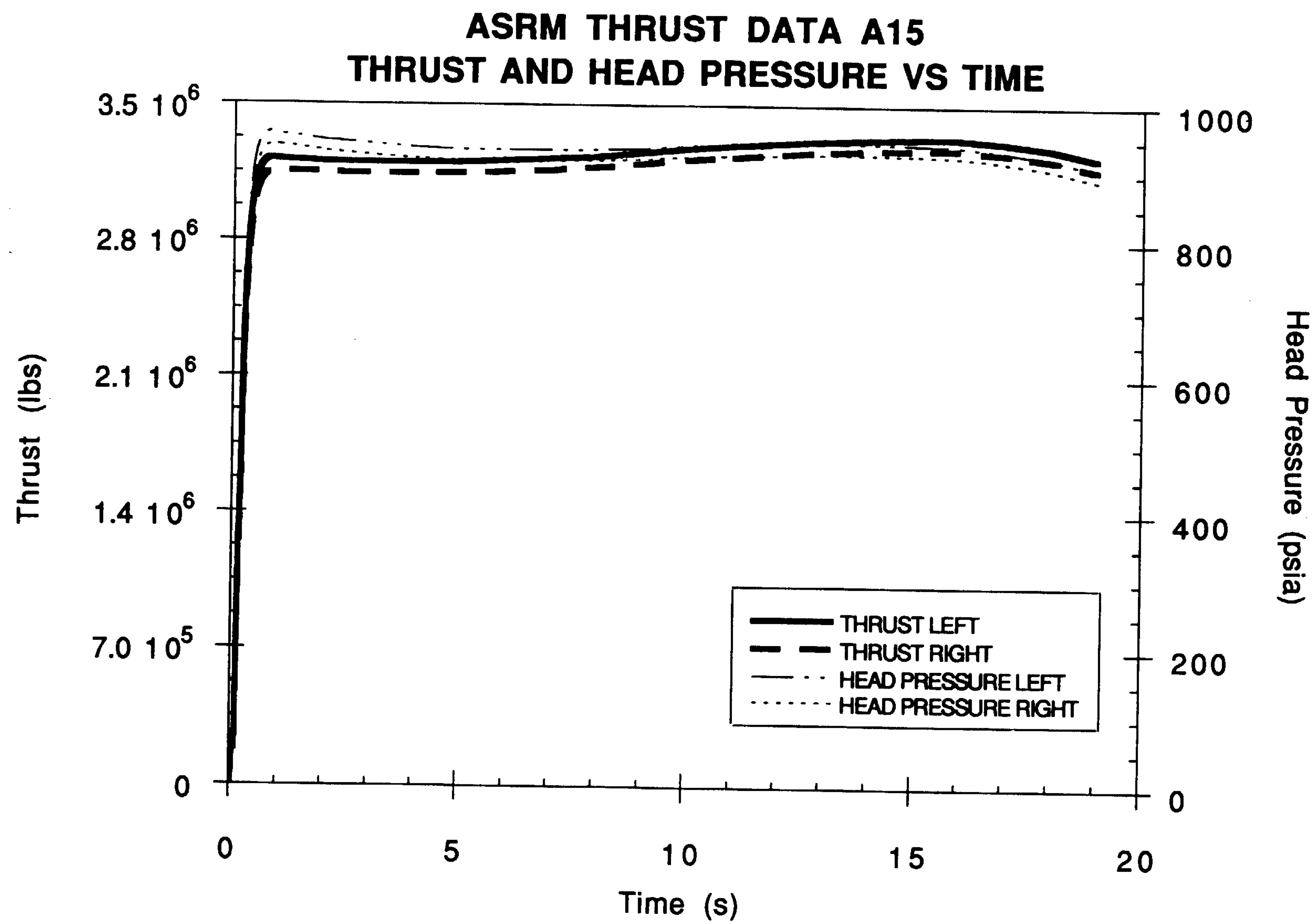
ASRM THRUST DATA A12
THRUST AND HEAD PRESSURE VS TIME
Head Pressure (psia)
1000
800
600
400
200
0
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Time (s)
0
5
10
15
20
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

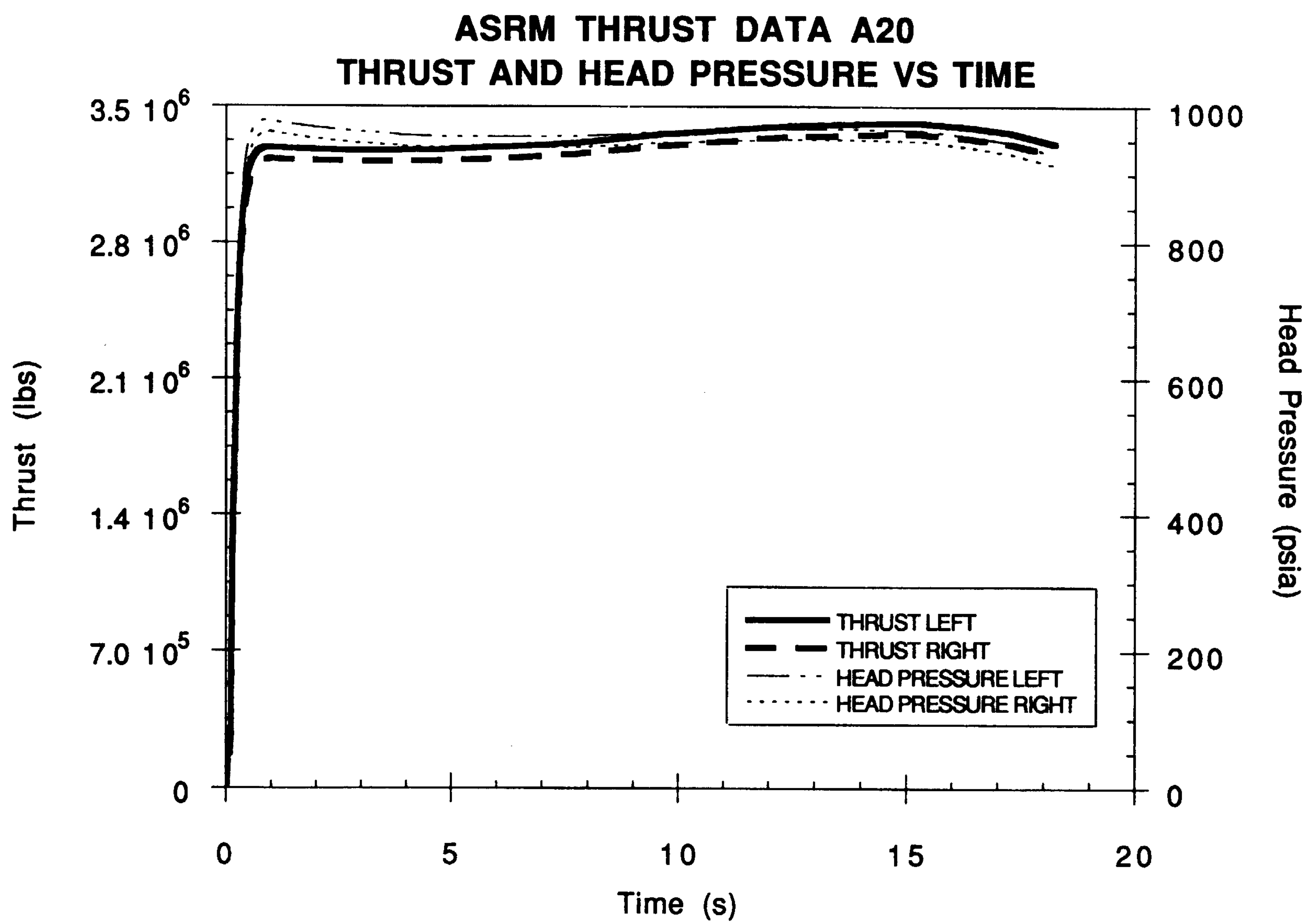


ASRM THRUST DATA A13
THRUST AND HEAD PRESSURE VS TIME
Head Pressure (psia)
1000
800
600
400
200
0
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Time (s)
0
5
10
15
20
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

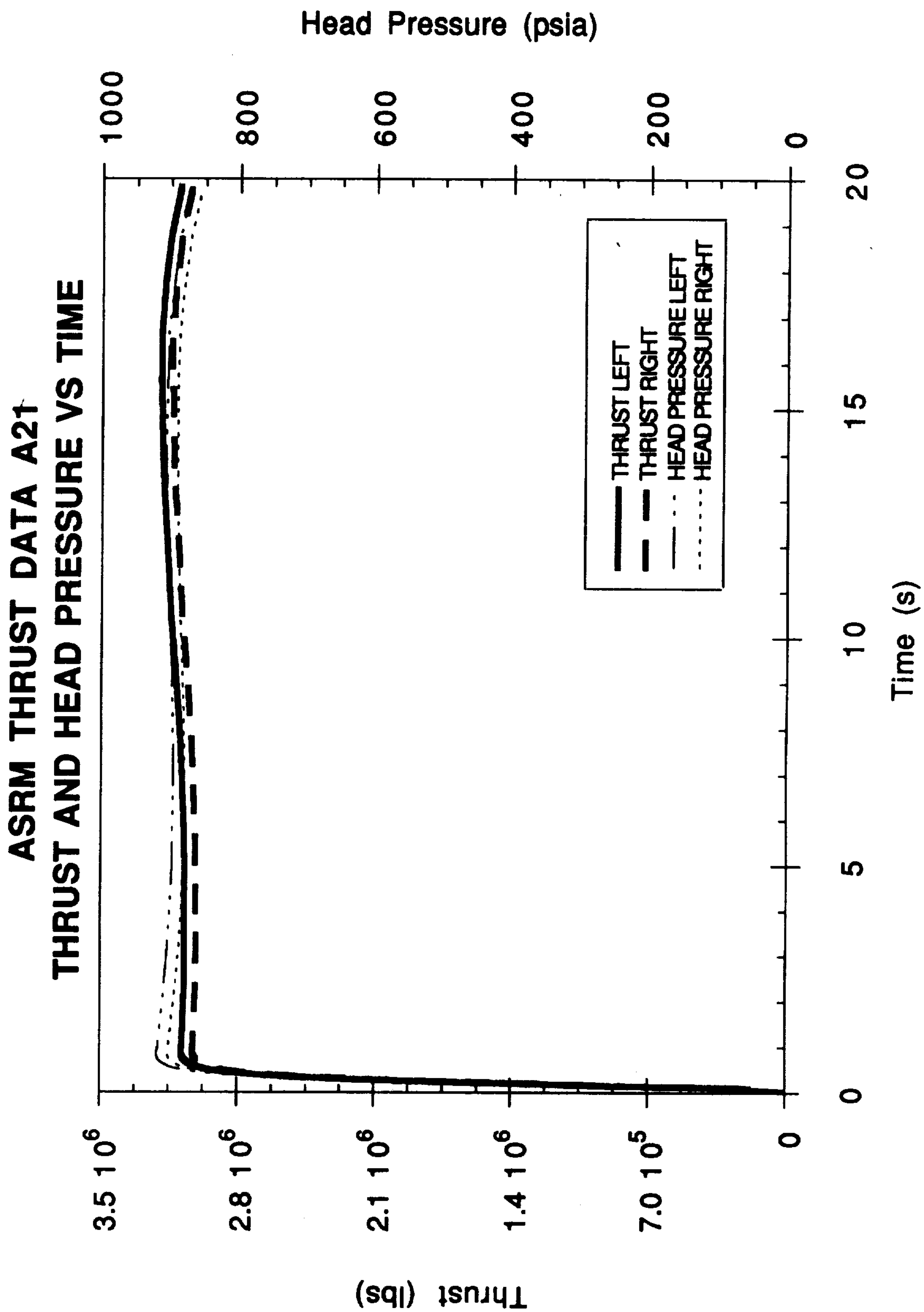
ASRM THRUST DATA A14
THRUST AND HEAD PRESSURE VS TIME




ASRM THRUST DATA A15
THRUST AND HEAD PRESSURE VS TIME
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Head Pressure (psia)
1000
800
600
400
200
0
Time (s)
0
5
10
15
20
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

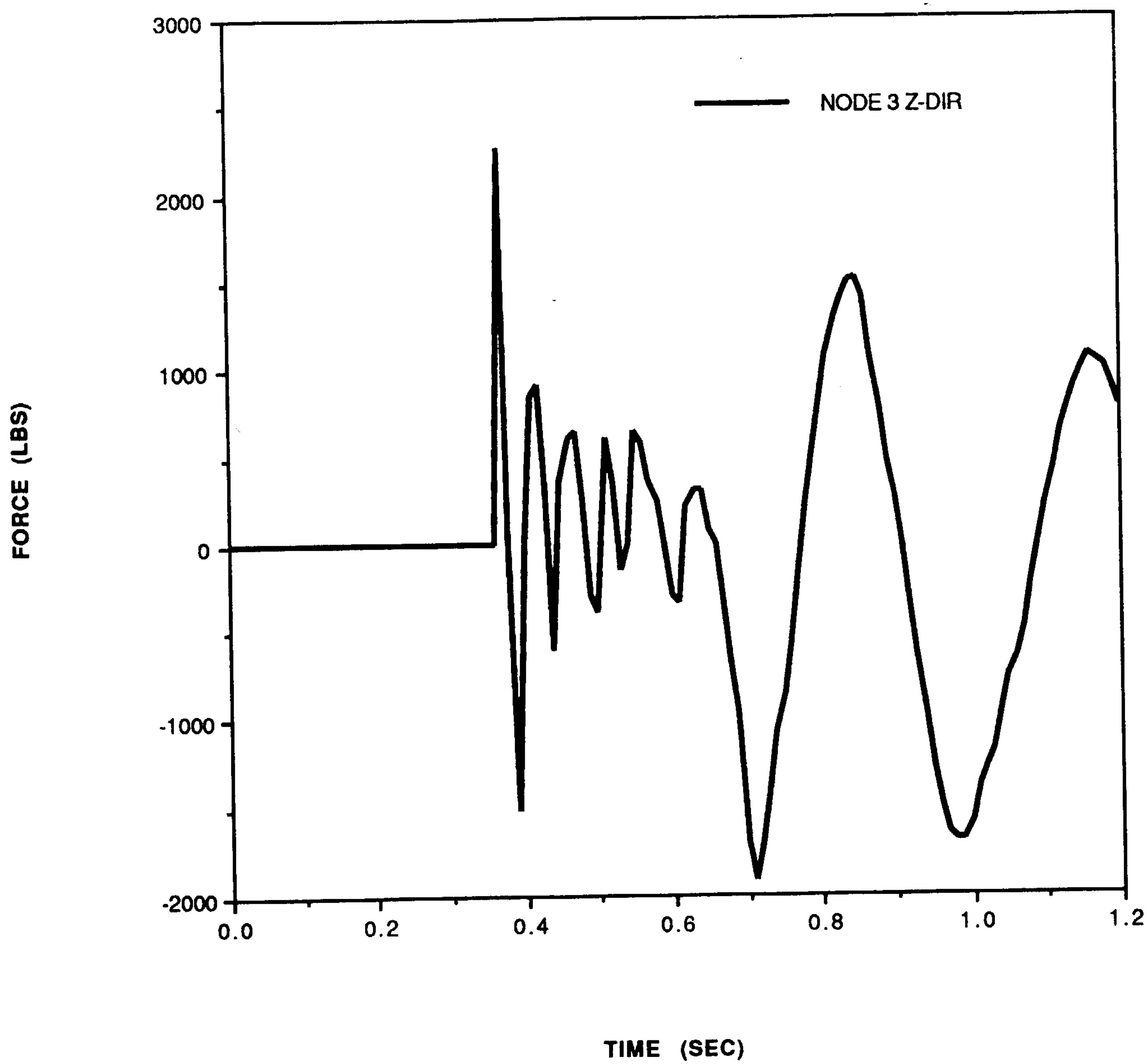


ASRM THRUST DATA A20
THRUST AND HEAD PRESSURE VS TIME
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
Head Pressure (psia)
1000
800
600
400
200
0
Time (s)
0
5
10
15
20
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

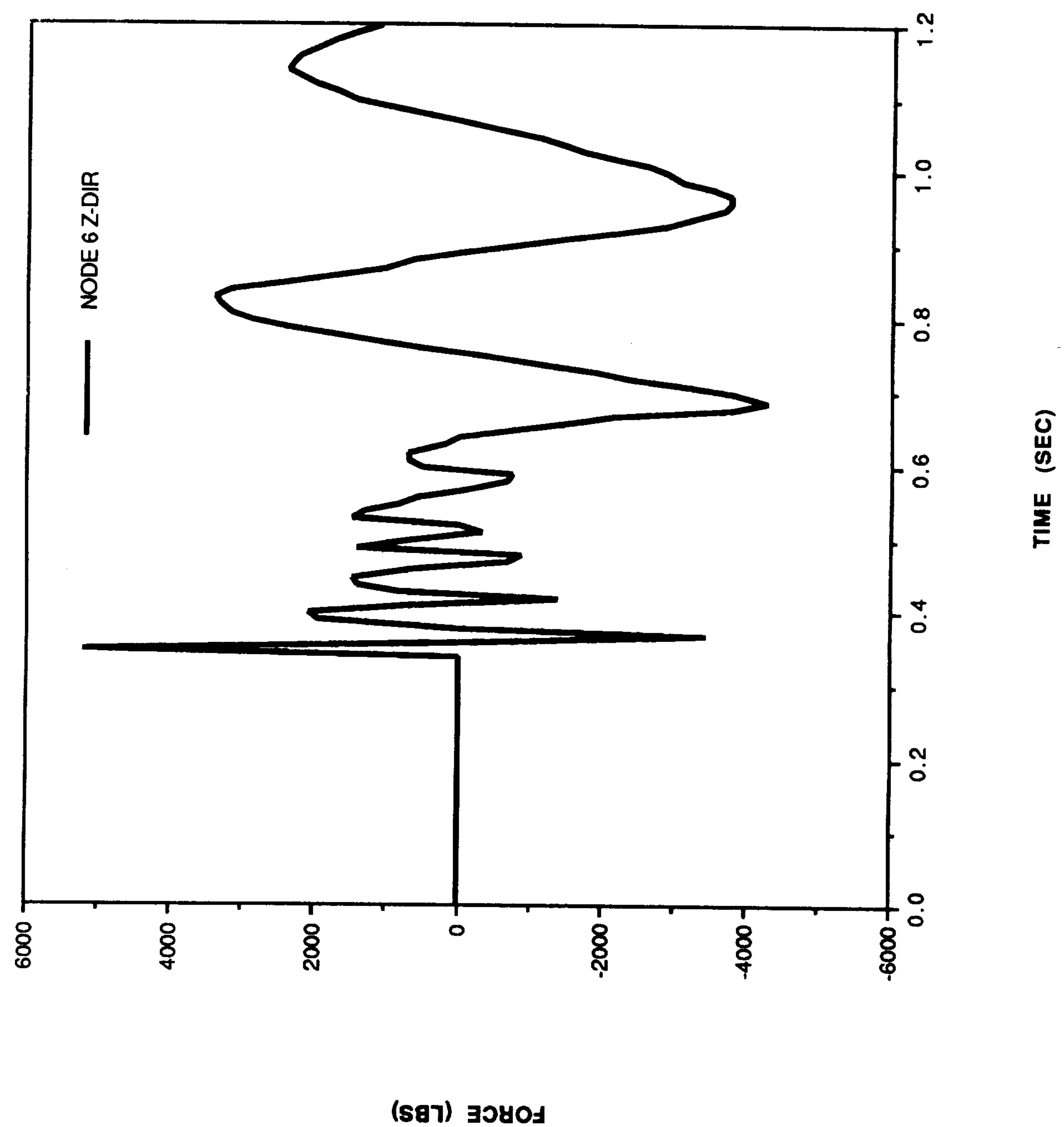


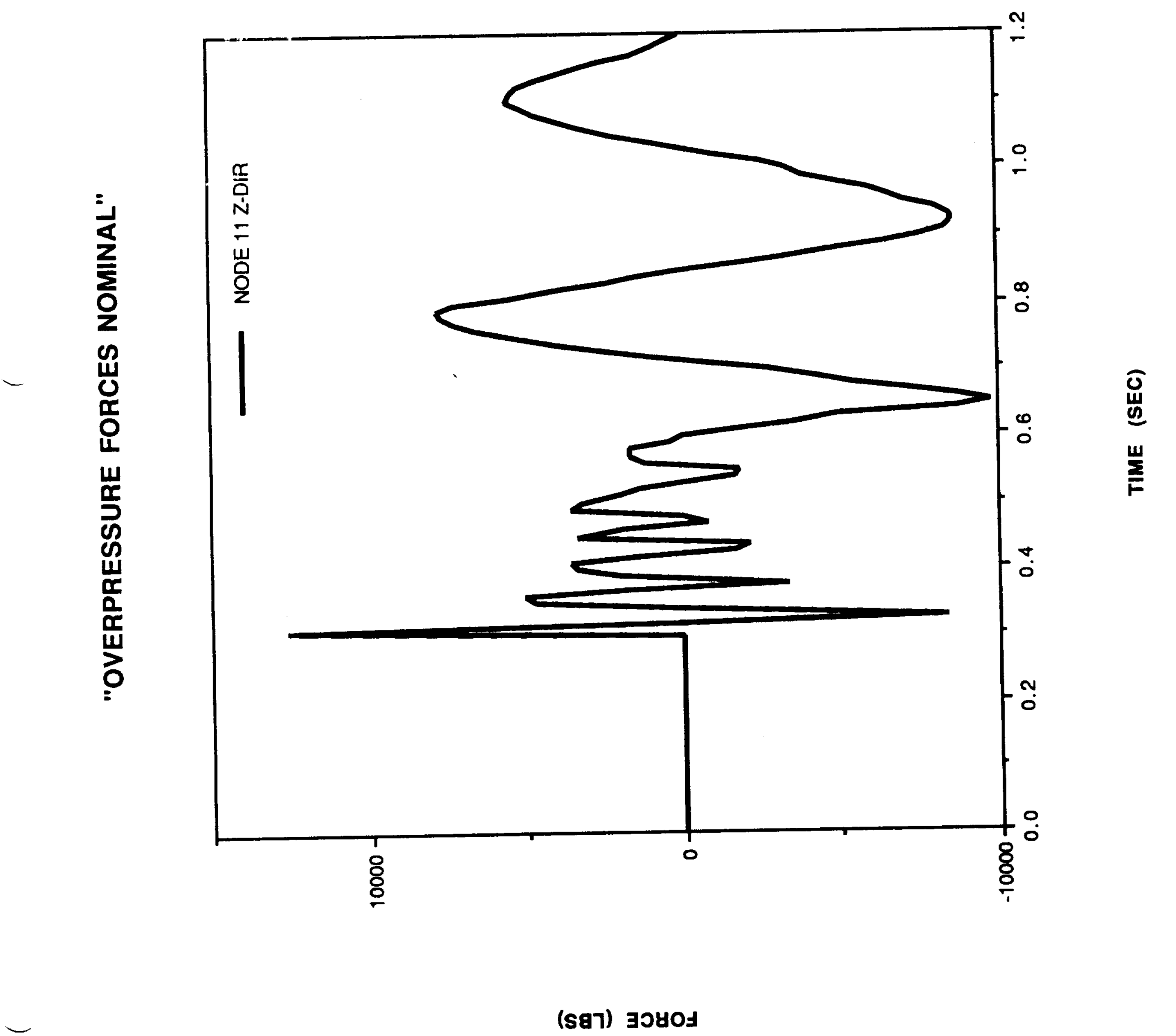
ASRM THRUST DATA A21
THRUST AND HEAD PRESSURE VS TIME
Head Pressure (psia)
1000
800
600
400
200
0
Thrust (lbs)
3.5 10^6
2.8 10^6
2.1 10^6
1.4 10^6
7.0 10^5
0
0
5
10
15
20
Time (s)
THRUST LEFT
THRUST RIGHT
HEAD PRESSURE LEFT
HEAD PRESSURE RIGHT

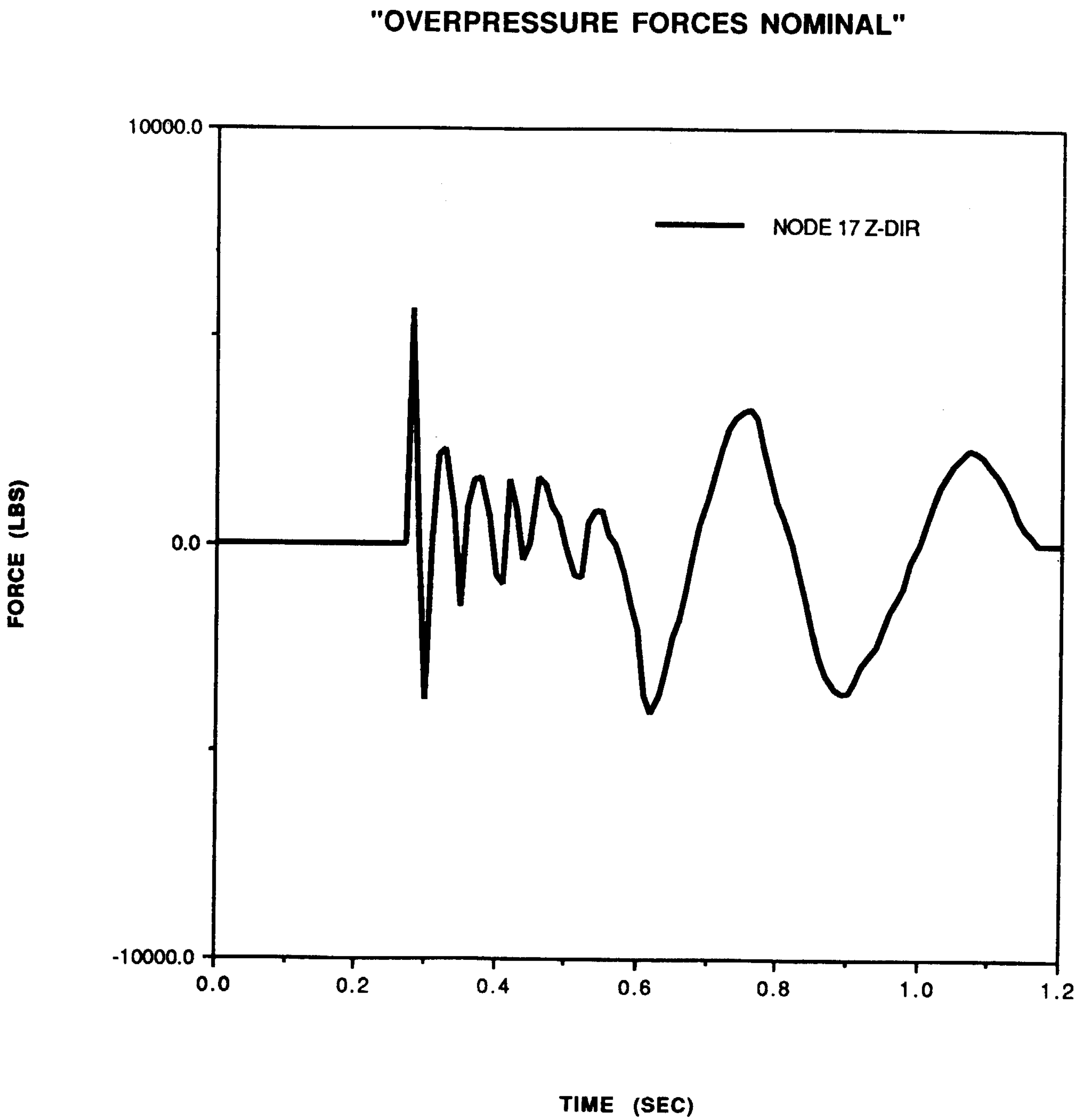
"OVERPRESSURE FORCES NOMINAL"



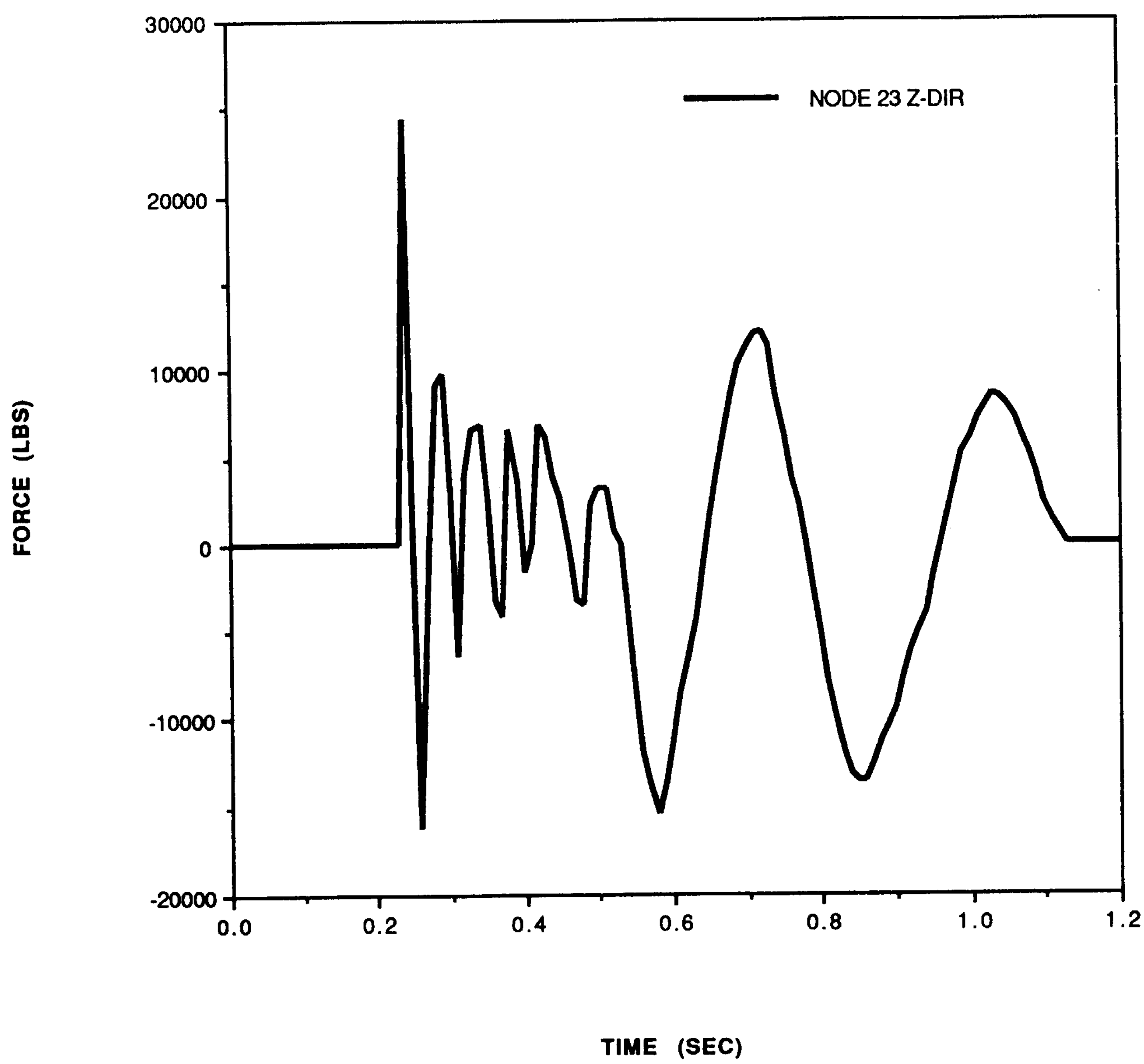
"OVERPRESSURE FORCES NOMINAL"



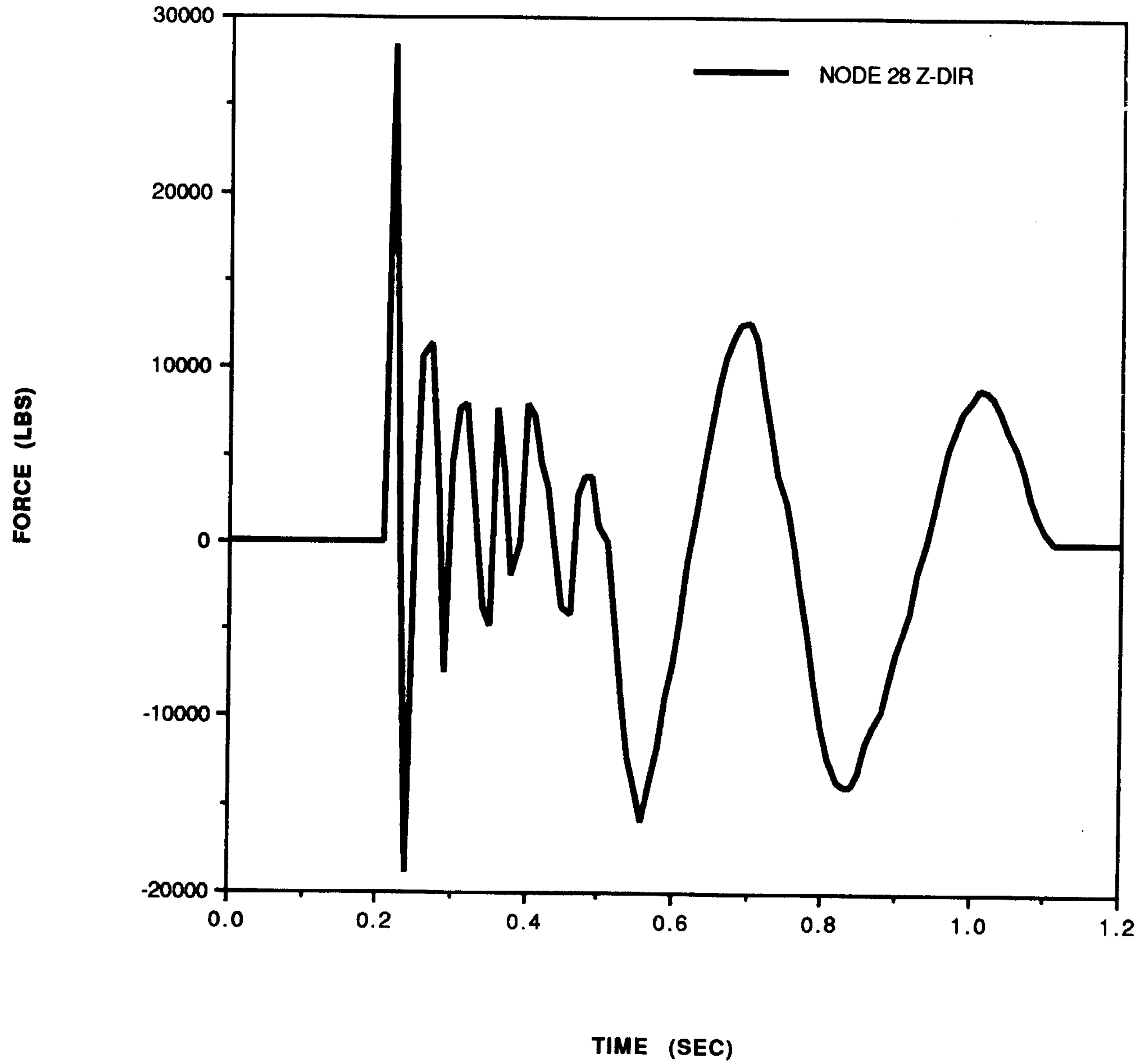

"OVERPRESSURE FORCES NOMINAL"
NODE 11 Z-DIR
FORCE (LBS)
TIME (SEC)
10000
0
-10000
0.0
0.2
0.4
0.6
0.8
1.0
1.2


"OVERPRESSURE FORCES NOMINAL"
NODE 17 Z-DIR
10000.0
0.0
-10000.0
FORCE (LBS)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
TIME (SEC)

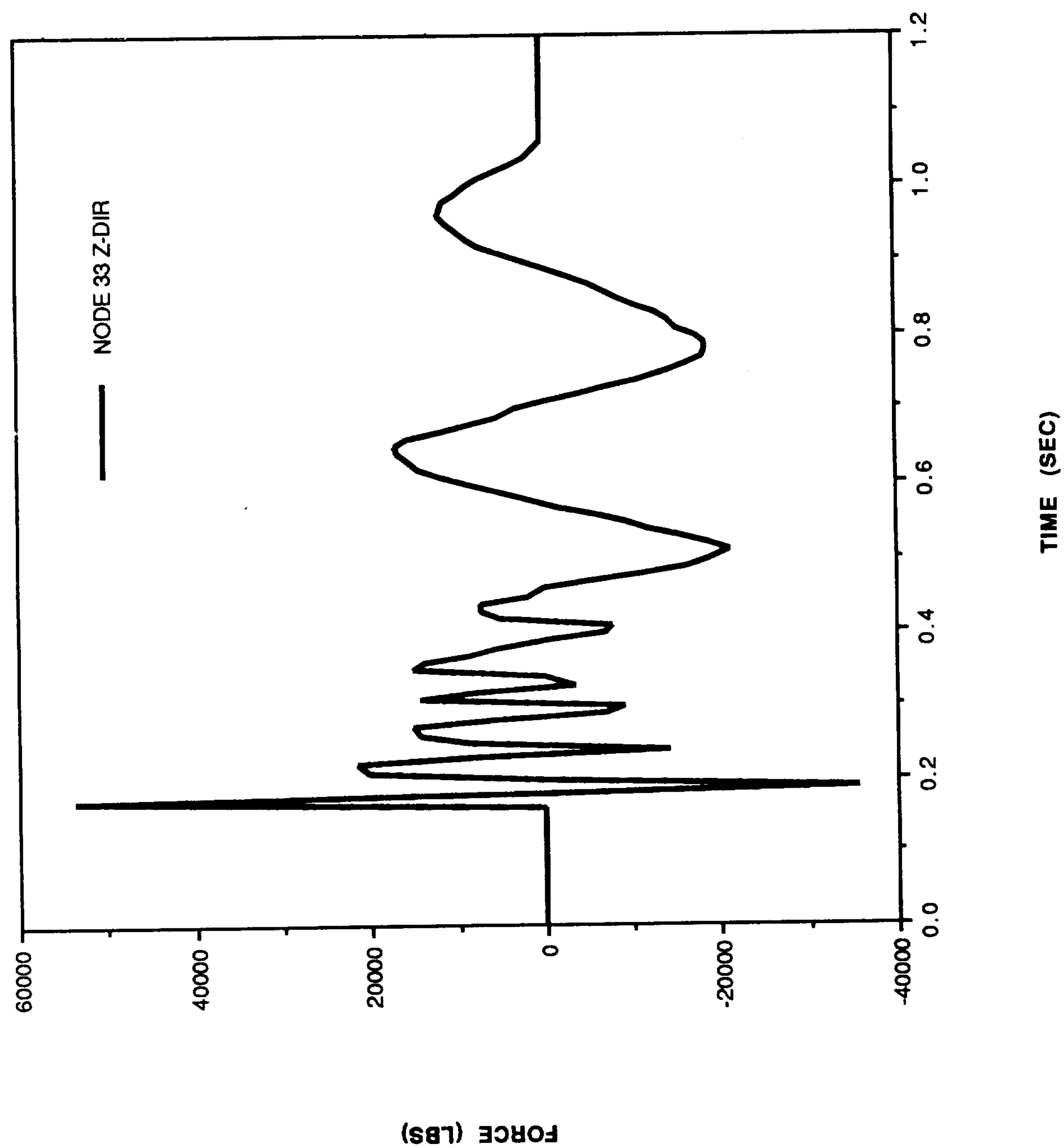
"OVERPRESSURE FORCES NOMINAL"



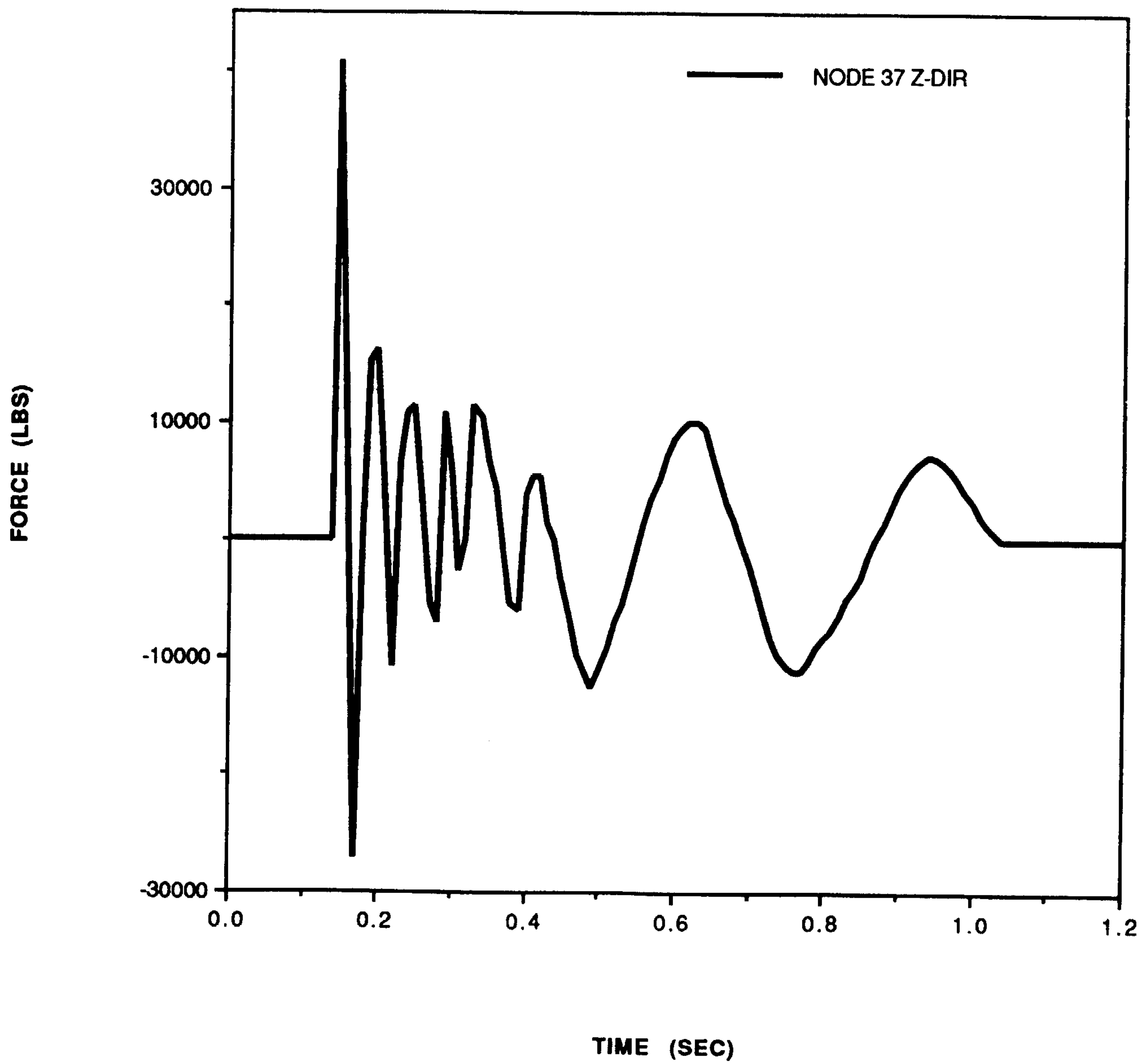
"OVERPRESSURE FORCES NOMINAL"



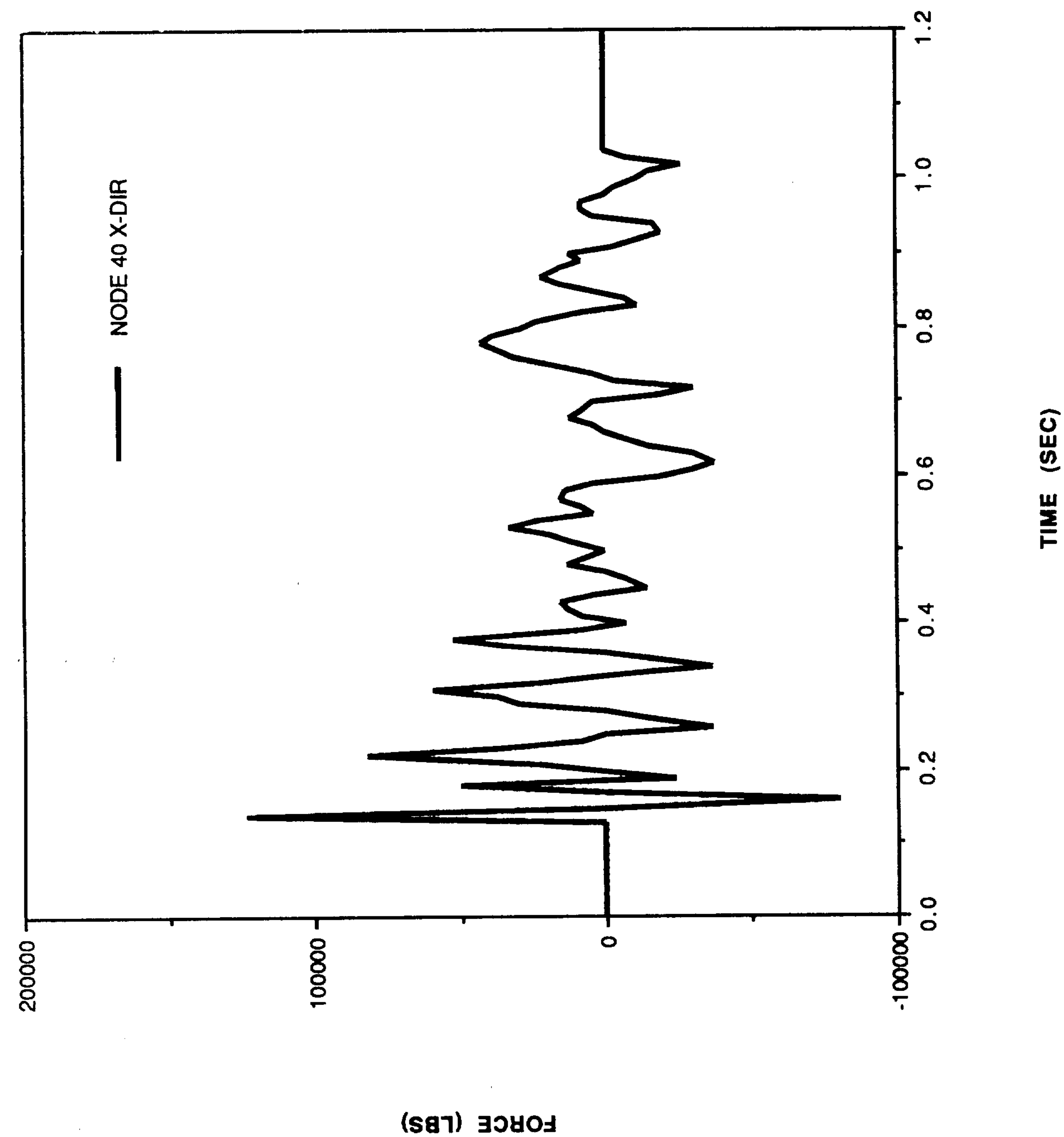
"OVERPRESSURE FORCES NOMINAL"

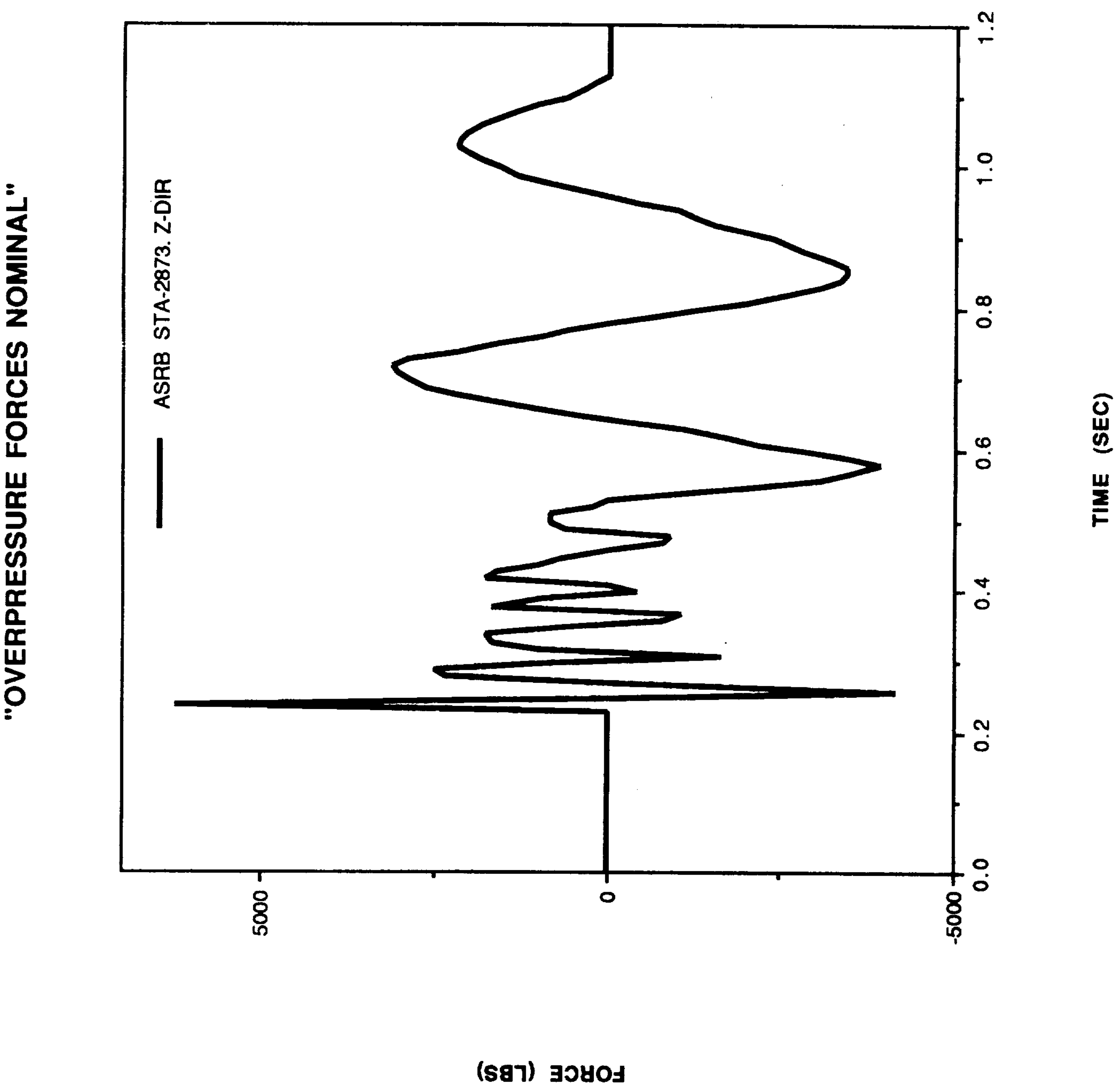


"OVERPRESSURE FORCES NOMINAL"



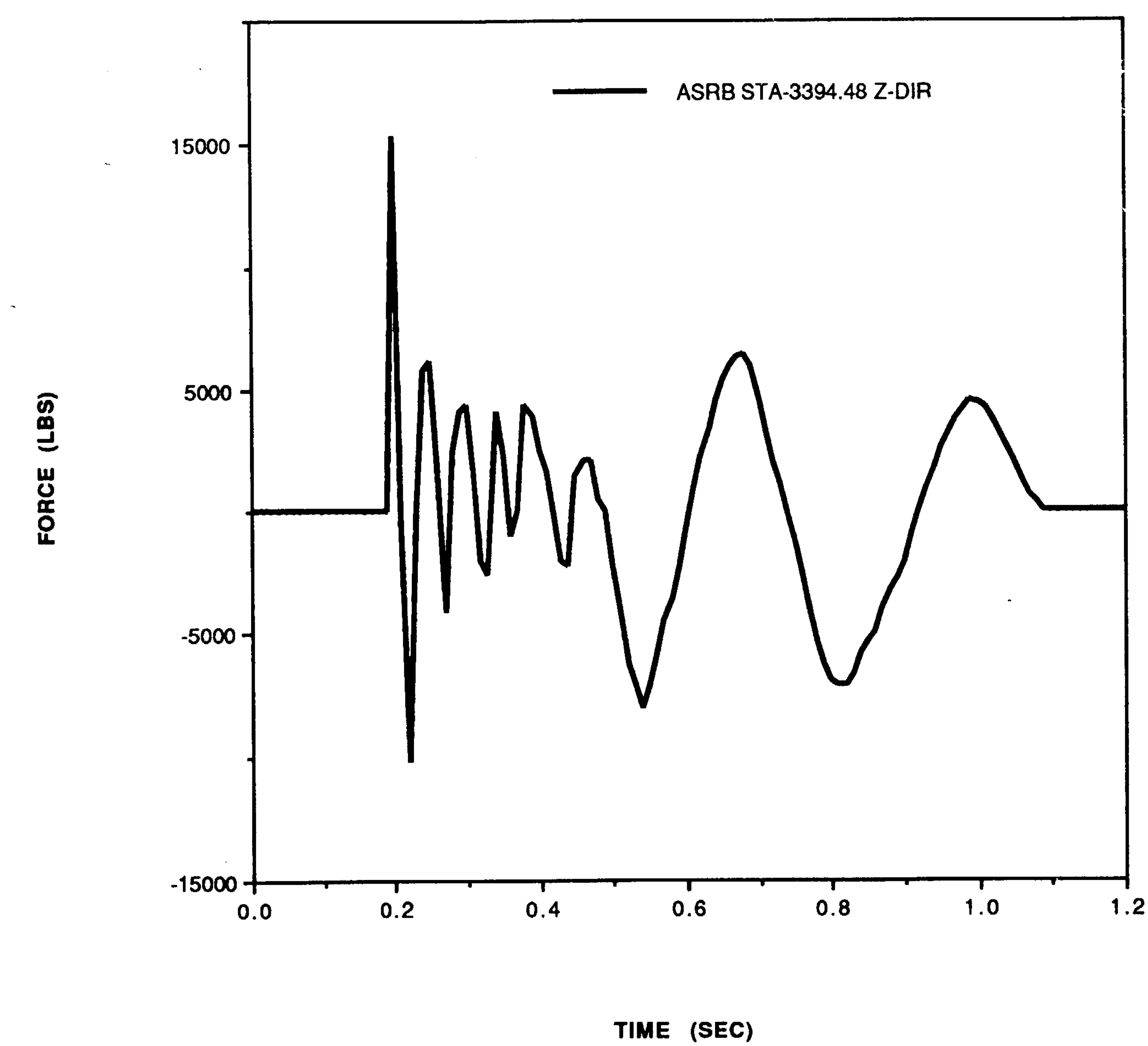
"OVERPRESSURE FORCES NOMINAL"



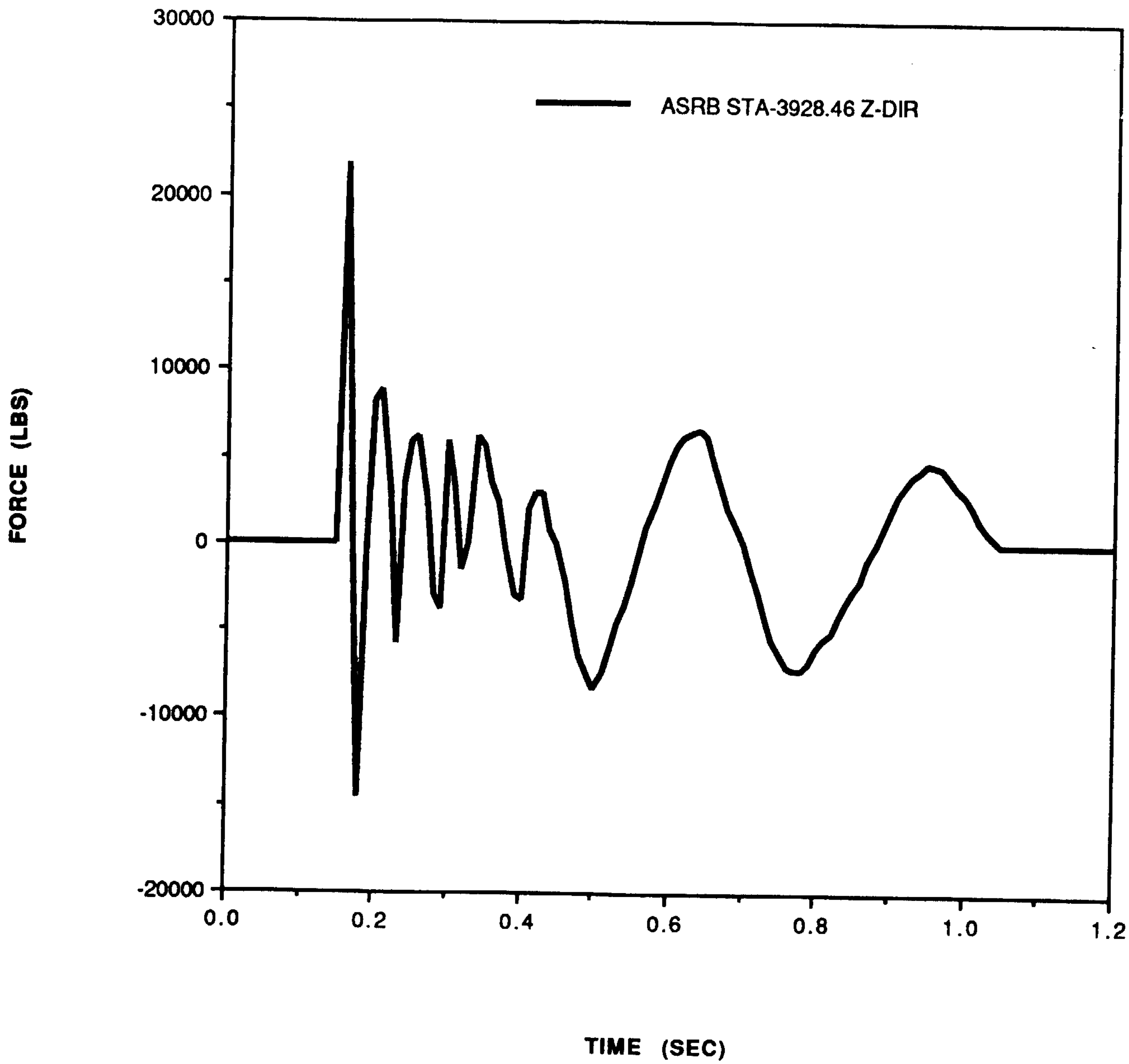


"OVERPRESSURE FORCES NOMINAL"
ASRB STA-2873. Z-DIR
5000
0
-5000
FORCE (LBS)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
TIME (SEC)

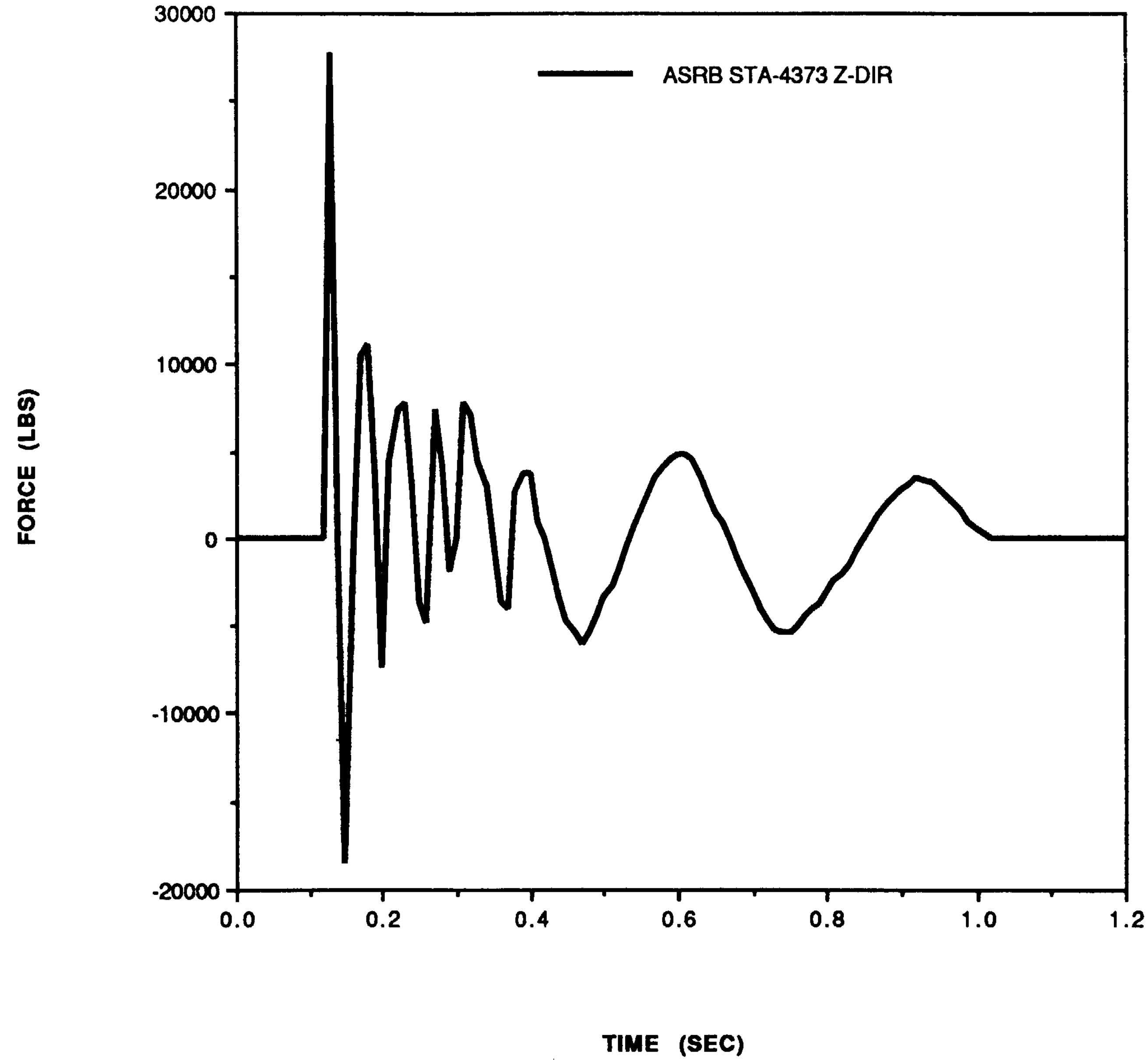
"OVERPRESSURE FORCES NOMINAL"



"OVERPRESSURE FORCES NOMINAL"



"OVERPRESSURE FORCES NOMINAL"



NLS 1

PRELAUNCH DATA

NLS1 WITH STME OUT BUILDUP/SHUTDOWN PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	-8.3	219.4	-20.8	-1015	-3.8	-227.1
M2	-340.1	-18.5	-88.5	-1274	-260.5	-325.8
M3	237	123.7	206.5	-696.5	-76.8	23
M4	268.3	82.9	316.5	-1008	-144.8	23.8
M5	-190	1.6	-86.6	-1021	-220.6	-224.7
M6	102.8	264.5	10	-1296	-19.4	-317.6
M7	272	66.5	212.7	-697.4	-123.9	18.1
M8	181.1	145.4	306.7	-957	-95.8	-6.5

NLS1 WITH OUT STME OUT BUILDUP/SHUTDOWN PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	-203.7	185.5	-60	-855.2	44.7	-188.9
M2	-354.8	-60.3	-115.1	-1070	-218.3	-312.5
M3	76.7	94.1	169.5	-542.8	-92	52.7
M4	16.2	36.4	302.7	-908.9	-120.2	85.2
M5	-274.1	-47.8	-87.5	-850.3	-182.9	-192
M6	-164	220.8	-48.2	-1074	41.8	-257.9
M7	65.6	27.9	197.7	-612	-99.5	56.7
M8	26.3	107.5	239.6	-730.9	-39.7	43.5

NLS1 Buildup/Shutdown Accelerations (G's)

	W/STME Out		W/O STME Out	
	Maximum	Minimum	Maximum	Minimum
Node 7 Payload 1 30K X-Dir	5.091	-3.338	2.872	-0.804
Node 7 Payload 1 30K Y-Dir	1.659	-1.639	0.1317	-0.1351
Node 7 Payload 1 30K Z-Dir	1.756	-1.763	0.0403	-0.045
Node 90 Payload 2 40K X-Dir	3.255	-2.057	2.351	0.0082
Node 90 Payload 2 40K Y-Dir	1.811	-1.799	0.0801	-0.08315
Node 90 Payload 2 40K Z-Dir	2.278	-2.264	0.02179	-0.02411
Node 12 Payload 3 30K X-Dir	3.882	-2.255	2.425	-0.25
Node 12 Payload 3 30K Y-Dir	2.306	-2.301	0.03563	-0.0373
Node 12 Payload 3 30K Z-Dir	2.66	-2.671	0.01366	-0.0153
Node 80 LO2 Slosh X-Dir	1.4923	0.4544	1.2088	0.7926
Node 81 LH2 Slosh X-Dir	2.686	2.659	1.7006	0.2734
Node 45 FPM X-Dir	5.566	-3.802	3.072	-1.01
Node 45 FPM Y-Dir	4.702	-4.674	0.1805	-0.184
Node 45 FPM Z-Dir	4.991	-5.013	0.06435	-0.06511
Node 46 CTV X-Dir	3.813	-1.559	2.112	-0.213
Node 46 CTV Y-Dir	1.341	-1.343	0.009897	-0.008607
Node 46 CTV Z-Dir	1.807	-1.819	0.009266	-0.01045

NLS1 Prelaunch Core Interface Loads (kips)

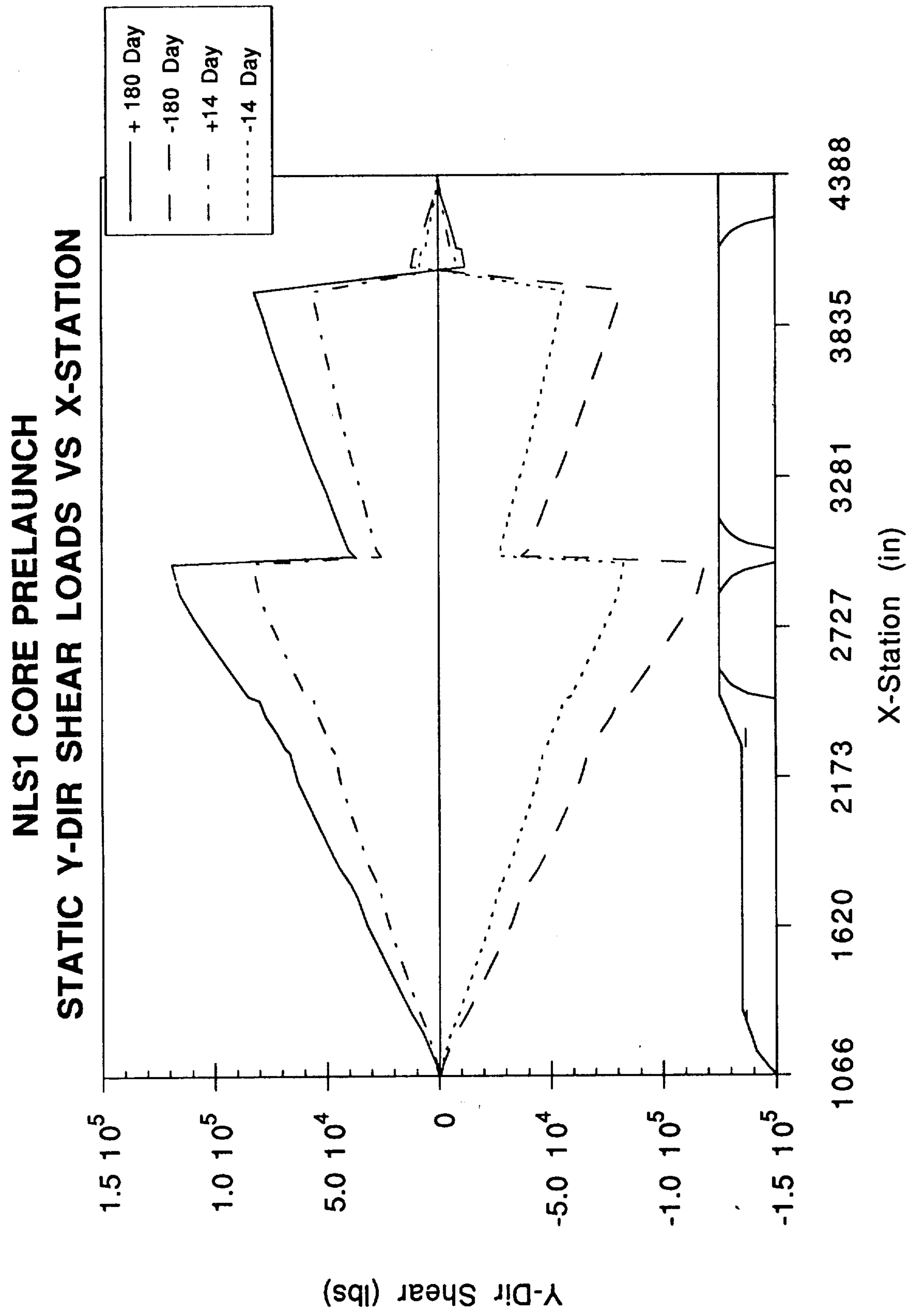
Location		With STME Out		Without STME Out		Allowable	Allowable
		Maximum	Minimum	Maximum	Minimum	(Max)	(Min)
Fwd Attach +y	FTB6	218.1	-1348	174.4	-1315	156	-1725
Fwd Attach +y	FTB4	142.4	-205.8	16.83	-111.6	86	-219
Fwd Attach +y	FTB2	64.26	-129.3	3.086	-68.9	204	-206
Fwd Attach -y	FTB5	418.6	-1332	315.4	-1111	178	-1754
Fwd Attach -y	FTB3	175	-147.4	92.32	-30.94	212	-95
Fwd Attach -y	FTB1	59.36	-127.6	3.644	-68.6	207	-190
Aft Attach +y	FTB10	86.38	-102	43.41	-35.07	188	-206
Aft Attach +y	FTB8*	79.48	-70.6	12.53	-7.795	245	-224
Aft Attach +y	FTBB	91.58	-125.6	40.53	-32.02	253	-121
Aft Attach +y	FTB8**	12.27	-8.783	3.067	-3.877	245	-224
Aft Attach -y	FTB9	103.7	-83.24	24.43	-47.53	216	-179
Aft Attach -y	FTB7*	84.39	-69.91	12.25	-7.619	247	-238
Aft Attach -y	FTBA	120.5	-94.58	29.76	-47.92	98	-209
Aft Attach -y	FTB7**	11.78	-9.071	2.856	-4.587	247	-233

*upper aft attach
**lower aft attach

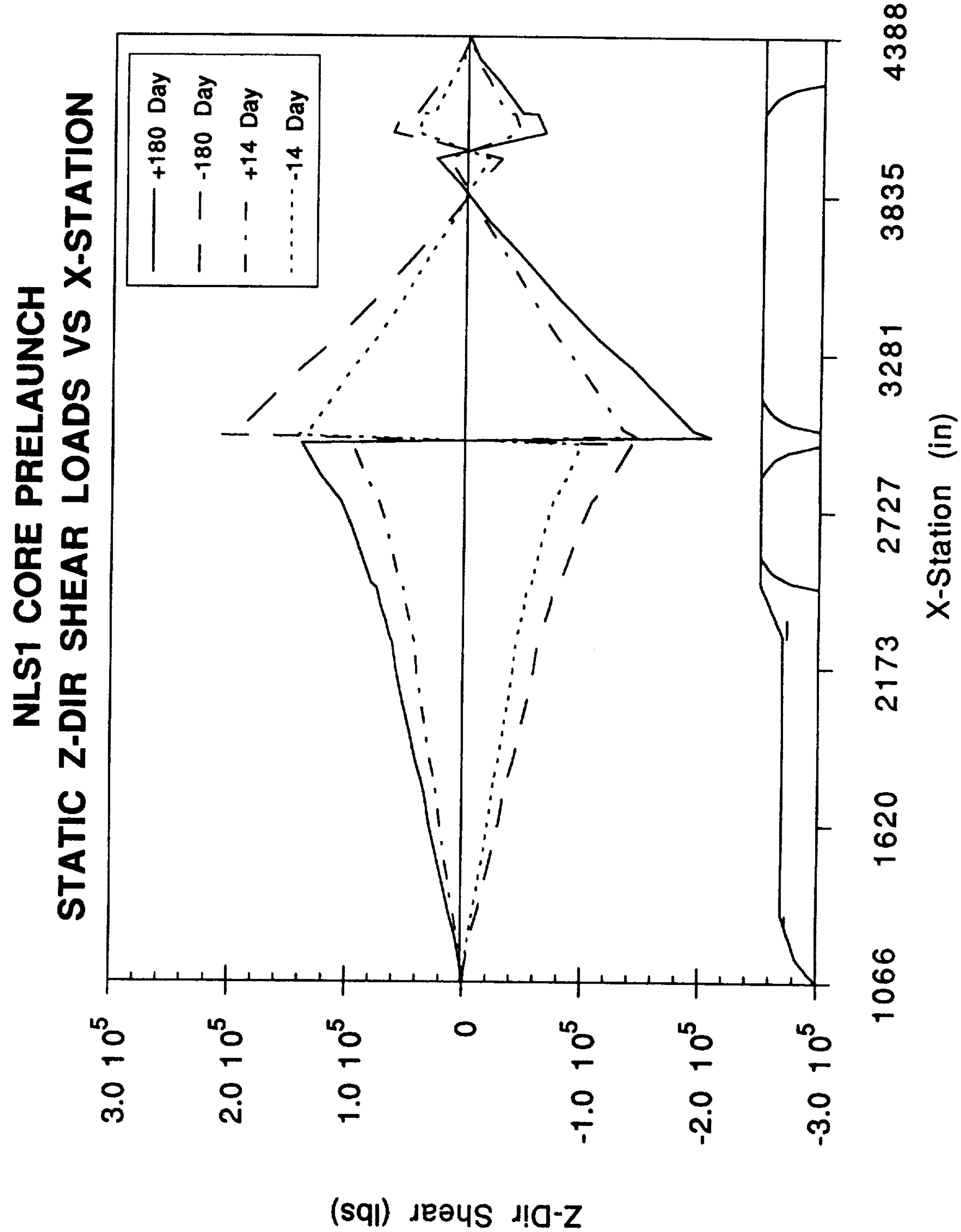
NLS1 GROUND WIND LOADS

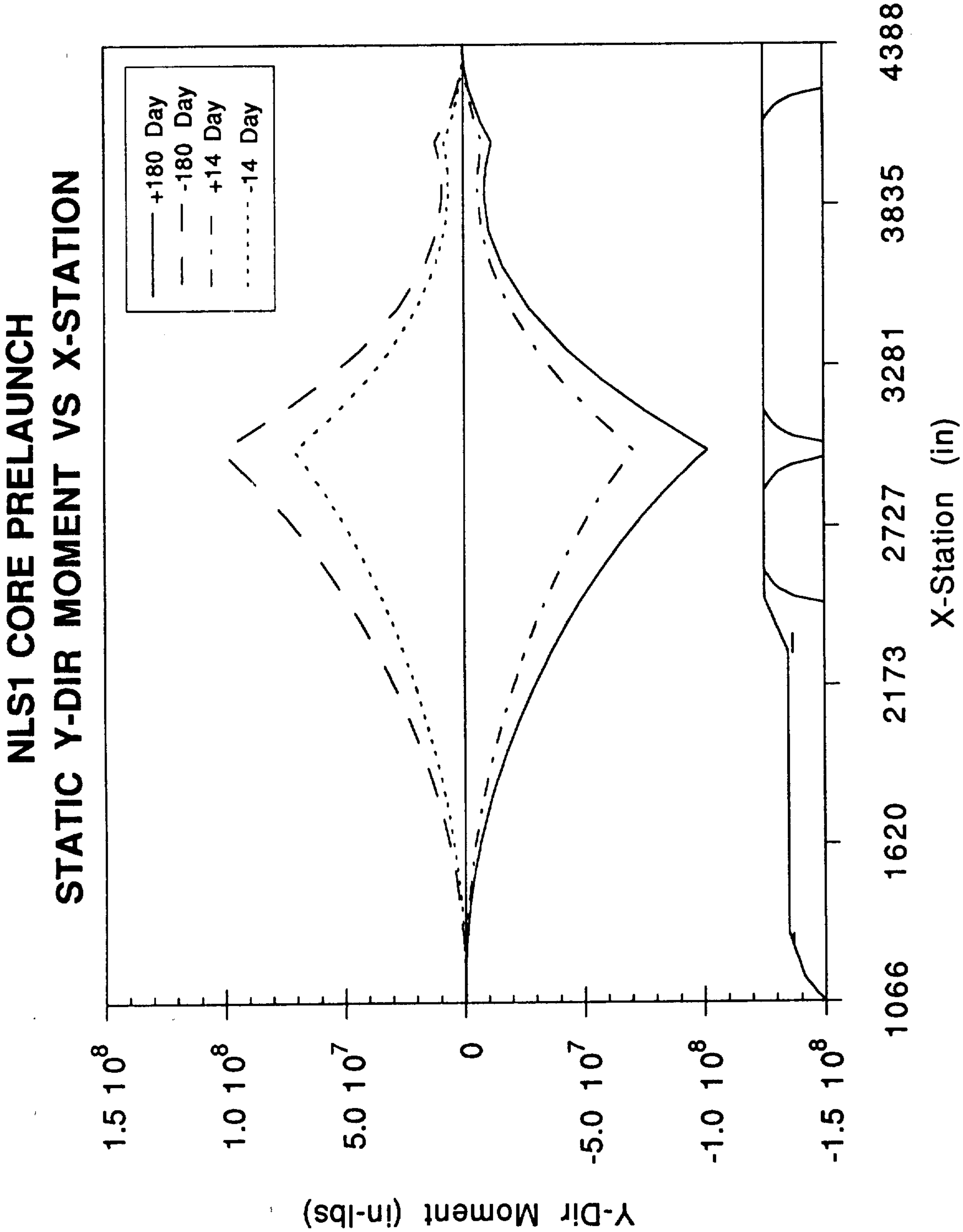
UNFUELED, UNPRESSURIZED, ON PAD WITH SIDE AND BROADSIDE WINDS

	14-Day Wind					180-Day Wind			
	X-Station (in)	Shear Forces Z-Direction (lbs)	Moment About Y-Axis (in-lbs)	Shear Forces Y-Direction (lbs)	Moment About Z-Axis (in-lbs)	Shear Forces Z-Direction (lbs)	Moment About Y-Axis (in-lbs)	Shear Forces Y-Direction (lbs)	Moment About Z-Axis (in-lbs)
	1066.06	195.16	0	251.88	0	278.19	0	359.06	0
	1110.6	886.25	-8692.4264	1066.81	-11218.7352	1263.61	-12390.5826	1521.06	-15992.5324
	1155.1	2340.75	-48130.5514	2686.61	-58691.7802	3338.31	-68621.2276	3831.66	-83679.7024
	1229.75	4699.75	-222867.5389	5252.01	-259247.2167	6705.01	-317826.0691	7492.96	-369713.1214
	1304.4	8165.65	-573703.8764	8967.31	-651309.7632	11654.81	-818355.0656	12799.06	-929062.5854
	1411	12343.55	-1444162.166	13437.61	-1607225.009	17626.21	-2060757.812	19188.46	-2293442.381
	1518	16504.15	-2764922.016	17889.51	-3045049.279	23578.31	-3946762.282	25557.26	-4346607.601
	1625	20639.15	-4530866.066	22314.11	-4959226.849	29499.31	-6469641.452	31892.86	-7081234.421
	1732	23702.25	-6739255.116	25591.81	-7346836.619	33889.11	-9626067.622	36590.06	-10493770.44
	1784.4	25749.15	-7981253.016	27782.11	-8687847.463	36824.61	-11401856.99	39731.06	-12411089.59
	1839	28826.65	-9387156.606	31075.11	-10204750.67	41241.01	-13412480.69	44456.66	-14580405.46
	1946	32837.35	-12471608.16	35366.71	-13529787.44	47001.51	-17825268.76	50620.56	-19337268.08
	2050.8	36861.95	-15912962.44	39673.21	-17236218.65	52788.11	-22751027.01	56812.36	-24642302.77
	2160	40851.65	-19938287.38	43942.31	-21568533.18	58530.41	-28515488.62	62956.86	-30846212.48
	2264.4	43178.95	-24203199.64	46428.71	-26156110.34	61882.61	-34626063.43	66538.36	-37418908.67
	2284.8	44732.55	-25084050.22	48025.21	-27103256.03	64121.91	-35888468.67	68839.56	-38776291.21
	2340.68	47285.75	-27583705.11	50584.51	-29786904.76	67803.71	-39471601	72530.16	-42623045.82
	2396.57	50376.35	-30226505.68	53675.11	-32614073.03	72263.31	-43261150.35	76989.76	-46676756.46
	2459.17	52580.45	-33380065.19	55879.21	-35974134.91	75445.31	-47784833.56	80171.76	-51496315.44
	2473.8	55913.85	-34149317.17	59212.61	-36791647.75	80260.61	-48888598.44	84987.06	-52669228.29
	2569.8	61625.25	-39517046.77	64924.01	-42476058.31	88517.61	-56593617	93244.06	-60827986.05
	2664.13	67247.45	-45330156.6	70542.91	-48600340.18	96654.81	-64943483.15	101376.46	-69623698.23
	2758.47	74066.75	-51674281.04	75819.41	-55255358.31	106540.01	-74061897.93	109020.96	-79187553.47
	2852.8	86534.75	-58660997.56	80263.81	-62407403.25	124638.01	-84111817.07	115466.76	-89471500.62
	2963.42	97386.75	-68233471.61	82623.81	-71286185.91	140400.01	-97899273.74	118893.86	-102244433.6
Fwd Attach	2990.67	-143721.0031	-70887260.55	25542.90794	42541399.74	-208171.5533	-101725174	37072.30167	61870279.89
	3012.52	-132770.0031	-67746956.9	27678.10794	41983287.2	-192180.5533	-97176625.57	40177.70167	61060250.1
	3123.15	-114389.0031	-53058612.8	31214.90794	38921258.12	-165363.5533	-75915690.96	45327.30167	56615390.96
	3233.63	-96725.00307	-40420917.09	34604.00794	35472635.09	-139602.5533	-57646325.58	50269.90167	51607630.67
	3337.35	-76614.00307	-30388601.03	38462.20794	31883507.38	-110218.5533	-43166748.75	55907.10167	46393636.47
	3480.57	-53606.00307	-19415945.26	42875.70794	26374949.96	-76531.55333	-27381247.55	62369.00167	38386621.37
	3623.8	-32501.00307	-11737959.18	46917.10794	20233862.31	-45560.55333	-16419633.16	68299.70167	29453509.26
	3747.4	-13271.00307	-7720836.704	50577.10794	14434907.77	-17271.55333	-10788348.77	73683.70167	21011666.14
	3871	3365.996931	-6080542.229	53723.90794	8183577.227	7257.446668	-8653584.778	78323.10167	11904360.61
	3964.5	17198.99693	-6395264.08	56325.60794	3160391.834	27695.44667	-9332156.041	82166.90167	4581150.603
Aft Attach	4054	-43561.91927	-7934575.394	-8127.331459	-1880750.077	-64773.66978	-11810898.52	-12084.68992	-2772787.096
	4118.65	-38458.31927	-5118297.601	-7173.101459	-1355318.098	-57210.76978	-7623280.767	-10670.68992	-1991511.893
	4122.65	-30001.41927	-4964464.342	-5595.001459	-1326625.692	-44660.76978	-7394437.688	-8328.789917	-1948829.133
	4233.27	-16365.41927	-1645707.835	-3051.801459	-707706.6309	-24392.76978	-2454063.335	-4548.589917	-1027498.392
	4309.4	-5423.419275	-399808.8053	-1011.001459	-475372.9859	-8090.769776	-597041.7722	-1508.189917	-681214.2421
	4385.5	-3.71927485	12913.06214	-0.20145911	-398435.7748	-5.3697761	18665.80778	-0.28991746	-566440.9894



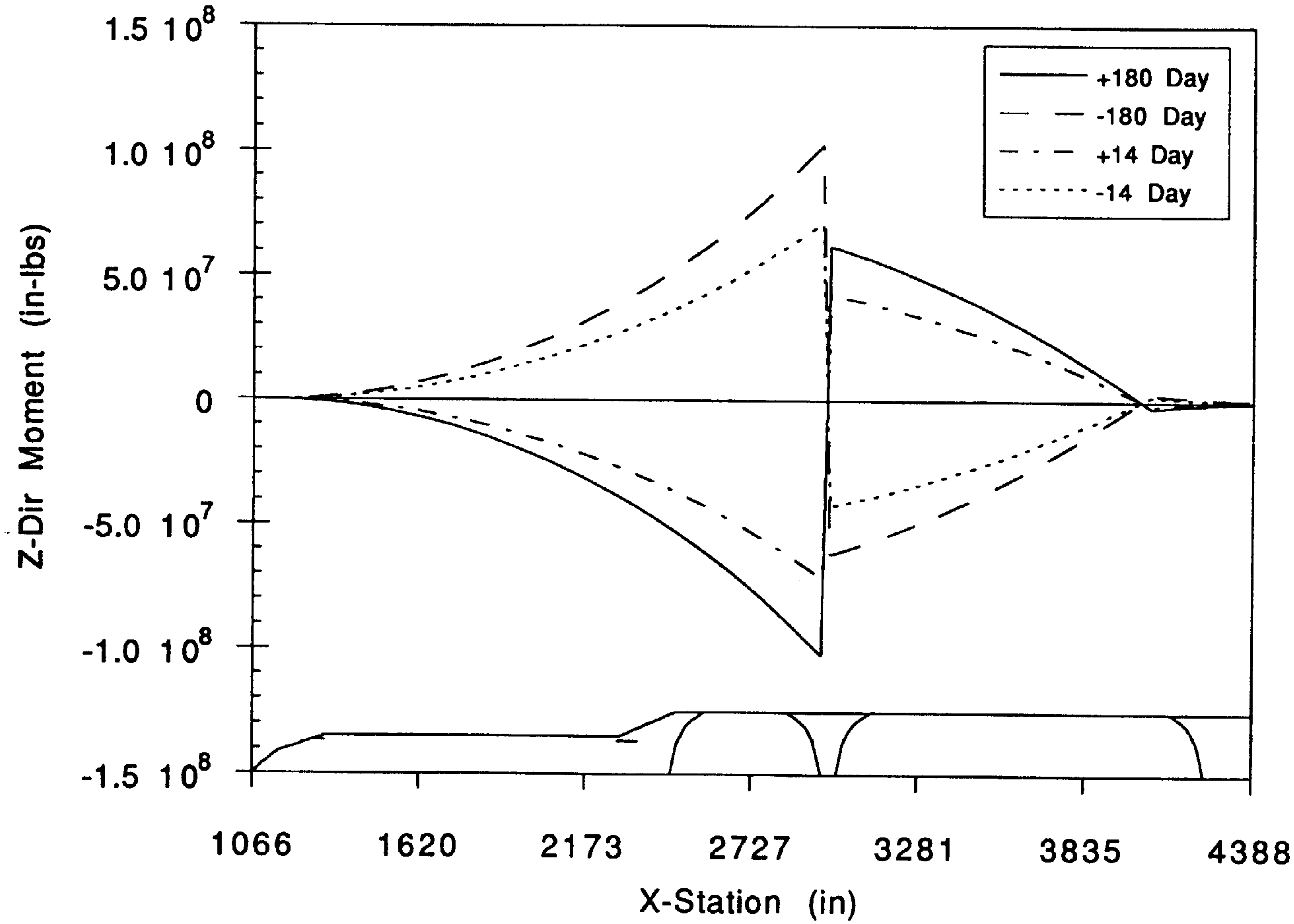
NLS1 CORE PRELAUNCH
STATIC Y-DIR SHEAR LOADS VS X-STATION
+ 180 Day
-180 Day
+14 Day
-14 Day
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Y-Dir Shear (lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS1 CORE PRELAUNCH
STATIC Z-DIR SHEAR LOADS VS X-STATION
+180 Day
-180 Day
+14 Day
-14 Day
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
Z-Dir Shear (lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



NLS1 CORE PRELAUNCH
STATIC Y-DIR MOMENT VS X-STATION
+180 Day
-180 Day
+14 Day
-14 Day
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
Y-Dir Moment (in-lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

NLS1 CORE PRELAUNCH
STATIC Z-DIR MOMENT VS X-STATION



NLS1 COMPOSITE SHEAR BODY LOADS W/STME OUT (LBS)

BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	118.4	-73.7	384.8	-231.7	343.8	-235.7
1110.6	1762	-1097	3547	-2999	3422	-3069
1155.1	4757	-2957	8712	-7248	8534	-7452
1229.75	10560	-6535	16260	-13080	16200	-13540
1304.4	40380	-24810	41570	-35830	43080	-37510
1411	50010	-30550	47040	-38370	49020	-40660
1518	219500	-128700	65480	-54420	78930	-67650
1625	227300	-132500	69080	-55130	81670	-67660
1732	233700	-134900	69860	-53800	81220	-65200
1784.4	371700	-173600	109200	-92230	116700	-99170
1839	376900	-174500	110600	-93660	120400	-100900
1946	381300	-174100	111700	-92640	122500	-100300
2050.8	455500	-144100	112700	-90880	133700	-134500
2160	460900	-142100	116400	-91770	133700	-134500
2264.4	465800	-139700	119200	-91750	133000	-133700
2284.8	548400	-138300	114000	-83810	139100	-123400
2340.68	551400	-138800	115300	-83460	141400	-122900
2396.57	554000	-139200	116700	-82900	143500	-122400
2459.17	676800	-142100	238300	-202100	311400	-273600
2473.8	801400	-154900	405500	-366500	521900	-480700
2569.8	912900	-144600	402000	-358600	460400	-415000
2664.13	1005000	-123900	284200	-280500	321300	-298500
2758.47	1059000	-103700	299800	-297500	427100	-374700
2852.8	1070000	-68050	290500	-237000	314000	-312800
2963.42	2435000	880900	331000	-276700	262100	-262400
2990.67	1949000	-685700	245600	-239200	263300	-334500
3012.52	1955000	-673400	232100	-224900	249800	-317700
3123.15	1954000	-659500	202000	-193800	205600	-269300
3233.63	1955000	-649200	175400	-166300	175900	-233300
3337.35	1960000	-638000	167600	-160700	178000	-228600
3480.57	1967000	-625900	163000	-156200	170300	-214600
3623.8	1973000	-613000	147300	-141100	179500	-216600
3747.4	1978000	-599500	170400	-158700	175800	-206300
3871	1984000	-585300	166500	-155000	204900	-229300
3964.5	1990000	-570800	156100	-152400	222000	-241200
4054	1996000	-555500	246700	-251400	230200	-256200
4118.65	2003000	-538800	218400	-222200	209400	-232400
4122.65	2009000	-522300	249600	-252400	229800	-248900
4233.27	2197000	-210200	246500	-247800	231600	-244700
4309.4	2224000	-131100	202700	-203000	191900	-199100
4385.5	6980	-21410	12490	-12430	1999	-2142

NLS1 COMPOSITE MOMENT BODY LOADS W/STME OUT (IN-LBS)

BUILD-UP AND SHUT-DOWN

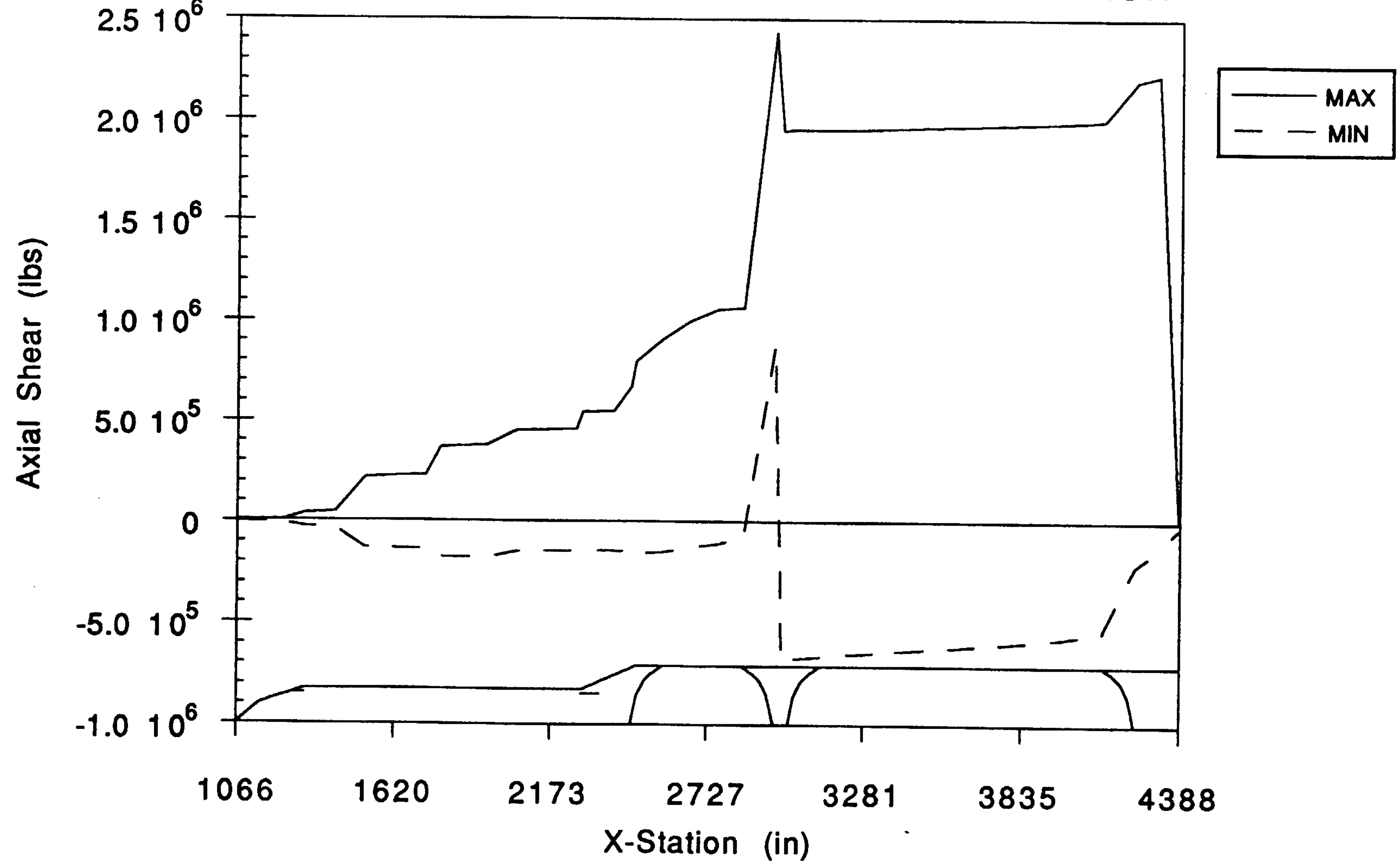
X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	44860	-44780	0	0	0	0
1110.6	61030	-60800	15310	-10500	17140	-10320
1155.1	73650	-73260	167600	-147100	175000	-143800
1229.75	82830	-82260	804700	-703400	825300	-684800
1304.4	140400	-135300	2608000	-2297000	2602000	-2215000
1411	191500	-184200	7196000	-6212000	7034000	-5999000
1518	563200	-540200	23960000	-23410000	23380000	-22410000
1625	608400	-583300	28960000	-25840000	26810000	-23690000
1732	649400	-622400	35040000	-30410000	30730000	-26120000
1784.4	943700	-901500	45160000	-39670000	35850000	-30380000
1839	980200	-936000	44550000	-38140000	36040000	-29630000
1946	1011000	-965200	43520000	-35060000	36650000	-28480000
2050.8	1214000	-1198000	44810000	-39110000	39470000	-30190000
2160	1250000	-1234000	40880000	-41450000	43010000	-32060000
2264.4	1286000	-1269000	50290000	-50150000	50790000	-36990000
2284.8	1674000	-1643000	62130000	-62730000	59080000	-43500000
2340.68	1741000	-1707000	66500000	-67080000	65350000	-48090000
2396.57	1807000	-1772000	71630000	-71540000	71730000	-52690000
2459.17	2001000	-1958000	80300000	-76860000	78970000	-57810000
2473.8	2128000	-2081000	81090000	-76290000	79070000	-57390000
2569.8	2252000	-2201000	80380000	-66040000	70960000	-45540000
2664.13	2372000	-2318000	92760000	-80540000	87750000	-58080000
2758.47	2489000	-2431000	113800000	-78520000	105300000	-71060000
2852.8	2774000	-2708000	111800000	-70830000	103500000	-64320000
2963.42	3047000	-2975000	111000000	-69550000	103600000	-62180000
2990.67	2752000	-2712000	108600000	-67980000	85750000	-108100000
3012.52	2940000	-2954000	103900000	-67120000	85440000	-107500000
3123.15	3139000	-3183000	79130000	-63680000	83720000	-104200000
3233.63	3271000	-3296000	74670000	-70690000	82050000	-100900000
3337.35	3394000	-3403000	74720000	-74520000	80710000	-98830000
3480.57	3505000	-3500000	78260000	-74710000	84830000	-98340000
3623.8	3604000	-3587000	87560000	-84330000	87290000	-99300000
3747.4	3692000	-3665000	93310000	-88290000	88590000	-99040000
3871	3769000	-3734000	95360000	-92960000	89530000	-97740000
3964.5	3837000	-3795000	95950000	-96750000	95520000	-100700000
4054	3649000	-3448000	103900000	-106300000	107500000	-107600000
4118.65	3470000	-3280000	101900000	-104100000	100600000	-101700000
4122.65	3290000	-3111000	101600000	-103800000	100200000	-101300000
4233.27	3068000	-2903000	90180000	-91770000	89460000	-90890000
4309.4	3011000	-2850000	80880000	-81800000	83930000	-85290000
4385.5	217000	-219900	1438000	-1366000	11310000	-11760000

NLS1 COMPOSITE LINE BODY LOADS W/STME OUT

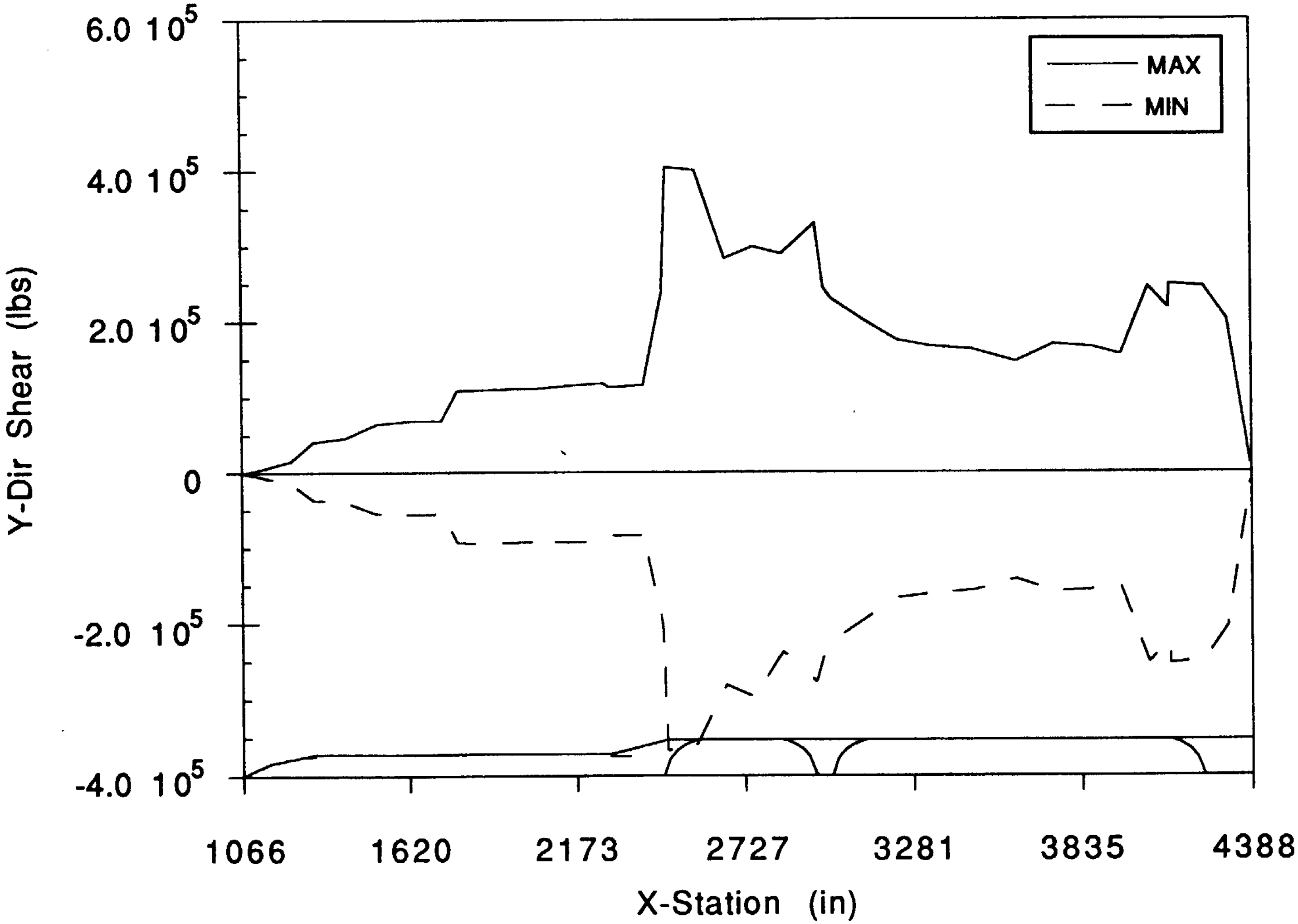
BUILD-UP AND SHUT-DOWN

X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1066.06	0	0	0	0	0	0	0	0
1110.6	9.68	-3.318	9.68	-3.318	9.68	-3.318	2129	-729.6
1155.1	15.23	-5.231	15.23	-5.231	15.23	-5.231	5741	-1972
1229.75	25.25	-8.747	25.25	-8.747	25.25	-8.747	12690	-4397
1304.4	98.3	-23.17	59.54	-39.57	59.54	-39.57	37410	-24870
1411	94.62	-33.52	94.62	-33.52	94.62	-33.52	59450	-21060
1518	885.7	-63.06	273.2	-435	273.2	-435	171700	-273300
1625	414.6	-157.7	414.6	-157.7	414.6	-157.7	260500	-99070
1732	423.4	-162.8	423.4	-162.8	423.4	-162.8	266000	-102300
1784.4	1054	-168	428.8	-472.3	428.8	-472.3	269400	-296700
1839	596.5	-282.2	596.5	-282.2	596.5	-282.2	374800	-177300
1946	601.1	-283.8	601.1	-283.8	601.1	-283.8	377700	-178300
2050.8	885.7	-143.4	606	-498.4	606	-498.4	380700	-313100
2160	690.9	-273.3	690.9	-273.3	690.9	-273.3	434100	-171700
2264.4	699.3	-268.7	699.3	-268.7	699.3	-268.7	439400	-168800
2284.8	1492	-112.2	563.3	-1457	563.3	-1457	376500	-973600
2340.68	691.7	-197.6	691.7	-197.6	691.7	-197.6	538300	-153800
2396.57	609.8	-172.8	609.8	-172.8	609.8	-172.8	541600	-153400
2459.17	699.1	-111.2	699.1	-111.2	699.1	-111.2	706800	-112400
2473.8	837.8	-82.21	837.8	-82.21	837.8	-82.21	871200	-85480
2569.8	940.4	-76.17	940.4	-76.17	940.4	-76.17	977800	-79210
2664.13	976.4	-107.8	976.4	-107.8	976.4	-107.8	1015000	-112100
2758.47	960.3	-154.3	960.3	-154.3	960.3	-154.3	998600	-160500
2852.8	930.2	-159.8	930.2	-159.8	930.2	-159.8	967200	-166200
2963.42	2278	775.9	2278	775.9	2278	775.9	2369000	806800
2990.67	3056	-490	1799	-1414	1799	-1414	1871000	-1471000
3012.52	1831	-647.9	1831	-647.9	1831	-647.9	1904000	-673700
3123.15	1861	-634.1	1861	-634.1	1861	-634.1	1935000	-659400
3233.63	1893	-623.7	1893	-623.7	1893	-623.7	1968000	-648600
3337.35	1949	-612.4	1949	-612.4	1949	-612.4	2027000	-636800
3480.57	2003	-600.3	2003	-600.3	2003	-600.3	2083000	-624300
3623.8	2046	-587.6	2046	-587.6	2046	-587.6	2127000	-611000
3747.4	2073	-574.4	2073	-574.4	2073	-574.4	2155000	-597300
3871	2077	-560.8	2077	-560.8	2077	-560.8	2160000	-583200
3964.5	2058	-547.1	2058	-547.1	2058	-547.1	2140000	-569000
4054	2014	-533	2014	-533	2014	-533	2094000	-554200
4118.65	1944	-517.8	1944	-517.8	1944	-517.8	2022000	-538400
4122.65	1873	-502.7	1873	-502.7	1873	-502.7	1948000	-522800
4233.27	1947	-209.7	1947	-209.7	1947	-209.7	2024000	-218100
4309.4	1381	-141.6	1381	-141.6	1381	-141.6	1436000	-147200
4385.5	400.1	0.0007267	-0.0006737	-400.1	-0.0006737	-400.1	-0.7006	-416000

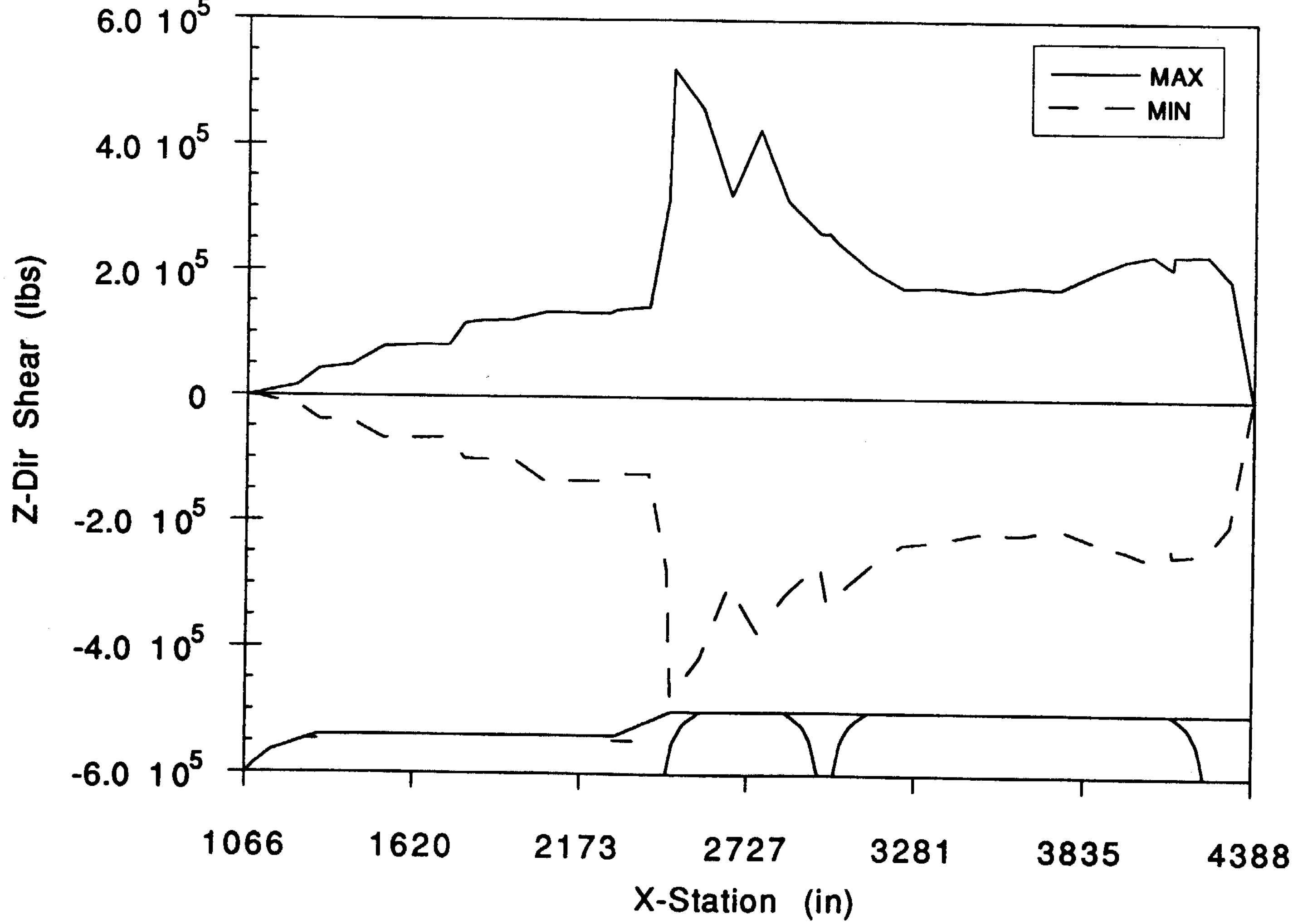
NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION

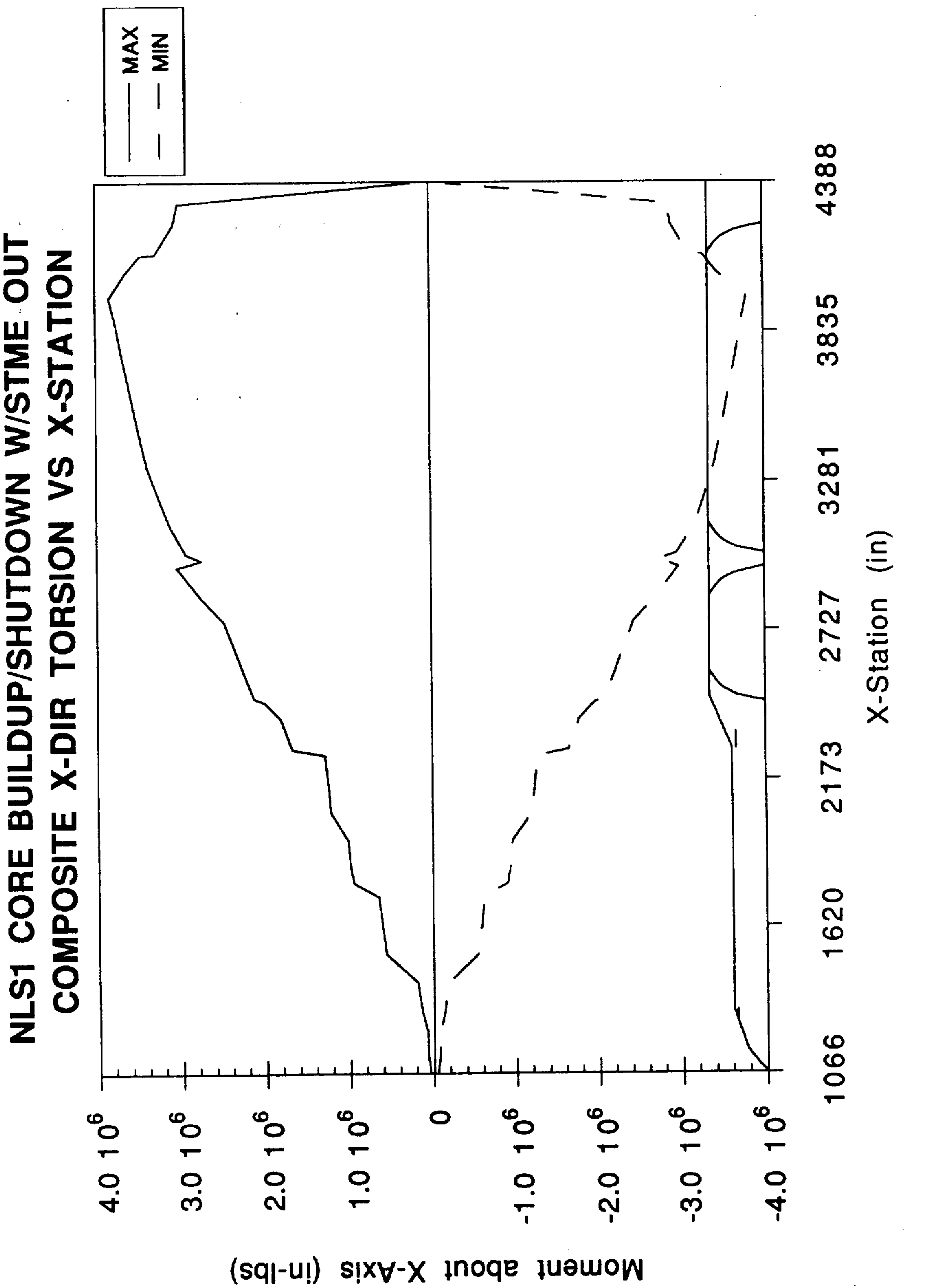


NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION

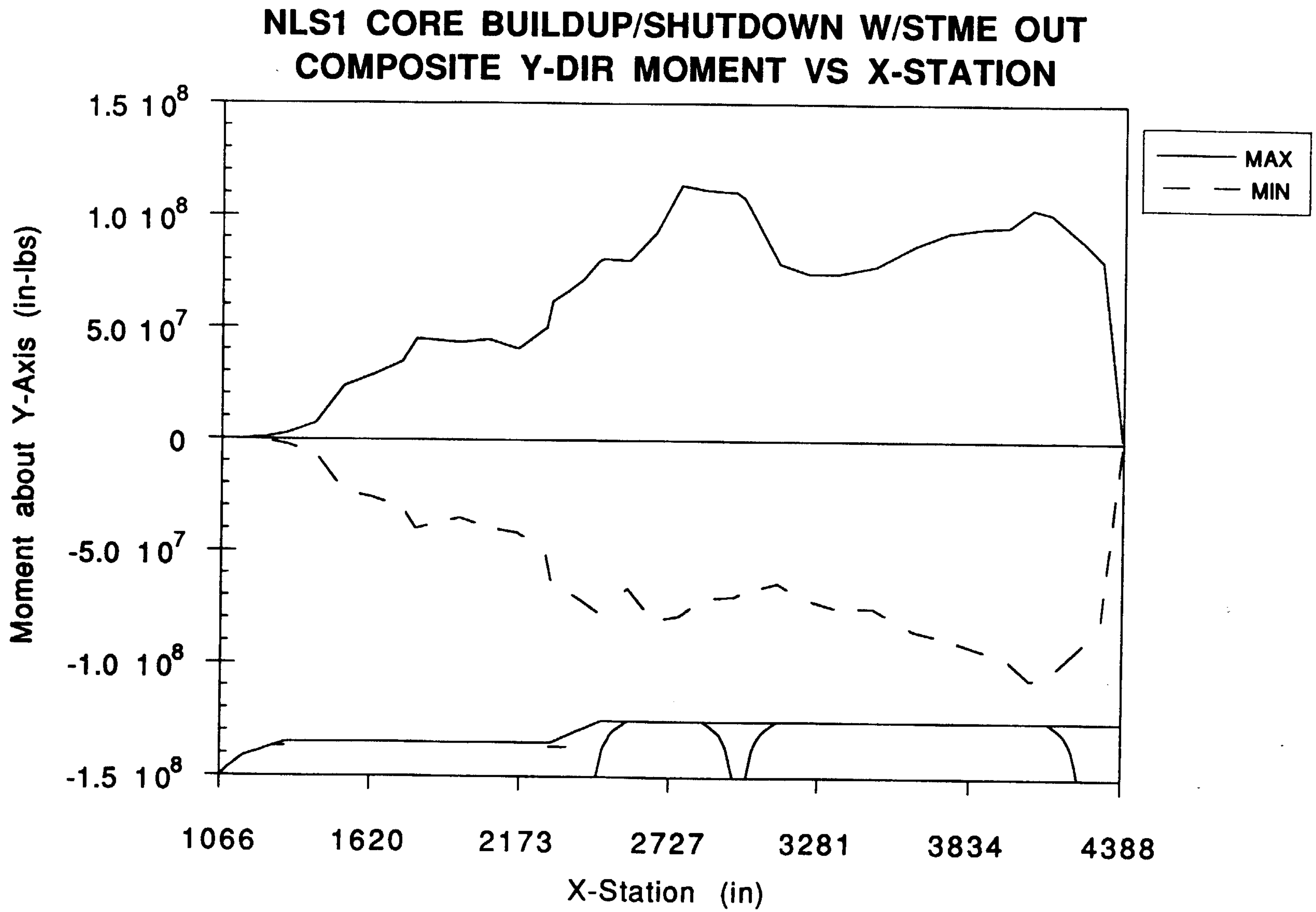


NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION

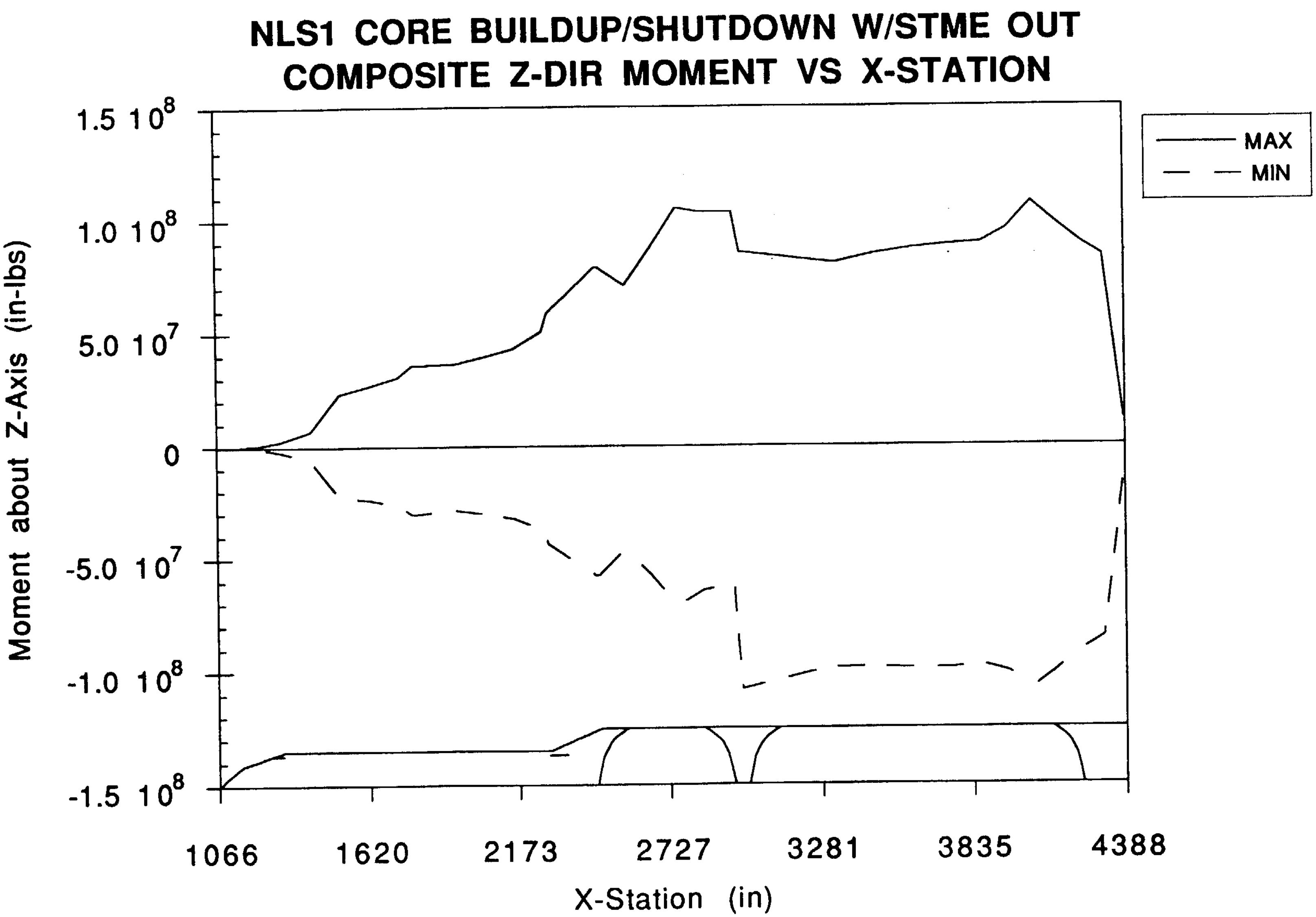




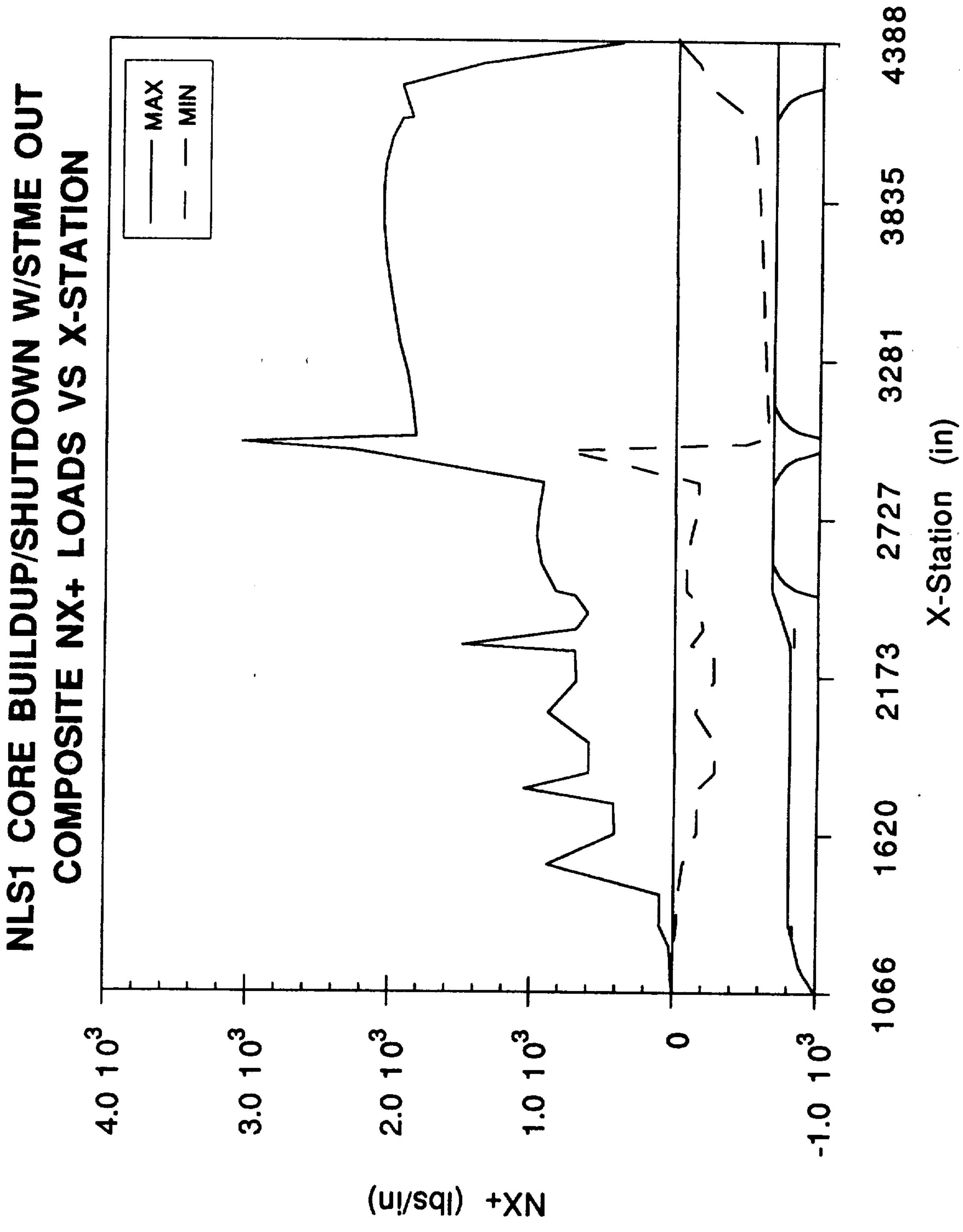
NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE X-DIR TORSION VS X-STATION
MAX
MIN
Moment about X-Axis (in-lbs)
4.0 10^6
3.0 10^6
2.0 10^6
1.0 10^6
0
-1.0 10^6
-2.0 10^6
-3.0 10^6
-4.0 10^6
X-Station (in)
1066
1620
2173
2727
3281
3835
4388

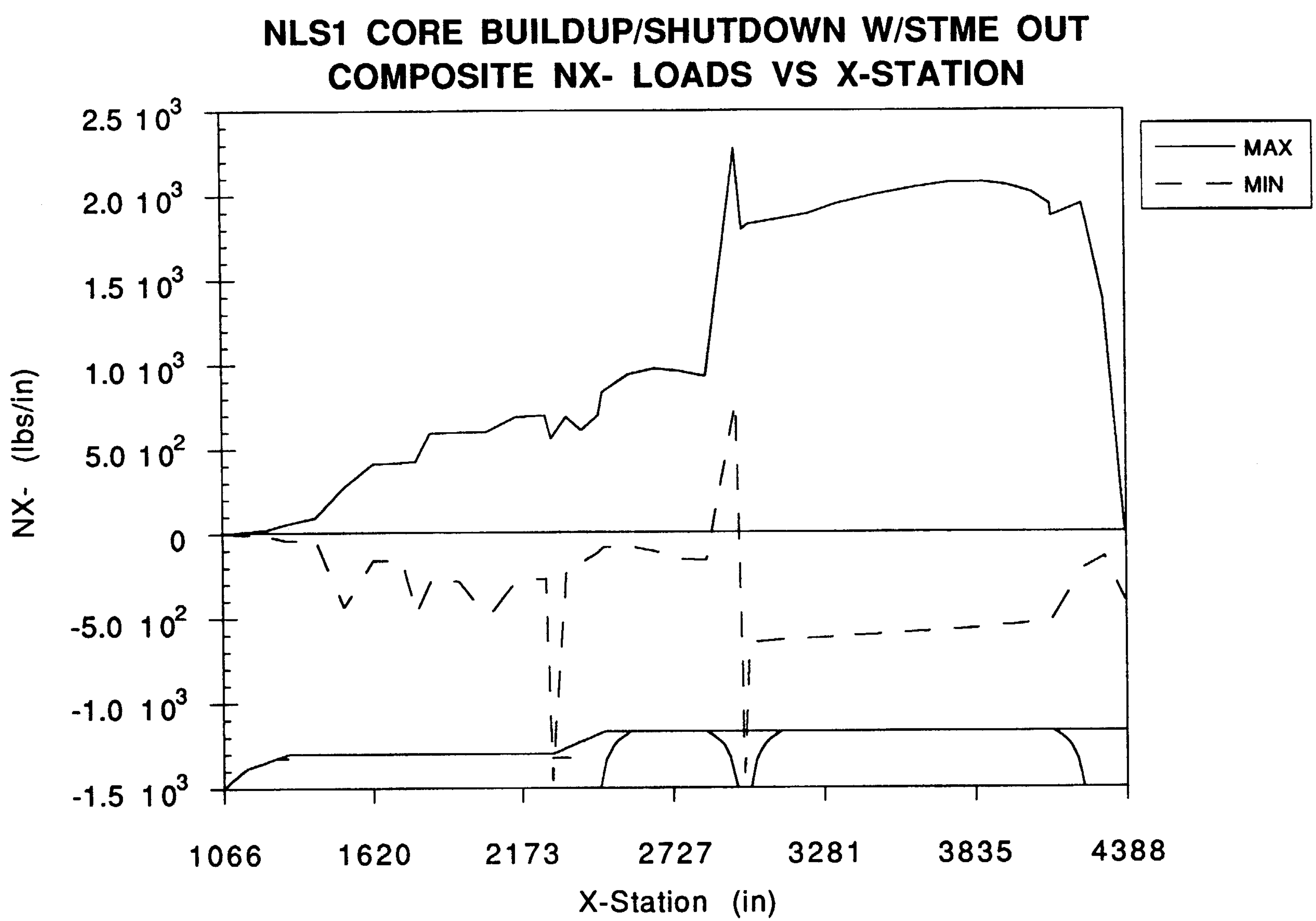


NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION
MAX
MIN
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
Moment about Y-Axis (in-lbs)
1066
1620
2173
2727
3281
3834
4388
X-Station (in)



NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION
MAX
MIN
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
Moment about Z-Axis (in-lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE NX+ LOADS VS X-STATION
MAX
MIN
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
NX+ (lbs/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS1 CORE BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE NX- LOADS VS X-STATION
2.5 10^3
2.0 10^3
1.5 10^3
1.0 10^3
5.0 10^2
0
-5.0 10^2
-1.0 10^3
-1.5 10^3
NX- (lbs/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)
MAX
MIN

NLS1 COMPOSITE SHEAR BODY LOADS W/O STME OUT (LBS)

BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	66.22	-17.1	24.25	-4.45	19.17	-1.682
1110.6	985.6	-254.5	335.4	-63.76	264.4	-23.76
1155.1	2660	-686.2	857.6	-167.6	674.6	-61.78
1229.75	5902	-1515	1734	-356.2	1357	-128.8
1304.4	22540	-5748	5761	-1278	4479	-448.9
1411	27890	-7071	6733	-1544	5202	-535.4
1518	121700	-29570	19280	-5724	14170	-1802
1625	126000	-30420	19750	-5916	14500	-1856
1732	129400	-30880	20130	-6072	14790	-1897
1784.4	201400	-38020	28810	-9418	21650	-2777
1839	204100	-38110	29170	-9540	21950	-2808
1946	206200	-37790	29520	-9629	22250	-2828
2050.8	235200	-32780	35330	-10750	27010	-3004
2160	236800	-32770	35580	-10780	27190	-3006
2264.4	238400	-32310	35760	-10800	27320	-3004
2284.8	274200	-28460	37860	-10890	28770	-2955
2340.68	276300	-28020	37940	-10900	28830	-2953
2396.57	278200	-27390	38000	-10890	28870	-2950
2459.17	373100	14230	44290	-9322	35620	-2877
2473.8	470800	52360	49820	-8039	42630	-3171
2569.8	548200	88450	51250	-6329	47650	-3658
2664.13	609200	122300	51200	-4695	50480	-3817
2758.47	662500	168500	54870	-6058	50970	-3681
2852.8	717800	243600	62670	-11960	53300	-3096
2963.42	1907000	1243000	74330	-18890	64100	-3491
2990.67	1833000	-509700	24210	-7031	3378	-73310
3012.52	1859000	-496600	25920	-7868	3246	-70980
3123.15	1916000	-477300	28280	-8718	3068	-66390
3233.63	1968000	-463300	30860	-9423	2879	-60480
3337.35	2027000	-453100	33800	-10050	2661	-53400
3480.57	2083000	-443400	36910	-10480	2433	-45780
3623.8	2127000	-433500	39800	-10670	2479	-38680
3747.4	2155000	-423700	42180	-10620	2513	-32320
3871	2160000	-414000	43870	-10320	2532	-26790
3964.5	2140000	-404400	44970	-9814	2993	-22590
4054	2094000	-394800	19060	-14960	7906	-21580
4118.65	2022000	-384700	19010	-12910	9890	-17670
4122.65	1948000	-374700	18900	-10860	11950	-13790
4233.27	2024000	-119400	17000	-8764	11950	-10480
4309.4	1436000	-80520	12860	-6047	9816	-6822
4385.5	0.0493	0.004476	1.201	-0.6032	1.053	-0.3609

NLS1 COMPOSITE MOMENT BODY LOADS W/O STME OUT (IN-LBS)

BUILD-UP AND SHUT-DOWN

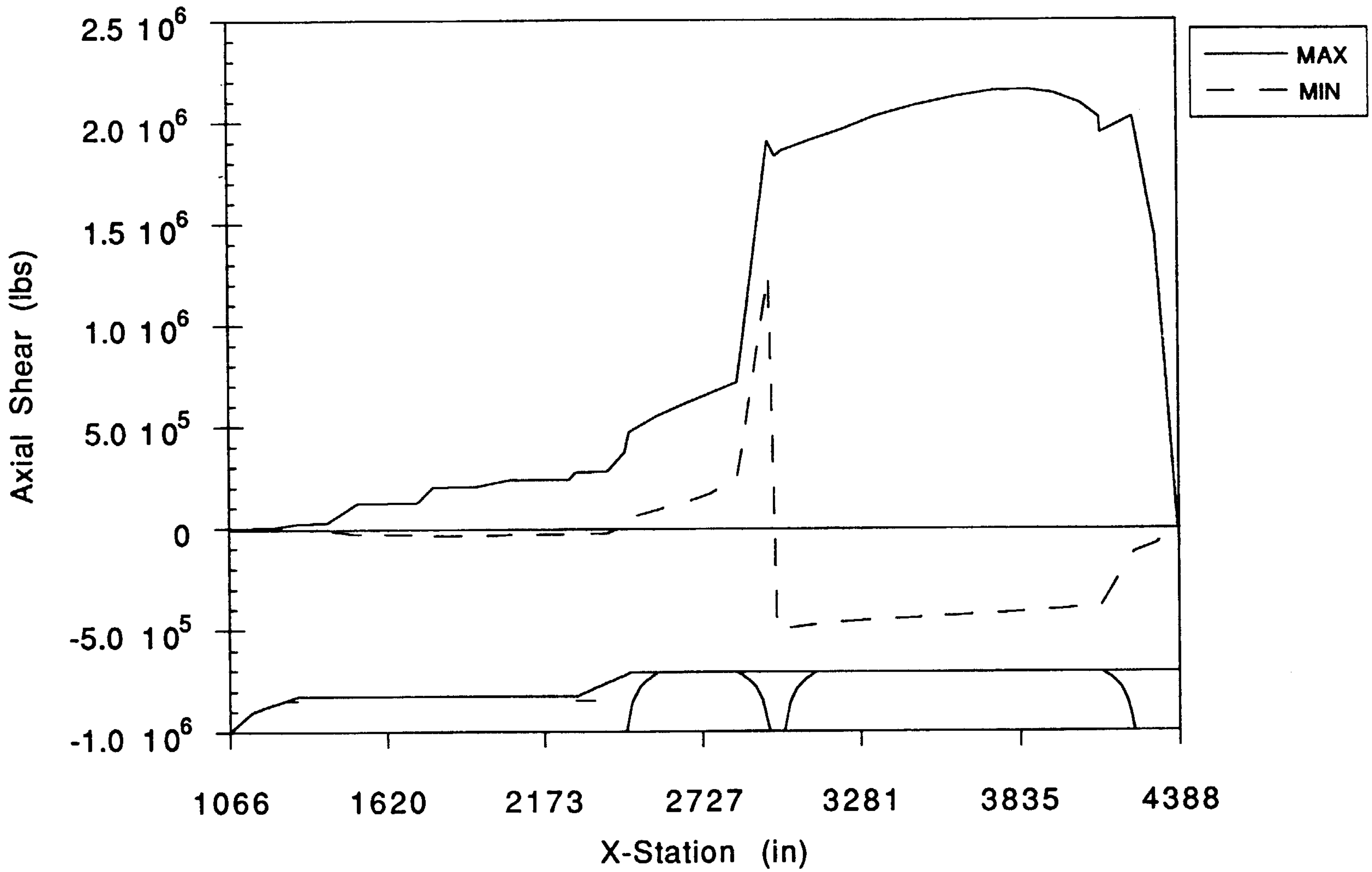
X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	352.6	-367	0.01801	-0.0004282	0.06722	-0.001604
1110.6	700.2	-671.6	854	-74.78	1080	-198.2
1155.1	1055	-972.6	12620	-1132	16010	-3035
1229.75	1422	-1274	62980	-5743	80020	-15550
1304.4	3001	-2631	234000	-22230	298200	-61580
1411	4260	-3723	711400	-70000	912200	-197800
1518	13640	-11910	2030000	-193500	2593000	-497300
1625	14850	-13000	3540000	-382800	4656000	-1110000
1732	16030	-14080	5087000	-580300	6769000	-1743000
1784.4	24730	-22370	5763000	-738000	7851000	-2186000
1839	25870	-23510	6945000	-874300	9423000	-2700000
1946	26970	-24670	9294000	-1158000	12540000	-3721000
2050.8	35330	-33440	11900000	-1479000	15830000	-4830000
2160	36470	-34580	14830000	-1806000	19690000	-6003000
2264.4	37590	-35680	17650000	-2118000	23400000	-7129000
2284.8	49590	-47470	19040000	-2214000	25270000	-7606000
2340.68	51660	-49500	20620000	-2379000	27380000	-8215000
2396.57	53730	-51510	22210000	-2544000	29500000	-8824000
2459.17	59780	-57320	24000000	-2728000	31880000	-9506000
2473.8	63760	-61140	24500000	-2764000	32530000	-9641000
2569.8	67720	-64860	28370000	-2957000	37290000	-10360000
2664.13	71650	-68490	32540000	-3124000	42010000	-10760000
2758.47	75560	-72020	36920000	-3286000	46470000	-10760000
2852.8	85310	-80650	41520000	-3435000	50530000	-10280000
2963.42	94980	-89080	47200000	-3578000	54860000	-9232000
2990.67	412600	-415600	48900000	-3607000	12540000	-39230000
3012.52	406300	-412300	47380000	-3547000	12400000	-38700000
3123.15	400000	-408900	40050000	-3252000	11550000	-35840000
3233.63	396800	-407400	33260000	-2980000	10600000	-32950000
3337.35	393500	-405900	27510000	-2745000	9640000	-30300000
3480.57	390100	-404700	20560000	-2452000	8227000	-26280000
3623.8	386700	-403600	14710000	-2195000	6758000	-21860000
3747.4	383300	-402300	10590000	-2014000	5474000	-17690000
3871	379900	-400800	7319000	-1889000	4208000	-13250000
3964.5	376500	-398800	5492000	-2142000	3290000	-9702000
4054	92870	-90880	4223000	-4120000	3392000	-6151000
4118.65	86120	-84330	2829000	-3618000	2425000	-4919000
4122.65	79380	-77790	2758000	-3578000	2374000	-4843000
4233.27	72420	-71010	1234000	-2257000	1172000	-2752000
4309.4	70790	-69410	436200	-1347000	505100	-1458000
4385.5	0.0004588	-3.942	2140	-907.5	3067	-2000

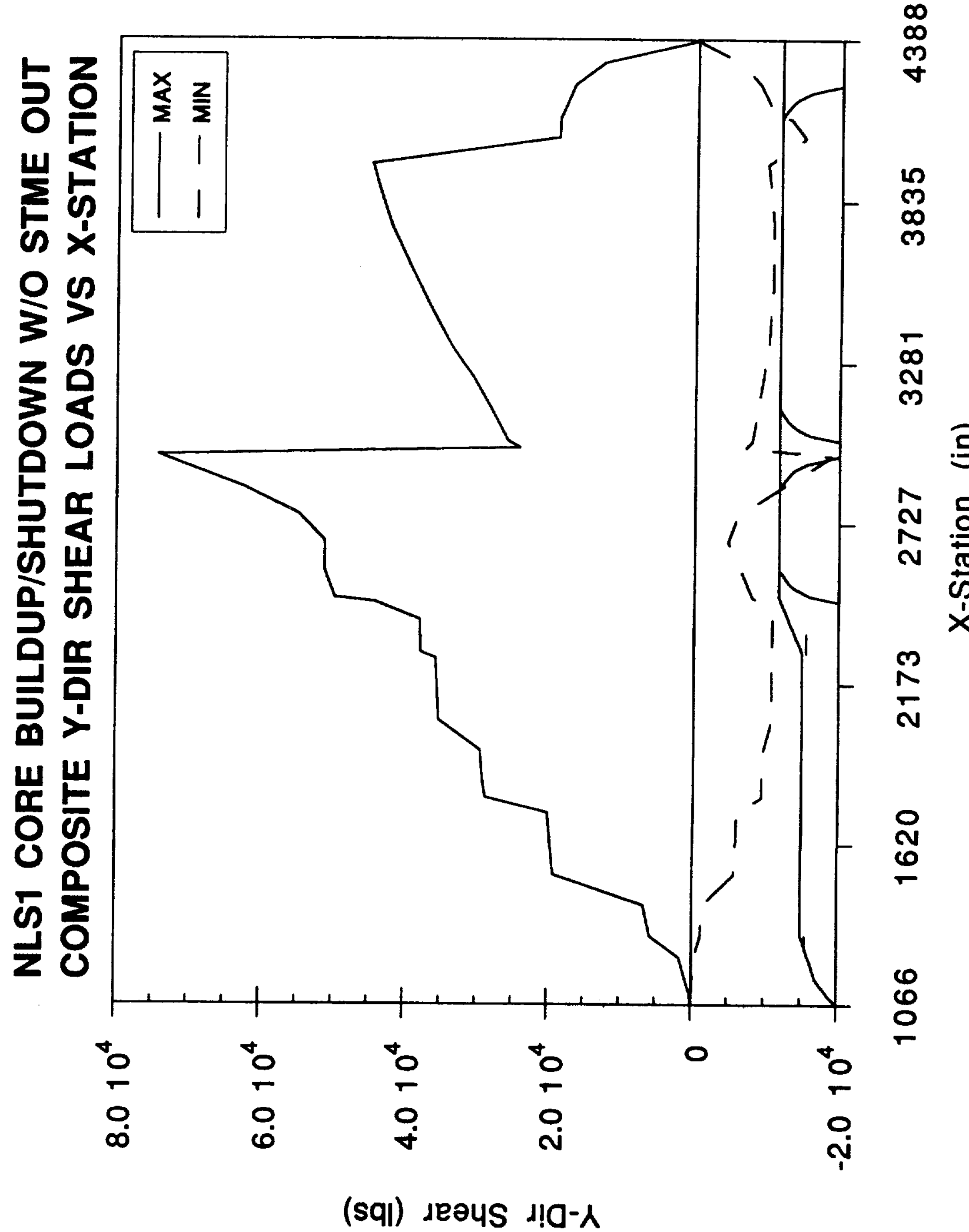
NLS1 COMPOSITE LINE BODY LOADS W/O STME OUT

BUILD-UP AND SHUT-DOWN

X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1066.06	0	0	0	0	0	0	0	0
1110.6	4.482	-1.157	4.482	-1.157	4.482	-1.157	985.6	-254.5
1155.1	7.057	-1.82	7.057	-1.82	7.057	-1.82	2660	-686.2
1229.75	11.74	-3.015	11.74	-3.015	11.74	-3.015	5902	-1515
1304.4	38.08	-9.131	35.83	-11.31	35.83	-11.31	22510	-7103
1411	44.39	-11.25	44.39	-11.25	44.39	-11.25	27890	-7071
1518	220	-46.97	193.5	-73.23	193.5	-73.23	121600	-46010
1625	200.5	-48.42	200.5	-48.42	200.5	-48.42	126000	-30420
1732	205.9	-49.15	205.9	-49.15	205.9	-49.15	129400	-30880
1784.4	325.1	-60.45	320.5	-65.12	320.5	-65.12	201300	-40910
1839	324.8	-60.66	324.8	-60.66	324.8	-60.66	204100	-38110
1946	328.2	-60.14	328.2	-60.14	328.2	-60.14	206200	-37790
2050.8	381.8	-52	374.3	-59.52	374.3	-59.52	235200	-37400
2160	376.9	-52.15	376.9	-52.15	376.9	-52.15	236800	-32770
2264.4	379.4	-51.42	379.4	-51.42	379.4	-51.42	238400	-32310
2284.8	434.7	-42.32	410.1	-67.02	410.1	-67.02	274100	-44790
2340.68	355	-36	355	-36	355	-36	276300	-28020
2396.57	313.2	-30.84	313.2	-30.84	313.2	-30.84	278200	-27390
2459.17	369	14.08	369	14.08	369	14.08	373100	14230
2473.8	452.7	50.35	452.7	50.35	452.7	50.35	470800	52360
2569.8	527.2	85.06	527.2	85.06	527.2	85.06	548200	88450
2664.13	585.8	117.6	585.8	117.6	585.8	117.6	609200	122300
2758.47	637.1	162	637.1	162	637.1	162	662500	168500
2852.8	690.3	234.2	690.3	234.2	690.3	234.2	717800	243600
2963.42	1834	1195	1834	1195	1834	1195	1907000	1243000
2990.67	2487	-490	1746	-1364	1746	-1364	1815000	-1418000
3012.52	1788	-477.6	1788	-477.6	1788	-477.6	1859000	-496600
3123.15	1843	-459	1843	-459	1843	-459	1916000	-477300
3233.63	1893	-445.5	1893	-445.5	1893	-445.5	1968000	-463300
3337.35	1949	-435.7	1949	-435.7	1949	-435.7	2027000	-453100
3480.57	2003	-426.4	2003	-426.4	2003	-426.4	2083000	-443400
3623.8	2046	-416.9	2046	-416.9	2046	-416.9	2127000	-433500
3747.4	2073	-407.5	2073	-407.5	2073	-407.5	2155000	-423700
3871	2077	-398.1	2077	-398.1	2077	-398.1	2160000	-414000
3964.5	2058	-388.9	2058	-388.9	2058	-388.9	2140000	-404400
4054	2014	-379.6	2014	-379.6	2014	-379.6	2094000	-394800
4118.65	1944	-370	1944	-370	1944	-370	2022000	-384700
4122.65	1873	-360.3	1873	-360.3	1873	-360.3	1948000	-374700
4233.27	1947	-114.8	1947	-114.8	1947	-114.8	2024000	-119400
4309.4	1381	-77.43	1381	-77.43	1381	-77.43	1436000	-80520
4385.5	7.035	0.0007267	-0.0006737	-7.035	-0.0006737	-7.035	-0.7006	-7315

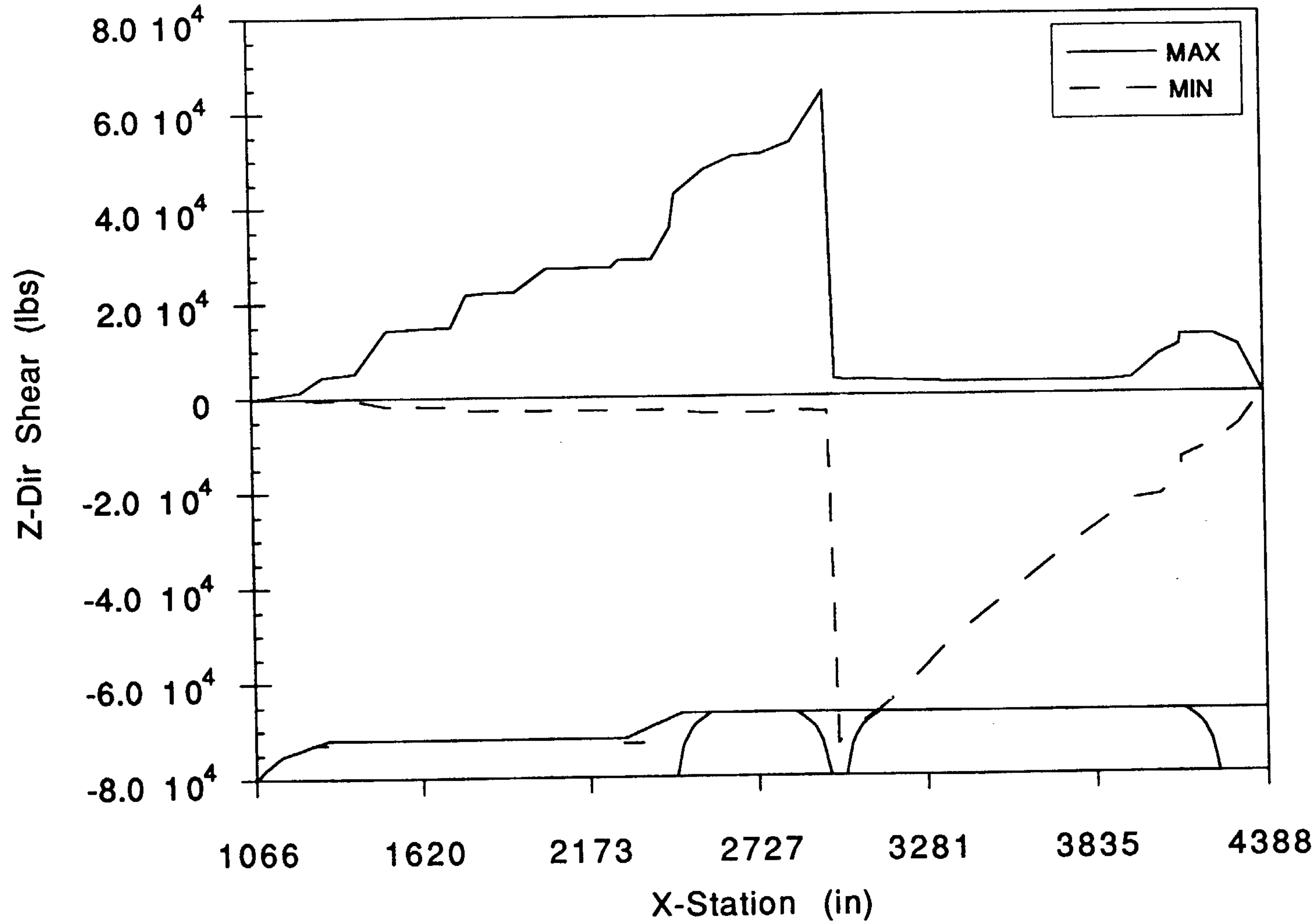
NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION



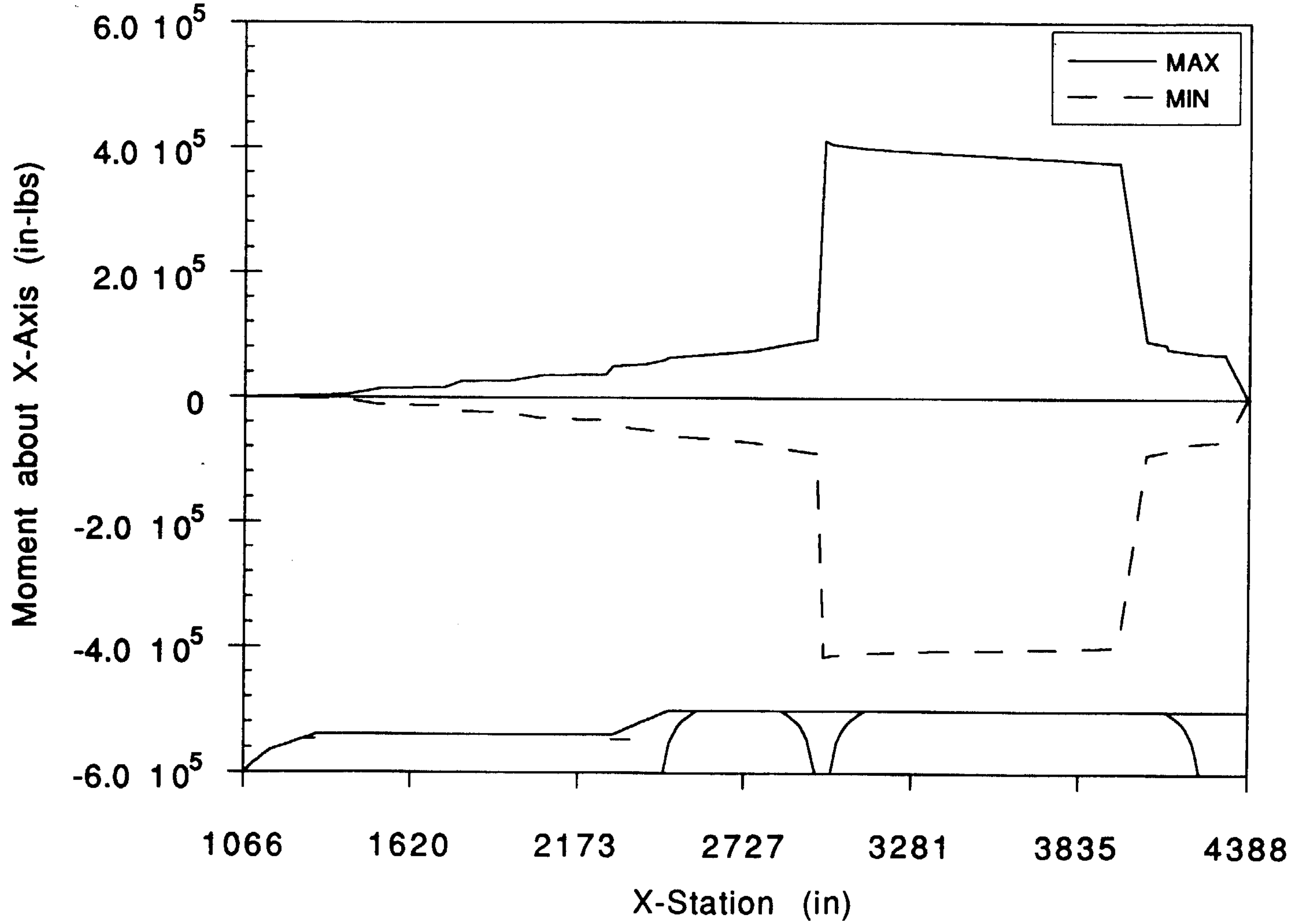


NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION
MAX
MIN
Y-Dir Shear (lbs)
8.0 10^4
6.0 10^4
4.0 10^4
2.0 10^4
0
-2.0 10^4
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

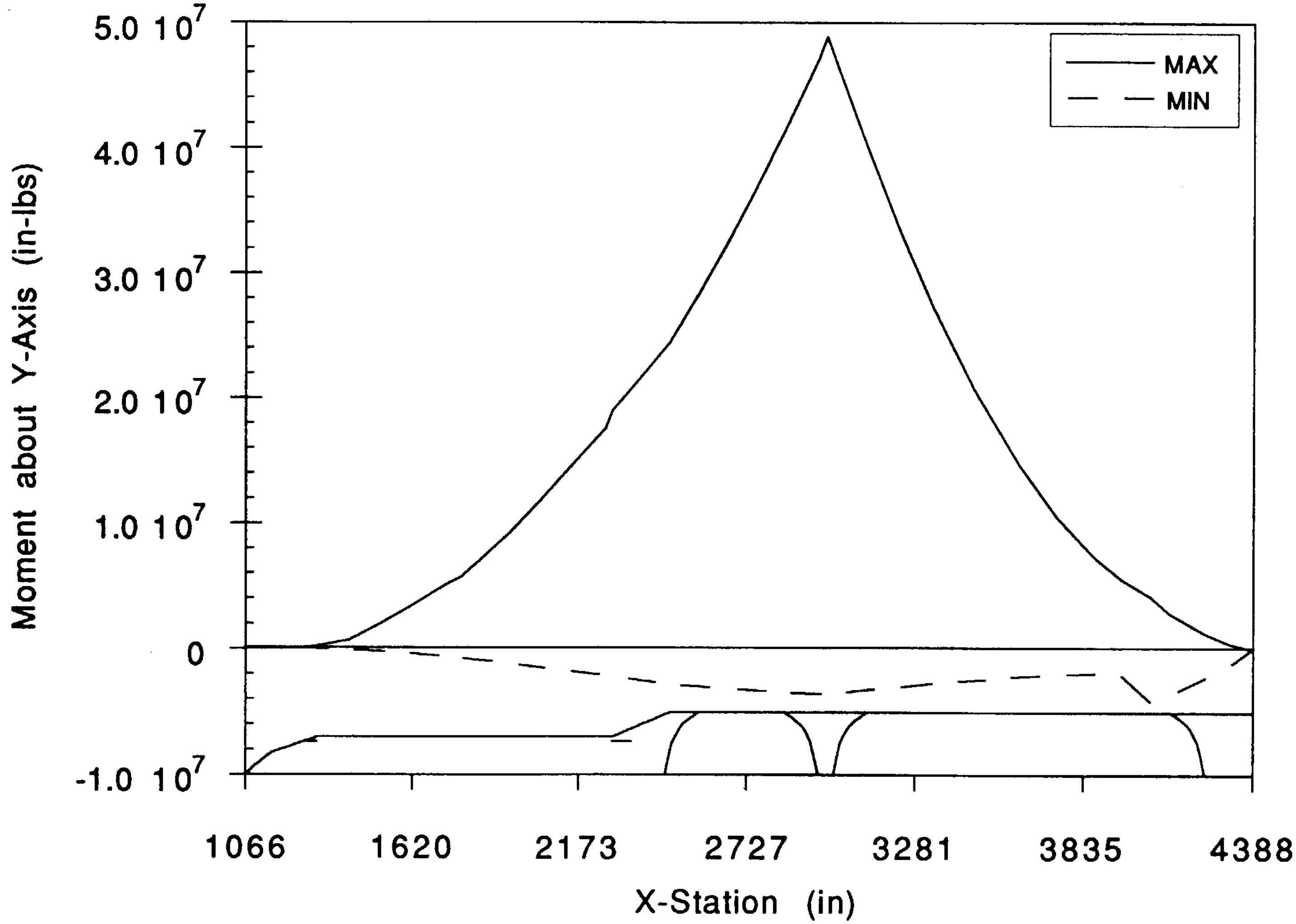
NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT COMPOSITE Z-DIR SHEAR LOADS VS X-STATION

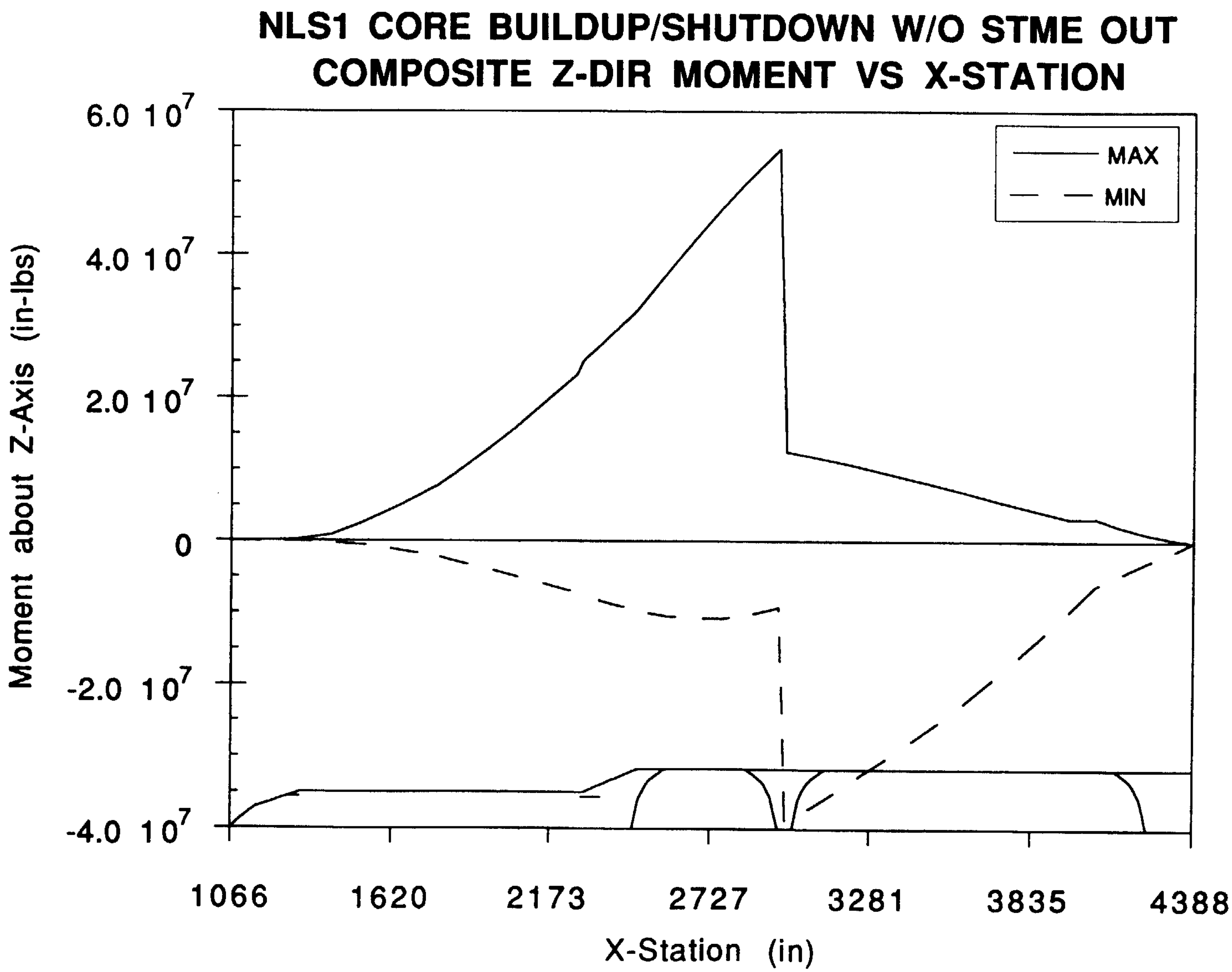


NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT COMPOSITE X-DIR TORSION VS X-STATION

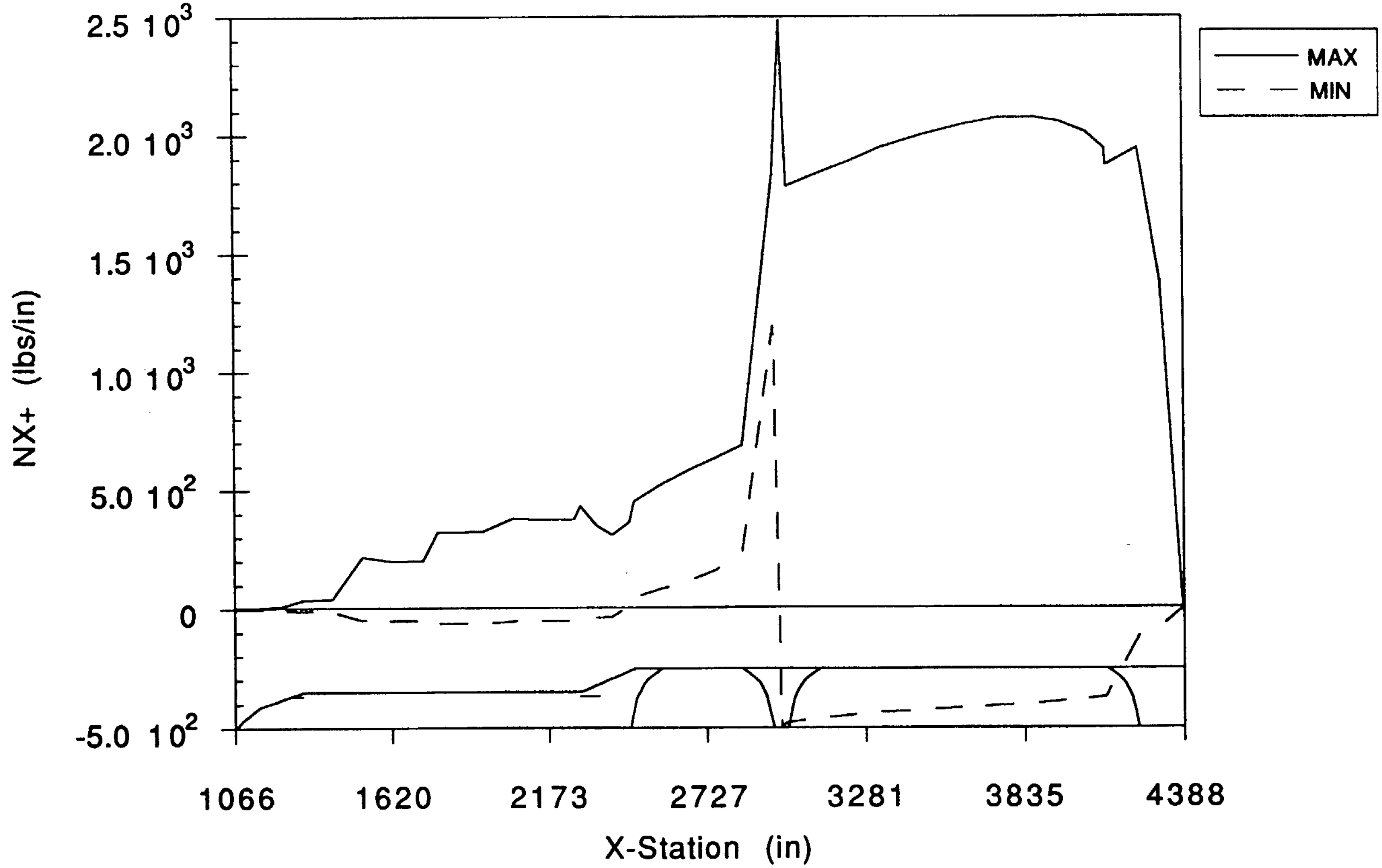


NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION

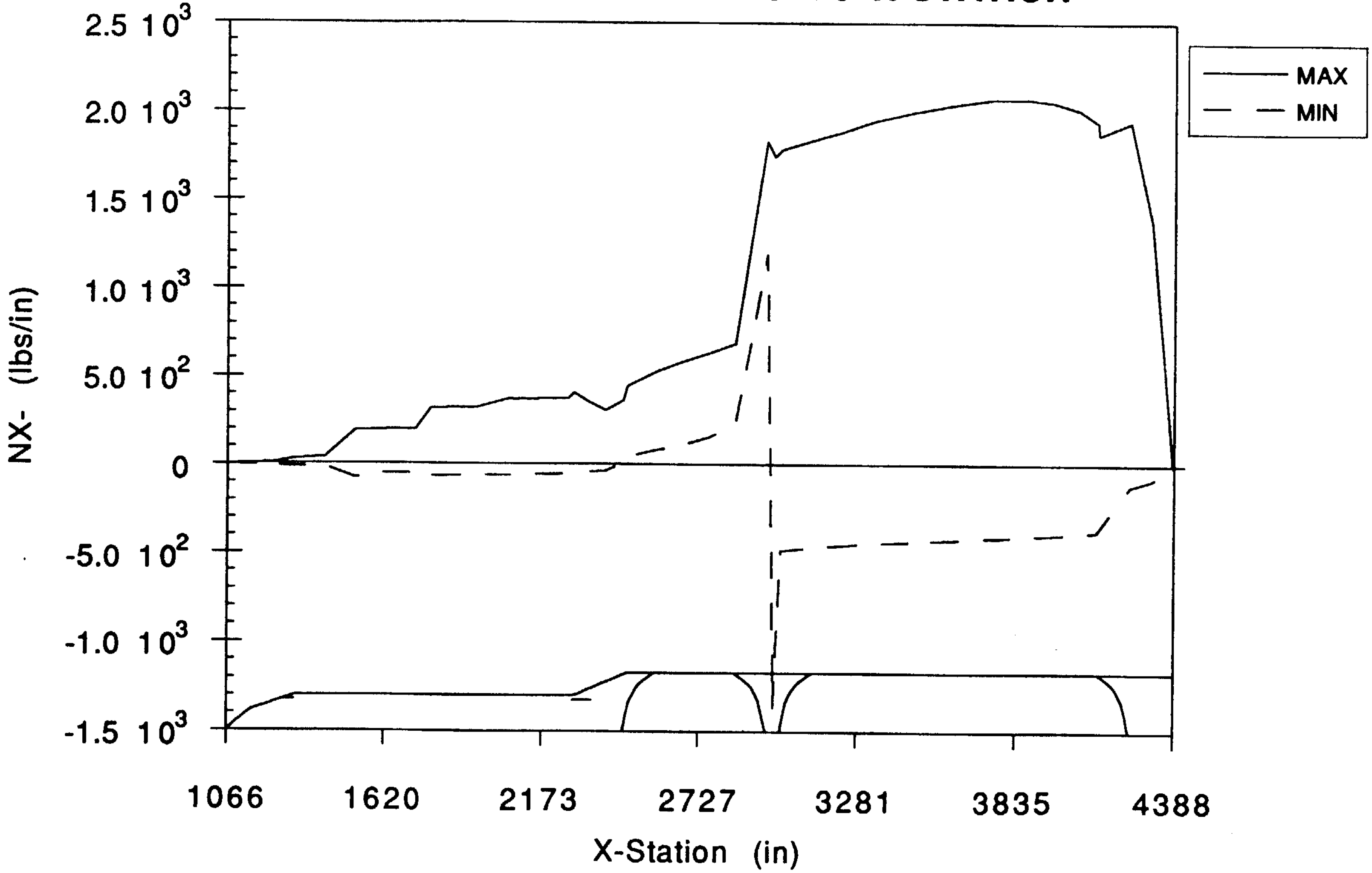



NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION
MAX
MIN
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
-4.0 10^7
Moment about Z-Axis (in-lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE NX+ LOADS VS X-STATION



NLS1 CORE BUILDUP/SHUTDOWN W/O STME OUT COMPOSITE NX- LOADS VS X-STATION



NLS 2

PRELAUNCH DATA

NLS2 WITH STME OUT BUILDUP/SHUTDOWN PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	319.8	95.1	30.3	-975.2	-64.6	-43.7
M2	709.3	67.6	21.1	-587.2	-80.9	-35.1
M3	717.5	38	21	-596.8	-65.1	-39.3
M4	283.9	46.3	59	-942.1	-44.2	-27.7

NLS2 WITH OUT STME OUT BUILDUP/SHUTDOWN PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	319.8	24.9	15.9	-913.2	-62.8	-40.4
M2	708.6	54.7	5.1	-498.9	-76.5	-18.1
M3	717.5	33.7	12.2	-512.9	-63.8	-39.3
M4	283.9	37.9	3.3	-885.3	-39.8	-26.7

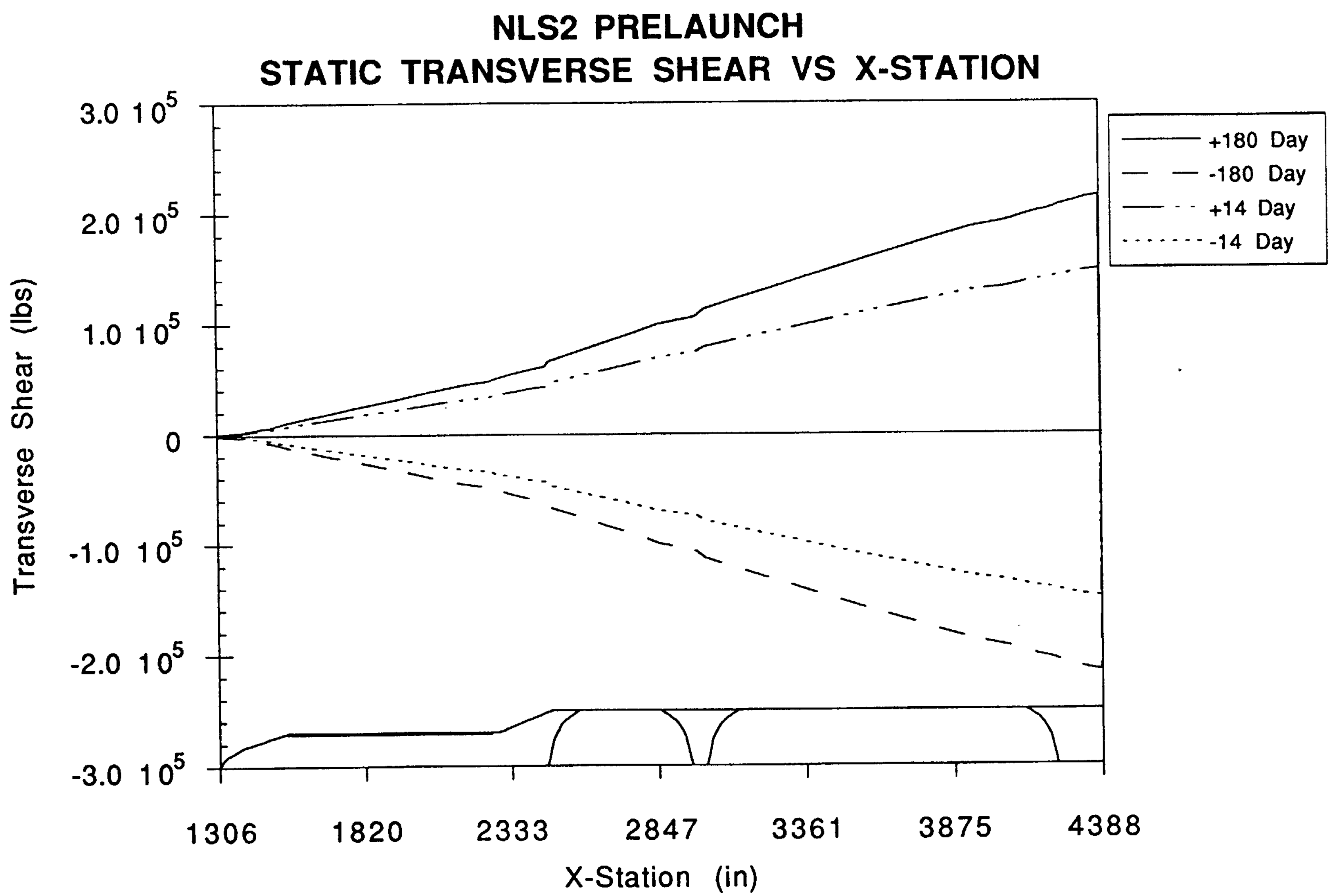
NLS2 LV Buildup/Shutdown Accelerations (G's)

	W/ STME Out		W/O STME Out	
	Maximum	Minimum	Maximum	Minimum
Node 999 Payload 50K X-Dir	3.953	-2.314	3.185	-1.113
Node 999 Payload 50K Y-Dir	0.8961	-0.8975	0.1402	-0.1661
Node 999 Payload 50K Z-Dir	0.8559	-0.7633	0.07746	-0.08507
Node 80 LO2 Slosh X-Dir	1.1613	0.7755	1.1012	0.8905
Node 81 LH2 Slosh X-Dir	1.8847	0.3323	1.4066	0.3892

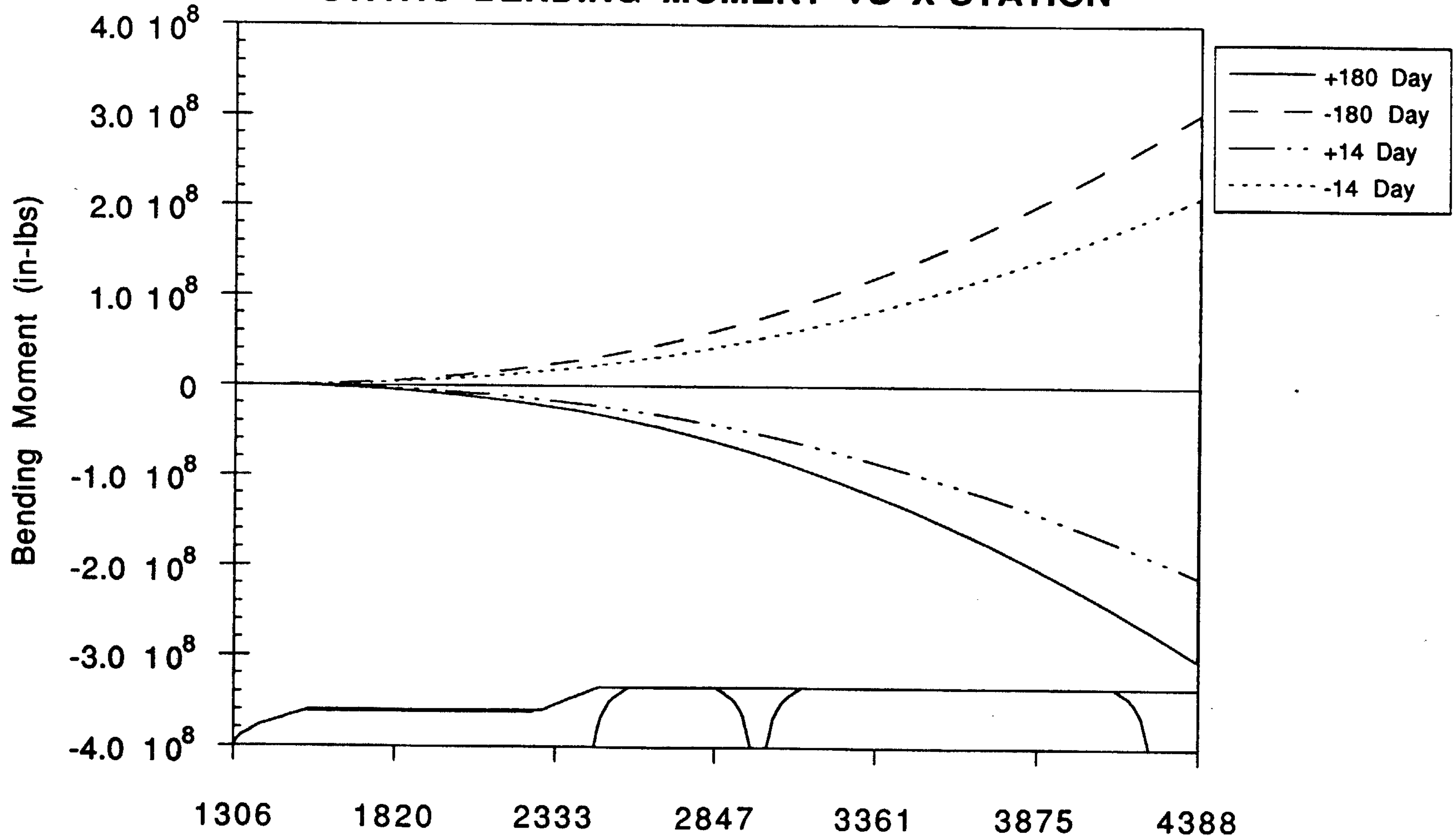
NLS2 GROUND WIND LOADS

UNFUELED, UNPRESSURIZED, ON PAD WITH SIDE AND BROADSIDE WINDS

14-Day Wind					180-Day Wind			
X-Station (in)	Shear Forces Z-Direction (lbs)	Moment About Y-Axis (in-lbs)	Shear Forces Y-Direction (lbs)	Moment About Z-Axis (in-lbs)	Shear Forces Z-Direction (lbs)	Moment About Y-Axis (in-lbs)	Shear Forces Y-Direction (lbs)	Moment About Z-Axis (in-lbs)
1306.6	540.27	0	540.27	0	765.01	0	765.01	0
1395.1	1978.99	-48105.39	1978.99	-48105.39	2803.23	-68116.25	2803.23	-68116.25
1444.87	3410.32	-146599.61	3410.32	-146599.61	4832.25	-207632.85	4832.25	-207632.85
1494.67	5096.66	-316331.05	5096.66	-316331.05	7224.11	-448133.69	7224.11	-448133.69
1544.4	7581.17	-569940.8	7581.17	-569940.8	10750.42	-807605.03	10750.42	-807605.03
1624.4	10684.37	-1176434.51	10684.37	-1176434.51	15158.34	-1667637.98	15158.34	-1667637.98
1704.4	13771.93	-2031184.29	13771.93	-2031184.29	19548.13	-2880304.74	19548.13	-2880304.74
1784.4	16843.58	-3132939.18	16843.58	-3132939.18	23919.42	-4444155.01	23919.42	-4444155.01
1864.4	19899.18	-4480426.14	19899.18	-4480426.14	28272.02	-6357708.69	28272.02	-6357708.69
1944.4	22938.4	-6072360.91	22938.4	-6072360.91	32605.53	-8619470.71	32605.53	-8619470.71
2024.4	25960.95	-7907432.93	25960.95	-7907432.93	36919.6	-11227913.89	36919.6	-11227913.89
2104.4	28974.08	-9984308.67	28974.08	-9984308.67	41224.6	-14181482.88	41224.6	-14181482.88
2184.8	31962.45	-12313824.19	31962.45	-12313824.19	45498.59	-17495941.41	45498.59	-17495941.41
2264.4	33845.27	-14858034.5	33845.27	-14858034.5	48193.52	-21117630.07	48193.52	-21117630.07
2284.8	35557.48	-15548477.73	35557.48	-15548477.73	50646.1	-22100778.19	50646.1	-22100778.19
2347.8	38488.22	-17788597.93	38488.22	-17788597.93	54846.93	-25291483.37	54846.93	-25291483.37
2410.8	41438.38	-20213354.46	41438.38	-20213354.46	59079.05	-28746840.94	59079.05	-28746840.94
2459.175	43173.79	-22217935.06	43173.79	-22217935.06	61569.96	-31604790.61	61569.96	-31604790.61
2471.15	46505.79	-22734940.97	46505.79	-22734940.97	66355.88	-32342090.98	66355.88	-32342090.98
2569.8	52294.11	-27322735.66	52294.11	-27322735.66	74678.12	-38888098.85	74678.12	-38888098.85
2664.133	57907.78	-32255794.45	57907.78	-32255794.45	82760.59	-45932710.33	82760.59	-45932710.33
2758.467	63476.78	-37718465.35	63476.78	-37718465.35	90790.03	-53739848.6	90790.03	-53739848.6
2852.8	69472.25	-43706419	69472.25	-43706419	99447.79	-62304345.29	99447.79	-62304345.29
2963.425	73331.19	-51391785.25	73331.19	-51391785.25	105027.11	-73305757.88	105027.11	-73305757.88
2985.675	74749.88	-53023404.01	74749.88	-53023404.01	107080.05	-75642611.19	107080.05	-75642611.19
3012.525	78701.7	-55030437.95	78701.7	-55030437.95	112803.64	-78517710.73	112803.64	-78517710.73
3123.15	85187.1	-63736812.31	85187.1	-63736812.31	122210.03	-90996614.52	122210.03	-90996614.52
3240.006	91771.49	-73691435.2	91771.49	-73691435.2	131779.17	-105277591.3	131779.17	-105277591.3
3356.863	98269.77	-84415575.26	98269.77	-84415575.26	141243.73	-120676911.1	141243.73	-120676911.1
3473.719	104681.42	-95898987.09	104681.42	-95898987.09	150603	-137182089.3	150603	-137182089.3
3590.575	111004.52	-108131638.4	111004.52	-108131638.4	159854.46	-154780954.1	159854.46	-154780954.1
3707.431	117229.23	-121103182.2	117229.23	-121103182.2	168985.1	-173460907.3	168985.1	-173460907.3
3824.288	123352.38	-134802237.7	123352.38	-134802237.7	177990.72	-193207999	177990.72	-193207999
3941.144	129373.49	-149216702.5	129373.49	-149216702.5	186870.69	-214007282.7	186870.69	-214007282.7
4058	133163.85	-164334770.1	133163.85	-164334770.1	192473.26	-235844243.7	192473.26	-235844243.7
4090.325	134788.96	-168639291.3	134788.96	-168639291.3	194879.36	-242065941.8	194879.36	-242065941.8
4122.65	136693.04	-172996344.2	136693.04	-172996344.2	197701.38	-248365417.1	197701.38	-248365417.1
4166.57	138866.56	-178999902.1	138866.56	-178999902.1	200926.43	-257048461.8	200926.43	-257048461.8
4210.32	140364.31	-185075313.6	140364.31	-185075313.6	203151.02	-265838993.2	203151.02	-265838993.2
4227.37	141436.27	-187468524.9	141436.27	-187468524.9	204744.55	-269302718.1	204744.55	-269302718.1
4254.07	143153.13	-191244872.9	143153.13	-191244872.9	207298.97	-274769397.8	207298.97	-274769397.8
4297.82	145270.41	-197507821.6	145270.41	-197507821.6	210452.75	-283838727.9	210452.75	-283838727.9
4341.57	147374.65	-203863401.3	147374.65	-203863401.3	213591.28	-293046035.8	213591.28	-293046035.8
4385.5	148423.12	-210337569.2	148423.12	-210337569.2	215156.5	-302429100.7	215156.5	-302429100.7


NLS2 PRELAUNCH
STATIC TRANSVERSE SHEAR VS X-STATION
+180 Day
-180 Day
+14 Day
-14 Day
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
Transverse Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 PRELAUNCH
STATIC BENDING MOMENT VS X-STATION



X-Station (in)

NLS2 COMPOSITE SHEAR BODY LOADS W/STME OUT (LBS)

BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	80.93	-50.79	152.2	-100.1	94.72	-124.1
1395.1	1295	-812.2	2169	-1359	1426	-1666
1444.9	3508	-2198	5582	-3413	3766	-4154
1494.6	7832	-4889	11750	-6962	8177	-8404
1544.4	10690	-6647	15520	-9015	11010	-10830
1624.4	13490	-8312	18720	-10570	13650	-12610
1704.4	16200	-9858	21360	-11640	16040	-13810
1784.4	18800	-11270	23460	-12330	18140	-14540
1864.4	21290	-12510	25040	-13040	19870	-14910
1944.4	23640	-13580	26170	-13510	21210	-15030
2024.4	25860	-14460	26900	-13780	22160	-14990
2104.4	27920	-15130	27340	-13880	22740	-14880
2184.4	29820	-15580	27610	-13860	23080	-14750
2264.4	31550	-15810	27860	-13730	23330	-14590
2284.8	227000	-95910	41720	-42590	42720	-37360
2347.8	227800	-95300	42200	-42430	43230	-37720
2410.8	228000	-94230	42400	-42290	43500	-38130
2459.2	283600	-33800	123400	-66500	133000	-81930
2471.1	403400	-28100	240700	-119700	244800	-135200
2569.8	497000	24740	199600	-110000	180700	-62900
2664.1	540400	88040	151100	-66730	167800	-98360
2758.5	539700	140600	185900	-92540	162800	-116600
2852.8	569800	190000	121200	-119500	133700	-116700
2963.4	635700	238100	88820	-86750	139500	-80750
2985.7	1755000	1240000	89030	-86910	139800	-82020
3012.5	1767000	1246000	91560	-85190	142200	-90370
3123.1	1778000	1268000	95610	-73200	145300	-85760
3240	1781000	1289000	99110	-58620	148000	-52540
3356.9	1781000	1313000	102700	-52240	150700	-60640
3473.7	1785000	1332000	106500	-63570	153200	-78410
3590.6	1793000	1339000	109600	-69200	154600	-101100
3707.4	1802000	1337000	112200	-77460	154700	-95600
3824.3	1805000	1334000	114600	-92820	154000	-108000
3941.1	1806000	1332000	116600	-101500	153700	-115700
4058	1812000	1340000	117900	-110500	152300	-128500
4090.3	1822000	1353000	118900	-121100	150200	-142500
4122.6	1836000	1373000	136400	-135200	147500	-158700
4166.6	2053000	1542000	167300	-190300	170300	-209100
4210.3	2076000	1577000	135000	-178600	142300	-186800
4227.4	2084000	1589000	119800	-174400	139900	-177000
4254	2118000	1640000	118600	-147600	138000	-148300
4297.8	2108000	1644000	119000	-135600	135900	-140600
4341.6	2047000	1557000	119400	-121600	134000	-131700
4385.5	0.6514	-0.2226	0.5038	-0.01113	0.9783	0.3295

NLS2 COMPOSITE MOMENT BODY LOADS W/STME OUT (IN-LBS)

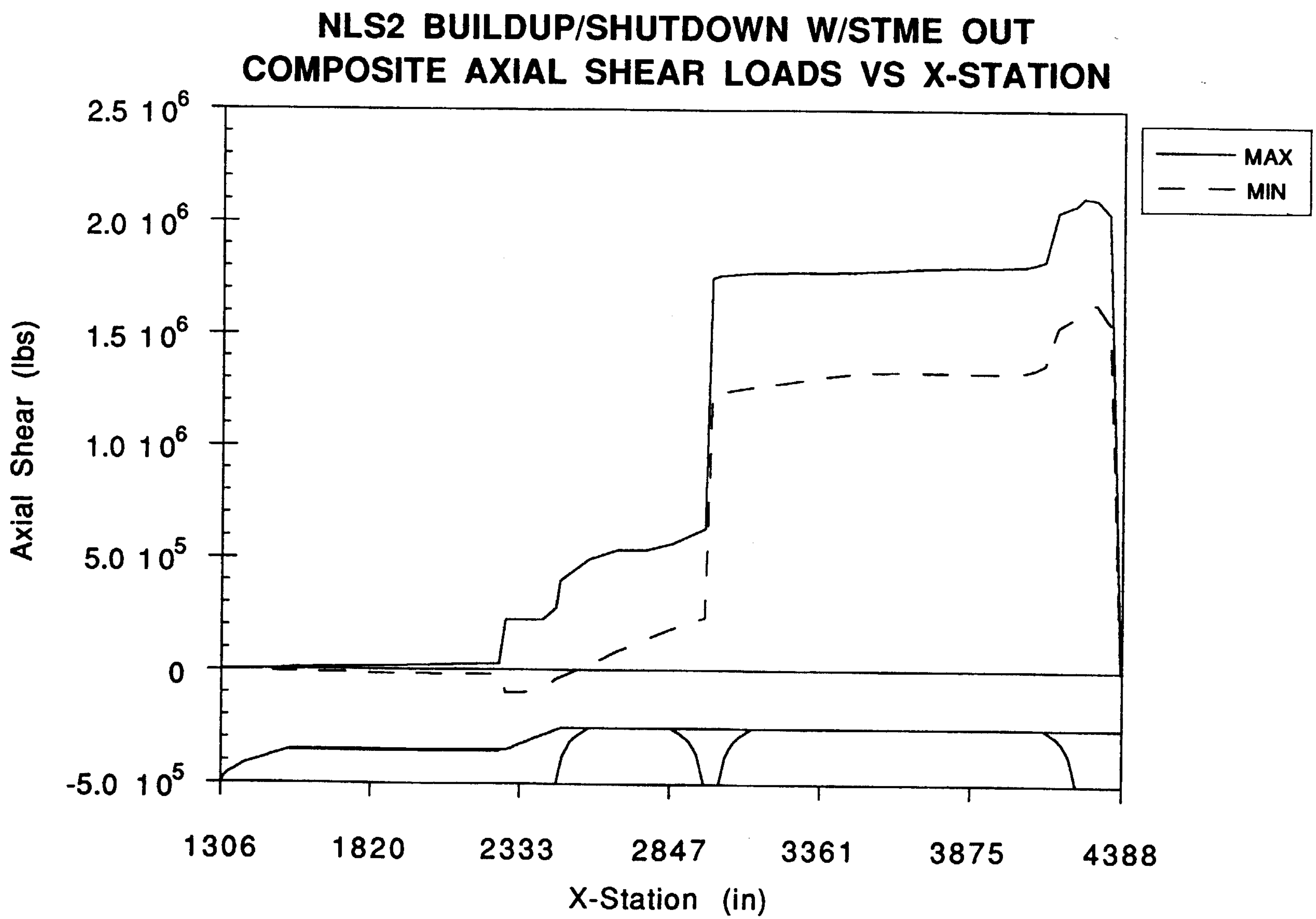
BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	3794	-3893	0.002345	0.0001585	0.001641	-0.004091
1395.1	27790	-28510	8434	-11050	13550	-8912
1444.9	59310	-60860	79400	-93940	121500	-76570
1494.6	127000	-130300	266800	-300700	399300	-246400
1544.4	707700	-726100	673700	-718900	984000	-592900
1624.4	1050000	-1077000	1554000	-1585000	2226000	-1314000
1704.4	1223000	-1253000	2643000	-2594000	3723000	-2159000
1784.4	1295000	-1326000	3927000	-3699000	5432000	-3090000
1864.4	1324000	-1353000	5378000	-4862000	7308000	-4072000
1944.4	1344000	-1371000	6967000	-6053000	9312000	-5075000
2024.4	1377000	-1393000	8665000	-7251000	11410000	-6073000
2104.4	1423000	-1413000	10440000	-8445000	13560000	-7131000
2184.4	1466000	-1396000	12260000	-9630000	15740000	-8242000
2264.4	1469000	-1289000	14100000	-10810000	17950000	-9350000
2284.8	3916000	-3349000	20050000	-17090000	17250000	-18910000
2347.8	3960000	-3339000	21600000	-19100000	19660000	-21580000
2410.8	3954000	-3276000	23100000	-21100000	22130000	-24240000
2459.2	3794000	-2786000	24230000	-22630000	24020000	-26270000
2471.1	3650000	-2403000	24500000	-22660000	23990000	-26500000
2569.8	3487000	-2090000	33670000	-28650000	25970000	-28170000
2664.1	3356000	-1987000	43060000	-31540000	31580000	-27850000
2758.5	3200000	-2014000	54060000	-24900000	38190000	-23440000
2852.8	2561000	-2124000	65970000	-22980000	45650000	-23760000
2963.4	2916000	-2227000	79280000	-21570000	53920000	-25410000
2985.7	2916000	-2227000	82020000	-22260000	55700000	-25450000
3012.5	7964000	-6422000	85330000	-23100000	57860000	-25500000
3123.1	5194000	-3198000	99100000	-26510000	66920000	-25550000
3240	5896000	-3386000	113900000	-30040000	76950000	-25580000
3356.9	5026000	-3474000	128900000	-33470000	87780000	-25860000
3473.7	4693000	-3509000	144100000	-36800000	98980000	-26630000
3590.6	4153000	-3525000	159900000	-40020000	110500000	-27420000
3707.4	4267000	-3542000	176500000	-43150000	122500000	-27820000
3824.3	5546000	-3580000	194400000	-47440000	134700000	-28090000
3941.1	8628000	-5505000	212400000	-51850000	147100000	-30800000
4058	7694000	-4054000	230200000	-56050000	159700000	-33600000
4090.3	8941000	-5963000	235000000	-57150000	163300000	-34480000
4122.6	13510000	-6534000	239800000	-58190000	166900000	-35500000
4166.6	14420000	-7162000	246900000	-59780000	172300000	-37370000
4210.3	13620000	-7793000	252800000	-60990000	177300000	-39720000
4227.4	13420000	-7897000	255100000	-61450000	179300000	-40680000
4254	12450000	-7754000	258600000	-62200000	182400000	-42230000
4297.8	12850000	-6831000	264400000	-63310000	187500000	-44740000
4341.6	13450000	-7003000	270200000	-64320000	192900000	-47210000
4385.5	8.434	-33.72	4184000	-4283000	4654000	-4381000

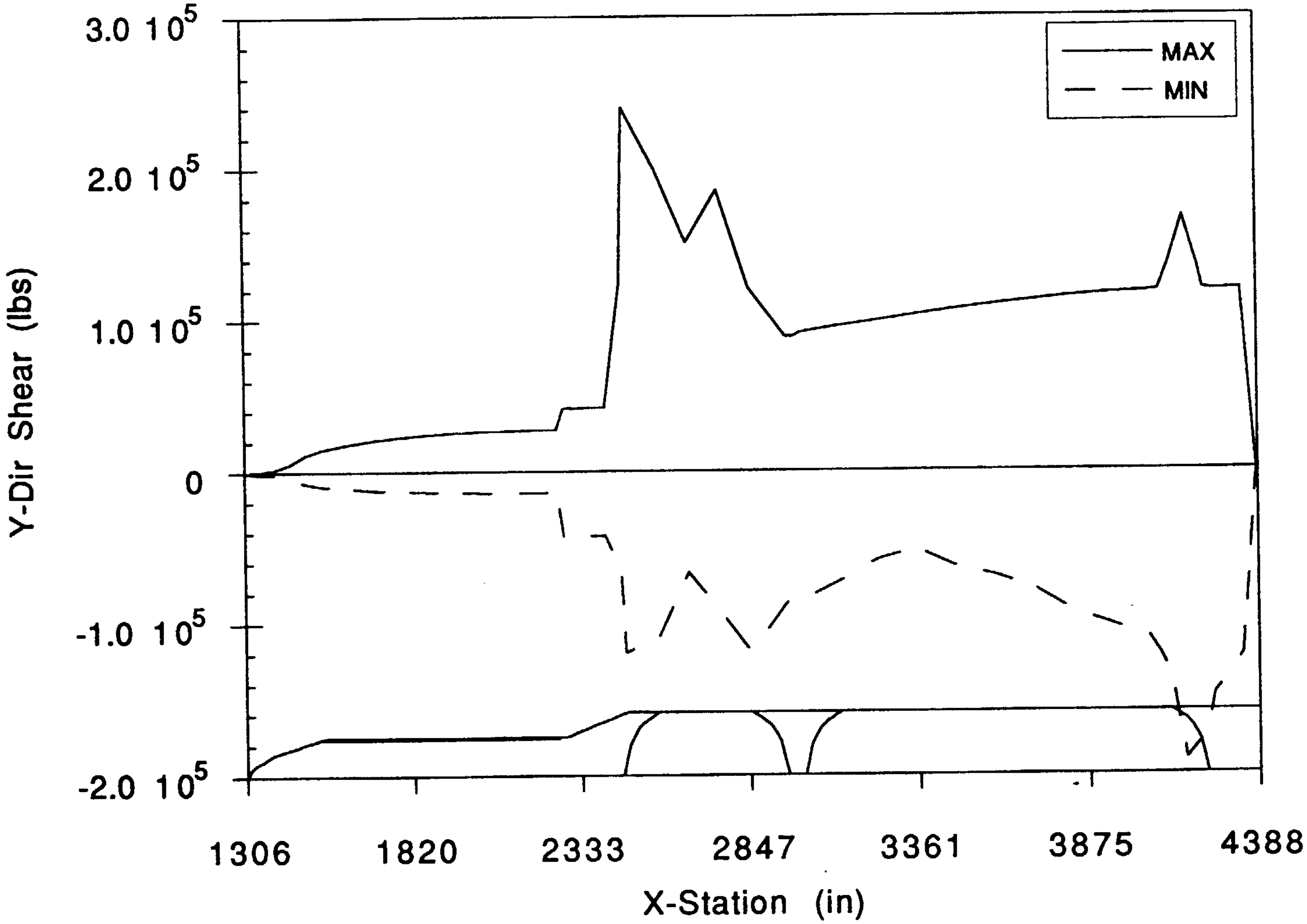
NLS2 COMPOSITE LINE BODY LOADS W/STME OUT

BUILD-UP AND SHUT-DOWN

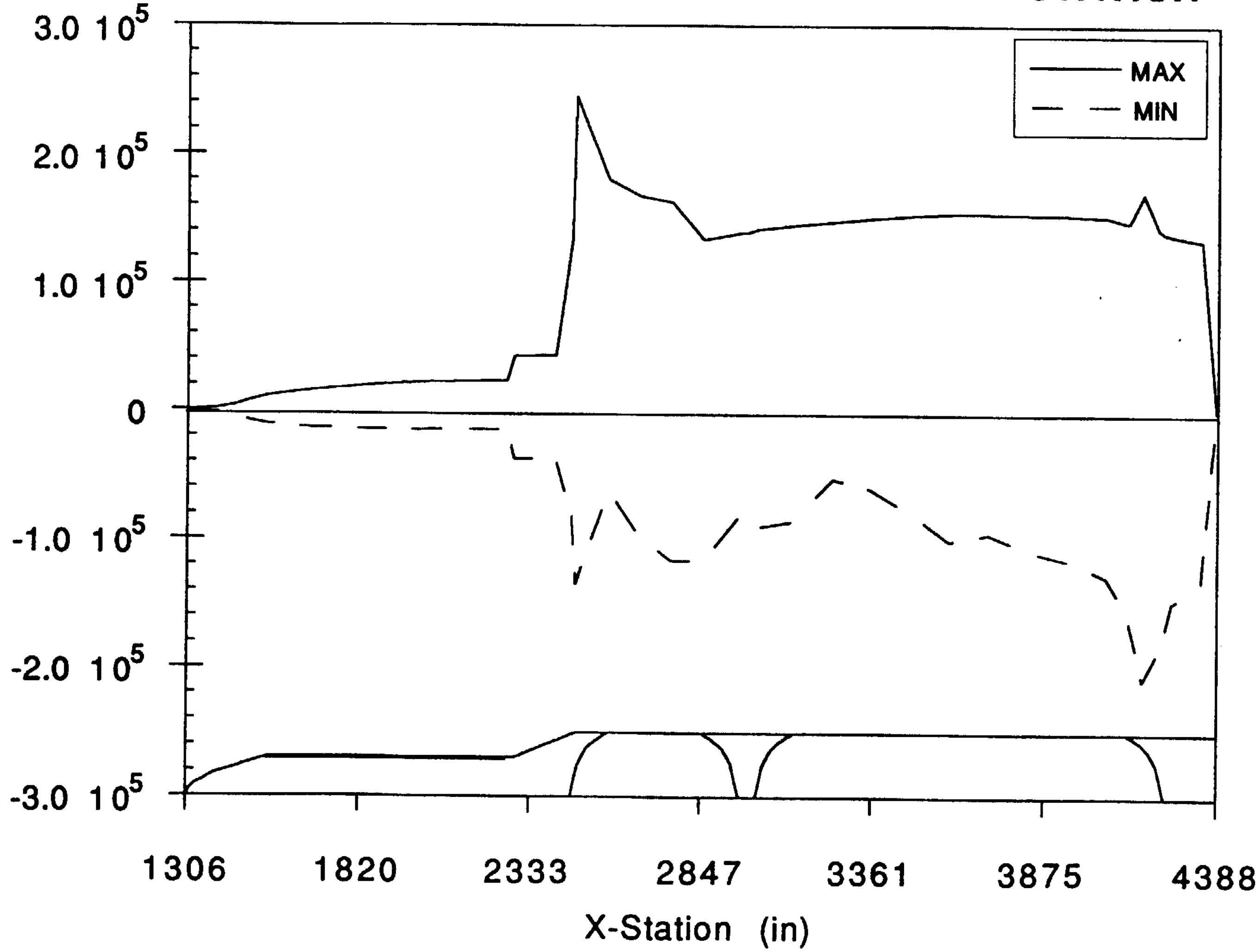
X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1306.1	0	0	0	0	0	0	0	0
1395.1	5.887	-3.693	5.887	-3.693	1295	-812.2	1295	-812.2
1444.9	9.305	-5.83	9.305	-5.83	3508	-2198	3508	-2198
1494.6	15.58	-9.727	15.58	-9.727	7832	-4889	7832	-4889
1544.4	17.02	-10.58	17.02	-10.58	10690	-6647	10690	-6647
1624.4	21.47	-13.23	21.47	-13.23	13490	-8312	13490	-8312
1704.4	25.78	-15.69	25.78	-15.69	16200	-9858	16200	-9858
1784.4	29.92	-17.93	29.92	-17.93	18800	-11270	18800	-11270
1864.4	33.88	-19.92	33.88	-19.92	21290	-12510	21290	-12510
1944.4	37.63	-21.62	37.63	-21.62	23640	-13580	23640	-13580
2024.4	41.15	-23.01	41.15	-23.01	25860	-14460	25860	-14460
2104.4	44.43	-24.08	44.43	-24.08	27920	-15130	27920	-15130
2184.4	47.45	-24.8	47.45	-24.8	29820	-15580	29820	-15580
2264.4	50.21	-25.17	50.21	-25.17	31550	-15810	31550	-15810
2284.8	1072	-109.5	251.6	-809.3	673900	-68810	158100	-508500
2347.8	302.8	-126.7	302.8	-126.7	227800	-95300	227800	-95300
2410.8	260.4	-107.6	260.4	-107.6	228000	-94230	228000	-94230
2459.2	292.1	-34.82	292.1	-34.82	283600	-33800	283600	-33800
2471.1	405.6	-28.25	405.6	-28.25	403400	-28100	403400	-28100
2569.8	477.9	23.79	477.9	23.79	497000	24740	497000	24740
2664.1	519.7	84.66	519.7	84.66	540400	88040	540400	88040
2758.5	519	135.2	519	135.2	539700	140600	539700	140600
2852.8	548	182.7	548	182.7	569800	190000	569800	190000
2963.4	611.3	228.9	611.3	228.9	635700	238100	635700	238100
2985.7	1688	1192	1688	1192	1755000	1240000	1755000	1240000
3012.5	1699	1198	1699	1198	1767000	1246000	1767000	1246000
3123.1	1710	1219	1710	1219	1778000	1268000	1778000	1268000
3240	1713	1240	1713	1240	1781000	1289000	1781000	1289000
3356.9	1713	1263	1713	1263	1781000	1313000	1781000	1313000
3473.7	1716	1280	1716	1280	1785000	1332000	1785000	1332000
3590.6	1724	1288	1724	1288	1793000	1339000	1793000	1339000
3707.4	1733	1286	1733	1286	1802000	1337000	1802000	1337000
3824.3	1736	1283	1736	1283	1805000	1334000	1805000	1334000
3941.1	1737	1281	1737	1281	1806000	1332000	1806000	1332000
4058	1743	1288	1743	1288	1812000	1340000	1812000	1340000
4090.3	1752	1301	1752	1301	1822000	1353000	1822000	1353000
4122.6	1765	1321	1765	1321	1836000	1373000	1836000	1373000
4166.6	2000	1534	1955	1316	2080000	1595000	2033000	1368000
4210.3	2008	1529	1984	1494	2088000	1590000	2063000	1553000
4227.4	2008	1537	2001	1518	2088000	1599000	2080000	1579000
4254	2051	1600	2024	1521	2132000	1664000	2105000	1582000
4297.8	2045	1618	2013	1502	2126000	1682000	2094000	1561000
4341.6	1995	1567	1967	1392	2075000	1630000	2046000	1448000
4385.5	3276	0.2145	-0.214	-3276	3407000	223.1	-222.5	-3407000


NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION
MAX
MIN
Axial Shear (lbs)
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

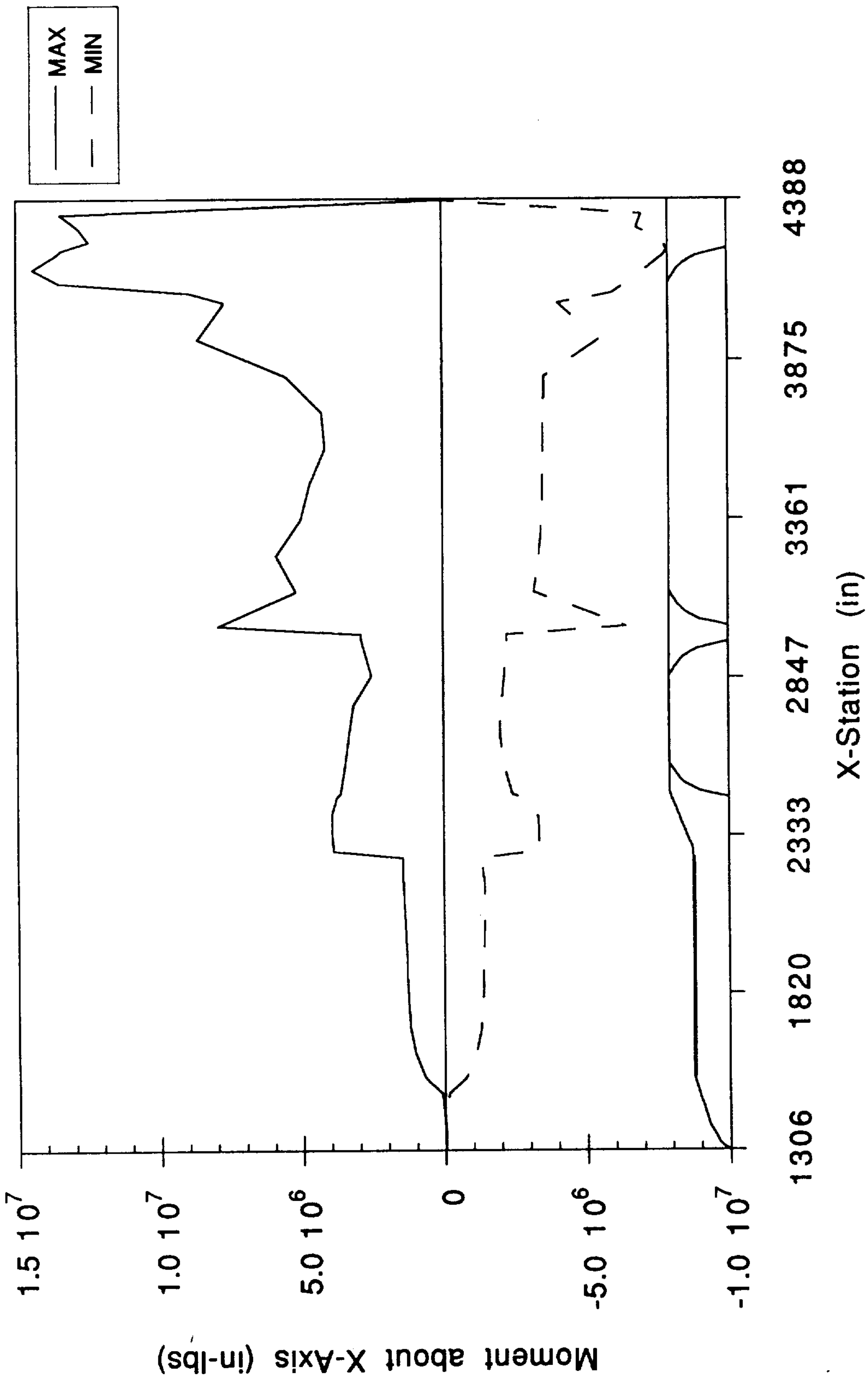
NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION

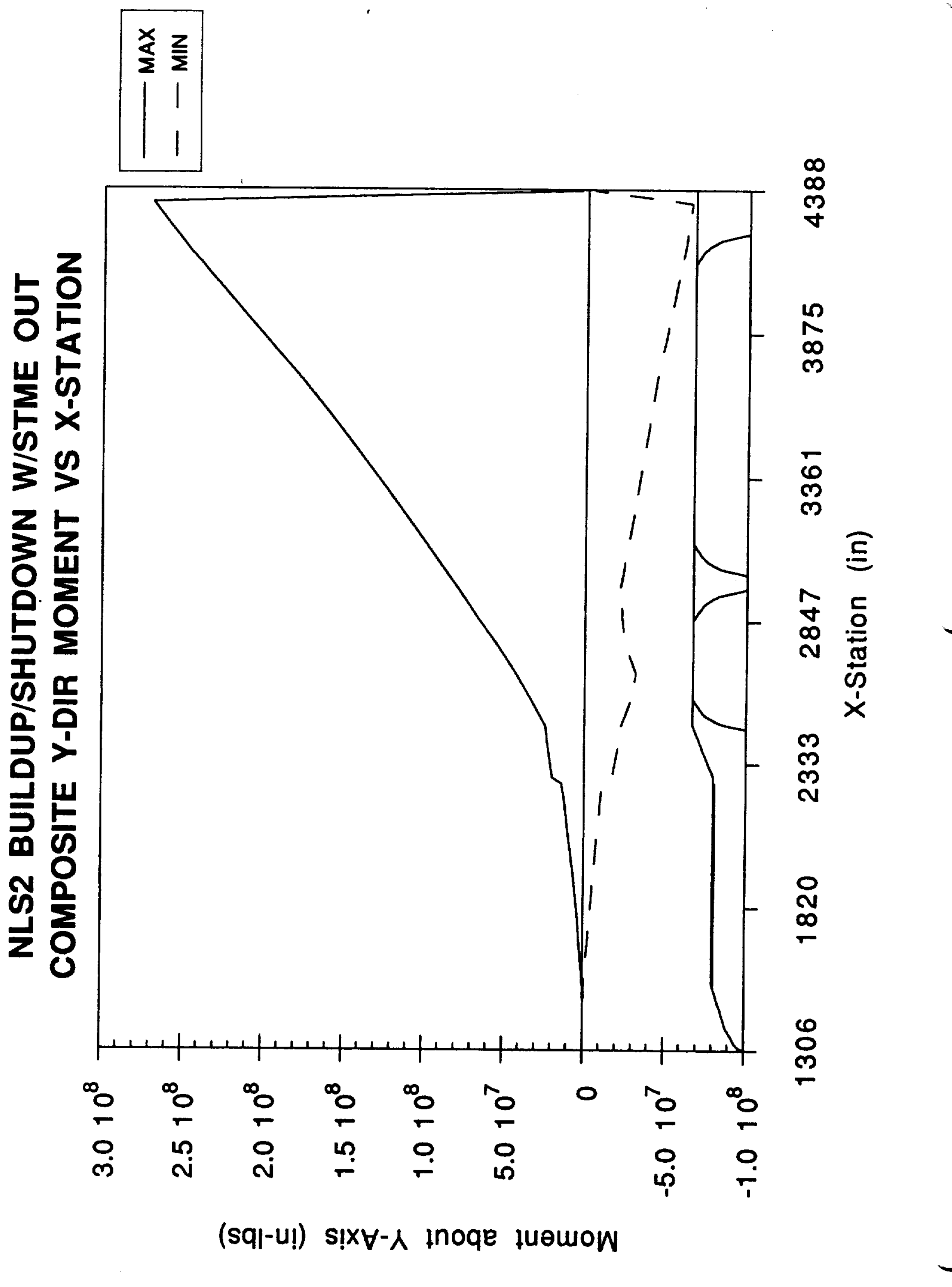


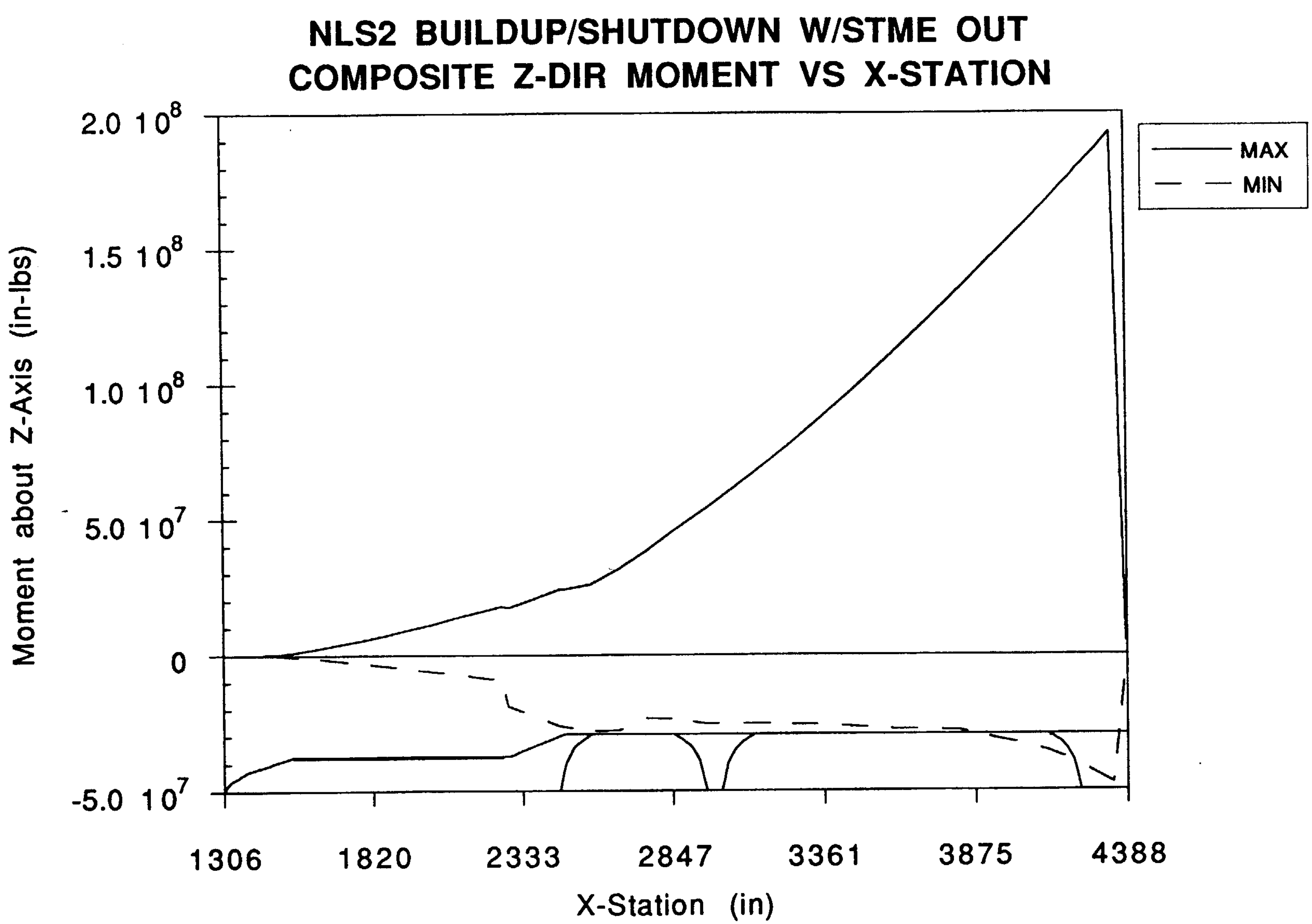
NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION



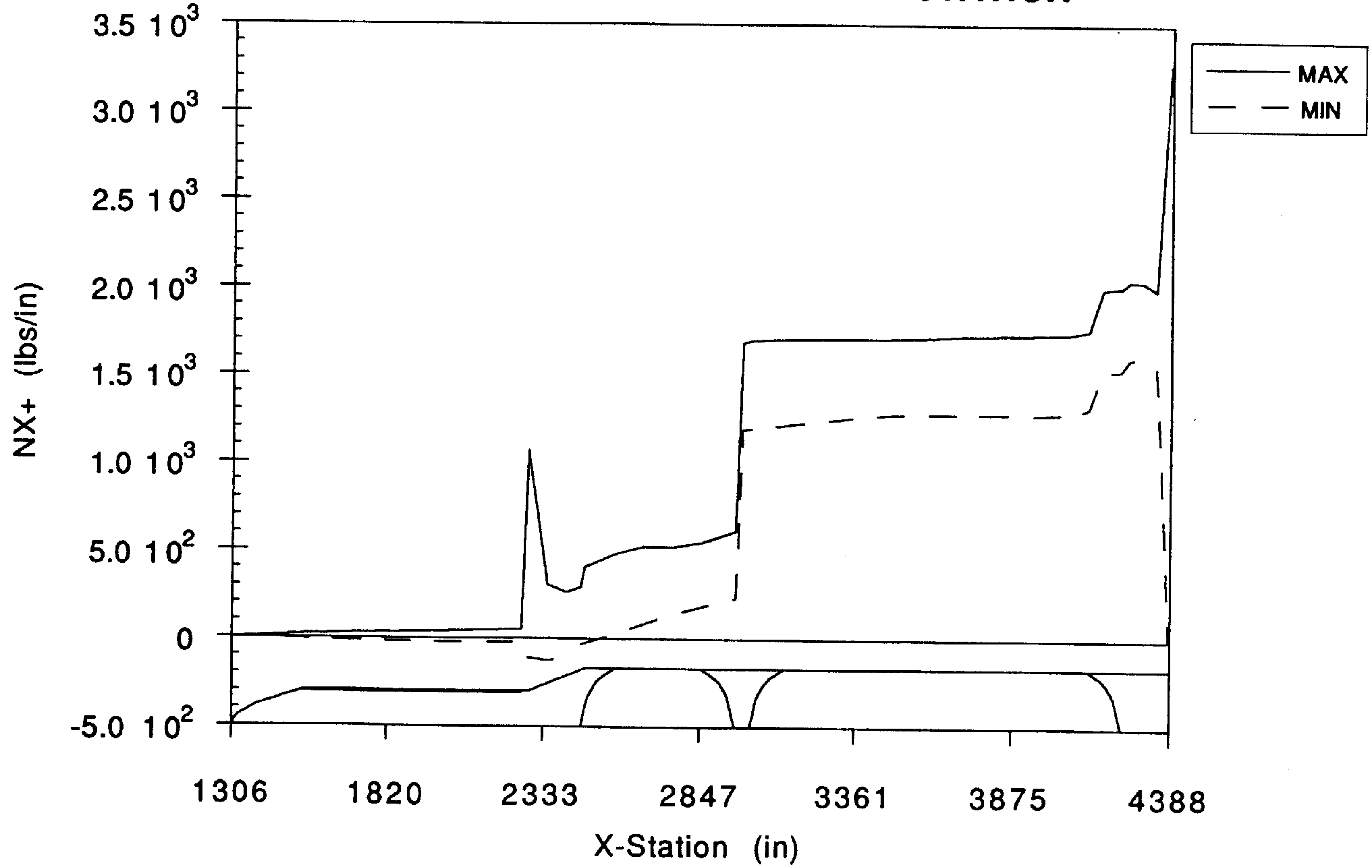
NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE X-DIR TORSION VS X-STATION



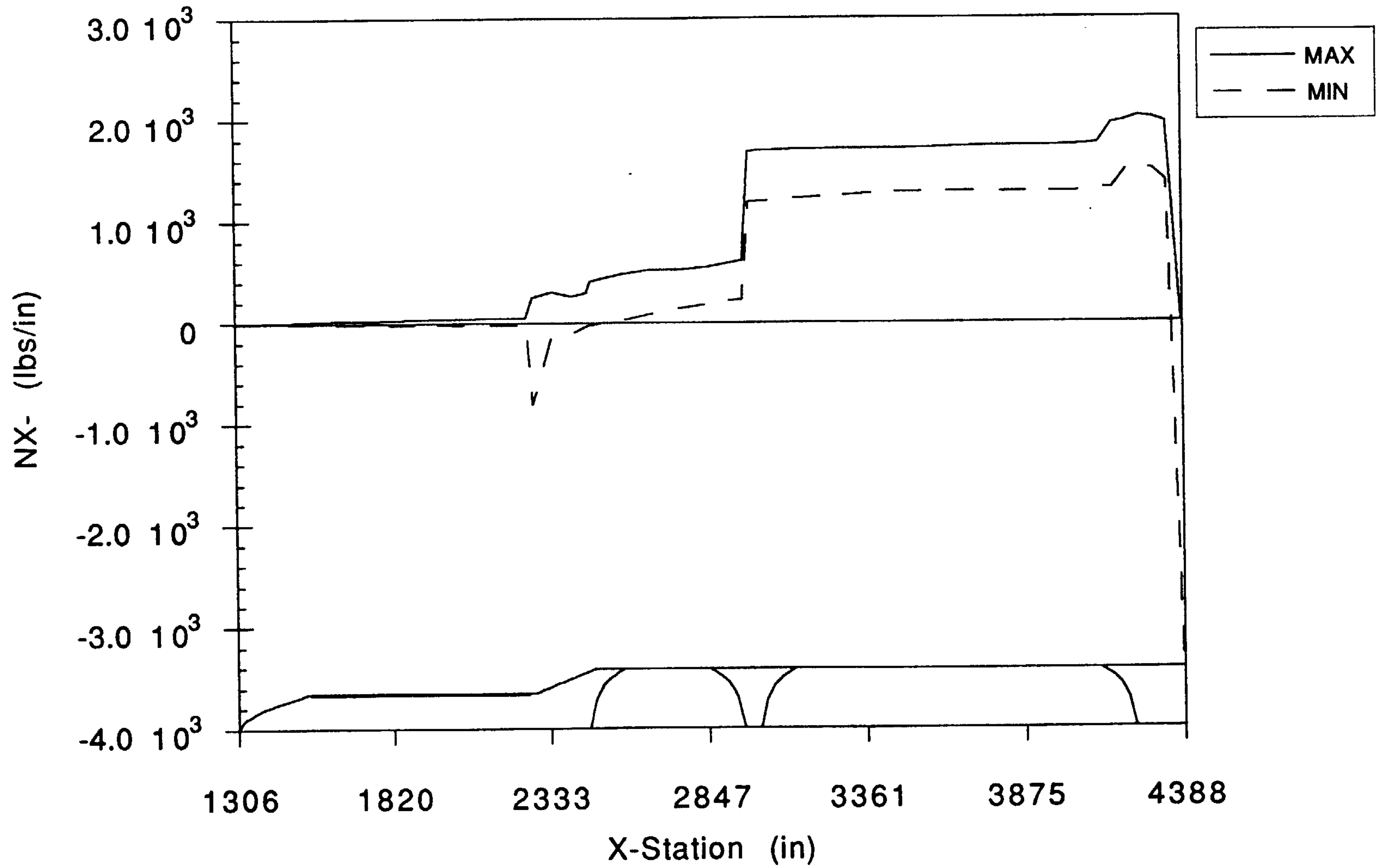

NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION
MAX
MIN
Moment about Y-Axis (in-lbs)
3.0 10^8
2.5 10^8
2.0 10^8
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION
MAX
MIN
2.0 10^8
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
Moment about Z-Axis (in-lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE NX+ LOADS VS X-STATION



NLS2 BUILDUP/SHUTDOWN W/STME OUT
COMPOSITE NX- LOADS VS X-STATION



NLS2 COMPOSITE SHEAR BODY LOADS W/O STME OUT (LBS)

BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	64.33	-16.61	79.43	-29.89	76.47	-12.38
1395.1	1029	-265.6	1138	-418.4	1113	-171.8
1444.9	2788	-718.3	2936	-1067	2893	-436.2
1494.6	6225	-1595	6200	-2221	6167	-903
1544.4	8499	-2165	8207	-2914	8208	-1181
1624.4	10720	-2696	9929	-3480	10010	-1404
1704.4	12870	-3179	11370	-3924	11560	-1576
1784.4	14930	-3605	12540	-4253	12880	-1702
1864.4	16900	-3965	13460	-4475	13950	-1787
1944.4	18770	-4252	14140	-4603	14790	-1838
2024.4	20520	-4459	14640	-4652	15410	-1863
2104.4	22150	-4580	15010	-4640	15860	-1868
2184.4	23650	-4611	15270	-4589	16190	-1861
2264.4	25020	-4548	15500	-4522	16490	-1849
2284.8	183600	-44580	31060	-6226	36010	-6335
2347.8	185200	-43370	31350	-6216	36390	-6376
2410.8	186500	-41830	31520	-6194	36620	-6409
2459.2	241300	13110	45020	-14450	59200	-12460
2471.1	322700	42580	56230	-29000	77650	-18200
2569.8	385200	76590	52440	-30430	82470	-19870
2664.1	438600	138300	65790	-18610	100500	-22860
2758.5	499800	229600	76140	-18500	113300	-25340
2852.8	569800	338600	69920	-16870	110800	-24880
2963.4	635700	413700	74520	-10190	118400	-25530
2985.7	1718000	1387000	74770	-10200	118600	-25550
3012.5	1730000	1396000	77380	-10200	120400	-25710
3123.1	1733000	1409000	81450	-9629	122900	-25360
3240	1727000	1416000	84370	-8267	125200	-24470
3356.9	1718000	1423000	87780	-6920	127700	-23600
3473.7	1713000	1430000	92330	-6411	130300	-23250
3590.6	1722000	1438000	97140	-7775	132200	-22900
3707.4	1736000	1446000	100200	-9473	132900	-21740
3824.3	1745000	1453000	101800	-9564	132700	-20230
3941.1	1751000	1460000	103800	-8628	132000	-19390
4058	1753000	1468000	106100	-7609	130300	-19000
4090.3	1755000	1478000	108000	-10190	128200	-18440
4122.6	1757000	1490000	109000	-12440	125600	-17540
4166.6	2026000	1735000	107500	-14810	120200	-14880
4210.3	2031000	1744000	103600	-14680	121700	-11680
4227.4	2032000	1747000	103600	-16330	122800	-10900
4254	2041000	1763000	104100	-15490	120900	-10560
4297.8	2048000	1775000	105100	-13740	118200	-11560
4341.6	2047000	1756000	109300	-12250	117300	-10040
4385.5	0.6509	-0.2014	0.4898	-0.009138	0.9523	0.3295

NLS2 COMPOSITE MOMENT BODY LOADS W/O STME OUT (IN-LBS)

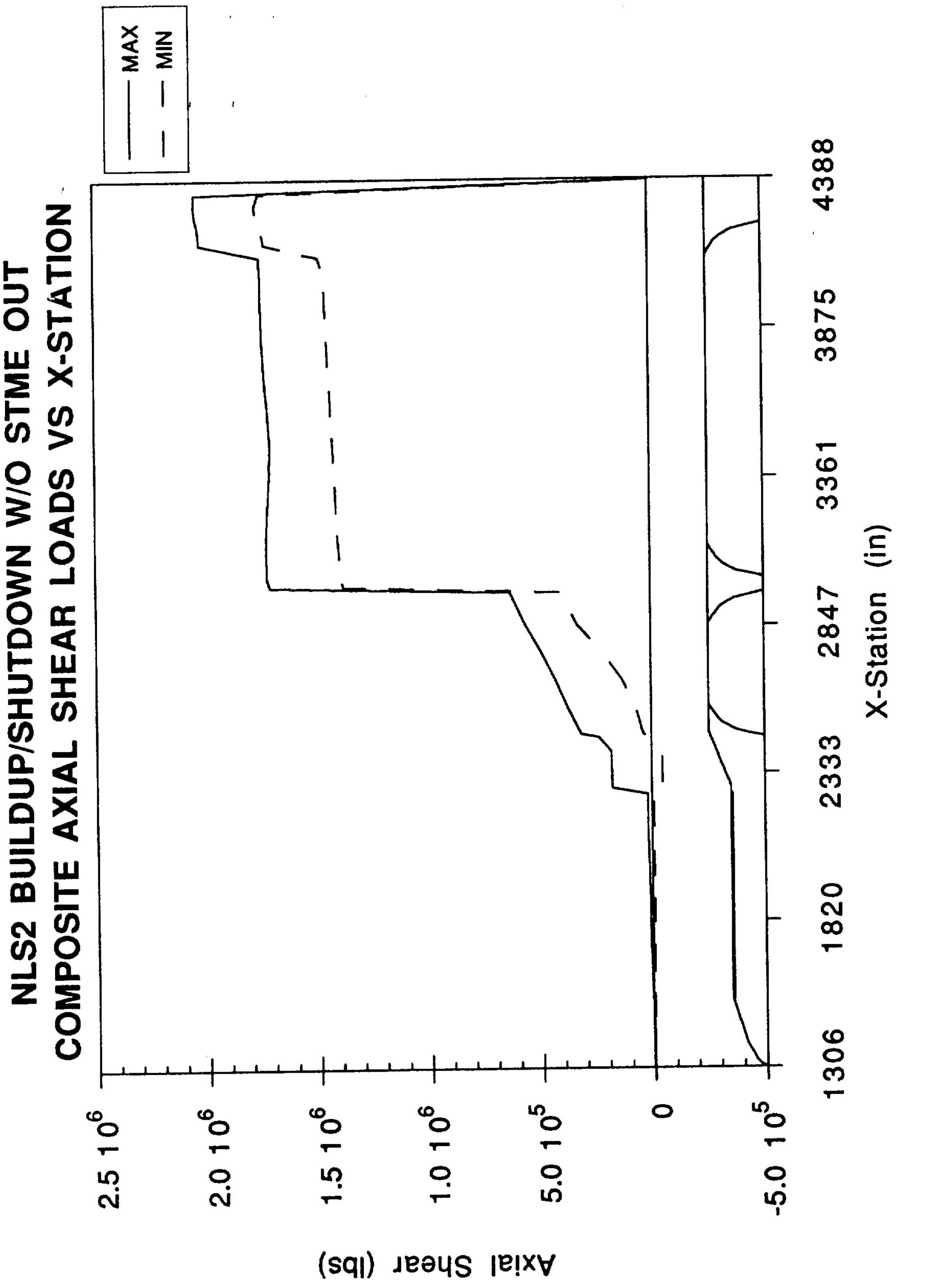
BUILD-UP AND SHUT-DOWN

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	734.5	-1047	0.002345	0.0005961	0.0005827	-0.003786
1395.1	5379	-7666	6809	-1102	7072	-2661
1444.9	11480	-16370	62200	-9652	63710	-23490
1494.6	24580	-35080	206200	-31360	209800	-76600
1544.4	137100	-196300	513100	-76300	518400	-187100
1624.4	203700	-294800	1170000	-170700	1175000	-420300
1704.4	237300	-347500	1970000	-283100	1969000	-698700
1784.4	251400	-371300	2895000	-409100	2879000	-1013000
1864.4	256700	-381300	3924000	-545300	3882000	-1353000
1944.4	260200	-389400	5040000	-688200	4959000	-1711000
2024.4	265000	-403700	6223000	-835200	6091000	-2079000
2104.4	269800	-428900	7456000	-984200	7261000	-2451000
2184.4	268500	-465400	8724000	-1134000	8457000	-2822000
2264.4	256600	-509100	10020000	-1283000	9672000	-3190000
2284.8	586900	-1381000	14340000	-2442000	13410000	-2995000
2347.8	602000	-1396000	16610000	-2841000	15360000	-3314000
2410.8	612400	-1398000	18890000	-3242000	17320000	-3629000
2459.2	660300	-1472000	20660000	-3551000	18830000	-3870000
2471.1	697300	-1556000	21370000	-3685000	19350000	-3931000
2569.8	716400	-1600000	28930000	-5300000	24380000	-4385000
2664.1	727300	-1626000	36620000	-7148000	28550000	-4527000
2758.5	738000	-1652000	45740000	-9010000	34210000	-4825000
2852.8	782500	-1760000	55760000	-10790000	41170000	-4686000
2963.4	824800	-1864000	67340000	-13010000	48340000	-4915000
2985.7	824800	-1864000	69920000	-13480000	49890000	-4873000
3012.5	1071000	-2779000	73030000	-14040000	51760000	-4817000
3123.1	1237000	-2897000	86020000	-16350000	59710000	-4435000
3240	1332000	-3144000	100000000	-18750000	68500000	-4236000
3356.9	1383000	-3282000	114300000	-21060000	77560000	-4279000
3473.7	1408000	-3350000	129000000	-23400000	86950000	-4286000
3590.6	1421000	-3387000	144100000	-25940000	96880000	-4371000
3707.4	1436000	-3433000	159400000	-28580000	107200000	-4418000
3824.3	1464000	-3526000	174900000	-31110000	117800000	-4424000
3941.1	1512000	-3717000	190300000	-33460000	128500000	-4519000
4058	1679000	-4054000	205700000	-35720000	140100000	-4885000
4090.3	1738000	-4455000	209900000	-36330000	143500000	-5005000
4122.6	2266000	-4872000	214000000	-36920000	146900000	-5117000
4166.6	2809000	-5705000	220300000	-38060000	152300000	-5287000
4210.3	2605000	-5821000	225400000	-38690000	157000000	-5548000
4227.4	2610000	-5868000	227400000	-38870000	158700000	-5657000
4254	2527000	-6076000	230500000	-39230000	161500000	-5824000
4297.8	2732000	-6242000	235500000	-39910000	166400000	-6098000
4341.6	2850000	-6381000	240500000	-40200000	171200000	-6373000
4385.5	8.434	-33.25	209900	-210100	274900	-267000

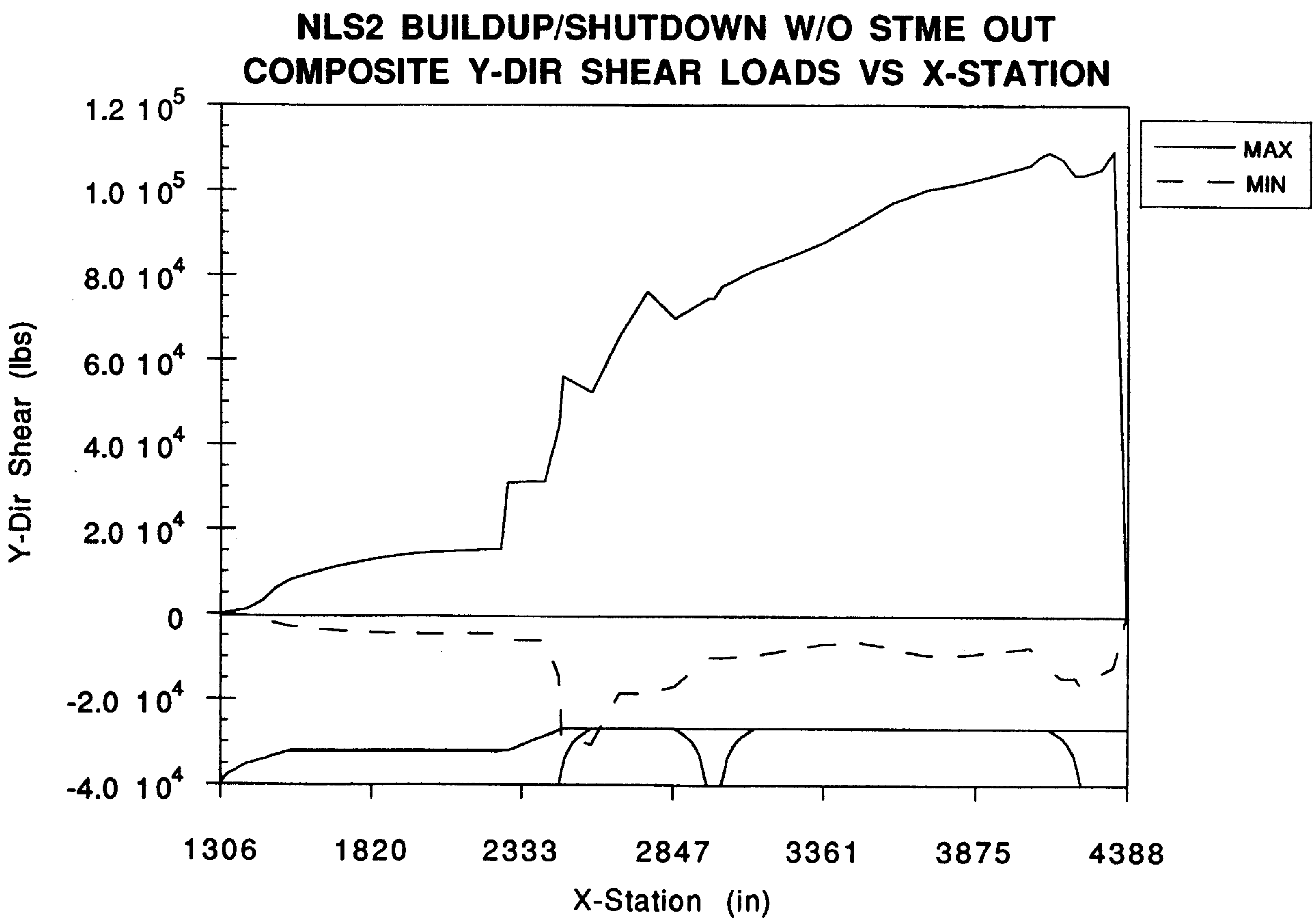
NLS2 COMPOSITE LINE BODY LOADS W/O STME OUT

BUILD-UP AND SHUT-DOWN

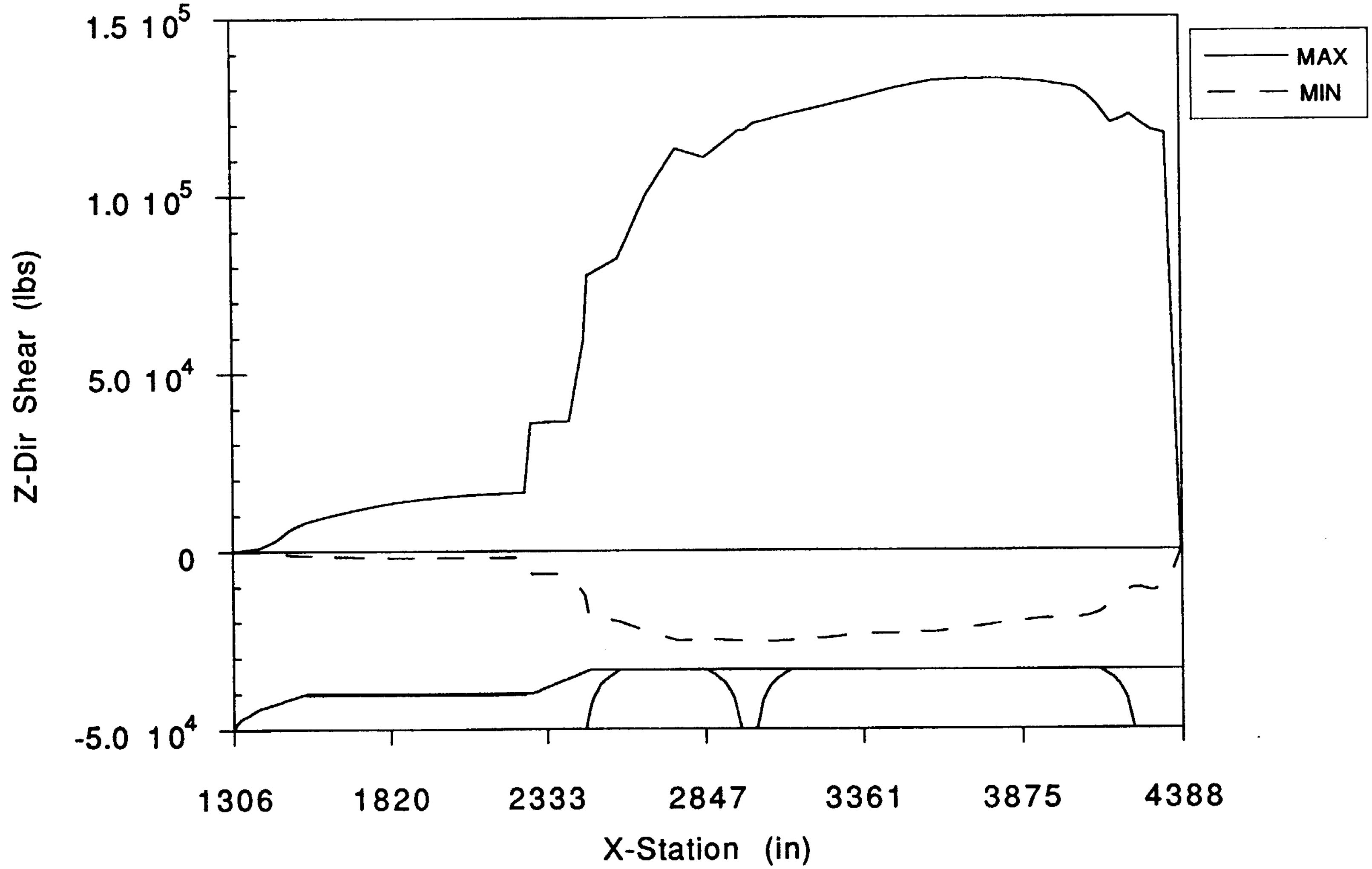
X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1306.1	0	0	0	0	0	0	0	0
1395.1	4.679	-1.208	4.679	-1.208	1029	-265.6	1029	-265.6
1444.9	7.396	-1.905	7.396	-1.905	2788	-718.3	2788	-718.3
1494.6	12.38	-3.174	12.38	-3.174	6225	-1595	6225	-1595
1544.4	13.53	-3.445	13.53	-3.445	8499	-2165	8499	-2165
1624.4	17.06	-4.29	17.06	-4.29	10720	-2696	10720	-2696
1704.4	20.48	-5.059	20.48	-5.059	12870	-3179	12870	-3179
1784.4	23.77	-5.737	23.77	-5.737	14930	-3605	14930	-3605
1864.4	26.9	-6.31	26.9	-6.31	16900	-3965	16900	-3965
1944.4	29.87	-6.767	29.87	-6.767	18770	-4252	18770	-4252
2024.4	32.66	-7.097	32.66	-7.097	20520	-4459	20520	-4459
2104.4	35.25	-7.29	35.25	-7.29	22150	-4580	22150	-4580
2184.4	37.64	-7.339	37.64	-7.339	23650	-4611	23650	-4611
2264.4	39.81	-7.238	39.81	-7.238	25020	-4548	25020	-4548
2284.8	345	-47.38	251.6	-99.9	216800	-29770	158100	-62770
2347.8	246.3	-57.67	246.3	-57.67	185200	-43370	185200	-43370
2410.8	212.9	-47.76	212.9	-47.76	186500	-41830	186500	-41830
2459.2	248.5	13.5	248.5	13.5	241300	13110	241300	13110
2471.1	324.4	42.81	324.4	42.81	322700	42580	322700	42580
2569.8	370.4	73.65	370.4	73.65	385200	76590	385200	76590
2664.1	421.8	133	421.8	133	438600	138300	438600	138300
2758.5	480.7	220.8	480.7	220.8	499800	229600	499800	229600
2852.8	548	325.6	548	325.6	569800	338600	569800	338600
2963.4	611.3	397.9	611.3	397.9	635700	413700	635700	413700
2985.7	1652	1333	1652	1333	1718000	1387000	1718000	1387000
3012.5	1663	1343	1663	1343	1730000	1396000	1730000	1396000
3123.1	1667	1355	1667	1355	1733000	1409000	1733000	1409000
3240	1661	1362	1661	1362	1727000	1416000	1727000	1416000
3356.9	1652	1368	1652	1368	1718000	1423000	1718000	1423000
3473.7	1647	1375	1647	1375	1713000	1430000	1713000	1430000
3590.6	1656	1383	1656	1383	1722000	1438000	1722000	1438000
3707.4	1669	1390	1669	1390	1736000	1446000	1736000	1446000
3824.3	1678	1398	1678	1398	1745000	1453000	1745000	1453000
3941.1	1684	1404	1684	1404	1751000	1460000	1751000	1460000
4058	1686	1412	1686	1412	1753000	1468000	1753000	1468000
4090.3	1688	1422	1688	1422	1755000	1478000	1755000	1478000
4122.6	1690	1433	1690	1433	1757000	1490000	1757000	1490000
4166.6	1950	1670	1947	1662	2028000	1737000	2025000	1728000
4210.3	1953	1677	1952	1677	2031000	1744000	2030000	1744000
4227.4	1954	1680	1954	1680	2032000	1747000	2032000	1747000
4254	1963	1695	1963	1695	2042000	1763000	2041000	1762000
4297.8	1971	1708	1969	1707	2049000	1776000	2047000	1775000
4341.6	1969	1692	1967	1685	2047000	1759000	2046000	1752000
4385.5	2870	0.2145	-0.214	-2870	2985000	223.1	-222.5	-2985000


NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION
MAX
MIN
Axial Shear (lbs)
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

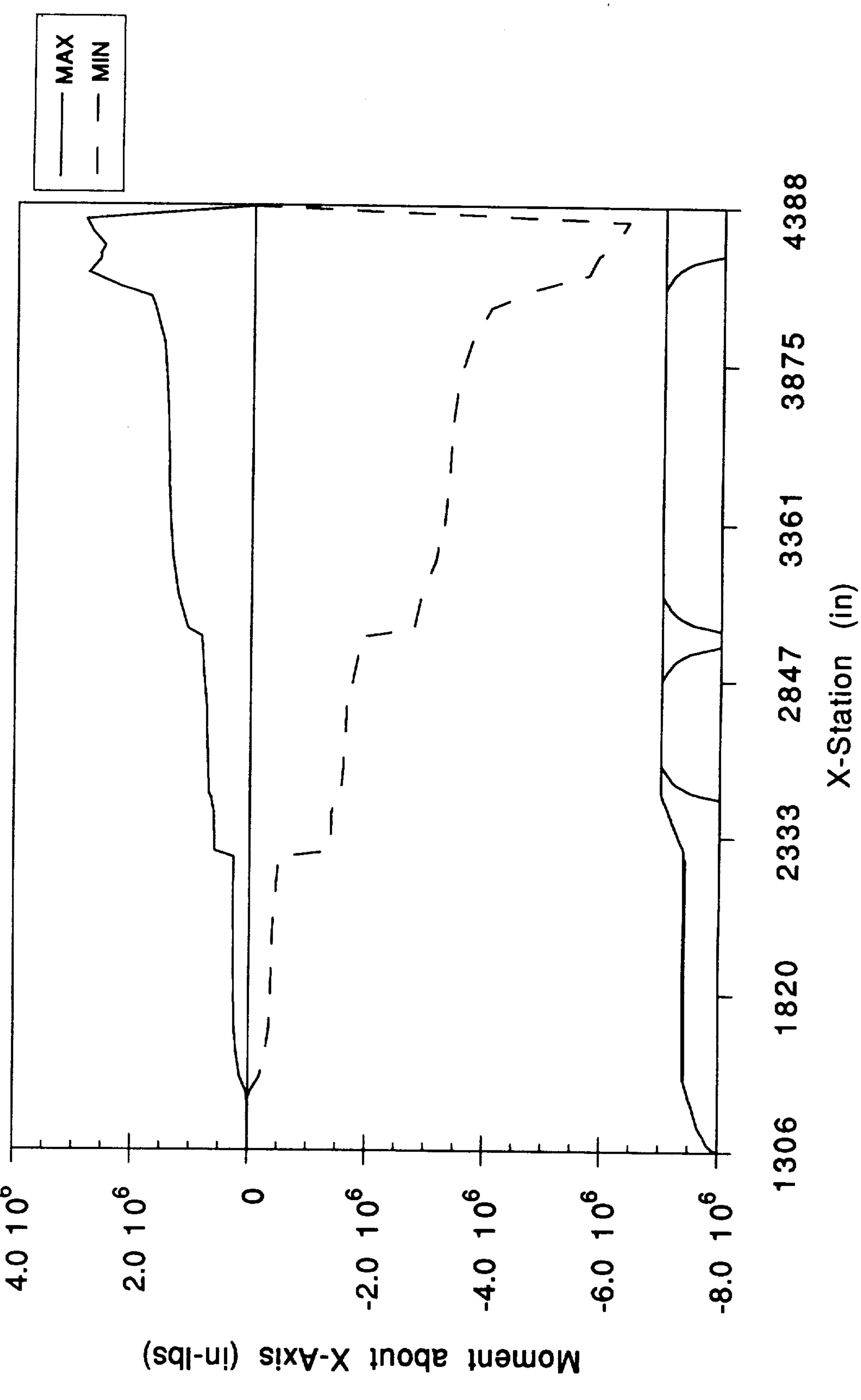
C-3


NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION
Y-Dir Shear (lbs)
1.2 10^5
1.0 10^5
8.0 10^4
6.0 10^4
4.0 10^4
2.0 10^4
0
-2.0 10^4
-4.0 10^4
1306
1820
2333
2847
3361
3875
4388
X-Station (in)
MAX
MIN

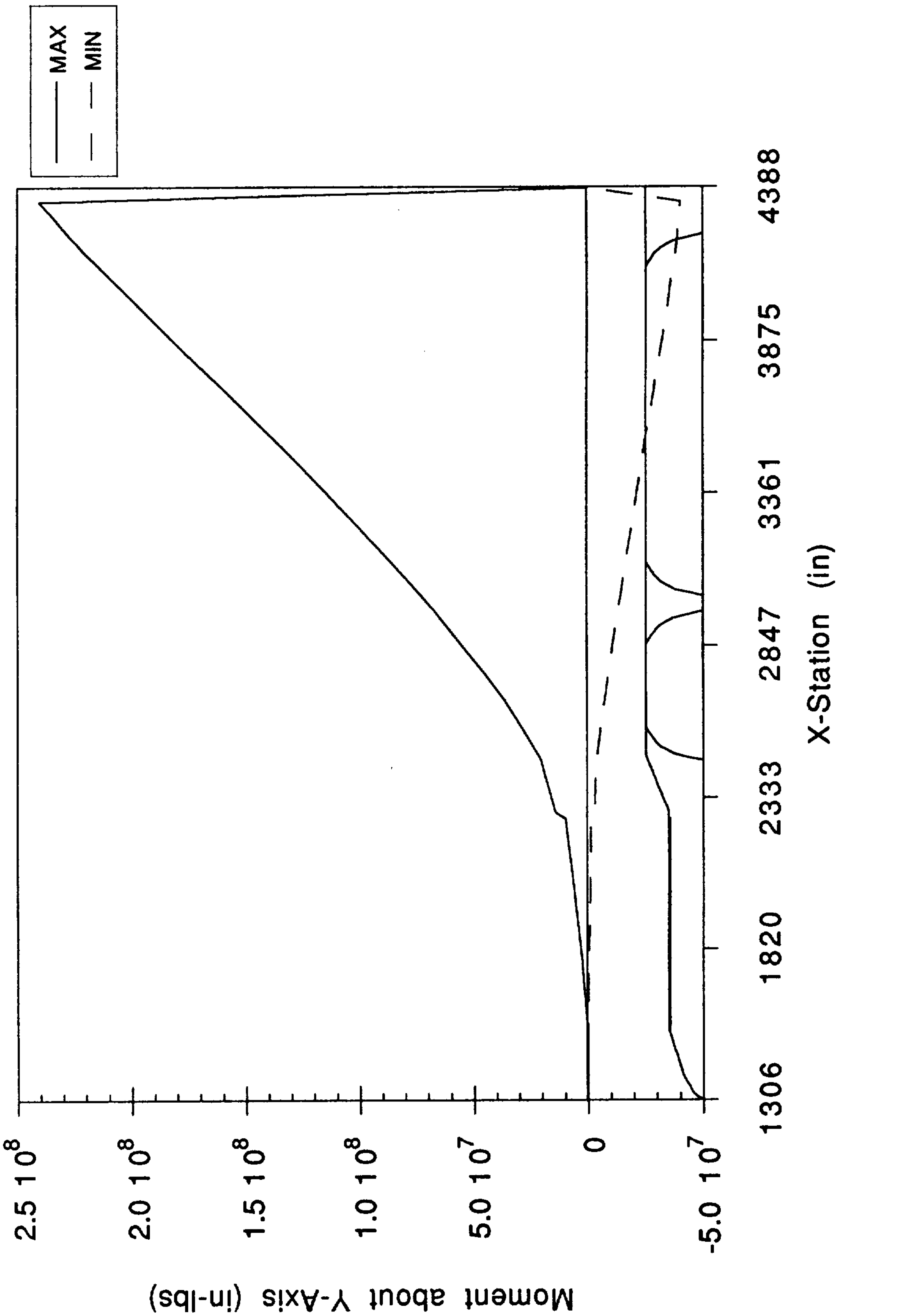
NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION



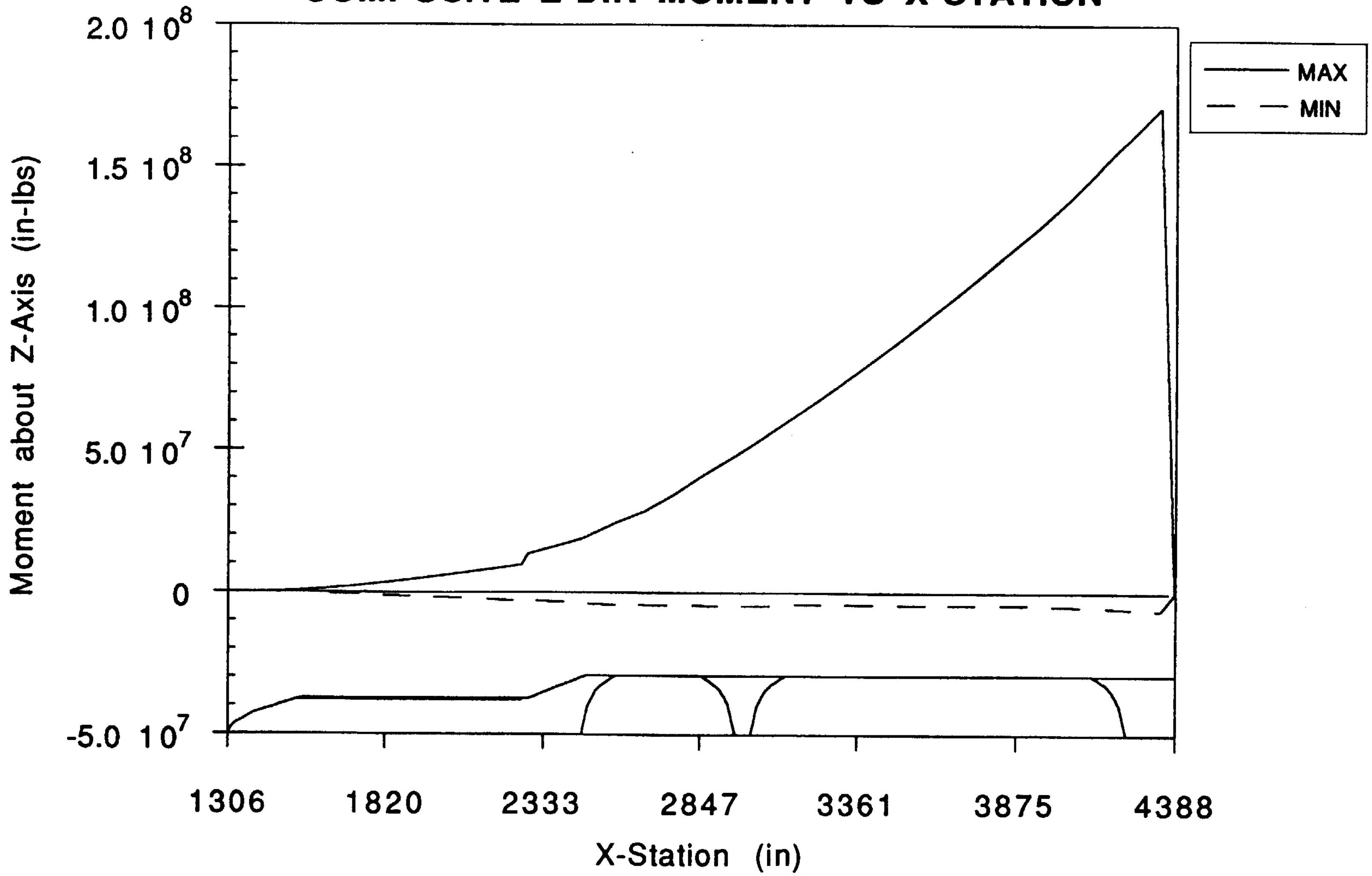
NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE X-DIR TORSION VS X-STATION



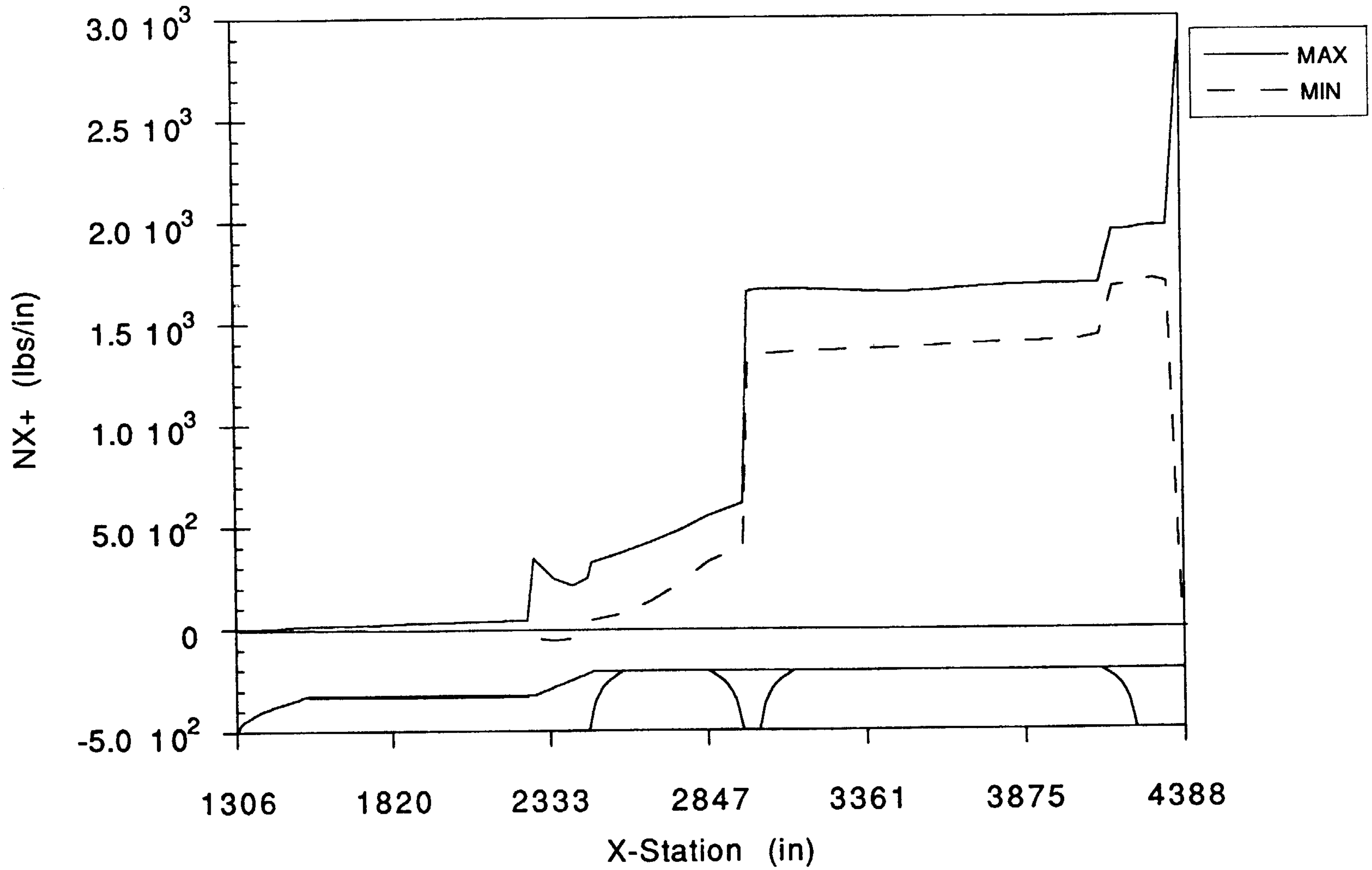
NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION

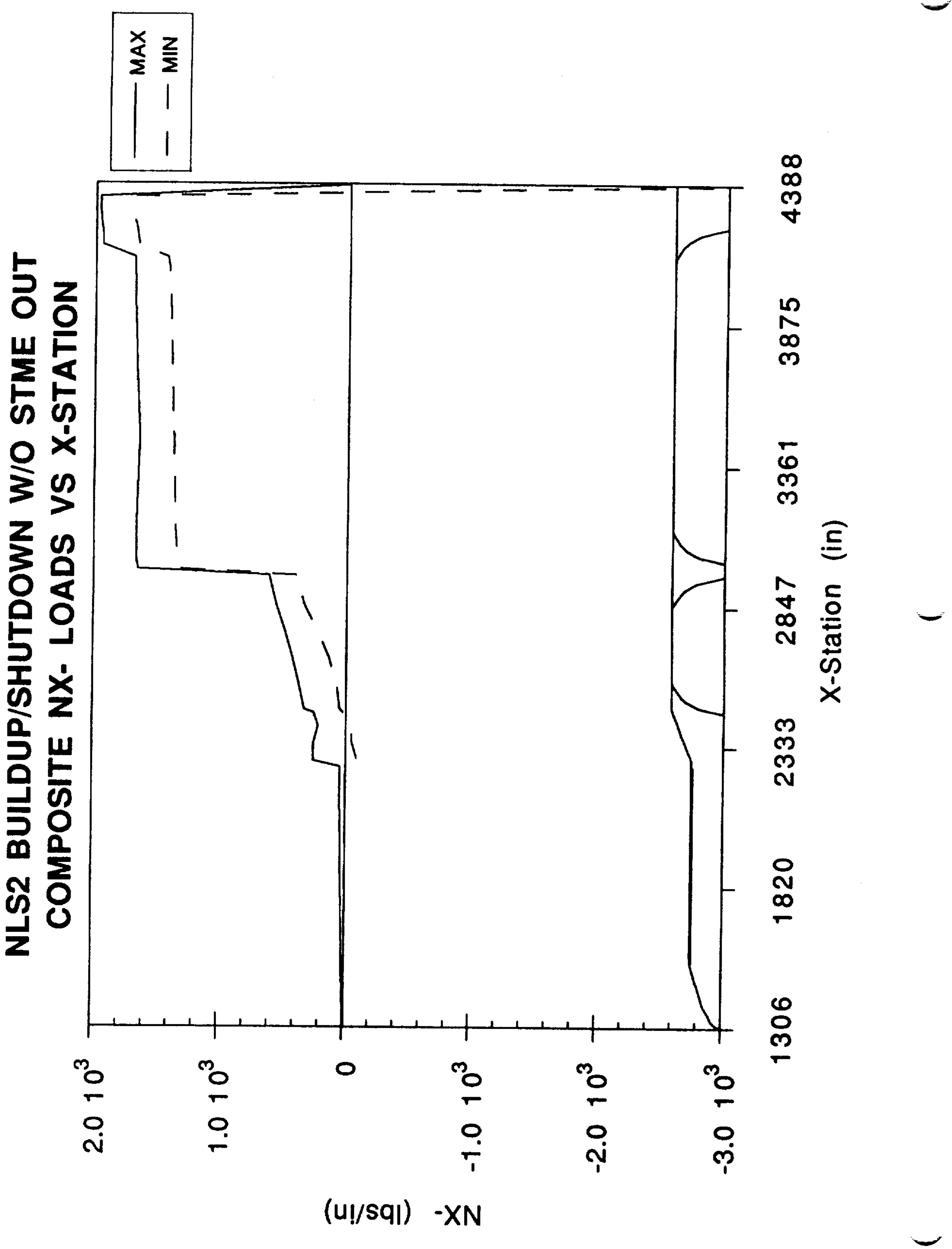


NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION



NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE NX+ LOADS VS X-STATION




NLS2 BUILDUP/SHUTDOWN W/O STME OUT
COMPOSITE NX- LOADS VS X-STATION
MAX
MIN
NX- (lbs/in)
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS 1

LIFTOFF DATA

NLS1 WITH STME OUT LIFTOFF PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	4.9	95.4	2.4	-495	-7.4	-154.8
M2	7.4	19.9	3.4	-833.3	-126.8	-276.9
M3	5.4	86.4	160.7	-511.1	0	-6.33
M4	6.4	35.2	271	-817.8	-111.4	-0.3
M5	3.5	16.6	2	-556.4	-99.8	-177.6
M6	7.5	112.8	4.3	-699.9	-9	-230.9
M7	5.2	10.2	183.4	-571.9	-92.5	-6.7
M8	6.5	97.9	224.7	-683.3	-13.5	-1.3

NLS1 WITH OUT STME OUT LIFTOFF PAD FORCES (KIPS)

PAD NUMBER	MAXIMUM			MINIMUM		
	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	4.9	95.4	2.4	-495	-7.4	-154.8
M2	7.4	19.9	3.4	-833.3	-126.8	-276.9
M3	5.4	86.4	160.7	-511.1	0	-6.3
M4	6.4	35.2	271	-817.8	-111.4	-0.3
M5	3.5	16.6	2	-556.4	-99.8	-177.6
M6	7.5	112.8	4.3	-699.9	-9	-230.9
M7	5.2	10.2	183.4	-571.9	-92.5	-6.7
M8	4	97.9	224.7	-683.3	-13.5	-1.3

NLS1 Liftoff Accelerations (G's)

	W/STME Out		W/O STME Out	
	Maximum	Minimum	Maximum	Minimum
Node 7 Payload 1 30K X-Dir	1.819	-0.916	1.819	-0.916
Node 7 Payload 1 30K Y-Dir	0.879	-0.6014	0.879	-0.6014
Node 7 Payload 1 30K Z-Dir	0.9074	-0.927	0.902	-0.927
Node 90 Payload 2 40K X-Dir	1.6023	-0.687	1.6023	-0.687
Node 90 Payload 2 40K Y-Dir	0.5394	-0.333	0.5394	-0.333
Node 90 Payload 2 40K Z-Dir	0.6216	-0.5757	0.6216	-0.5757
Node 12 Payload 3 30K X-Dir	1.6855	-0.49	1.6855	-0.49
Node 12 Payload 3 30K Y-Dir	0.3054	-0.2446	0.3054	-0.2446
Node 12 Payload 3 30K Z-Dir	0.495	-0.4656	0.495	-0.4656
Node 80 LO2 Slosh X-Dir	1.2051	-0.23	1.2051	-0.23
Node 81 LH2 Slosh X-Dir	1.5274	-0.59	1.5274	-0.59
Node 45 FPM X-Dir	1.8837	-0.96	1.8837	-0.96
Node 45 FPM Y-Dir	1.391	-0.9517	1.391	-0.9517
Node 45 FPM Z-Dir	1.445	-1.679	1.434	-1.679
Node 46 CTV X-Dir	1.8615	-0.379	1.8615	-0.379
Node 46 CTV Y-Dir	0.2237	-0.1194	0.2237	-0.1194
Node 46 CTV Z-Dir	0.3612	-0.3424	0.3599	-0.3424

NLS1 Liftoff Core Interface Loads (kips)

Location		With STME Out		Without STME Out		Allowable	Allowable
		Maximum	Minimum	Maximum	Minimum	(Max)	(Min)
Fwd Attach +y	FTB6	94.43	-1163	94.43	-1163	156	-1725
Fwd Attach +y	FTB4	118.9	-228.7	118.9	-228.7	86	-219
Fwd Attach +y	FTB2	18.14	-16.64	18.14	-16.48	[illegible]	[illegible]
Fwd Attach -y	FTB5	237.8	-1129	237.8	-1129	[illegible]	[illegible]
Fwd Attach -y	FTB3	210.6	-120.8	210.6	-120.8	[illegible]	[illegible]
Fwd Attach -y	FTB1	16.21	-14.59	16.21	-14.32	[illegible]	[illegible]
Aft Attach +y	FTB10	111.4	-80.37	111.4	-80.37	[illegible]	[illegible]
Aft Attach +y	FTB8*	48.3	-38.86	45.71	-38.86	[illegible]	[illegible]
Aft Attach +y	FTBB	115.1	-65.72	113.6	-65.72	[illegible]	[illegible]
Aft Attach +y	FTB8**	6.073	-11.22	6.073	-11.09	[illegible]	[illegible]
Aft Attach -y	FTB9	79.63	-113.3	79.63	-113.3	[illegible]	[illegible]
Aft Attach -y	FTB7*	48.62	-38.75	48.62	-38.75	[illegible]	[illegible]
Aft Attach -y	FTBA	64.18	-121.7	64.18	-120.5	[illegible]	[illegible]
Aft Attach -y	FTB7**	5.933	-11.82	5.933	-11.76	[illegible]	[illegible]

*upper aft attach

**lower aft attach

NLS1 COMPOSITE SHEAR BODY LOADS W/STME OUT (LBS)

LIFTOFF

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	92.67	7.684	39.73	-26.85	45.39	-39.46
1110.6	1379	114.4	543.9	-380.3	631.3	-554.5
1155.1	3720	308.7	1379	-990.6	1630	-1436
1229.75	8234	684.7	2779	-2071	3353	-2968
1304.4	31340	2615	9485	-7247	11430	-10220
1411	38670	3237	11220	-8649	13480	-12100
1518	165500	14190	35280	-29890	42320	-38050
1625	170900	14720	36240	-30920	43460	-39010
1732	174900	15190	36930	-31680	44150	-39530
1784.4	251900	25850	51220	-46200	56480	-48240
1839	254700	26360	51740	-46630	56810	-48940
1946	256900	27020	52090	-46760	56780	-49300
2050.8	287300	20920	56230	-48150	51740	-50820
2160	289500	21190	56570	-48350	51350	-50680
2264.4	292400	22590	56790	-48440	50930	-50400
2284.8	336200	34310	58520	-48930	45530	-46120
2340.68	338600	35010	58590	-48950	45450	-45950
2396.57	341400	36020	58590	-48930	45340	-45770
2459.17	507600	101600	57290	-40110	63530	-77710
2473.8	676500	165300	68600	-56980	108700	-122400
2569.8	828500	214900	73290	-75220	132400	-136000
2664.13	942000	242500	79530	-90050	145400	-130700
2758.47	1009000	250200	90810	-114700	127300	-104900
2852.8	1044000	257200	101600	-132500	93670	-97750
2963.42	3219000	1303000	115000	-152400	51750	-69340
2990.67	1653000	-421100	29300	-70980	65460	-65470
3012.52	1677000	-410200	30400	-69500	59220	-59710
3123.15	1728000	-396600	31380	-68070	48870	-50170
3233.63	1776000	-386300	32690	-65990	37550	-42660
3337.35	1829000	-375300	34660	-63660	43530	-39440
3480.57	1880000	-364200	37450	-59610	50420	-48000
3623.8	1921000	-353900	40480	-55030	57110	-60160
3747.4	1946000	-344600	43040	-53310	62460	-71200
3871	1955000	-337200	44580	-52100	65780	-72880
3964.5	1948000	-330400	45130	-51100	67630	-71810
4054	1915000	-323400	24990	-39520	64760	-60870
4118.65	1858000	-315900	23500	-57360	72440	-55010
4122.65	1799000	-308500	24660	-76380	87540	-49590
4233.27	1851000	-90230	22640	-81800	94350	-41800
4309.4	1317000	-61010	17350	-71000	84760	-29920
4385.5	0.02736	-81.7	0.09784	-116.7	88.08	-0.2868

NLS1 COMPOSITE MOMENT BODY LOADS W/STME OUT (IN-LBS)

LIFTOFF

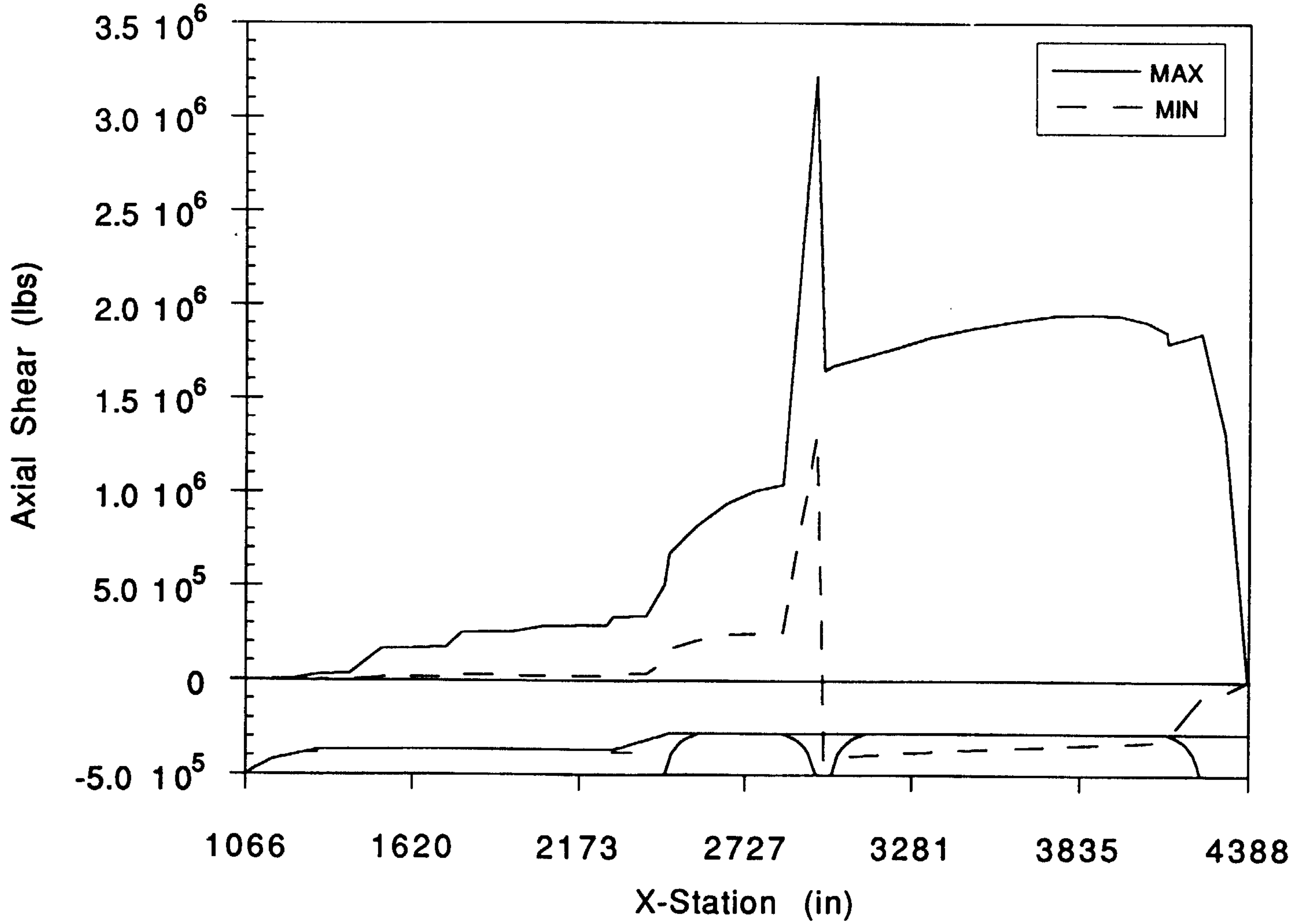
X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	24950	-24730	0.01646	-0.02552	0.06142	-0.0006733
1110.6	30750	-29320	2022	-1757	1770	-1196
1155.1	34150	-31480	30100	-26430	25970	-18120
1229.75	35200	-31360	151800	-133600	128900	-92070
1304.4	39180	-34620	578300	-510600	477800	-357600
1411	47870	-39720	1796000	-1600000	1489000	-1130000
1518	109200	-103700	5166000	-4588000	4331000	-3051000
1625	115500	-113300	9557000	-8635000	7920000	-6177000
1732	119900	-121100	14120000	-12800000	11800000	-9400000
1784.4	147100	-172700	17860000	-16290000	14420000	-11810000
1839	149700	-178300	20840000	-18860000	17200000	-14240000
1946	150400	-181300	26790000	-23910000	22700000	-19130000
2050.8	162700	-189100	33440000	-29280000	28610000	-24500000
2160	165700	-192600	38940000	-33630000	34690000	-29440000
2264.4	167900	-194800	44180000	-37780000	40510000	-34140000
2284.8	198100	-222400	44780000	-37270000	42780000	-35220000
2340.68	204700	-227500	47020000	-38980000	45860000	-37600000
2396.57	216200	-232300	49380000	-40660000	48950000	-39970000
2459.17	253600	-255900	52020000	-43070000	52400000	-42630000
2473.8	278800	-282700	52010000	-43190000	52980000	-42980000
2569.8	301200	-312200	48430000	-40650000	55230000	-44880000
2664.13	320500	-339900	42970000	-35270000	55710000	-45250000
2758.47	336700	-364900	37900000	-38170000	57680000	-43630000
2852.8	367900	-422600	41980000	-46200000	60250000	-39970000
2963.42	389300	-473100	50750000	-51690000	65620000	-49700000
2990.67	696900	-1231000	51310000	-51250000	63480000	-42200000
3012.52	715600	-1242000	51380000	-51260000	62090000	-41560000
3123.15	699600	-1246000	50820000	-50300000	55160000	-38200000
3233.63	677000	-1246000	49130000	-48140000	49010000	-34730000
3337.35	643600	-1241000	46540000	-45070000	44000000	-31340000
3480.57	599900	-1233000	41670000	-39430000	37250000	-26380000
3623.8	607000	-1221000	35650000	-35690000	30360000	-21010000
3747.4	654600	-1208000	29660000	-32280000	26320000	-17670000
3871	693700	-1197000	23050000	-30510000	28680000	-13740000
3964.5	722700	-1188000	17750000	-31880000	29180000	-10140000
4054	459600	-539900	15610000	-33650000	27890000	-7952000
4118.65	431800	-520500	11750000	-30610000	25380000	-6554000
4122.65	408800	-501200	11530000	-30340000	25150000	-6462000
4233.27	381200	-470300	6060000	-21210000	16700000	-3767000
4309.4	373900	-461300	3106000	-14340000	10470000	-2065000
4385.5	349.9	-0.4949	187900	-710.1	352.6	-439100

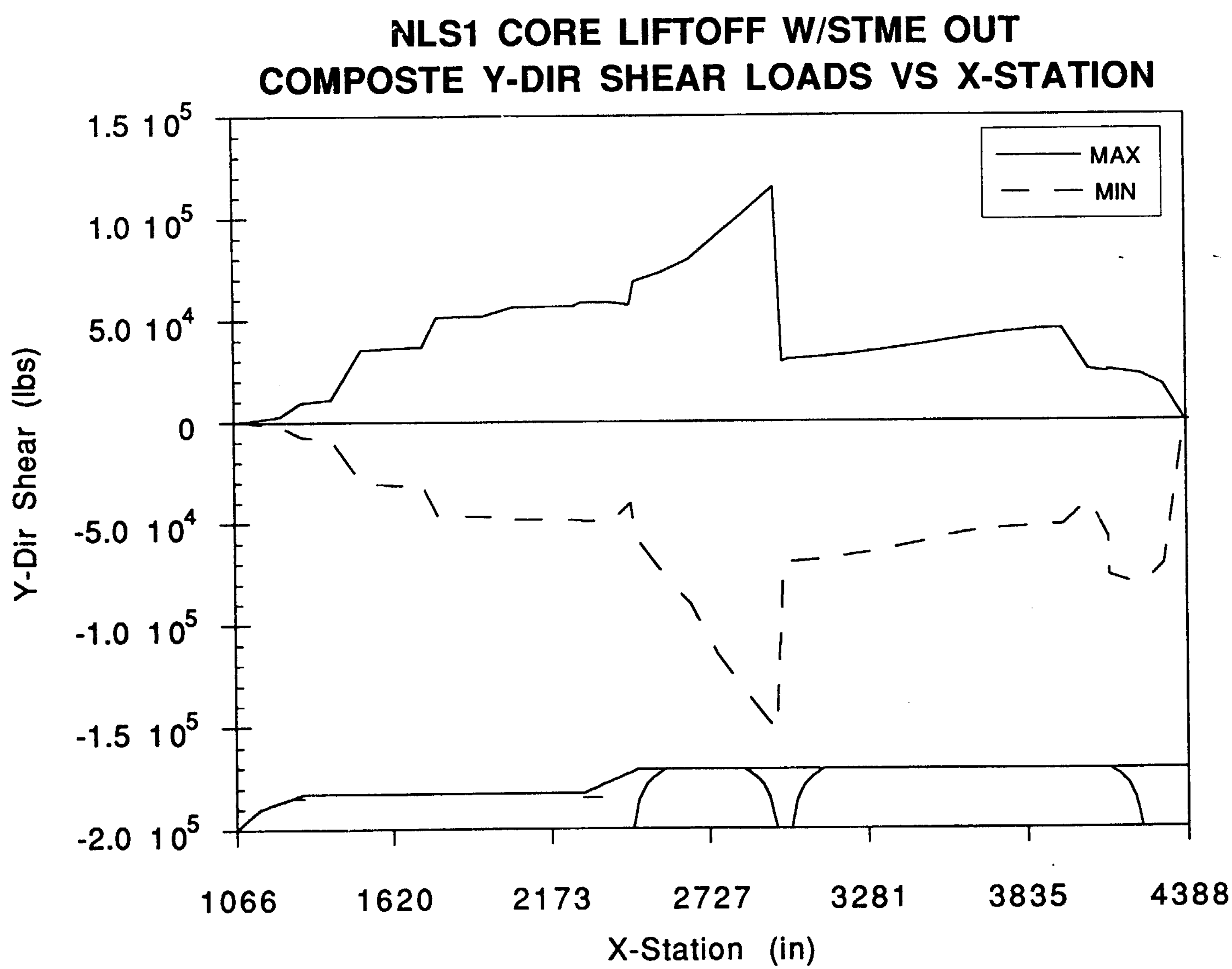
NLS1 COMPOSITE LINE BODY LOADS W/STME OUT

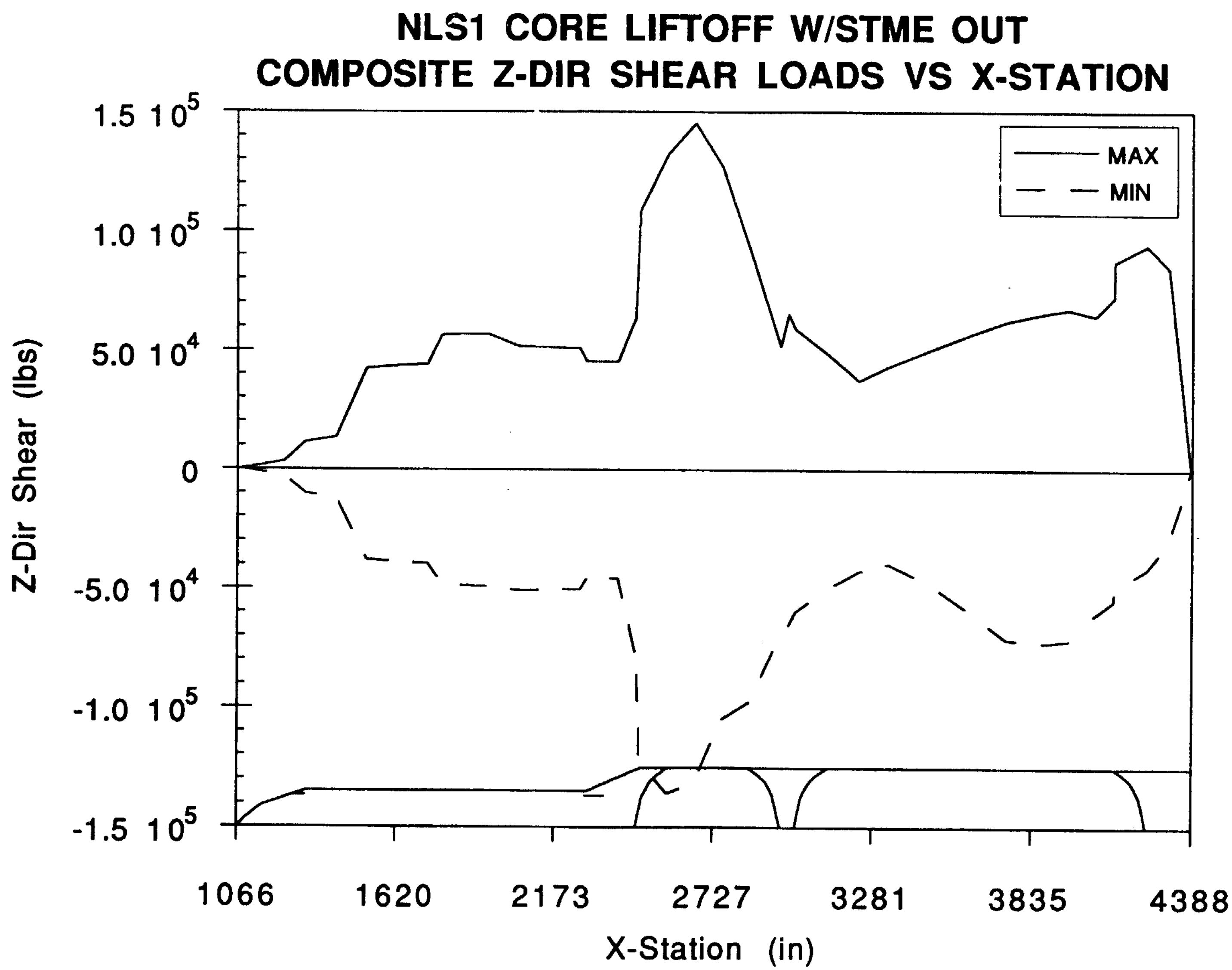
LIFTOFF

X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1066.06	0	0	0	0	0	0	0	0
1110.6	6.272	0.5201	6.272	0.5201	6.272	0.5201	1379	114.4
1155.1	9.869	0.8188	9.869	0.8188	9.869	0.8188	3720	308.7
1229.75	16.38	1.362	16.38	1.362	16.38	1.362	8234	684.7
1304.4	51.05	4.169	49.5	2.828	49.5	2.828	31100	1777
1411	61.54	5.152	61.54	5.152	61.54	5.152	38670	3237
1518	307.9	22.63	260.1	6.425	260.1	6.425	163400	4037
1625	272	23.43	272	23.43	272	23.43	170900	14720
1732	278.3	24.18	278.3	24.18	278.3	24.18	174900	15190
1784.4	412.5	41.18	390.6	39.21	390.6	39.21	245400	24640
1839	405.4	41.95	405.4	41.95	405.4	41.95	254700	26360
1946	408.9	43.01	408.9	43.01	408.9	43.01	256900	27020
2050.8	460.6	35.53	454.5	30.87	454.5	30.87	285600	19390
2160	460.8	33.72	460.8	33.72	460.8	33.72	289500	21190
2264.4	465.4	35.95	465.4	35.95	465.4	35.95	292400	22590
2284.8	528	71.86	490.3	26.49	490.3	26.49	327700	17710
2340.68	435.1	44.99	435.1	44.99	435.1	44.99	338600	35010
2396.57	384.4	40.56	384.4	40.56	384.4	40.56	341400	36020
2459.17	502	100.4	502	100.4	502	100.4	507600	101600
2473.8	650.5	159	650.5	159	650.5	159	676500	165300
2569.8	796.7	206.6	796.7	206.6	796.7	206.6	828500	214900
2664.13	905.9	233.2	905.9	233.2	905.9	233.2	942000	242500
2758.47	970.4	240.6	970.4	240.6	970.4	240.6	1009000	250200
2852.8	1004	247.3	1004	247.3	1004	247.3	1044000	257200
2963.42	3096	1253	3096	1253	3096	1253	3219000	1303000
2990.67	2236	-404.9	1574	-982.7	1574	-982.7	1637000	-1022000
3012.52	1612	-394.5	1612	-394.5	1612	-394.5	1677000	-410200
3123.15	1662	-381.4	1662	-381.4	1662	-381.4	1728000	-396600
3233.63	1708	-371.5	1708	-371.5	1708	-371.5	1776000	-386300
3337.35	1759	-360.9	1759	-360.9	1759	-360.9	1829000	-375300
3480.57	1808	-350.2	1808	-350.2	1808	-350.2	1880000	-364200
3623.8	1847	-340.3	1847	-340.3	1847	-340.3	1921000	-353900
3747.4	1871	-331.4	1871	-331.4	1871	-331.4	1946000	-344600
3871	1880	-324.2	1880	-324.2	1880	-324.2	1955000	-337200
3964.5	1874	-317.7	1874	-317.7	1874	-317.7	1948000	-330400
4054	1842	-311	1842	-311	1842	-311	1915000	-323400
4118.65	1787	-303.8	1787	-303.8	1787	-303.8	1858000	-315900
4122.65	1730	-296.7	1730	-296.7	1730	-296.7	1799000	-308500
4233.27	1780	-86.77	1780	-86.77	1780	-86.77	1851000	-90230
4309.4	1266	-58.67	1266	-58.67	1266	-58.67	1317000	-61010
4385.5	113.8	-0.03237	-5.054E-06	-113.9	-5.054E-06	-113.9	-0.005256	-118500

NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION

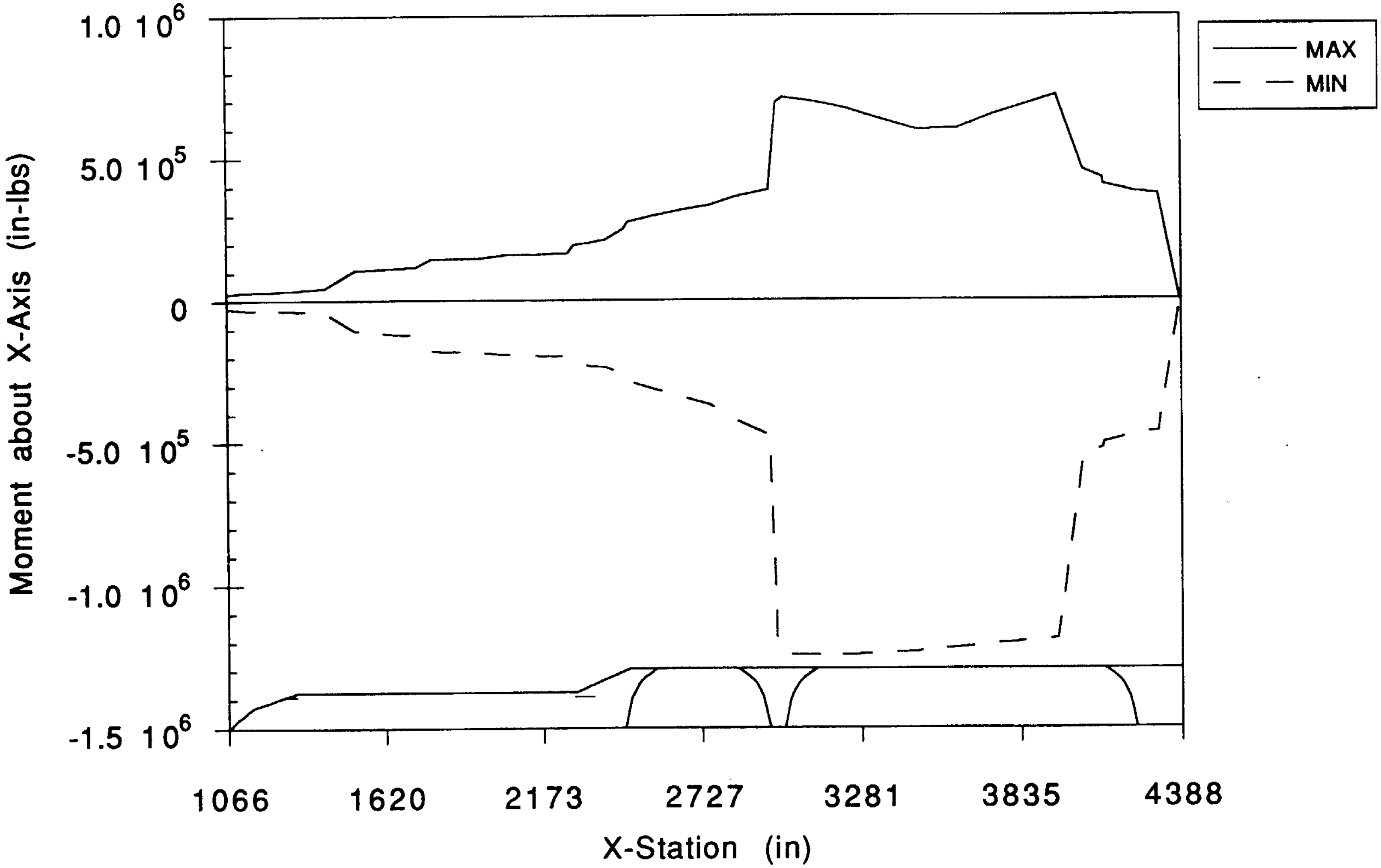



NLS1 CORE LIFTOFF W/STME OUT
COMPOSTE Y-DIR SHEAR LOADS VS X-STATION
MAX
MIN
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
Y-Dir Shear (lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

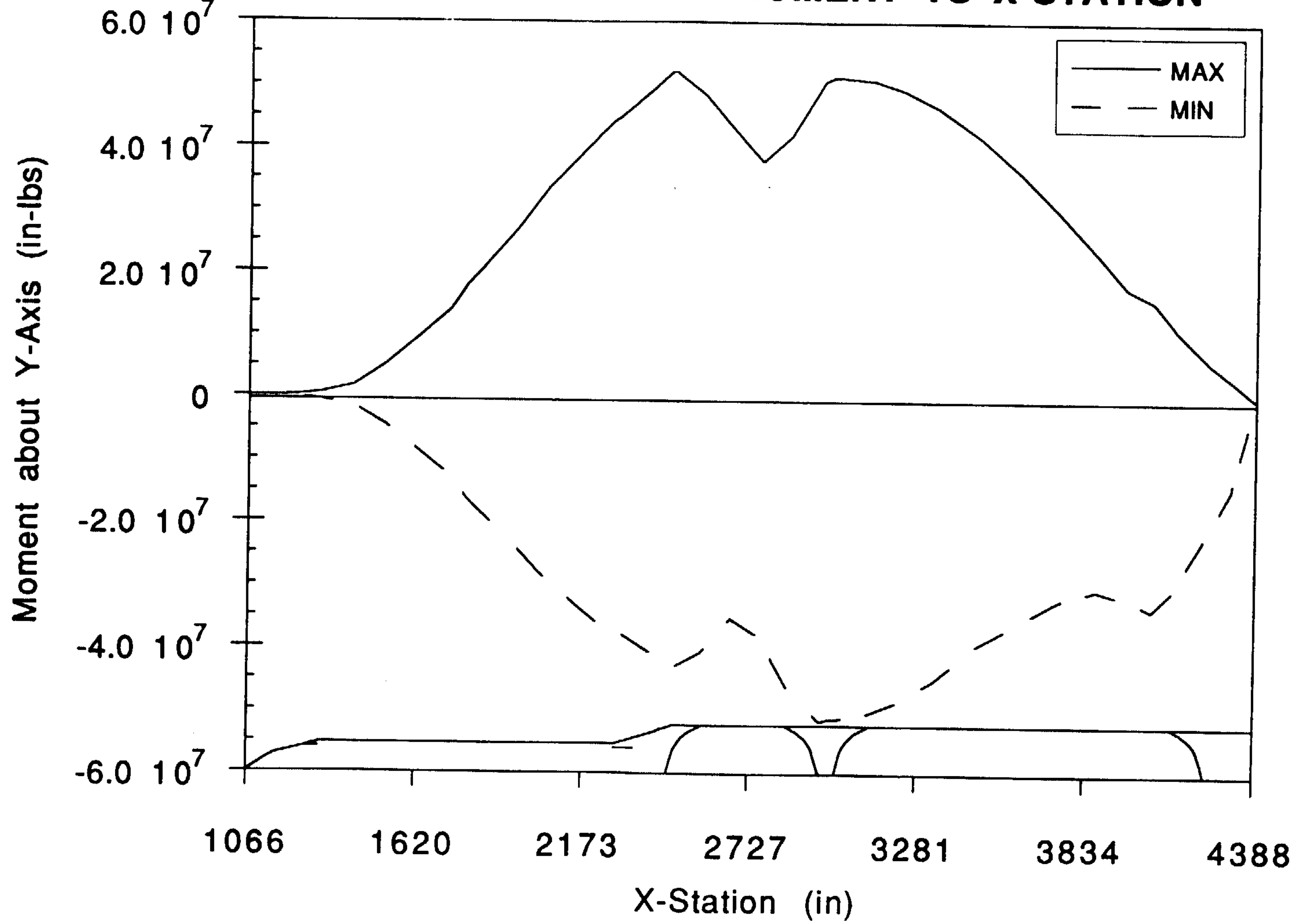


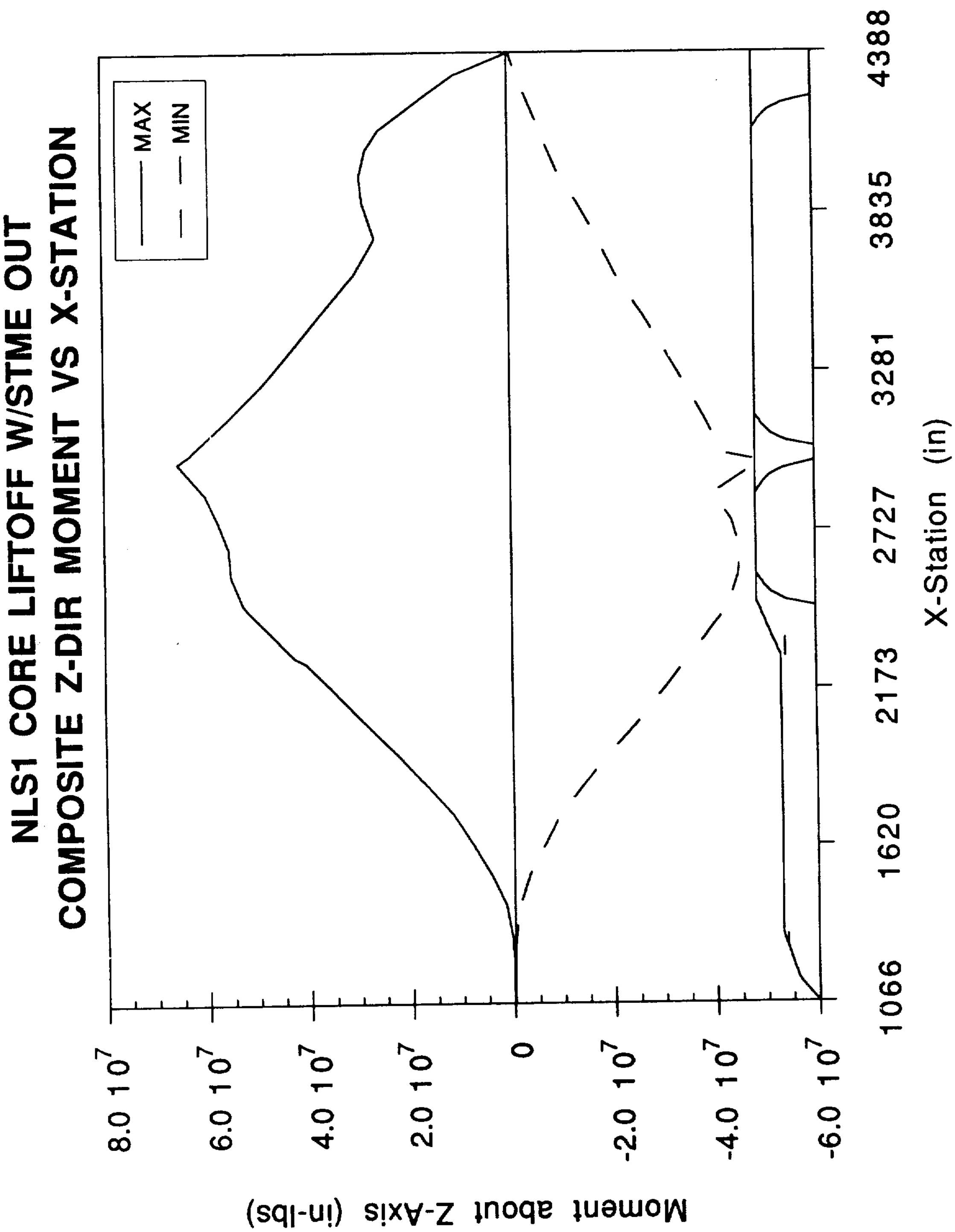
NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION
MAX
MIN
Z-Dir Shear (lbs)
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

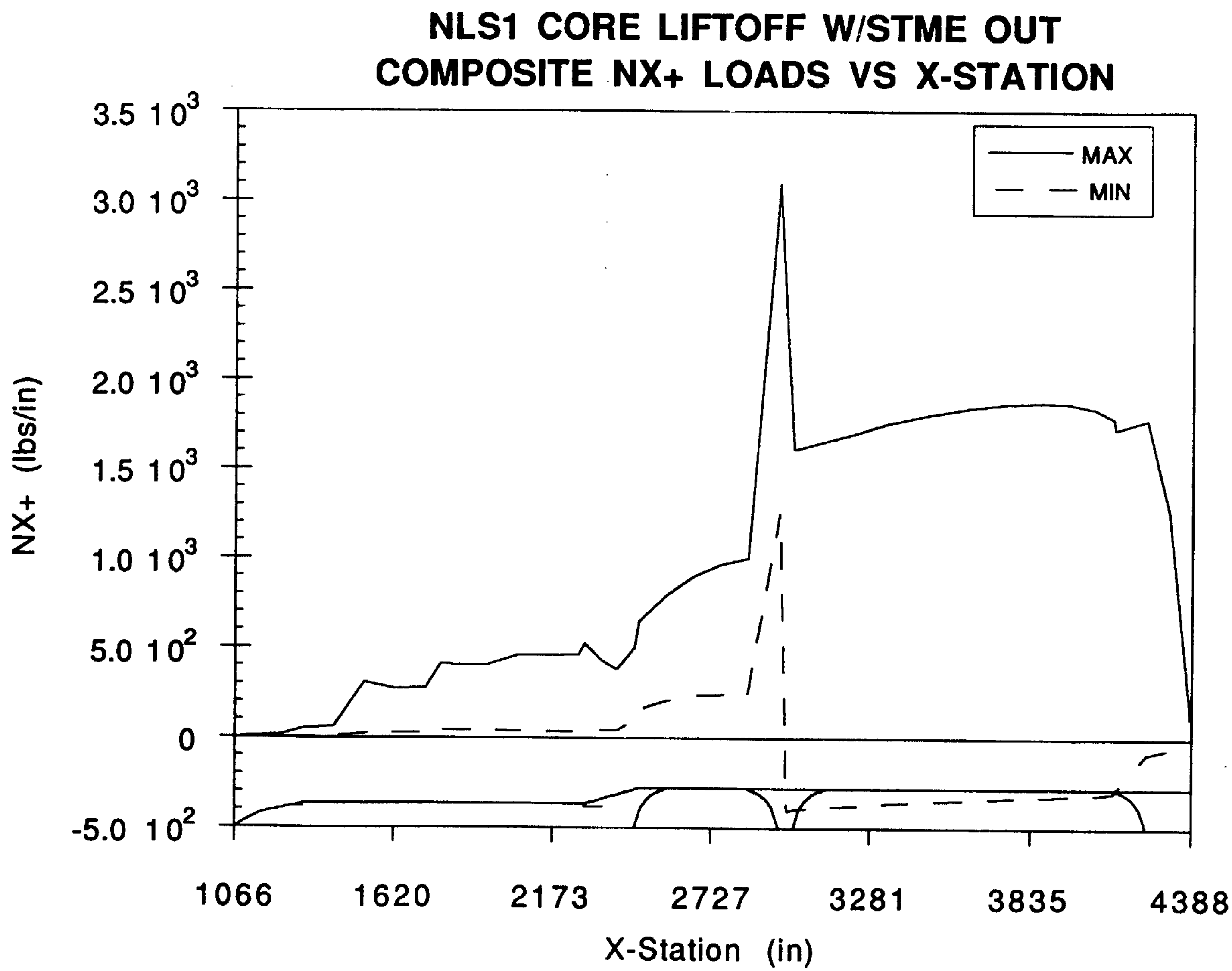
NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE X-DIR TORSION VS X-STATION



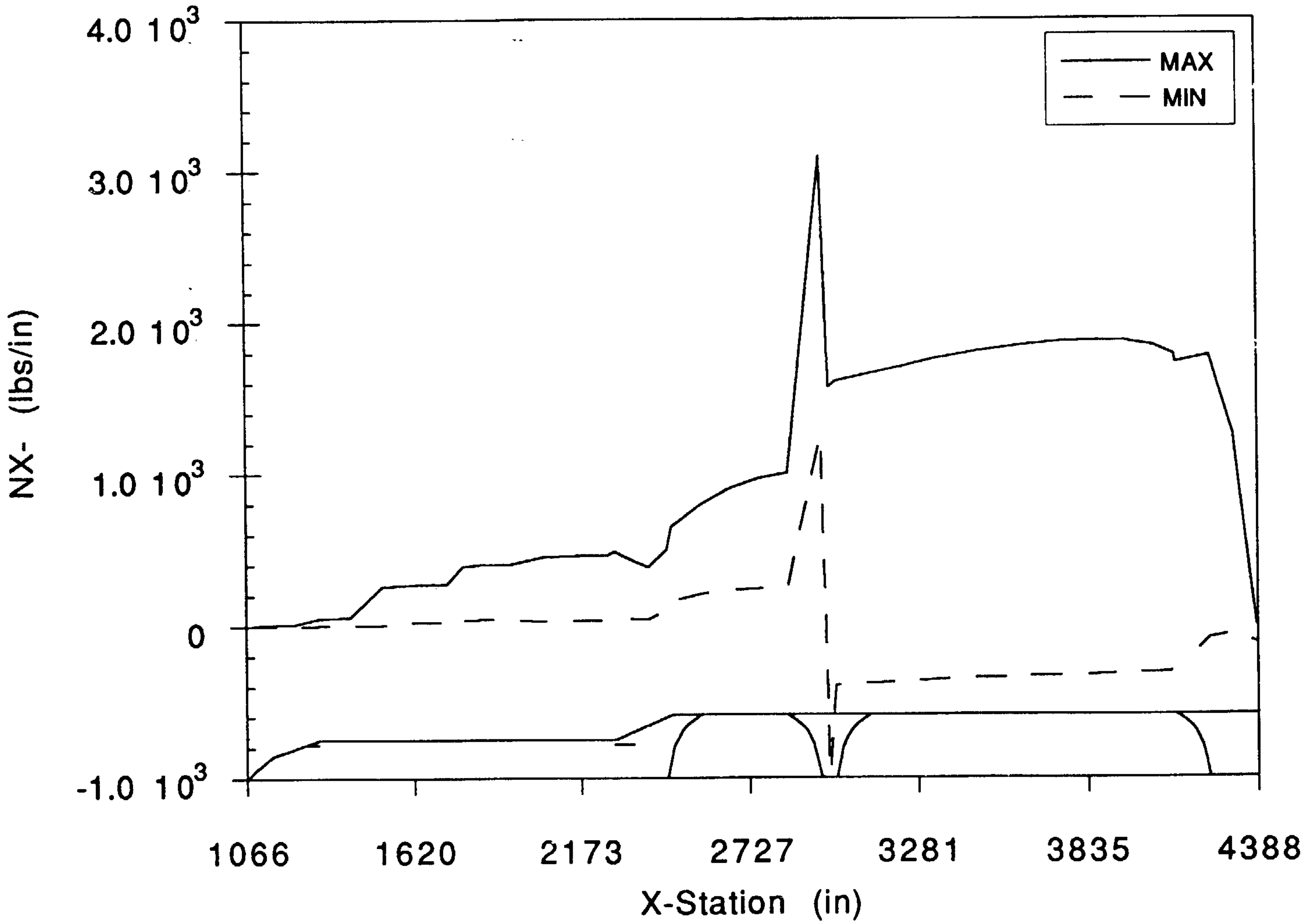
NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION




NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION
MAX
MIN
Moment about Z-Axis (in-lbs)
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE NX+ LOADS VS X-STATION
MAX
MIN
NX+ (lbs/in)
3.5 10^3
3.0 10^3
2.5 10^3
2.0 10^3
1.5 10^3
1.0 10^3
5.0 10^2
0
-5.0 10^2
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

NLS1 CORE LIFTOFF W/STME OUT
COMPOSITE NX- LOADS VS X-STATION



NLS1 COMPOSITE SHEAR BODY LOADS W/O STME OUT (LBS)

LIFTOFF

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	92.67	7.684	39.73	-26.85	45.39	-39.46
1110.6	1379	114.4	543.9	-380.3	629.3	-554.5
1155.1	3720	308.7	1379	-990.6	1626	-1436
1229.75	8234	684.7	2779	-2071	3349	-2968
1304.4	31340	2615	9485	-7247	11430	-10190
1411	38670	3237	11220	-8649	13480	-12060
1518	165500	14190	35280	-29890	42320	-37810
1625	170900	14720	36240	-30920	43460	-38760
1732	174900	15190	36930	-31680	44150	-39270
1784.4	251900	25850	51220	-46200	56480	-47740
1839	254700	26360	51740	-46630	56810	-48420
1946	256900	27020	52090	-46760	56780	-48780
2050.8	287300	20920	56230	-48150	51740	-49690
2160	289500	21190	56570	-48350	51350	-49500
2264.4	292400	22590	56790	-48440	50930	-49180
2284.8	336200	34310	58520	-48930	45530	-43980
2340.68	338600	35010	58590	-48950	45450	-43780
2396.57	341400	36020	58590	-48930	45340	-43560
2459.17	507600	101600	57290	-40110	63530	-72390
2473.8	676500	165300	68600	-56980	108700	-115700
2569.8	828500	214900	73290	-75220	132400	-135000
2664.13	942000	242500	79530	-90050	141200	-130700
2758.47	1009000	250200	90810	-114700	126600	-104900
2852.8	1044000	257200	101600	-132500	93670	-85800
2963.42	3219000	1303000	115000	-152400	51750	-60220
2990.67	1653000	-421100	29300	-70980	65460	-56600
3012.52	1677000	-410200	30400	-69500	59220	-51950
3123.15	1728000	-396600	31380	-68070	48870	-45830
3233.63	1776000	-386300	32690	-65990	37550	-41990
3337.35	1829000	-375300	34660	-63660	43500	-39430
3480.57	1880000	-364200	37450	-59610	50420	-45960
3623.8	1921000	-353900	40480	-55030	57110	-53070
3747.4	1946000	-344600	43040	-53310	62460	-58230
3871	1955000	-337200	44580	-52100	65780	-61610
3964.5	1948000	-330400	45130	-51100	67630	-66460
4054	1915000	-323400	24990	-39520	63460	-60870
4118.65	1858000	-315900	23500	-34920	57700	-55010
4122.65	1799000	-308500	24660	-31620	51870	-49590
4233.27	1851000	-90230	22640	-27200	43430	-41800
4309.4	1317000	-61010	17350	-19980	31340	-29920
4385.5	0.02736	-81.7	0.09784	-116.7	88.08	-0.2868

NLS1 COMPOSITE MOMENT BODY LOADS W/O STME OUT (IN-LBS)

LIFTOFF

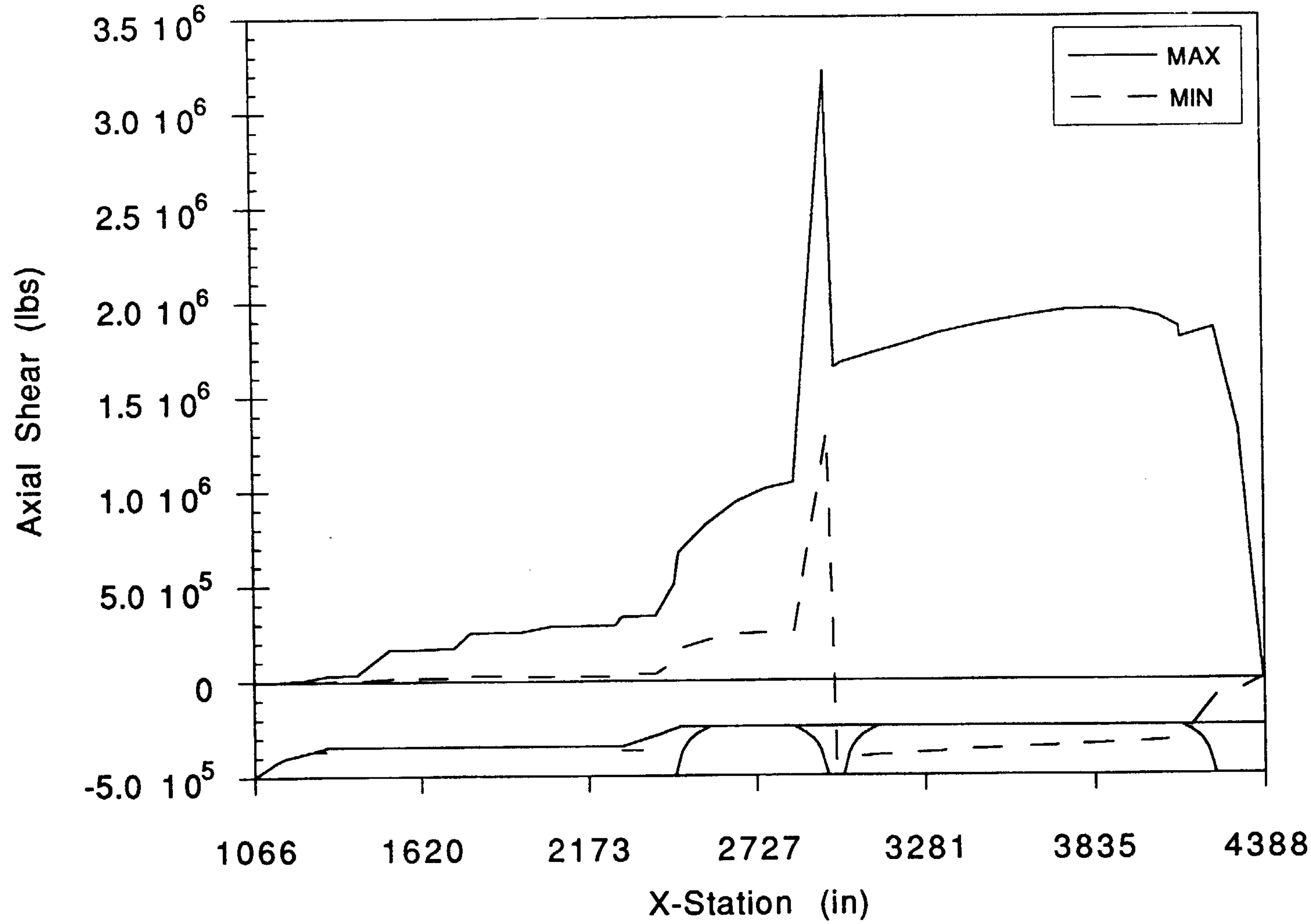
X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1066.06	24950	-24730	0.01646	-0.02484	0.06142	-0.0006733
1110.6	30750	-29320	2022	-1757	1770	-1196
1155.1	34150	-31480	30000	-26430	25970	-18120
1229.75	35200	-31360	151400	-133600	128900	-92070
1304.4	39180	-34620	577800	-510600	477800	-357600
1411	47870	-39720	1796000	-1597000	1489000	-1130000
1518	109200	-103700	5166000	-4578000	4331000	-3051000
1625	115500	-113300	9557000	-8587000	7920000	-6177000
1732	119900	-121100	14120000	-12730000	11800000	-9400000
1784.4	147100	-172700	17860000	-16230000	14420000	-11810000
1839	149700	-178300	20840000	-18780000	17200000	-14240000
1946	150400	-181300	26790000	-23790000	22700000	-19130000
2050.8	162700	-189100	33440000	-29280000	28610000	-24500000
2160	165700	-192600	38940000	-33500000	34690000	-29440000
2264.4	167900	-194800	44180000	-37480000	40510000	-34140000
2284.8	198100	-222400	44650000	-37270000	42780000	-35220000
2340.68	204700	-227500	47020000	-38980000	45860000	-37600000
2396.57	216200	-232300	49380000	-40660000	48950000	-39970000
2459.17	253600	-255900	52020000	-42740000	52400000	-42630000
2473.8	278800	-282700	52010000	-42800000	52980000	-42980000
2569.8	301200	-312200	48430000	-39790000	55230000	-44880000
2664.13	320500	-339900	42970000	-34390000	55710000	-45250000
2758.47	336700	-364900	37900000	-37620000	57680000	-43630000
2852.8	367900	-422600	41980000	-45740000	60250000	-39970000
2963.42	389300	-473100	50750000	-50430000	65620000	-49700000
2990.67	696900	-1231000	51310000	-49780000	63480000	-42200000
3012.52	715600	-1242000	51380000	-49620000	62090000	-41560000
3123.15	699600	-1246000	50820000	-47930000	55160000	-38200000
3233.63	677000	-1246000	49130000	-45300000	49010000	-34730000
3337.35	643600	-1241000	46540000	-42070000	44000000	-31340000
3480.57	599900	-1233000	41670000	-36400000	37250000	-26380000
3623.8	607000	-1221000	35650000	-30670000	30360000	-21010000
3747.4	654600	-1208000	29660000	-26190000	24340000	-17670000
3871	693700	-1197000	23050000	-21470000	18360000	-13740000
3964.5	722700	-1188000	17750000	-17740000	13950000	-10140000
4054	459600	-539900	15610000	-16220000	10110000	-7952000
4118.65	431800	-520500	11750000	-12250000	7751000	-6554000
4122.65	408800	-501200	11530000	-12030000	7617000	-6462000
4233.27	381200	-470300	6060000	-6460000	4166000	-3767000
4309.4	373900	-461300	3106000	-3204000	2117000	-2065000
4385.5	349.9	-0.4949	187900	-710.1	352.6	-439100

NLS1 COMPOSITE LINE BODY LOADS W/O STME OUT

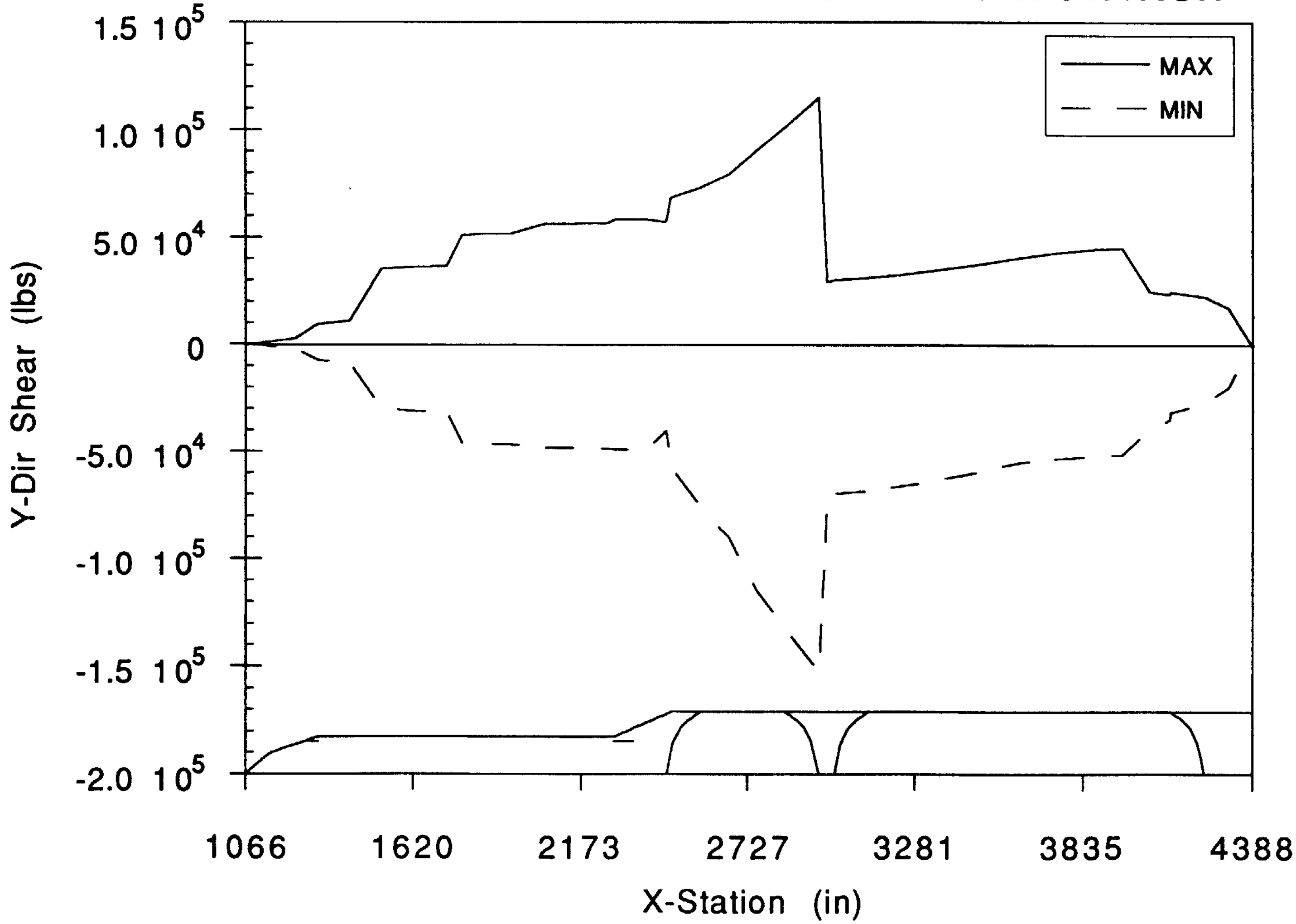
LIFTOFF

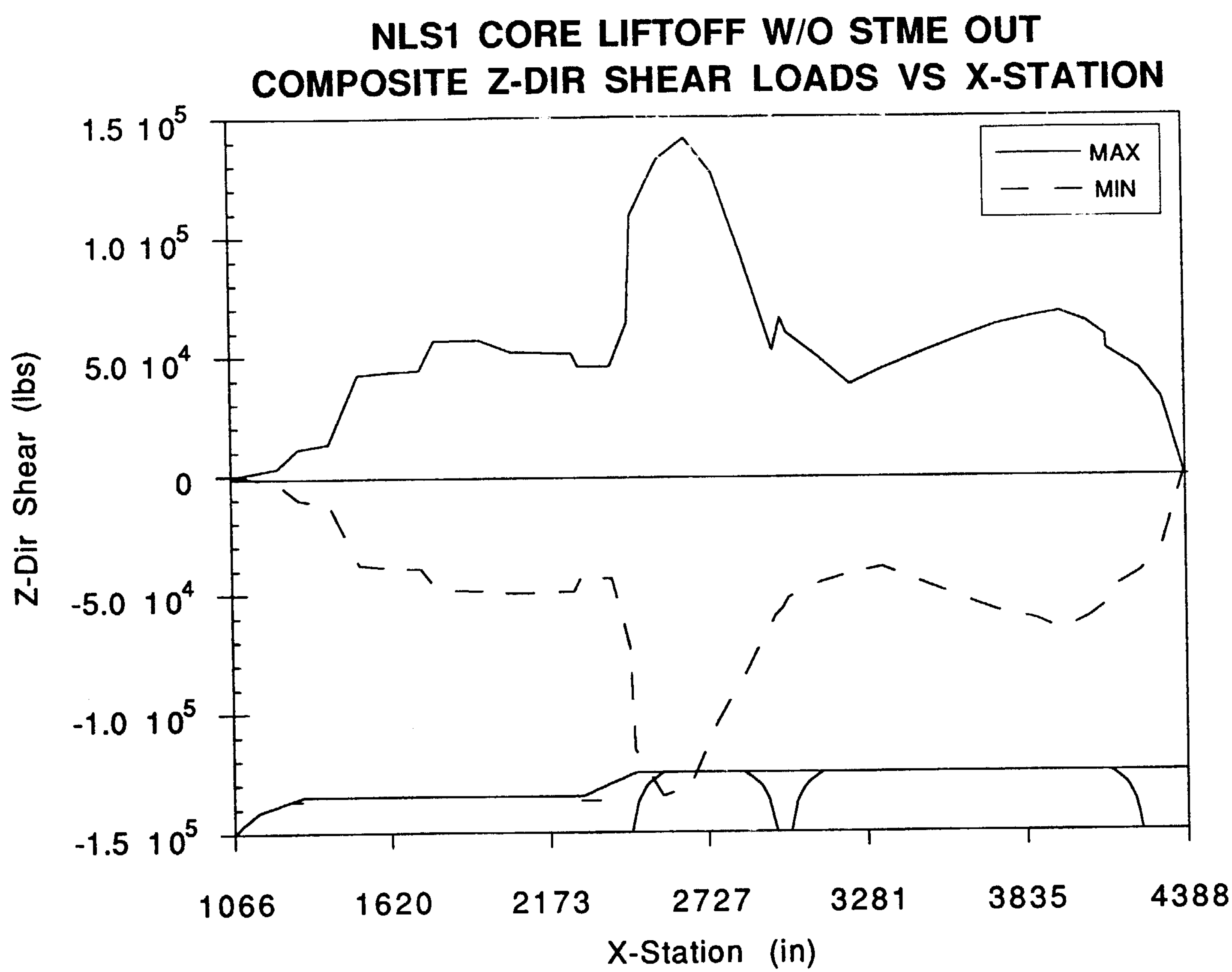
X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1066.06	0	0	0	0	0	0	0	0
1110.6	6.272	0.5201	6.272	0.5201	6.272	0.5201	1379	114.4
1155.1	9.869	0.8188	9.869	0.8188	9.869	0.8188	3720	308.7
1229.75	16.38	1.362	16.38	1.362	16.38	1.362	8234	684.7
1304.4	51.05	4.169	49.5	2.828	49.5	2.828	31100	1777
1411	61.54	5.152	61.54	5.152	61.54	5.152	38670	3237
1518	307.9	22.63	260.1	6.425	260.1	6.425	163400	4037
1625	272	23.43	272	23.43	272	23.43	170900	14720
1732	278.3	24.18	278.3	24.18	278.3	24.18	174900	15190
1784.4	412.5	41.18	390.6	39.21	390.6	39.21	245400	24640
1839	405.4	41.95	405.4	41.95	405.4	41.95	254700	26360
1946	408.9	43.01	408.9	43.01	408.9	43.01	256900	27020
2050.8	460.6	35.53	454.5	30.87	454.5	30.87	285600	19390
2160	460.8	33.72	460.8	33.72	460.8	33.72	289500	21190
2264.4	465.4	35.95	465.4	35.95	465.4	35.95	292400	22590
2284.8	528	71.86	490.3	26.49	490.3	26.49	327700	17710
2340.68	435.1	44.99	435.1	44.99	435.1	44.99	338600	35010
2396.57	384.4	40.56	384.4	40.56	384.4	40.56	341400	36020
2459.17	502	100.4	502	100.4	502	100.4	507600	101600
2473.8	650.5	159	650.5	159	650.5	159	676500	165300
2569.8	796.7	206.6	796.7	206.6	796.7	206.6	828500	214900
2664.13	905.9	233.2	905.9	233.2	905.9	233.2	942000	242500
2758.47	970.4	240.6	970.4	240.6	970.4	240.6	1009000	250200
2852.8	1004	247.3	1004	247.3	1004	247.3	1044000	257200
2963.42	3096	1253	3096	1253	3096	1253	3219000	1303000
2990.67	2236	-404.9	1574	-982.7	1574	-982.7	1637000	-1022000
3012.52	1612	-394.5	1612	-394.5	1612	-394.5	1677000	-410200
3123.15	1662	-381.4	1662	-381.4	1662	-381.4	1728000	-396600
3233.63	1708	-371.5	1708	-371.5	1708	-371.5	1776000	-386300
3337.35	1759	-360.9	1759	-360.9	1759	-360.9	1829000	-375300
3480.57	1808	-350.2	1808	-350.2	1808	-350.2	1880000	-364200
3623.8	1847	-340.3	1847	-340.3	1847	-340.3	1921000	-353900
3747.4	1871	-331.4	1871	-331.4	1871	-331.4	1946000	-344600
3871	1880	-324.2	1880	-324.2	1880	-324.2	1955000	-337200
3964.5	1874	-317.7	1874	-317.7	1874	-317.7	1948000	-330400
4054	1842	-311	1842	-311	1842	-311	1915000	-323400
4118.65	1787	-303.8	1787	-303.8	1787	-303.8	1858000	-315900
4122.65	1730	-296.7	1730	-296.7	1730	-296.7	1799000	-308500
4233.27	1780	-86.77	1780	-86.77	1780	-86.77	1851000	-90230
4309.4	1266	-58.67	1266	-58.67	1266	-58.67	1317000	-61010
4385.5	13.89	-0.03237	-5.054E-06	-13.89	-5.054E-06	-13.89	-0.005256	-14440

NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION



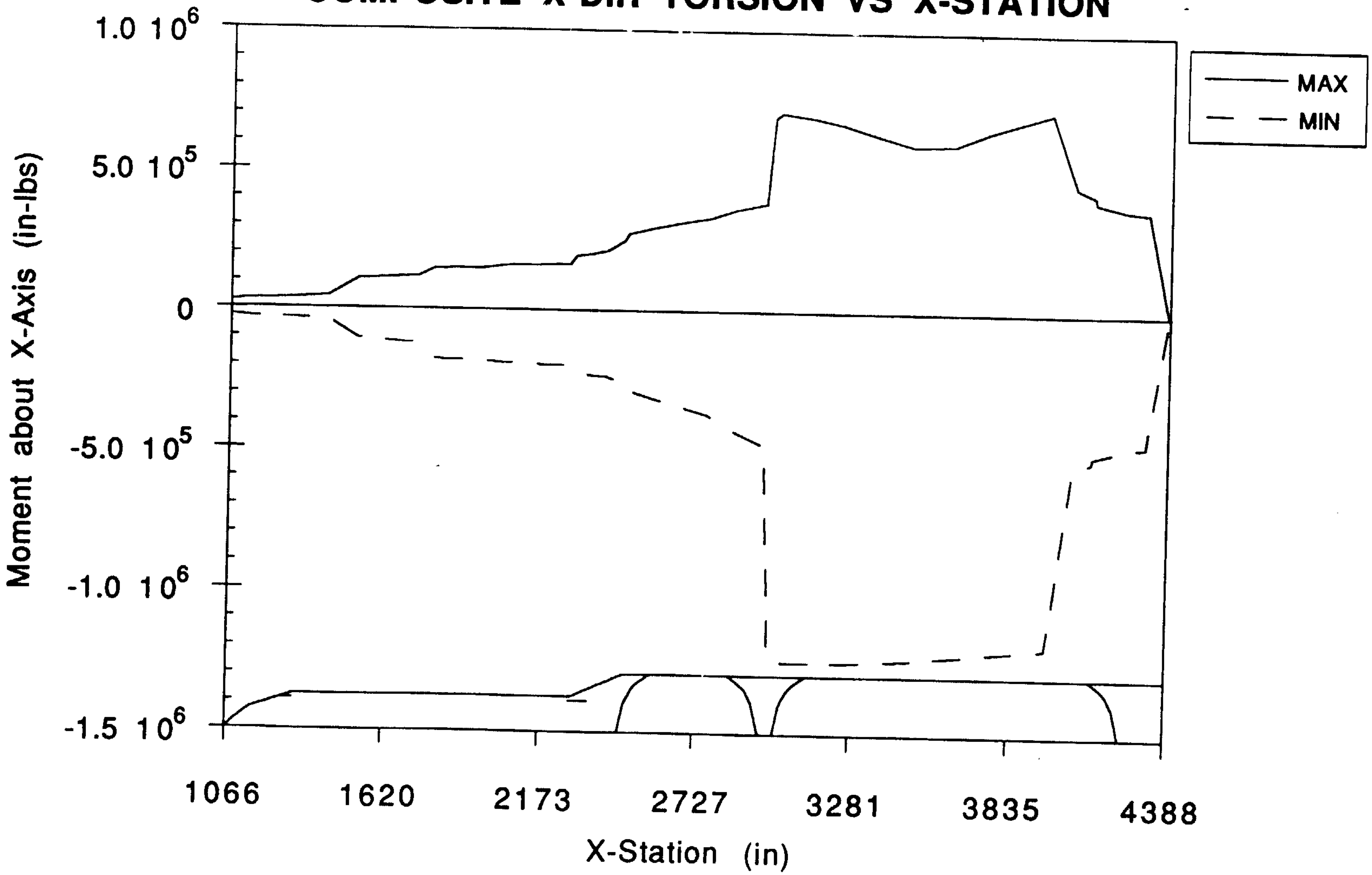
NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION

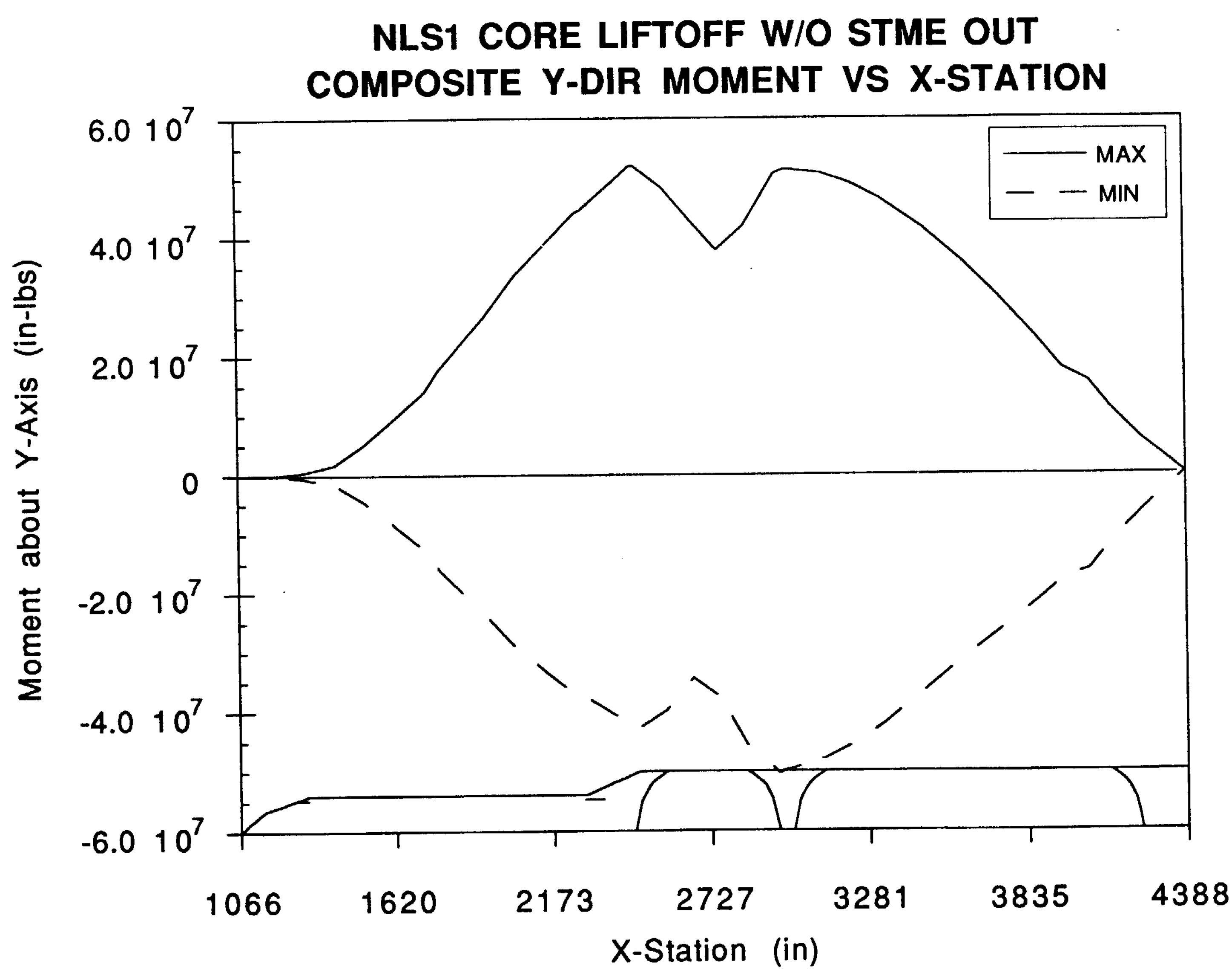




NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION
MAX
MIN
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Z-Dir Shear (lbs)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

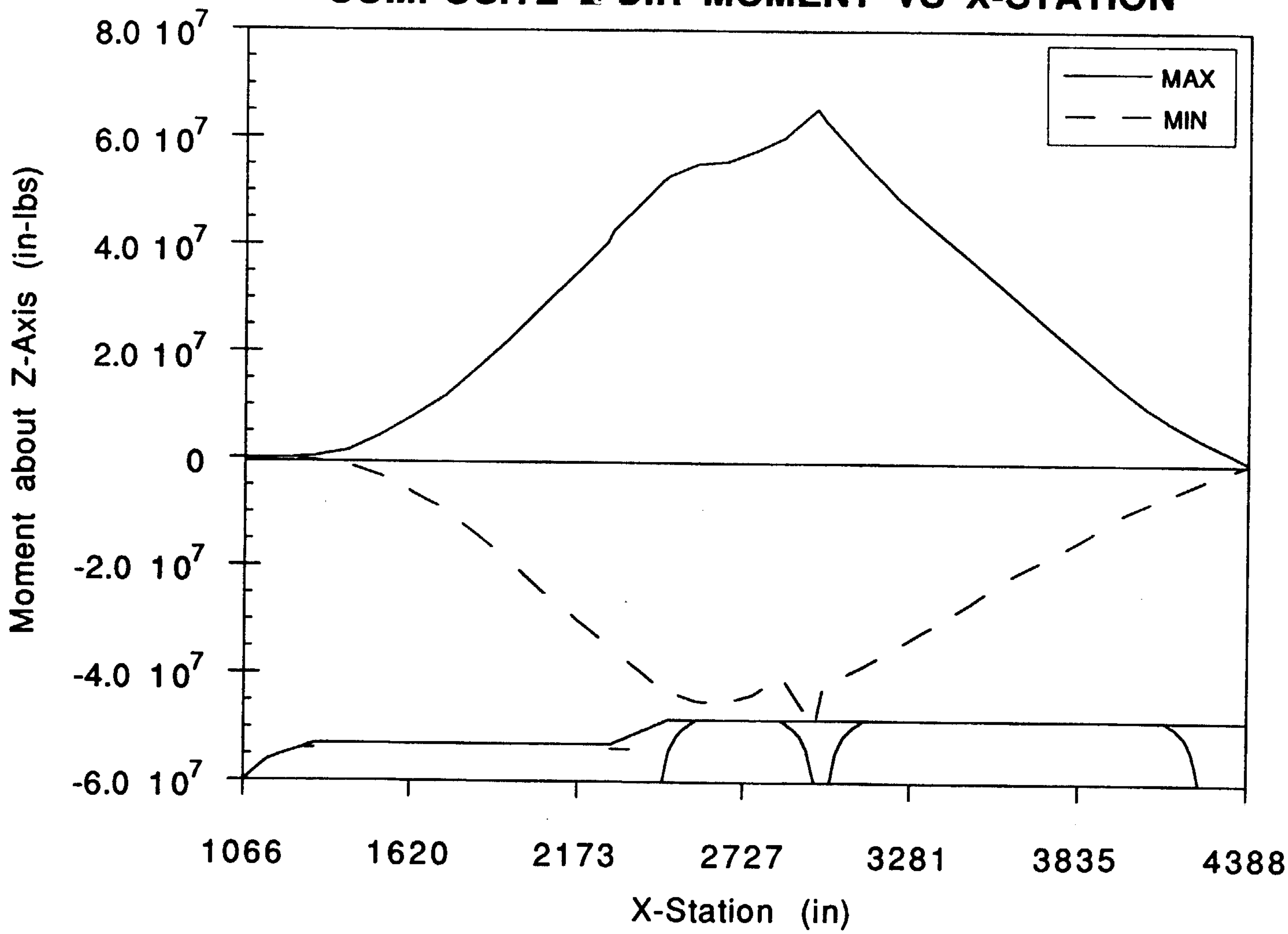
NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE X-DIR TORSION VS X-STATION



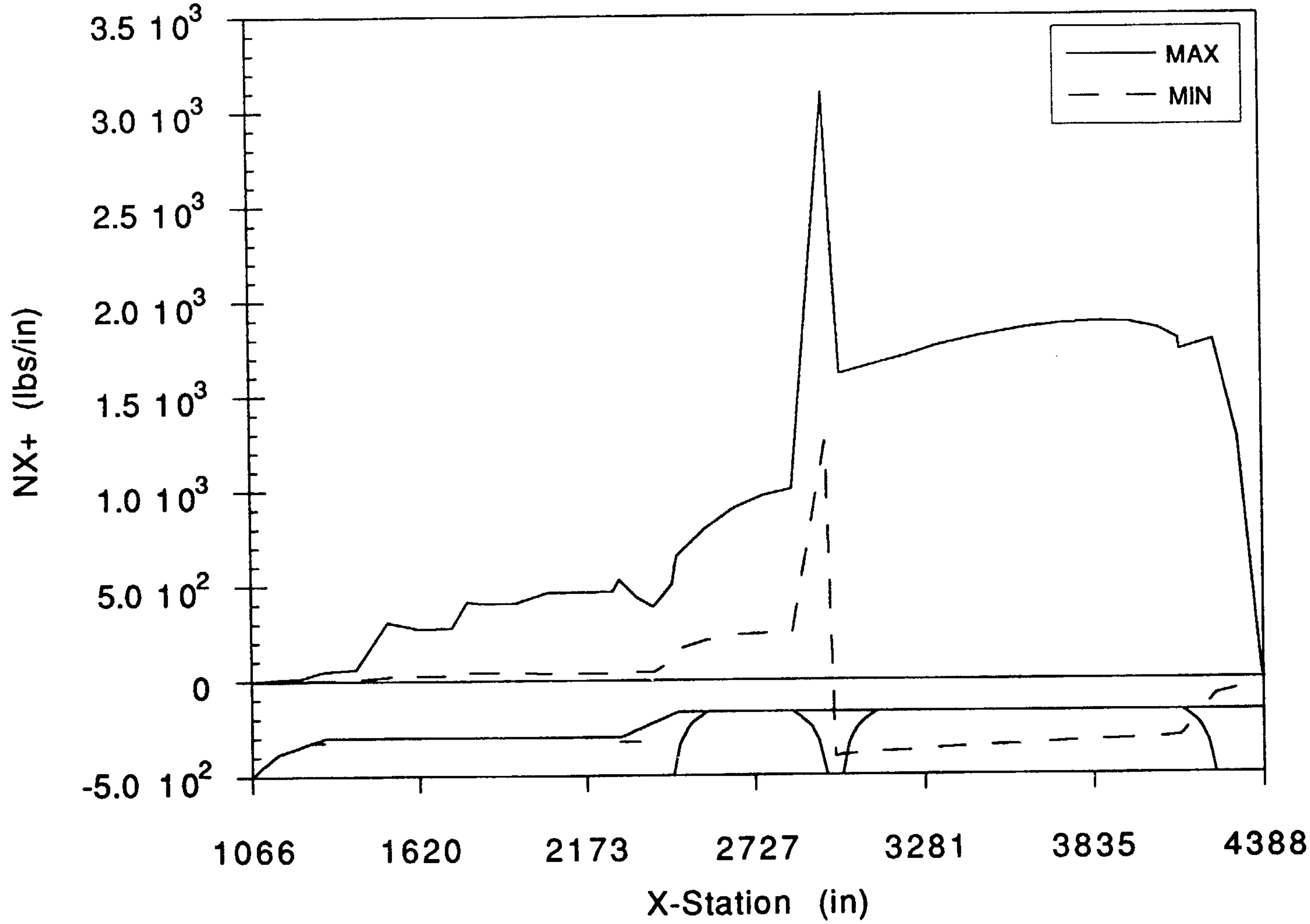


NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION
MAX
MIN
Moment about Y-Axis (in-lbs)
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
X-Station (in)
1066
1620
2173
2727
3281
3835
4388

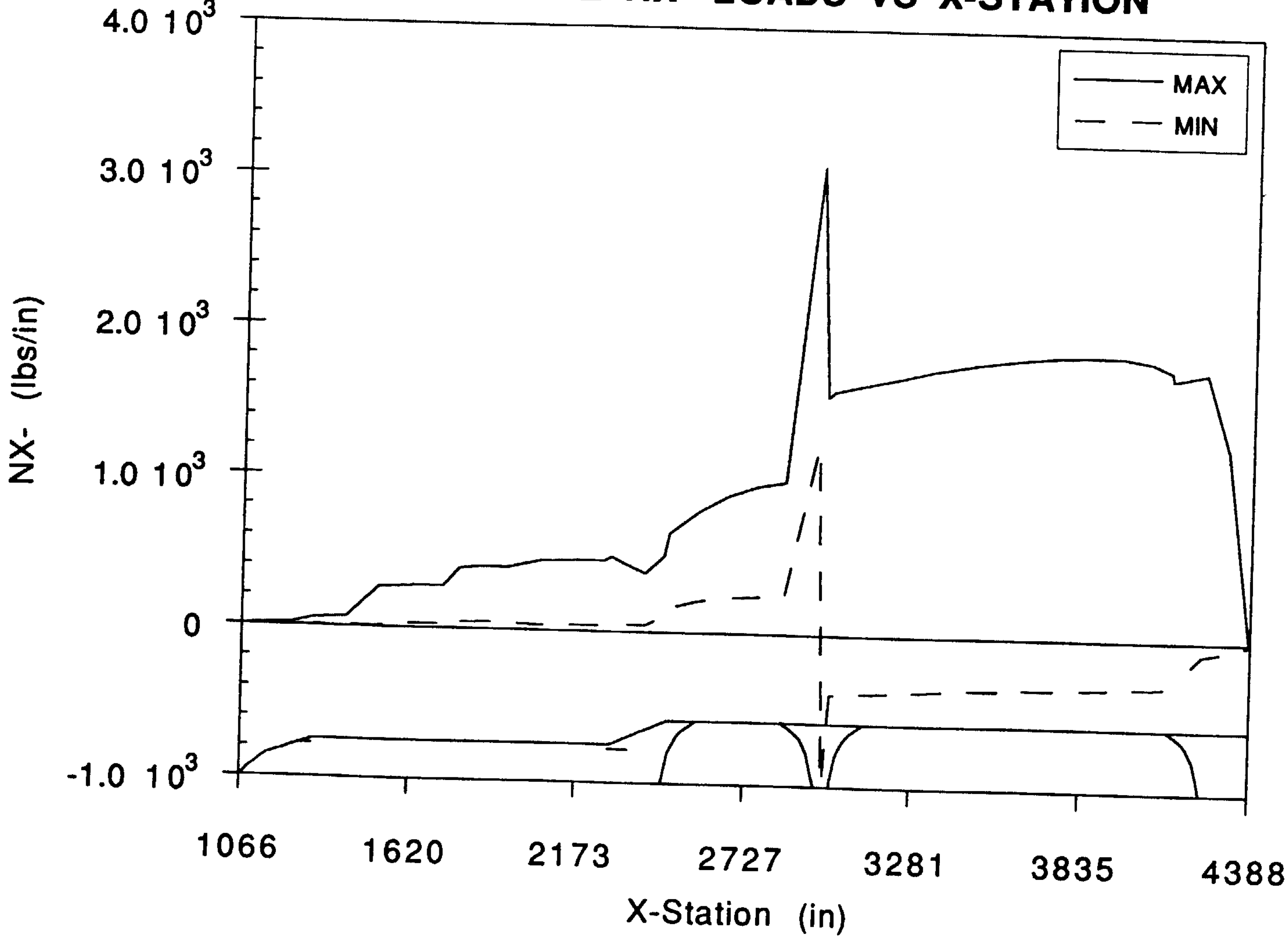
NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION



NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE NX+ LOADS VS X-STATION



NLS1 CORE LIFTOFF W/O STME OUT
COMPOSITE NX- LOADS VS X-STATION



NLS 2

LIFTOFF DATA

NLS2 WITH STME OUT LIFTOFF PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	319.8	24.9	13.7	-745.6	-54.1	-27.3
M2	541.9	52.6	5.1	-478.9	-65.3	-11
M3	553.1	32.4	11.3	-502.5	-54.7	-27.8
M4	280.7	36.6	3.3	-721.2	-36	-17.6

NLS2 WITH OUT STME OUT LIFTOFF PAD FORCES (KIPS)

	MAXIMUM			MINIMUM		
PAD NUMBER	X-DIR	Y-DIR	Z-DIR	X-DIR	Y-DIR	Z-DIR
M1	319.8	24.9	13.5	-745.6	-54.1	-27.3
M2	541.2	52.6	5.1	-478.9	-60.8	-11
M3	553.1	32.4	11.3	-502.5	-54.7	-27.8
M4	280.7	36.6	3.3	-721.2	-31.6	-17.6

NLS2 LV Liftoff Accelerations (G's)

	W/STME Out		W/O STME Out	
	Maximum	Minimum	Maximum	Minimum
Node 999 Payload 50K X-Dir	5.263	-6.159	5.263	-6.157
Node 999 Payload 50K Y-Dir	3.234	-2.792	3.234	-2.792
Node 999 Payload 50K Z-Dir	2.414	-2.536	2.414	-2.499
Node 80 LO2 Slosh X-Dir	1.5582	-0.752	1.5539	-0.752
Node 81 LH2 Slosh X-Dir	5.665	-4.628	5.662	-4.628

NLS2 COMPOSITE SHEAR BODY LOADS W/STME OUT (LBS)

LIFTOFF

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	260.4	-158.7	300.7	-307.3	303.5	-188.8
1395.1	4164	-2538	4220	-4306	3530	-1870
1444.9	11260	-6856	10780	-10990	9020	-4412
1494.6	24980	-15180	22560	-22880	18820	-9172
1544.4	33880	-20540	29710	-30030	24890	-12020
1624.4	42130	-25410	35670	-35900	30460	-14360
1704.4	49600	-29690	40510	-40530	35340	-16290
1784.4	56170	-33290	44310	-44000	39550	-17960
1864.4	61720	-36110	47120	-46430	43090	-19410
1944.4	66190	-38100	49420	-47940	46010	-20720
2024.4	69530	-39230	52050	-48710	48390	-21910
2104.4	71880	-40250	54310	-48890	50340	-23110
2184.4	73310	-40510	56700	-48880	52070	-29990
2264.4	73710	-39980	59430	-49050	53860	-38440
2284.8	461400	-192200	159600	-139200	195300	-211100
2347.8	462100	-192900	161400	-138600	204800	-222400
2410.8	461800	-193200	162400	-137900	209400	-228000
2459.2	862900	-264100	404600	-468400	335200	-364600
2471.1	1271000	-352000	612500	-625100	500900	-376300
2569.8	1227000	-281300	461400	-433600	457100	-375000
2664.1	1586000	-324100	711300	-425700	565500	-328100
2758.5	1576000	-271500	492300	-390400	515000	-335200
2852.8	1600000	-152100	634100	-511500	474100	-447000
2963.4	1645000	-209700	370800	-312800	326200	-241800
2985.7	3657000	1011000	370500	-320800	328600	-244300
3012.5	3672000	1031000	375900	-367100	334100	-250200
3123.1	3622000	1031000	267800	-267900	207100	-211700
3240	3608000	1048000	272800	-265400	246500	-221800
3356.9	3661000	1032000	245800	-285000	190700	-196700
3473.7	3708000	1024000	227500	-202100	212500	-178700
3590.6	3715000	1071000	185000	-236700	145100	-238800
3707.4	3677000	1044000	151500	-225900	158800	-242300
3824.3	3601000	1038000	121200	-317900	120200	-268300
3941.1	3580000	1073000	156100	-309700	125000	-339600
4058	3562000	1035000	245600	-358000	139600	-379400
4090.3	3532000	1017000	298100	-473800	177200	-429400
4122.6	3506000	1054000	312500	-522500	212200	-458100
4166.6	4066000	1233000	297700	-319800	221300	-288100
4210.3	4058000	1360000	270400	-321500	202200	-273900
4227.4	4051000	1420000	263000	-329300	199700	-269500
4254	3968000	1692000	193800	-285400	192500	-345100
4297.8	4060000	1712000	162100	-341600	197000	-311100
4341.6	4091000	1169000	200600	-322800	200200	-267800
4385.5	3939	-0.1894	0.3714	-765.7	0.8306	-2389

NLS2 COMPOSITE MOMENT BODY LOADS W/STME OUT (IN-LBS)

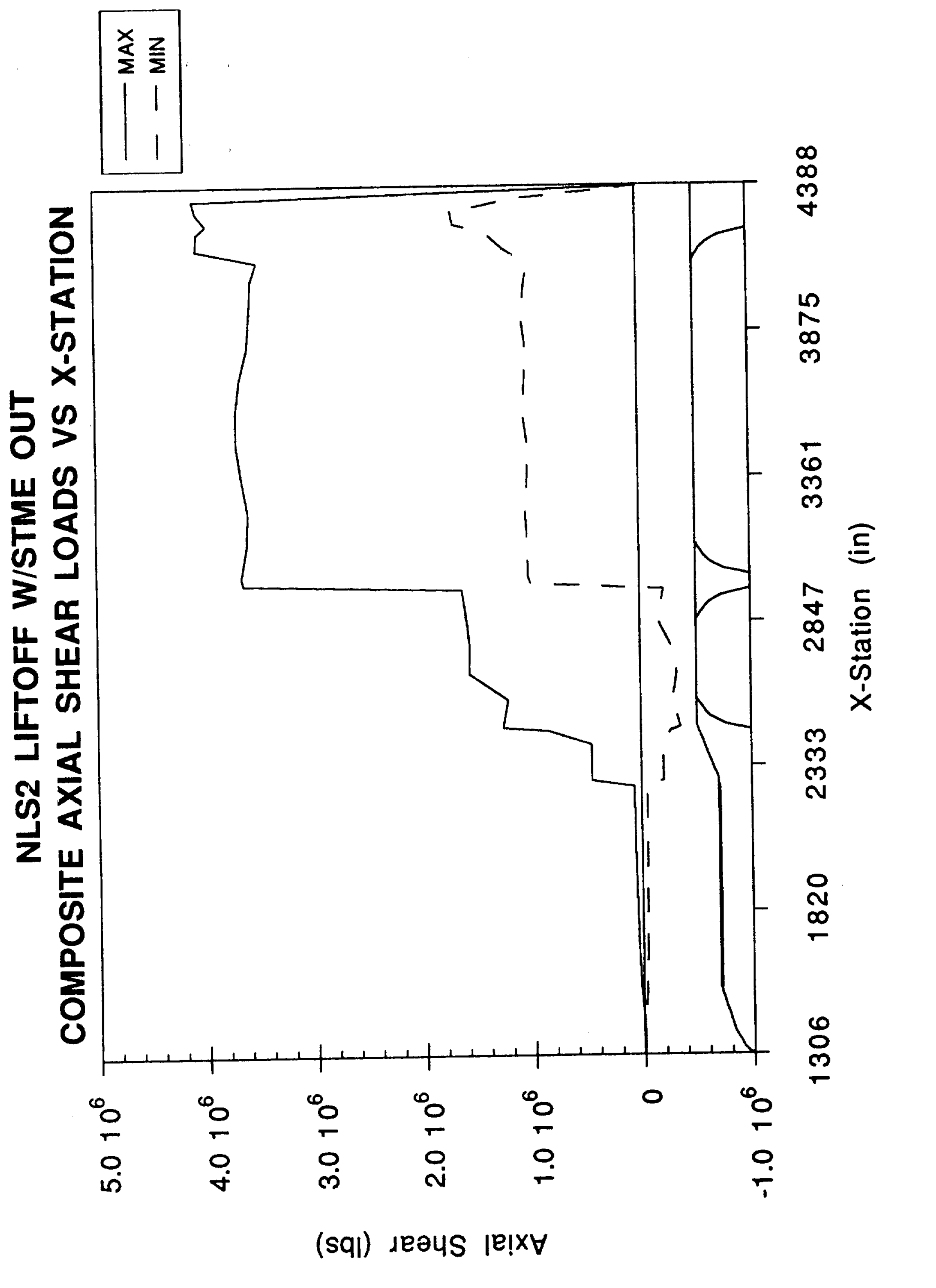
LIFTOFF

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	1740	-1554	2.221	0.0005961	0.0006522	-6.266
1395.1	12740	-11380	27020	-16810	26770	-27360
1444.9	27190	-24280	198100	-109900	236800	-241700
1494.6	58180	-51950	647000	-316800	773200	-788500
1544.4	323800	-289100	1583000	-773200	1895000	-1927000
1624.4	478300	-426800	3561000	-1735000	4271000	-4330000
1704.4	554100	-494100	5977000	-2884000	7125000	-7201000
1784.4	584400	-520800	8805000	-4181000	10370000	-10440000
1864.4	595000	-530000	11970000	-5593000	13910000	-13960000
1944.4	601400	-535400	15420000	-7123000	17680000	-17680000
2024.4	607700	-540300	19100000	-8745000	21610000	-21510000
2104.4	607100	-545300	22970000	-10470000	25640000	-25410000
2184.4	582100	-554400	27000000	-12270000	29760000	-29320000
2264.4	512500	-536100	31160000	-14170000	33940000	-33220000
2284.8	1361000	-1381000	67400000	-50460000	68160000	-58650000
2347.8	1337000	-1396000	71370000	-55240000	77640000	-66930000
2410.8	1279000	-1398000	76310000	-59970000	87160000	-75110000
2459.2	1174000	-1438000	84440000	-63630000	94520000	-81320000
2471.1	1215000	-1493000	85430000	-63360000	94140000	-80590000
2569.8	1227000	-1511000	80880000	-76540000	95010000	-75800000
2664.1	1229000	-1517000	79970000	-73590000	84230000	-76230000
2758.5	1226000	-1517000	78140000	-56780000	91560000	-79440000
2852.8	1192000	-1531000	93740000	-64520000	102700000	-59460000
2963.4	1136000	-1625000	88860000	-63390000	101900000	-59700000
2985.7	1136000	-1625000	85430000	-63000000	94980000	-58330000
3012.5	3214000	-2904000	81390000	-63320000	86360000	-56740000
3123.1	1714000	-2563000	67810000	-61230000	65350000	-51890000
3240	2476000	-2789000	75440000	-63230000	74090000	-51680000
3356.9	1912000	-2915000	72440000	-69530000	73870000	-54040000
3473.7	1348000	-2978000	87250000	-70900000	88210000	-68350000
3590.6	1360000	-3014000	86570000	-74110000	89010000	-75640000
3707.4	1374000	-3057000	94240000	-75110000	94310000	-74340000
3824.3	1936000	-3144000	103400000	-71790000	90200000	-66960000
3941.1	2921000	-3310000	112500000	-66480000	94330000	-58880000
4058	4473000	-4632000	121500000	-57280000	97640000	-54770000
4090.3	4746000	-5031000	124000000	-54080000	101900000	-53100000
4122.6	4377000	-5066000	126400000	-53940000	106900000	-50590000
4166.6	4071000	-4960000	130100000	-50520000	111500000	-55160000
4210.3	4251000	-5051000	133200000	-47850000	109000000	-52790000
4227.4	4523000	-5090000	134400000	-45970000	106600000	-52690000
4254	5466000	-6479000	136200000	-53240000	98910000	-53420000
4297.8	7569000	-5543000	139100000	-79150000	102000000	-71620000
4341.6	8054000	-5889000	142300000	-95070000	105100000	-91920000
4385.5	49490	-24.93	14940000	-16520000	16830000	-19210000

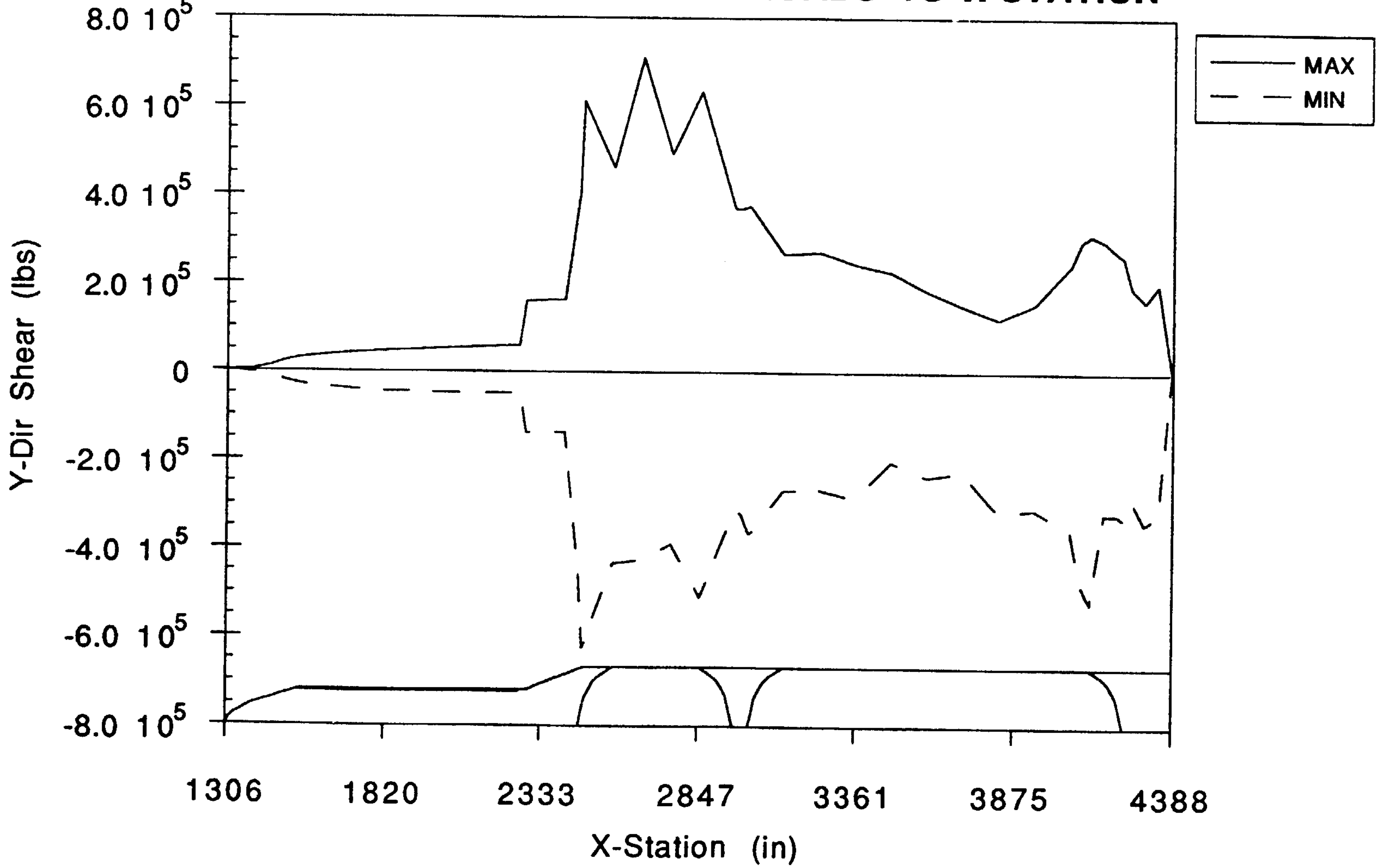
NLS2 COMPOSITE LINE BODY LOADS W/STME OUT

LIFTOFF

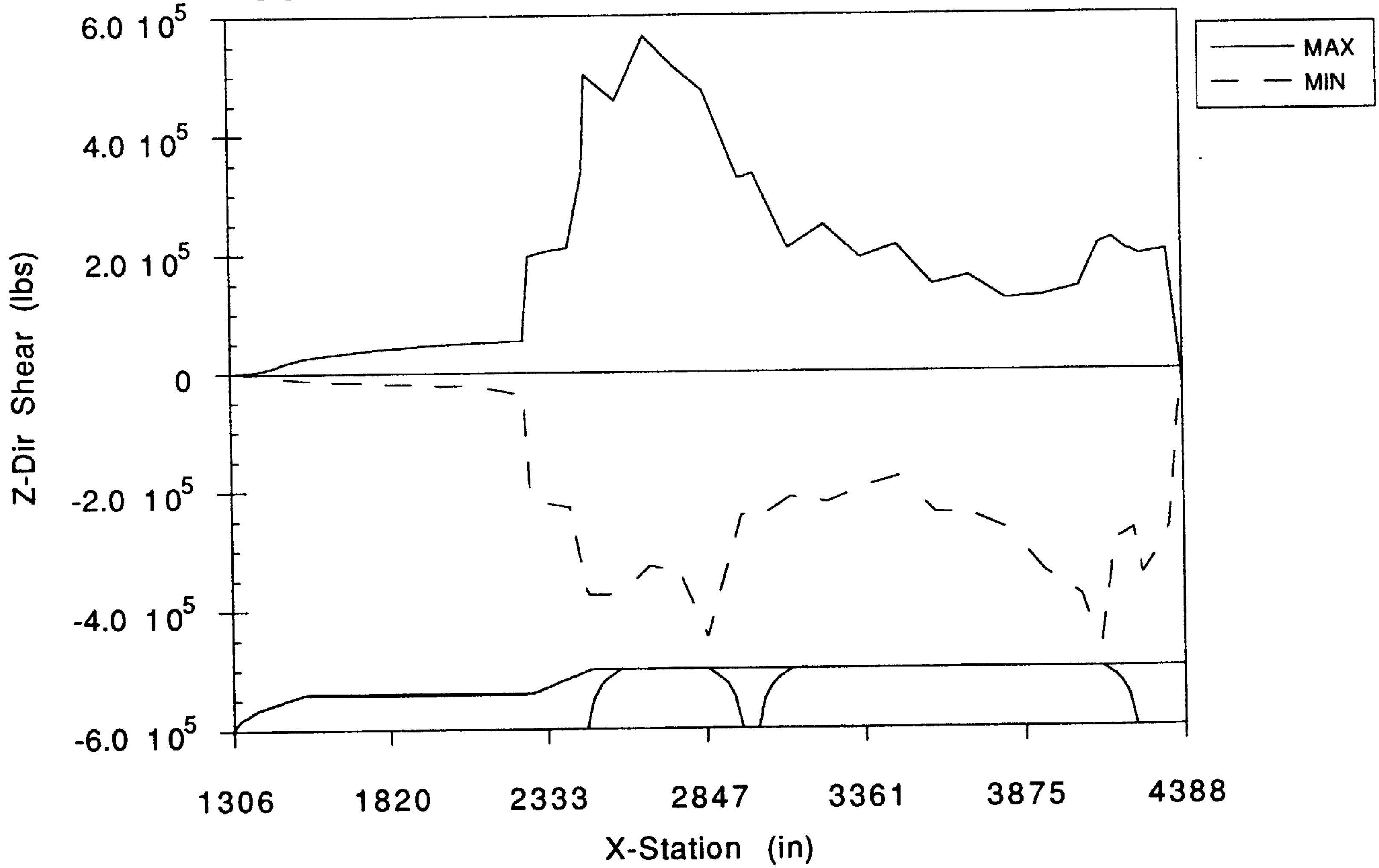
X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1306.1	0	0	0	0	0	0	0	0
1395.1	18.93	-11.54	18.93	-11.54	4164	-2538	4164	-2538
1444.9	29.86	-18.19	29.86	-18.19	11260	-6856	11260	-6856
1494.6	49.7	-30.21	49.7	-30.21	24980	-15180	24980	-15180
1544.4	53.91	-32.69	53.91	-32.69	33880	-20540	33880	-20540
1624.4	67.05	-40.44	67.05	-40.44	42130	-25410	42130	-25410
1704.4	78.95	-47.26	78.95	-47.26	49600	-29690	49600	-29690
1784.4	89.39	-52.98	89.39	-52.98	56170	-33290	56170	-33290
1864.4	98.23	-57.47	98.23	-57.47	61720	-36110	61720	-36110
1944.4	105.3	-60.64	105.3	-60.64	66190	-38100	66190	-38100
2024.4	110.7	-62.44	110.7	-62.44	69530	-39230	69530	-39230
2104.4	114.4	-64.07	114.4	-64.07	71880	-40250	71880	-40250
2184.4	116.7	-64.47	116.7	-64.47	73310	-40510	73310	-40510
2264.4	117.3	-63.63	117.3	-63.63	73710	-39980	73710	-39980
2284.8	2440	-230.9	710.9	-2179	1533000	-145100	446700	-1369000
2347.8	614.4	-256.5	614.4	-256.5	462100	-192900	462100	-192900
2410.8	527.2	-220.6	527.2	-220.6	461800	-193200	461800	-193200
2459.2	888.9	-272	888.9	-272	862900	-264100	862900	-264100
2471.1	1278	-353.9	1278	-353.9	1271000	-352000	1271000	-352000
2569.8	1180	-270.5	1180	-270.5	1227000	-281300	1227000	-281300
2664.1	1525	-311.6	1525	-311.6	1586000	-324100	1586000	-324100
2758.5	1516	-261.1	1516	-261.1	1576000	-271500	1576000	-271500
2852.8	1538	-146.2	1538	-146.2	1600000	-152100	1600000	-152100
2963.4	1582	-201.7	1582	-201.7	1645000	-209700	1645000	-209700
2985.7	3517	972.6	3517	972.6	3657000	1011000	3657000	1011000
3012.5	3531	991	3531	991	3672000	1031000	3672000	1031000
3123.1	3483	991	3483	991	3622000	1031000	3622000	1031000
3240	3469	1008	3469	1008	3608000	1048000	3608000	1048000
3356.9	3521	992	3521	992	3661000	1032000	3661000	1032000
3473.7	3566	984.4	3566	984.4	3708000	1024000	3708000	1024000
3590.6	3573	1030	3573	1030	3715000	1071000	3715000	1071000
3707.4	3536	1004	3536	1004	3677000	1044000	3677000	1044000
3824.3	3463	998	3463	998	3601000	1038000	3601000	1038000
3941.1	3443	1032	3443	1032	3580000	1073000	3580000	1073000
4058	3425	995.5	3425	995.5	3562000	1035000	3562000	1035000
4090.3	3397	978	3397	978	3532000	1017000	3532000	1017000
4122.6	3372	1013	3372	1013	3506000	1054000	3506000	1054000
4166.6	4117	1188	3884	923.2	4281000	1236000	4039000	960000
4210.3	3904	1313	3900	1226	4060000	1365000	4056000	1275000
4227.4	3896	1369	3896	1327	4052000	1423000	4051000	1380000
4254	4013	1633	3806	1446	4173000	1698000	3958000	1504000
4297.8	4113	1671	3882	1186	4277000	1737000	4036000	1233000
4341.6	4071	1151	3912	773.1	4234000	1197000	4067000	804000
4385.5	1705	0.2368	0.177	-1705	1773000	246.2	184	-1773000

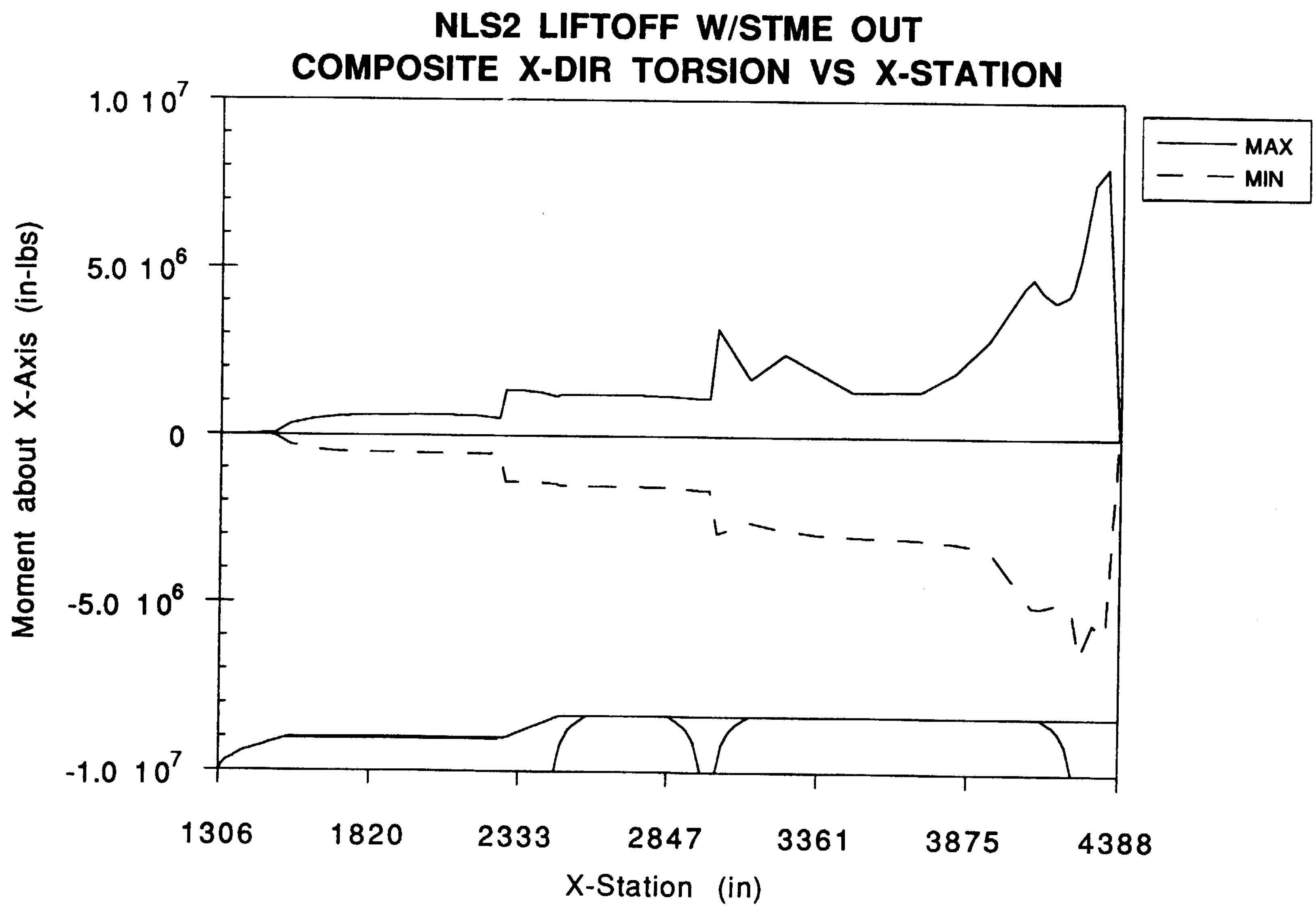

NLS2 LIFTOFF W/STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION
MAX
MIN
Axial Shear (lbs)
5.0 10^6
4.0 10^6
3.0 10^6
2.0 10^6
1.0 10^6
0
-1.0 10^6
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 LIFTOFF W/STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION

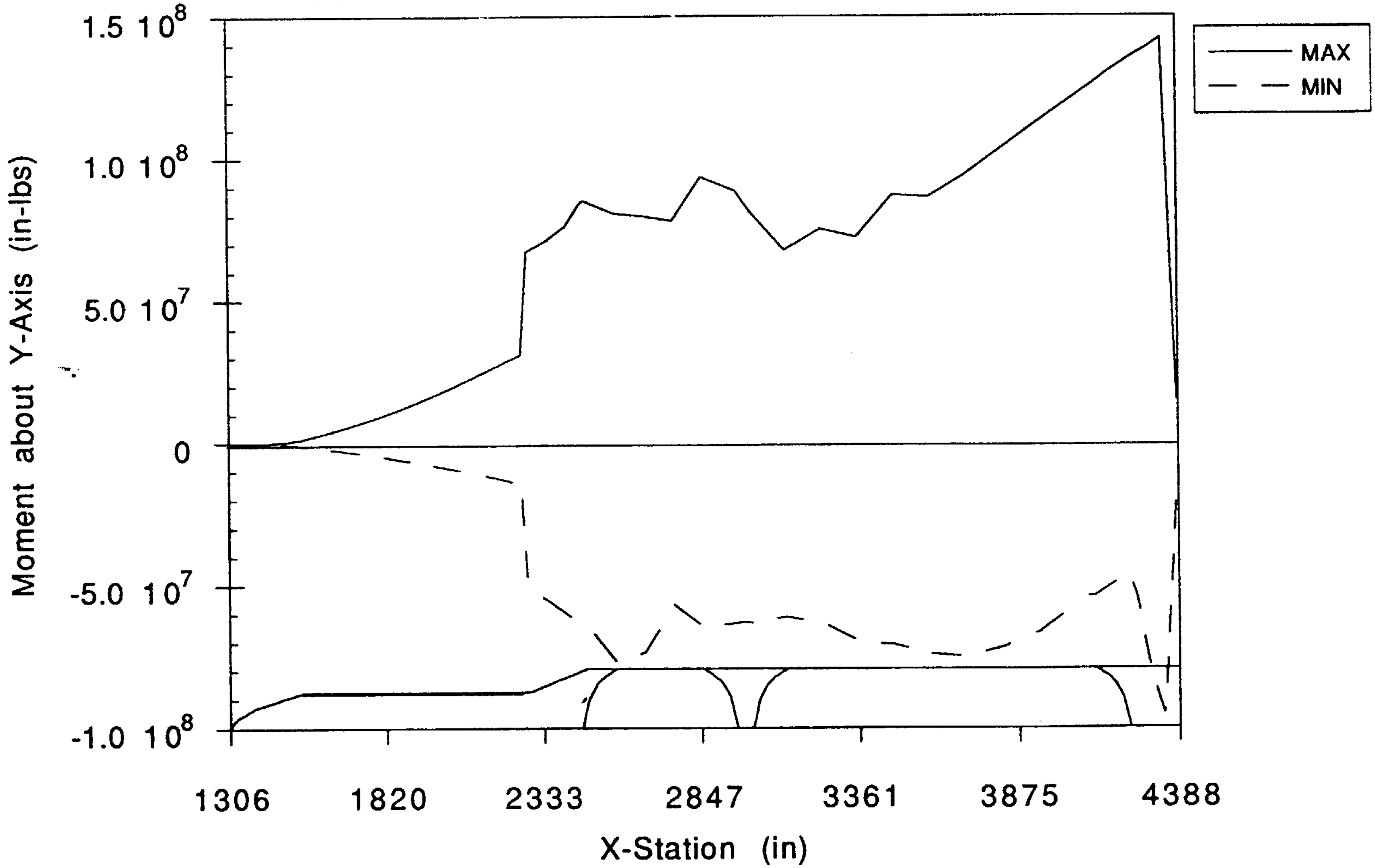


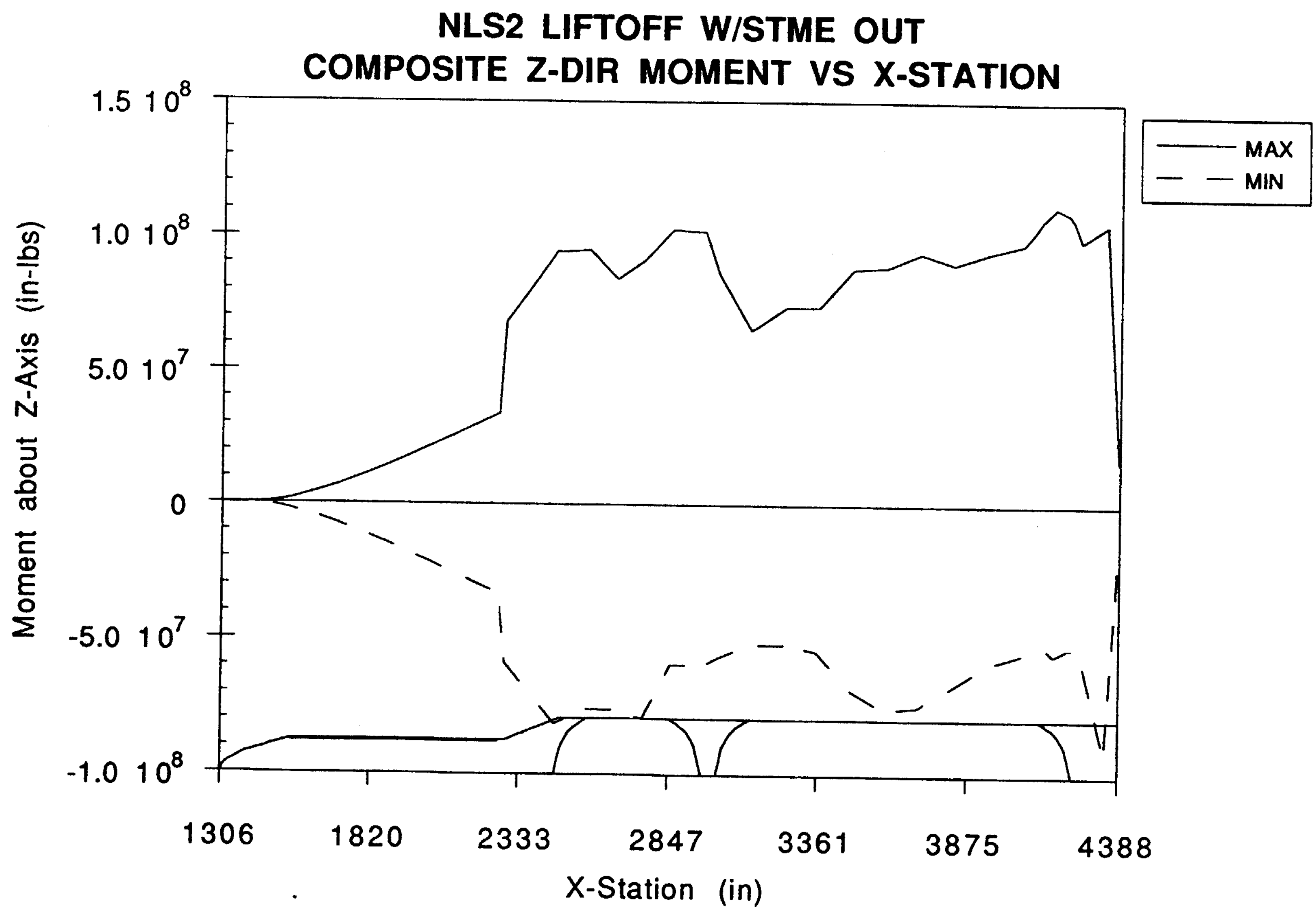
NLS2 LIFTOFF W/STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION



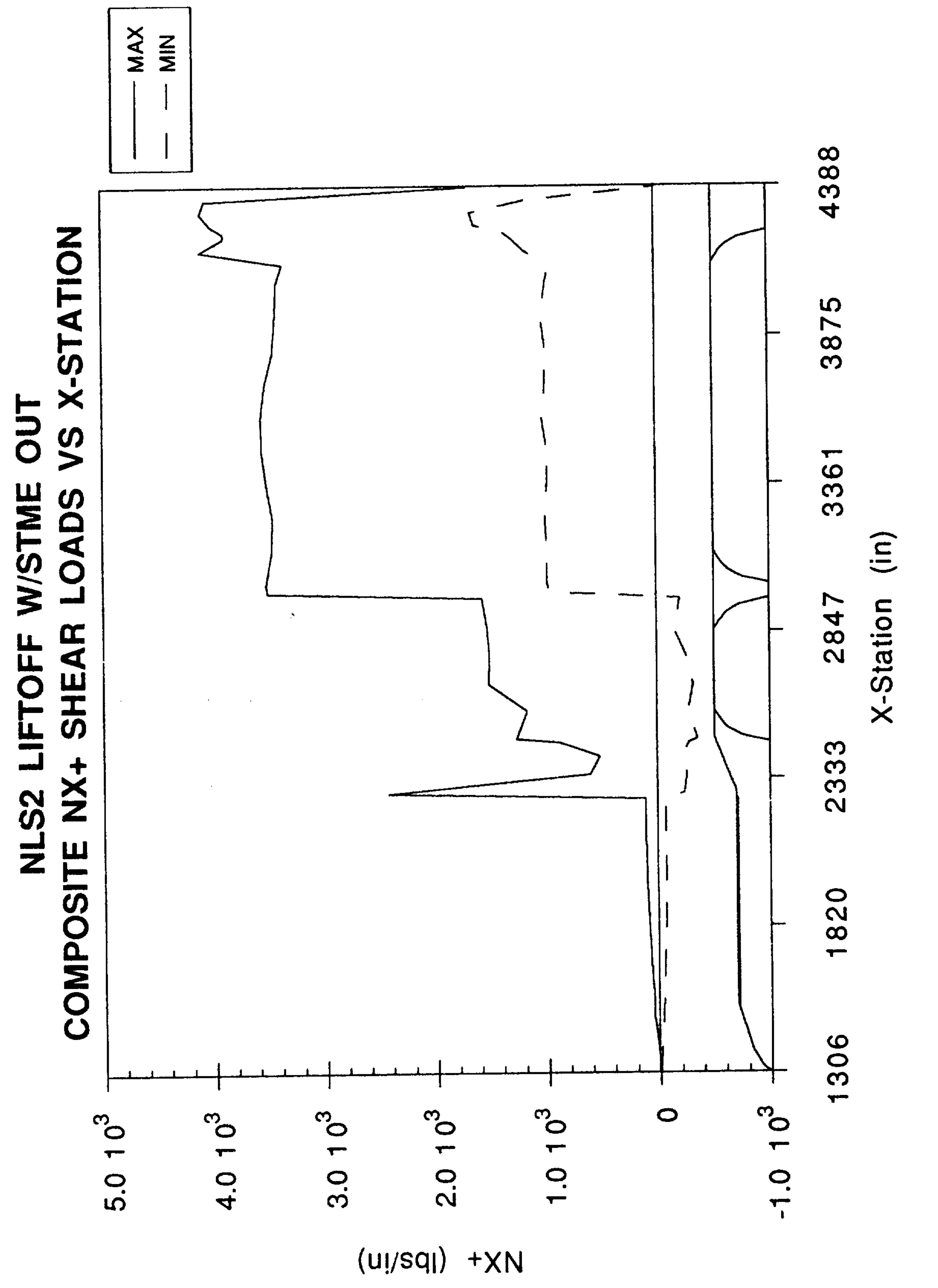

NLS2 LIFTOFF W/STME OUT
COMPOSITE X-DIR TORSION VS X-STATION
Moment about X-Axis (in-lbs)
1.0 10^7
5.0 10^6
0
-5.0 10^6
-1.0 10^7
1306
1820
2333
2847
3361
3875
4388
X-Station (in)
MAX
MIN

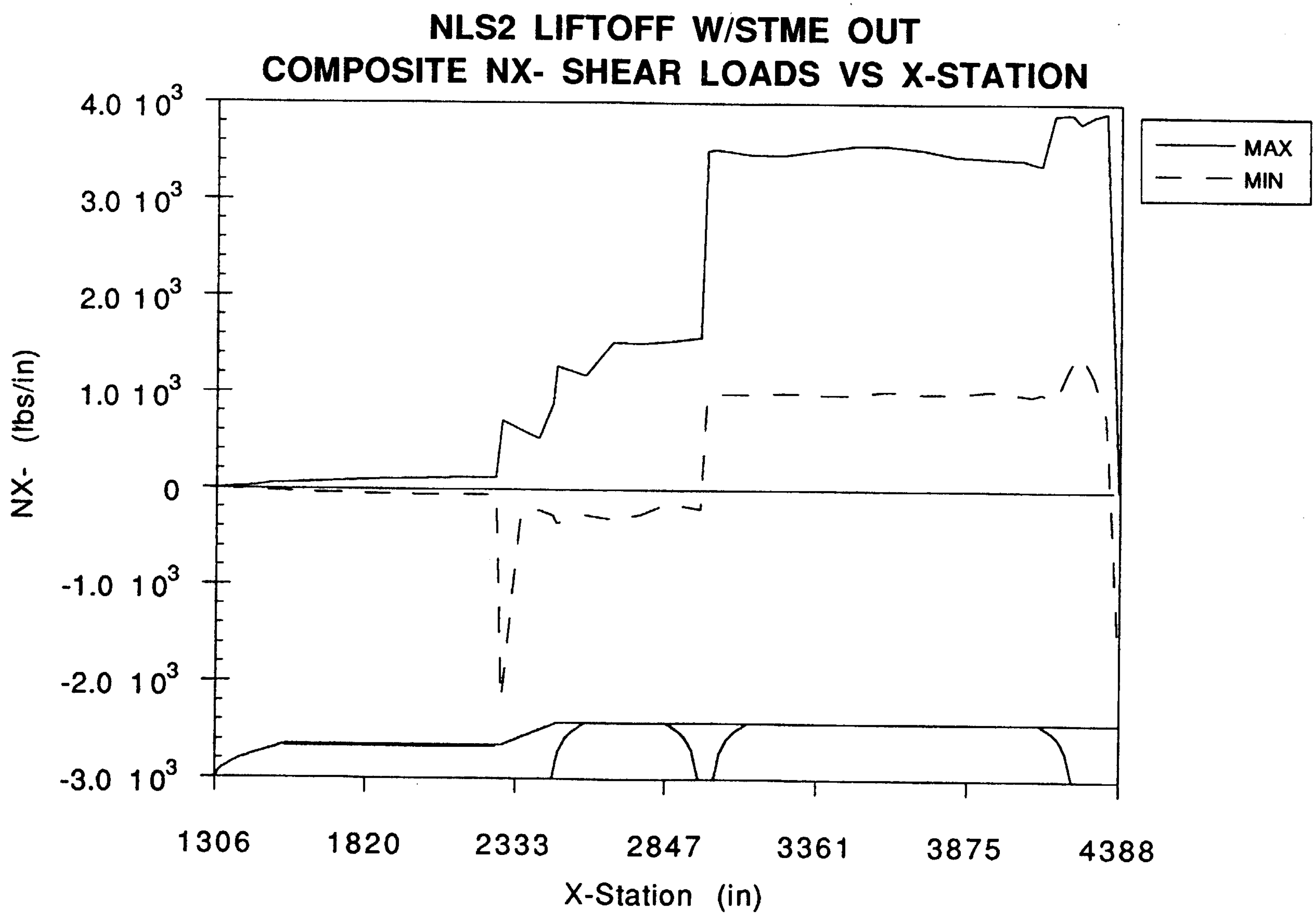
NLS2 LIFTOFF W/STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION





NLS2 LIFTOFF W/STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION
MAX
MIN
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
Moment about Z-Axis (in-lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 LIFTOFF W/STME OUT
COMPOSITE NX+ SHEAR LOADS VS X-STATION
NX+ (lbs/in)
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)
MAX
MIN


NLS2 LIFTOFF W/STME OUT
COMPOSITE NX- SHEAR LOADS VS X-STATION
MAX
MIN
NX- (lbs/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 COMPOSITE SHEAR BODY LOADS W/O STME OUT (LBS)

LIFTOFF

X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	260.2	-158.7	296.8	-307.3	303.4	-188.8
1395.1	4161	-2537	4171	-4306	3483	-1870
1444.9	11250	-6854	10690	-10990	8893	-4136
1494.6	24970	-15180	22380	-22880	18540	-8581
1544.4	33850	-20530	29470	-30030	24420	-11240
1624.4	42100	-25400	35440	-35900	29660	-13400
1704.4	49570	-29690	40310	-40530	34400	-15100
1784.4	56130	-33280	44110	-44000	38500	-16470
1864.4	61680	-36100	46930	-46430	41960	-17720
1944.4	66140	-38080	49420	-47940	44820	-18810
2024.4	69480	-39200	52050	-48710	47150	-19880
2104.4	71880	-40220	54310	-48890	49080	-22860
2184.4	73310	-40470	56700	-48880	50800	-29990
2264.4	73710	-39940	59430	-49050	52600	-38440
2284.8	461300	-192200	159600	-139200	195000	-211100
2347.8	462000	-192900	161400	-138600	204500	-222400
2410.8	461700	-193200	162400	-137900	209100	-228000
2459.2	862900	-264000	404600	-465300	335200	-364600
2471.1	1271000	-351900	612500	-621500	493500	-376300
2569.8	1227000	-280900	461400	-429500	454300	-375000
2664.1	1586000	-323600	711300	-415000	559300	-318200
2758.5	1576000	-270900	492300	-387400	509400	-325500
2852.8	1600000	-151200	634100	-502500	473100	-447000
2963.4	1645000	-208700	370800	-312800	325200	-230700
2985.7	3657000	1012000	370500	-320800	327700	-233300
3012.5	3672000	1031000	375900	-367100	333200	-239500
3123.1	3622000	1031000	267800	-267900	206400	-203100
3240	3608000	1049000	272800	-265400	245900	-214500
3356.9	3661000	1032000	245800	-285000	190400	-192000
3473.7	3708000	1024000	227400	-202100	212400	-171800
3590.6	3715000	1071000	184300	-236700	145100	-234500
3707.4	3677000	1044000	150100	-225900	158800	-237500
3824.3	3601000	1038000	121200	-317900	117600	-266200
3941.1	3580000	1073000	156100	-309700	123000	-335800
4058	3562000	1035000	245600	-358000	137000	-377100
4090.3	3532000	1017000	298100	-473800	173500	-426100
4122.6	3506000	1054000	312500	-522500	205100	-454300
4166.6	4066000	1233000	297700	-319700	213200	-286800
4210.3	4058000	1361000	270400	-317200	195400	-273900
4227.4	4051000	1421000	263000	-325000	192600	-269500
4254	3968000	1692000	193800	-276700	181300	-345100
4297.8	4060000	1712000	162100	-333300	188200	-311100
4341.6	4091000	1169000	200600	-311800	187800	-267800
4385.5	3939	-0.1894	0.3714	-703.1	0.8306	-2389

NLS2 COMPOSITE MOMENT BODY LOADS W/O STME OUT (IN-LBS)

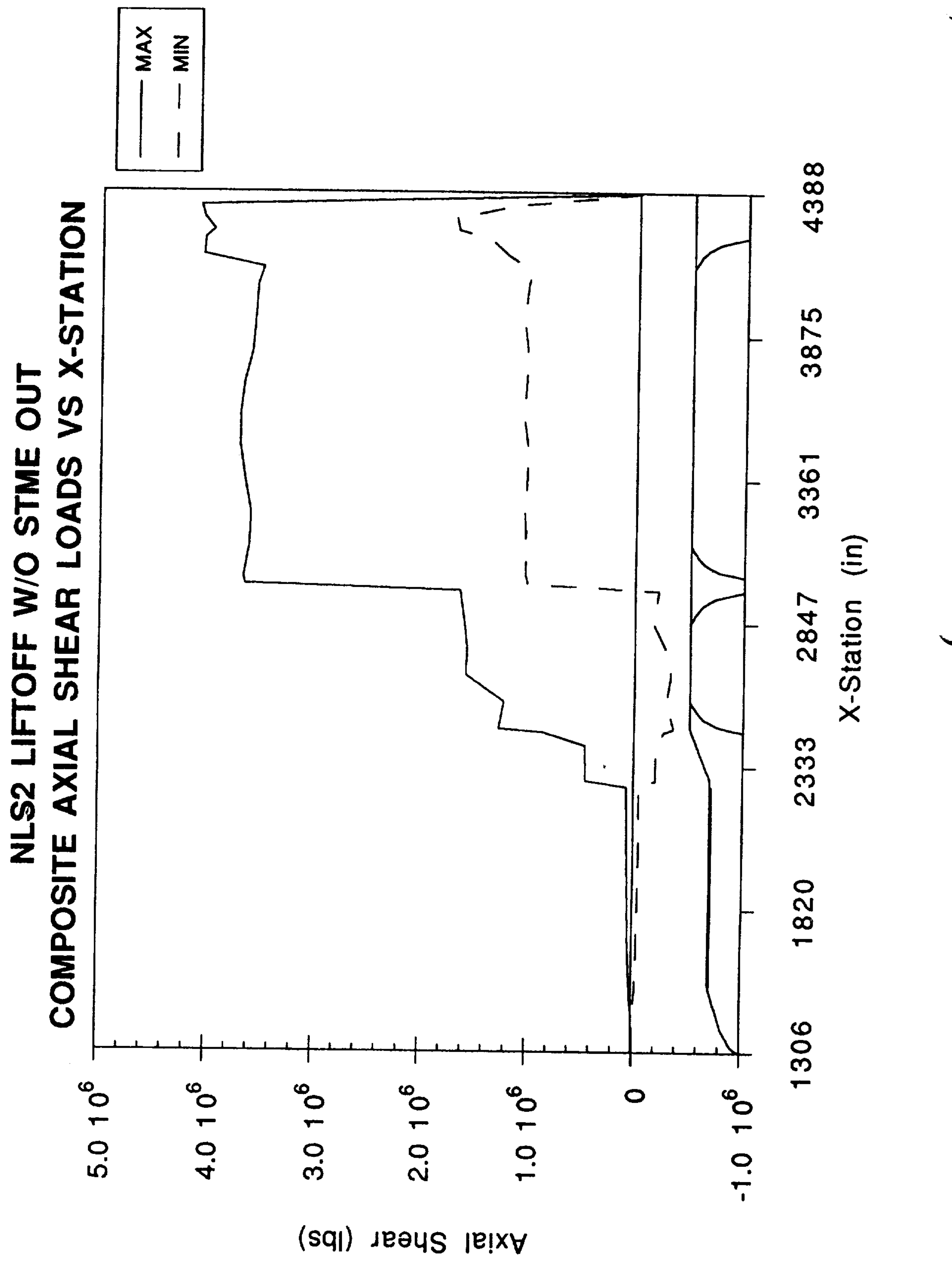
LIFTOFF

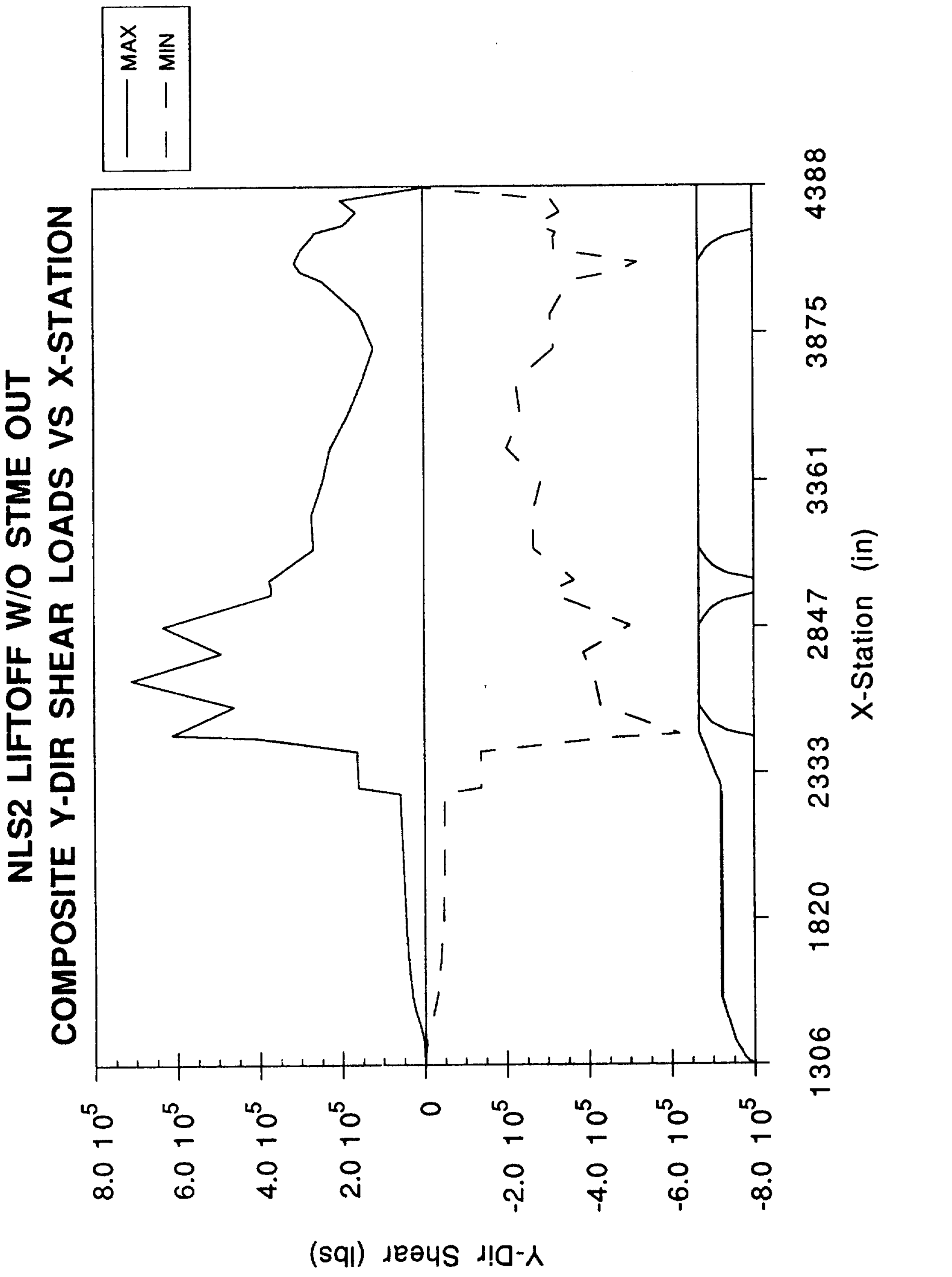
X-Station (in)	X-Dir. Maximum	X-Dir. Minimum	Y-Dir. Maximum	Y-Dir. Minimum	Z-Dir. Maximum	Z-Dir. Minimum
1306.1	1722	-1545	2.221	0.0005961	0.0006276	-6.266
1395.1	12610	-11310	27020	-16810	26430	-27360
1444.9	26920	-24140	195400	-109900	233800	-241700
1494.6	57590	-51650	638100	-297400	765800	-788500
1544.4	320600	-287500	1561000	-724200	1880000	-1927000
1624.4	473500	-424400	3509000	-1623000	4237000	-4330000
1704.4	548600	-491300	5860000	-2695000	7069000	-7201000
1784.4	578600	-517800	8581000	-3903000	10290000	-10440000
1864.4	589100	-527000	11650000	-5215000	13820000	-13960000
1944.4	595400	-532400	15000000	-6602000	17580000	-17680000
2024.4	601700	-537300	18590000	-8049000	21490000	-21510000
2104.4	601100	-538400	22360000	-9577000	25490000	-25410000
2184.4	576500	-547600	26290000	-11210000	29550000	-29320000
2264.4	506400	-529900	30350000	-12890000	33700000	-33220000
2284.8	1349000	-1381000	65380000	-47280000	68160000	-58650000
2347.8	1325000	-1396000	69010000	-51570000	77640000	-66930000
2410.8	1267000	-1398000	73610000	-55910000	87160000	-75110000
2459.2	1152000	-1414000	81360000	-59190000	94520000	-81320000
2471.1	1190000	-1424000	82380000	-58820000	94140000	-80590000
2569.8	1201000	-1409000	77840000	-70990000	95010000	-75800000
2664.1	1201000	-1411000	76970000	-67790000	84230000	-76230000
2758.5	1197000	-1434000	74880000	-49490000	91560000	-79440000
2852.8	1156000	-1531000	91260000	-56040000	102700000	-59460000
2963.4	1094000	-1625000	86530000	-53870000	101900000	-59700000
2985.7	1094000	-1625000	82990000	-53400000	94980000	-58330000
3012.5	3194000	-2902000	78970000	-53720000	86360000	-56740000
3123.1	1714000	-2563000	65770000	-51770000	65350000	-51890000
3240	2474000	-2789000	73650000	-53640000	74090000	-51680000
3356.9	1890000	-2915000	70580000	-59810000	73870000	-54040000
3473.7	1348000	-2978000	85400000	-61010000	88210000	-68350000
3590.6	1360000	-3014000	85210000	-64510000	89010000	-75640000
3707.4	1374000	-3057000	94210000	-66060000	94310000	-74340000
3824.3	1929000	-3144000	103300000	-63520000	90200000	-66960000
3941.1	2912000	-3310000	112400000	-59120000	94330000	-58880000
4058	4441000	-4628000	121500000	-51000000	97640000	-54770000
4090.3	4733000	-5031000	124000000	-50460000	101900000	-53100000
4122.6	4326000	-5066000	126400000	-50700000	106900000	-50590000
4166.6	4007000	-4960000	130100000	-48350000	111500000	-55160000
4210.3	4195000	-5051000	133200000	-46020000	109000000	-52790000
4227.4	4470000	-5090000	134400000	-44280000	106600000	-52690000
4254	5417000	-6479000	136200000	-53160000	98850000	-53420000
4297.8	7504000	-5543000	139100000	-79100000	102000000	-71620000
4341.6	7995000	-5889000	142300000	-95070000	105000000	-91810000
4385.5	49490	-24.93	14940000	-16520000	16740000	-19210000

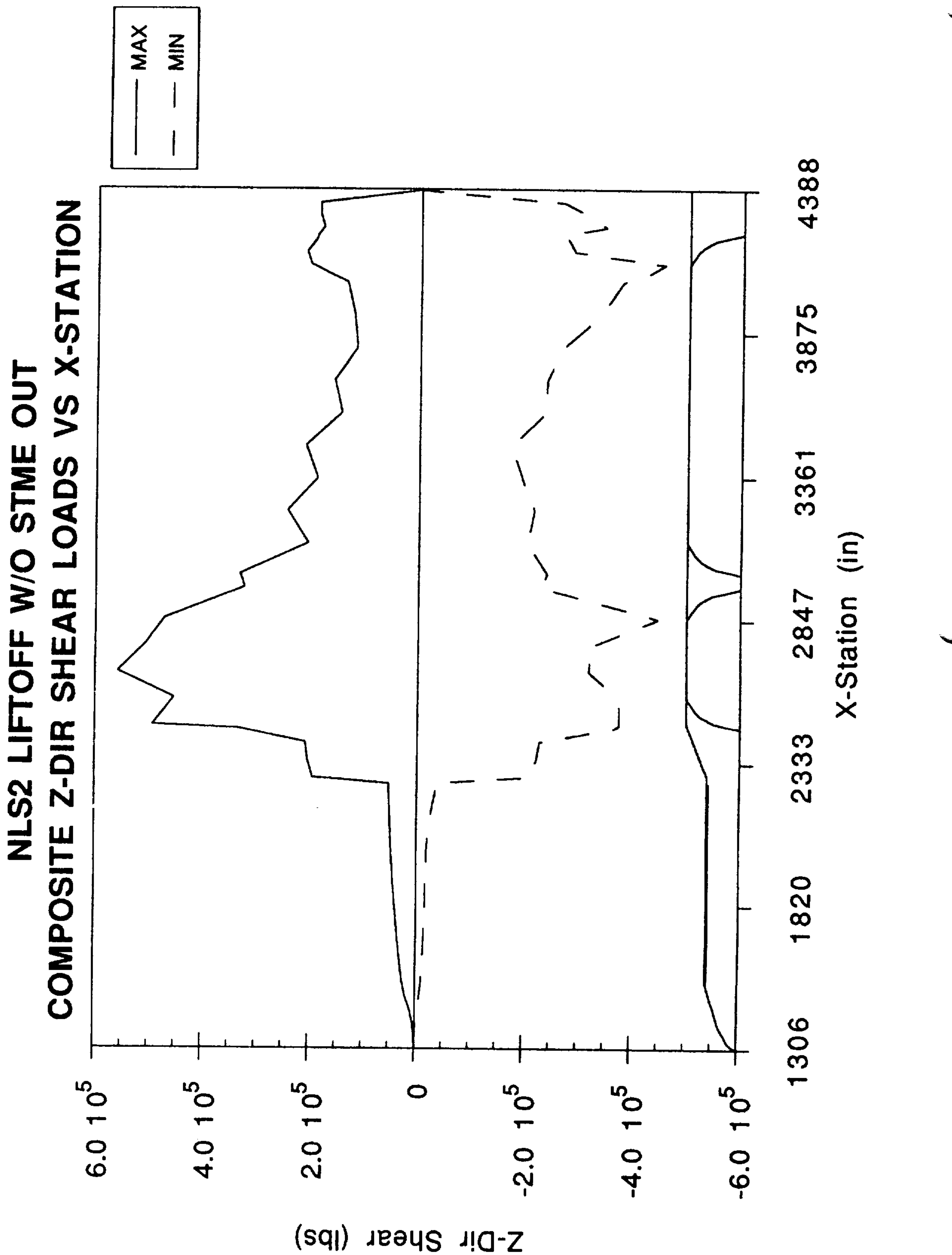
NLS2 COMPOSITE LINE BODY LOADS W/O STME OUT

LIFTOFF

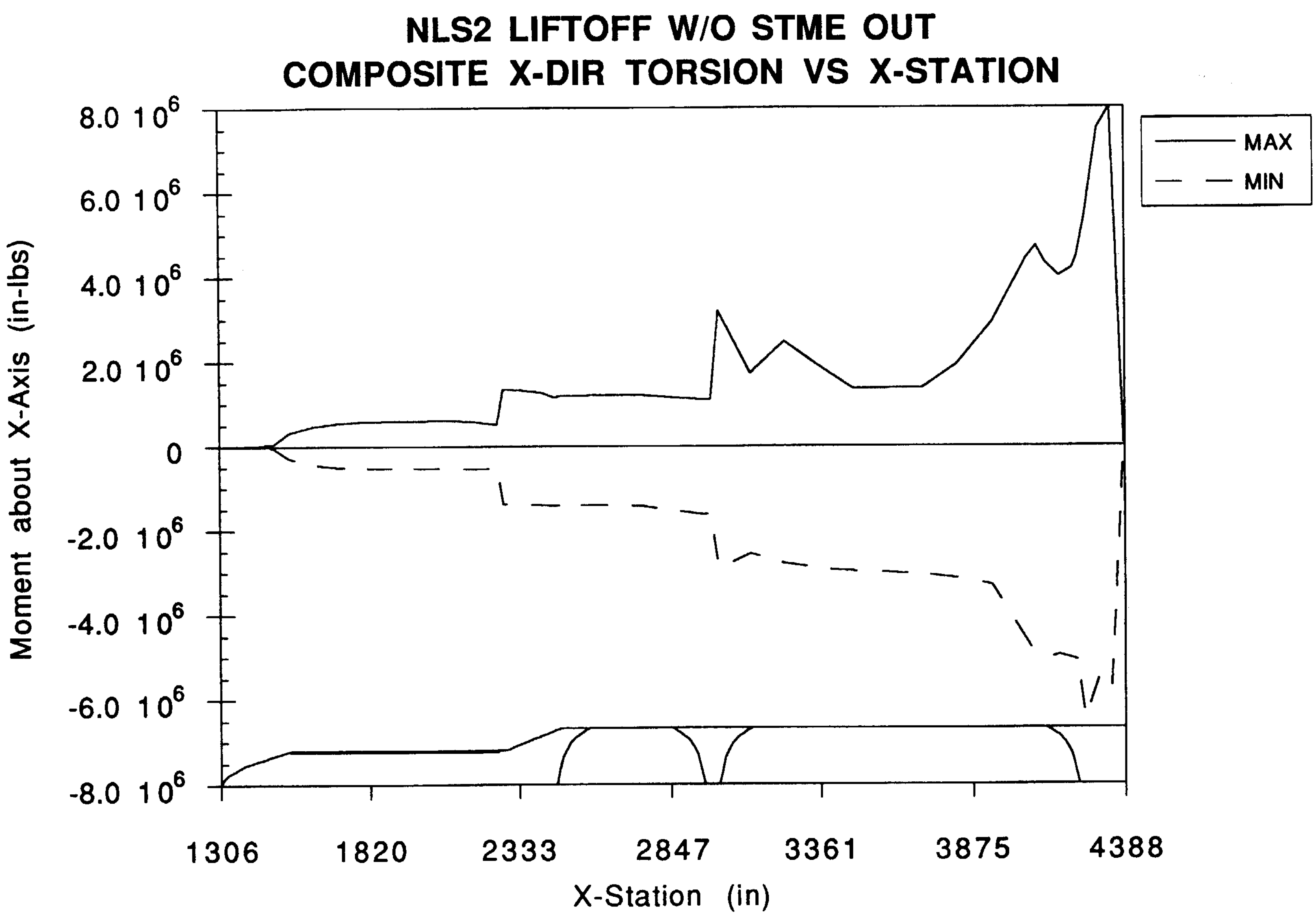
X-Station (in)	NX+ (lbs/in) Maximum	NX+ (lbs/in) Minimum	NX- (lbs/in) Maximum	NX- (lbs/in) Minimum	PEQ+ (lbs) Maximum	PEQ+ (lbs) Minimum	PEQ- (lbs) Maximum	PEQ- (lbs) Minimum
1306.1	0	0	0	0	0	0	0	0
1395.1	18.92	-11.54	18.92	-11.54	4161	-2537	4161	-2537
1444.9	29.84	-18.18	29.84	-18.18	11250	-6854	11250	-6854
1494.6	49.67	-30.2	49.67	-30.2	24970	-15180	24970	-15180
1544.4	53.88	-32.68	53.88	-32.68	33850	-20530	33850	-20530
1624.4	67.01	-40.43	67.01	-40.43	42100	-25400	42100	-25400
1704.4	78.89	-47.25	78.89	-47.25	49570	-29690	49570	-29690
1784.4	89.33	-52.96	89.33	-52.96	56130	-33280	56130	-33280
1864.4	98.16	-57.45	98.16	-57.45	61680	-36100	61680	-36100
1944.4	105.3	-60.61	105.3	-60.61	66140	-38080	66140	-38080
2024.4	110.6	-62.38	110.6	-62.38	69480	-39200	69480	-39200
2104.4	114.4	-64.01	114.4	-64.01	71880	-40220	71880	-40220
2184.4	116.7	-64.4	116.7	-64.4	73310	-40470	73310	-40470
2264.4	117.3	-63.56	117.3	-63.56	73710	-39940	73710	-39940
2284.8	2440	-194.2	710.8	-2179	1533000	-122000	446600	-1369000
2347.8	614.3	-256.5	614.3	-256.5	462000	-192900	462000	-192900
2410.8	527.1	-220.6	527.1	-220.6	461700	-193200	461700	-193200
2459.2	888.9	-271.9	888.9	-271.9	862900	-264000	862900	-264000
2471.1	1278	-353.8	1278	-353.8	1271000	-351900	1271000	-351900
2569.8	1180	-270.1	1180	-270.1	1227000	-280900	1227000	-280900
2664.1	1525	-311.2	1525	-311.2	1586000	-323600	1586000	-323600
2758.5	1516	-260.5	1516	-260.5	1576000	-270900	1576000	-270900
2852.8	1538	-145.4	1538	-145.4	1600000	-151200	1600000	-151200
2963.4	1582	-200.7	1582	-200.7	1645000	-208700	1645000	-208700
2985.7	3517	973.2	3517	973.2	3657000	1012000	3657000	1012000
3012.5	3531	991.7	3531	991.7	3672000	1031000	3672000	1031000
3123.1	3483	991.5	3483	991.5	3622000	1031000	3622000	1031000
3240	3469	1009	3469	1009	3608000	1049000	3608000	1049000
3356.9	3521	992.3	3521	992.3	3661000	1032000	3661000	1032000
3473.7	3566	984.9	3566	984.9	3708000	1024000	3708000	1024000
3590.6	3573	1030	3573	1030	3715000	1071000	3715000	1071000
3707.4	3536	1004	3536	1004	3677000	1044000	3677000	1044000
3824.3	3463	998.4	3463	998.4	3601000	1038000	3601000	1038000
3941.1	3443	1032	3443	1032	3580000	1073000	3580000	1073000
4058	3425	995.7	3425	995.7	3562000	1035000	3562000	1035000
4090.3	3397	978.2	3397	978.2	3532000	1017000	3532000	1017000
4122.6	3372	1013	3372	1013	3506000	1054000	3506000	1054000
4166.6	4114	1188	3884	927.2	4278000	1236000	4039000	964200
4210.3	3904	1313	3900	1227	4060000	1365000	4056000	1276000
4227.4	3896	1369	3896	1328	4052000	1423000	4051000	1381000
4254	4013	1633	3806	1447	4173000	1698000	3958000	1504000
4297.8	4113	1671	3882	1186	4277000	1737000	4036000	1233000
4341.6	4071	1151	3912	773.1	4234000	1197000	4067000	804000
4385.5	1705	0.2368	0.177	-1705	1773000	246.2	184	-1773000

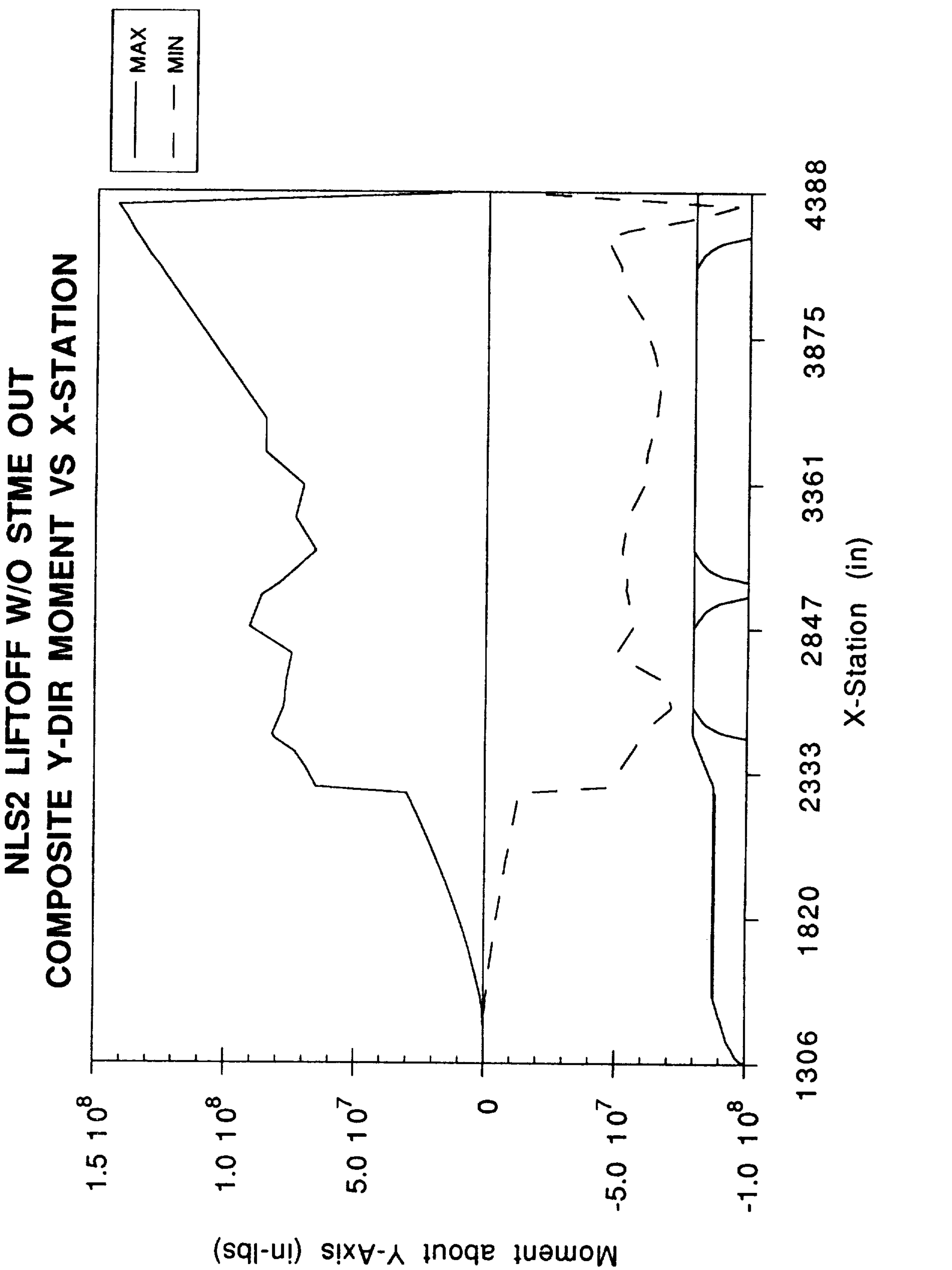

NLS2 LIFTOFF W/O STME OUT
COMPOSITE AXIAL SHEAR LOADS VS X-STATION
MAX
MIN
Axial Shear (lbs)
5.0 10^6
4.0 10^6
3.0 10^6
2.0 10^6
1.0 10^6
0
-1.0 10^6
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 LIFTOFF W/O STME OUT
COMPOSITE Y-DIR SHEAR LOADS VS X-STATION
MAX
MIN
8.0 10^5
6.0 10^5
4.0 10^5
2.0 10^5
0
-2.0 10^5
-4.0 10^5
-6.0 10^5
-8.0 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)



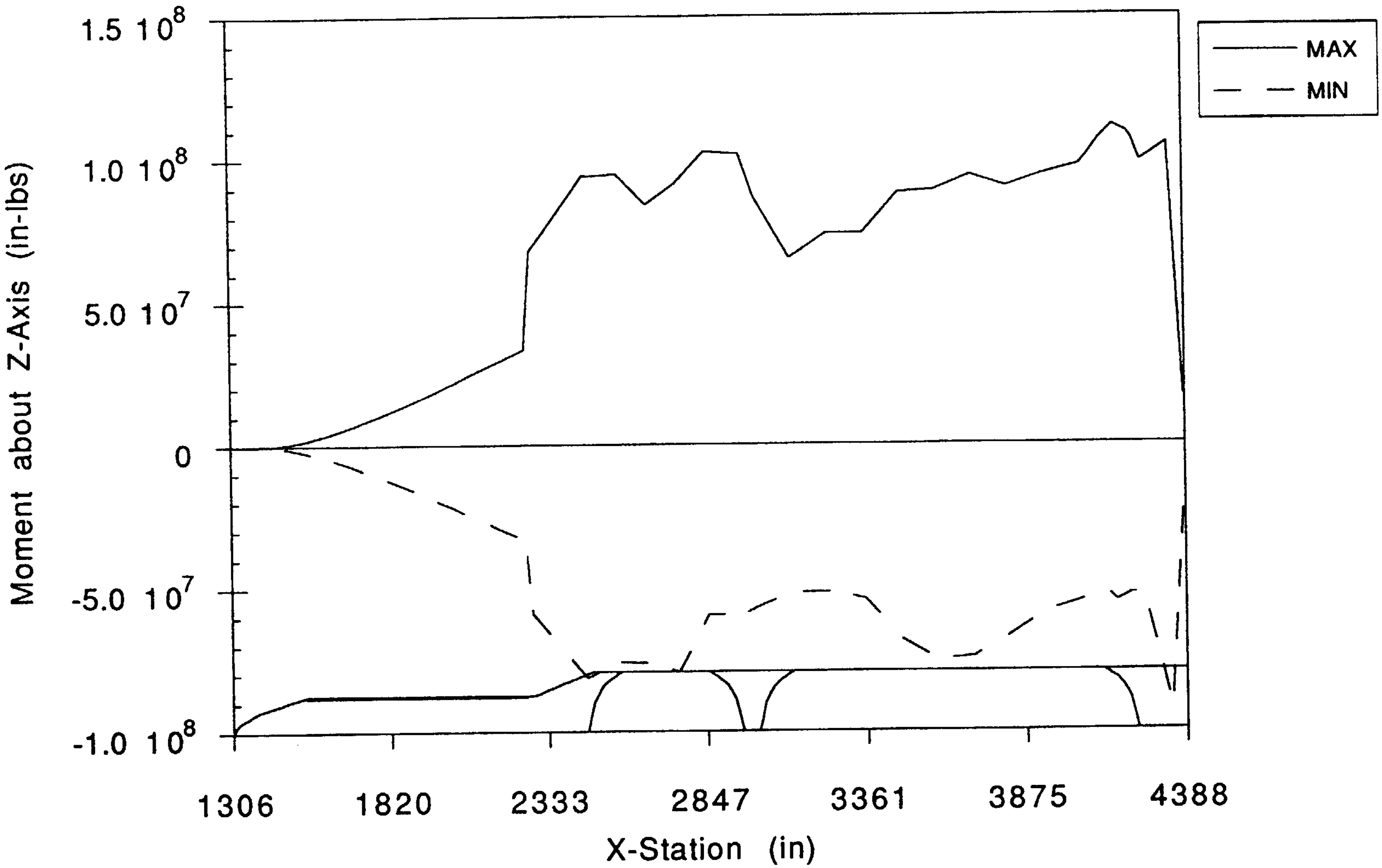
NLS2 LIFTOFF W/O STME OUT
COMPOSITE Z-DIR SHEAR LOADS VS X-STATION
MAX
MIN
6.0 10^5
4.0 10^5
2.0 10^5
0
-2.0 10^5
-4.0 10^5
-6.0 10^5
Z-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 LIFTOFF W/O STME OUT
COMPOSITE X-DIR TORSION VS X-STATION
8.0 10^6
6.0 10^6
4.0 10^6
2.0 10^6
0
-2.0 10^6
-4.0 10^6
-6.0 10^6
-8.0 10^6
Moment about X-Axis (in-lbs)
MAX
MIN
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

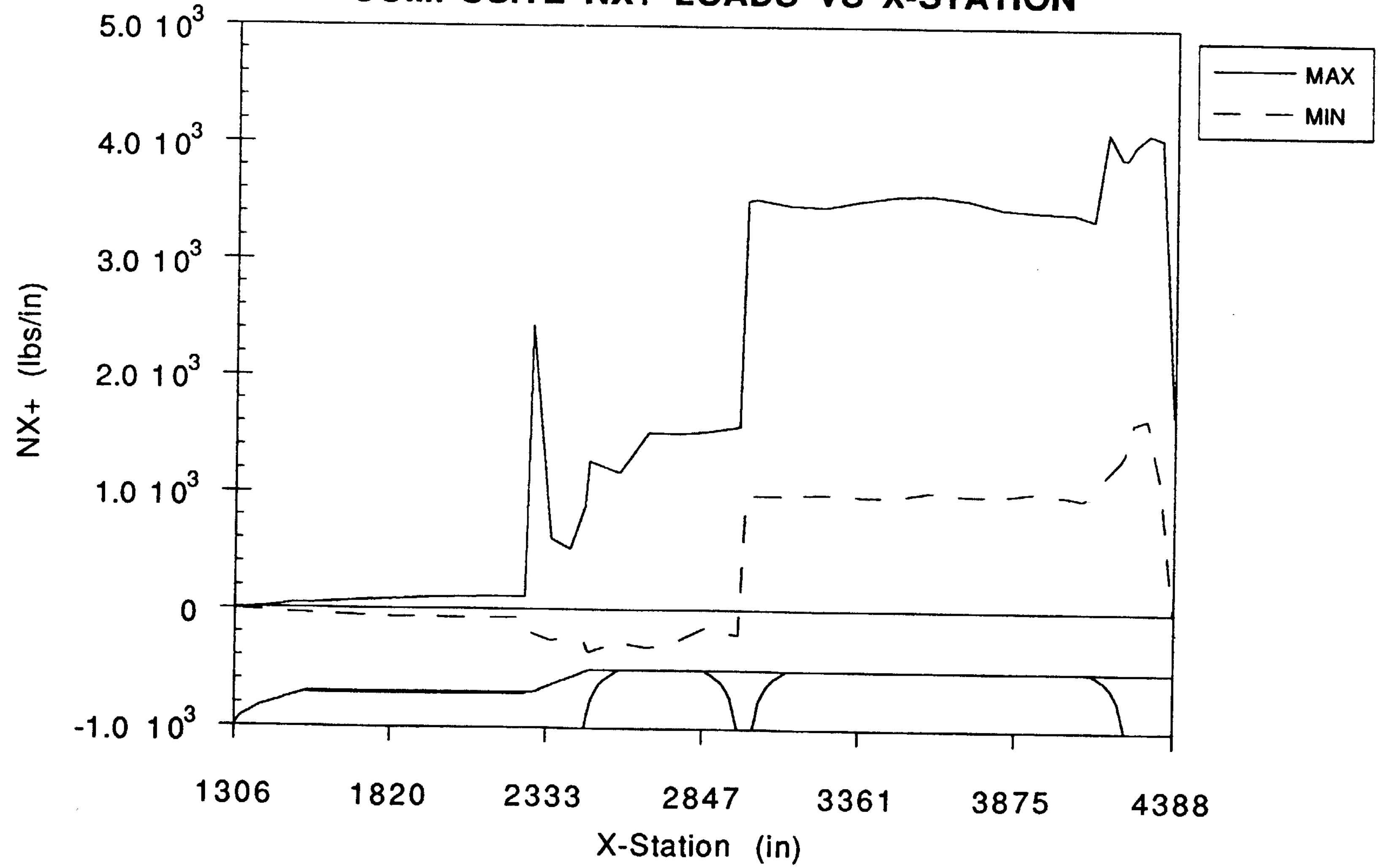


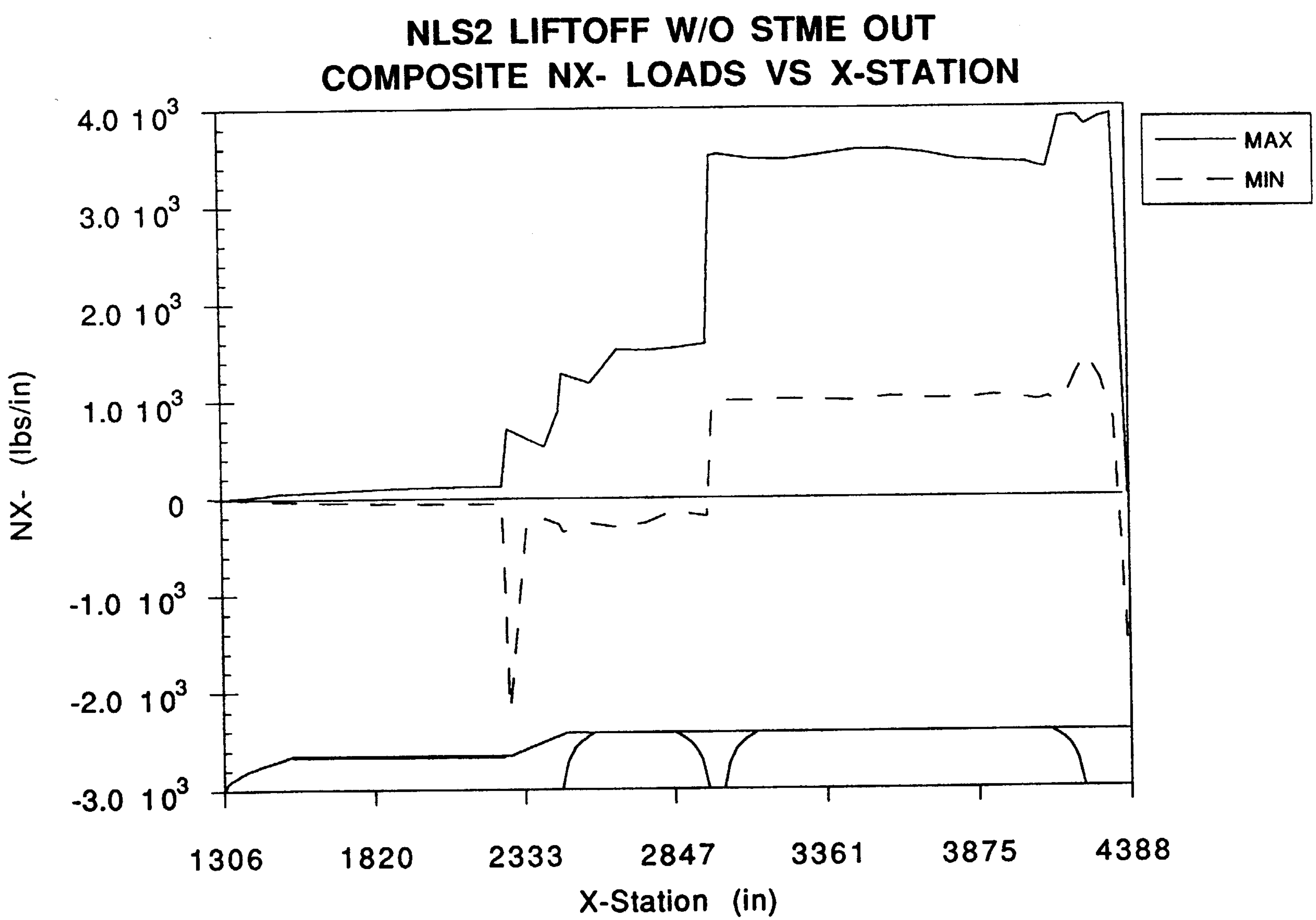
NLS2 LIFTOFF W/O STME OUT
COMPOSITE Y-DIR MOMENT VS X-STATION
MAX
MIN
Moment about Y-Axis (in-lbs)
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 LIFTOFF W/O STME OUT
COMPOSITE Z-DIR MOMENT VS X-STATION



NLS2 LIFTOFF W/O STME OUT
COMPOSITE NX+ LOADS VS X-STATION



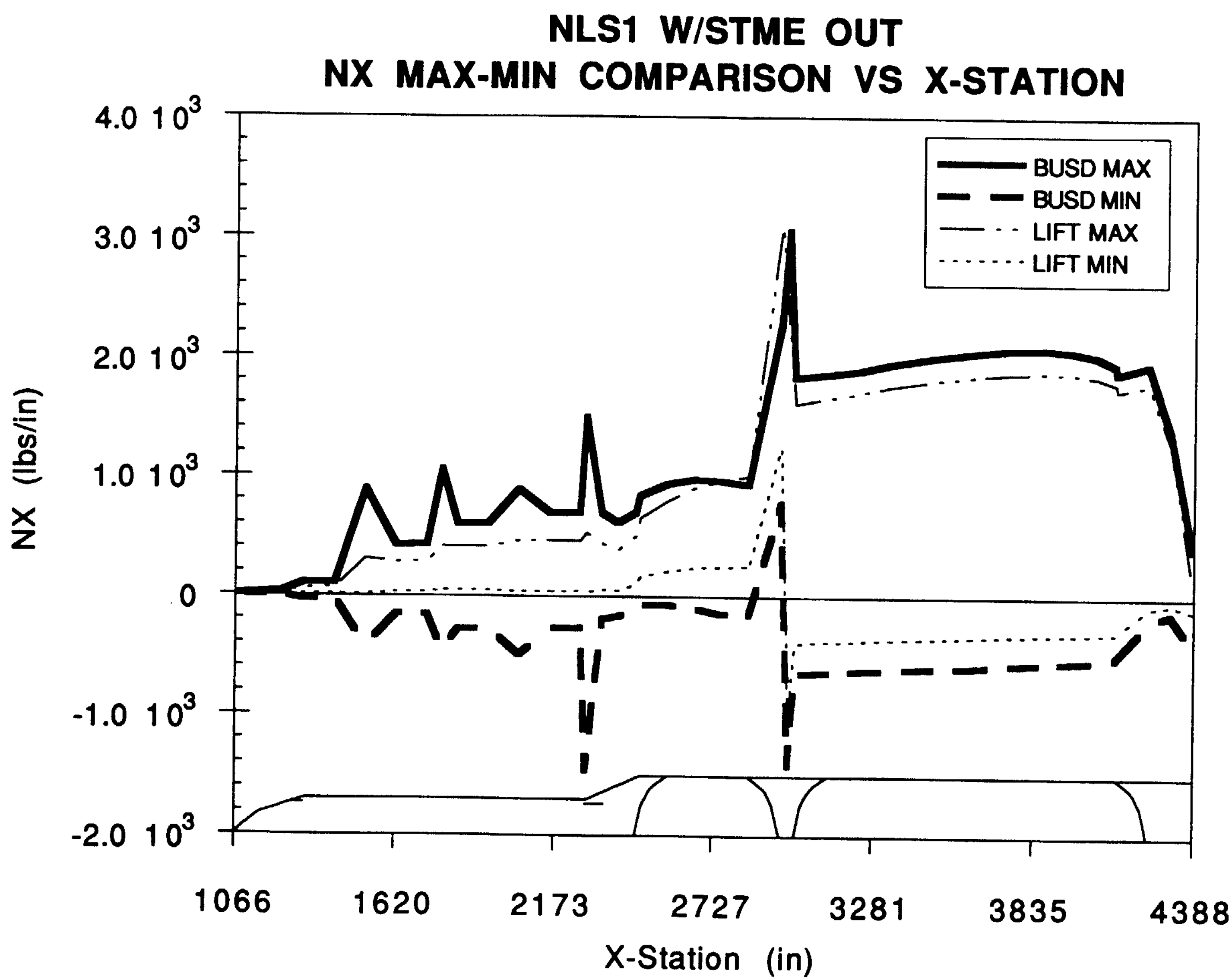


NLS2 LIFTOFF W/O STME OUT
COMPOSITE NX- LOADS VS X-STATION
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
NX- (lbs/in)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)
MAX
MIN

NLS 1 AND NLS 2

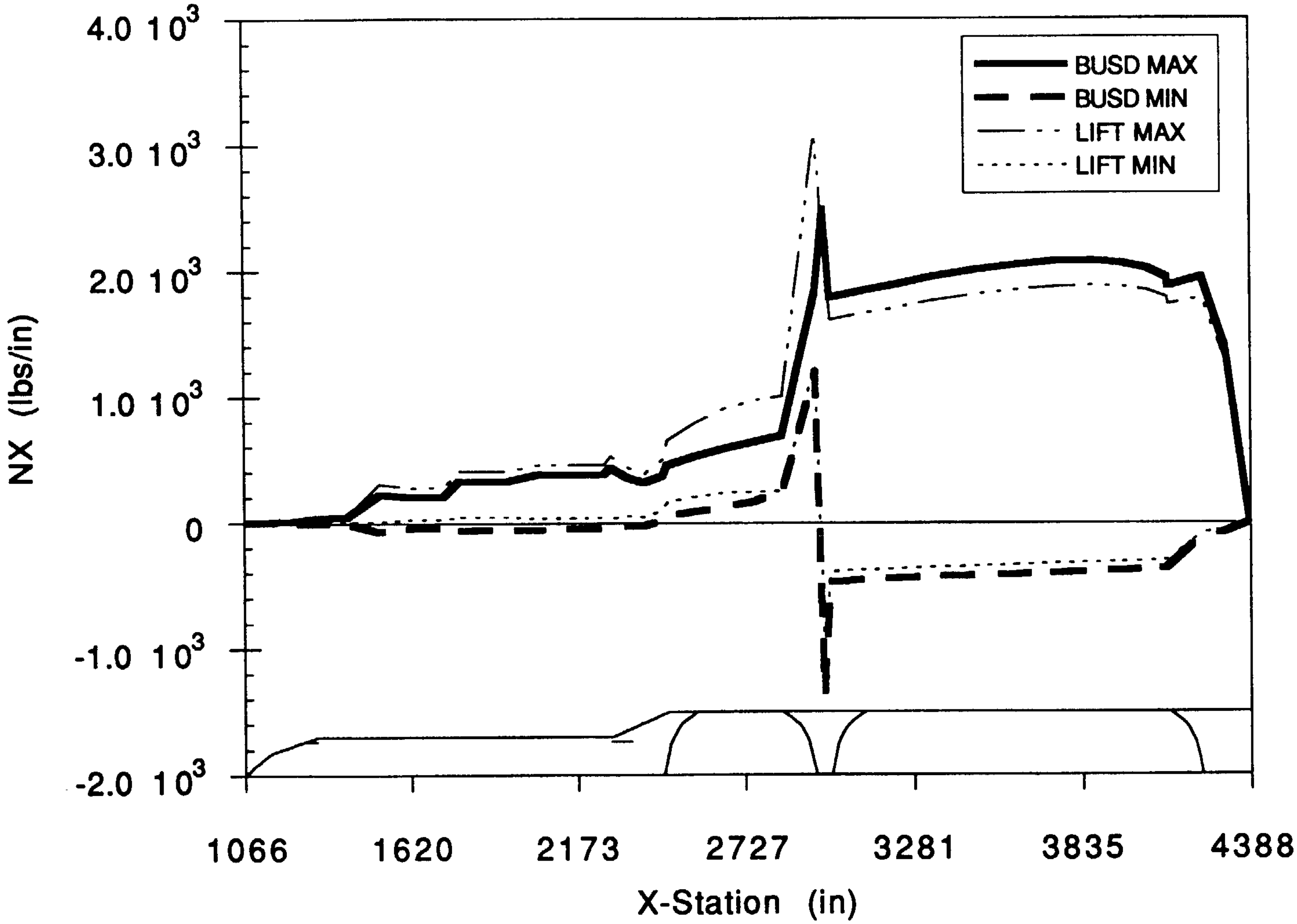
PRELAUNCH AND LIFTOFF

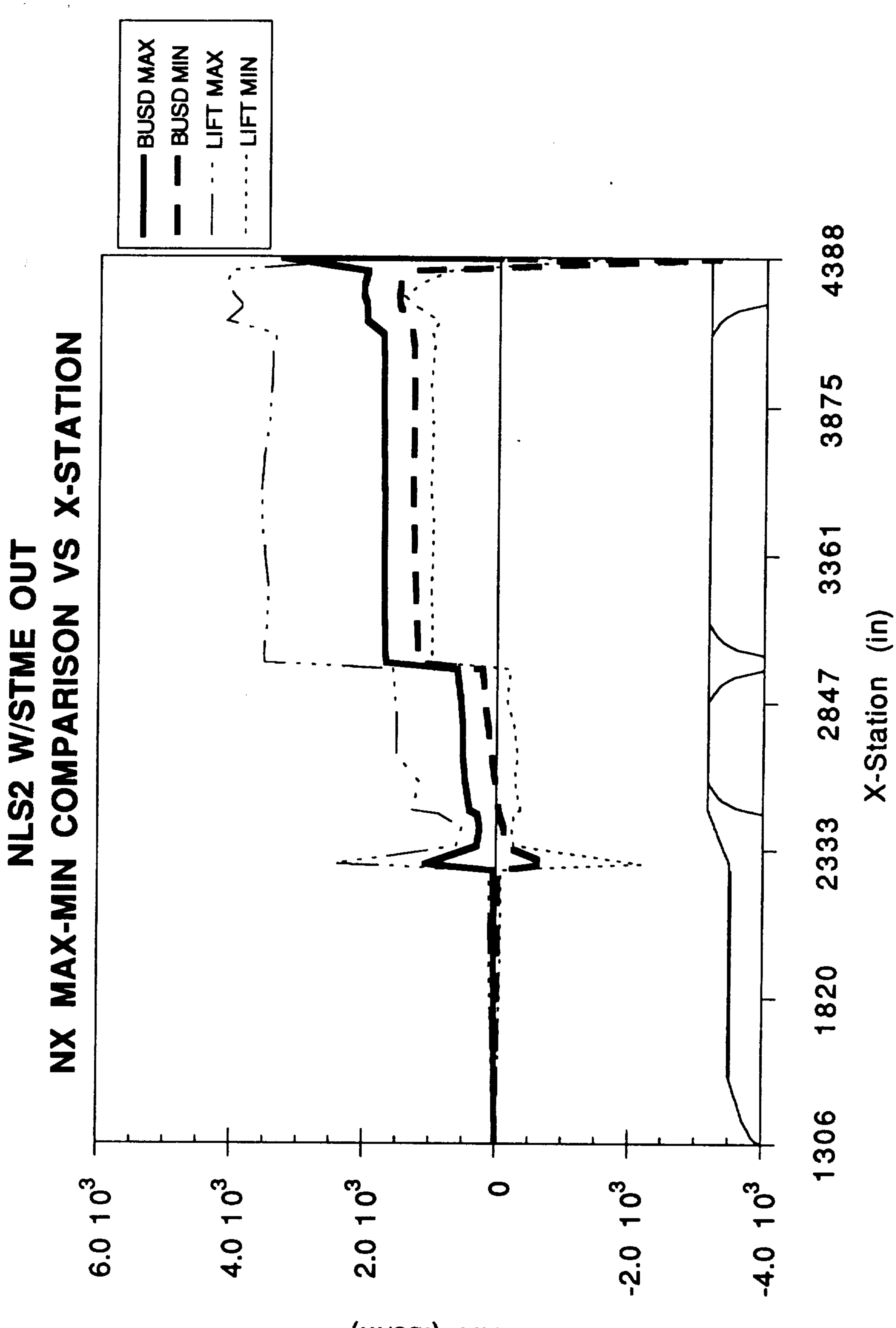
LINE LOAD COMPARISONS



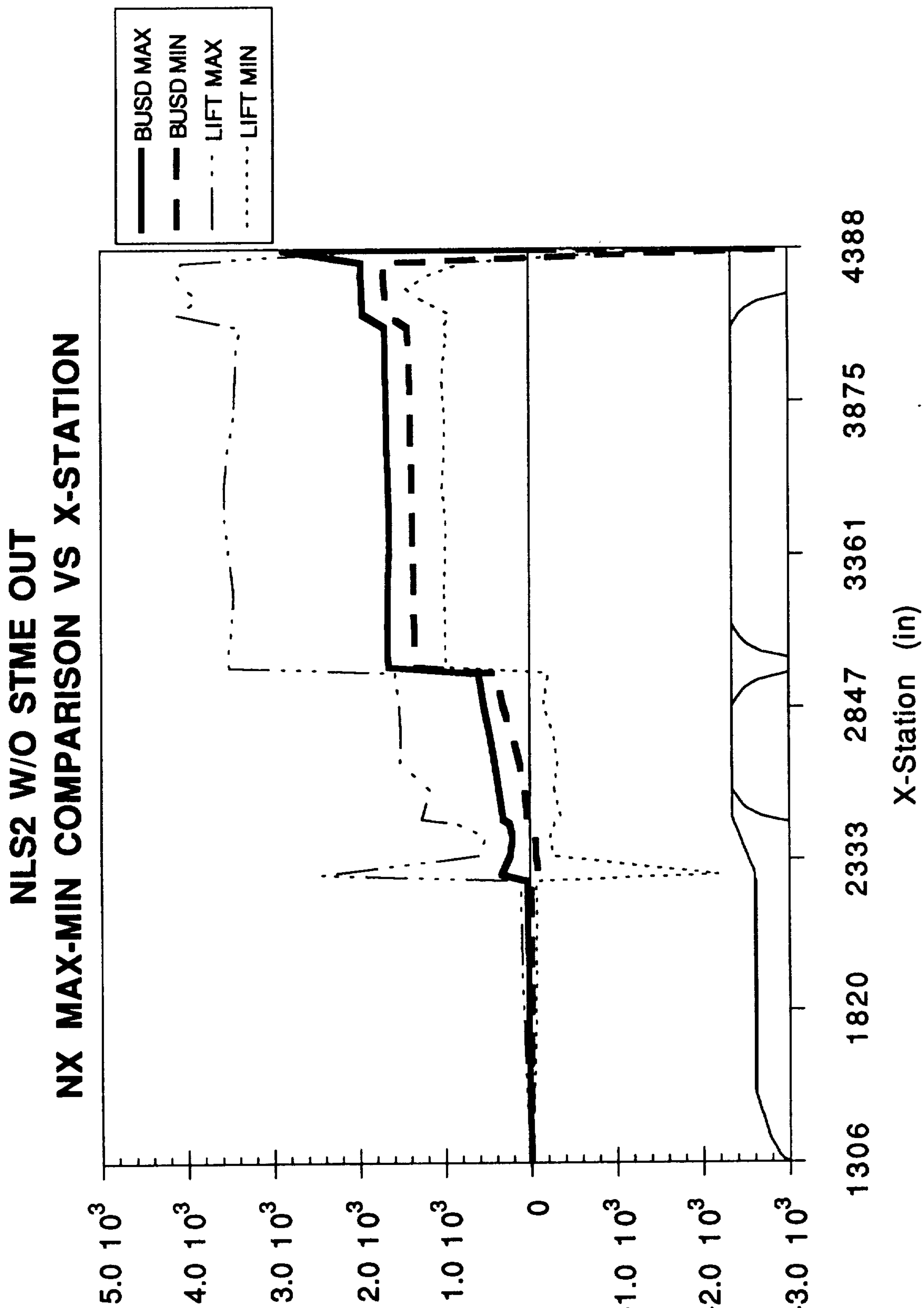
NLS1 W/STME OUT
NX MAX-MIN COMPARISON VS X-STATION
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
NX (lbs/in)
BUSD MAX
BUSD MIN
LIFT MAX
LIFT MIN
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

NLS1 W/O STME OUT
NX MAX-MIN COMPARISON VS X-STATION



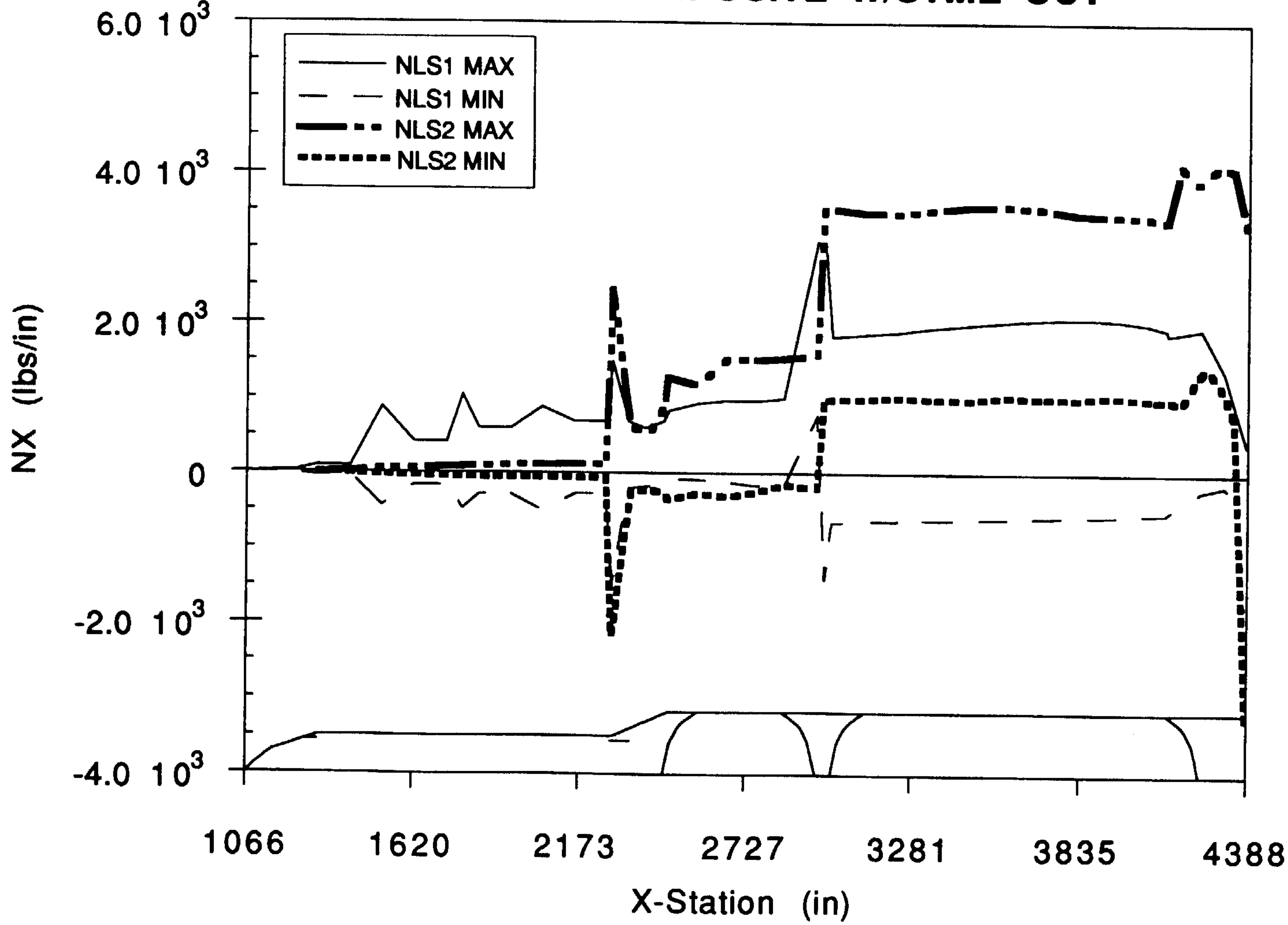


NLS2 W/STME OUT
NX MAX-MIN COMPARISON VS X-STATION
BUSD MAX
BUSD MIN
LIFT MAX
LIFT MIN
NX (lbs/in)
6.0 10³
4.0 10³
2.0 10³
0
-2.0 10³
-4.0 10³
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

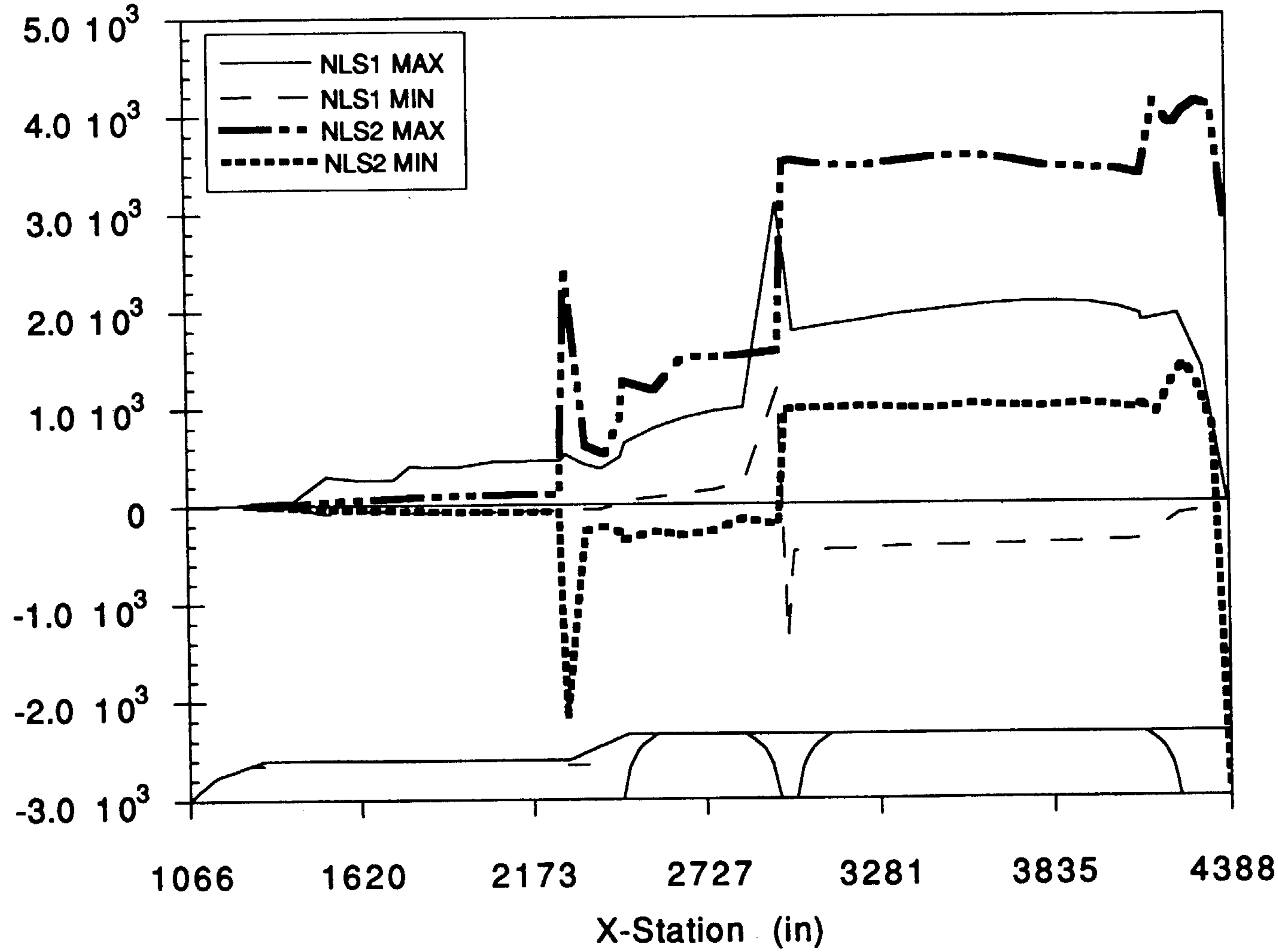


NLS2 W/O STME OUT
NX MAX-MIN COMPARISON VS X-STATION
BUSD MAX
BUSD MIN
LIFT MAX
LIFT MIN
NX (lbs/in)
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NX COMPARISONS VS X-STATION
NLS1/NLS2 COMPOSITE W/STME OUT



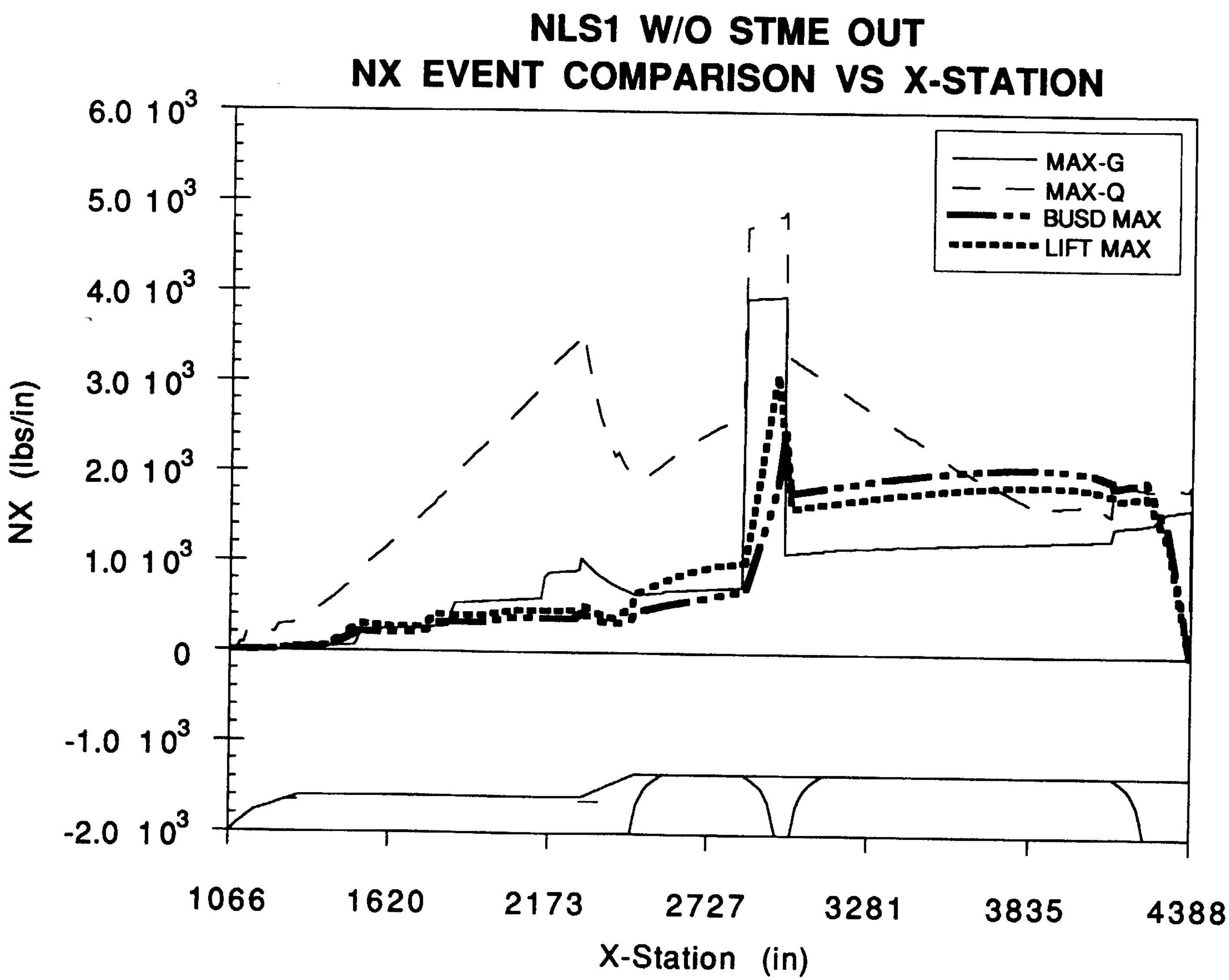
NX COMPARISONS VS X-STATION
NLS1/NLS2 COMPOSITE W/O STME OUT



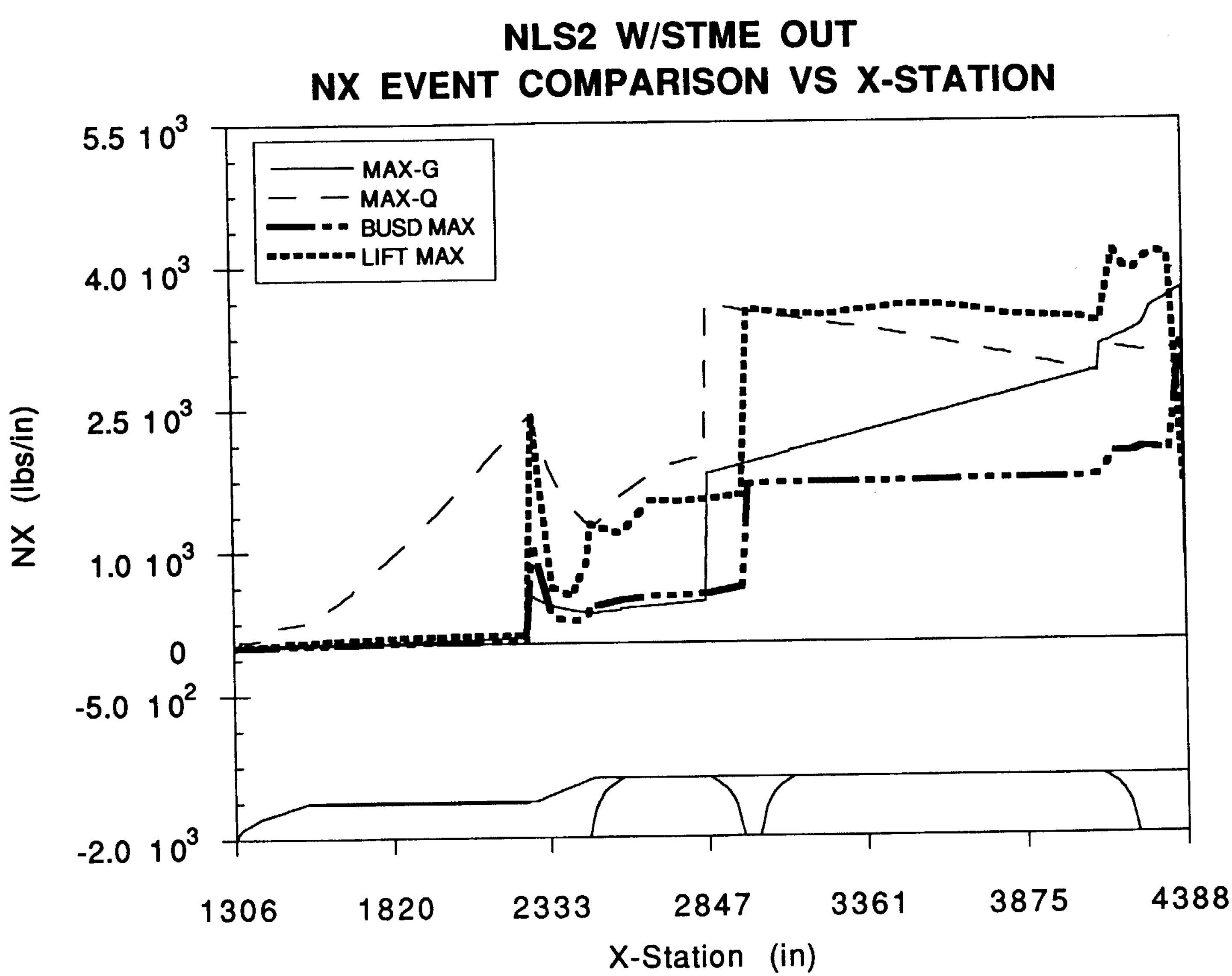
NLS 1 AND NLS 2

OVERALL

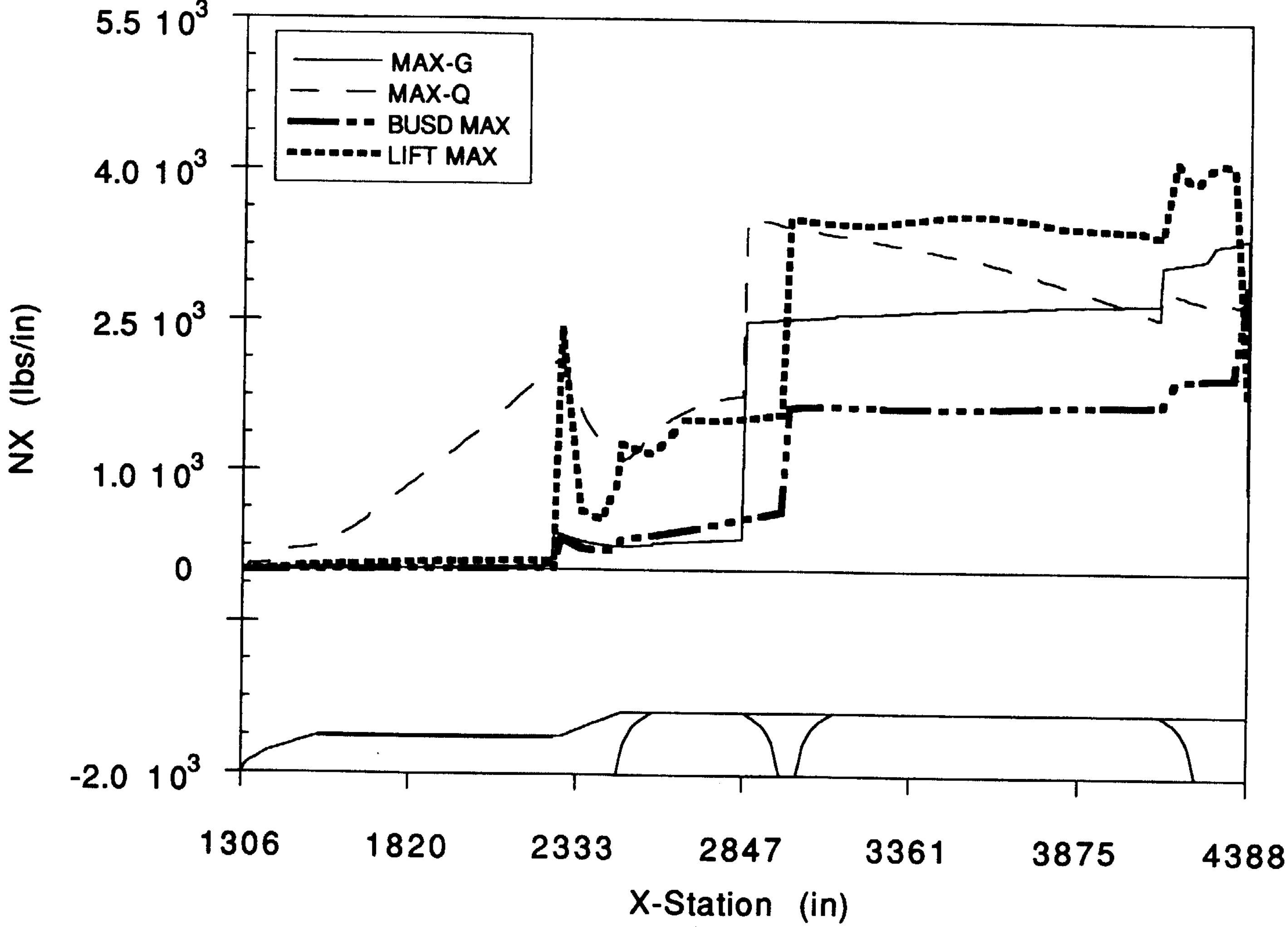
LINE LOAD COMPARISONS



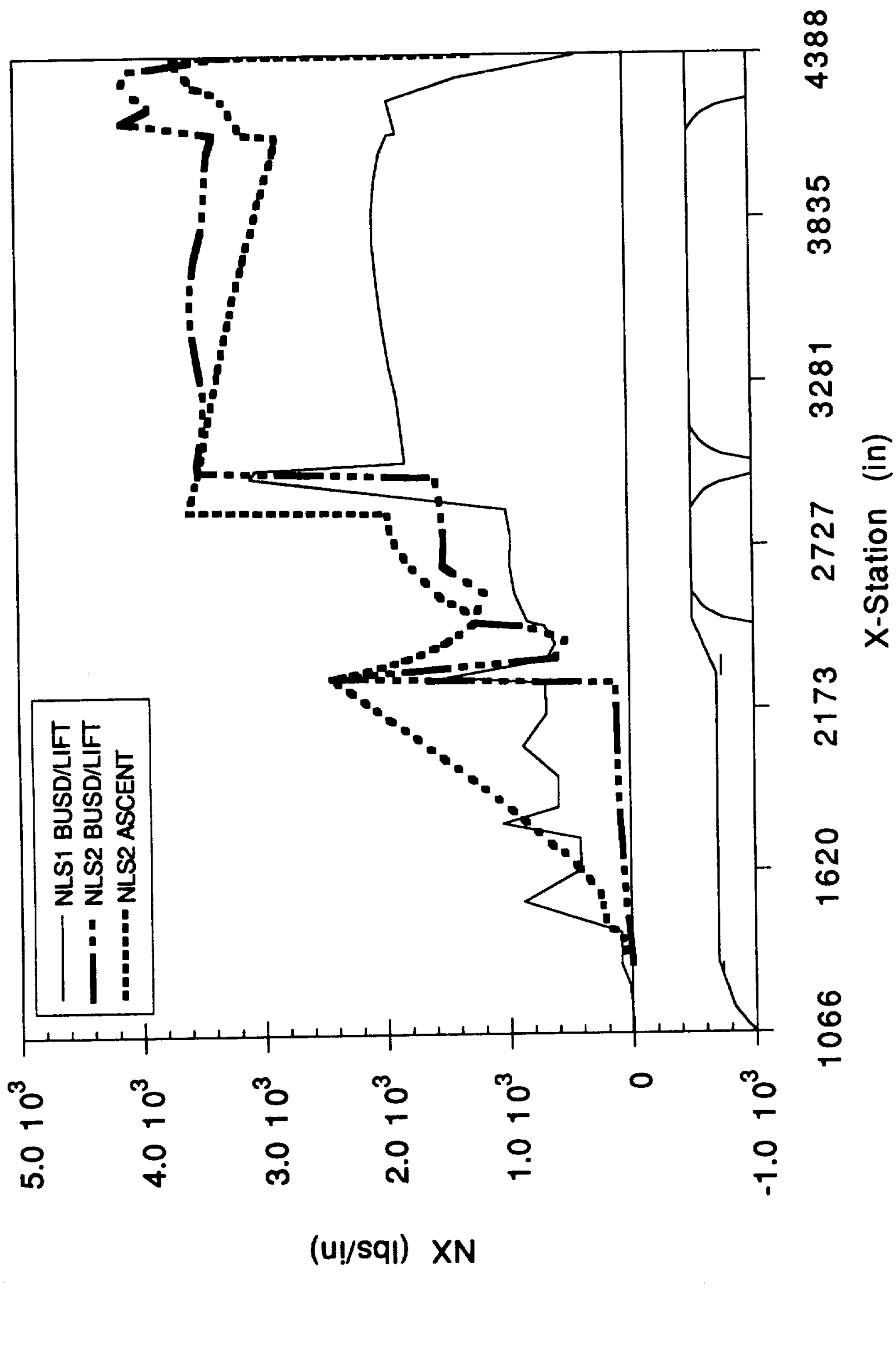
NLS1 W/O STME OUT
NX EVENT COMPARISON VS X-STATION
MAX-G
MAX-Q
BUSD MAX
LIFT MAX
6.0 10^3
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
NX (lbs/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS2 W/STME OUT
NX EVENT COMPARISON VS X-STATION
MAX-G
MAX-Q
BUSD MAX
LIFT MAX
5.5 10^3
4.0 10^3
2.5 10^3
1.0 10^3
0
-5.0 10^2
-2.0 10^3
NX (lbs/in)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

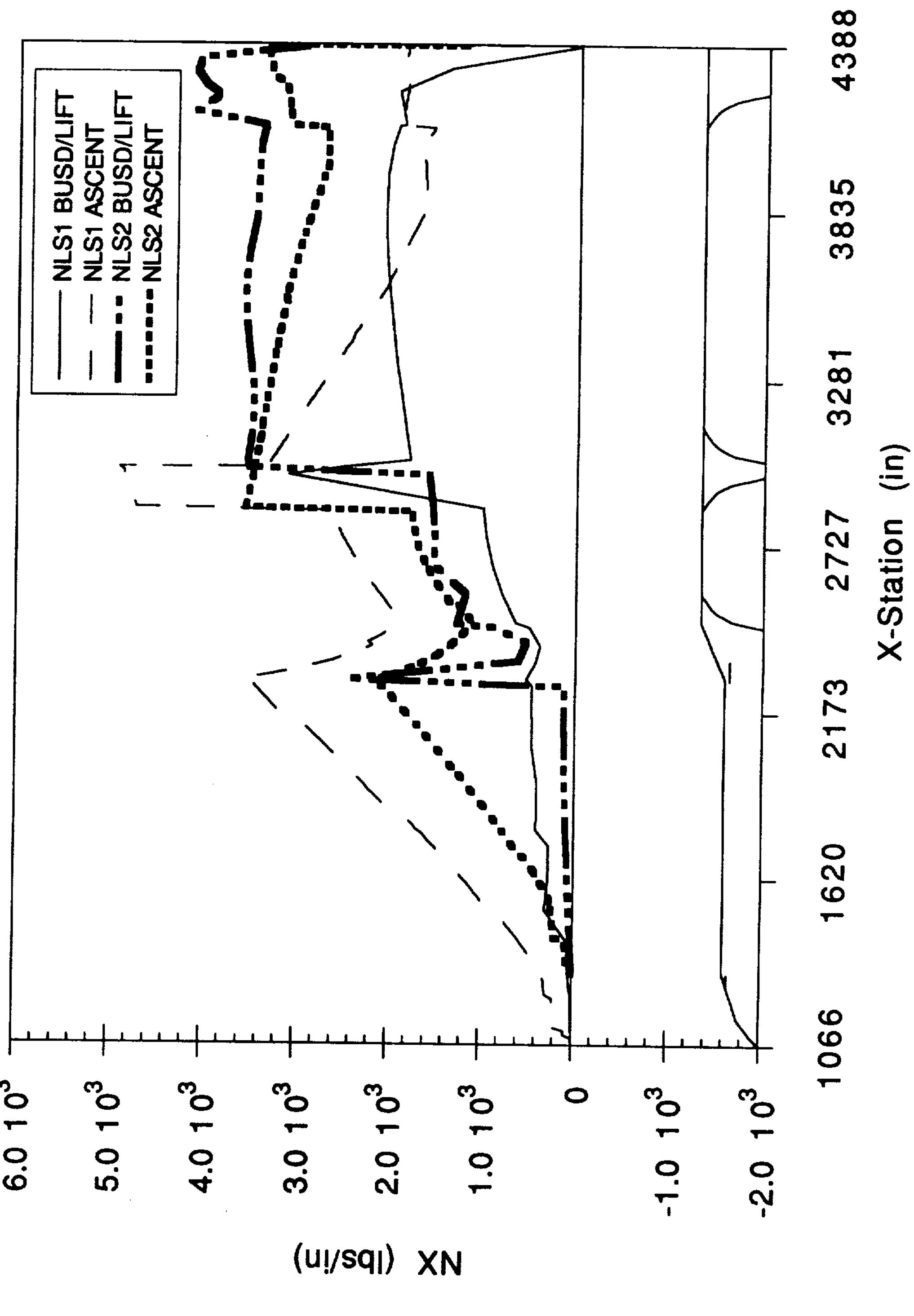
NLS2 W/O STME OUT
NX EVENT COMPARISON VS X-STATION



NLS1 AND NLS2 W/STME OUT
NX EVENT COMPARISON VS X-STATION



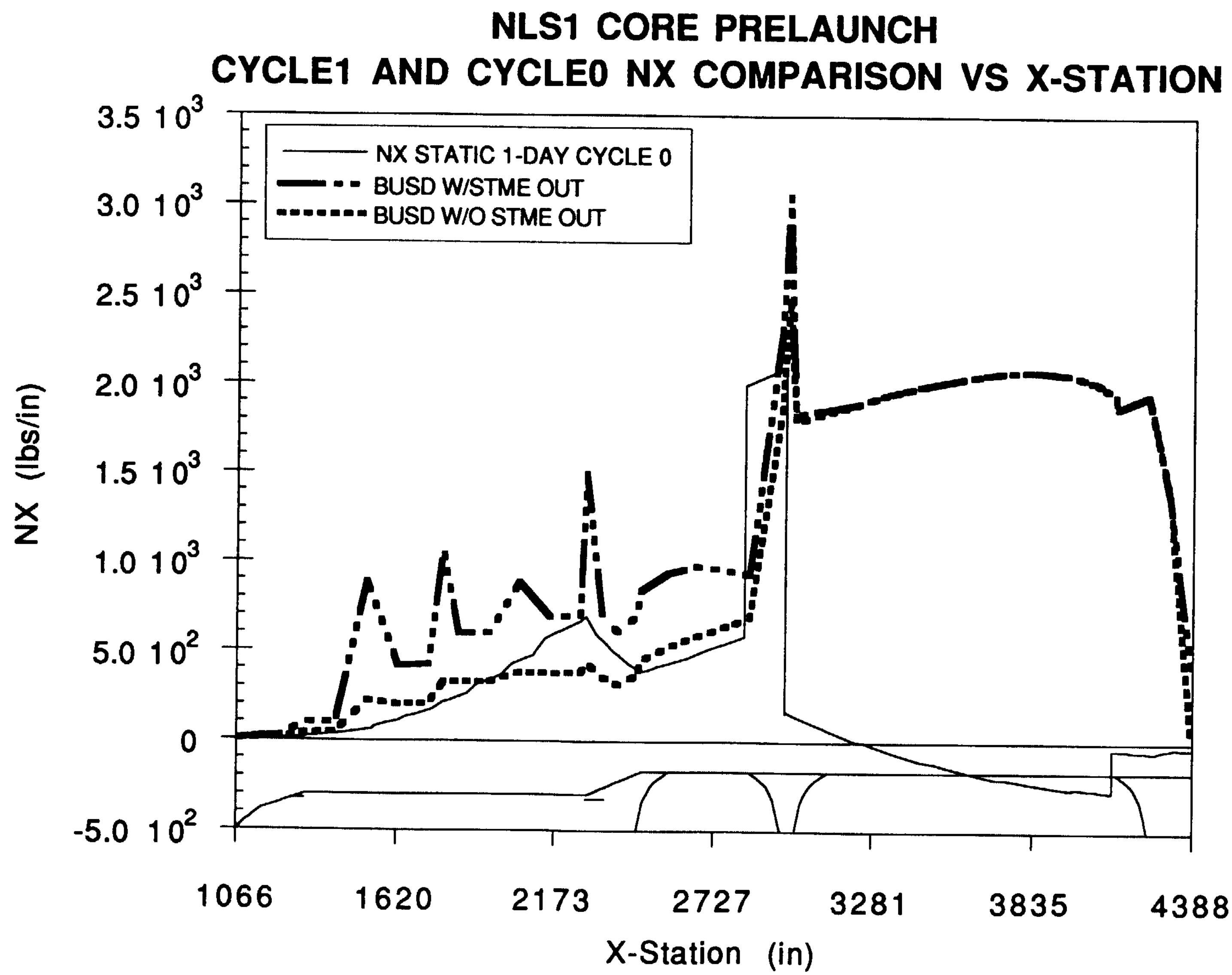
NLS1 AND NLS2 W/O STME OUT
NX EVENT COMPARISON VS X-STATION

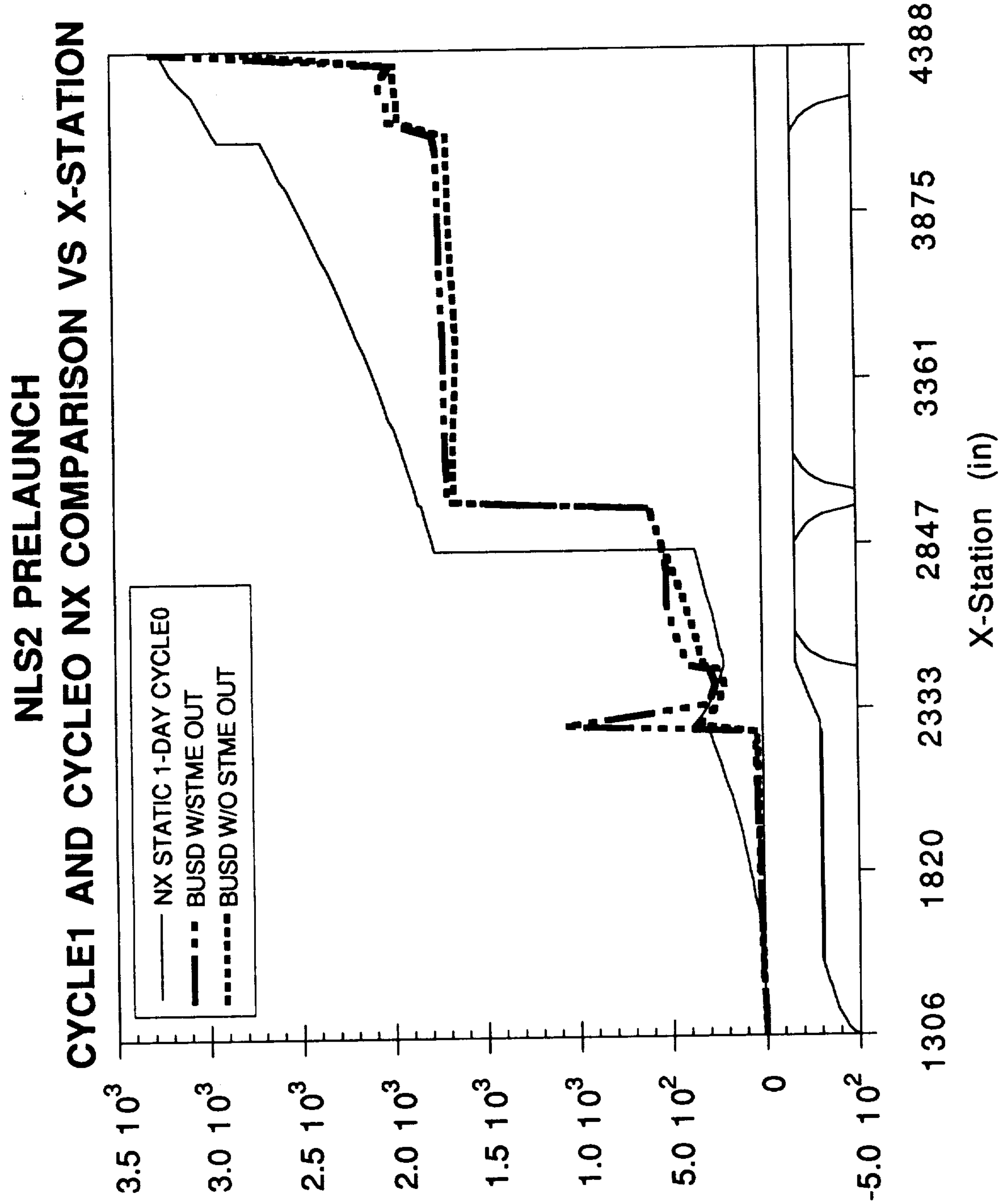


NLS1 INTERFACE LOADS SUMMARY

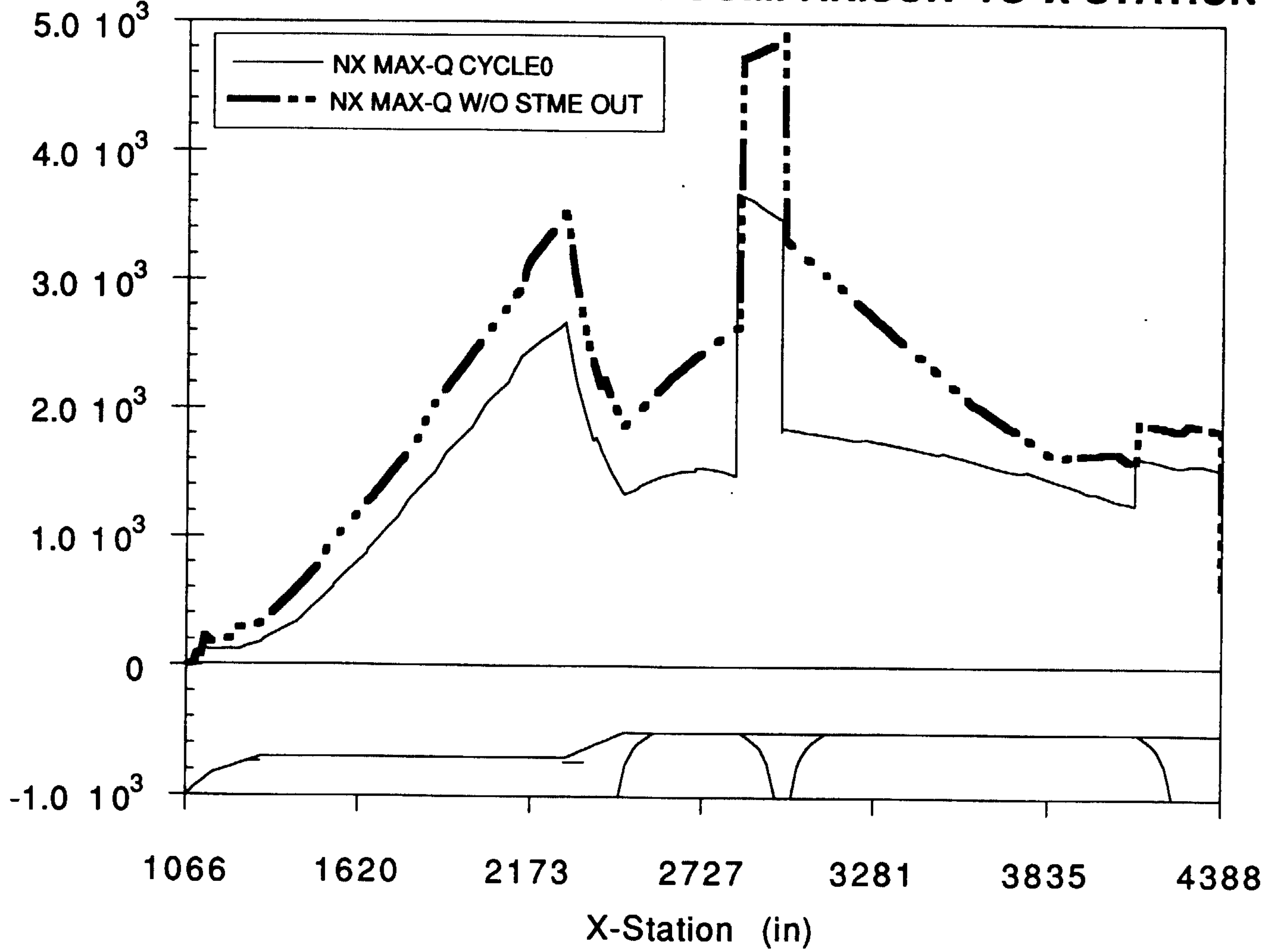
MEMBER	Maximum Load (Kips)	Minimum Load (Kips)	STS Hardware Upper Limit	STS Hardware Lower Limit	Flight Conditions
FTB1	59	-128	212	-190	Prelaunch/Prelaunch
FTB2	64	-129	214	-206	Prelaunch/Prelaunch
FTB3	211	-147	212	-95	Liftoff/Prelaunch
FTB4	142	-229	86	-219	Prelaunch/Liftoff
FTB5	419	-1332	178	-1672	Prelaunch/Prelaunch
FTB6	254	-1348	156	-1672	Ascent/Prelaunch
FTB7	85	-71	247	-233	Prelaunch/Prelaunch
FTB8	80	-71	263	-224	Prelaunch/Prelaunch
FTB9U	104	-113	295	-256	Prelaunch/Liftoff
FTB10U	111	-102	277	-293	Liftoff/Prelaunch
FTBA	121	-122	127	-267	Prelaunch/Liftoff
FTBB	115	-126	277	-121	Liftoff/Prelaunch
P (08)	66	-21	271	-264	Ascent/Ascent
P (09)	67	-24	358	-291	Ascent/Ascent
P (10)	41	-38	233	-274	Ascent/Ascent
P (11)	66	-21	265	-299	Ascent/Ascent
P (12)	67	-24	296	-274	Ascent/Ascent
P (13)	41	-38	244	-258	Ascent/Ascent
MTBLS	9235	-9000	11800	-11800	Ascent/Ascent
MTBRS	8994	-9238	11800	-11800	Ascent/Ascent

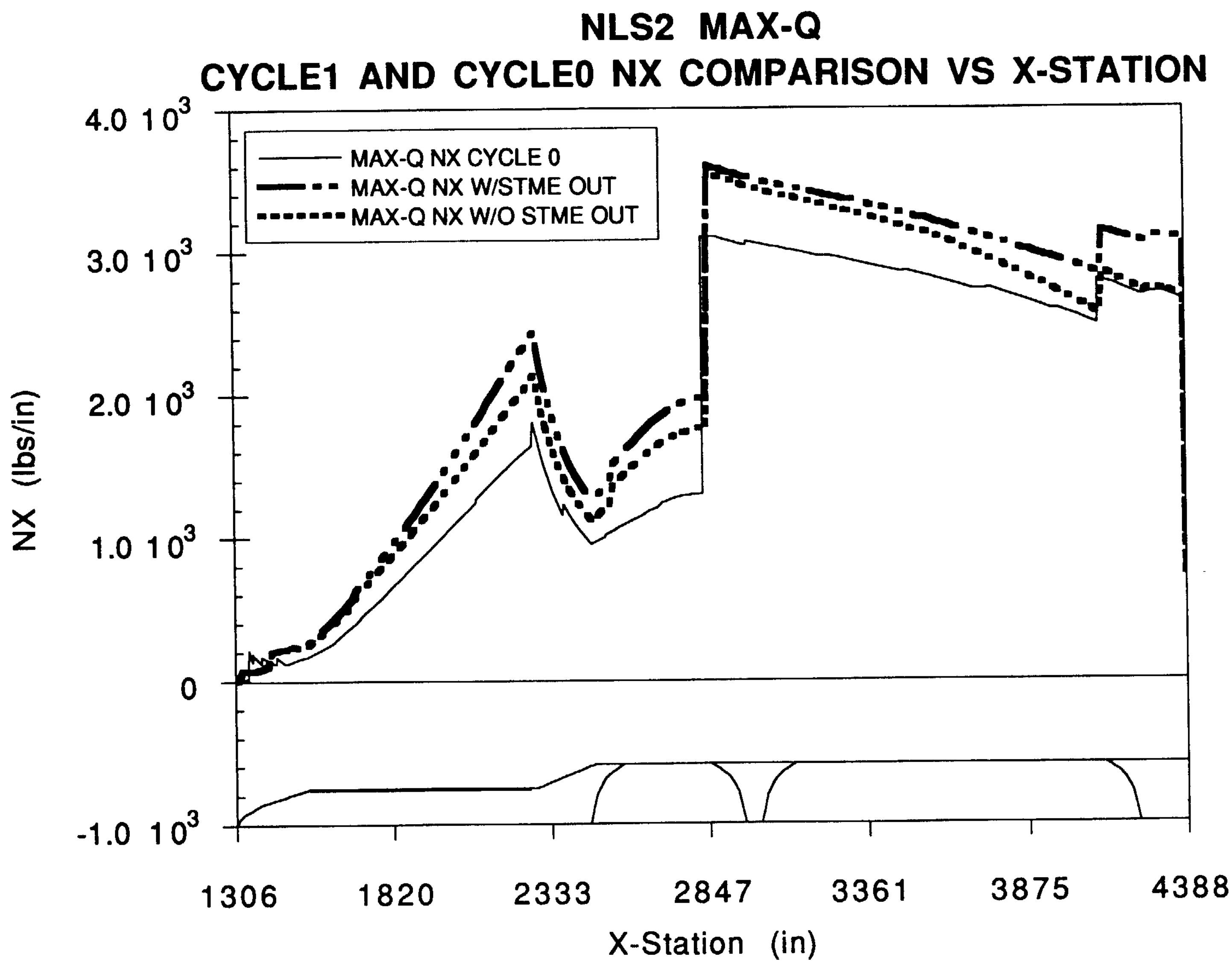
NLS 1 and NLS 2
Cycle 1 and Cycle 0 Loads Comparisons


NLS1 CORE PRELAUNCH
CYCLE1 AND CYCLE0 NX COMPARISON VS X-STATION
NX STATIC 1-DAY CYCLE 0
BUSD W/STME OUT
BUSD W/O STME OUT
3.5 10^3
3.0 10^3
2.5 10^3
2.0 10^3
1.5 10^3
1.0 10^3
5.0 10^2
0
-5.0 10^2
NX (lbs/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

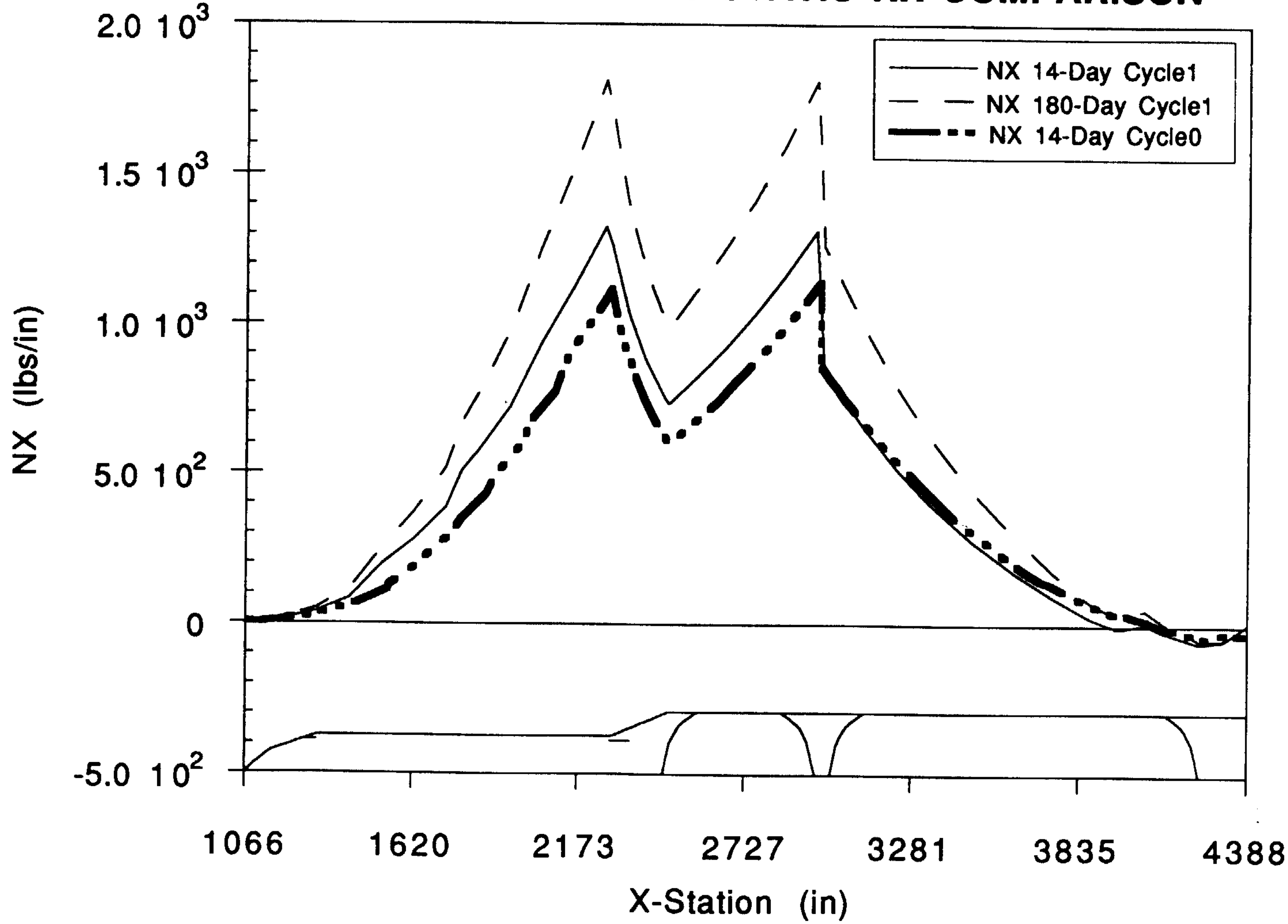

NLS2 PRELAUNCH
CYCLE1 AND CYCLEO NX COMPARISON VS X-STATION
NX STATIC 1-DAY CYCLE0
BUSD W/STME OUT
BUSD W/O STME OUT
NX (lbs/in)
3.5 10^3
3.0 10^3
2.5 10^3
2.0 10^3
1.5 10^3
1.0 10^3
5.0 10^2
0
-5.0 10^2
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS1 CORE MAX-Q
CYCLE1 AND CYCLE0 NX COMPARISON VS X-STATION

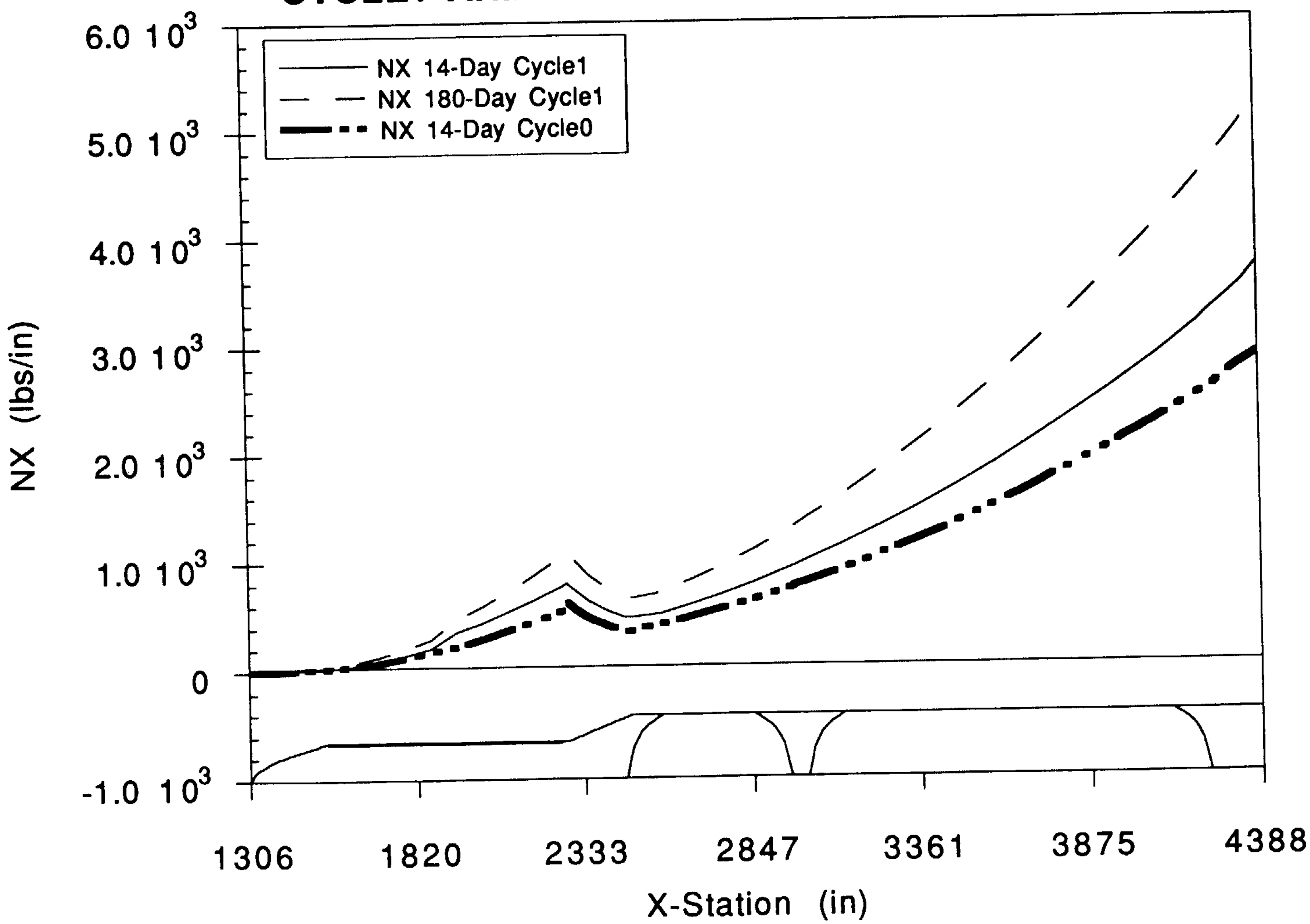



NLS2 MAX-Q
CYCLE1 AND CYCLE0 NX COMPARISON VS X-STATION
MAX-Q NX CYCLE 0
MAX-Q NX W/STME OUT
MAX-Q NX W/O STME OUT
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
NX (lbs/in)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

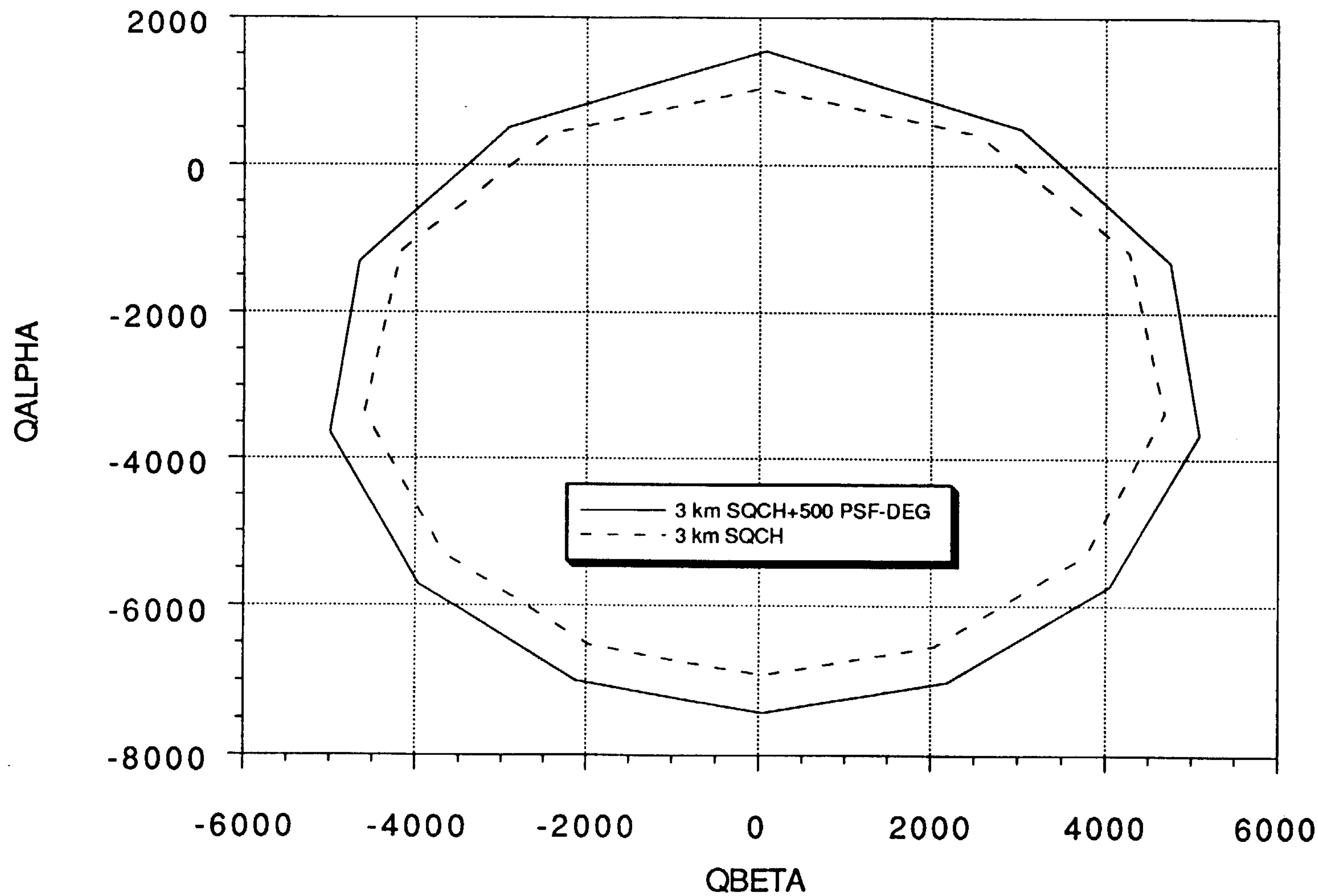
NLS1 CORE PRELAUNCH
CYCLE1 AND CYCLE0 STATIC NX COMPARISON



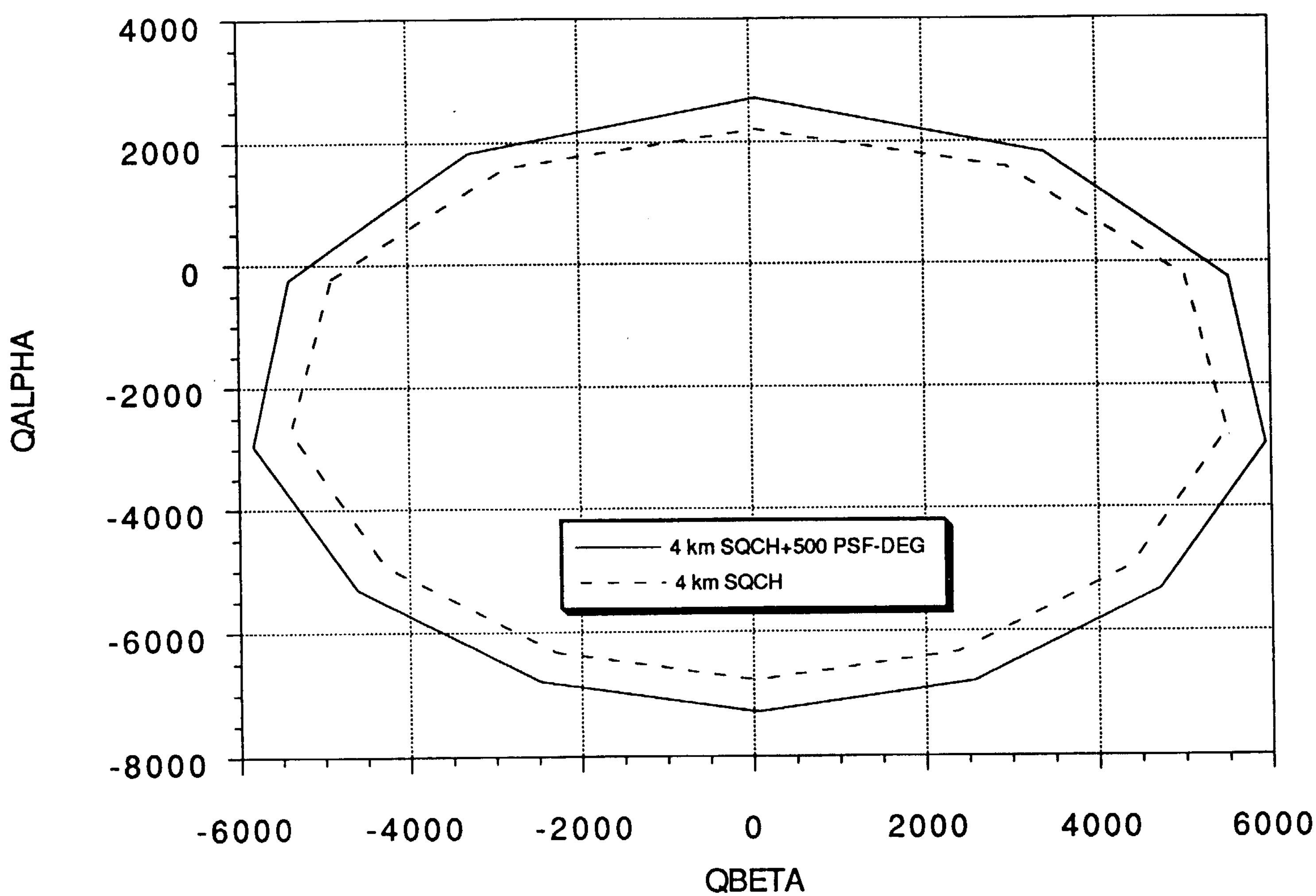
NLS2 PRELAUNCH
CYCLE1 AND CYCLE0 STATIC NX COMPARISON

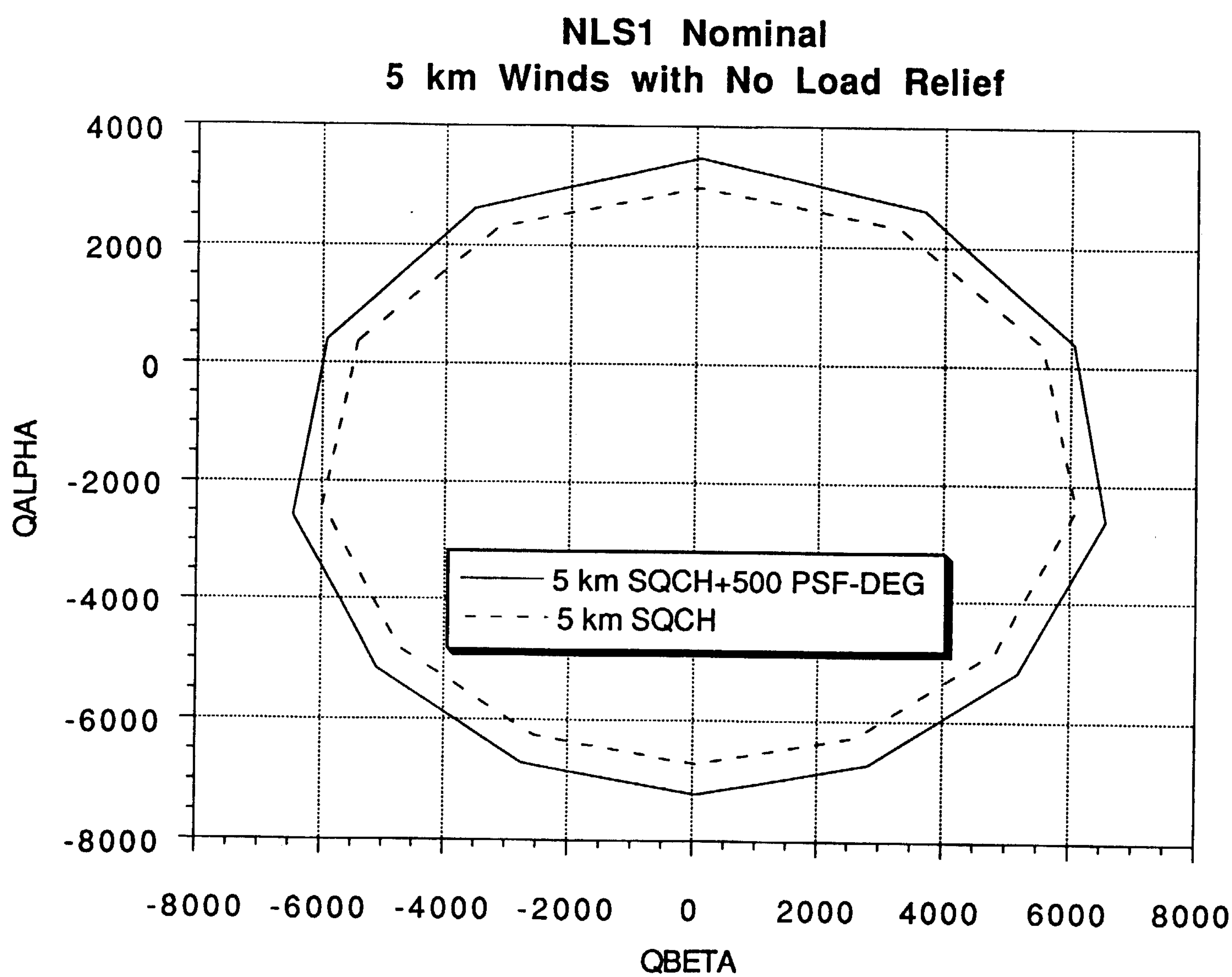


NLS1 NOMINAL
3 km WINDS with NO LOAD RELIEF

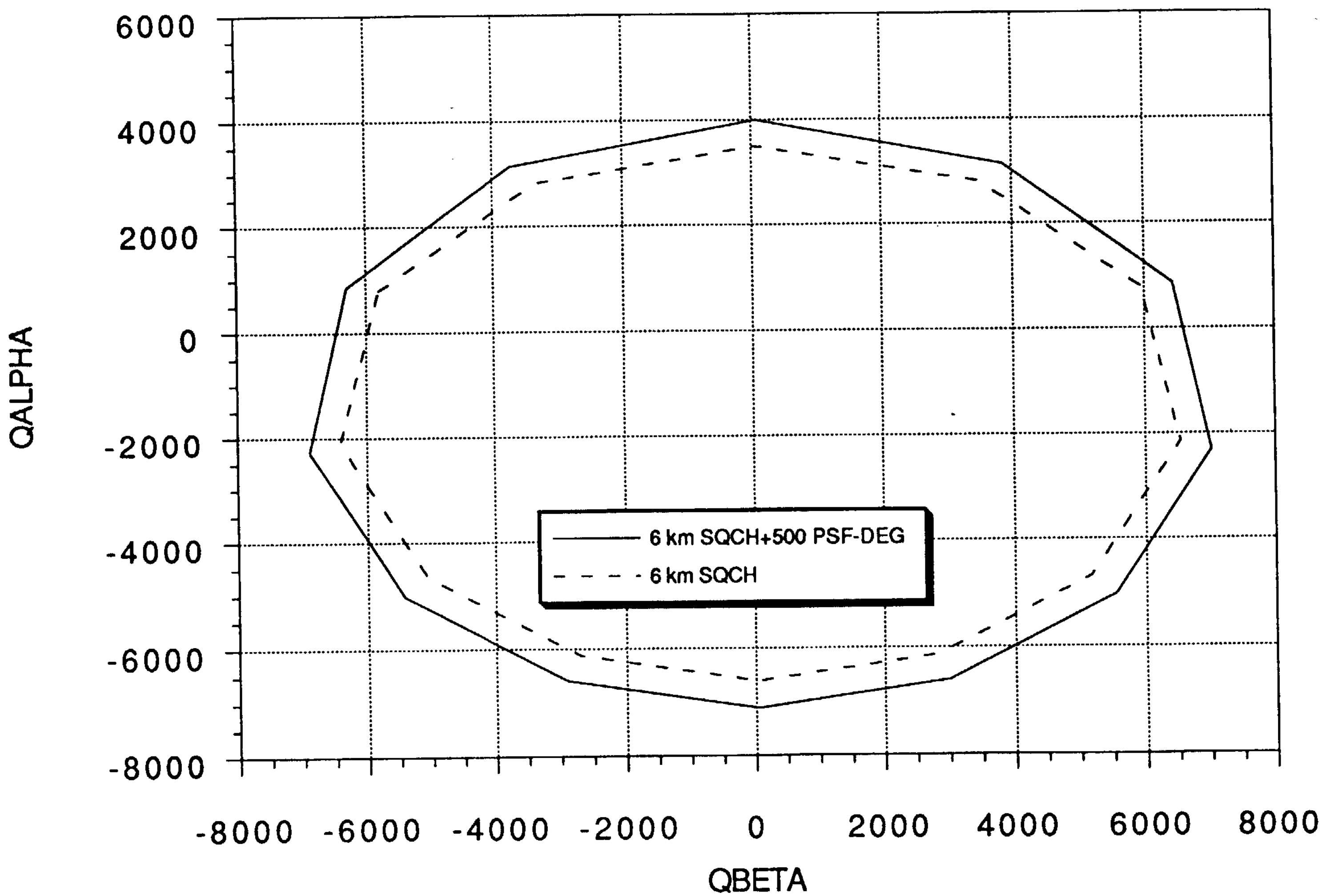


NLS1 NOMINAL
4 km Winds with No Load Relief

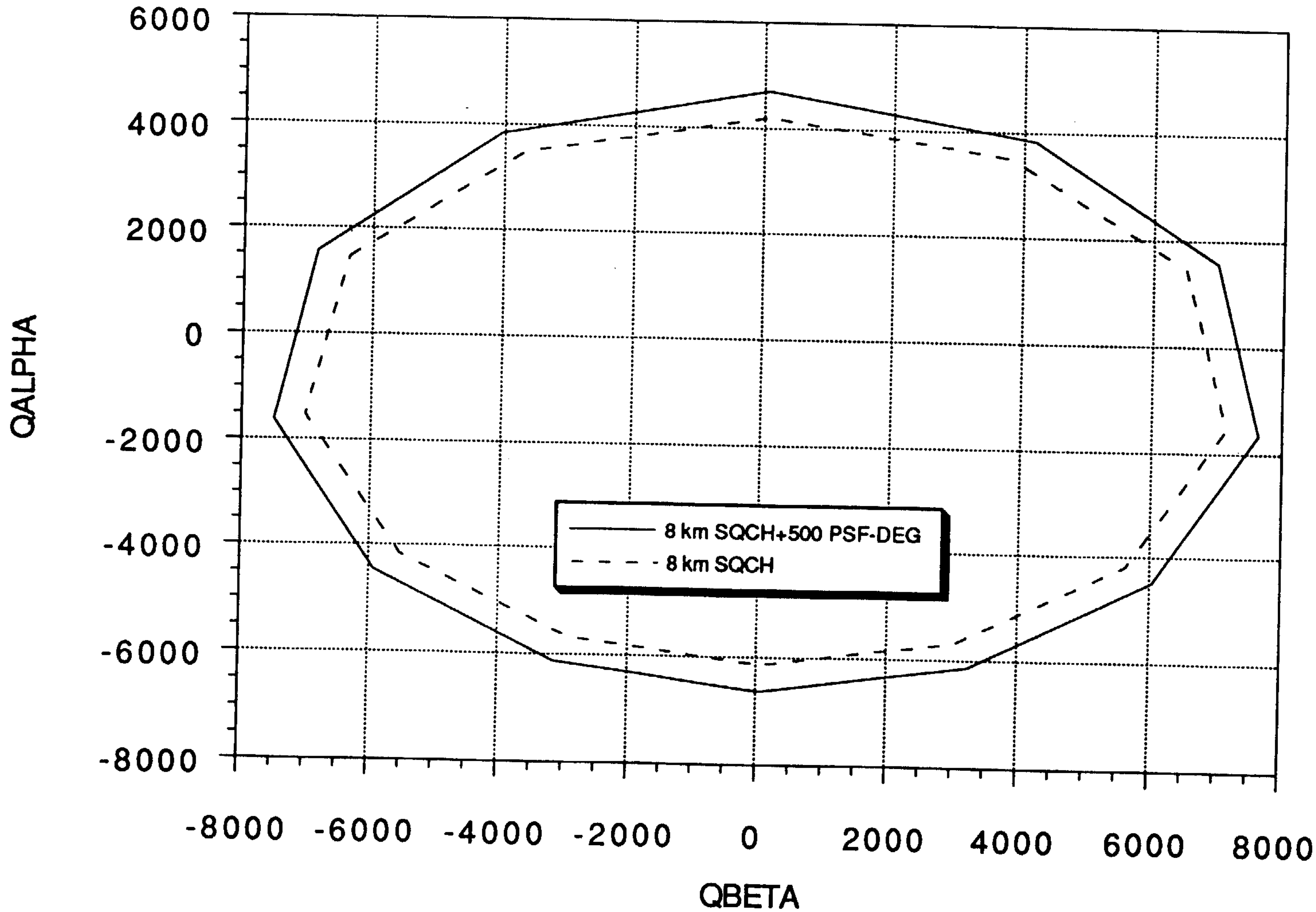



NLS1 Nominal
5 km Winds with No Load Relief
4000
2000
0
-2000
-4000
-6000
-8000
QALPHA
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
QBETA
5 km SQCH+500 PSF-DEG
5 km SQCH

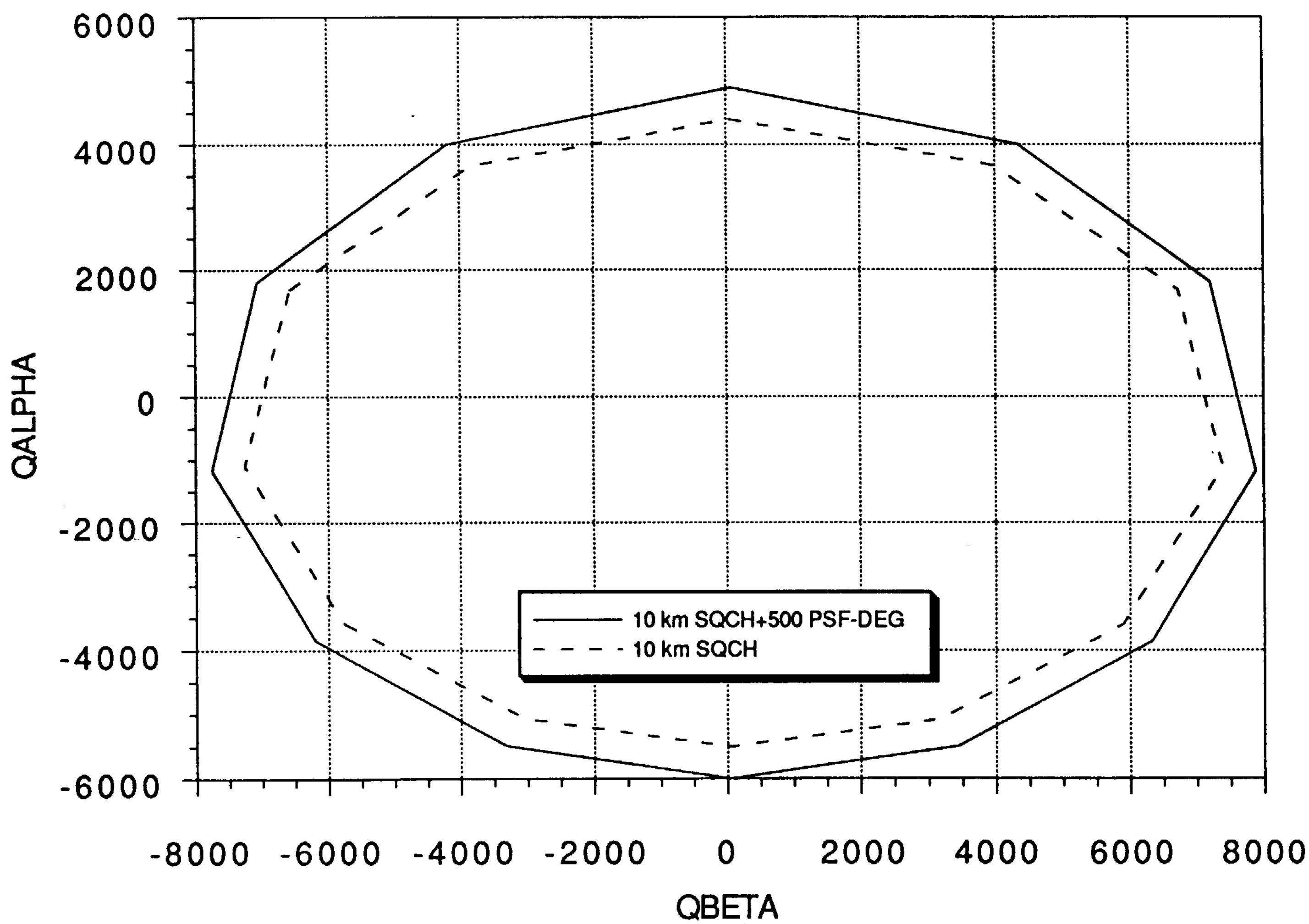
NLS1 Nominal
6 km Winds With No Load Relief



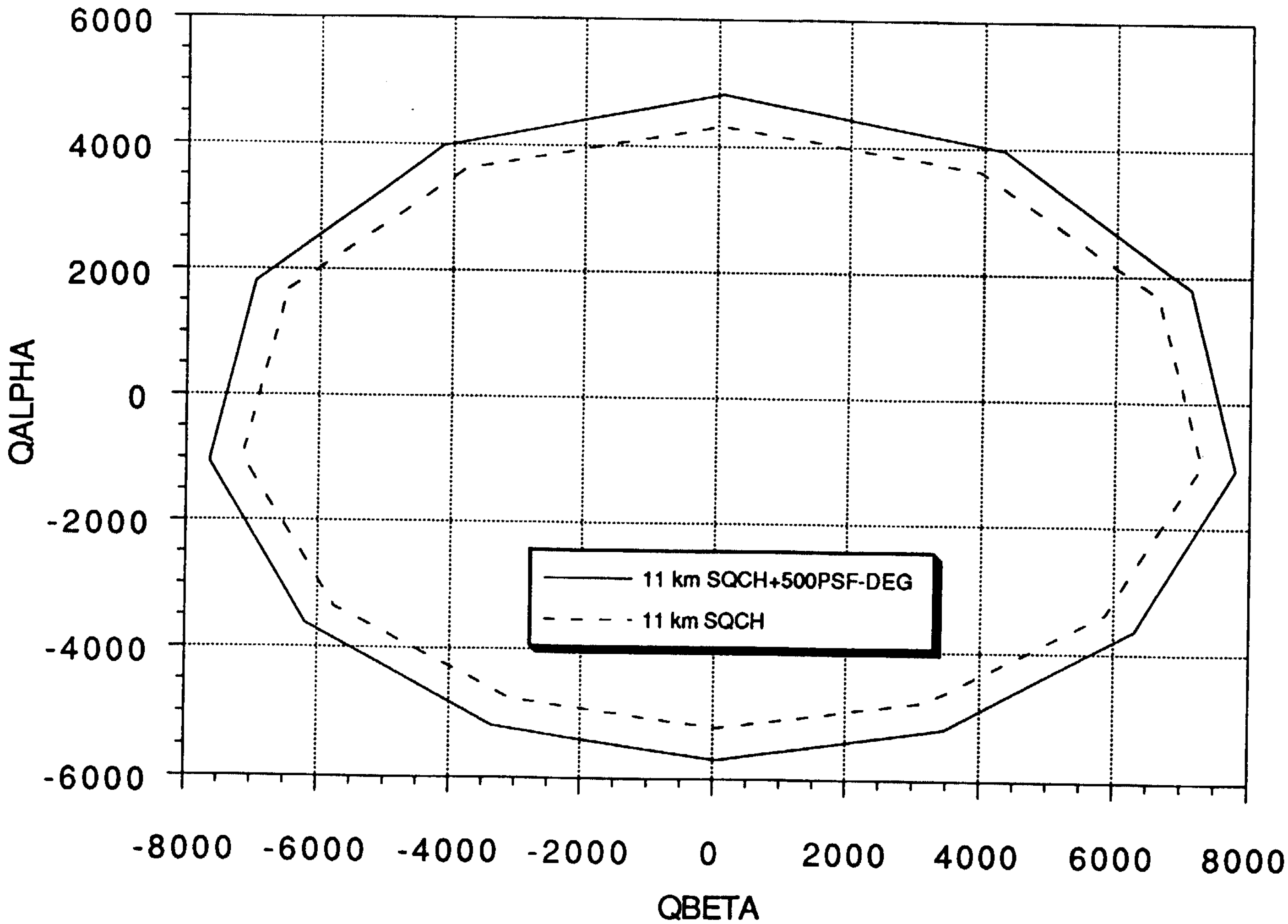
NLS1 Nominal
8 km Winds with No Load Relief



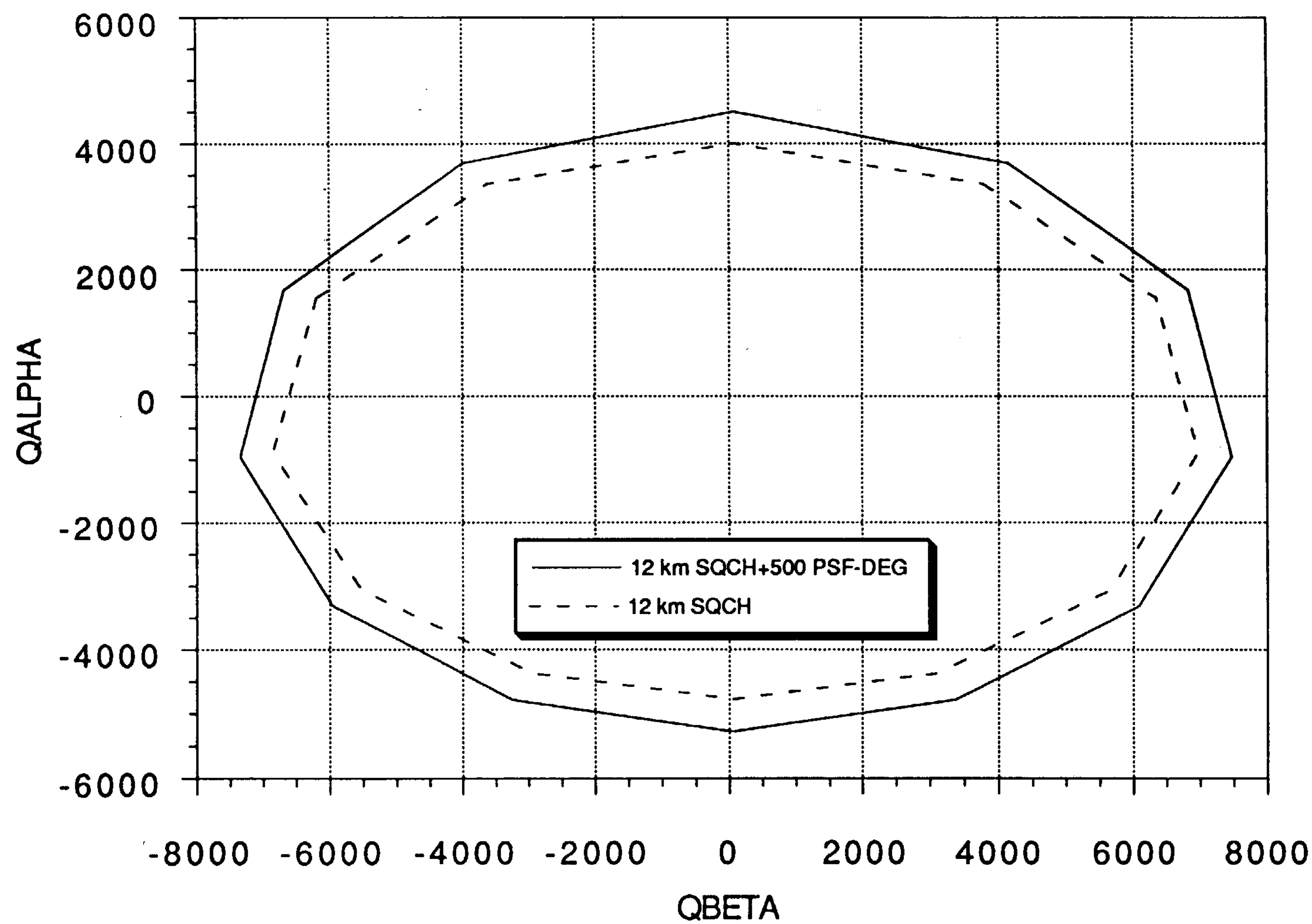
NLS1 Nominal
10 km Winds with No Load Relief



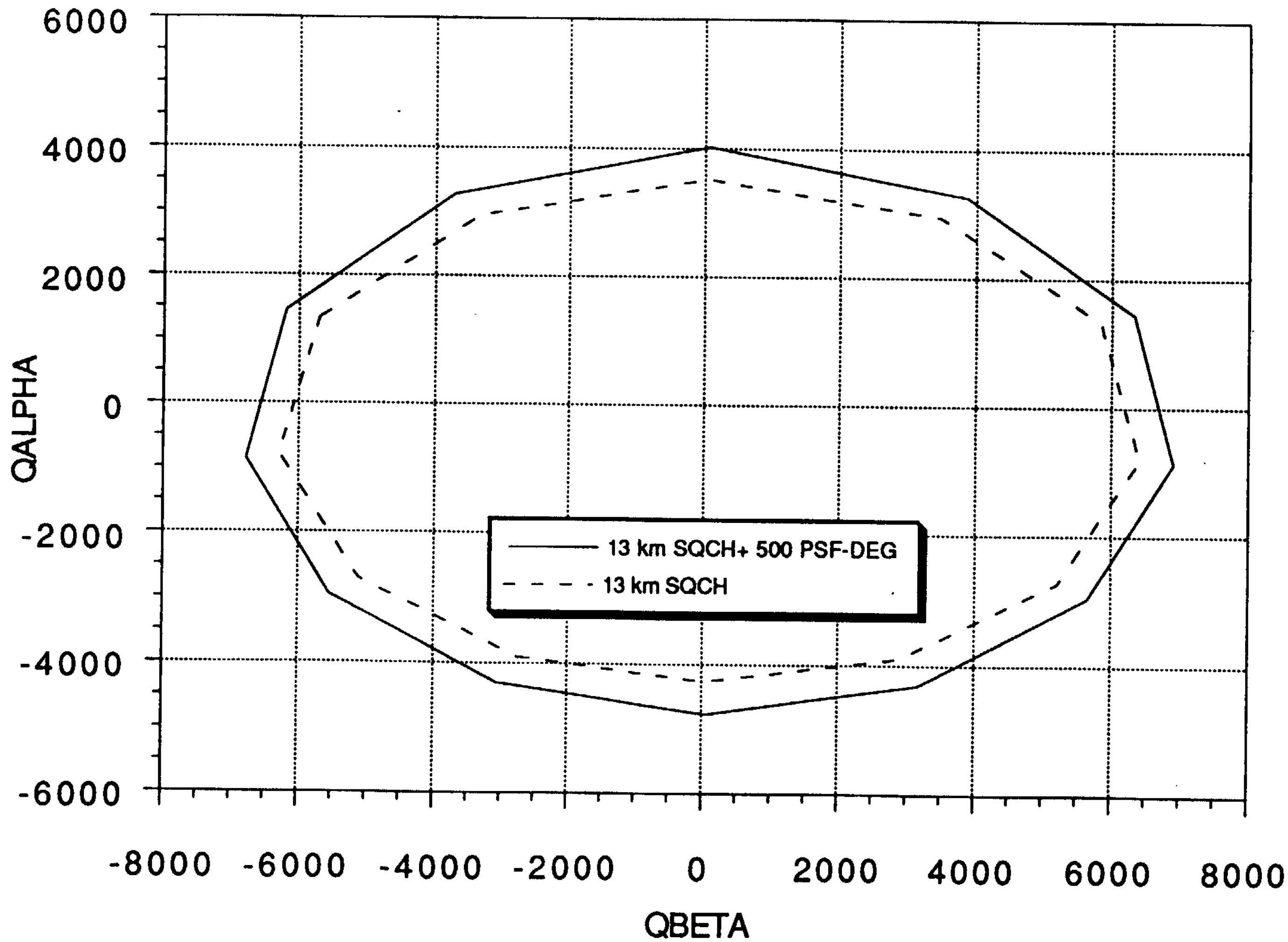
NLS1 Nominal
11 km Winds with No Load Relief



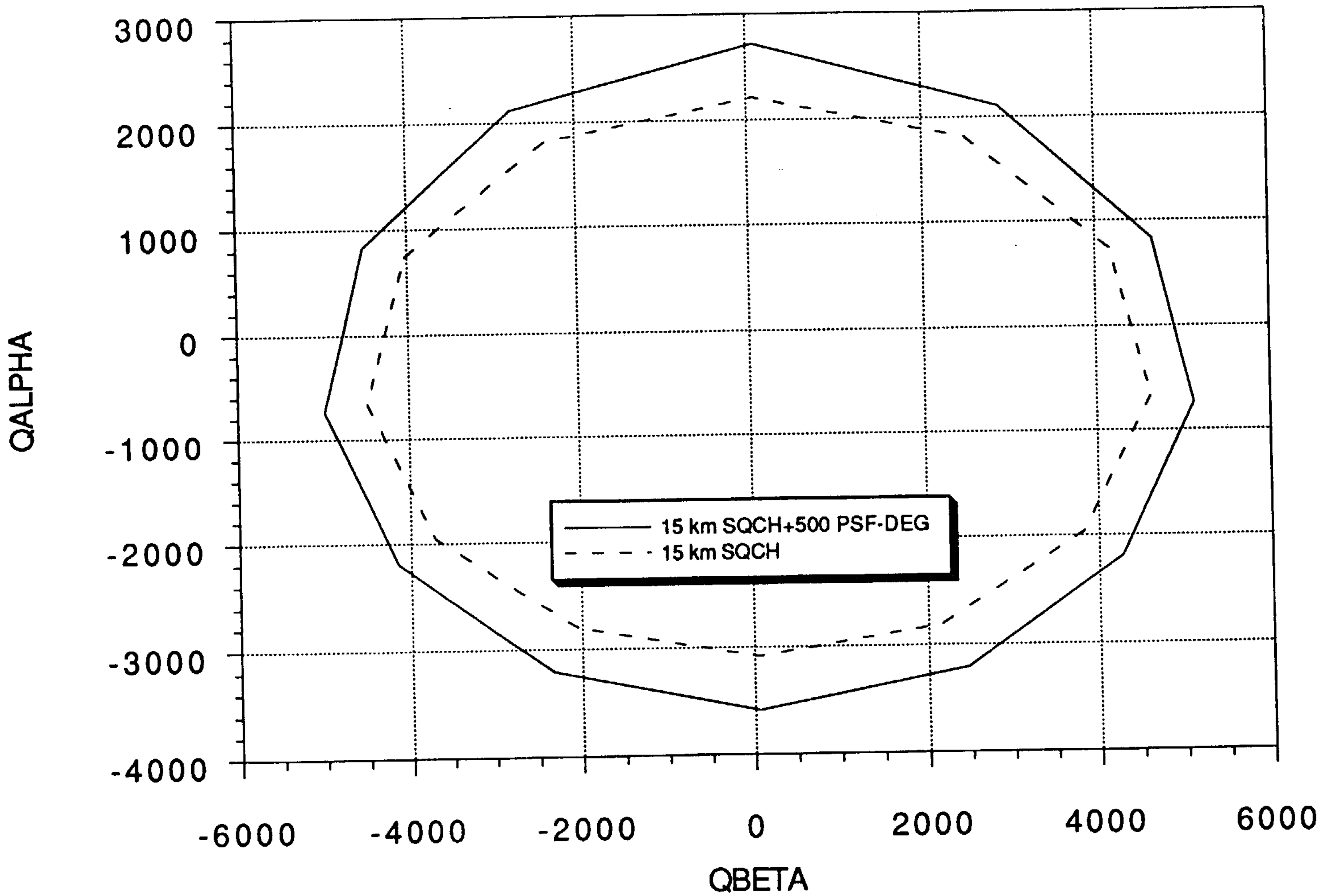
NLS1 Nominal
12 km Winds with No Load Relief



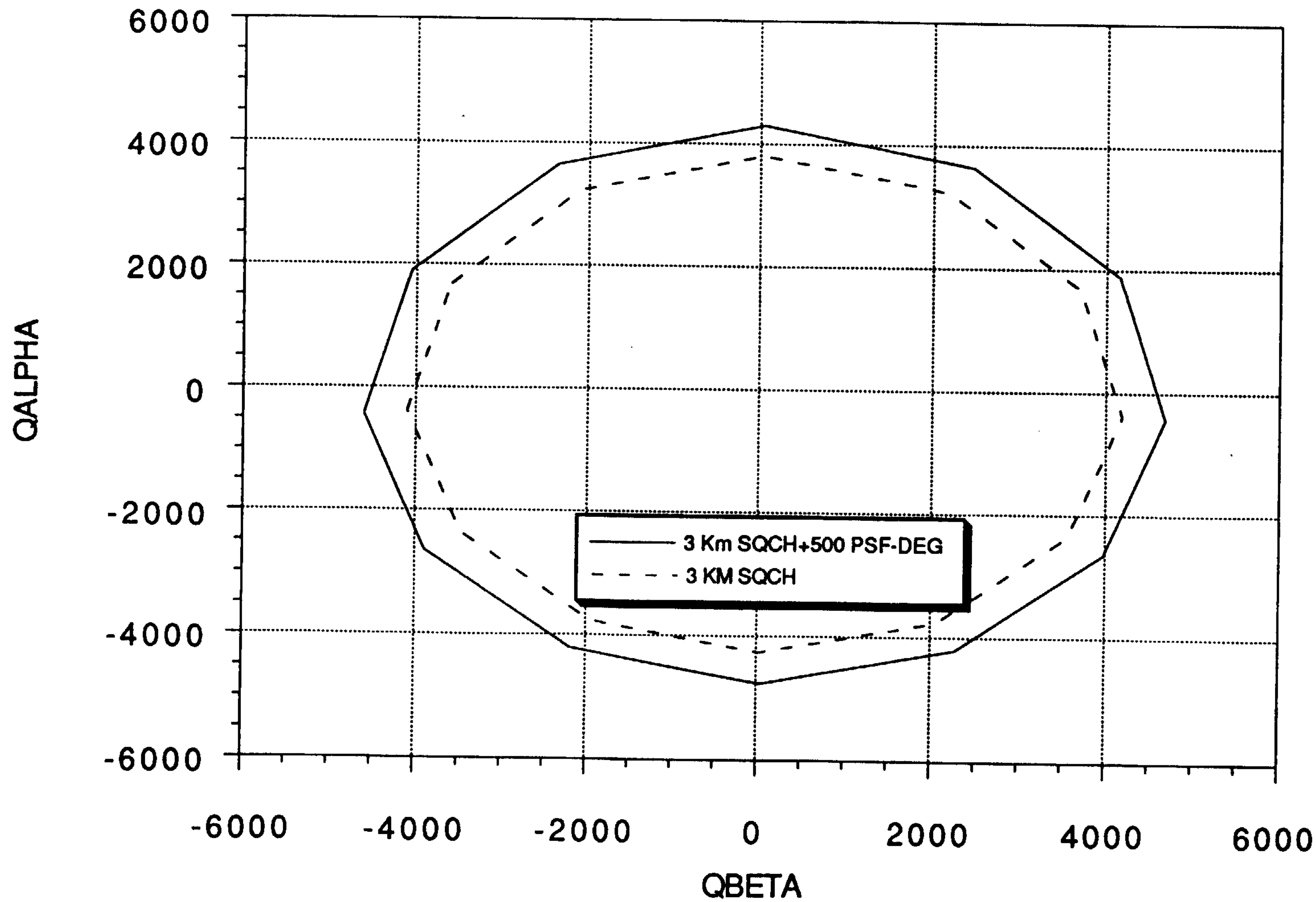
NLS1 Nominal
13 km Winds with NO Load Relief



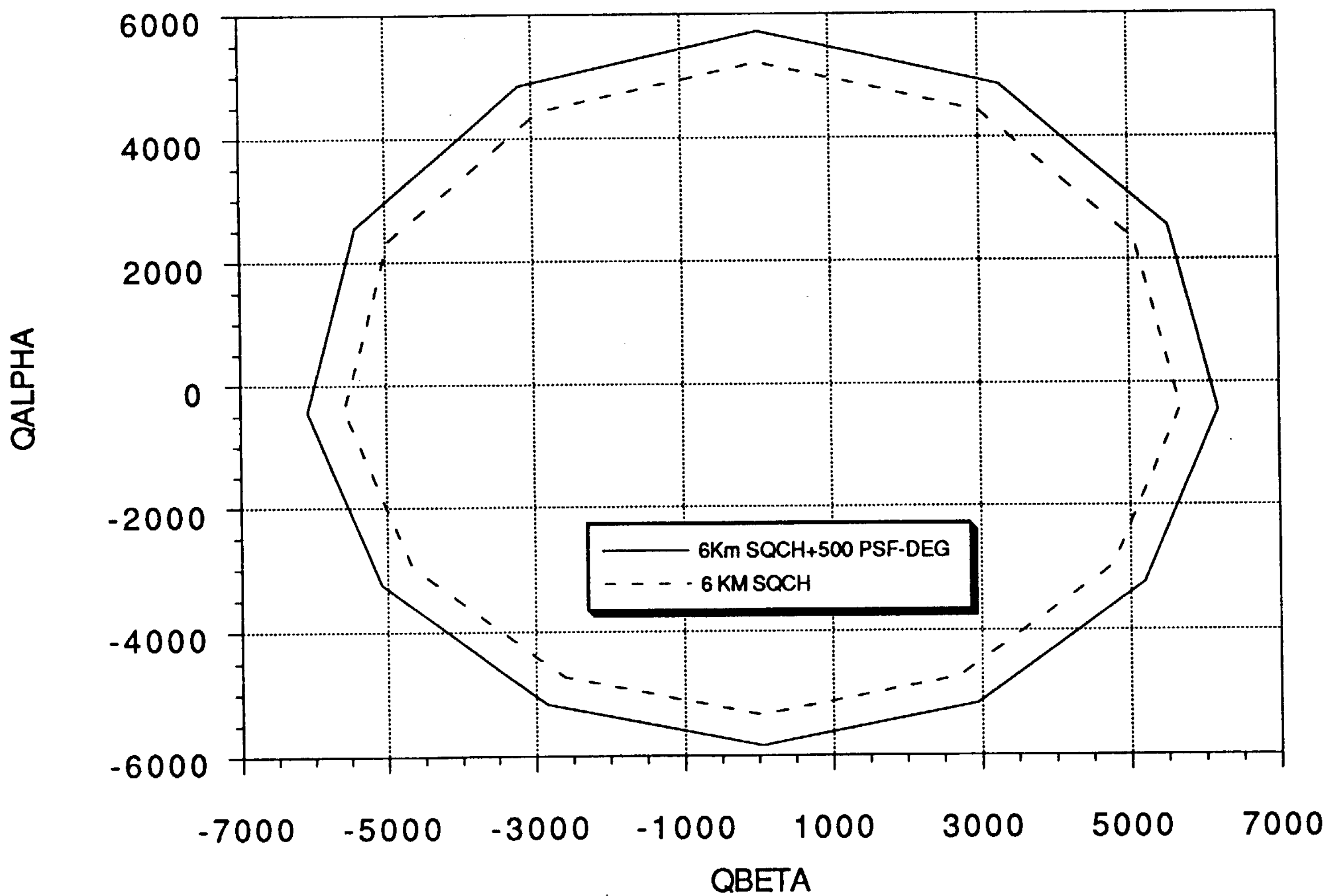
NLS1 Nominal
15 km Winds with No Load Relief



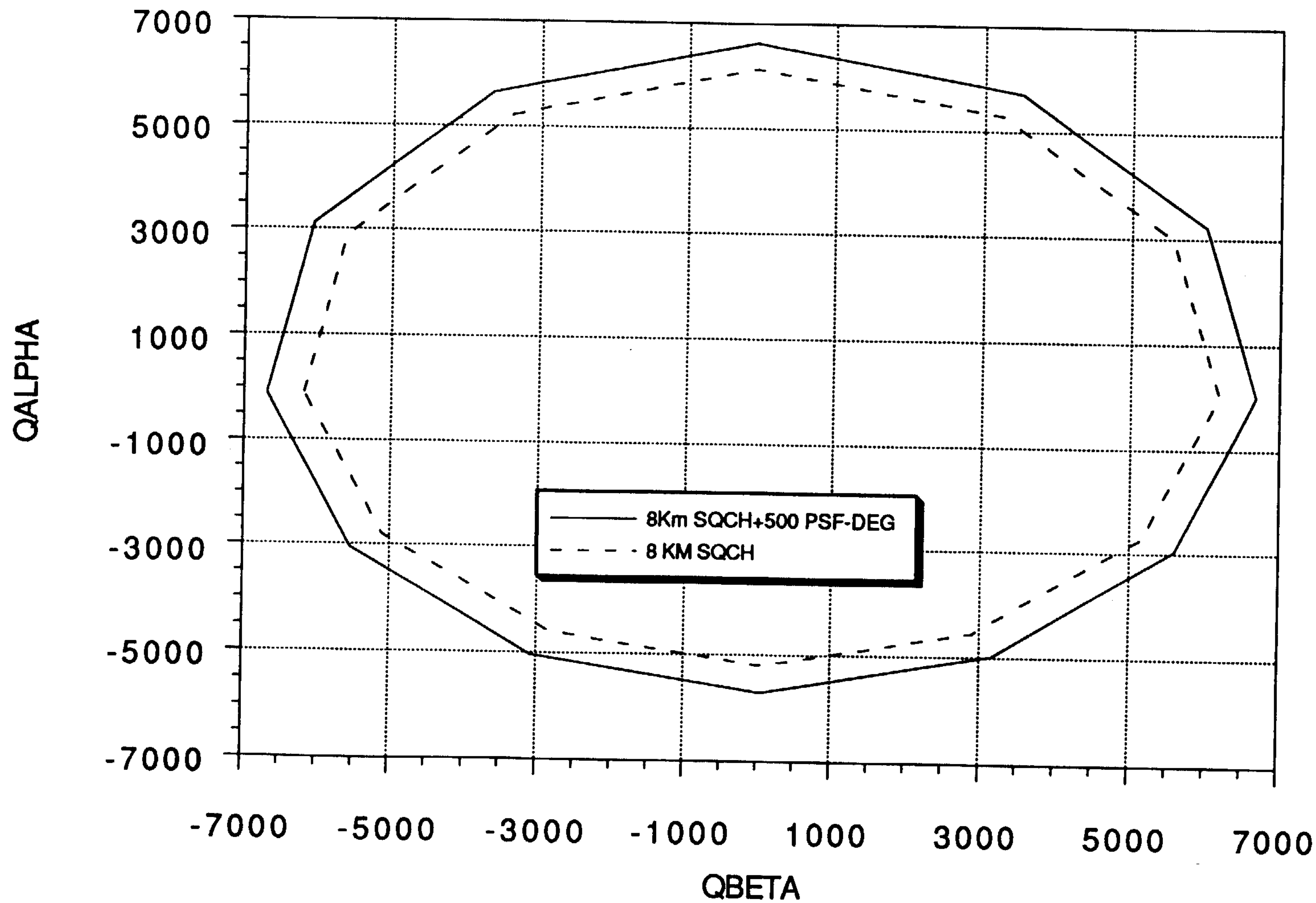
NLS2 Nominal
3 Km Winds with No Load Relief



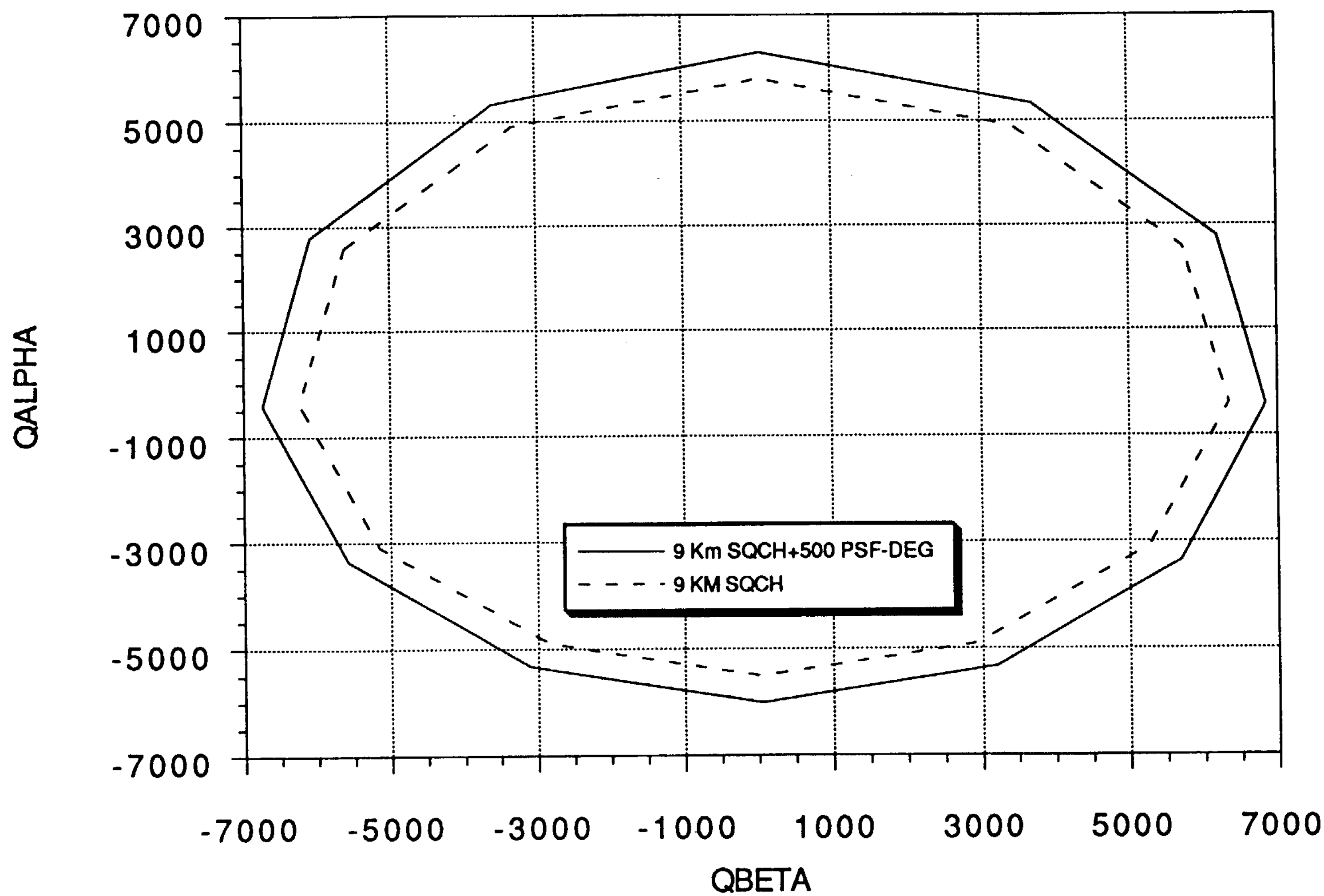
NLS2 Nominal
6 Km Winds with No Load Relief



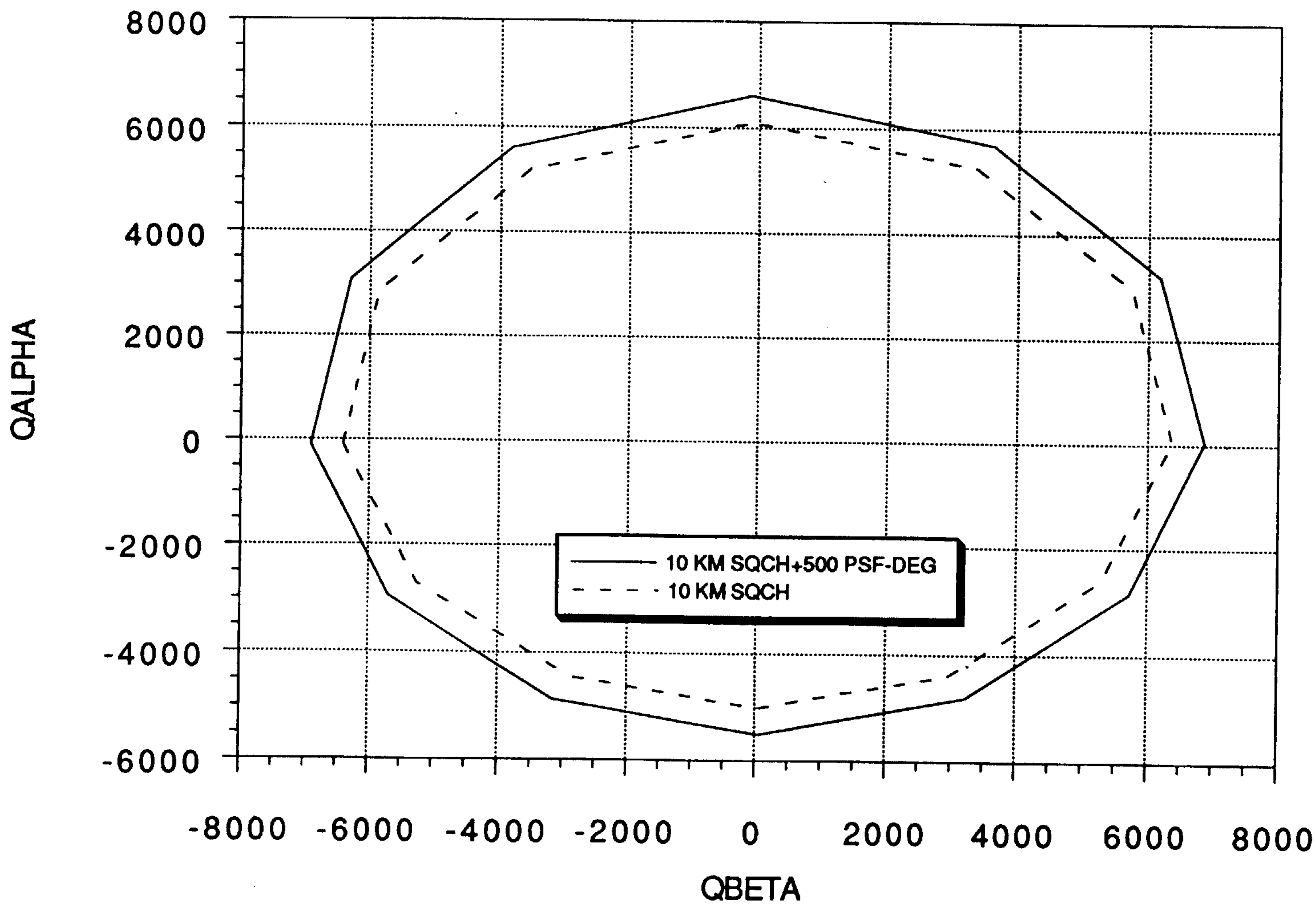
NLS2 Nominal
8 Km Winds with No Load Relief



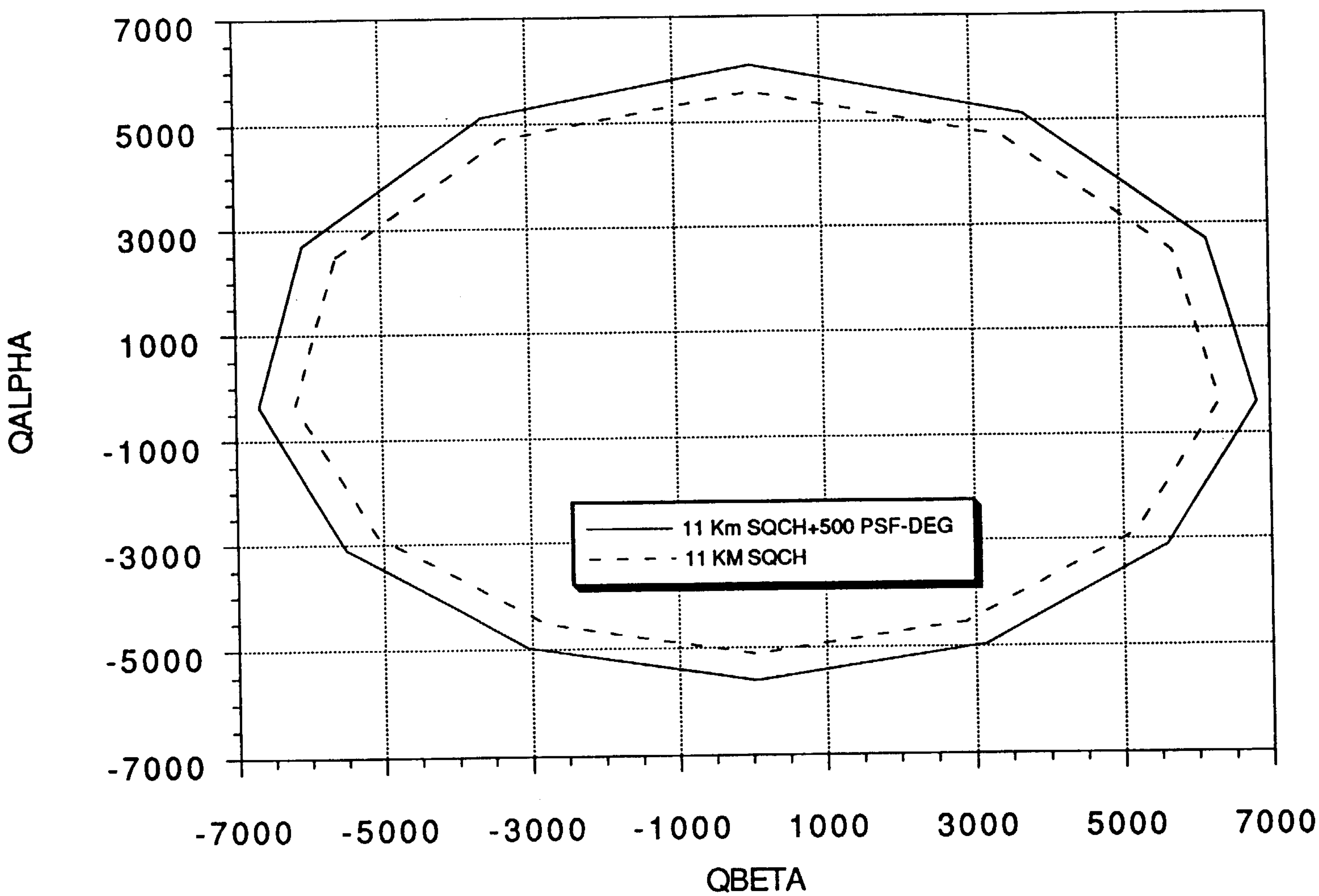
NLS2 Nominal
9 Km Winds with No Load Relief



NLS2 Stage Nominal
10 Km Winds with No Load Relief

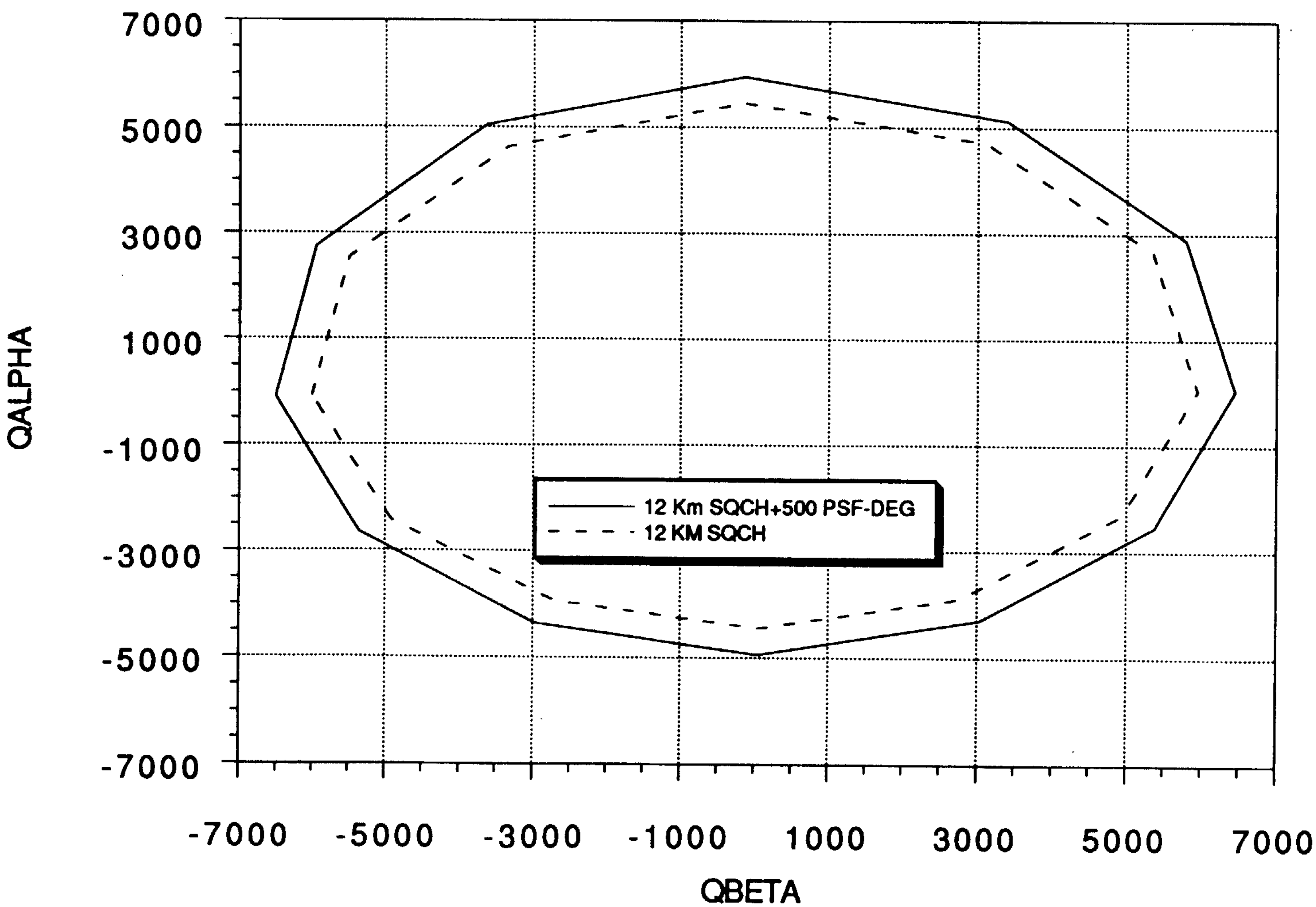


NLS2 Stage Nominal
11 Km Winds with No Load Relief

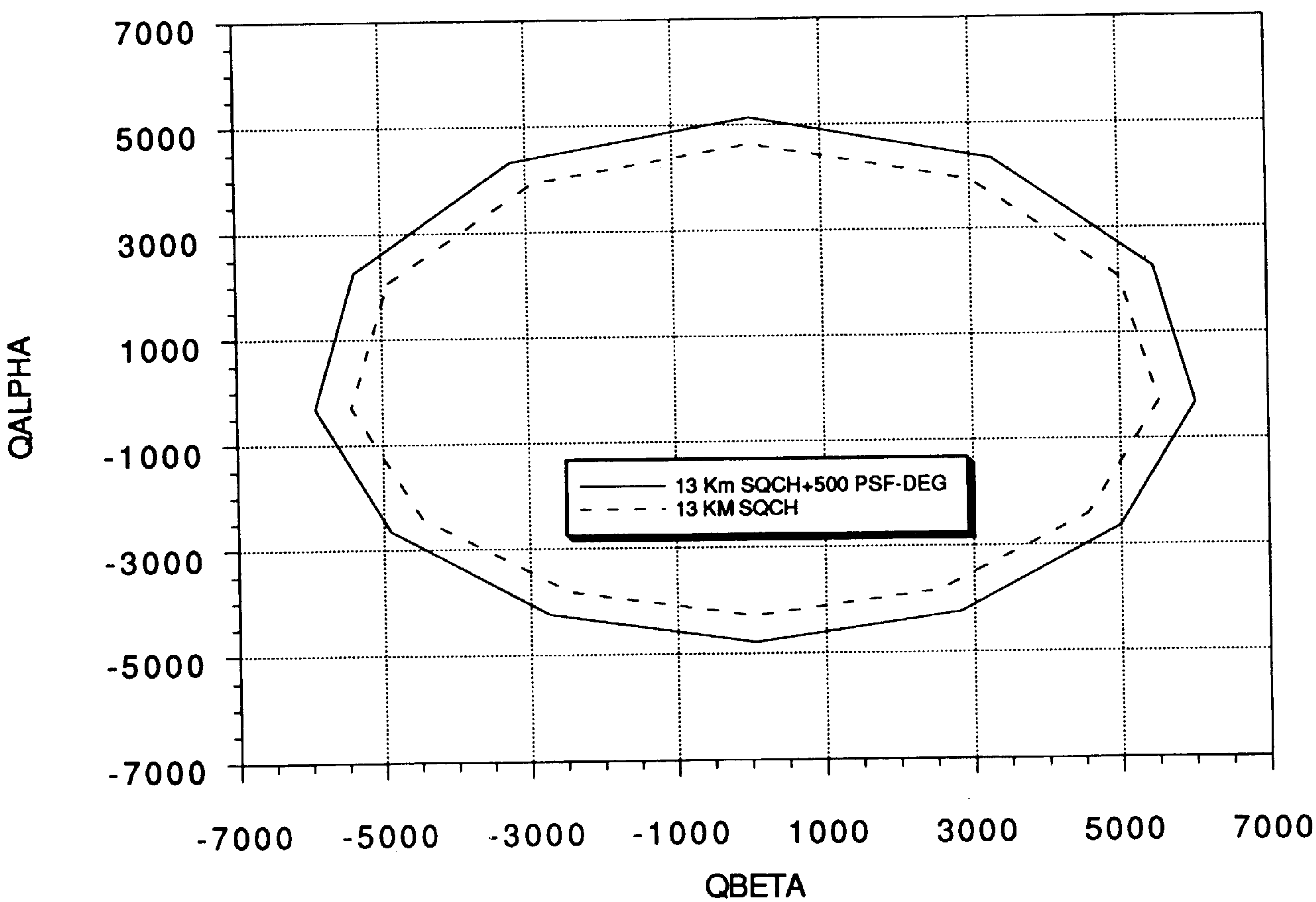


C-4

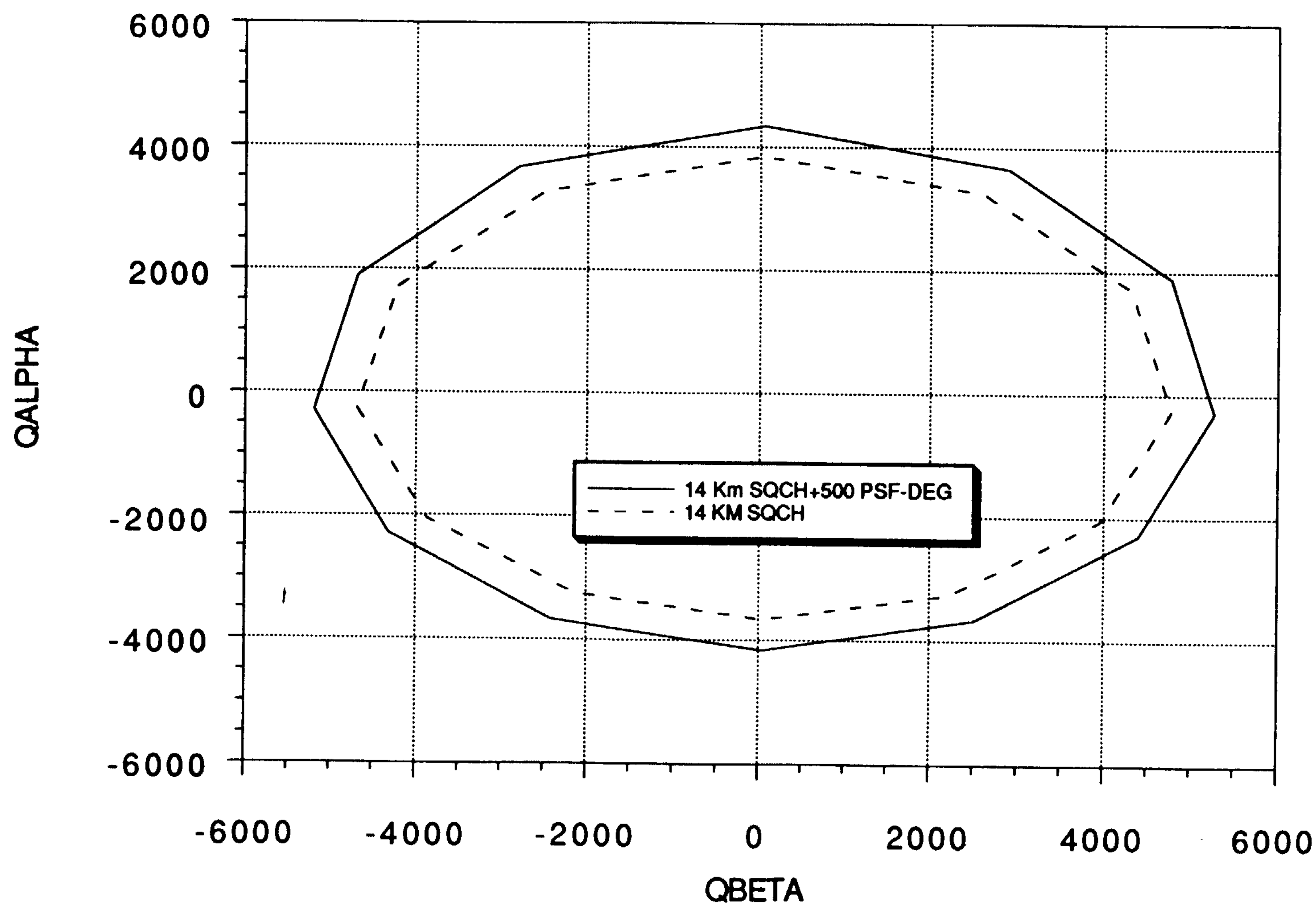
NLS2 Nominal
12 Km Winds with No Load Relief



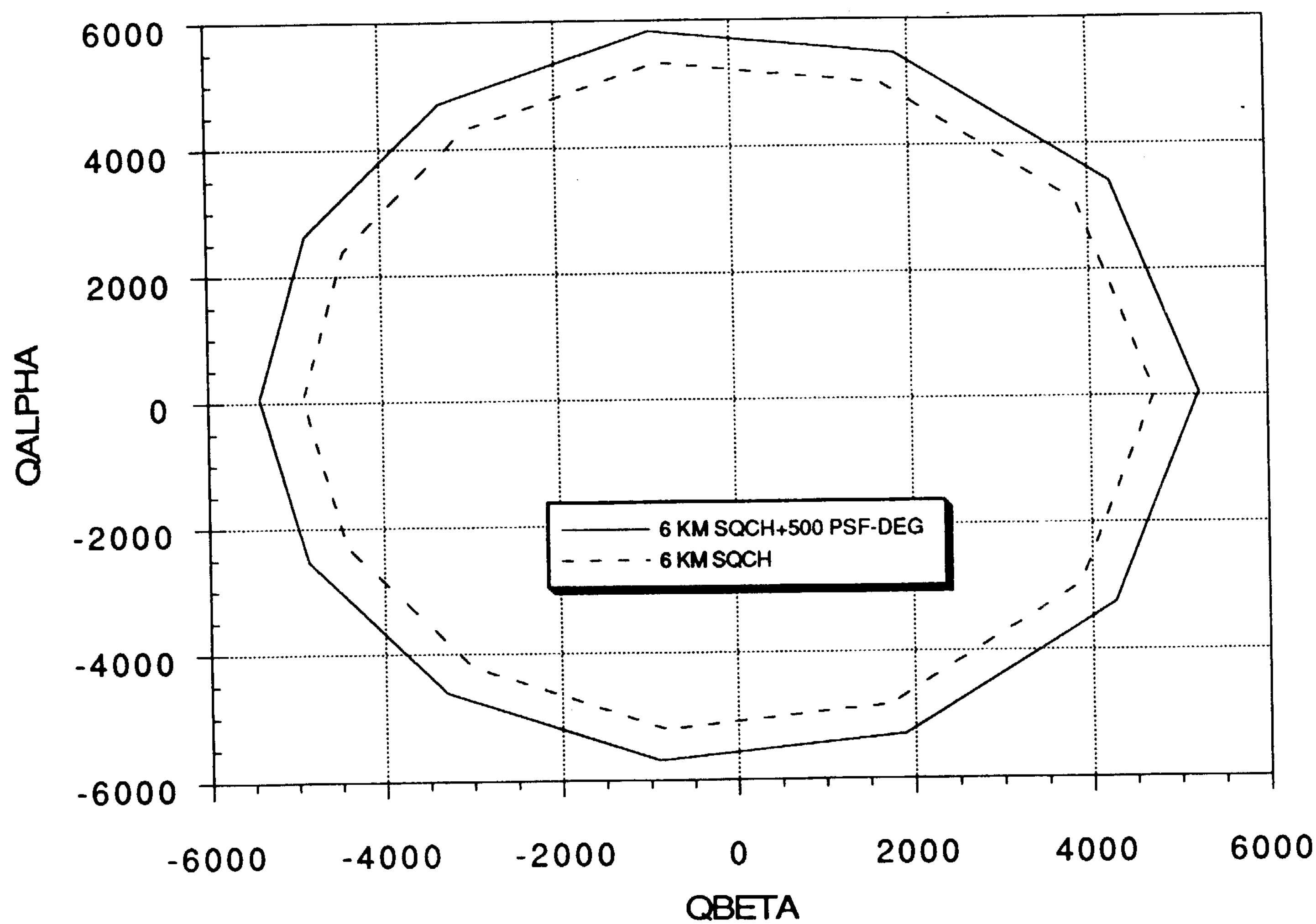
NLS2 Nominal
13 Km Winds with No Load Relief



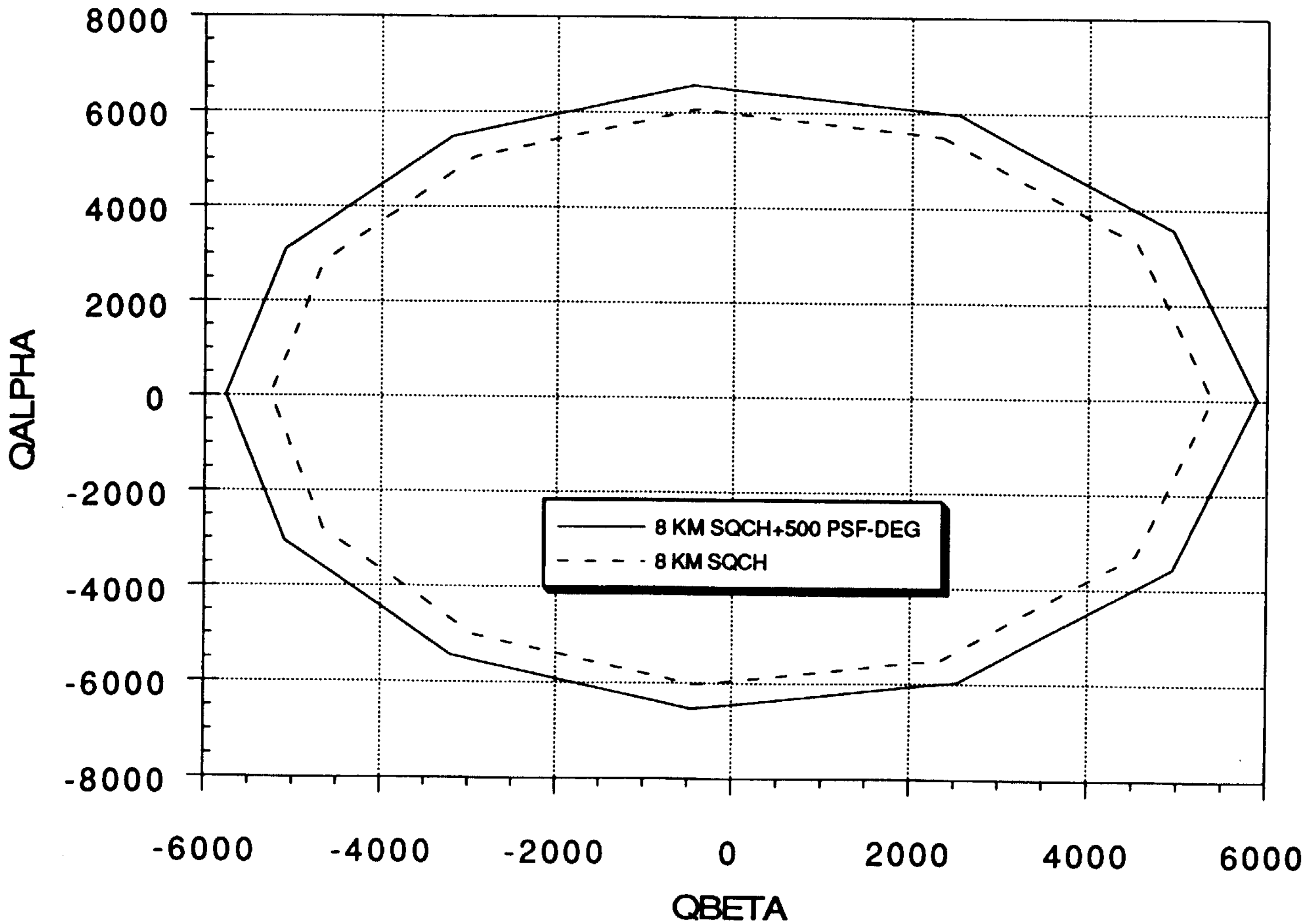
NLS2 Nominal
14 Km Winds with No Load Relief



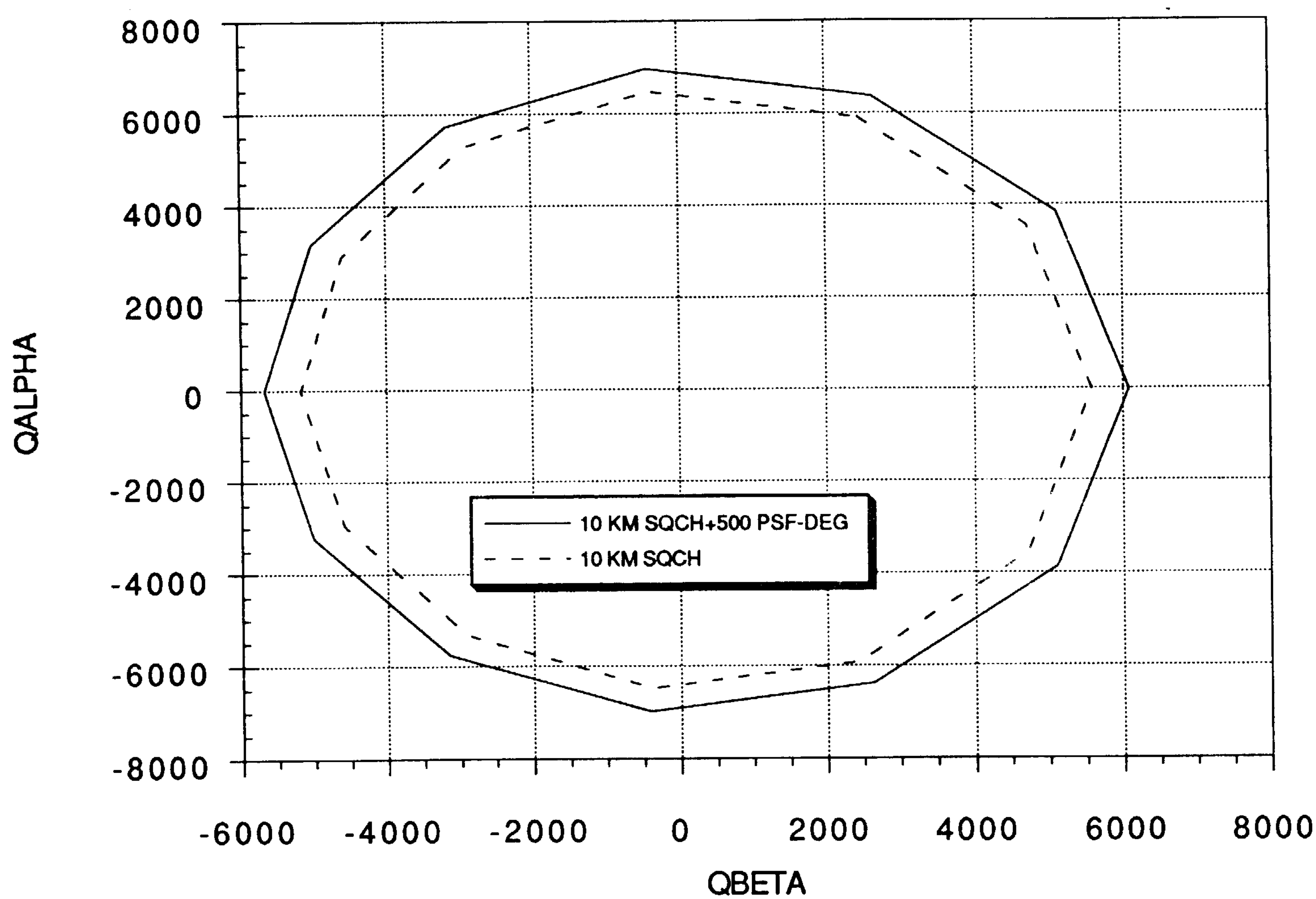
NLS2 Engine Out @ Liftoff
6 Km winds with No Load Relief



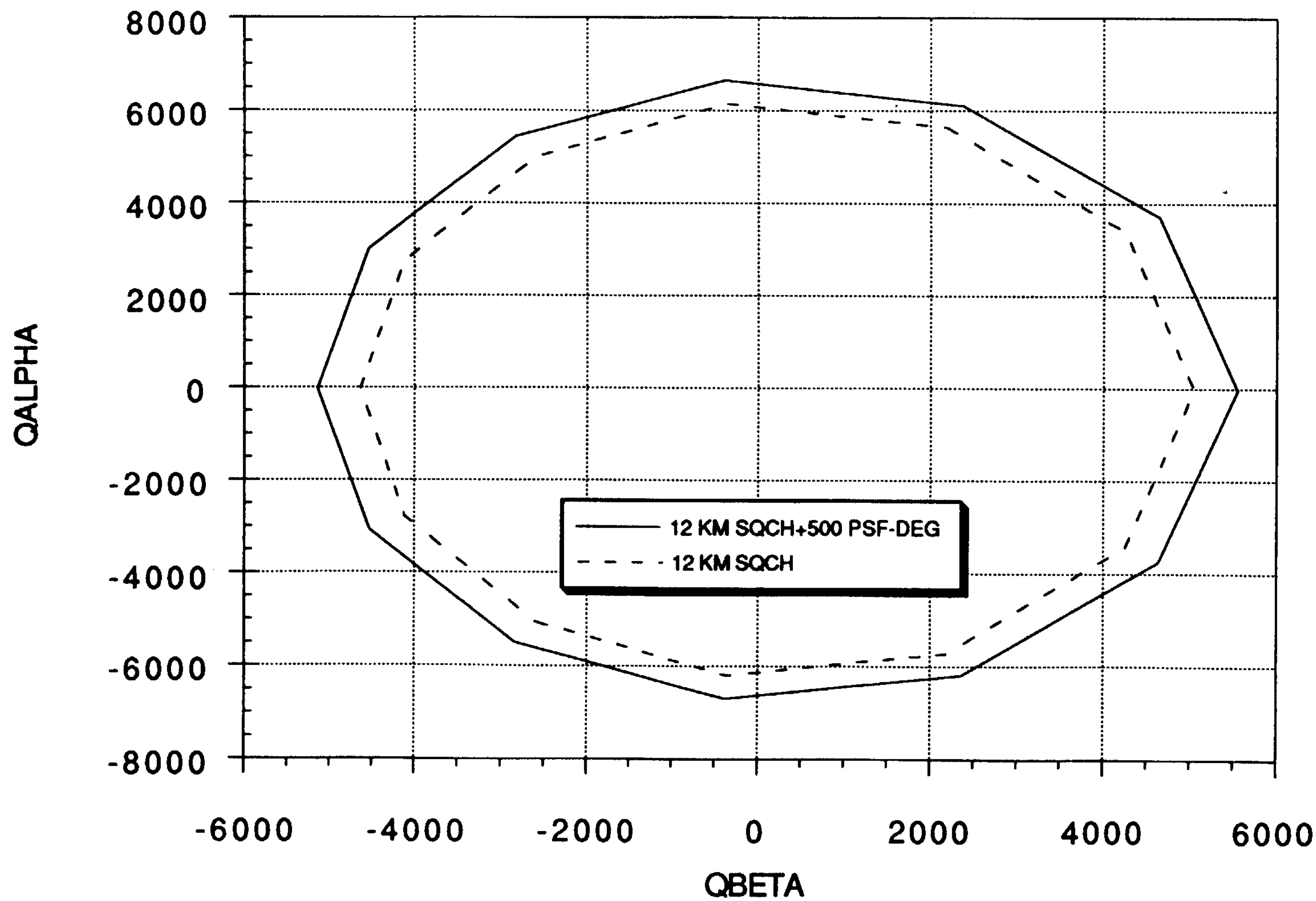
NLS2 Engine Out @ Liftoff
8 Km winds with No Load Relief

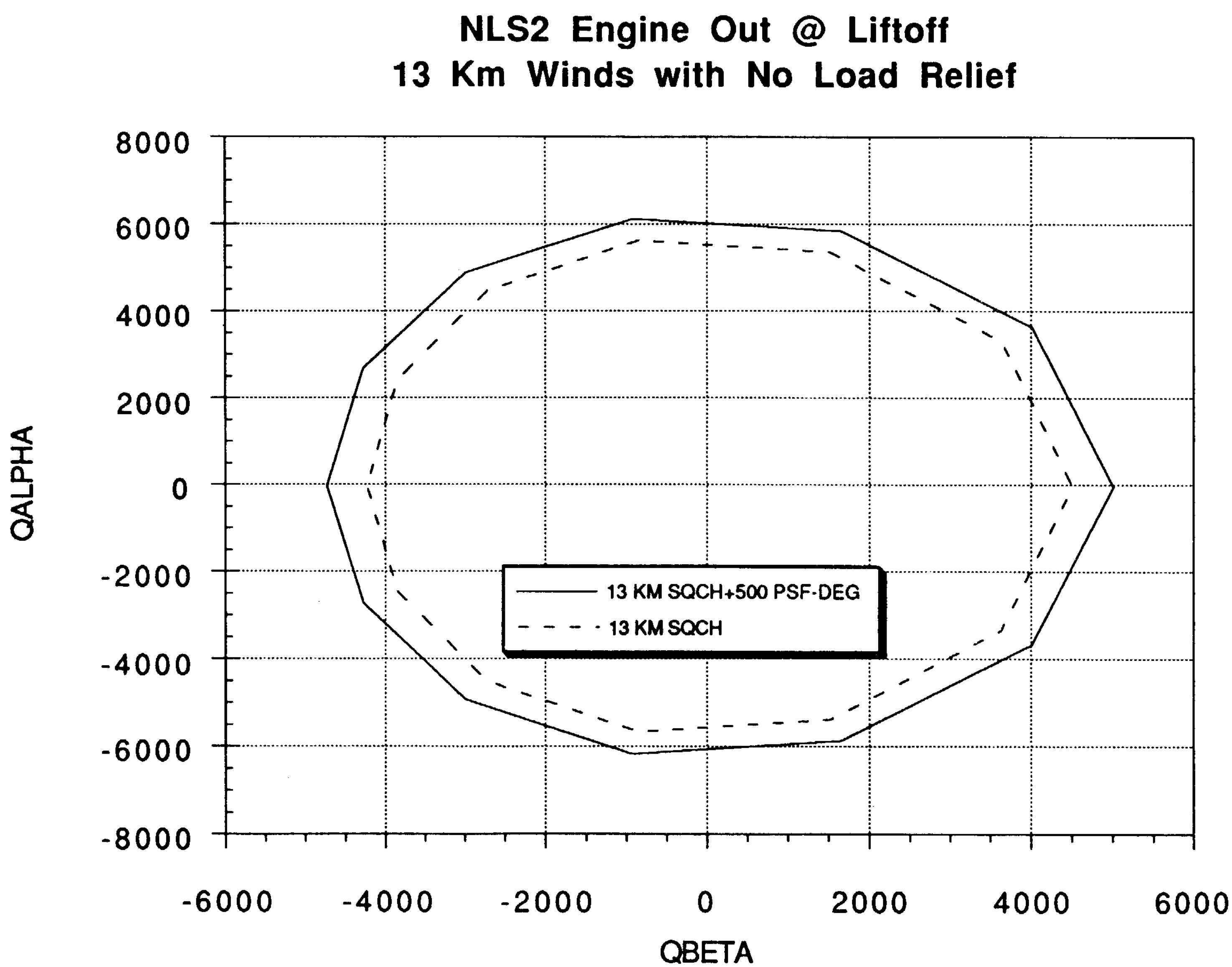


NLS2 Engine Out @ Liftoff
10 Km Winds with No Load Relief

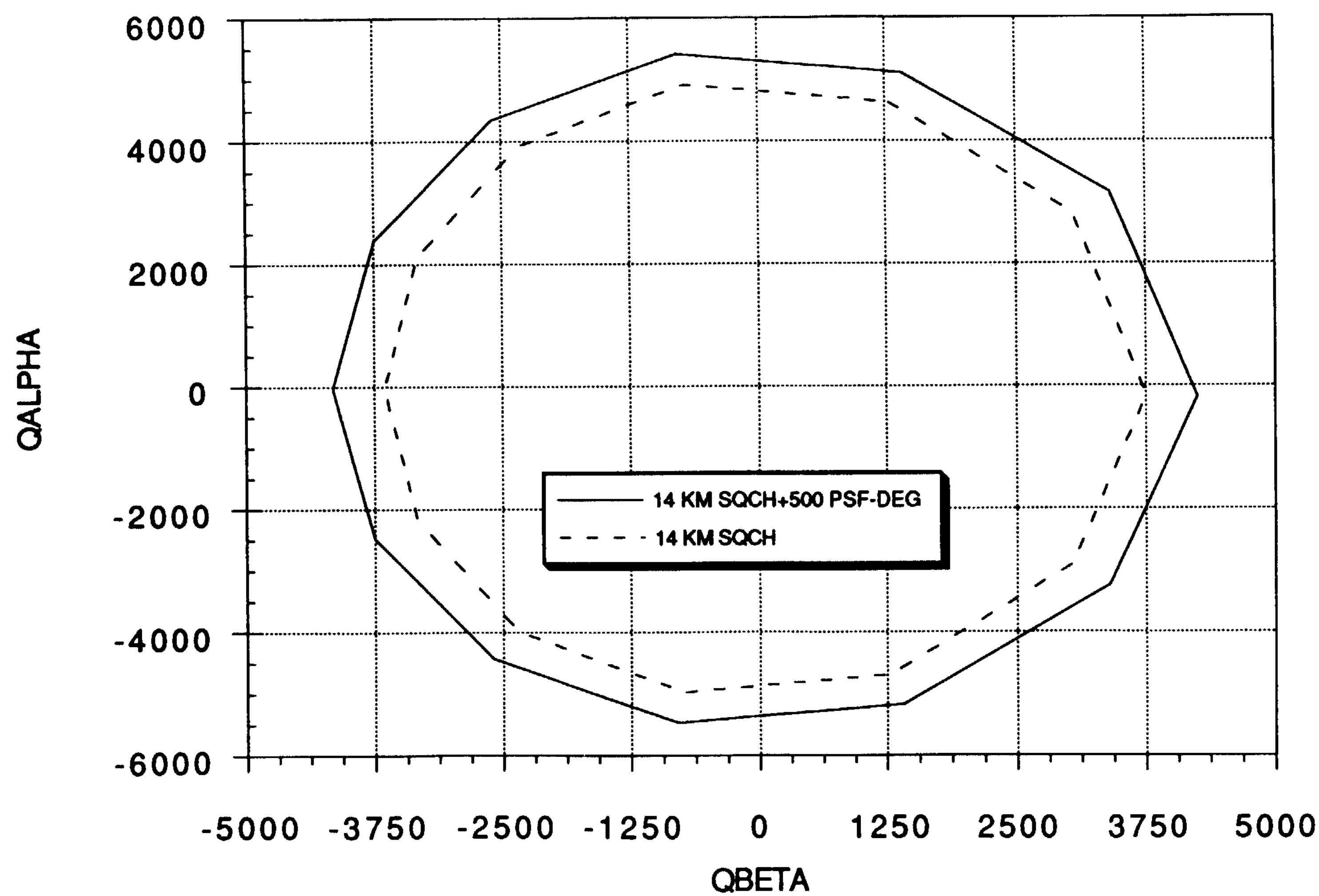


NLS2 Engine Out @ Liftoff
12 Km Winds with No Load Relief

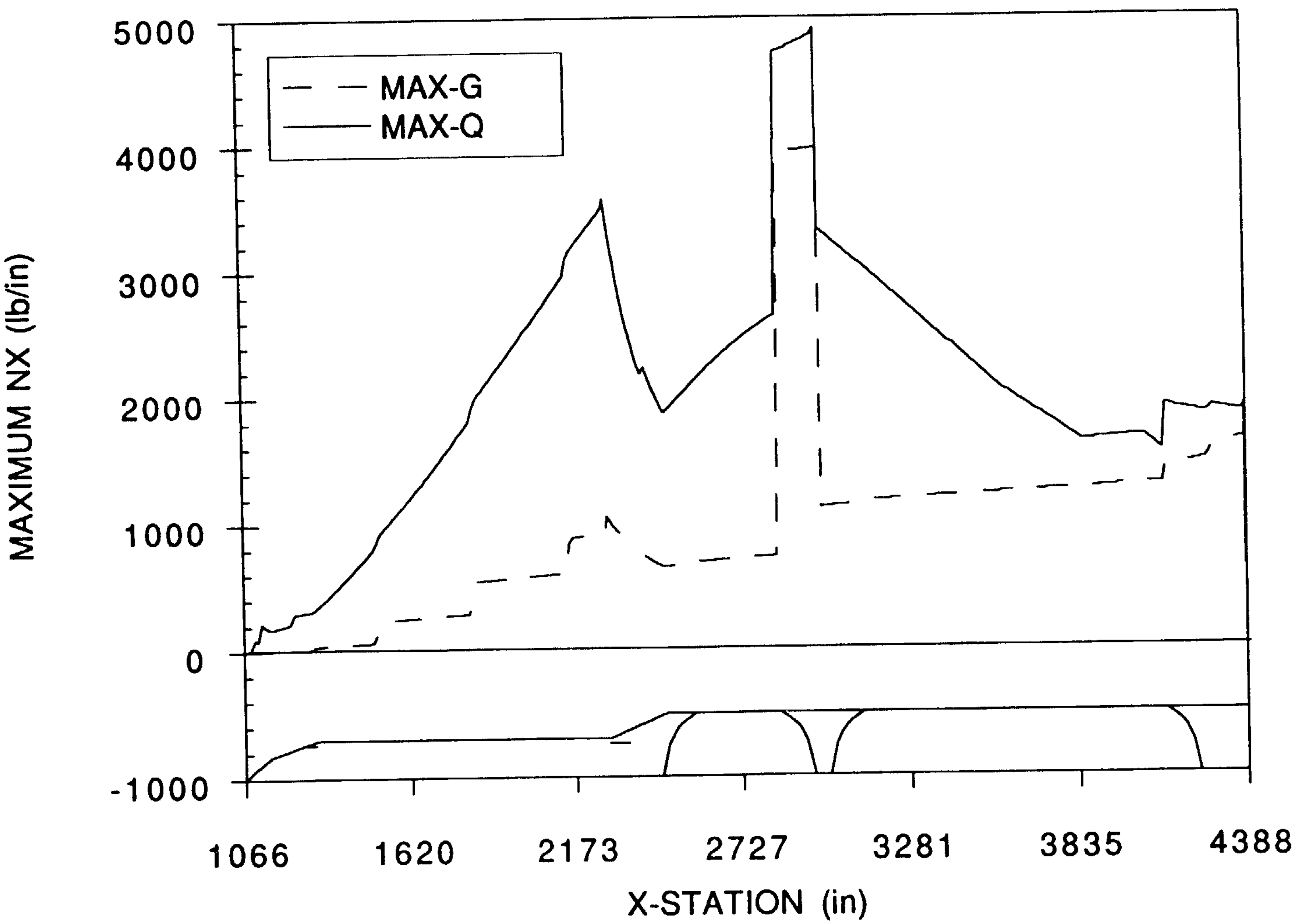


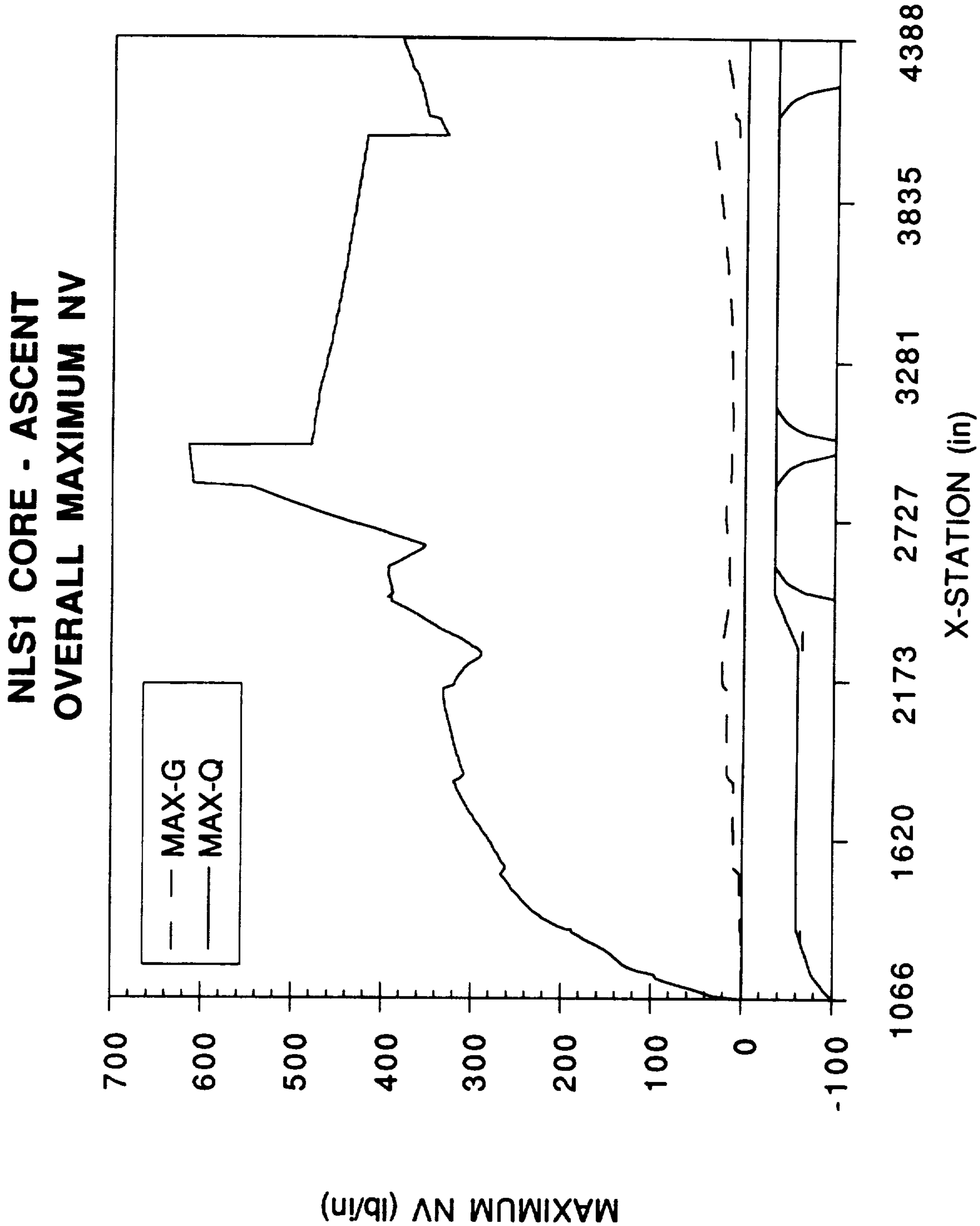

NLS2 Engine Out @ Liftoff
13 Km Winds with No Load Relief
QALPHA
8000
6000
4000
2000
0
-2000
-4000
-6000
-8000
-6000
-4000
-2000
0
2000
4000
6000
QBETA
13 KM SQCH+500 PSF-DEG
13 KM SQCH

NLS2 Engine Out @ Liftoff
14 Km Winds with No Load Relief

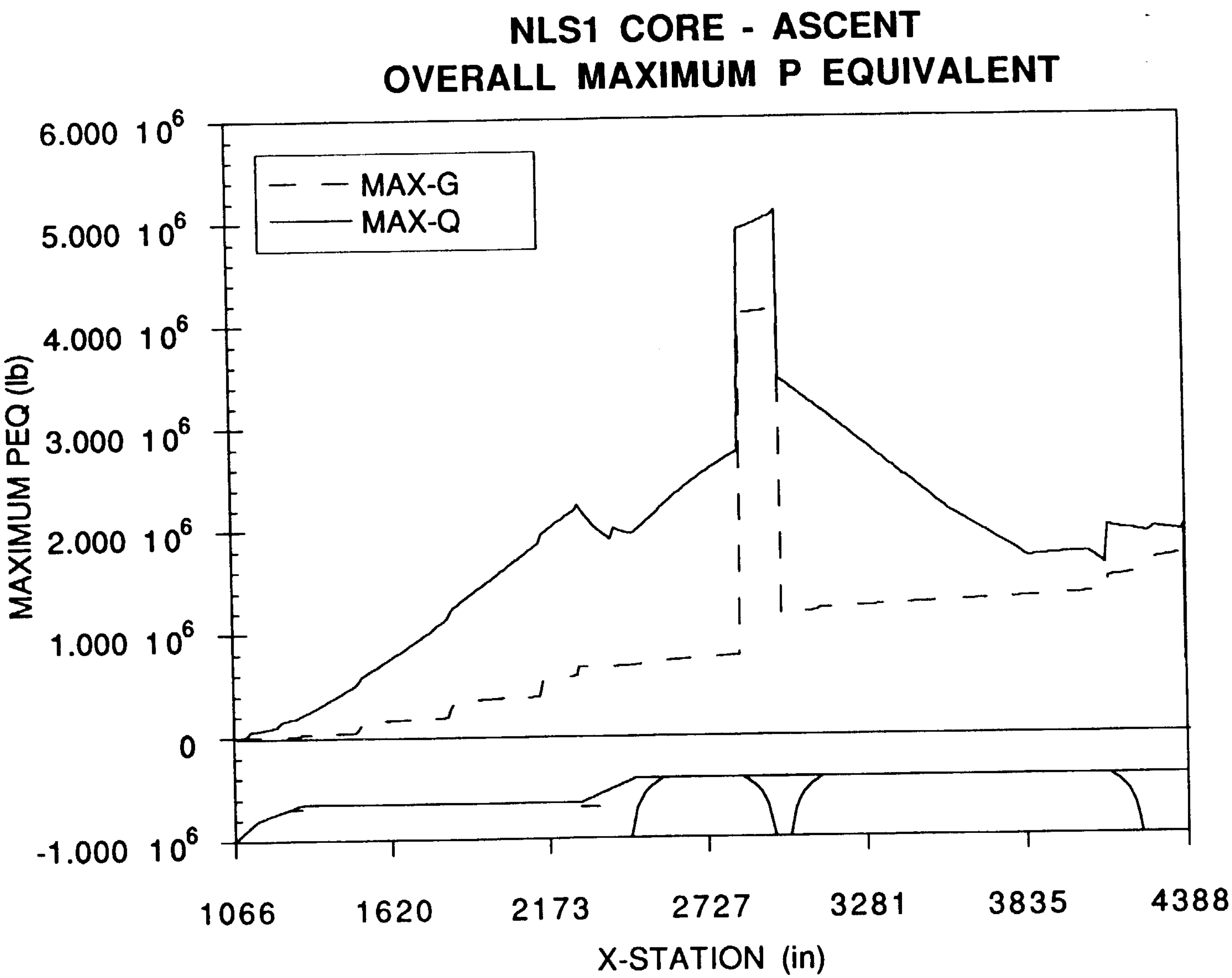


NLS1 CORE - ASCENT
OVERALL MAXIMUM NX

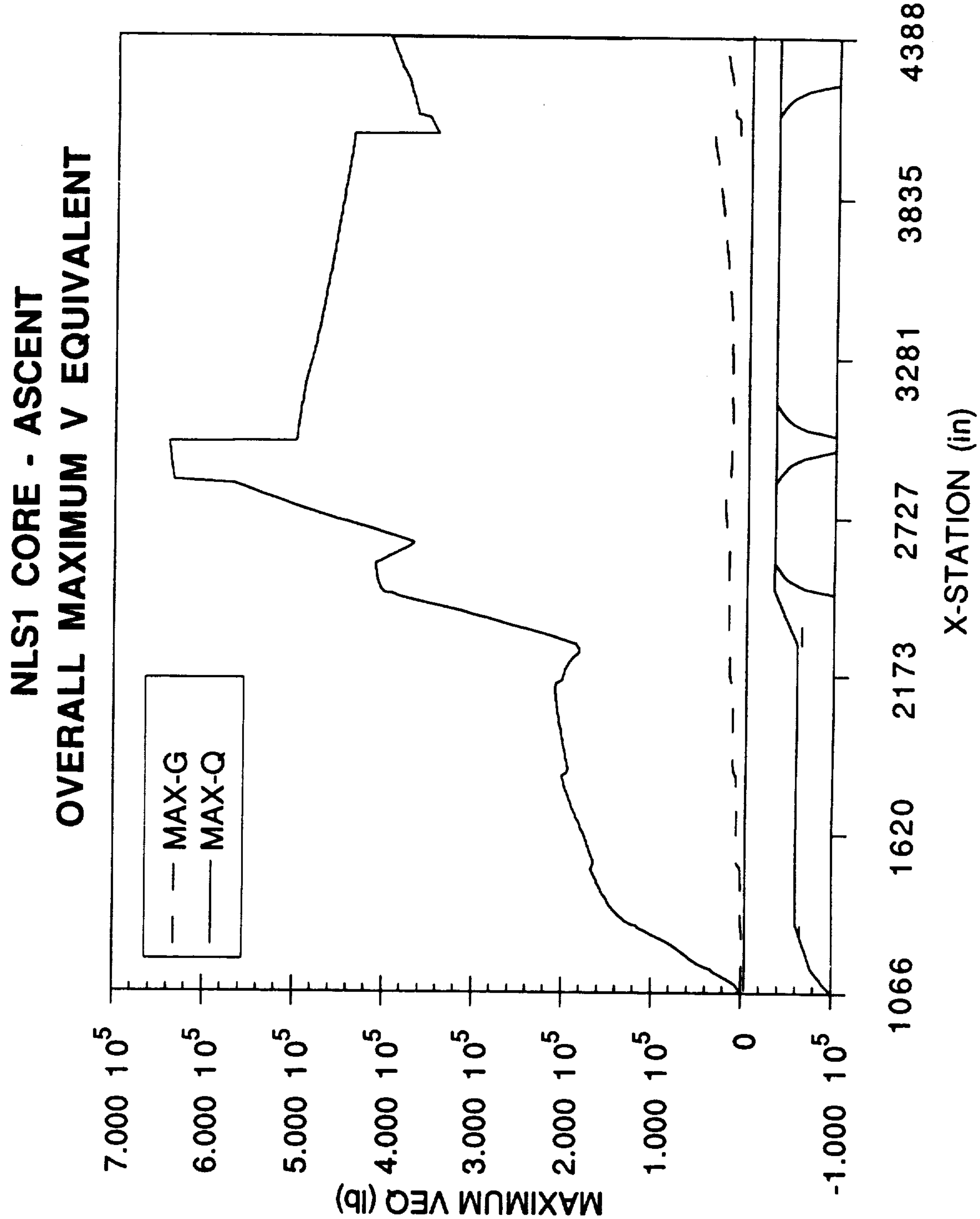


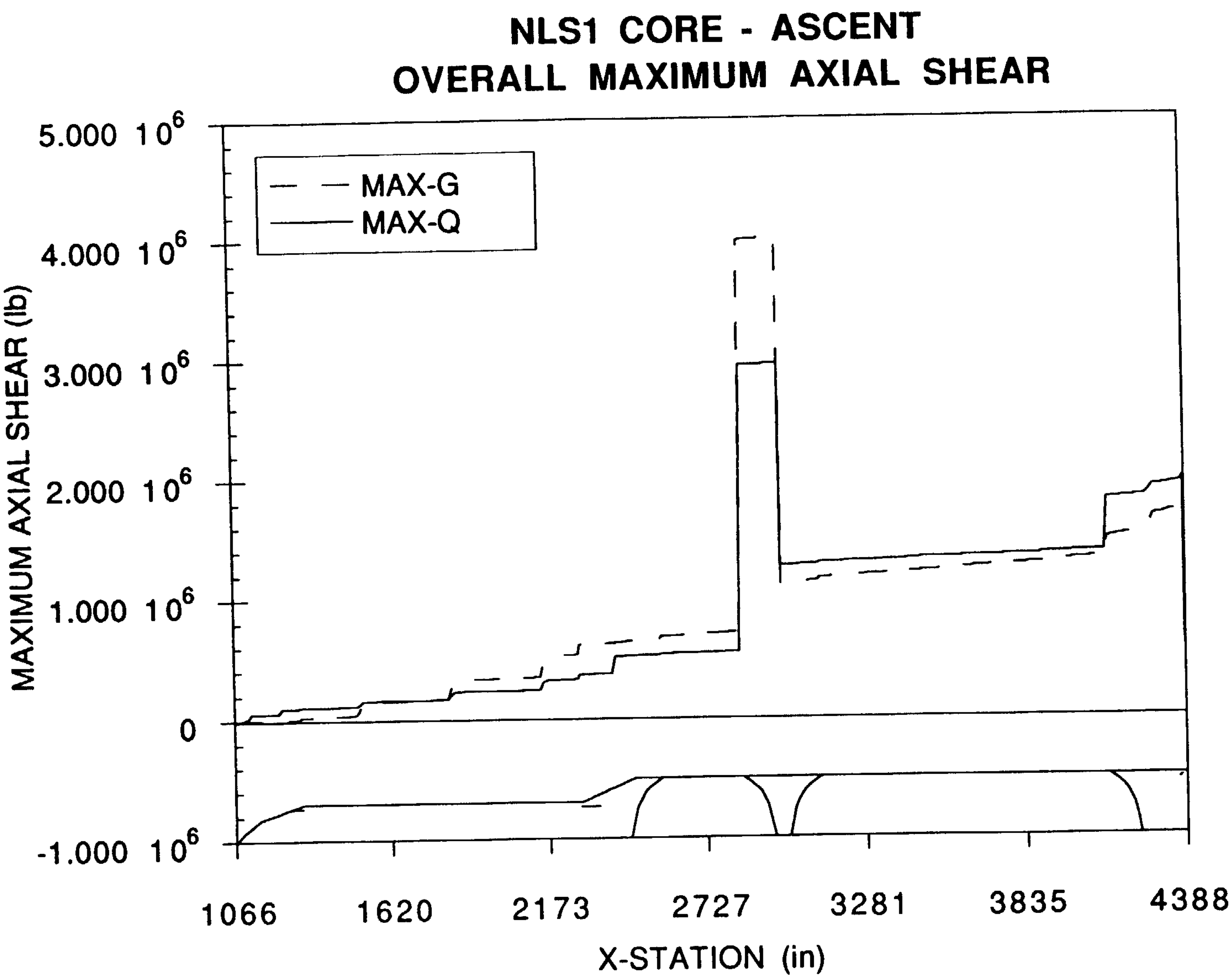


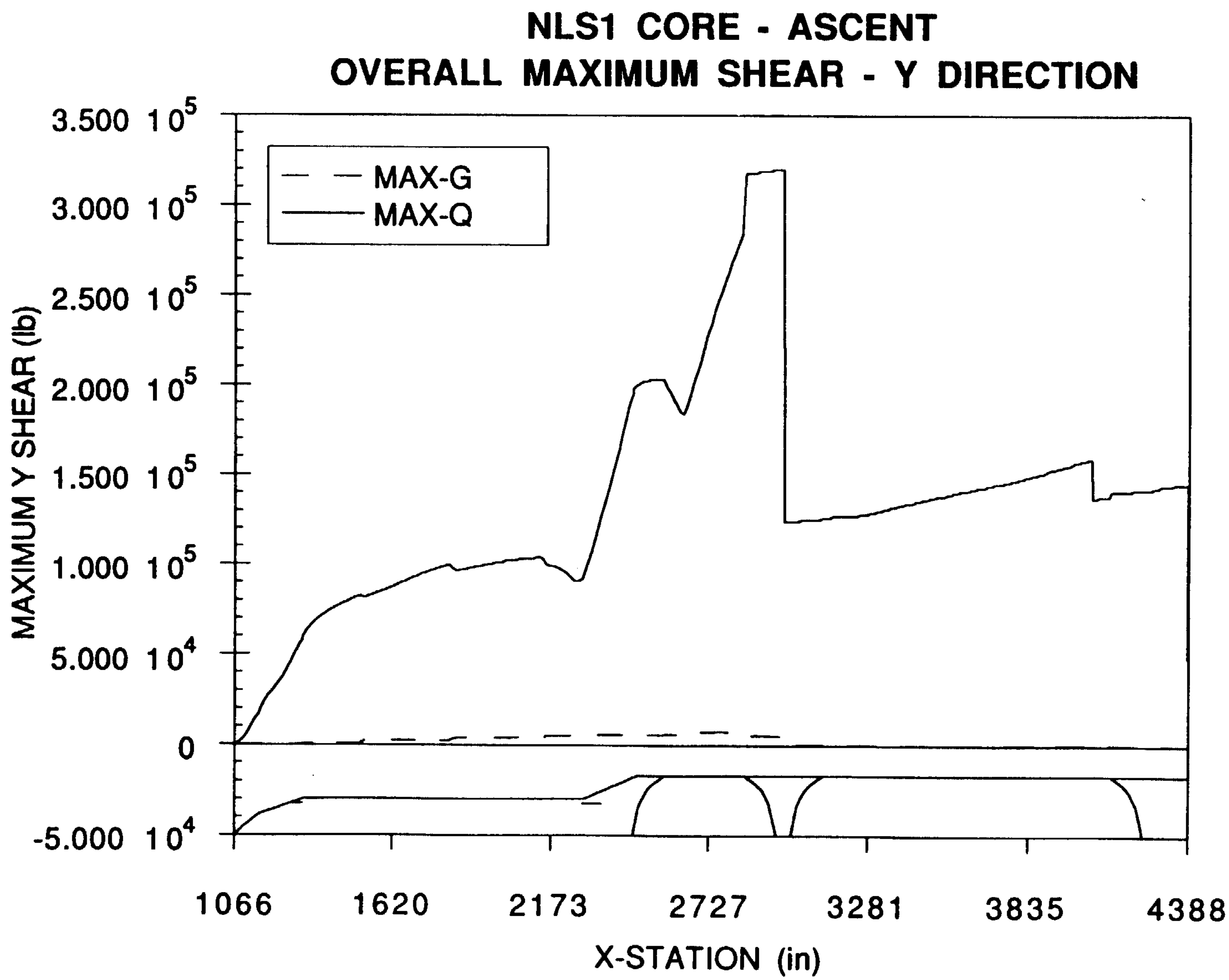
NLS1 CORE - ASCENT
OVERALL MAXIMUM NV
MAX-G
MAX-Q
MAXIMUM NV (lb/in)
700
600
500
400
300
200
100
0
-100
X-STATION (in)
1066
1620
2173
2727
3281
3835
4388

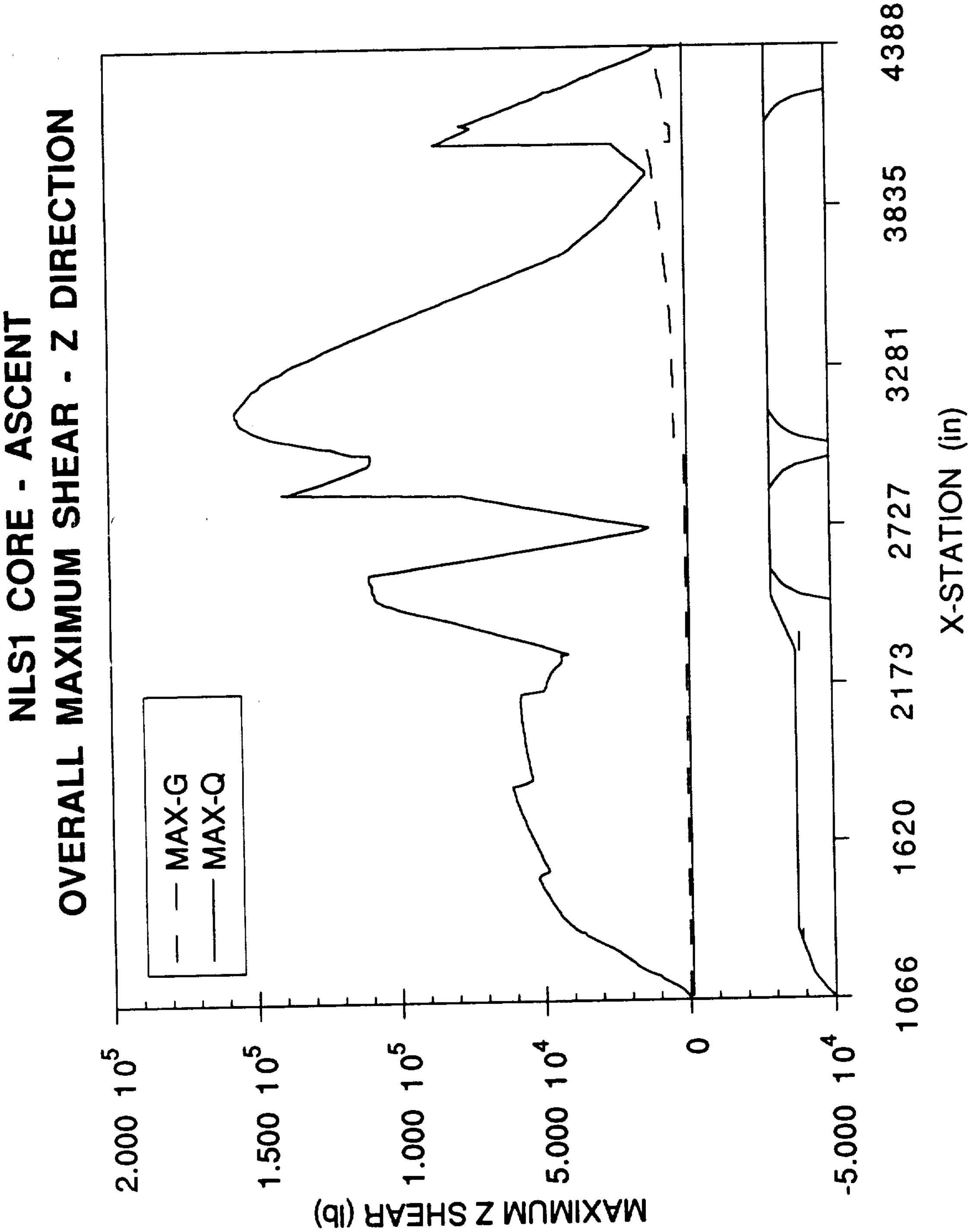


NLS1 CORE - ASCENT
OVERALL MAXIMUM P EQUIVALENT
MAX-G
MAX-Q
MAXIMUM PEQ (lb)
6.000 10^6
5.000 10^6
4.000 10^6
3.000 10^6
2.000 10^6
1.000 10^6
0
-1.000 10^6
1066
1620
2173
2727
3281
3835
4388
X-STATION (in)

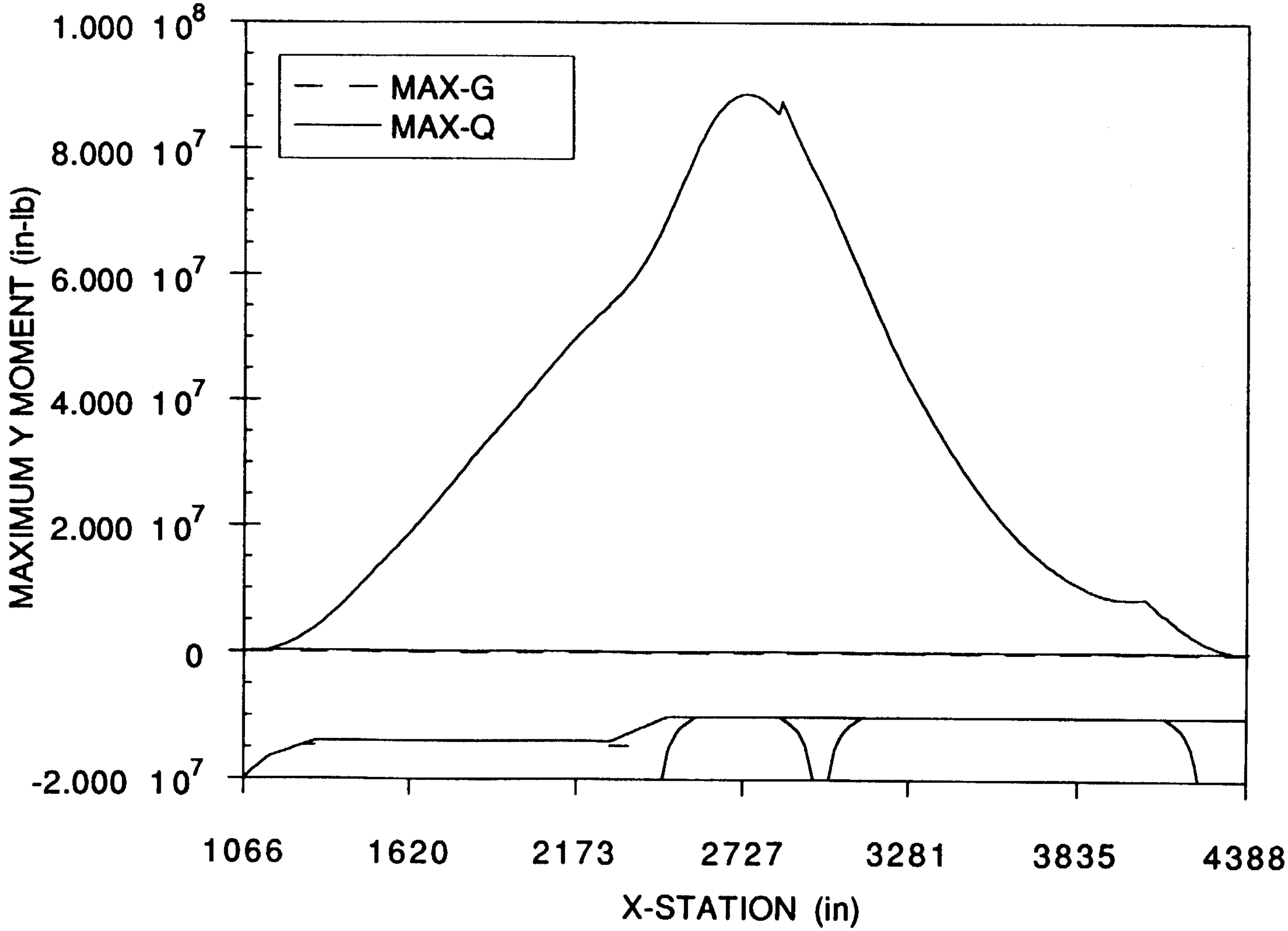

NLS1 CORE - ASCENT
OVERALL MAXIMUM V EQUIVALENT
MAX-G
MAX-Q
MAXIMUM VEQ (lb)
7.000 10^5
6.000 10^5
5.000 10^5
4.000 10^5
3.000 10^5
2.000 10^5
1.000 10^5
0
-1.000 10^5
1066
1620
2173
2727
3281
3835
4388
X-STATION (in)


NLS1 CORE - ASCENT
OVERALL MAXIMUM AXIAL SHEAR
MAX-G
MAX-Q
MAXIMUM AXIAL SHEAR (lb)
5.000 10^6
4.000 10^6
3.000 10^6
2.000 10^6
1.000 10^6
0
-1.000 10^6
1066
1620
2173
2727
3281
3835
4388
X-STATION (in)

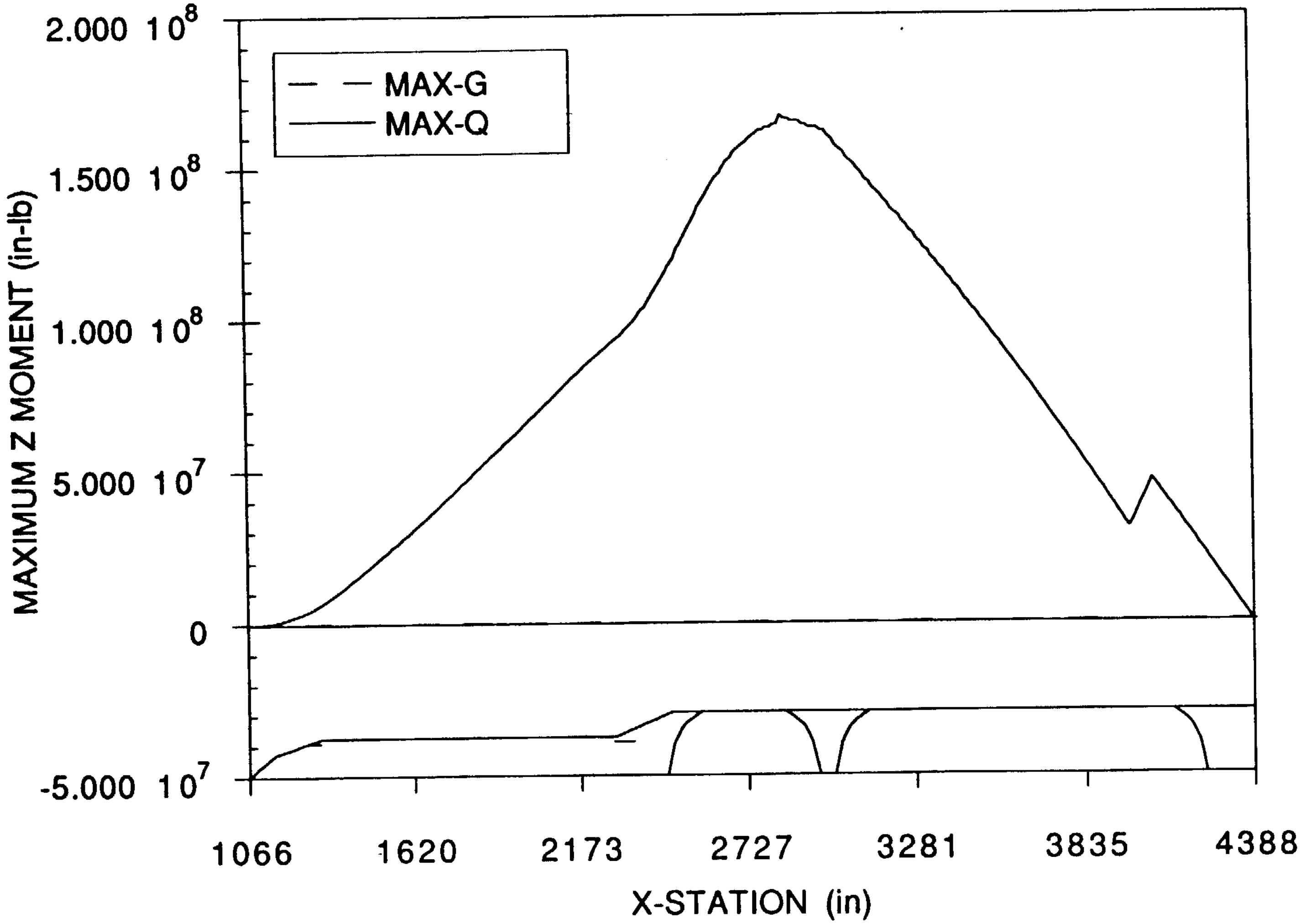

NLS1 CORE - ASCENT
OVERALL MAXIMUM SHEAR - Y DIRECTION
MAX-G
MAX-Q
MAXIMUM Y SHEAR (lb)
3.500 10^5
3.000 10^5
2.500 10^5
2.000 10^5
1.500 10^5
1.000 10^5
5.000 10^4
0
-5.000 10^4
1066
1620
2173
2727
3281
3835
4388
X-STATION (in)


NLS1 CORE - ASCENT
OVERALL MAXIMUM SHEAR - Z DIRECTION
MAX-G
MAX-Q
MAXIMUM Z SHEAR (lb)
2.000 10^5
1.500 10^5
1.000 10^5
5.000 10^4
0
-5.000 10^4
X-STATION (in)
1066
1620
2173
2727
3281
3835
4388

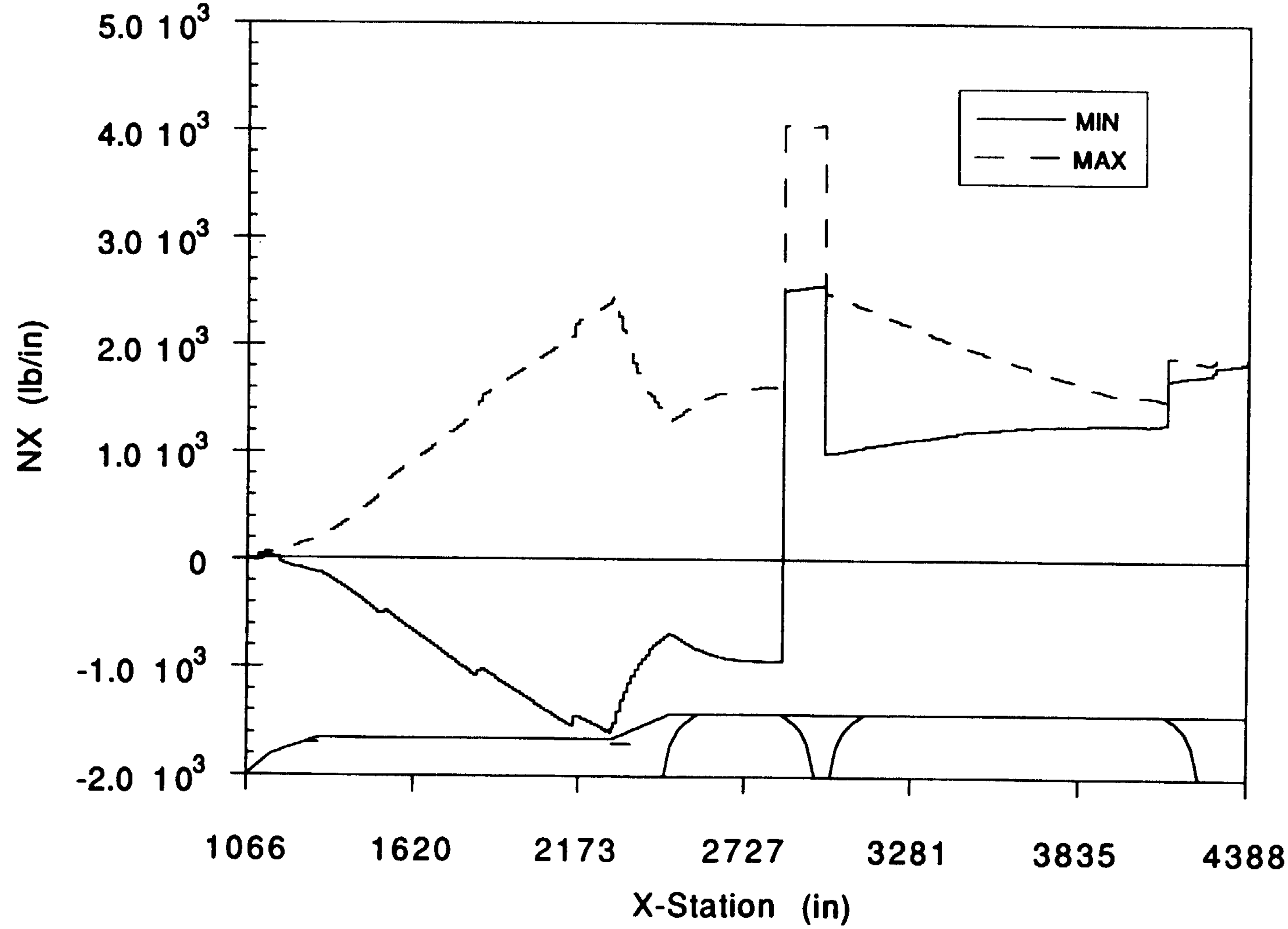
NLS1 CORE - ASCENT
OVERALL MAXIMUM MOMENT - Y DIRECTION

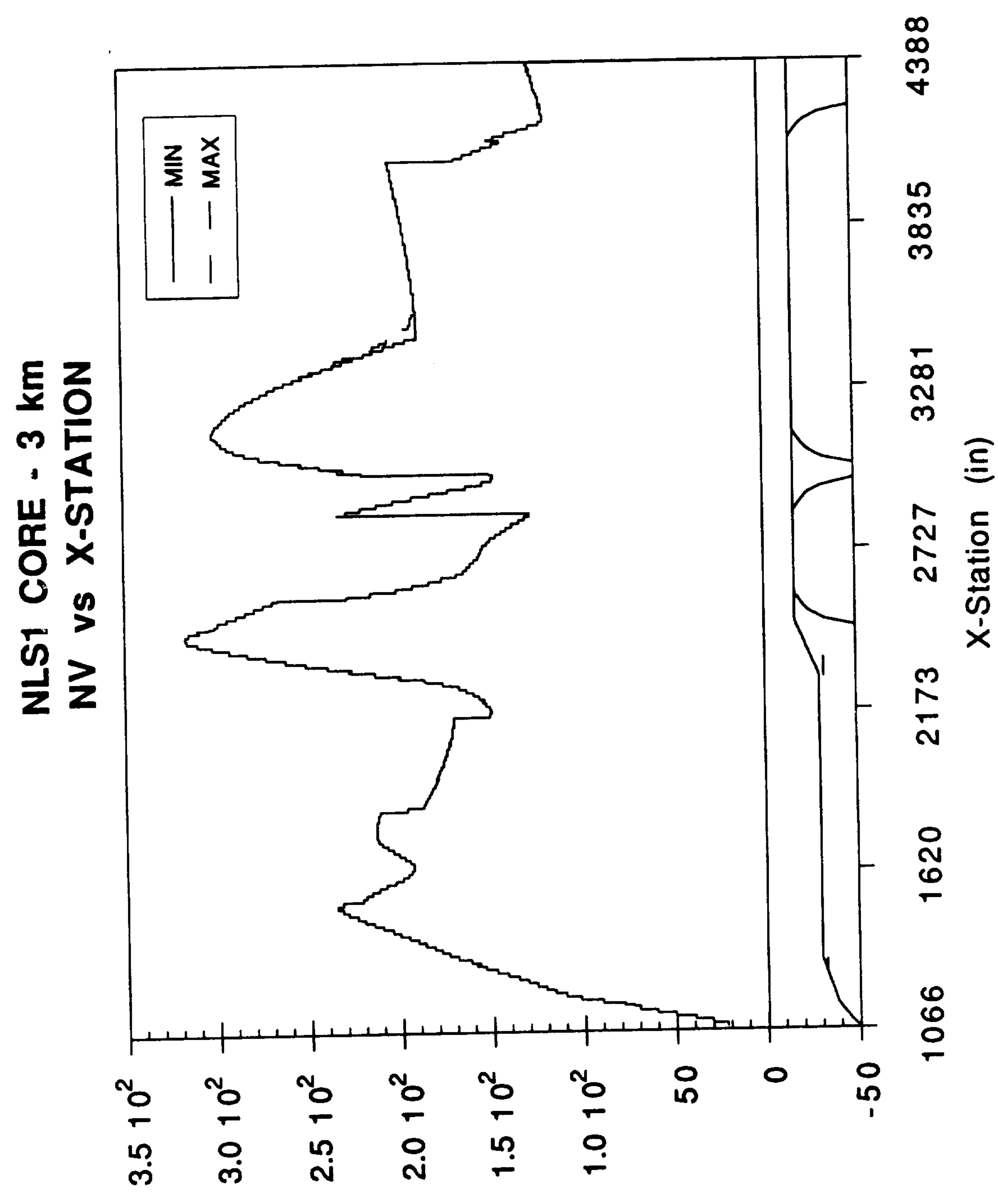


NLS1 CORE - ASCENT
OVERALL MAXIMUM MOMENT - Z DIRECTION

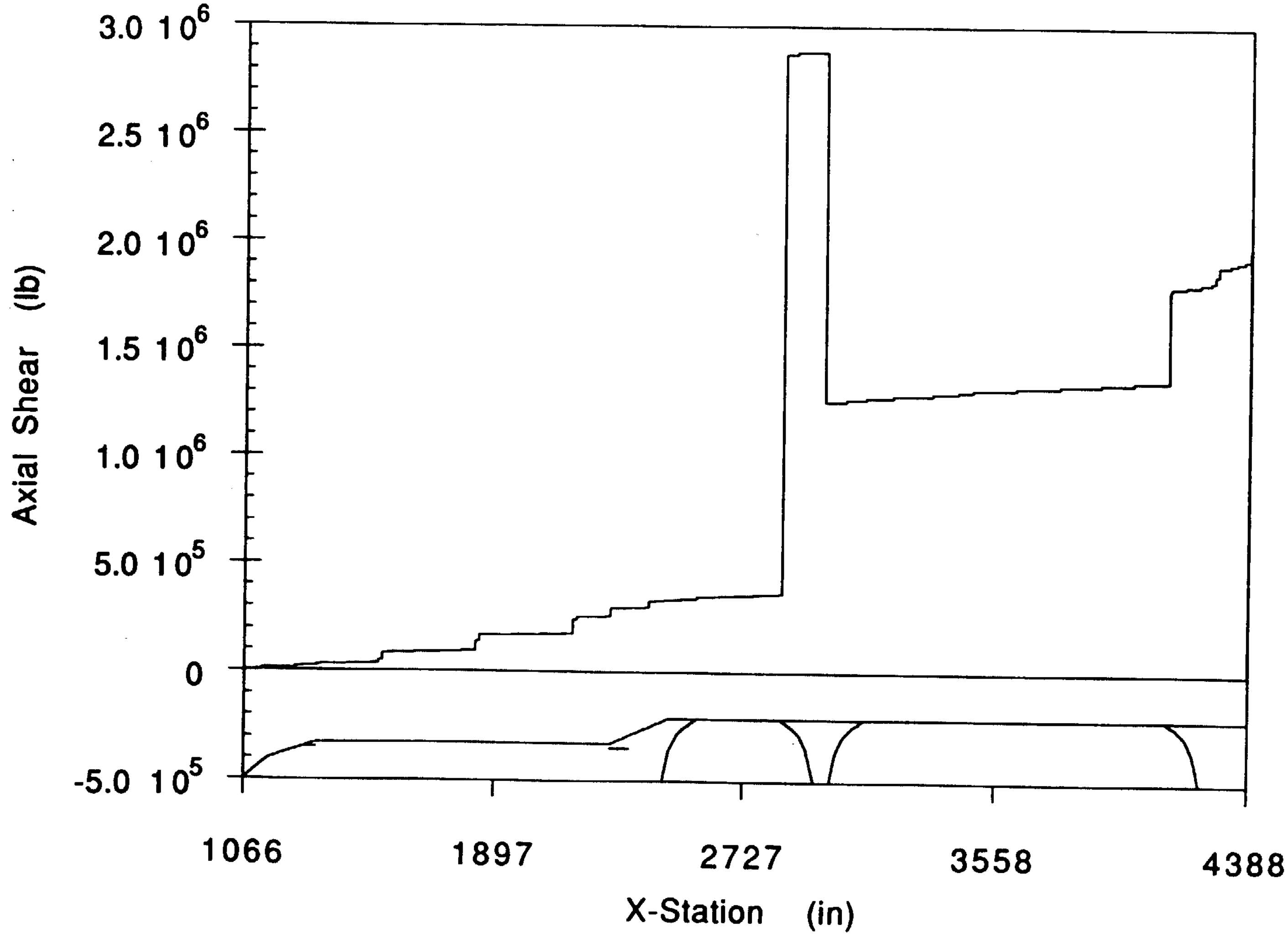


NLS1 CORE - 3 km
NX vs X-STATION

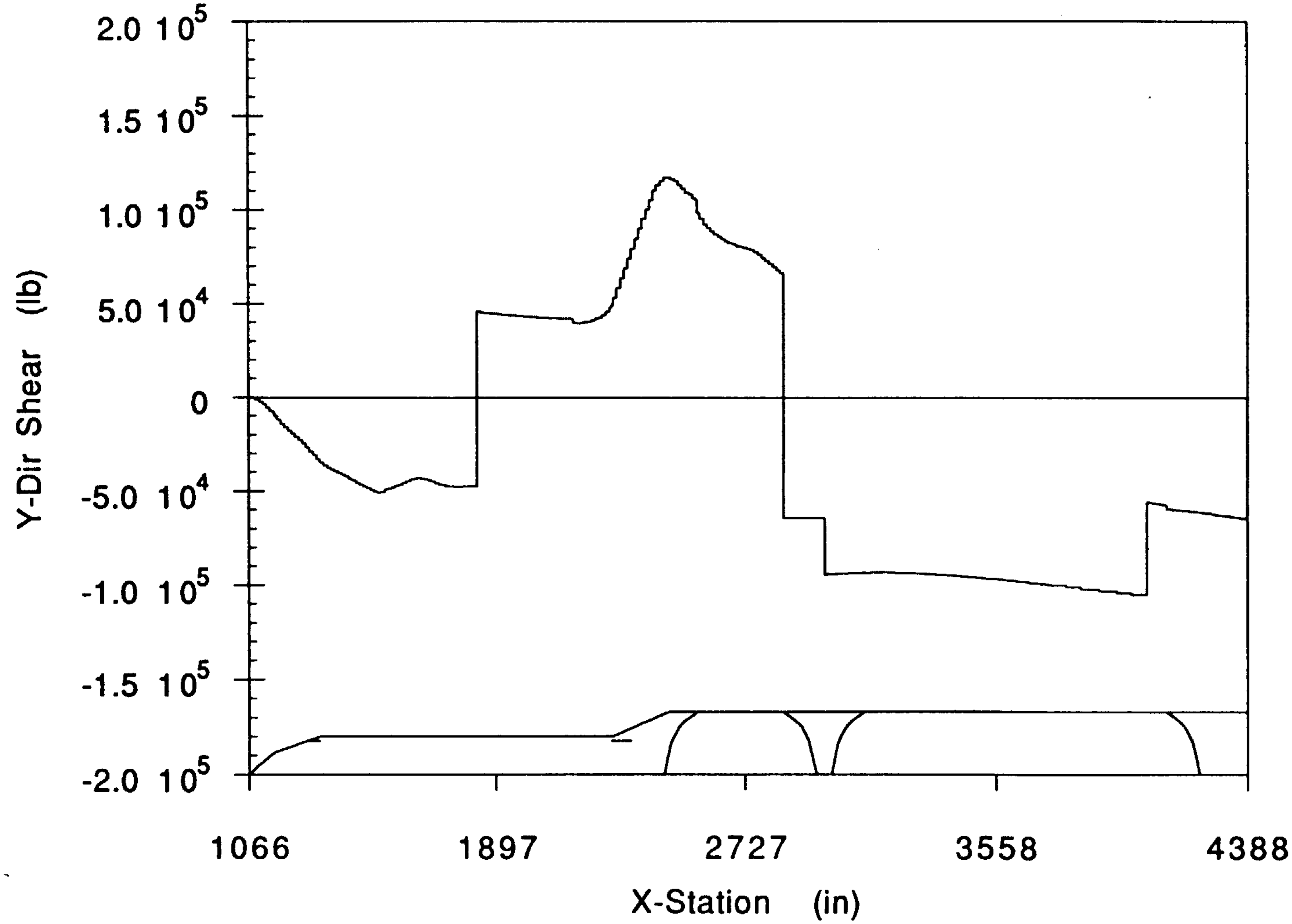


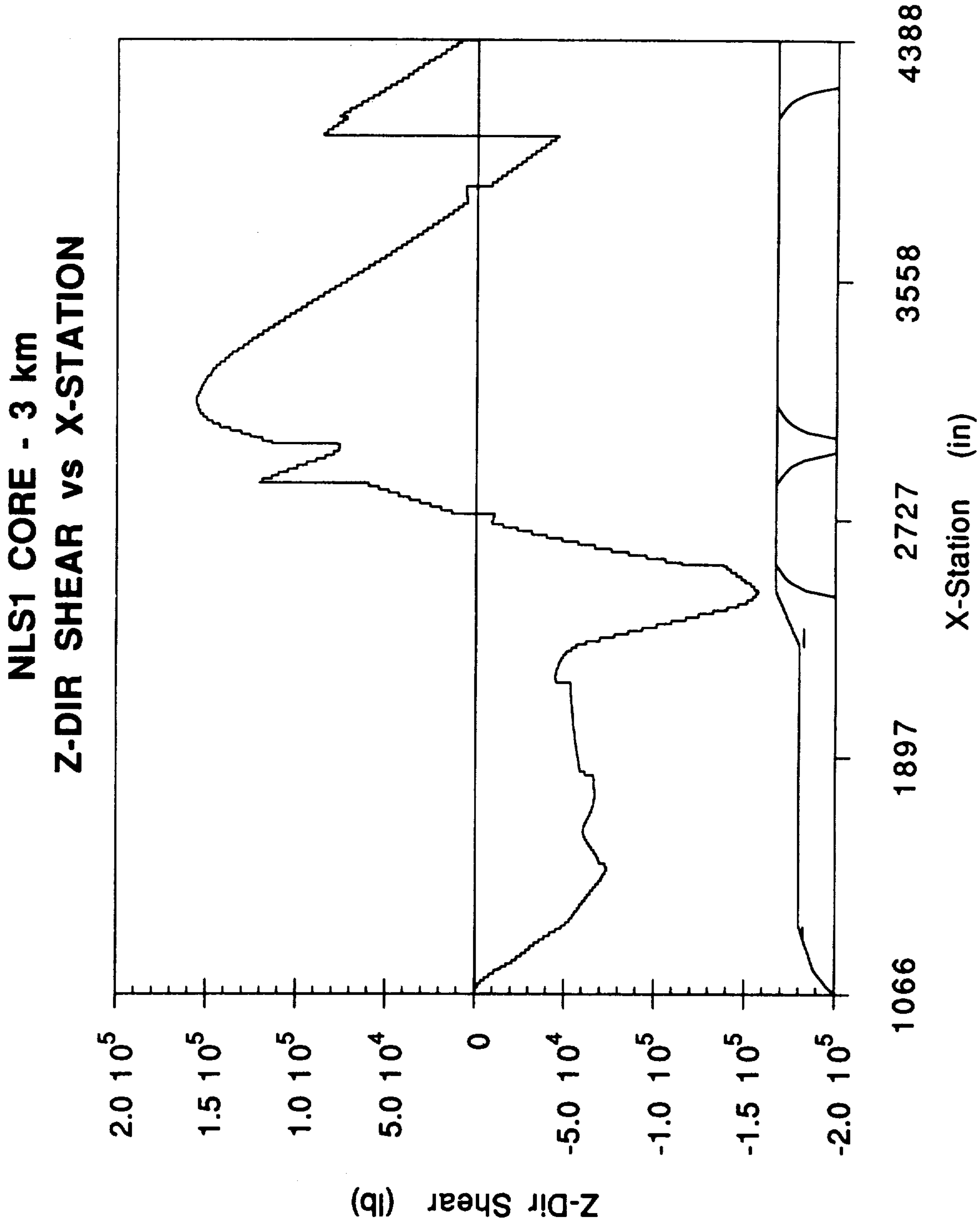

NLS1 CORE - 3 km
NV vs X-STATION
MIN
MAX
NV (lb/in)
3.5 10^2
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

NLS1 CORE - 3 km
AXIAL SHEAR vs X-STATION



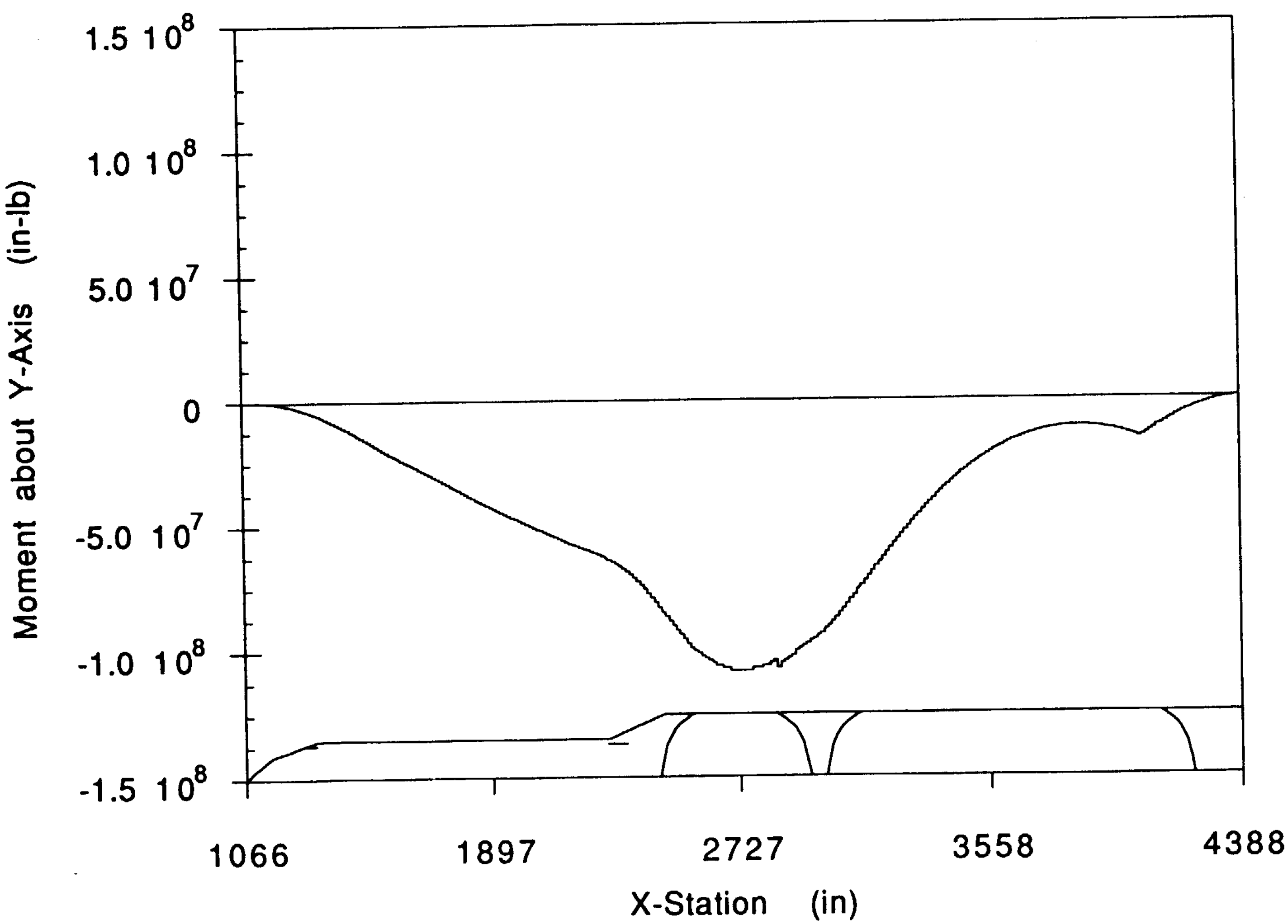
NLS1 CORE - 3 km
Y-DIR SHEAR vs X-STATION

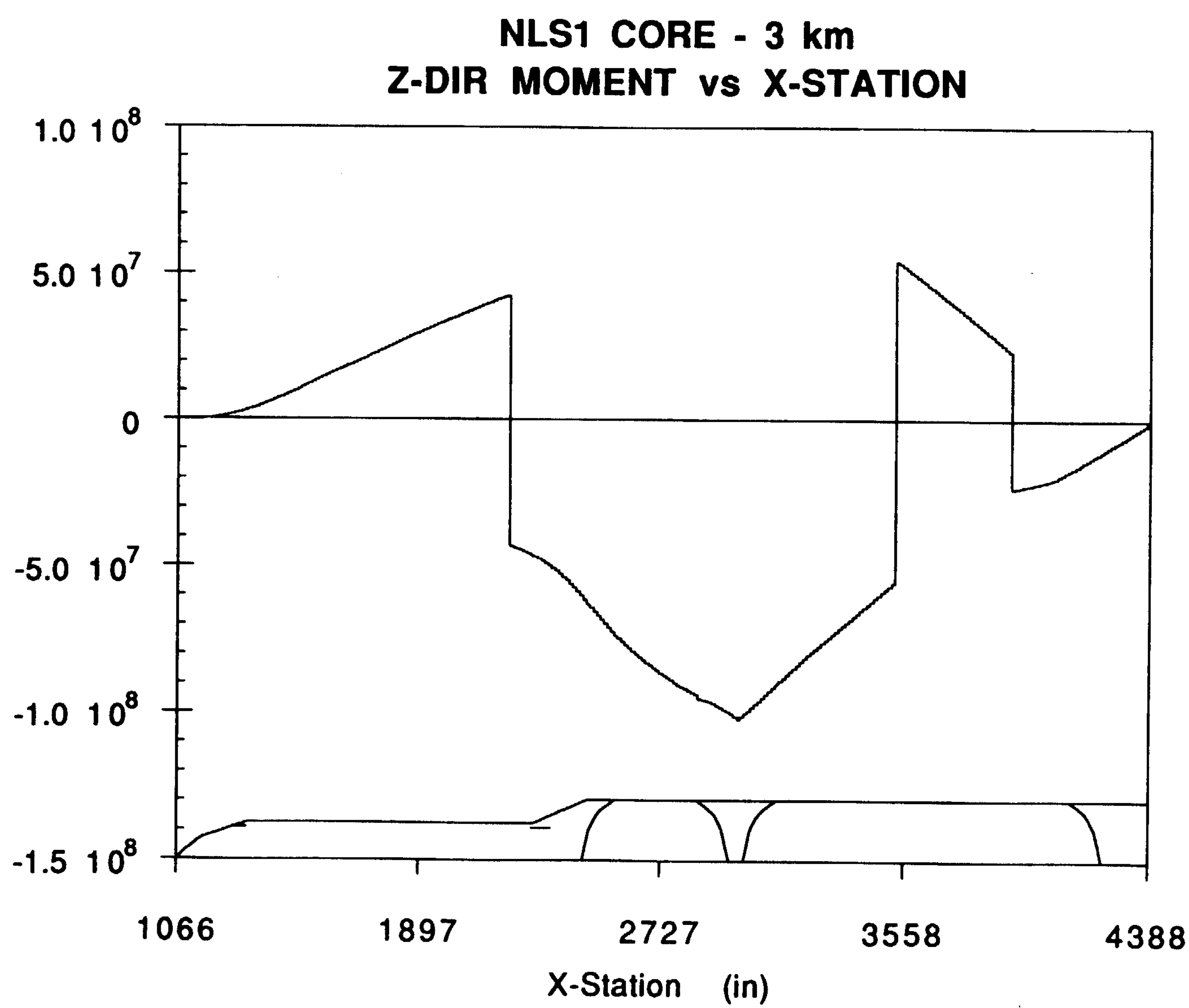


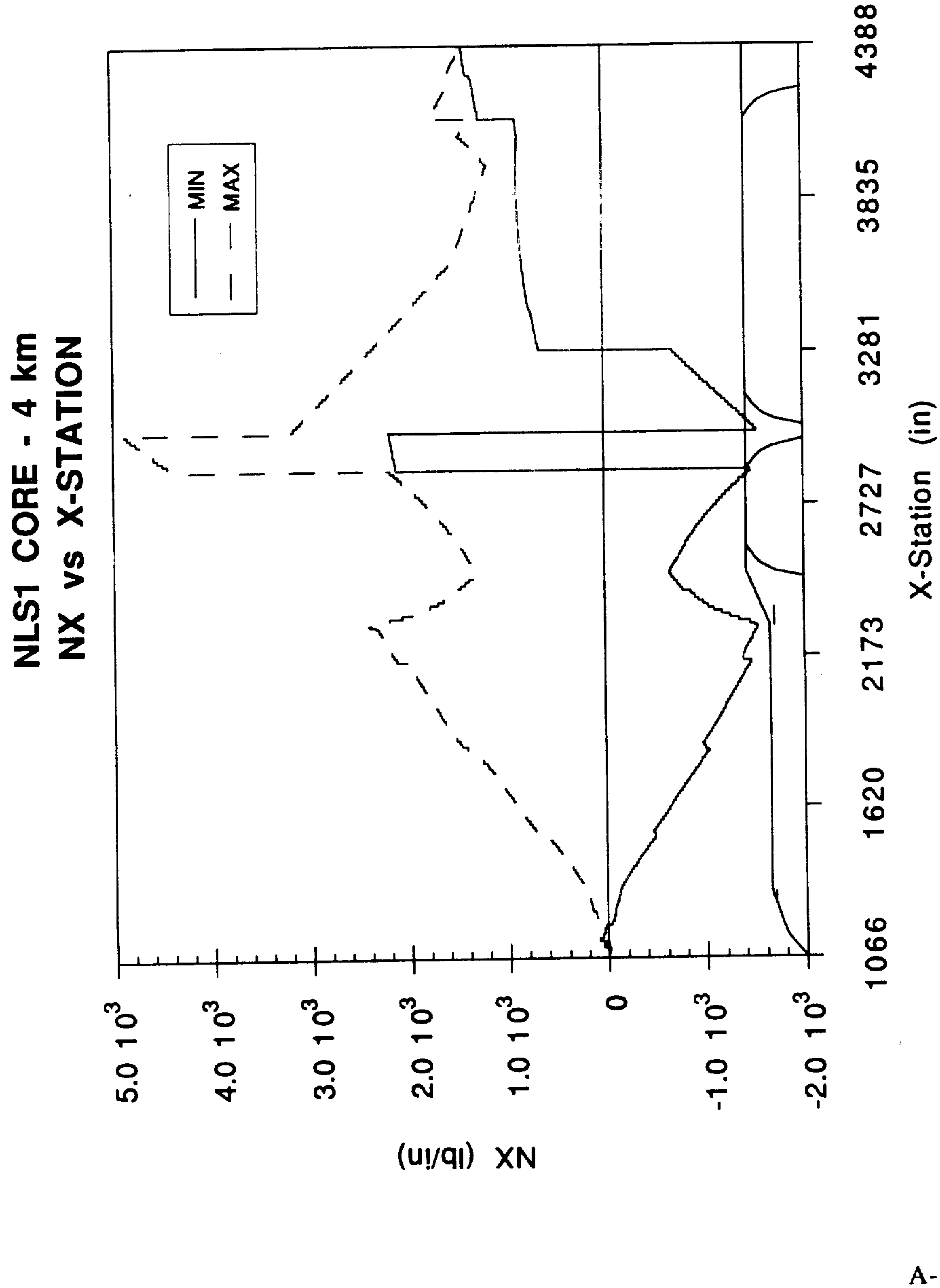


NLS1 CORE - 3 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

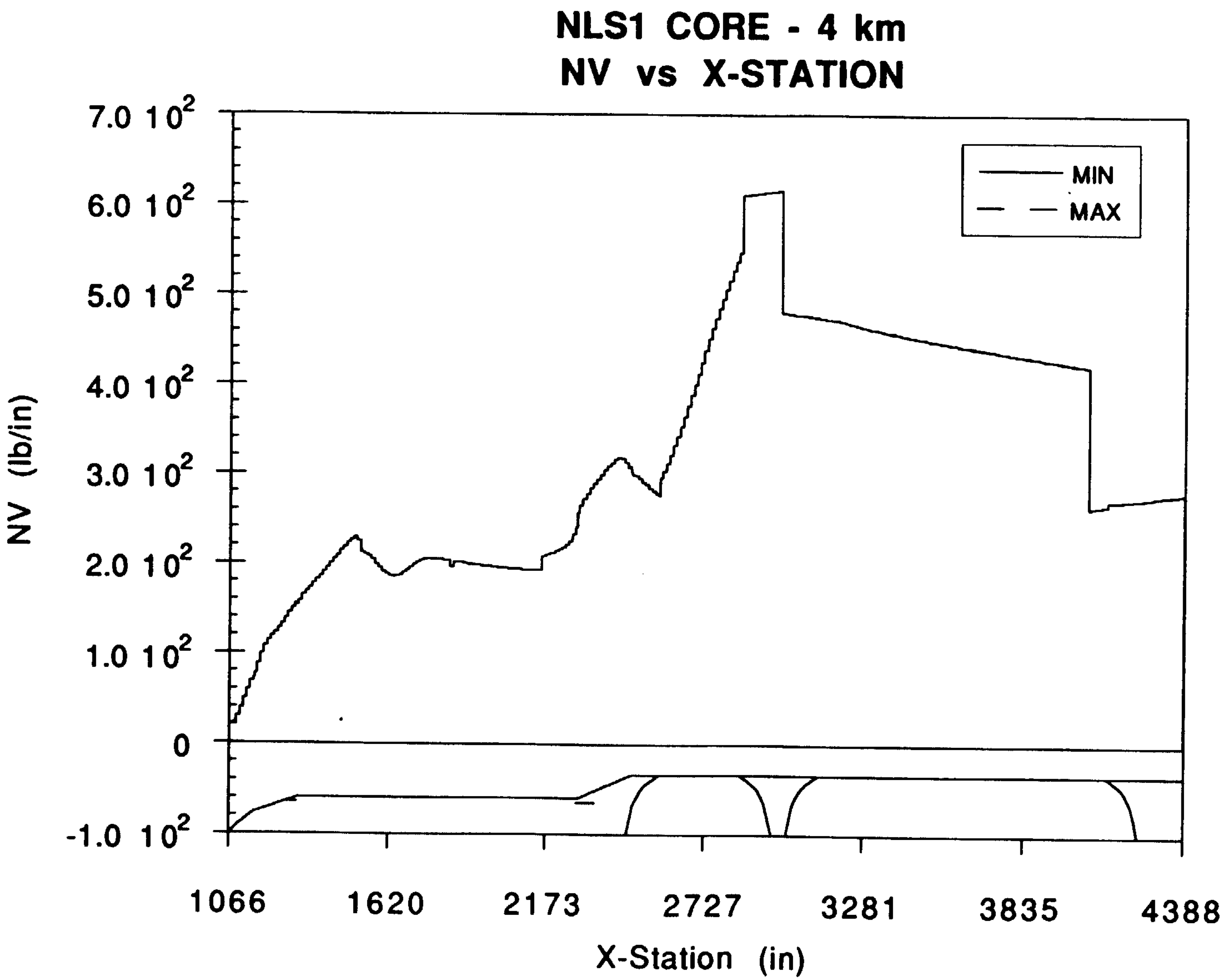
NLS1 CORE - 3 km
Y-DIR MOMENT vs X-STATION



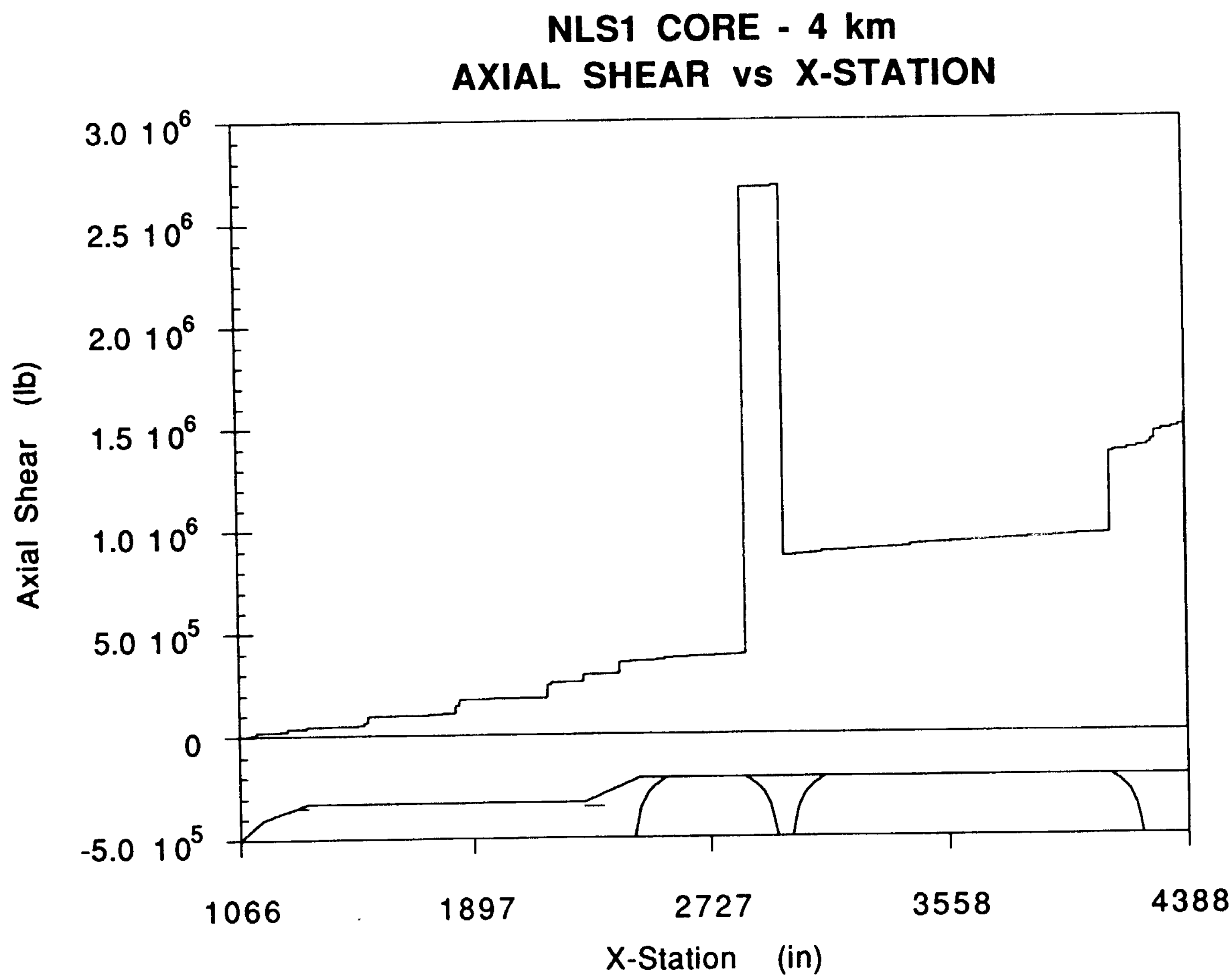

NLS1 CORE - 3 km
Z-DIR MOMENT vs X-STATION
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
Moment about Z-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)



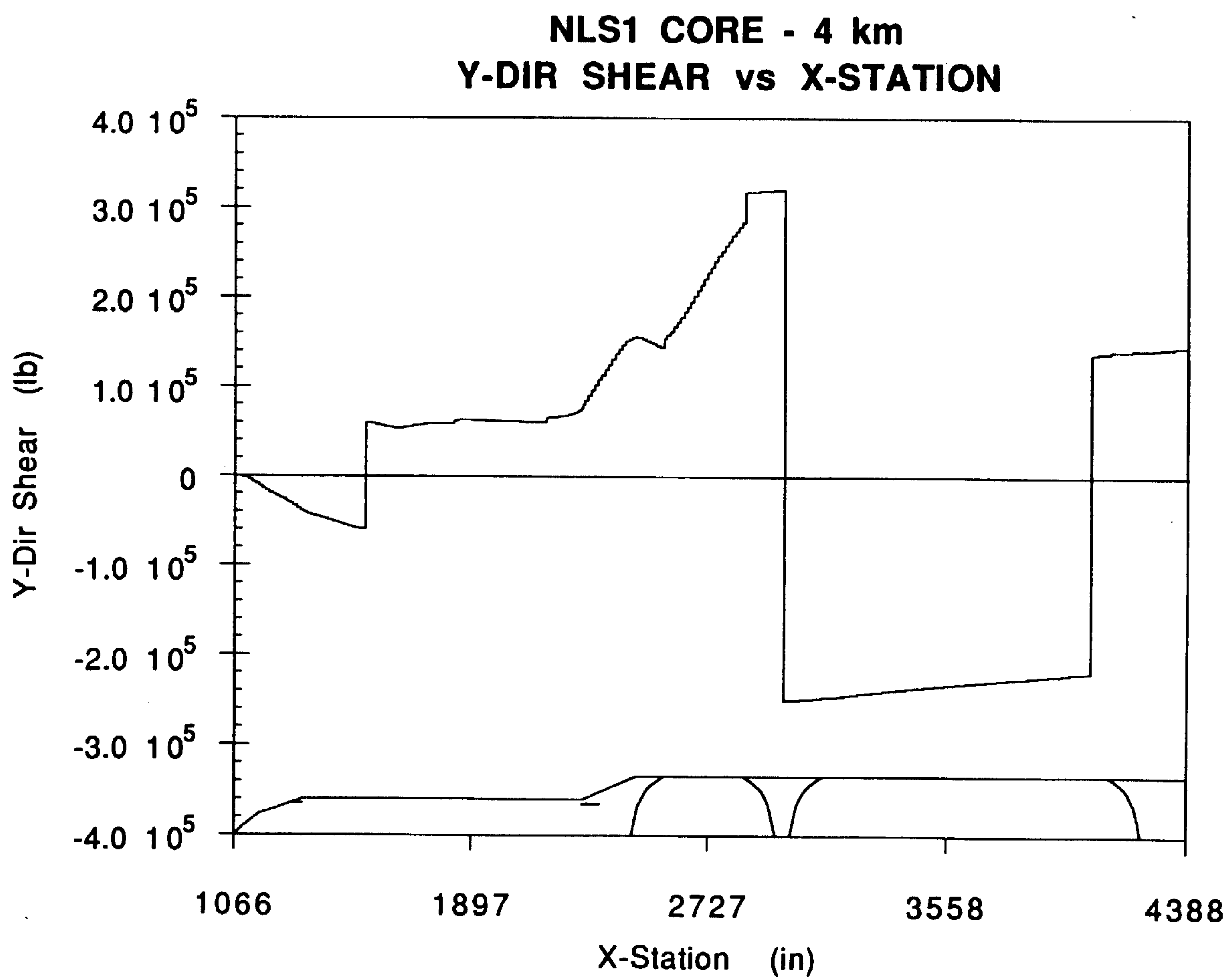
NLS1 CORE - 4 km
NX vs X-STATION
MIN
MAX
NX (lb/in)
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



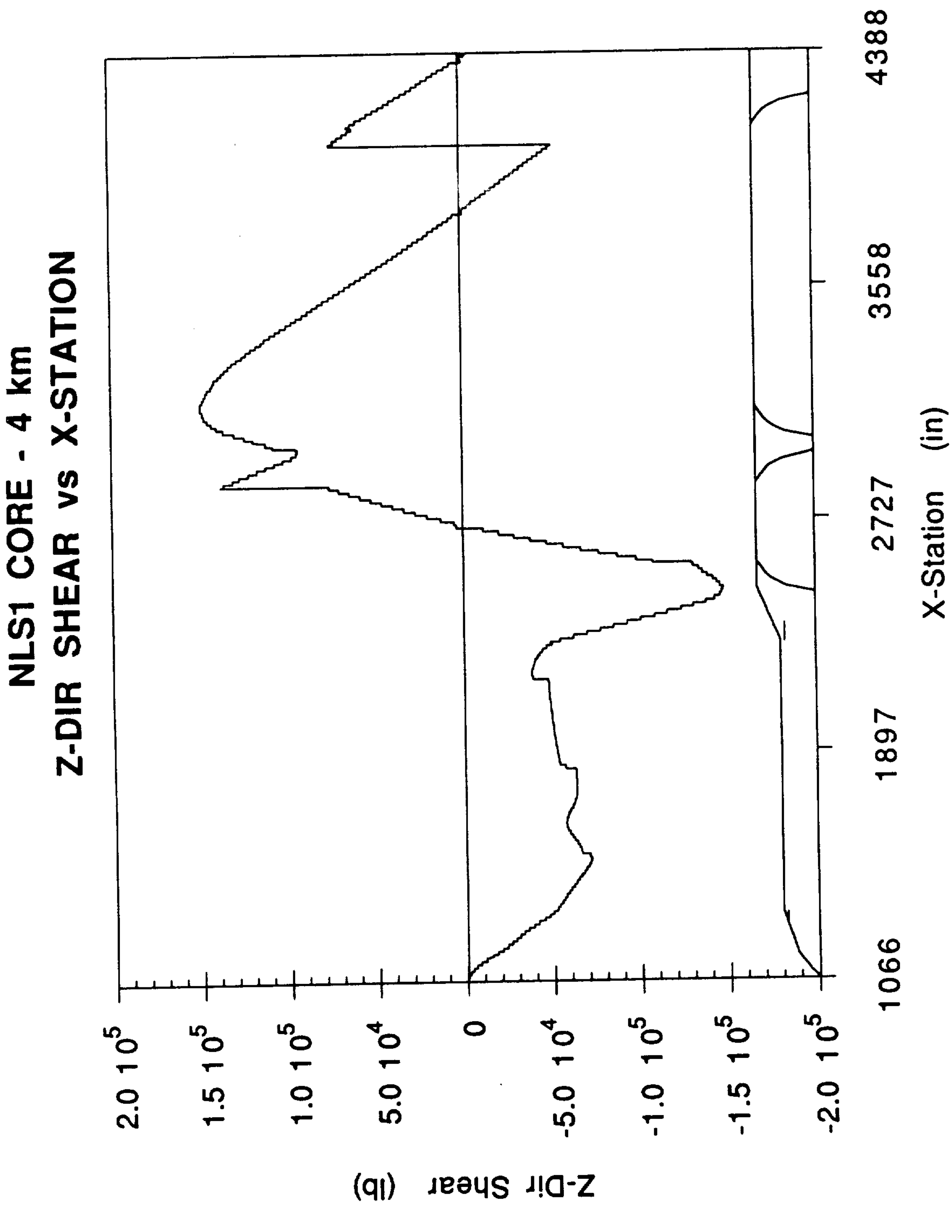
NLS1 CORE - 4 km
NV vs X-STATION
7.0 10^2
6.0 10^2
5.0 10^2
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
NV (lb/in)
MIN
MAX
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



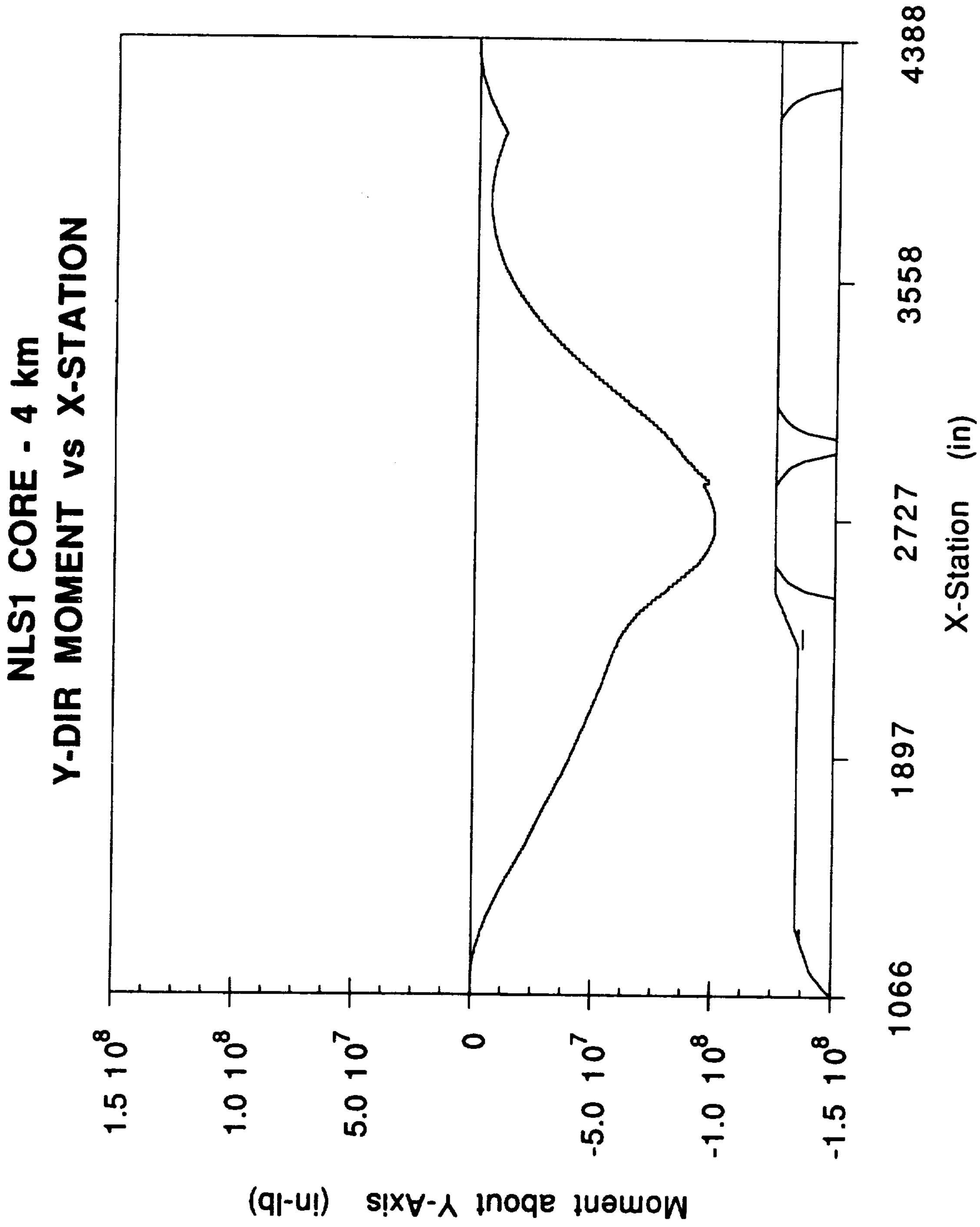
NLS1 CORE - 4 km
AXIAL SHEAR vs X-STATION
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
Axial Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)



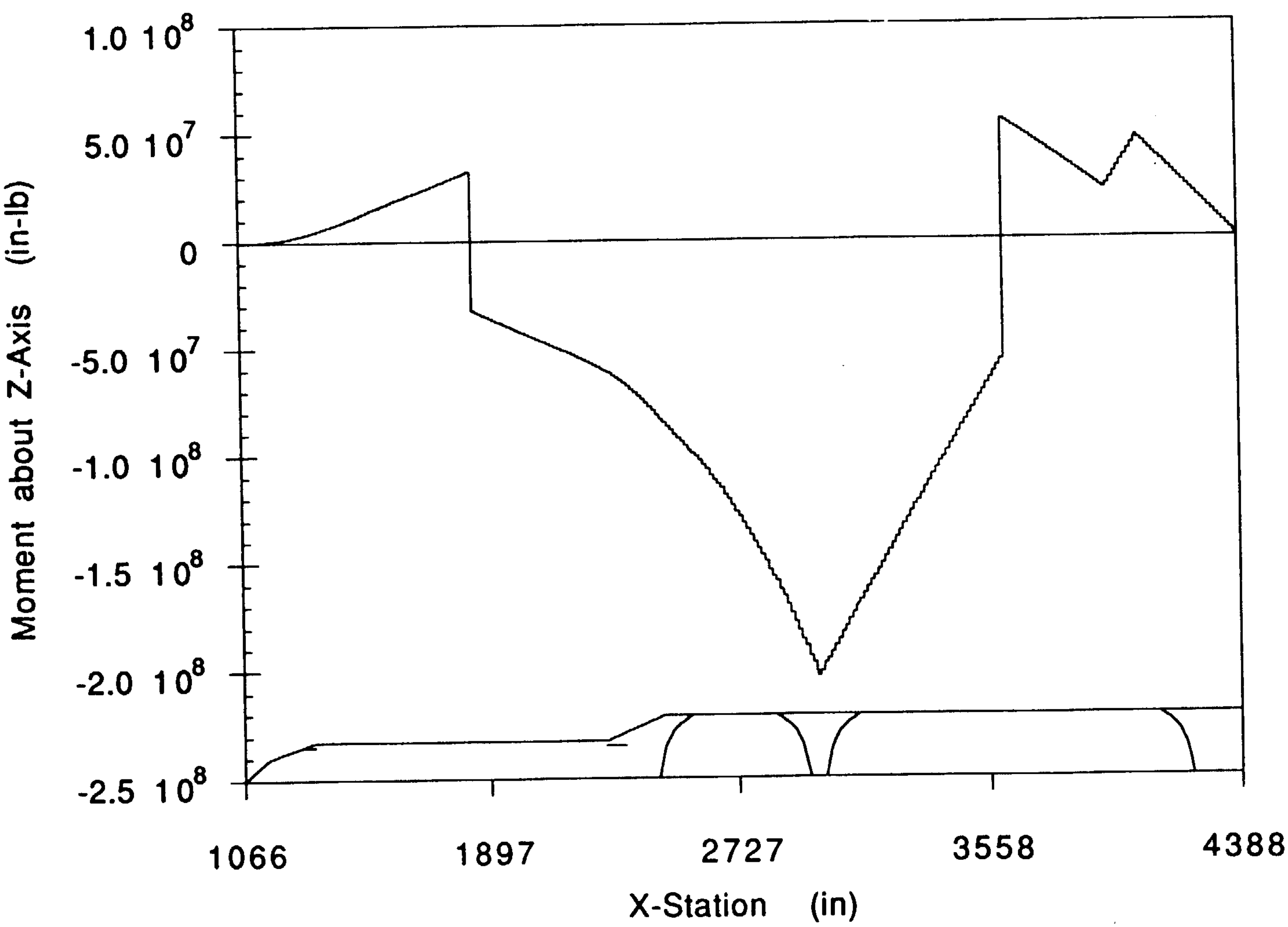
NLS1 CORE - 4 km
Y-DIR SHEAR vs X-STATION
4.0 10^5
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
-4.0 10^5
Y-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)

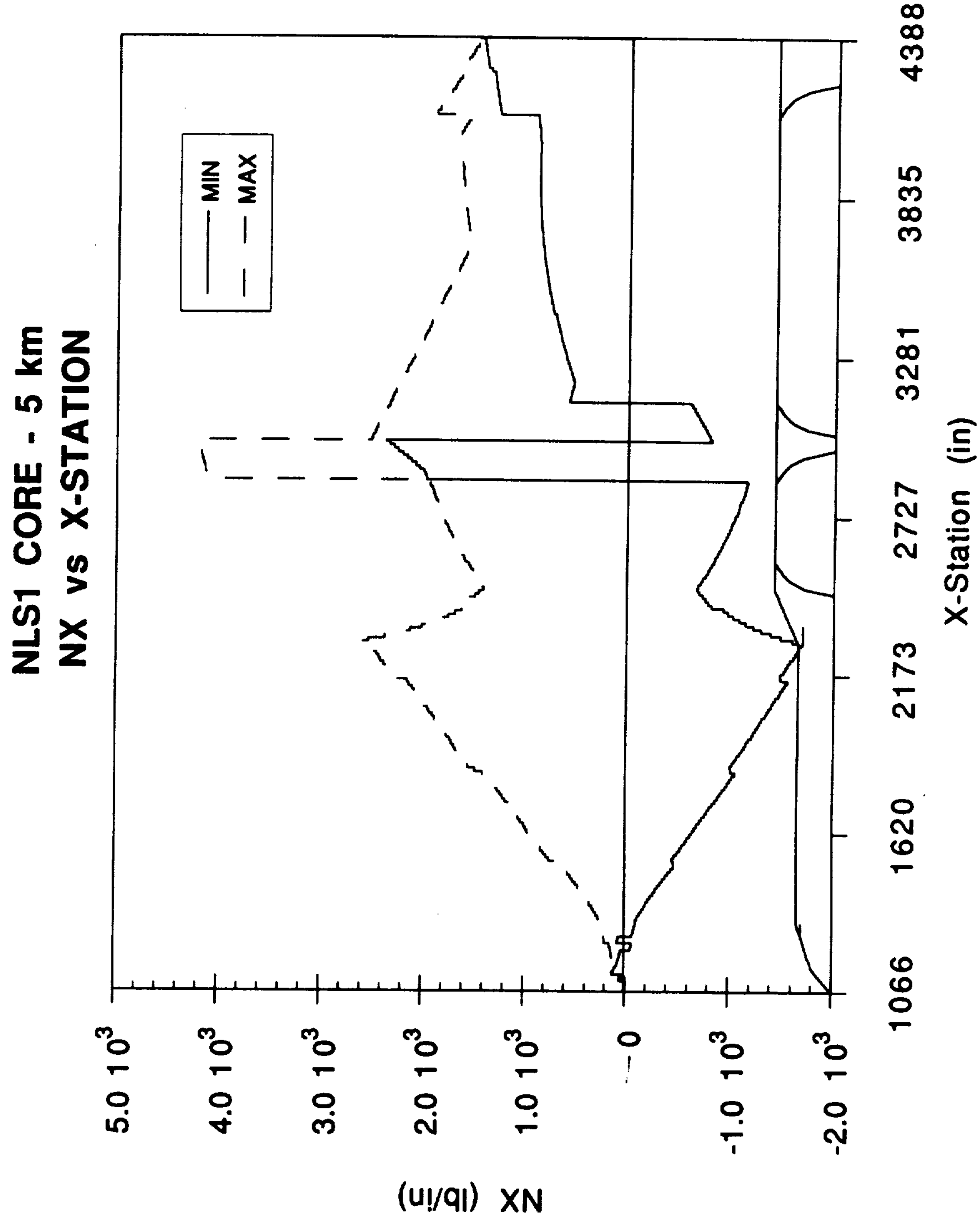


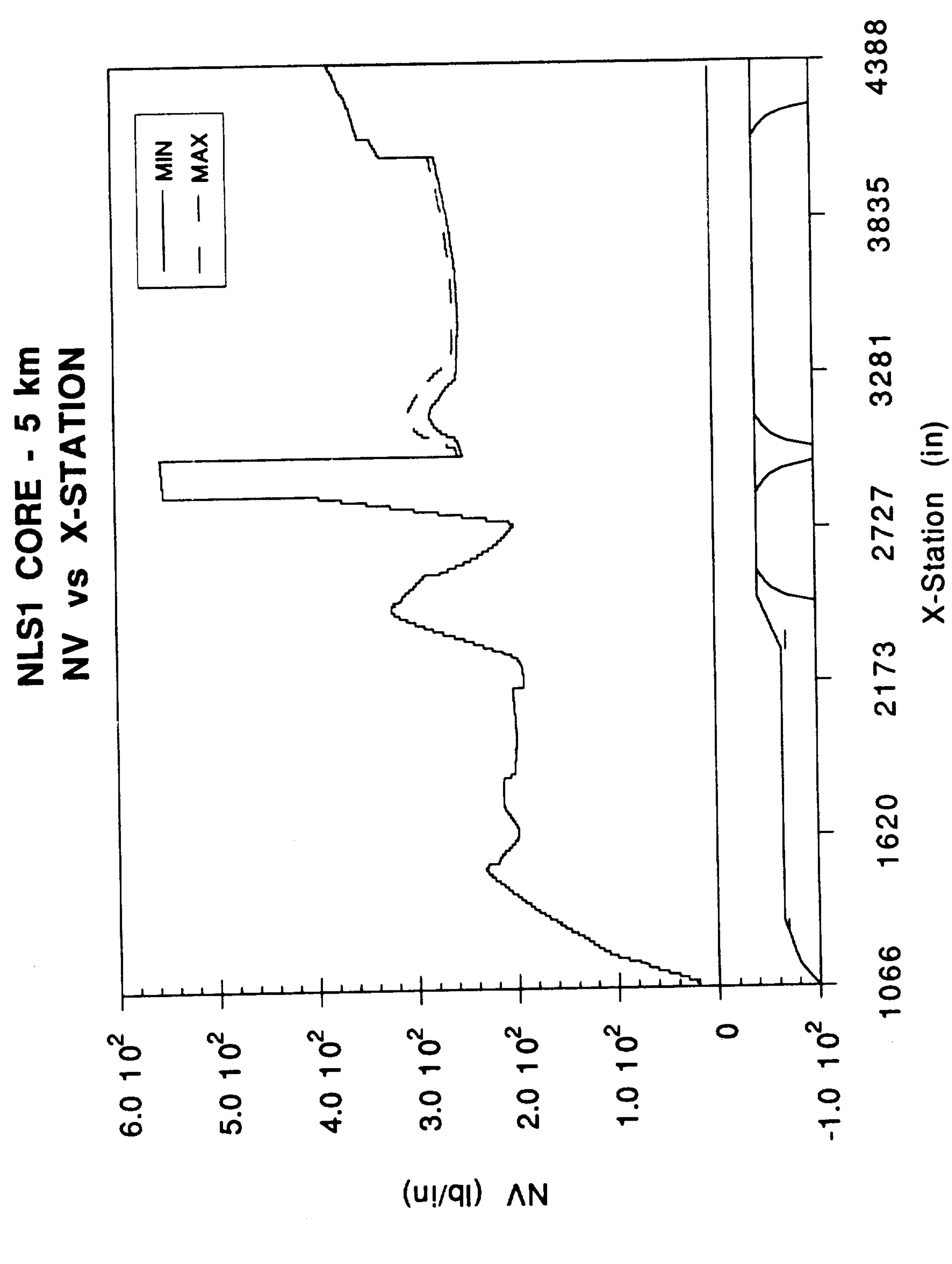
NLS1 CORE - 4 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

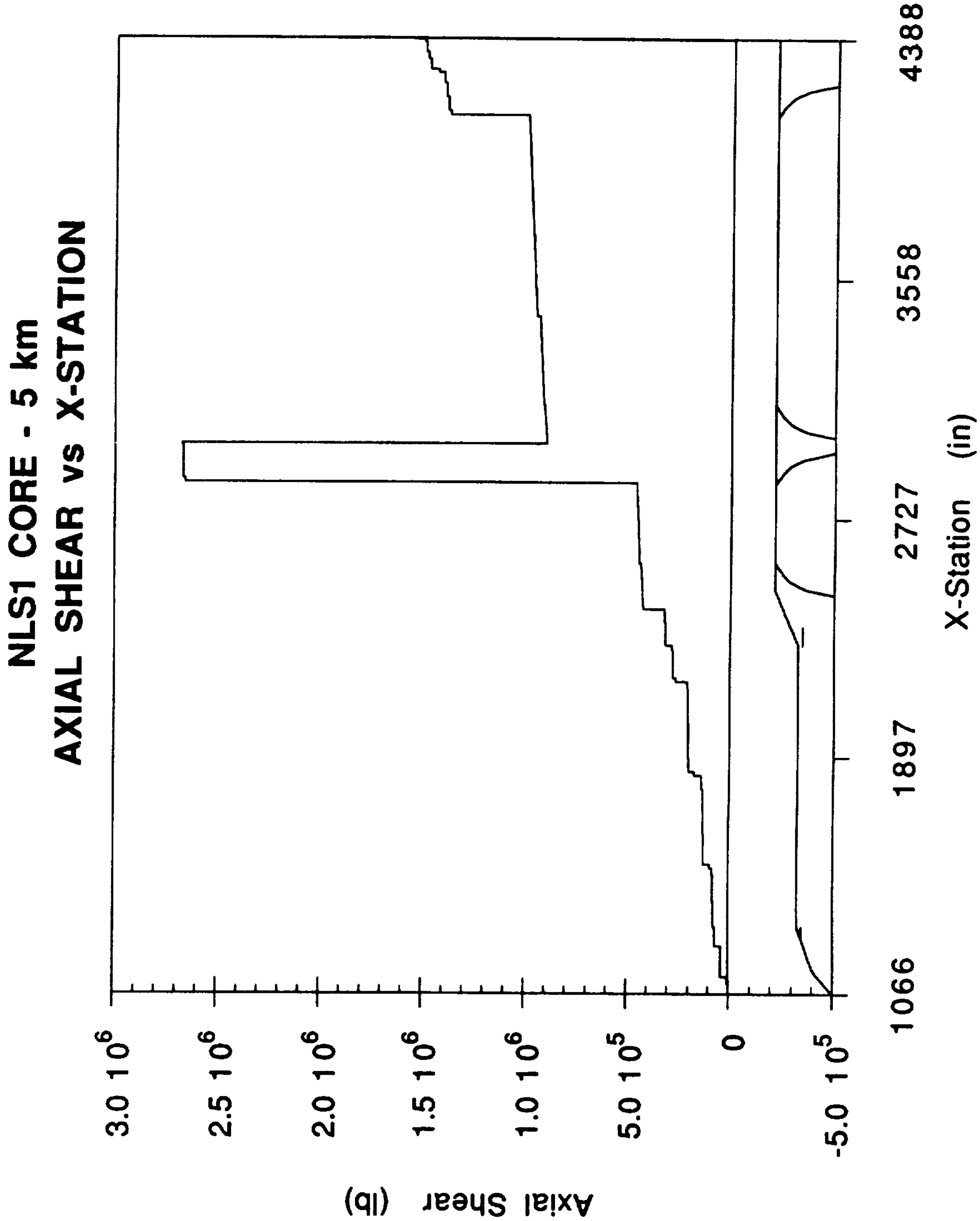

NLS1 CORE - 4 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lb)
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
1066
1897
2727
3558
4388
X-Station (in)

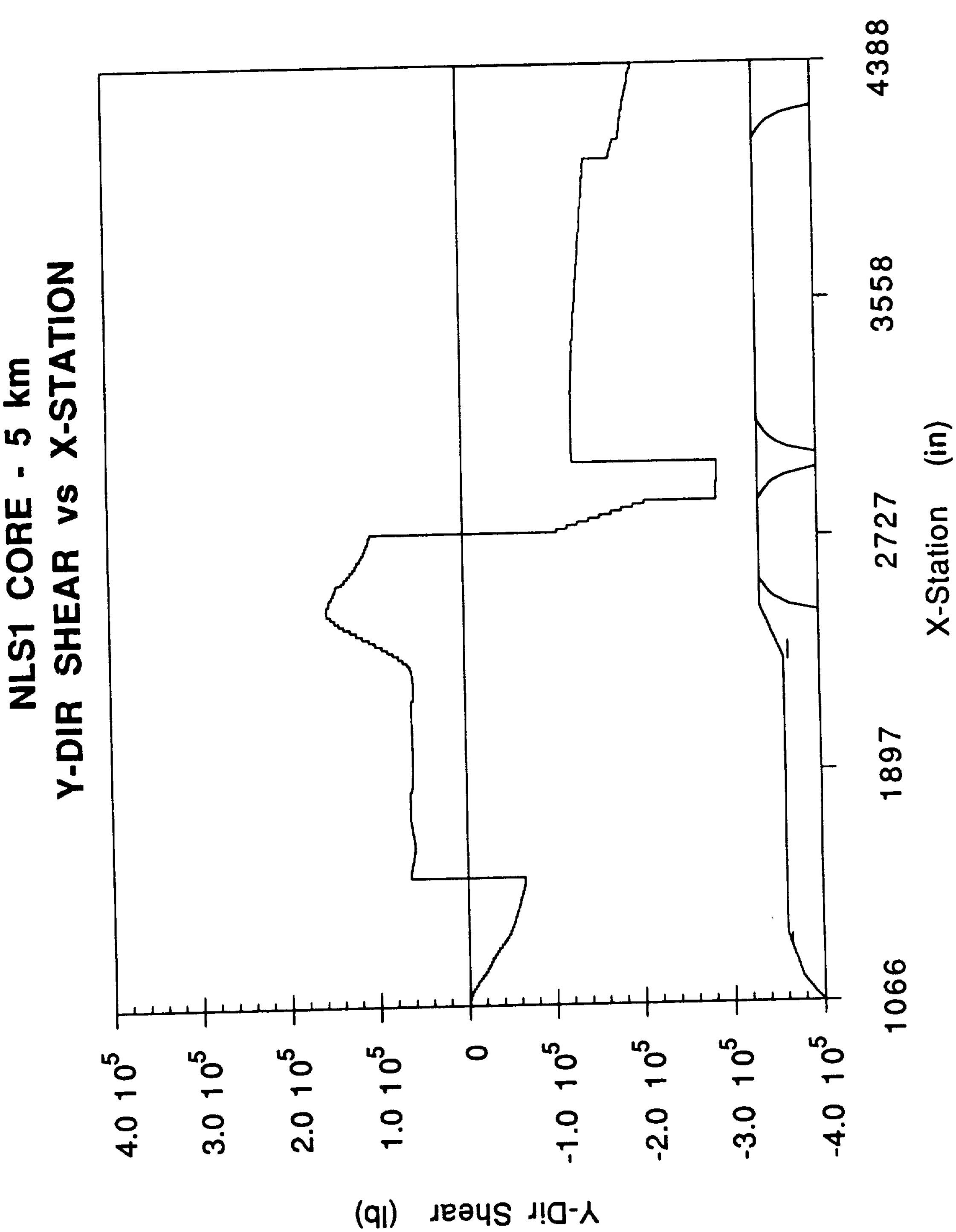
NLS1 CORE - 4 km
Z-DIR MOMENT vs X-STATION

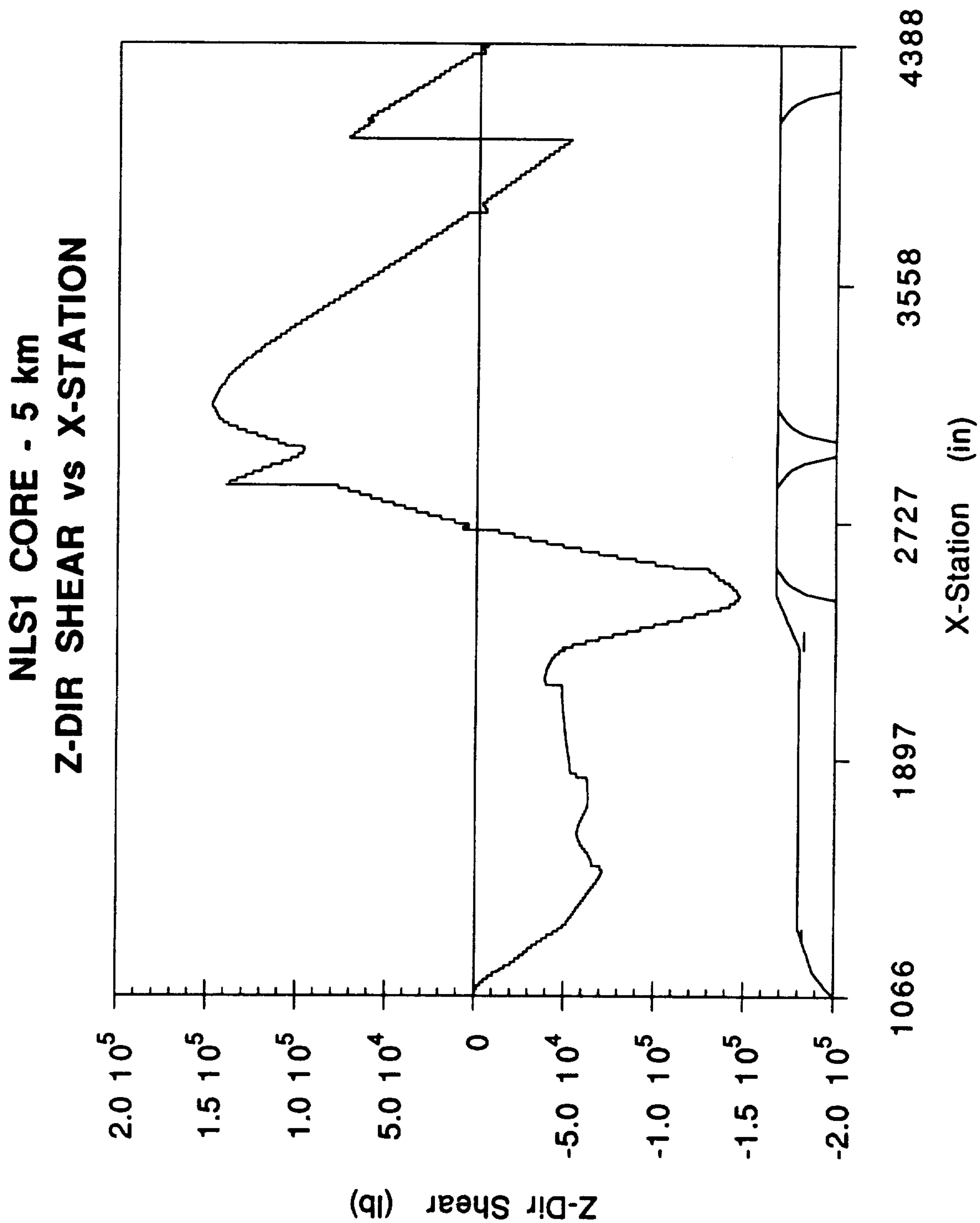


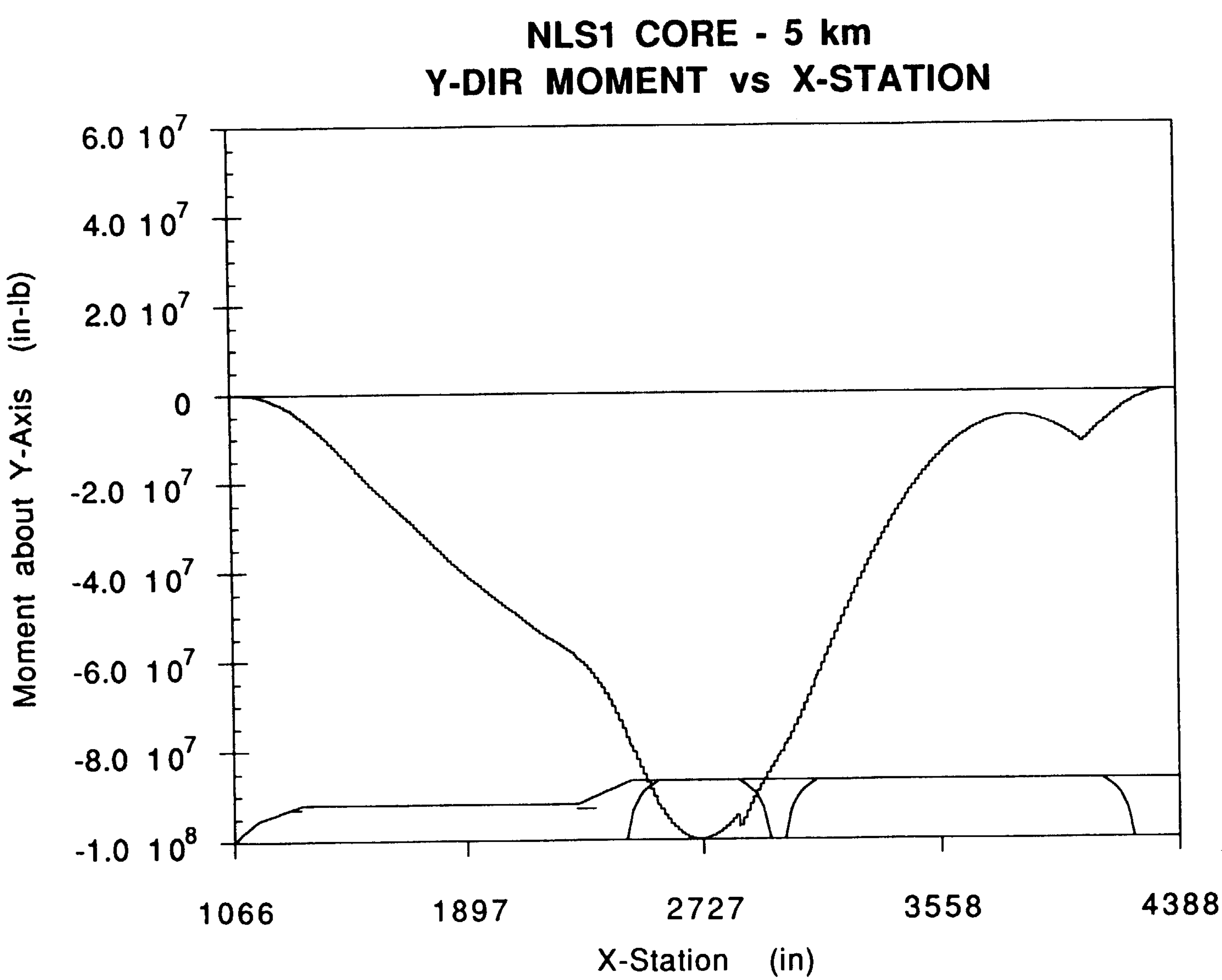

NLS1 CORE - 5 km
NX vs X-STATION
MIN
MAX
NX (lb/in)
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

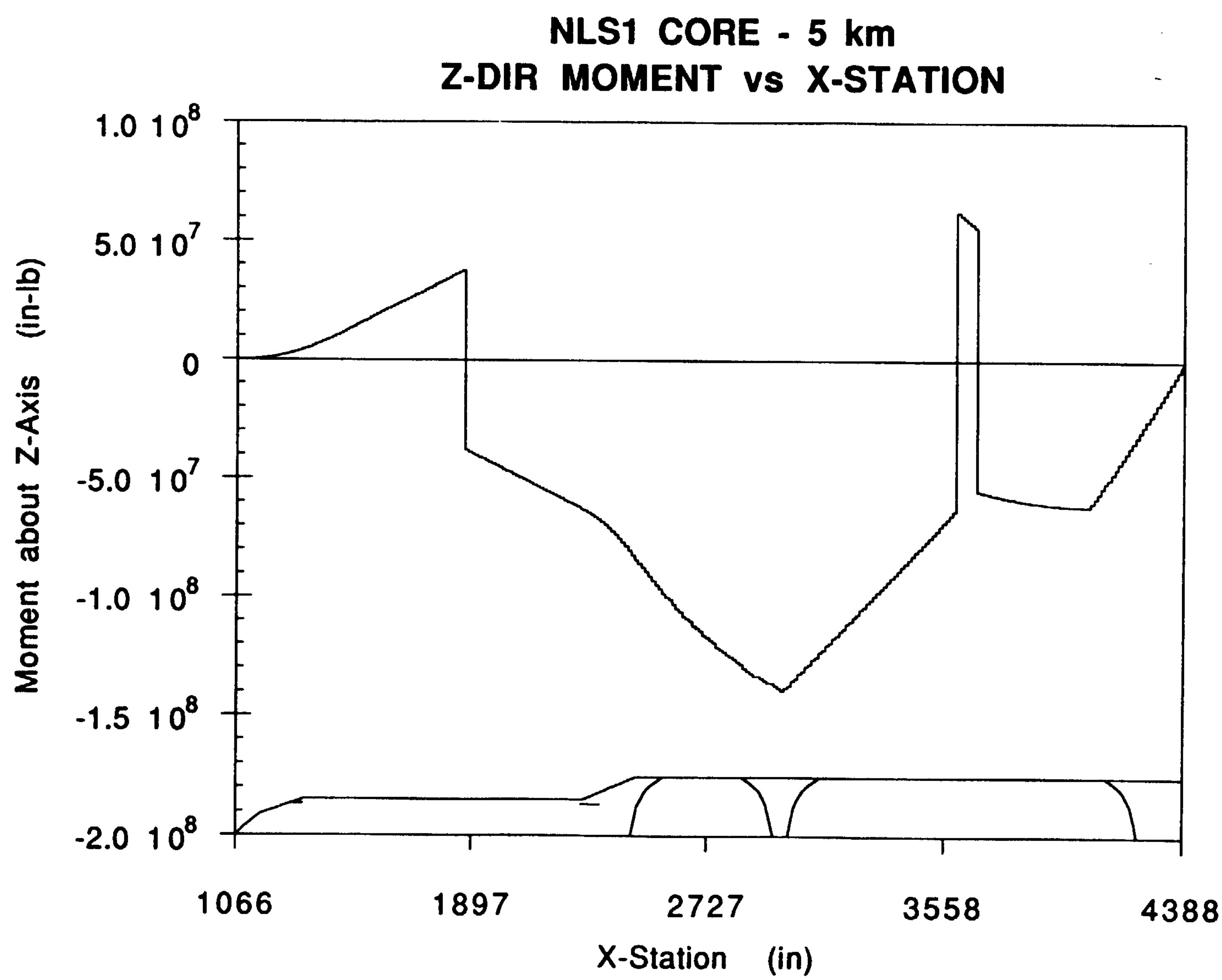

NLS1 CORE - 5 km
NV vs X-STATION
NV (lb/in)
6.0 10^2
5.0 10^2
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
1066
1620
2173
2727
3281
3835
4388
X-Station (in)
MIN
MAX


NLS1 CORE - 5 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - 5 km
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lb)
4.0 10^5
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
-4.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

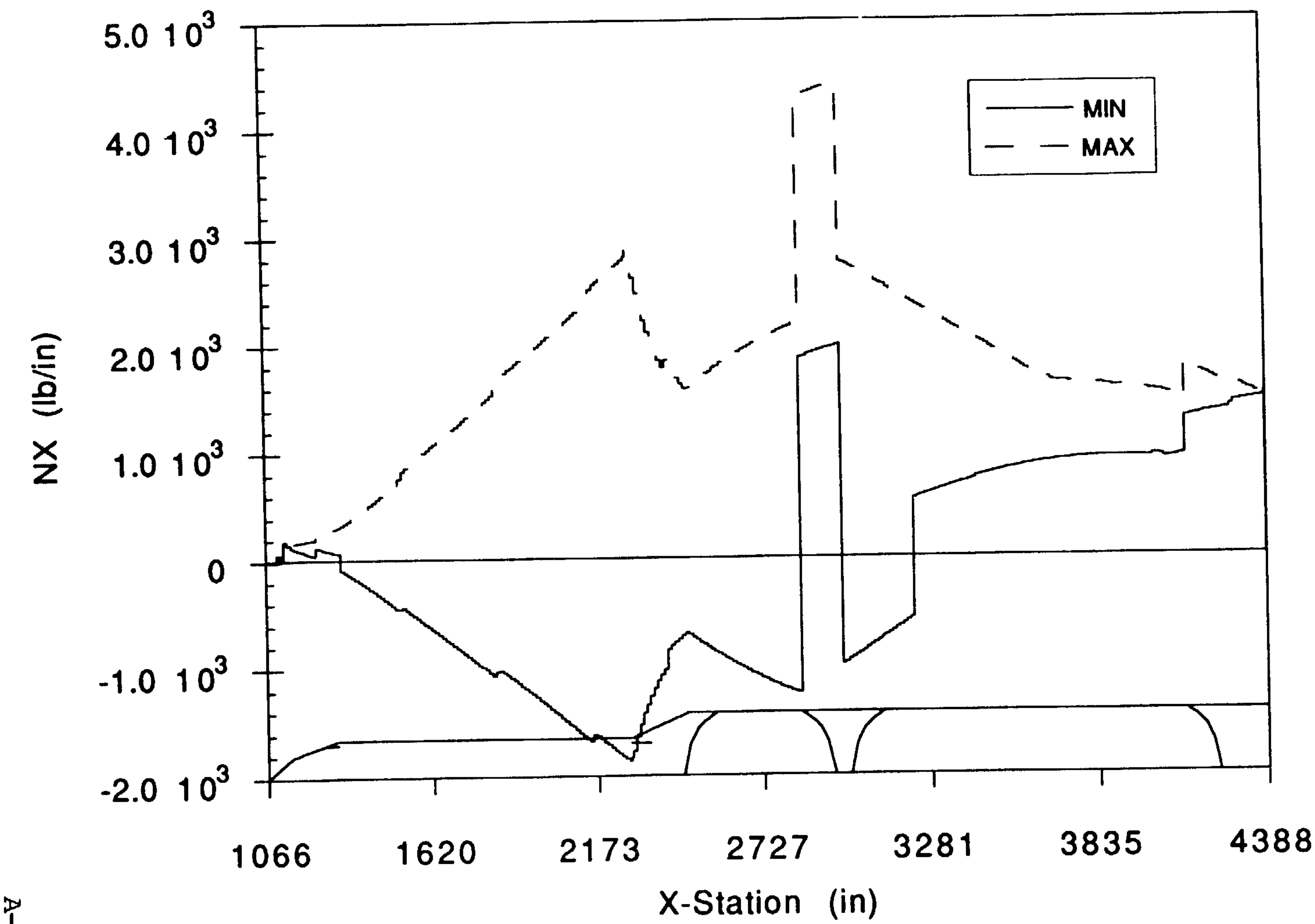

NLS1 CORE - 5 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

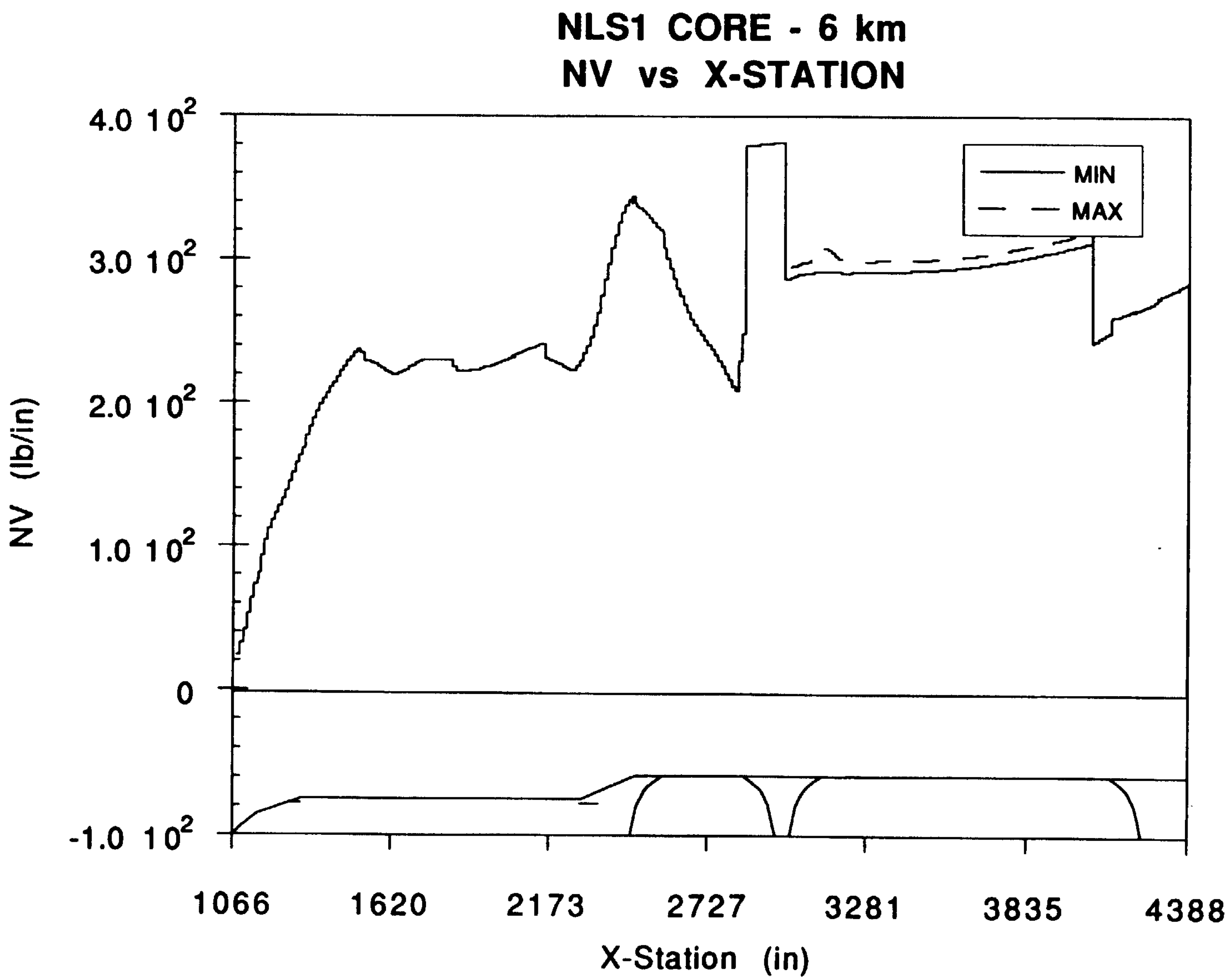

NLS1 CORE - 5 km
Y-DIR MOMENT vs X-STATION
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
-8.0 10^7
-1.0 10^8
Moment about Y-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)



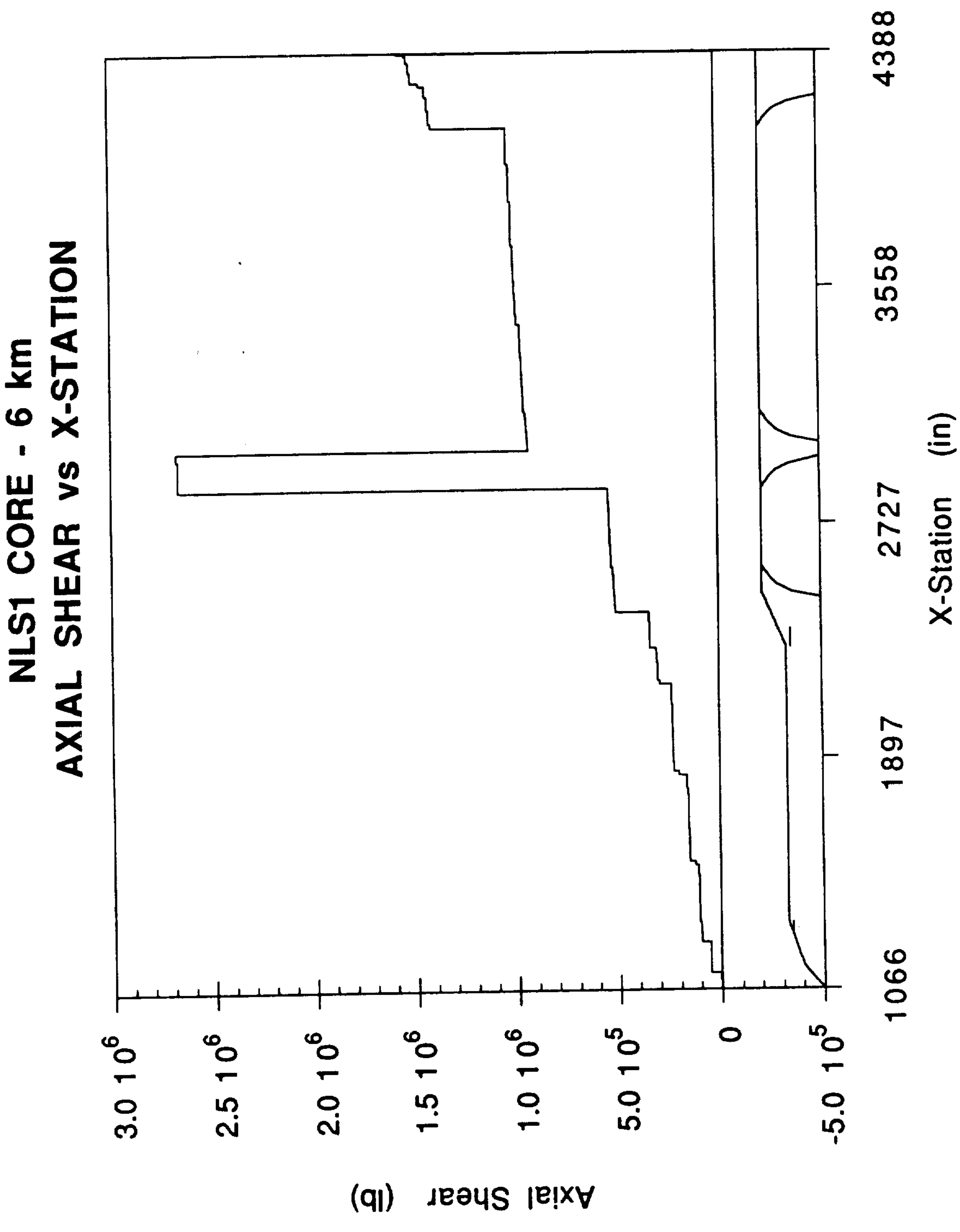
NLS1 CORE - 5 km
Z-DIR MOMENT vs X-STATION
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
Moment about Z-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)

NLS1 CORE - 6 km
NX vs X-STATION

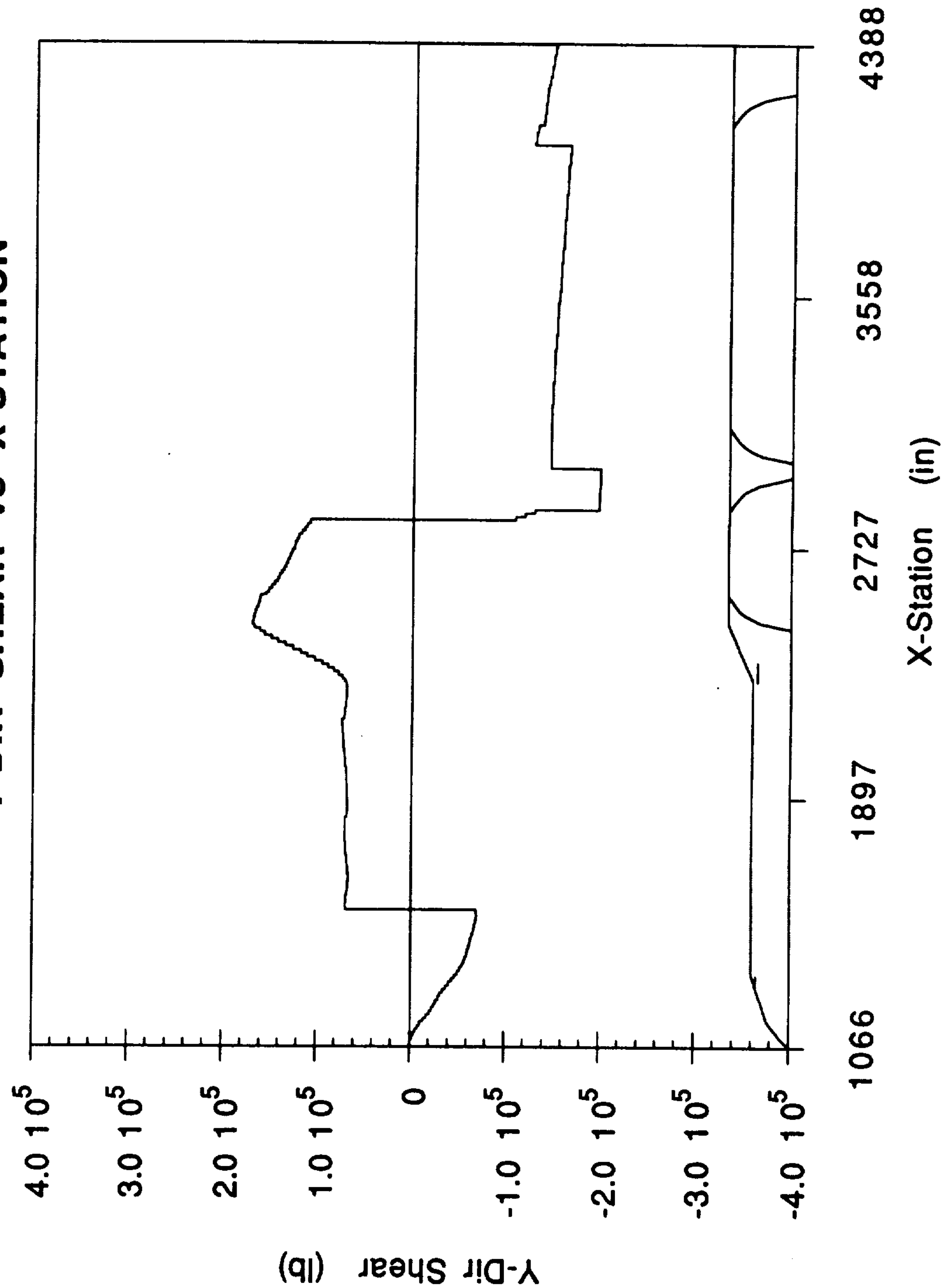




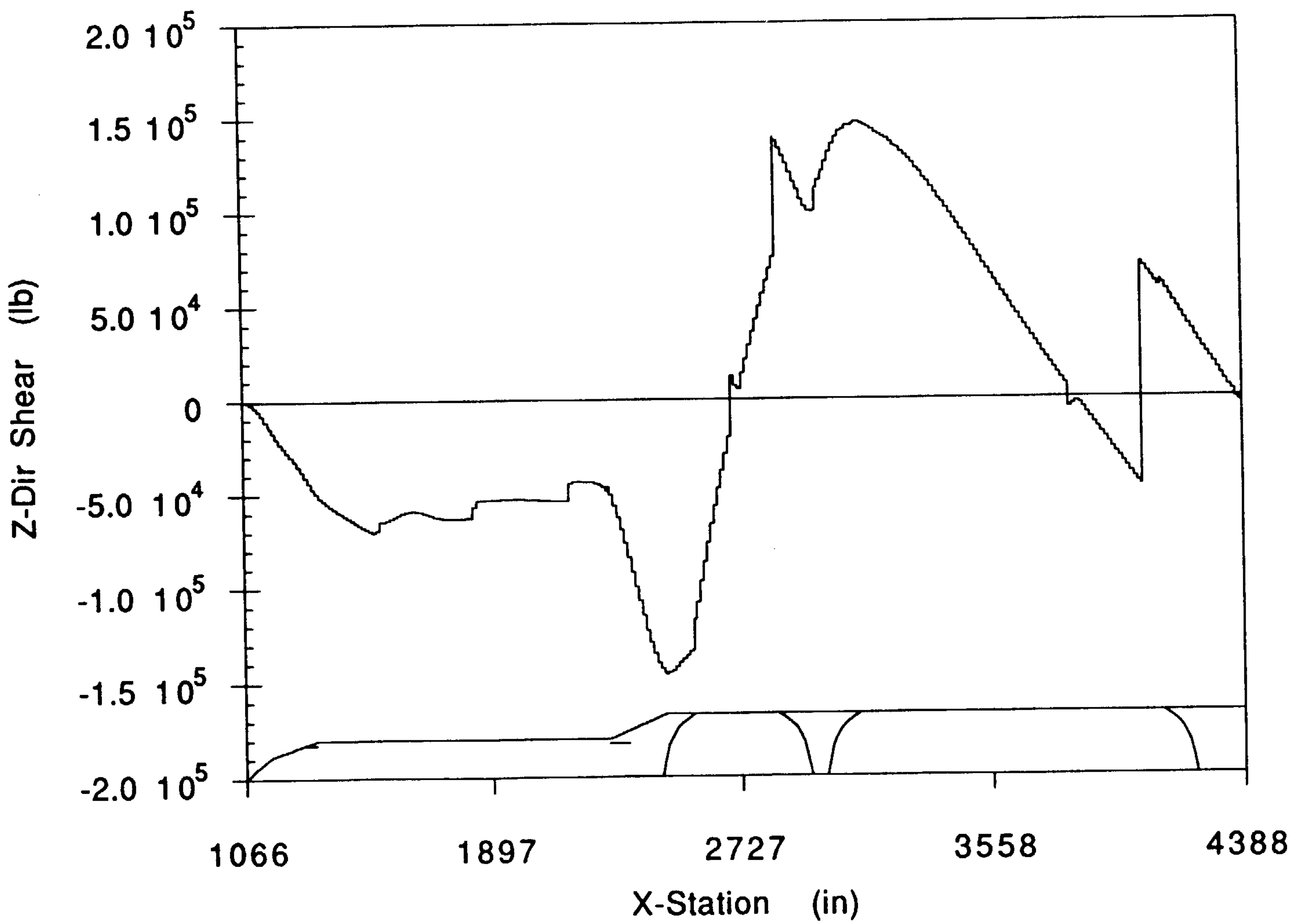
NLS1 CORE - 6 km
NV vs X-STATION
MIN
MAX
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
NV (lb/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)


NLS1 CORE - 6 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

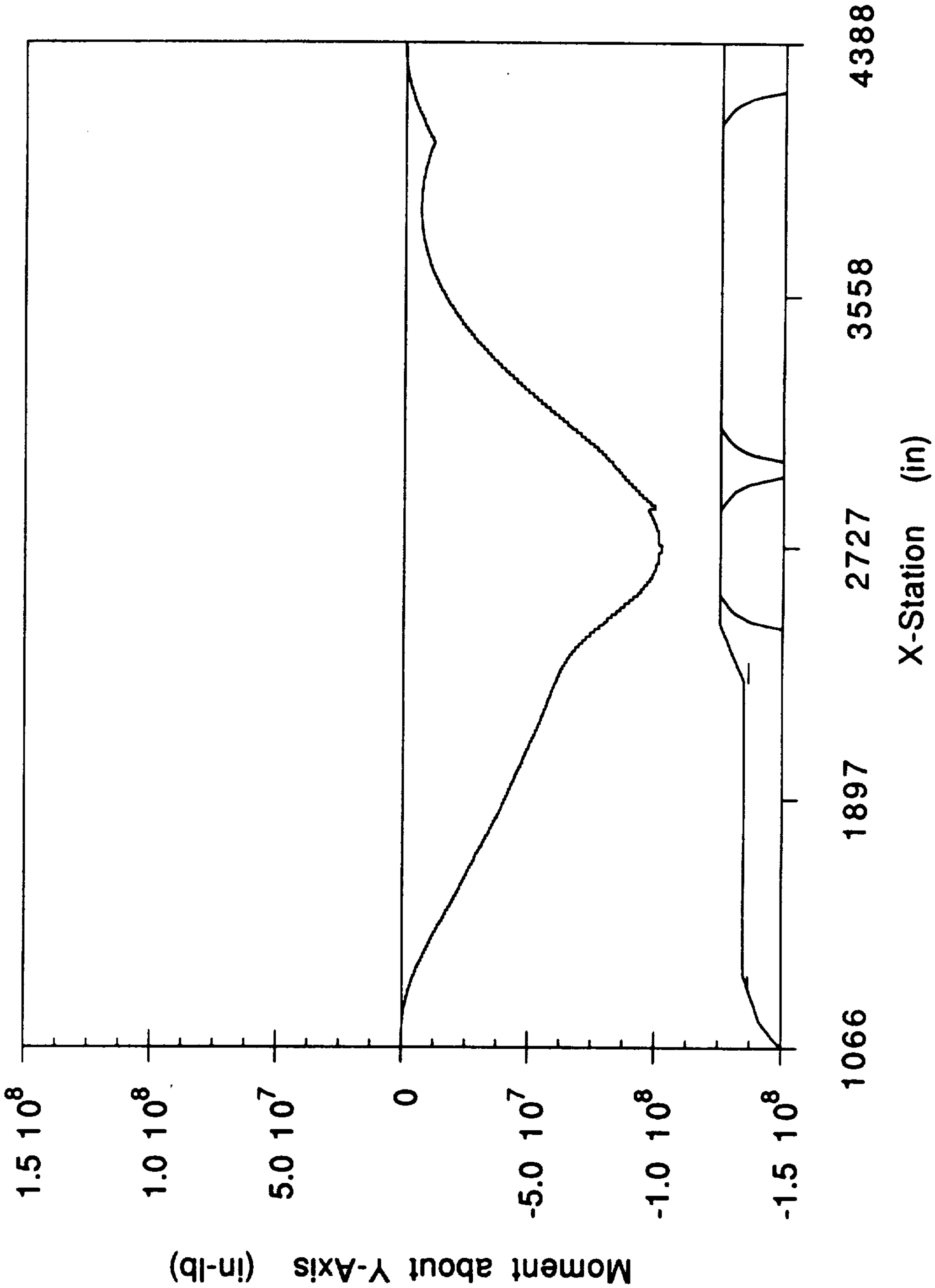
NLS1 CORE - 6 km
Y-DIR SHEAR vs X-STATION



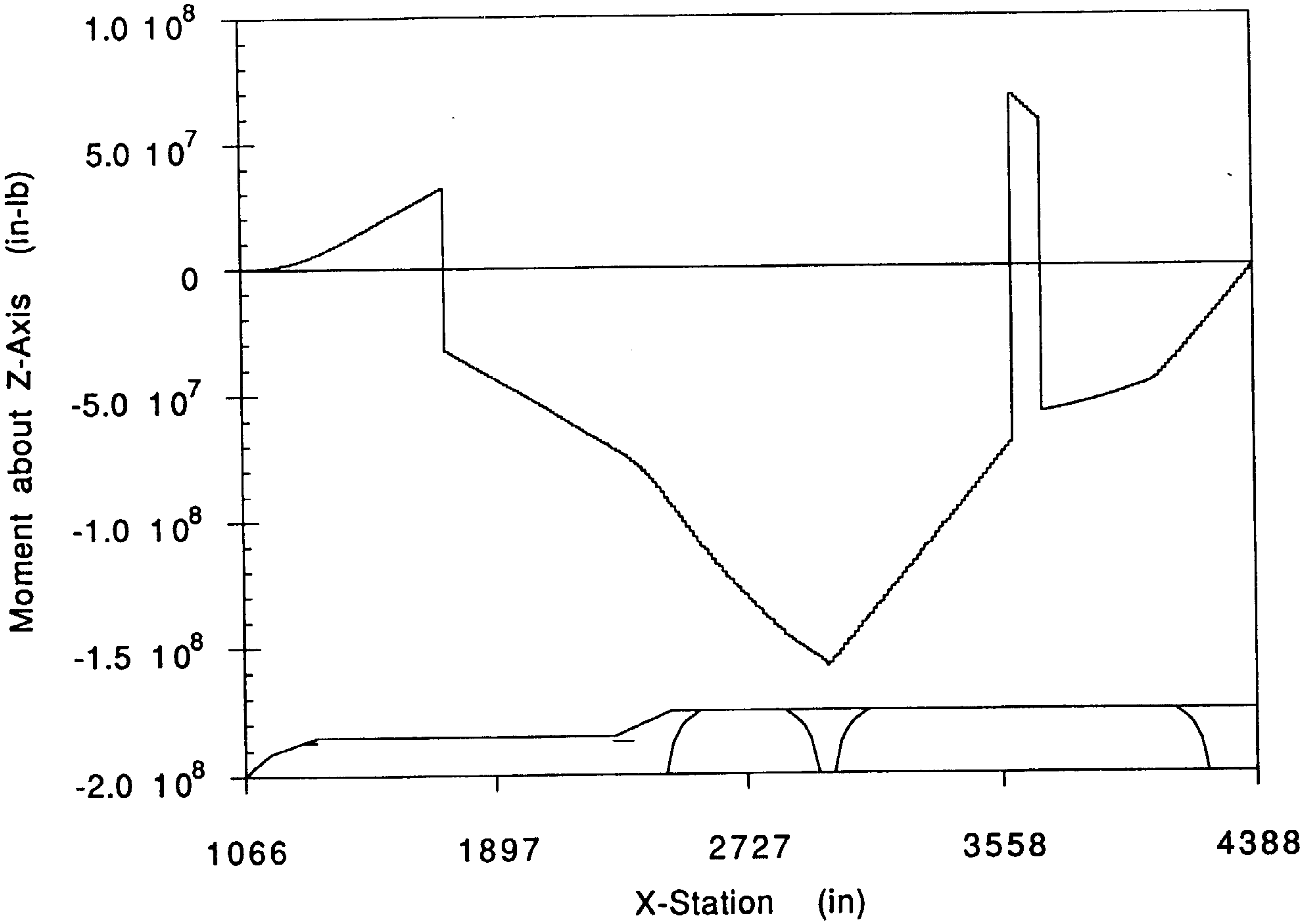
NLS1 CORE - 6 km
Z-DIR SHEAR vs X-STATION

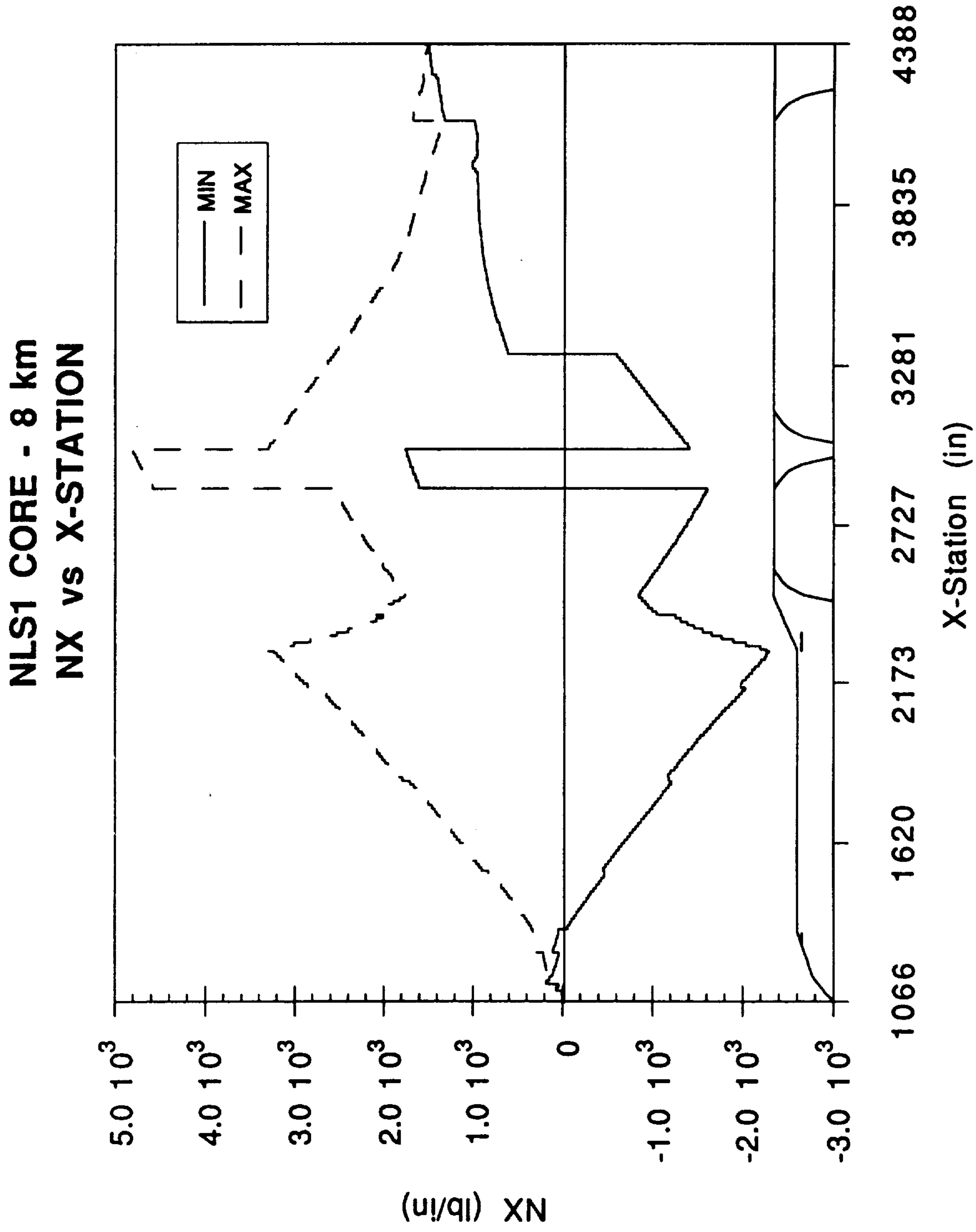


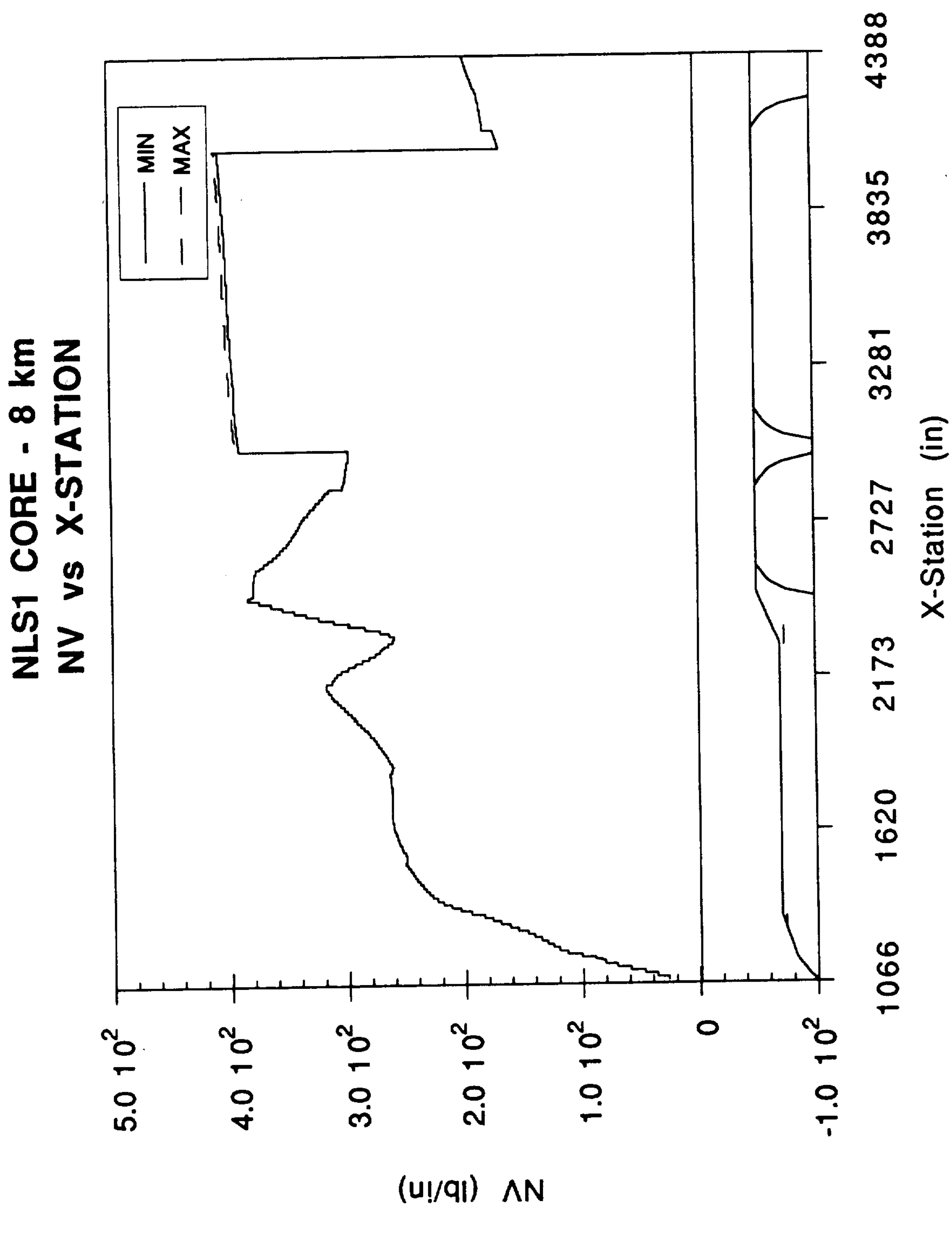
NLS1 CORE - 6 km
Y-DIR MOMENT vs X-STATION



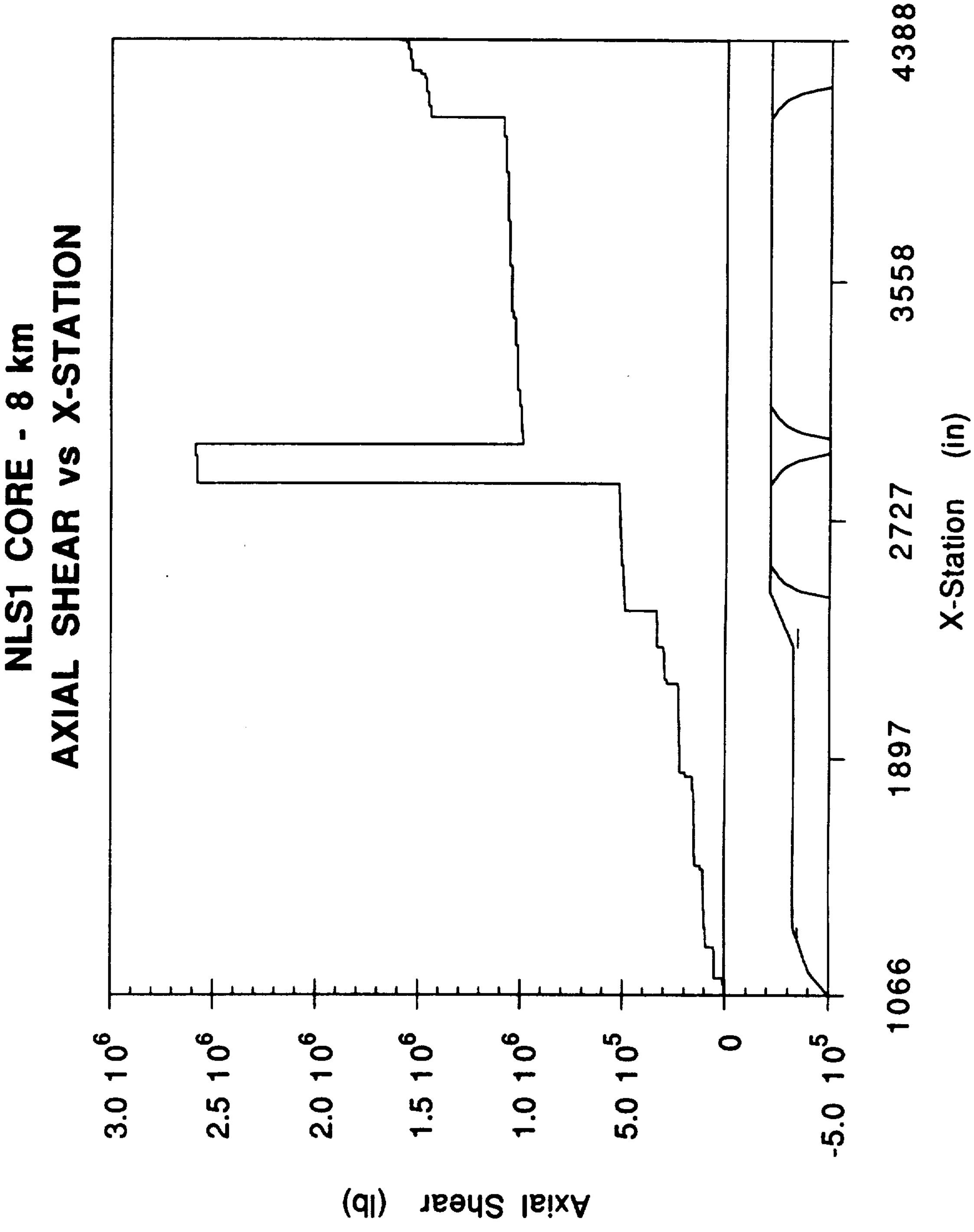
NLS1 CORE - 6 km
Z-DIR MOMENT vs X-STATION




NLS1 CORE - 8 km
NX vs X-STATION
MIN
MAX
NX (lb/in)
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

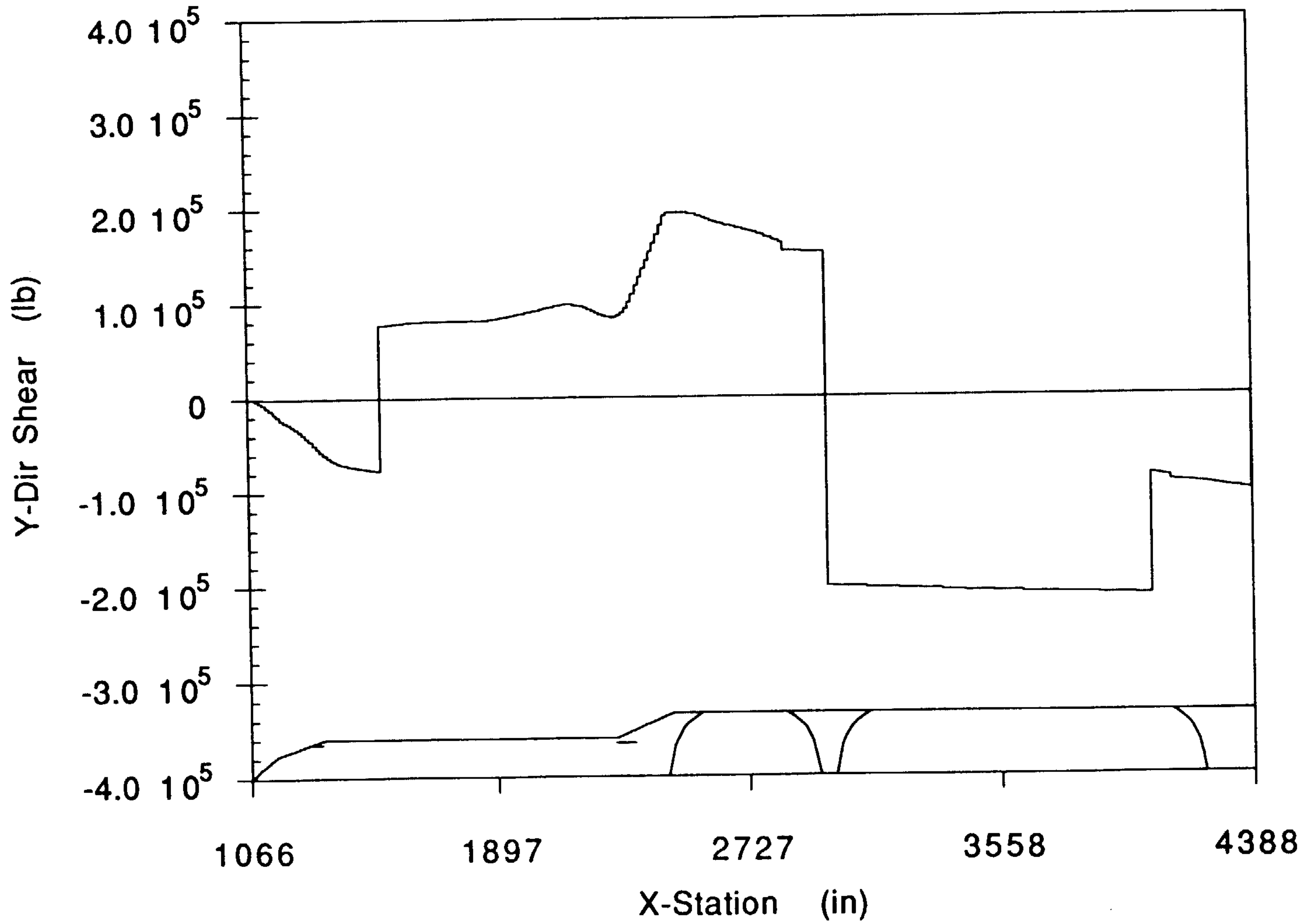


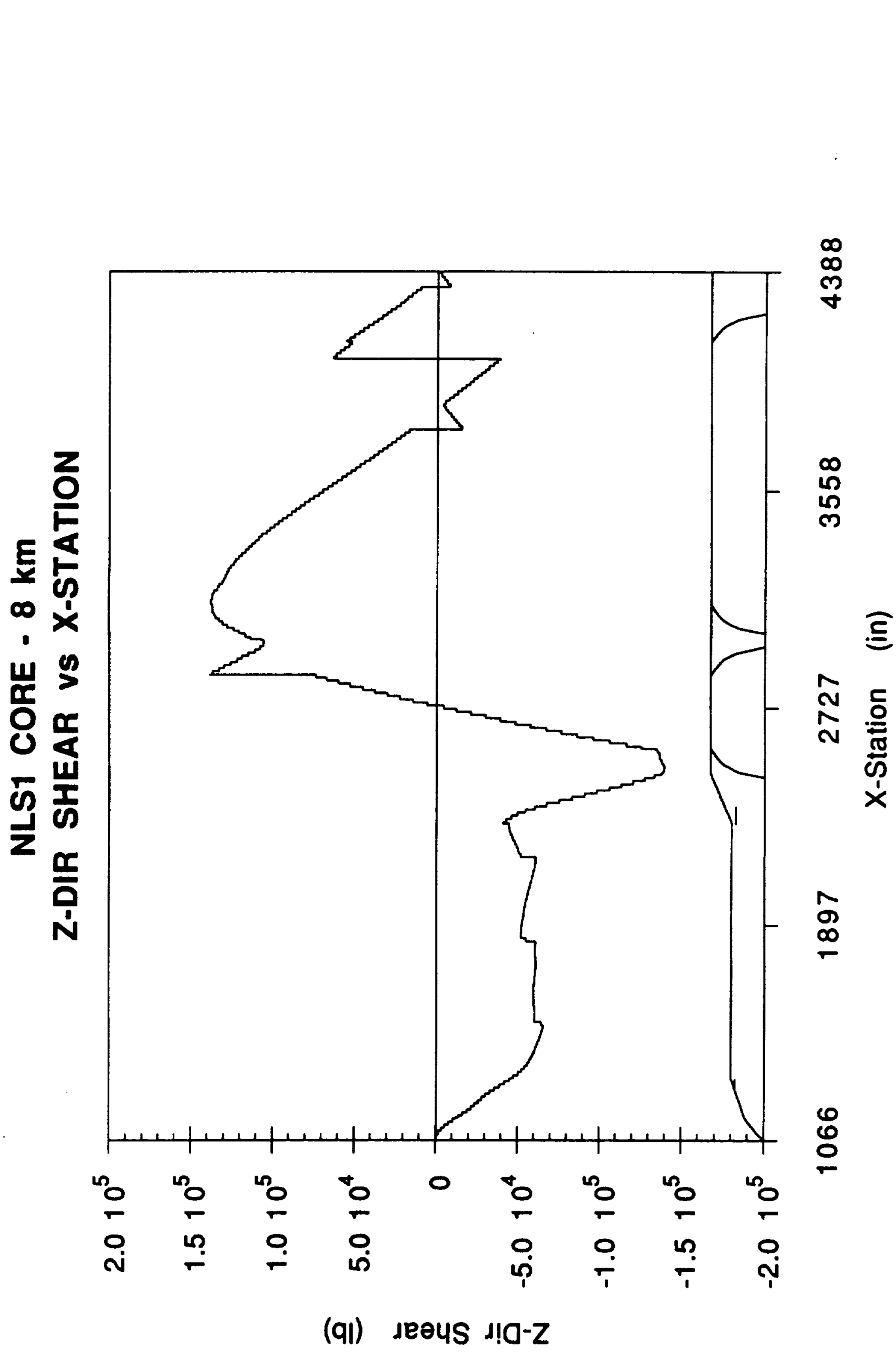
NLS1 CORE - 8 km
NV vs X-STATION
MIN
MAX
NV (lb/in)
5.0 10^2
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
X-Station (in)
1066
1620
2173
2727
3281
3835
4388



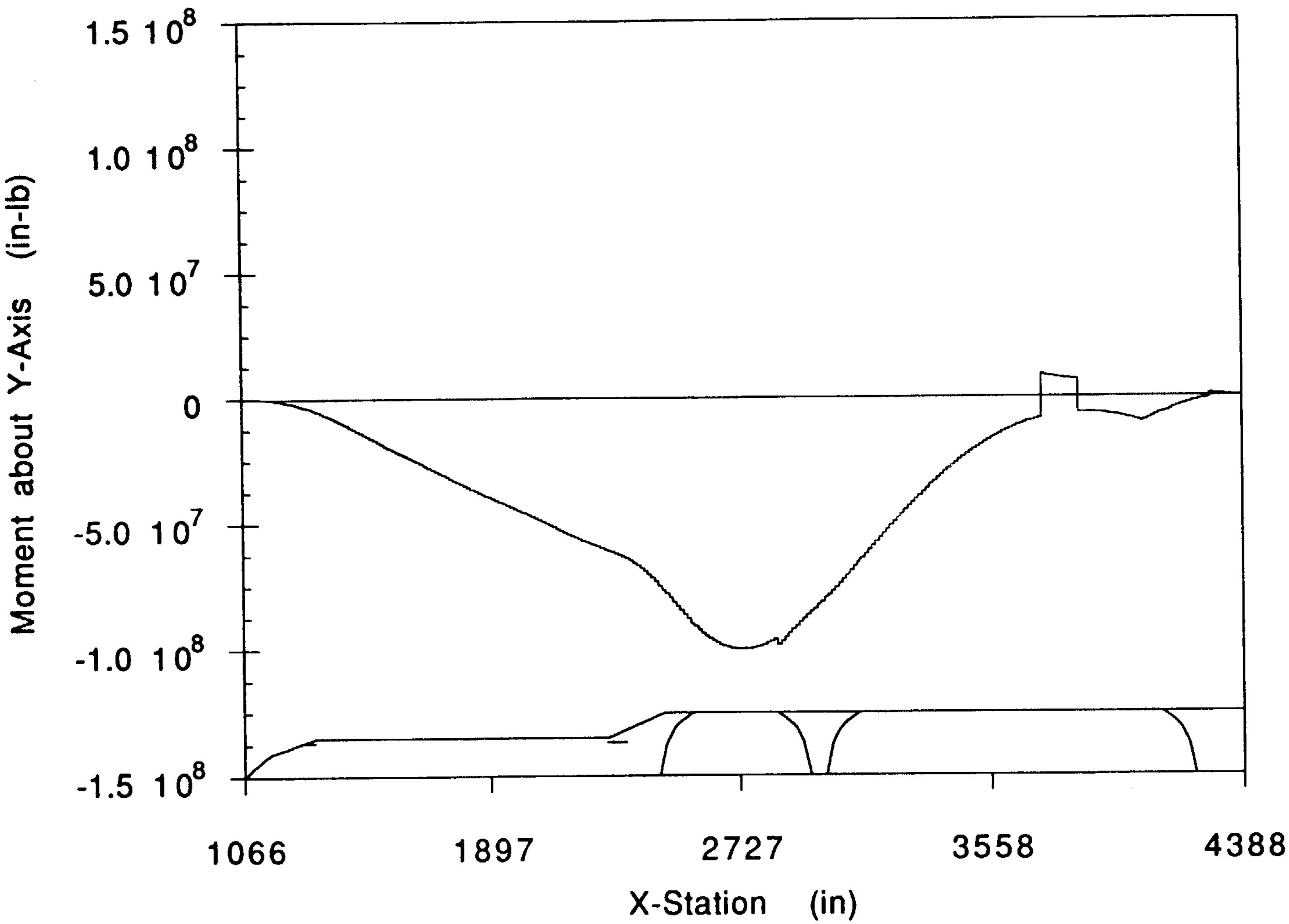
NLS1 CORE - 8 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

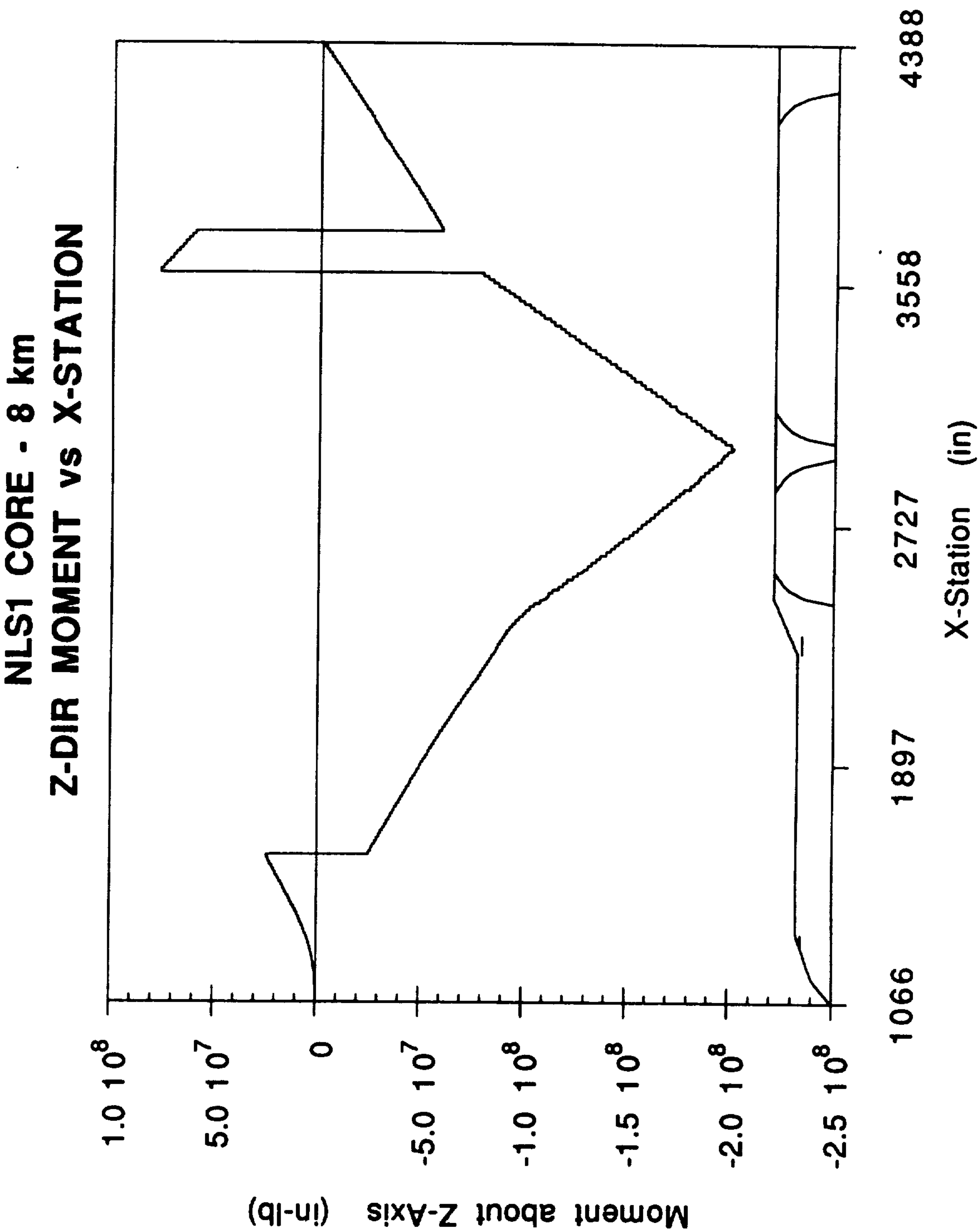
NLS1 CORE - 8 km
Y-DIR SHEAR vs X-STATION



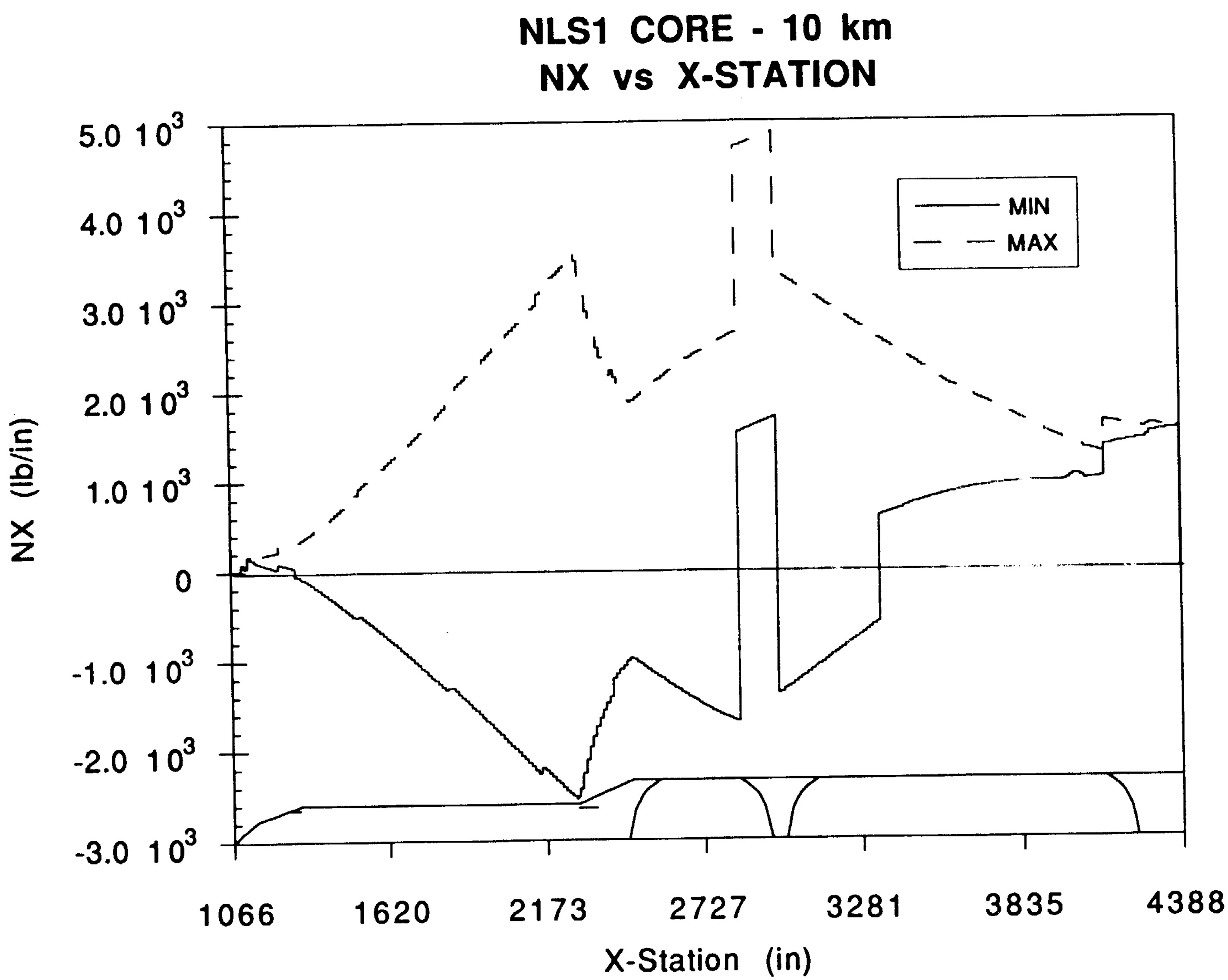

NLS1 CORE - 8 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

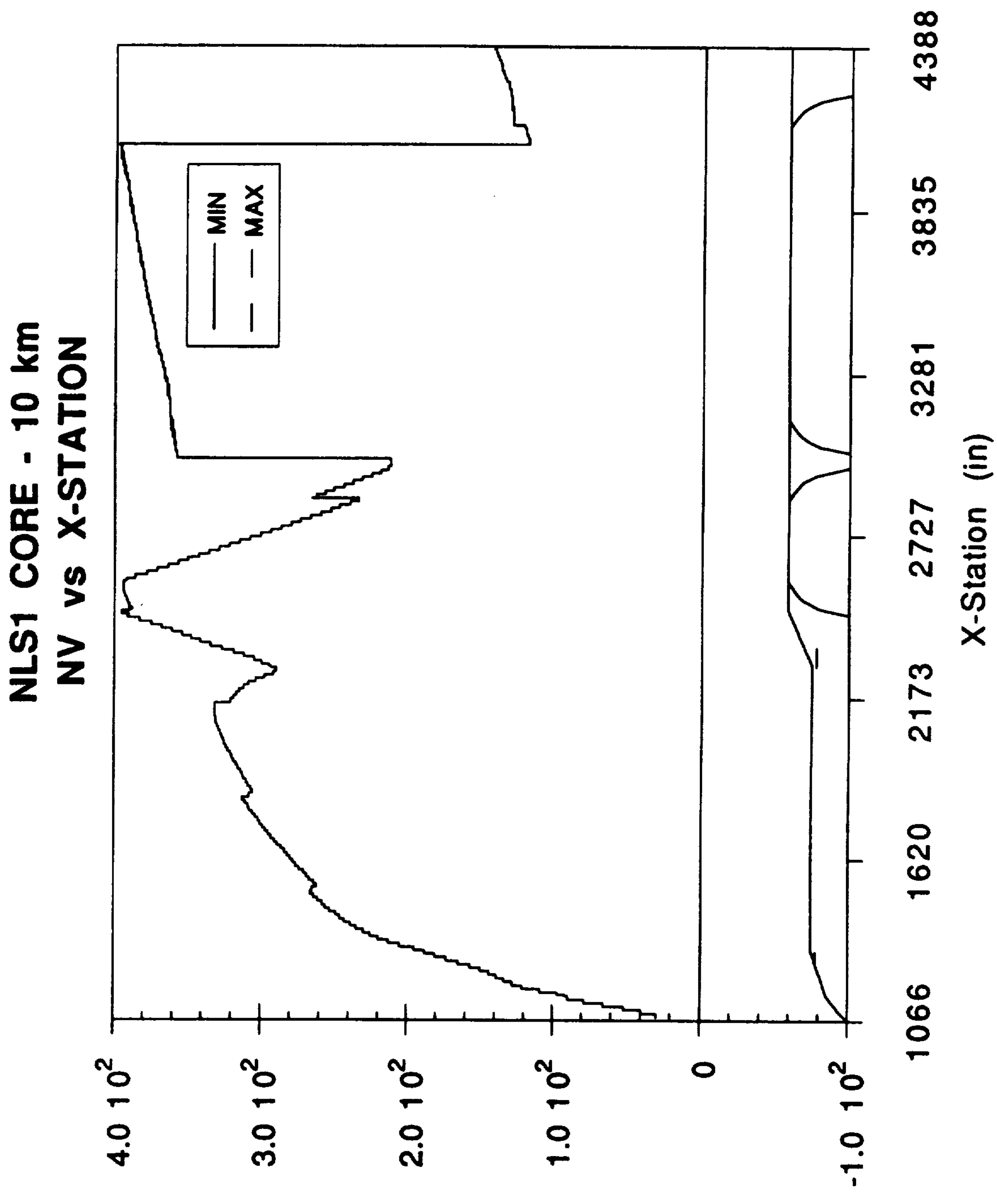
NLS1 CORE - 8 km
Y-DIR MOMENT vs X-STATION



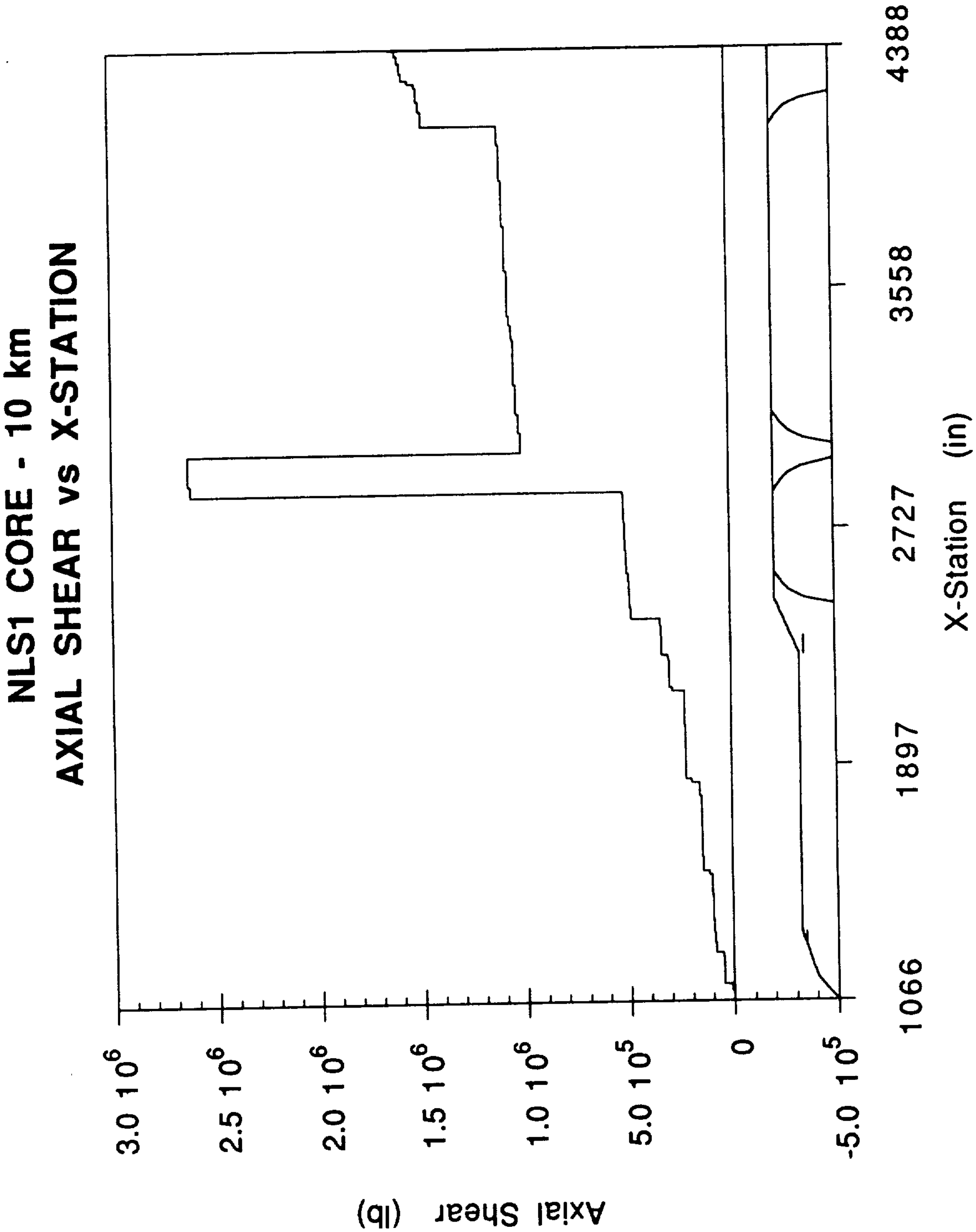


NLS1 CORE - 8 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lb)
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
-2.5 10^8
1066
1897
2727
3558
4388
X-Station (in)

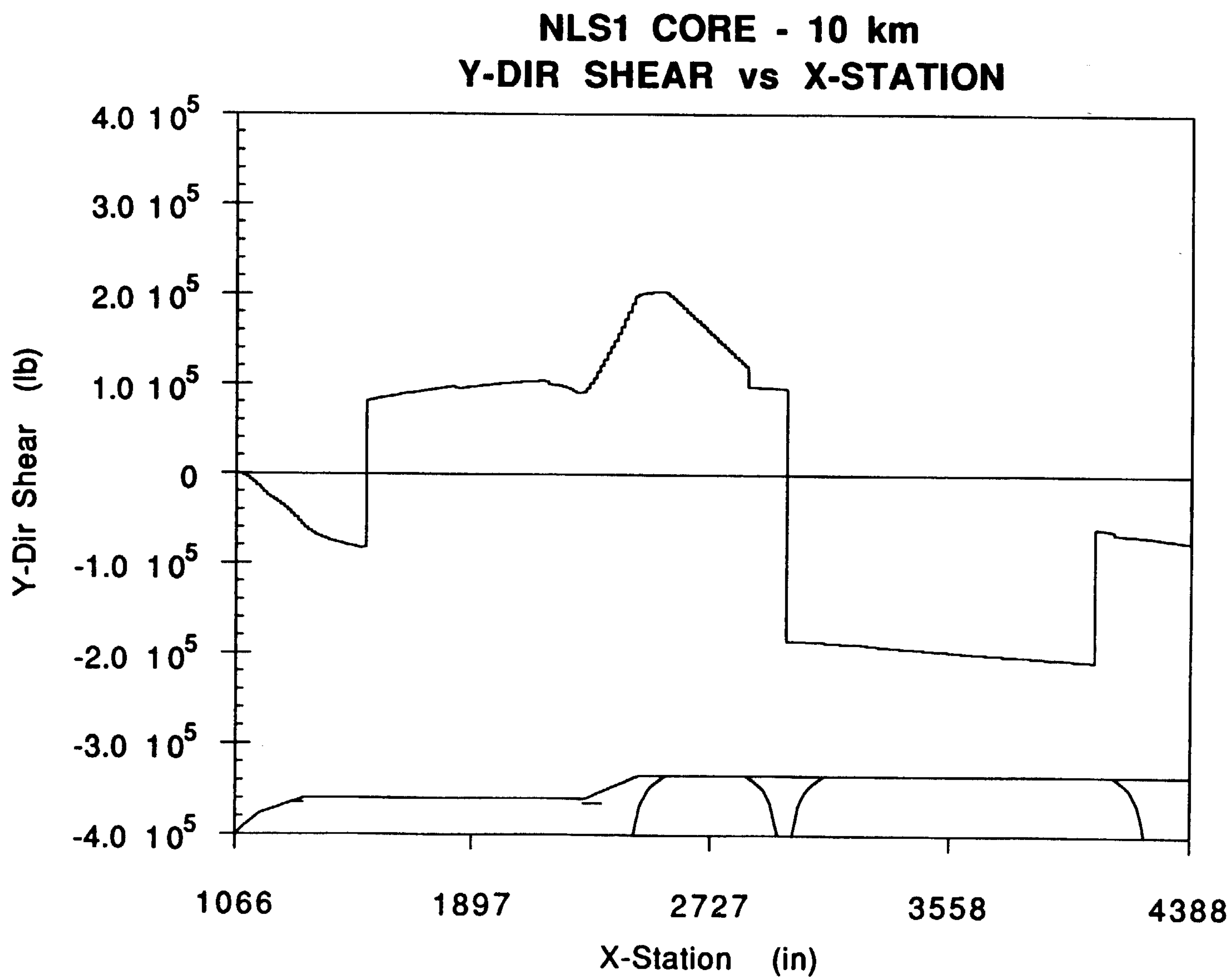

NLS1 CORE - 10 km
NX vs X-STATION
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
NX (lb/in)
MIN
MAX
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



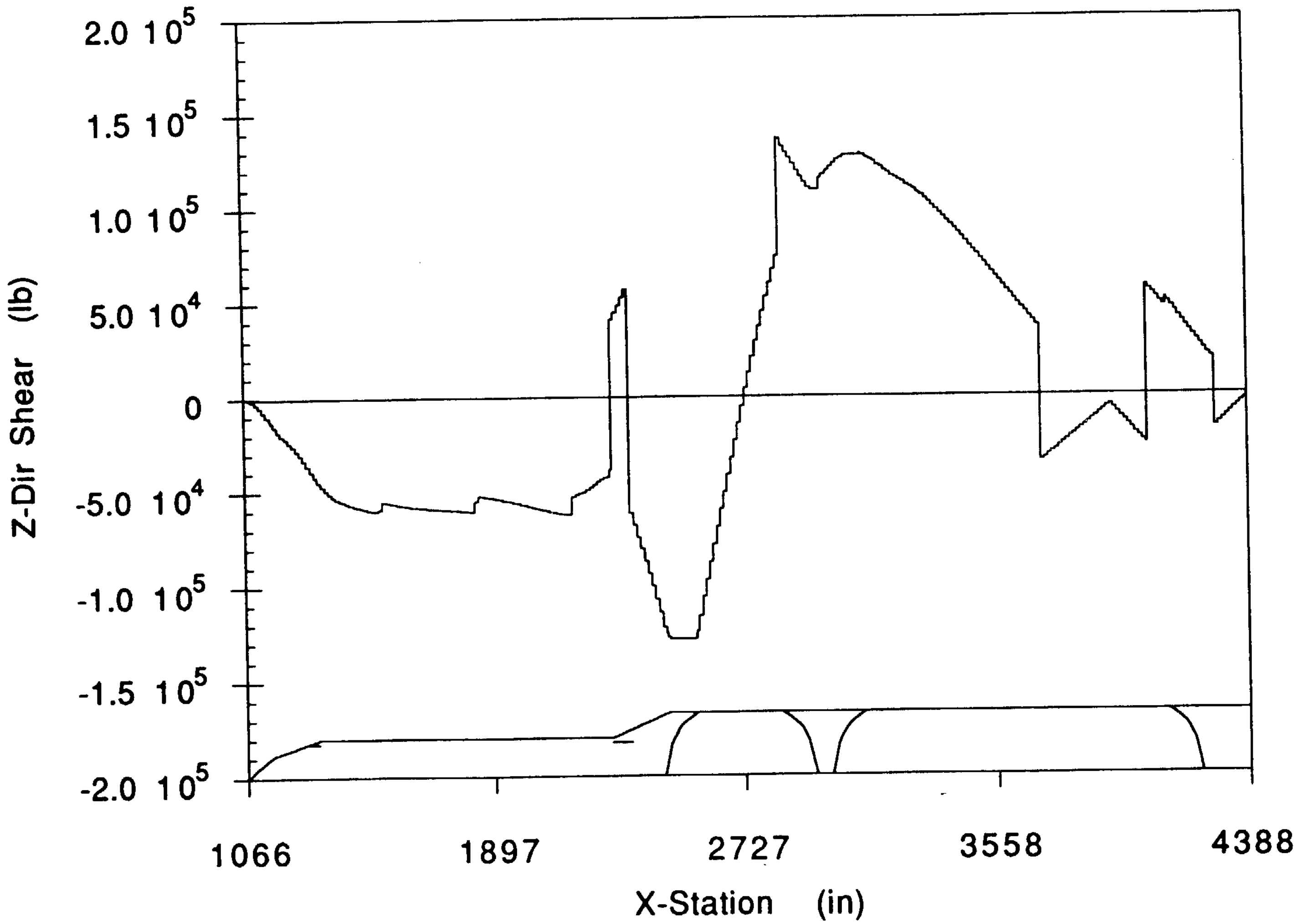
NLS1 CORE - 10 km
NV vs X-STATION
NV (lb/in)
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
1066
1620
2173
2727
3281
3835
4388
X-Station (in)
MIN
MAX

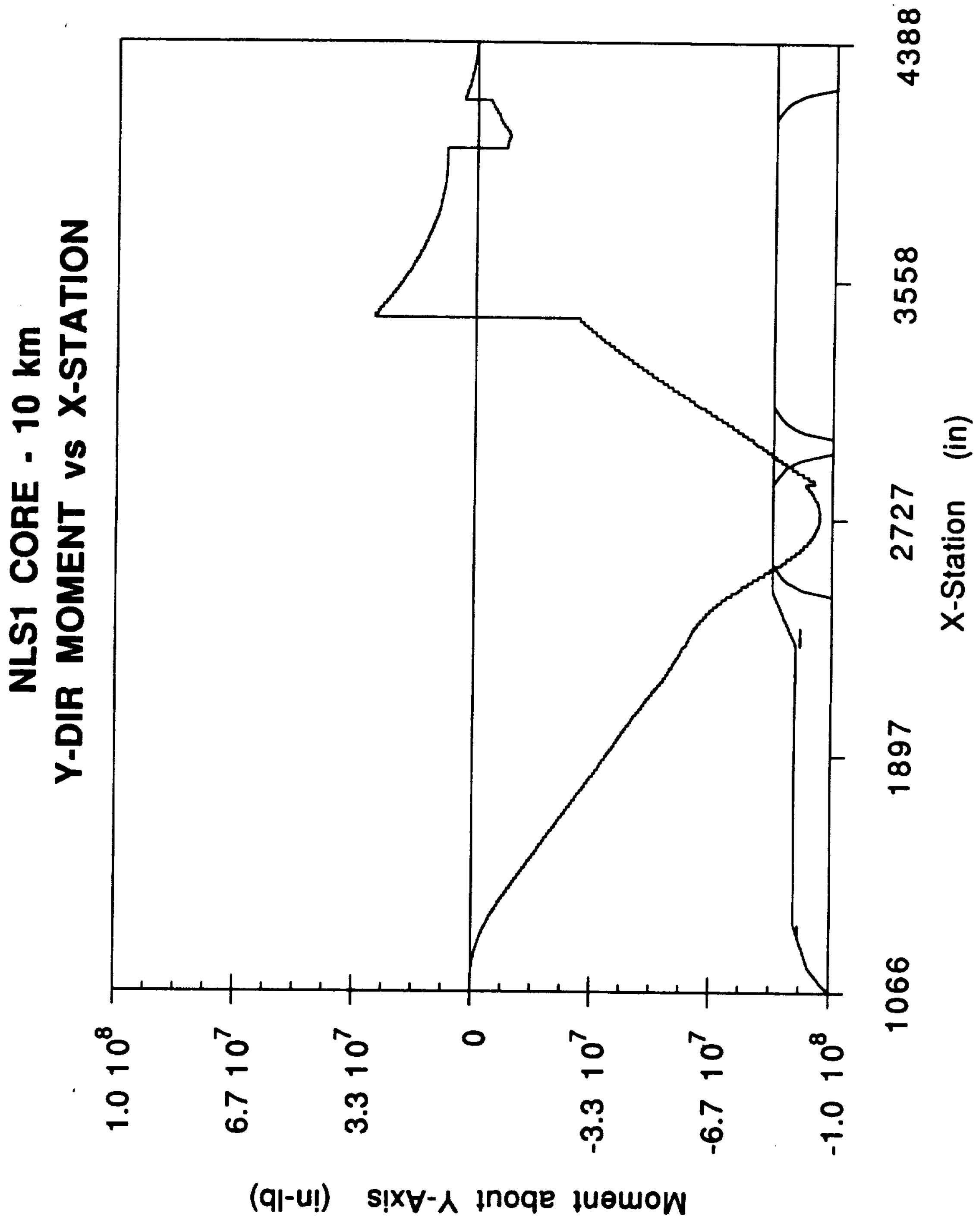


NLS1 CORE - 10 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

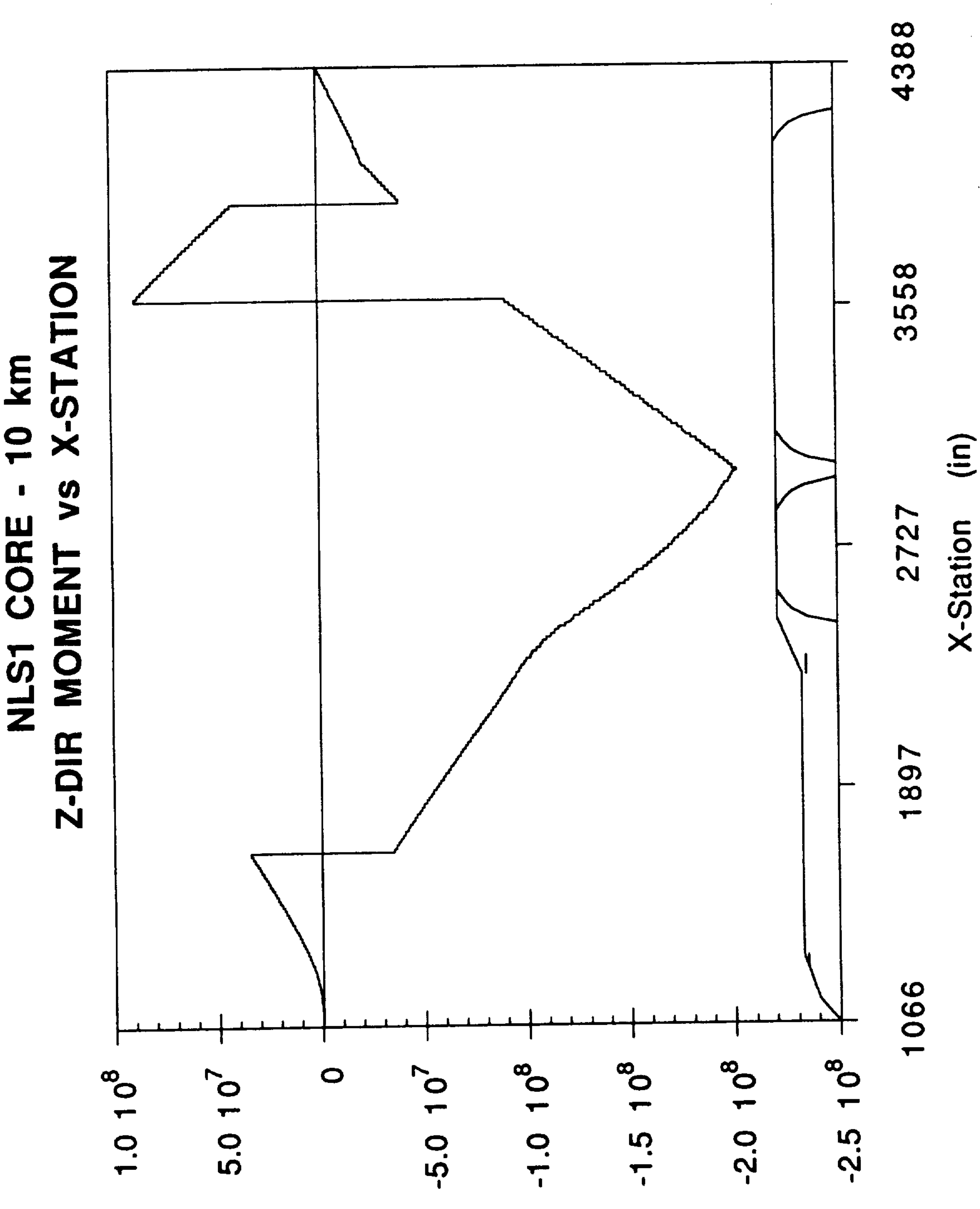

NLS1 CORE - 10 km
Y-DIR SHEAR vs X-STATION
4.0 10^5
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
-4.0 10^5
Y-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)

NLS1 CORE - 10 km
Z-DIR SHEAR vs X-STATION

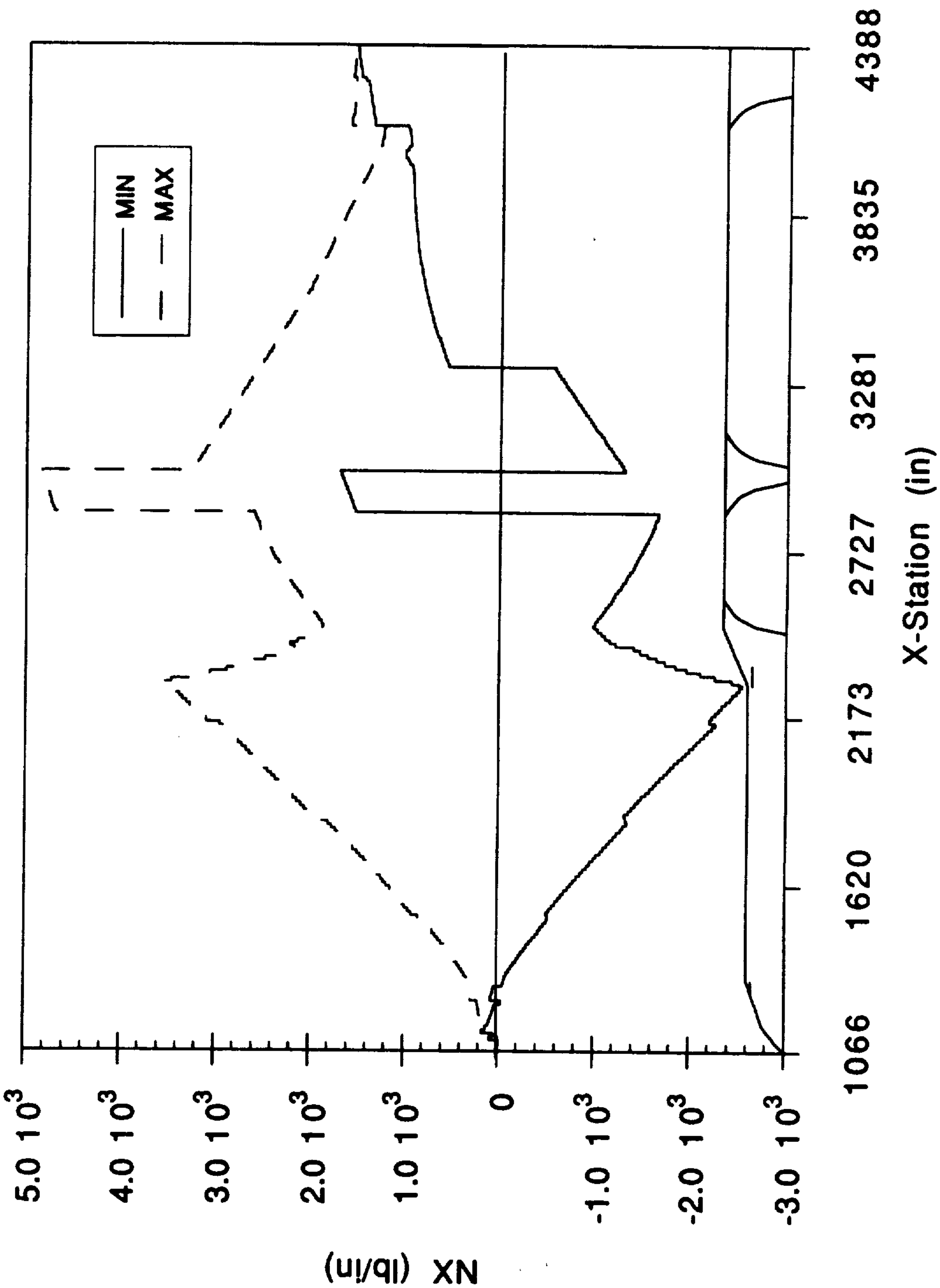


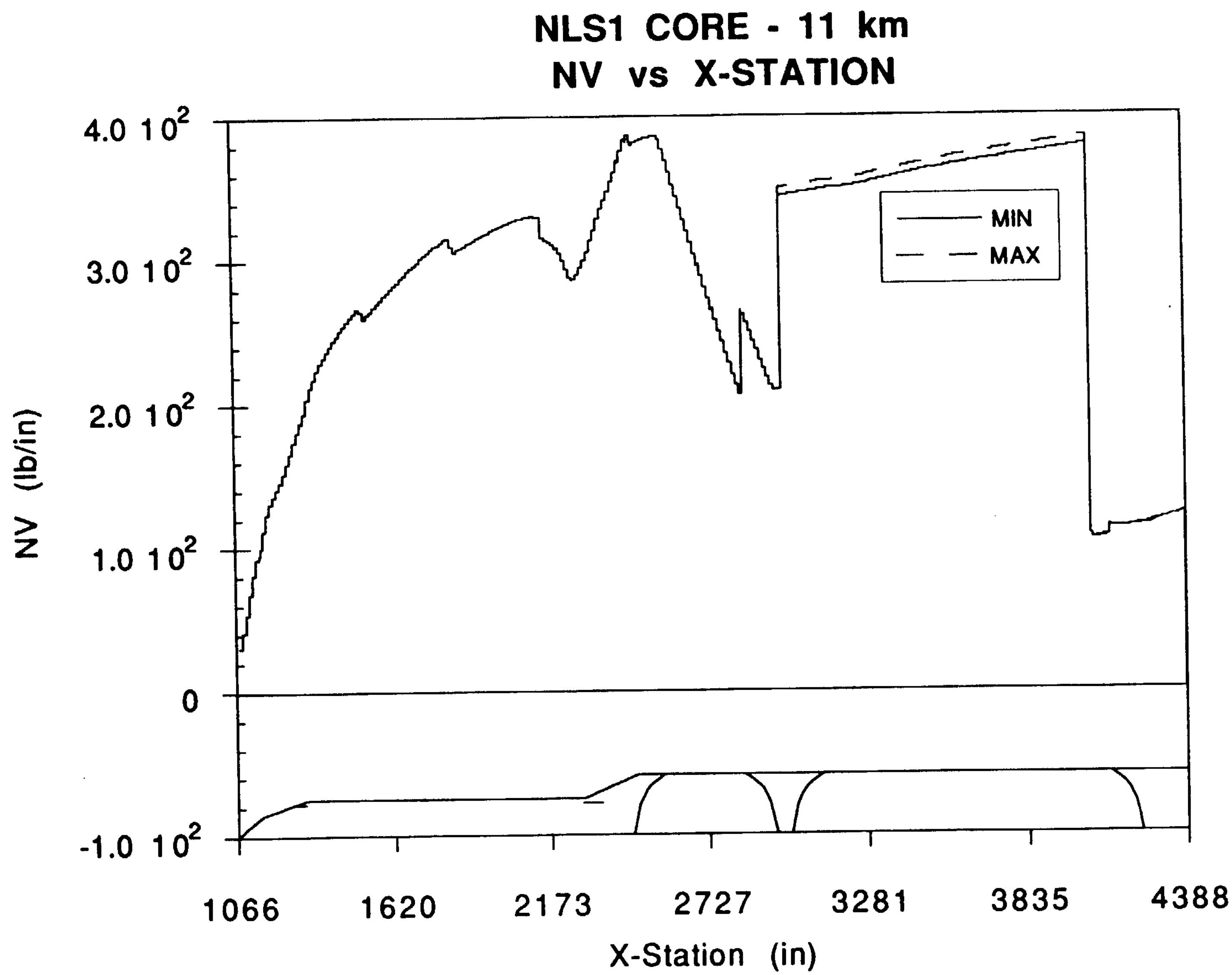


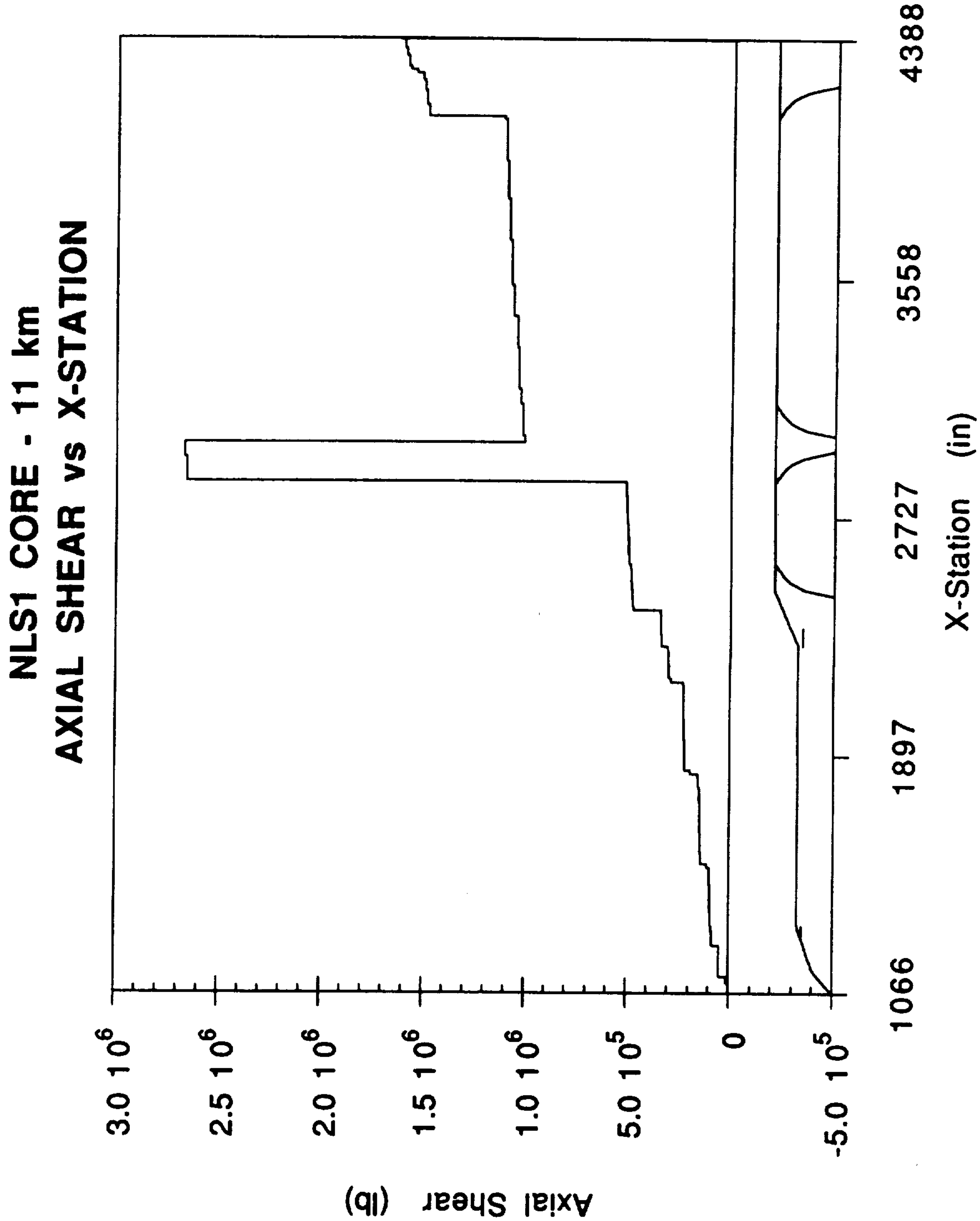
NLS1 CORE - 10 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lb)
1.0 10^8
6.7 10^7
3.3 10^7
0
-3.3 10^7
-6.7 10^7
-1.0 10^8
X-Station (in)
1066
1897
2727
3558
4388


NLS1 CORE - 10 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lb)
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
-2.5 10^8
1066
1897
2727
3558
4388
X-Station (in)

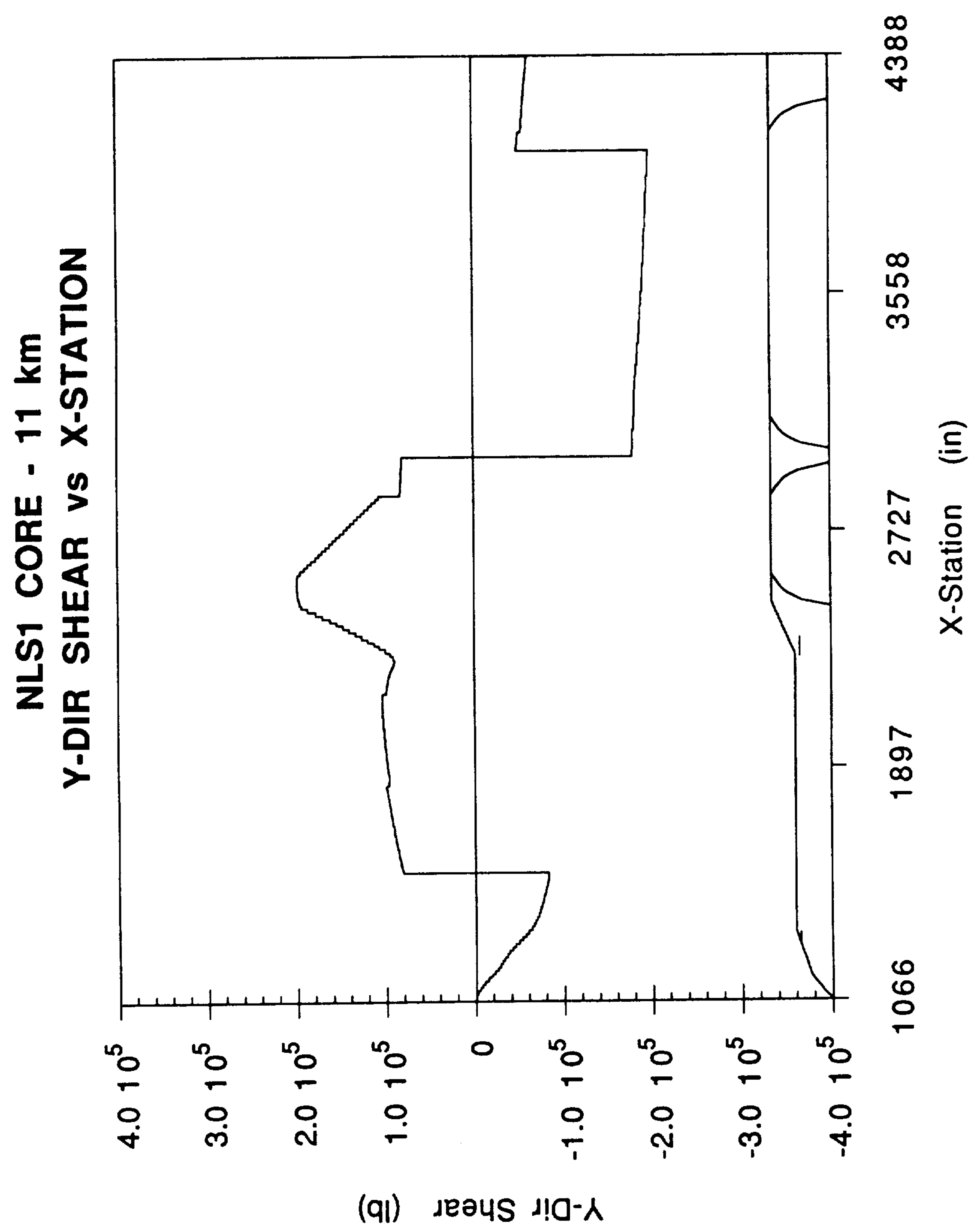
NLS1 CORE - 11 km
NX vs X-STATION

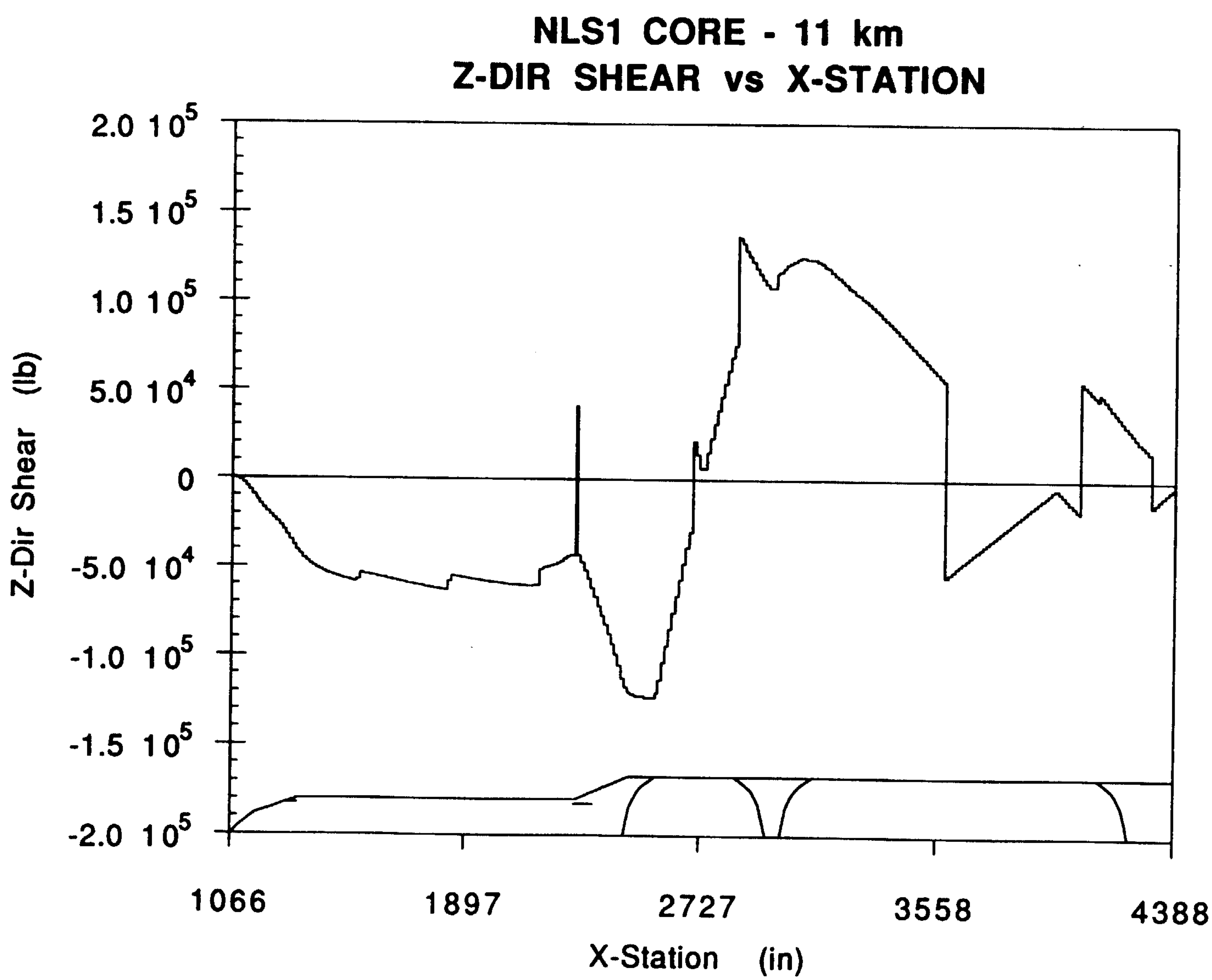



NLS1 CORE - 11 km
NV vs X-STATION
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
NV (lb/in)
MIN
MAX
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

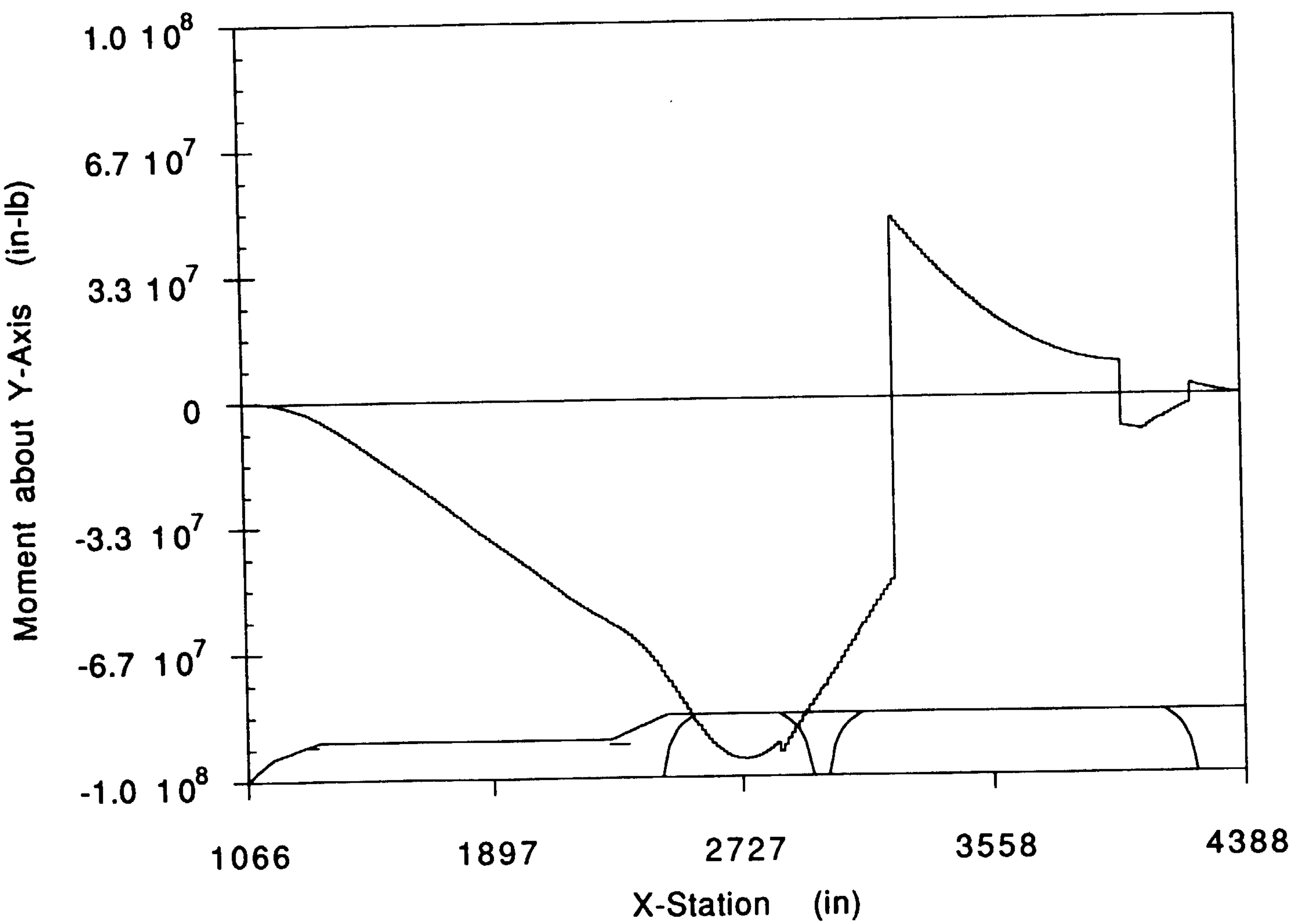


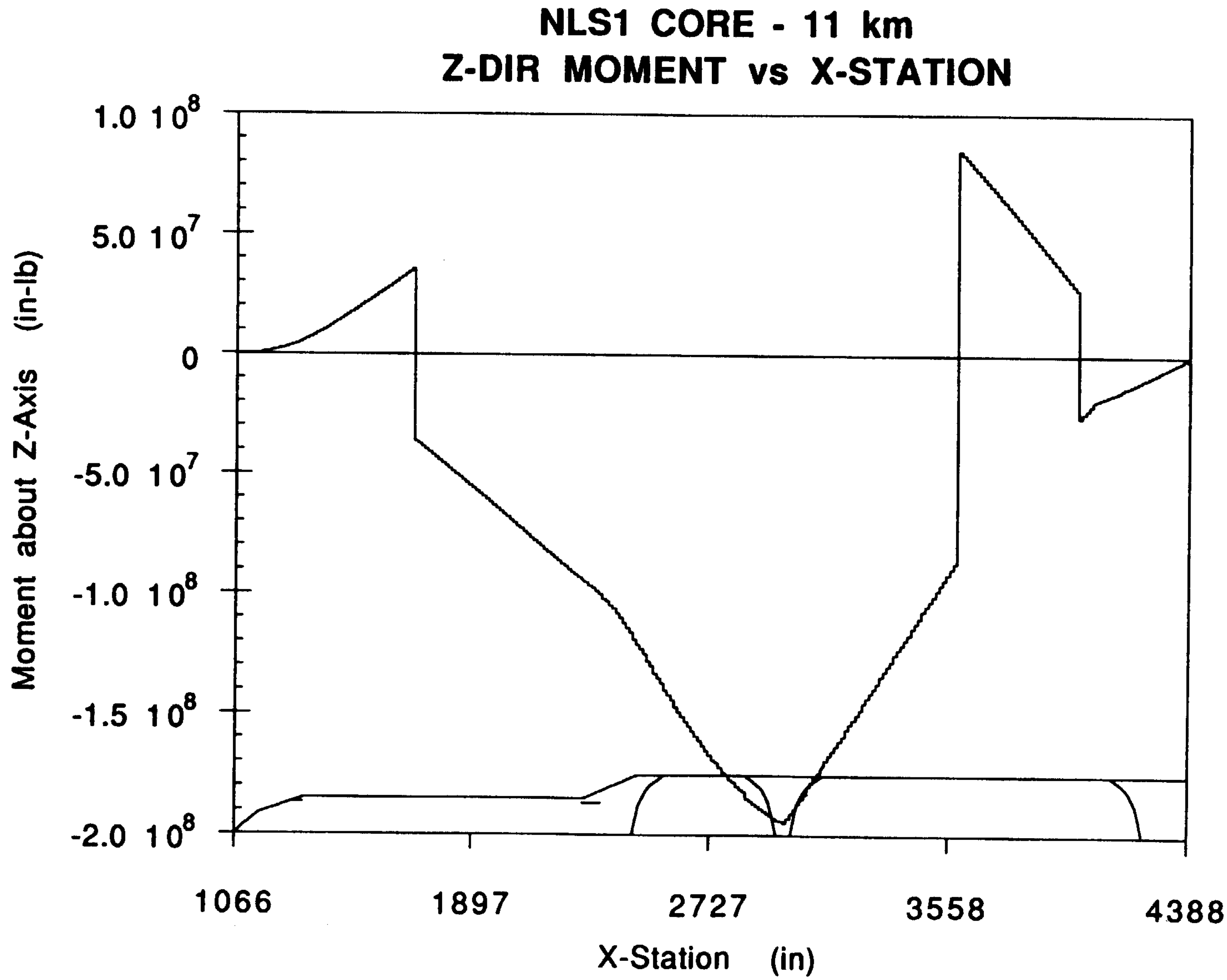
NLS1 CORE - 11 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

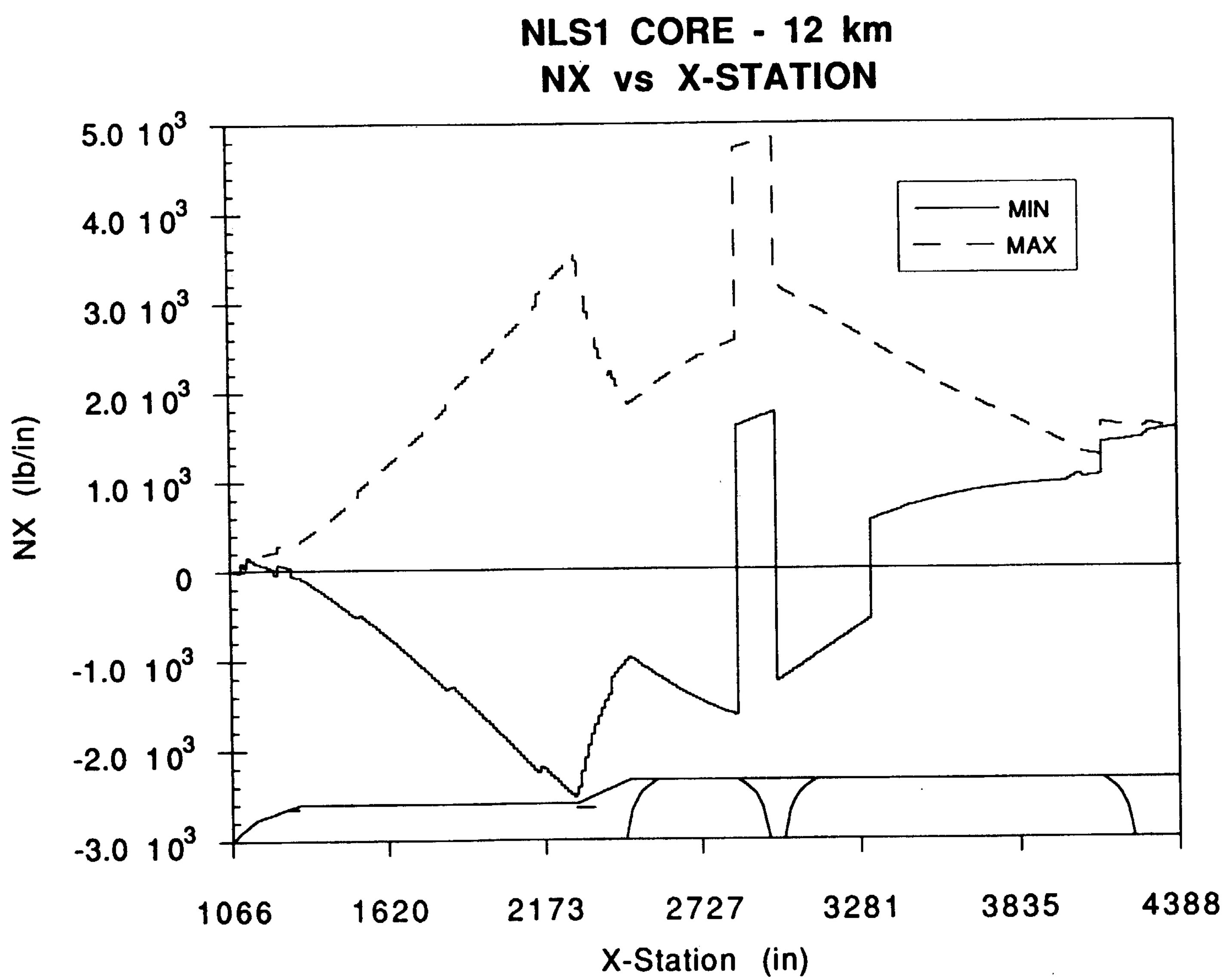

NLS1 CORE - 11 km
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lb)
4.0 10^5
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
-4.0 10^5
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - 11 km
Z-DIR SHEAR vs X-STATION
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
Z-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)

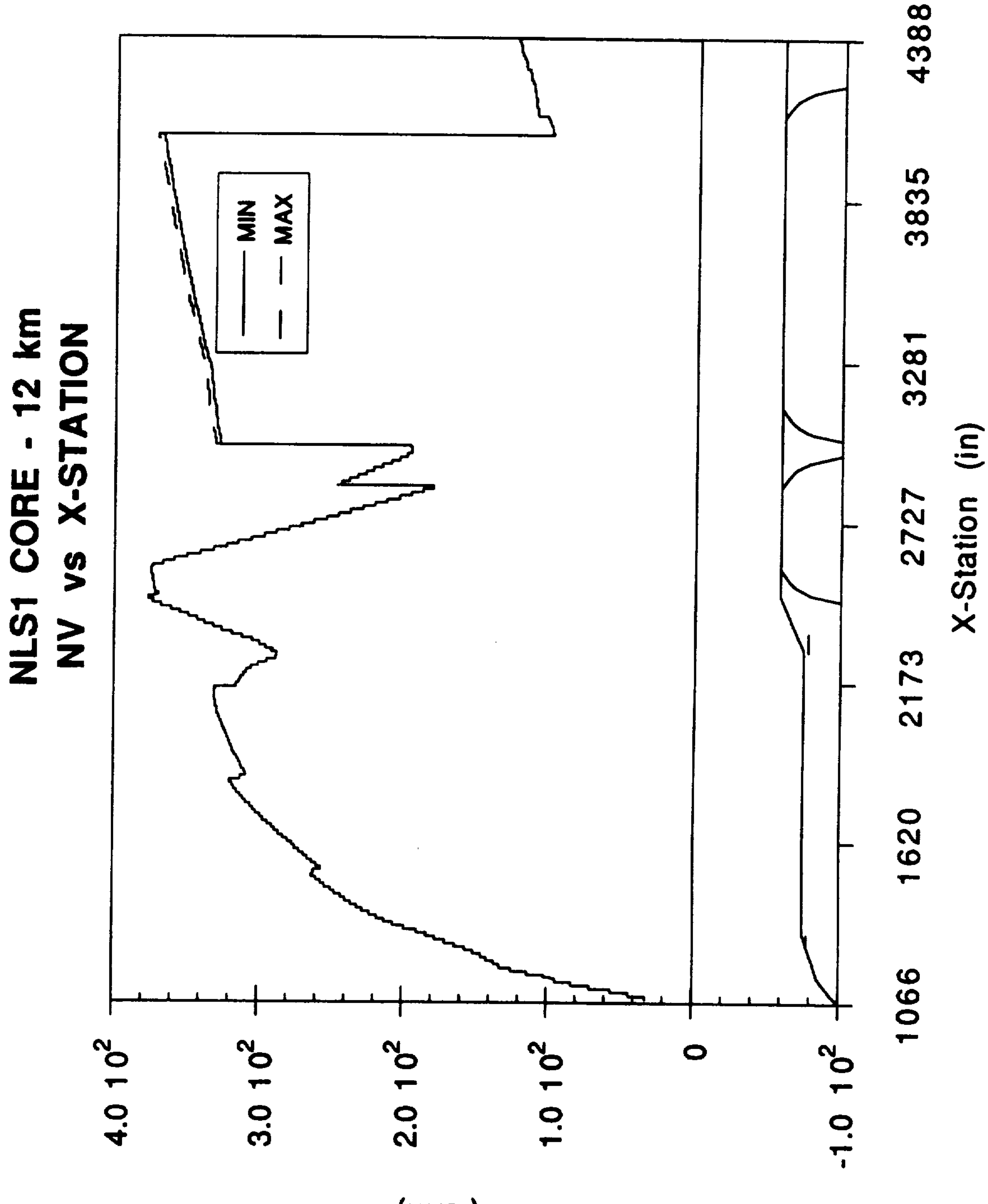
NLS1 CORE - 11 km
Y-DIR MOMENT vs X-STATION



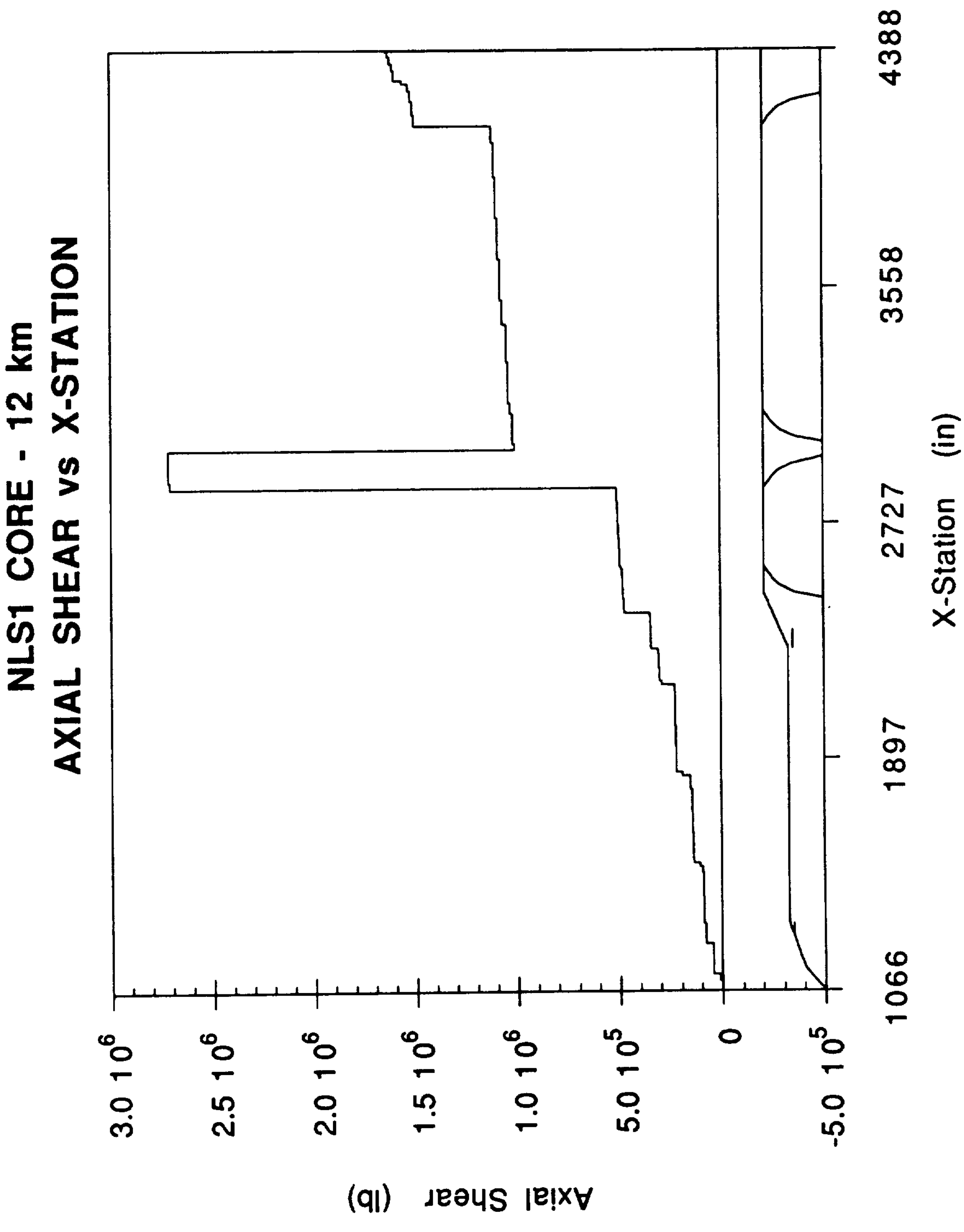

NLS1 CORE - 11 km
Z-DIR MOMENT vs X-STATION
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
Moment about Z-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)



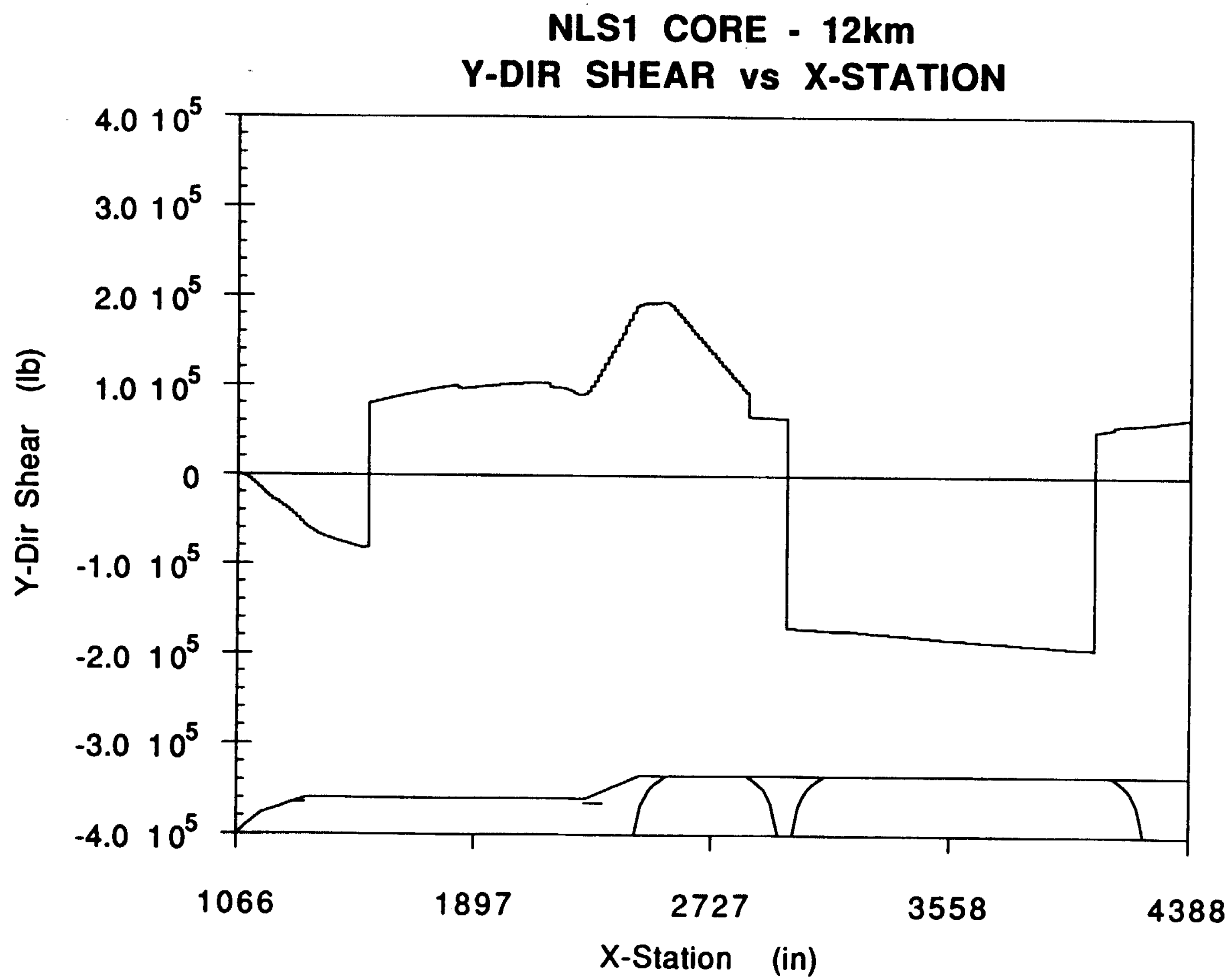
NLS1 CORE - 12 km
NX vs X-STATION
MIN
MAX
5.0 10^3
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
NX (lb/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



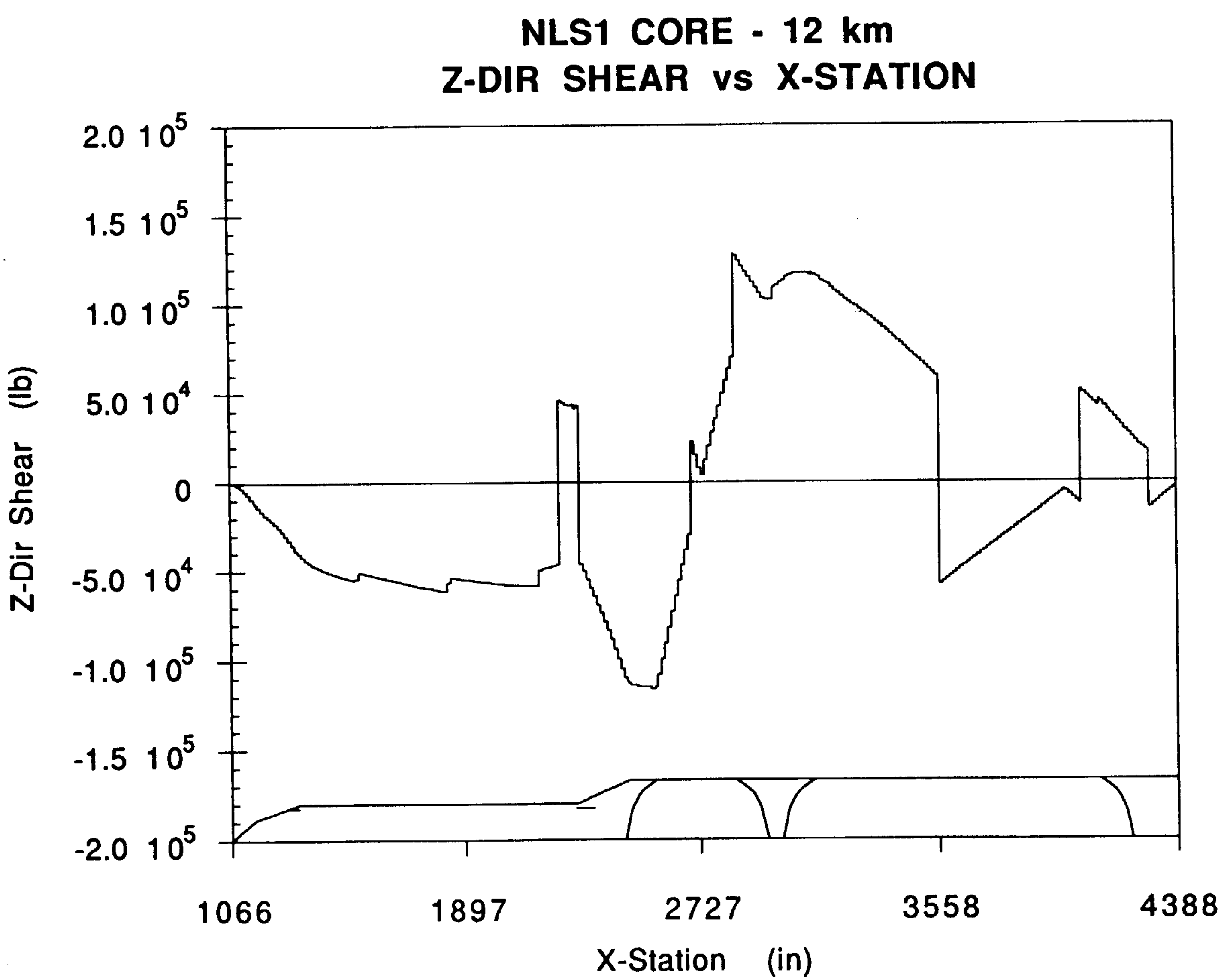
NLS1 CORE - 12 km
NV vs X-STATION
MIN
MAX
NV (lb/in)
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
1066
1620
2173
2727
3281
3835
4388
X-Station (in)



NLS1 CORE - 12 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

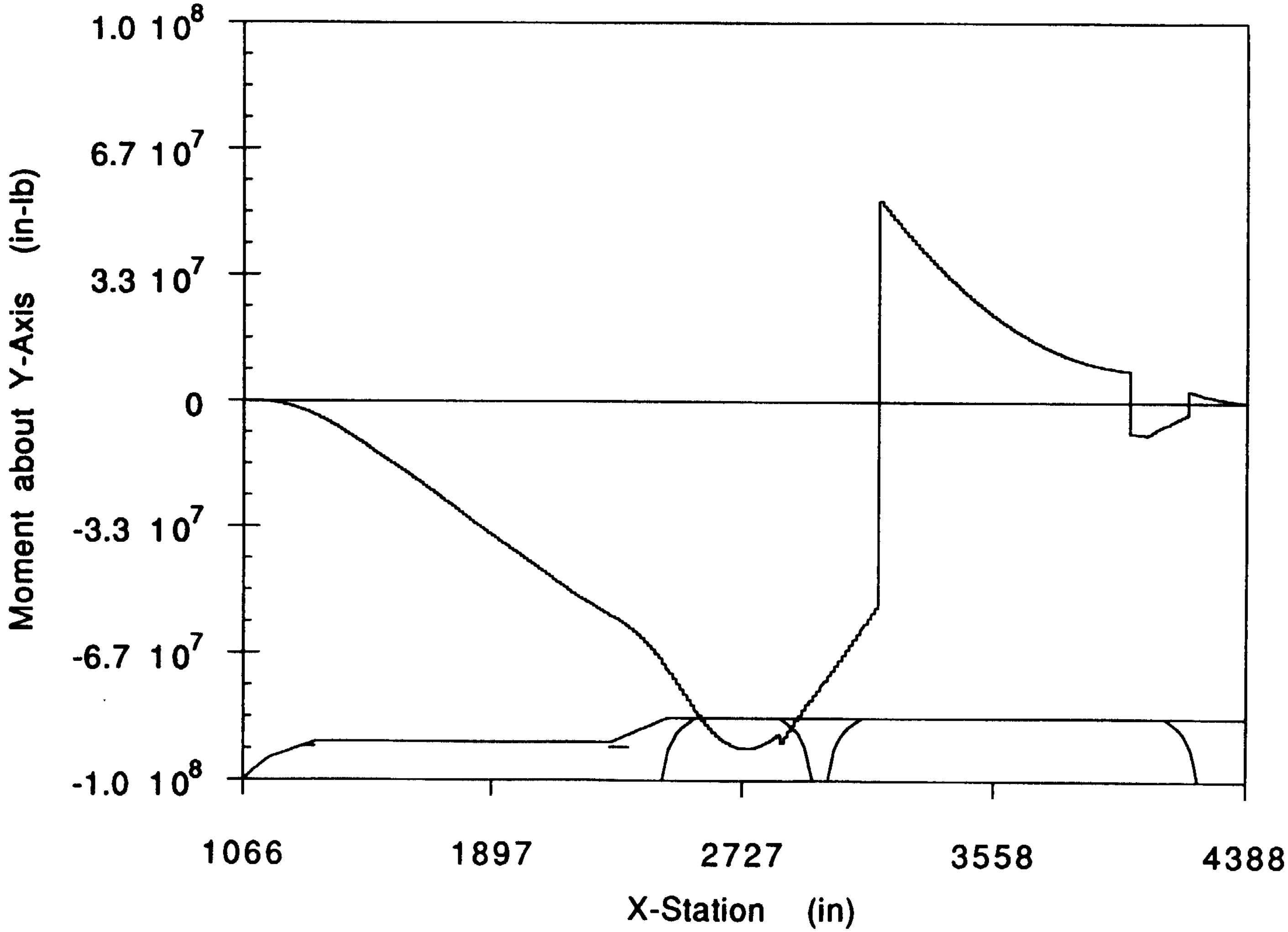


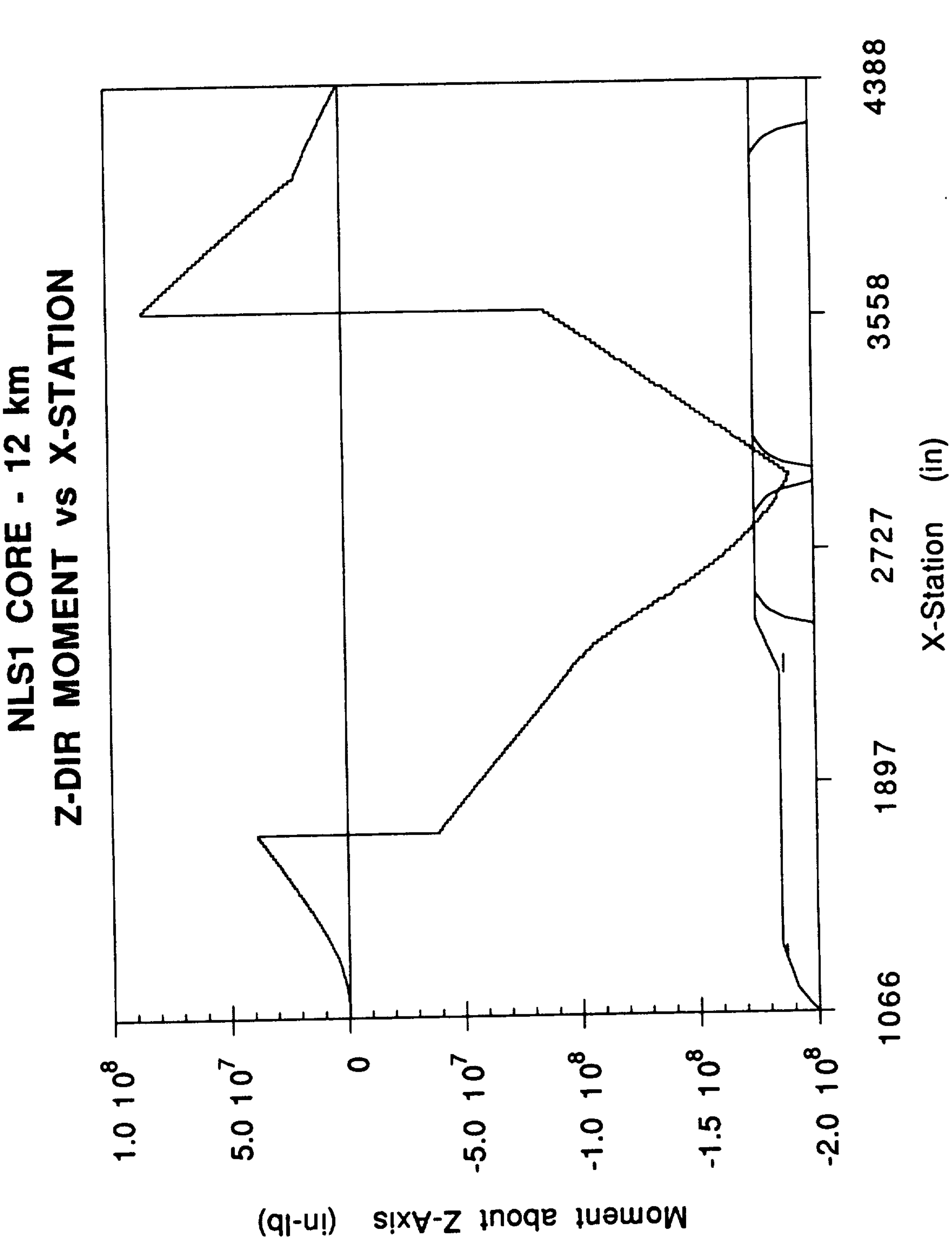
NLS1 CORE - 12km
Y-DIR SHEAR vs X-STATION
4.0 10^5
3.0 10^5
2.0 10^5
1.0 10^5
0
-1.0 10^5
-2.0 10^5
-3.0 10^5
-4.0 10^5
Y-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)

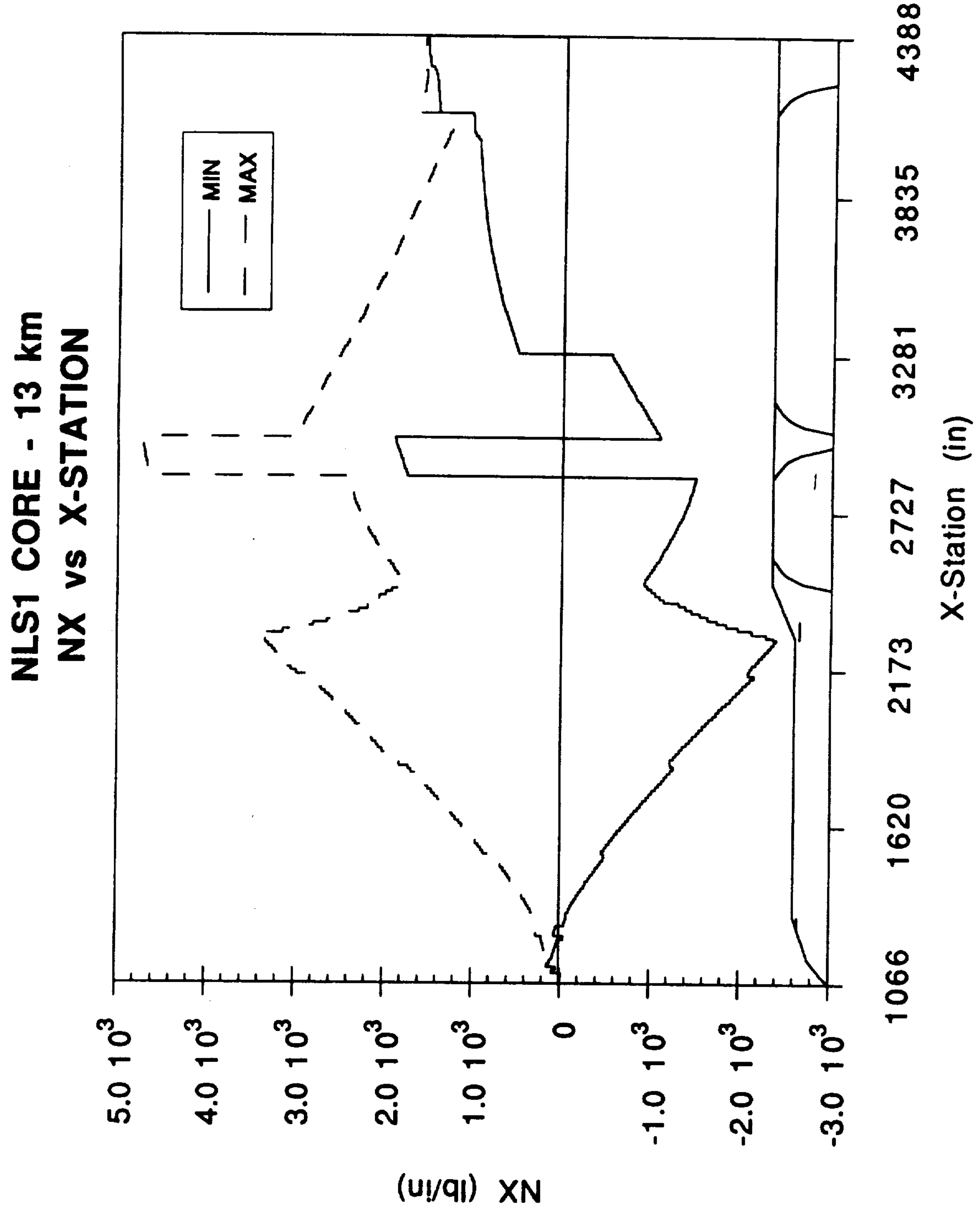


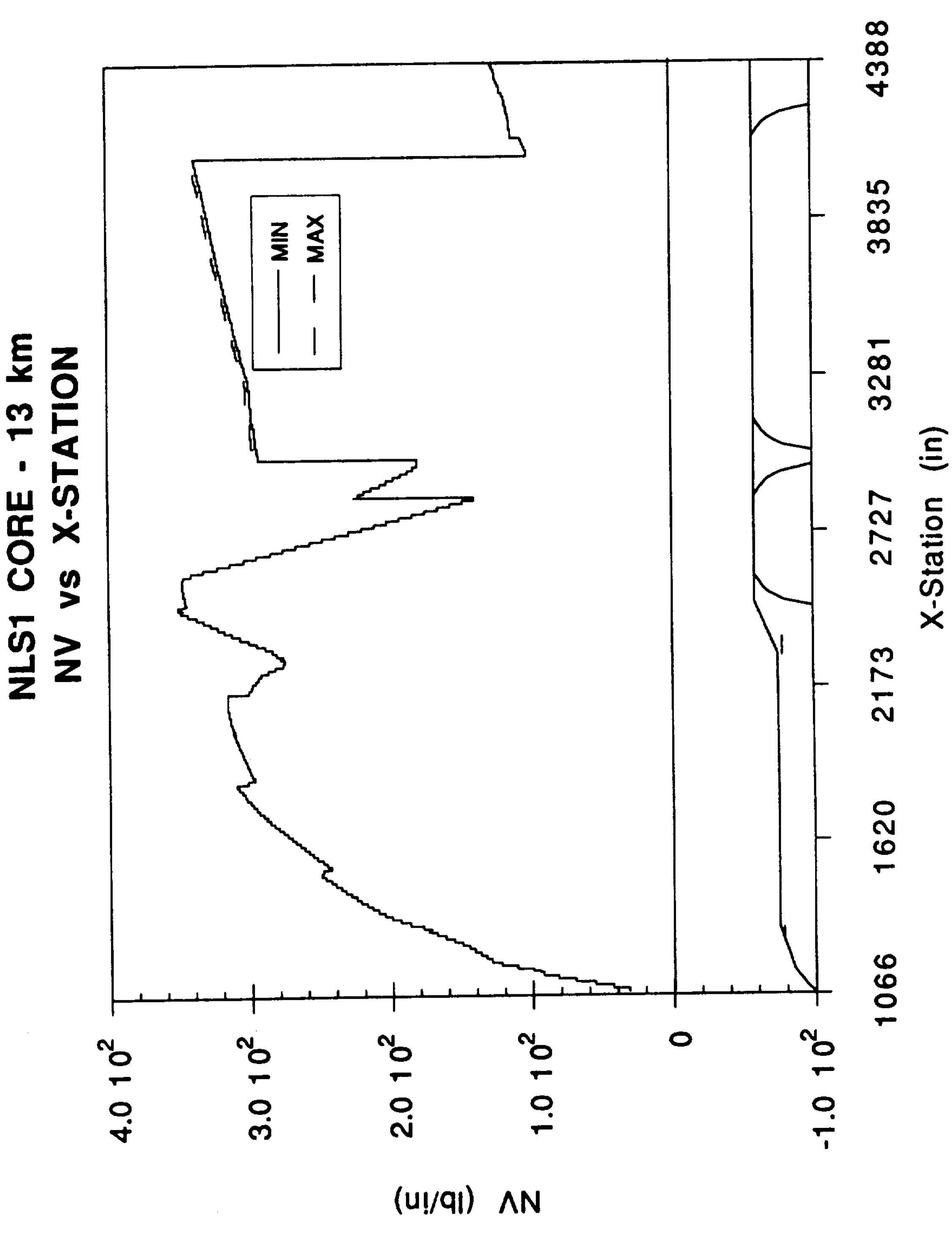
NLS1 CORE - 12 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

NLS1 CORE - 12 km
Y-DIR MOMENT vs X-STATION

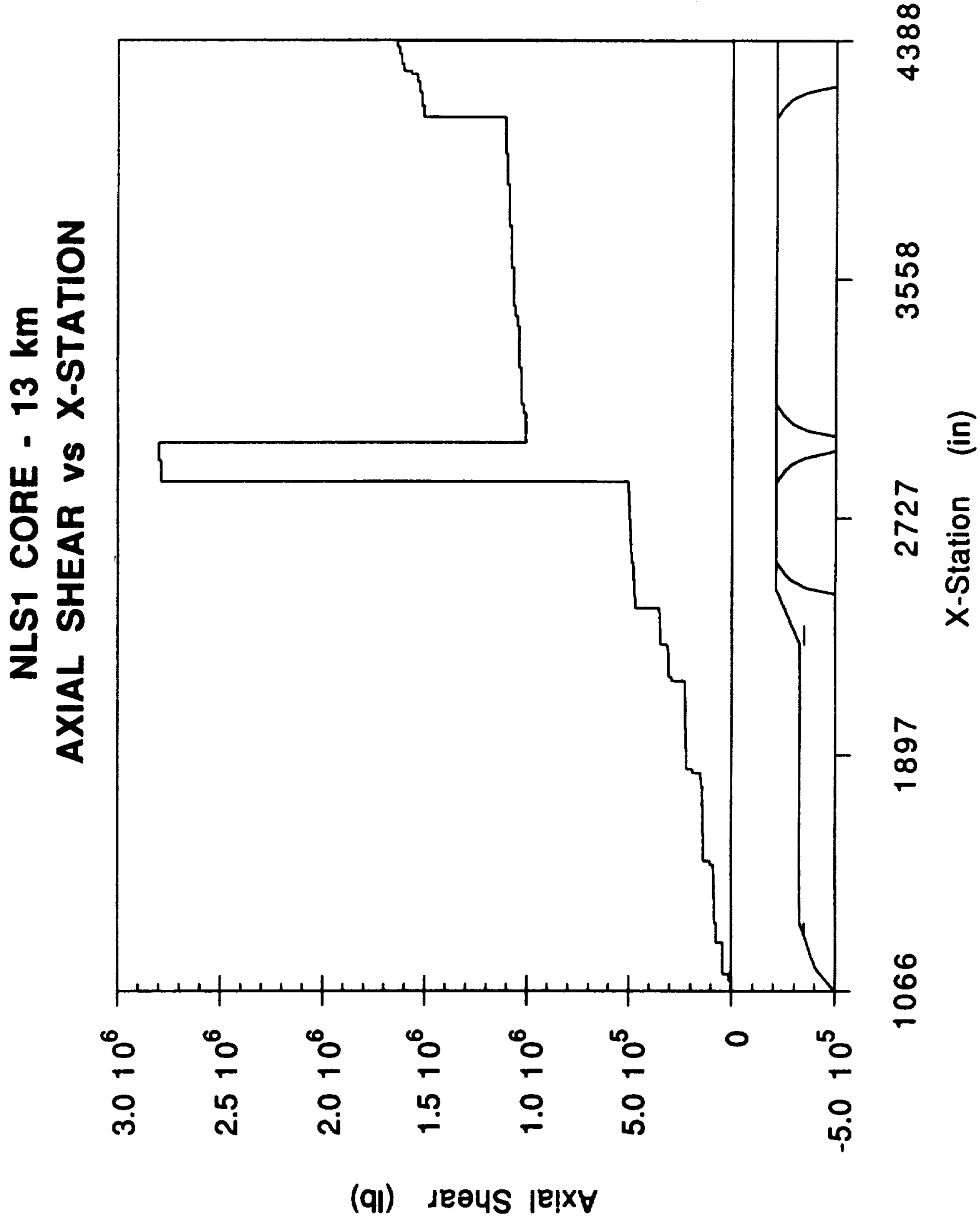



NLS1 CORE - 12 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lb)
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - 13 km
NX vs X-STATION
MIN
MAX
NX (lb/in)
5.0 10³
4.0 10³
3.0 10³
2.0 10³
1.0 10³
0
-1.0 10³
-2.0 10³
-3.0 10³
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

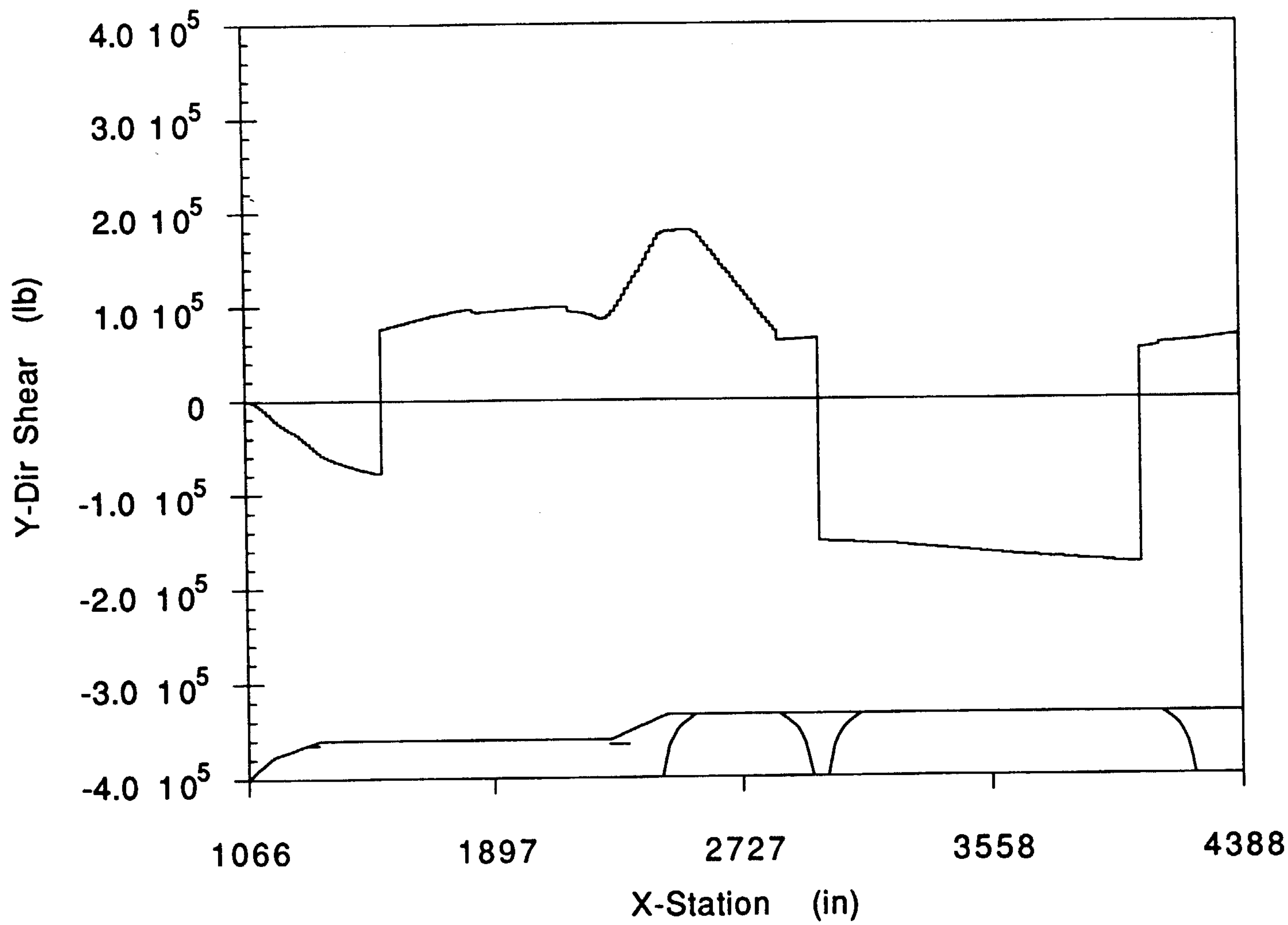


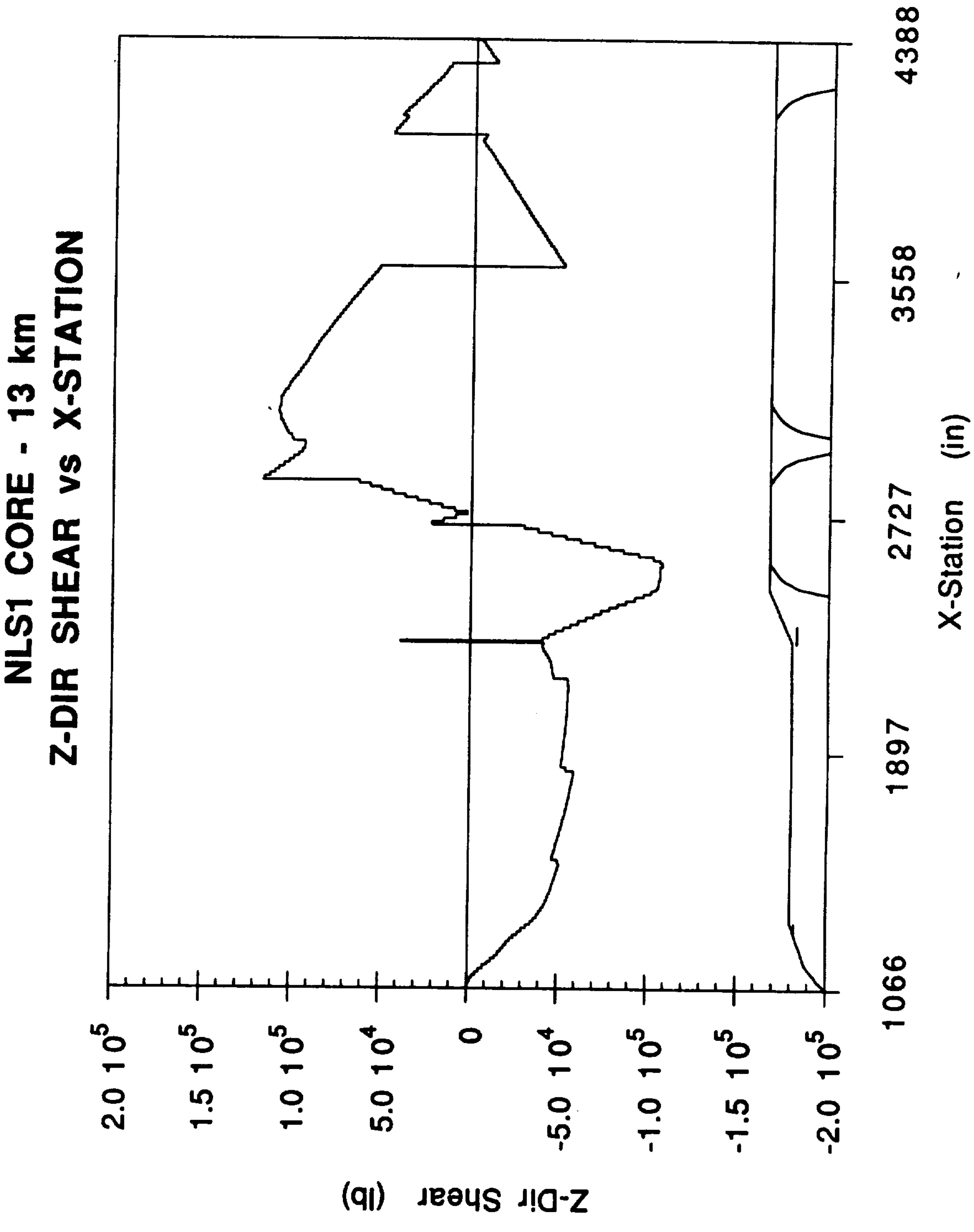
NLS1 CORE - 13 km
NV vs X-STATION
NV (lb/in)
4.0 10^2
3.0 10^2
2.0 10^2
1.0 10^2
0
-1.0 10^2
X-Station (in)
1066
1620
2173
2727
3281
3835
4388
MIN
MAX



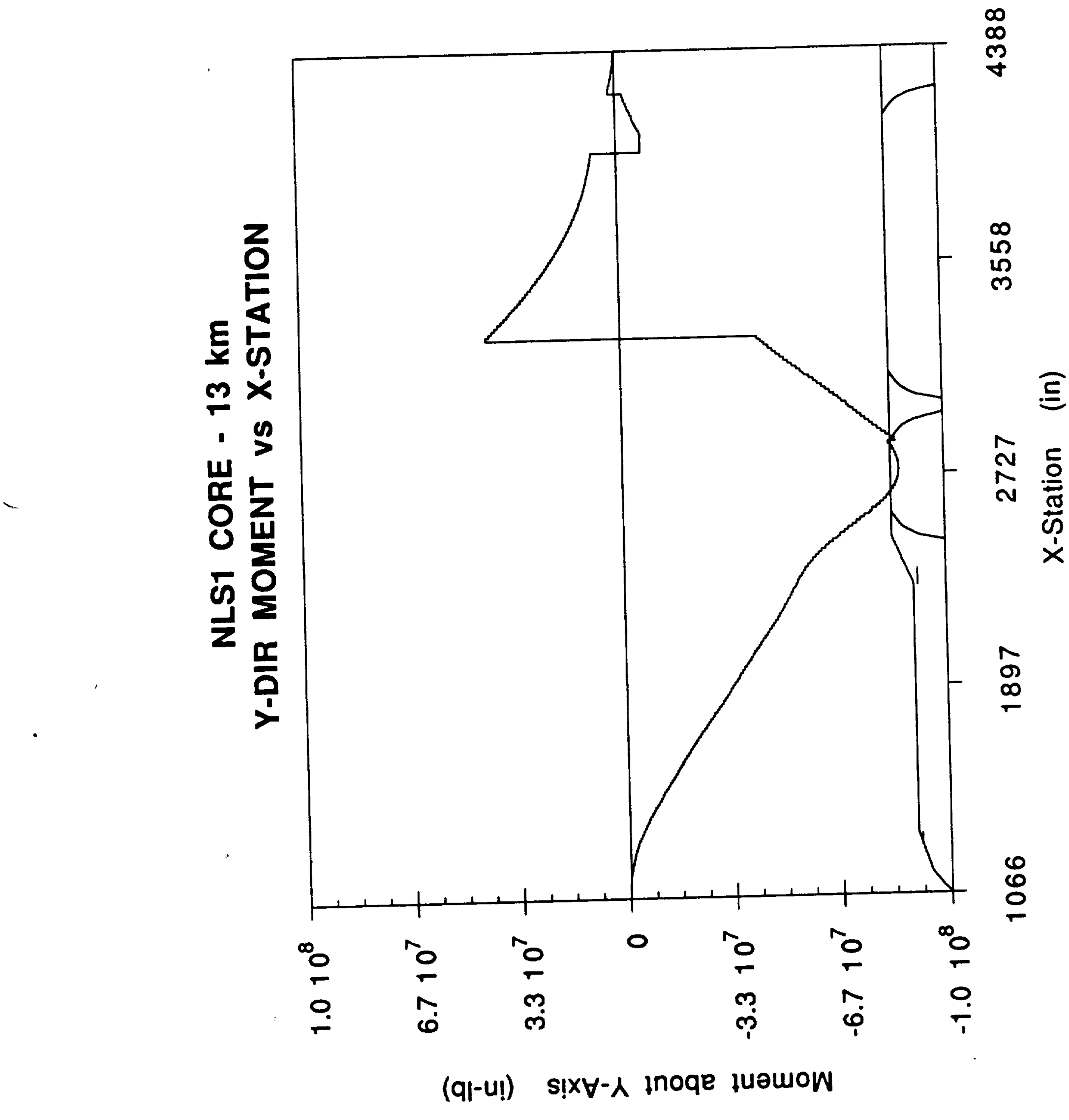
NLS1 CORE - 13 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

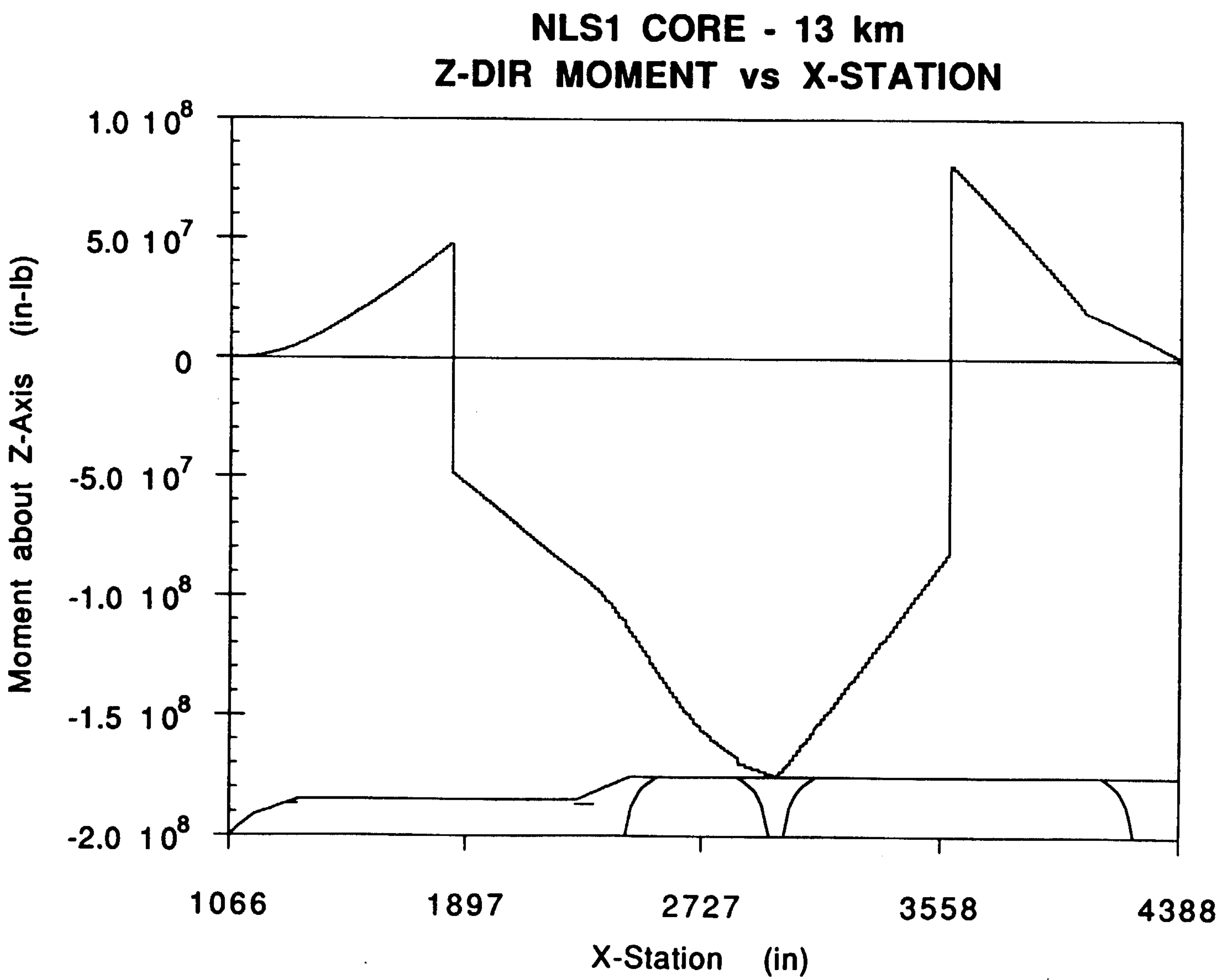
NLS1 CORE - 13 km
Y-DIR SHEAR vs X-STATION

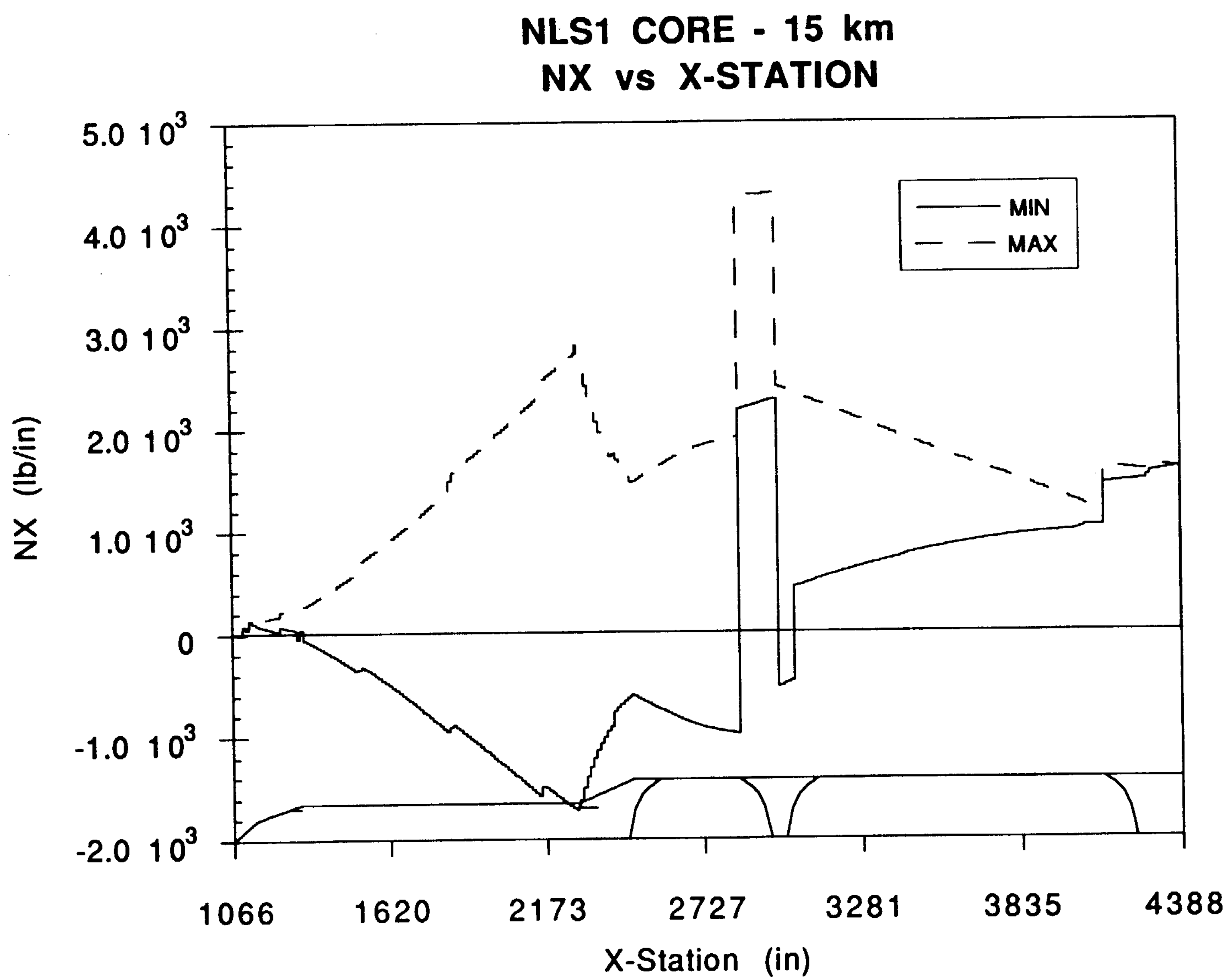


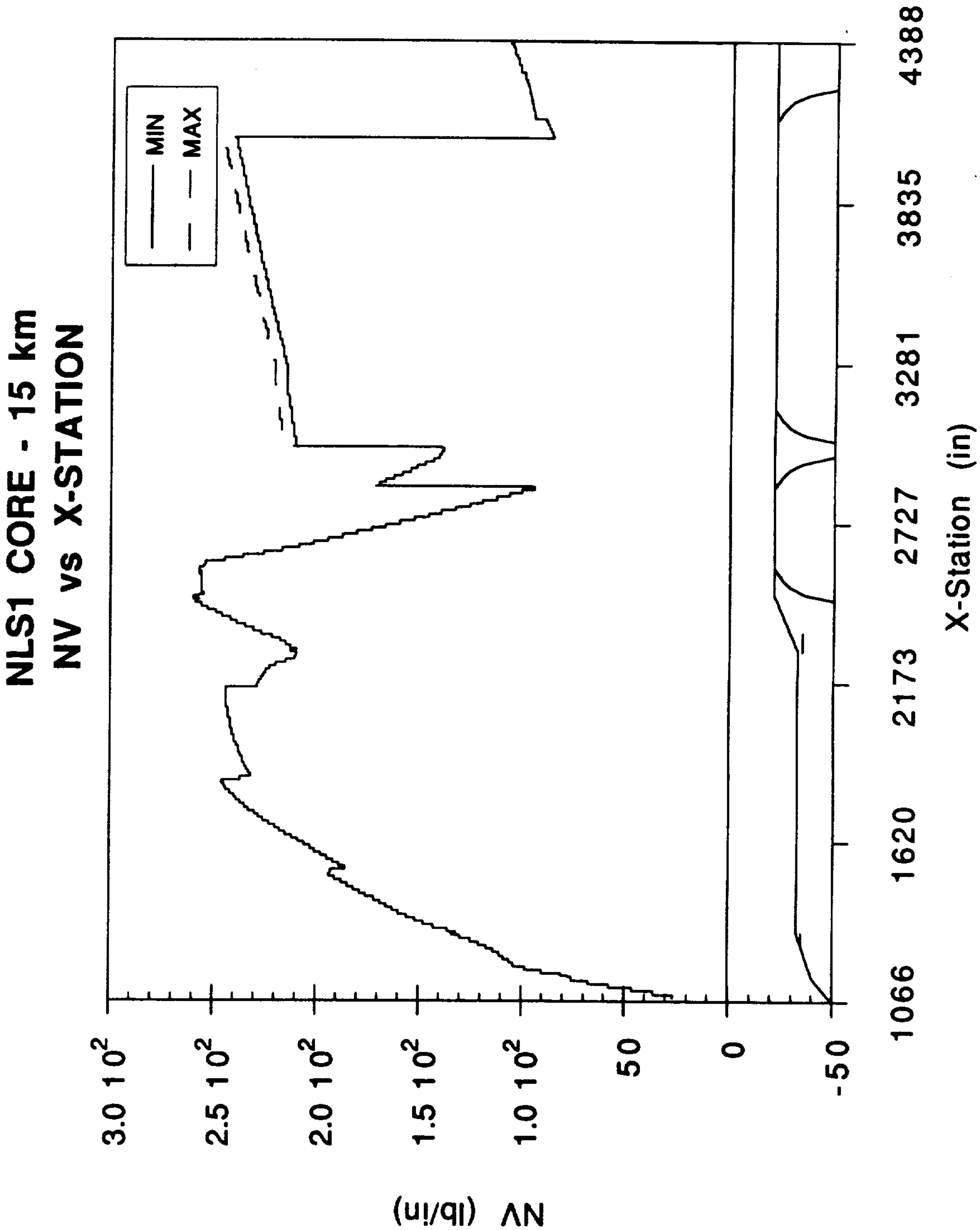


NLS1 CORE - 13 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - 13 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lb)
1.0 10^8
6.7 10^7
3.3 10^7
0
-3.3 10^7
-6.7 10^7
-1.0 10^8
1066
1897
2727
3558
4388
X-Station (in)

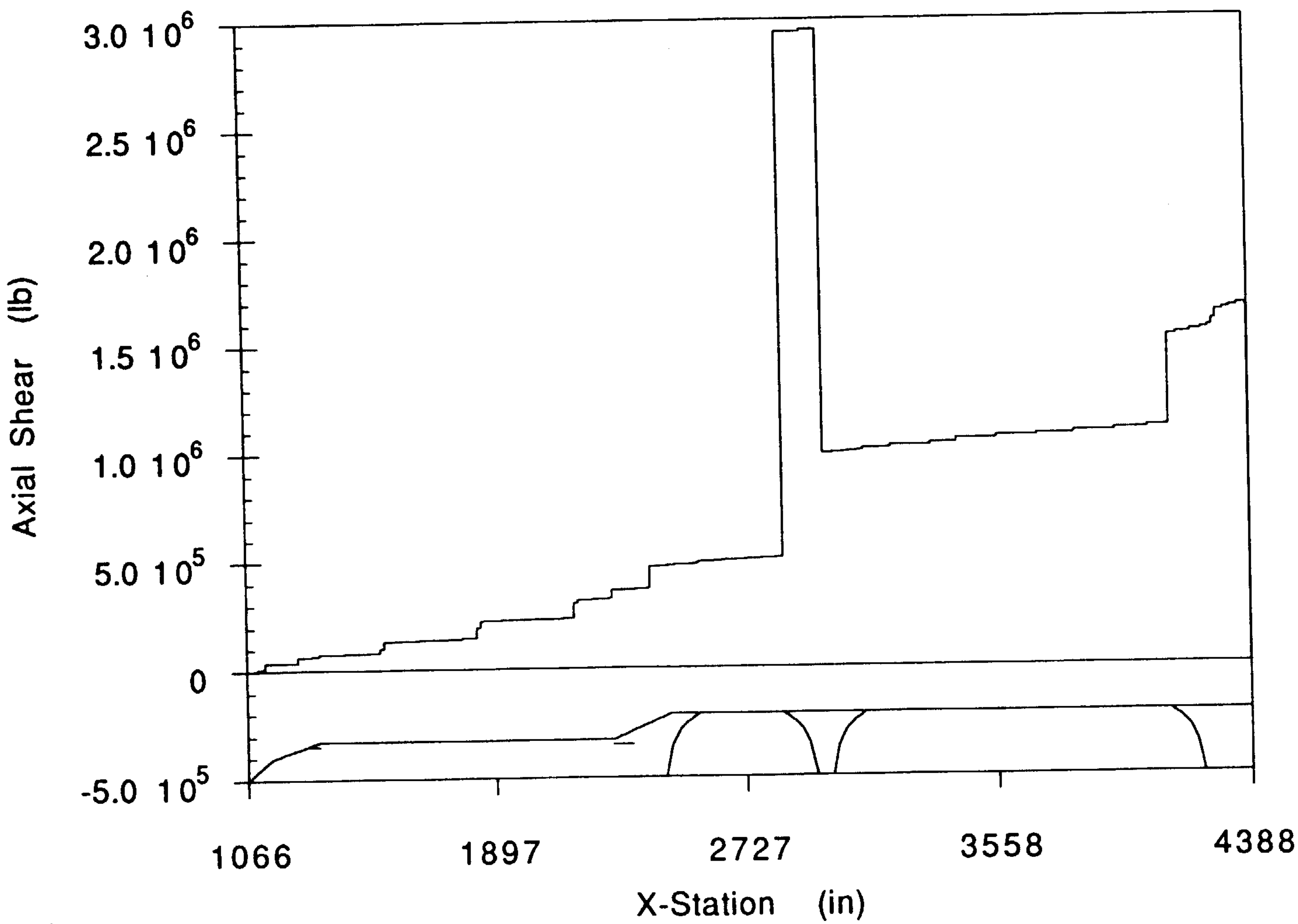

NLS1 CORE - 13 km
Z-DIR MOMENT vs X-STATION
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
-2.0 10^8
Moment about Z-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)

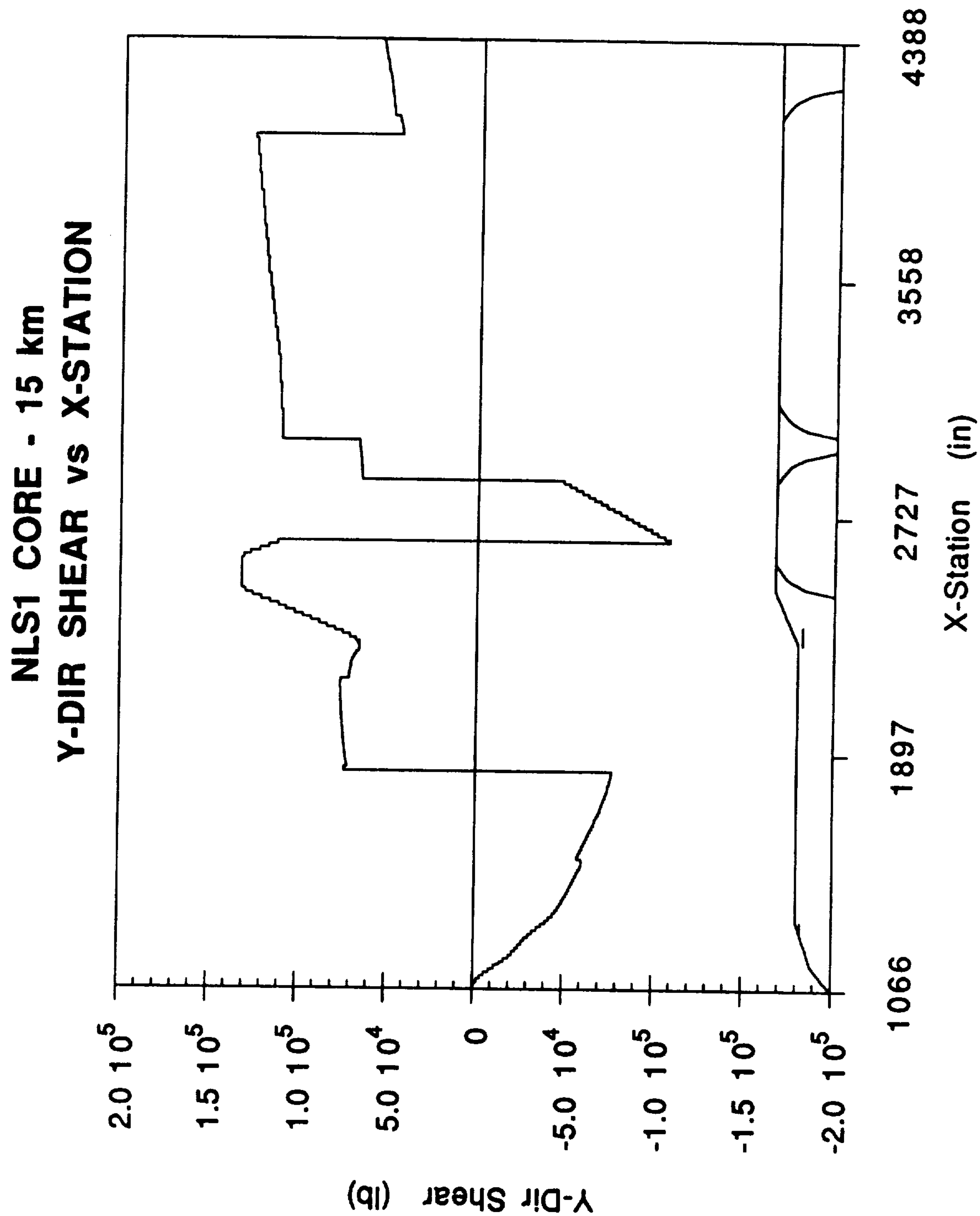

NLS1 CORE - 15 km
NX vs X-STATION
MIN
MAX
5.0 10³
4.0 10³
3.0 10³
2.0 10³
1.0 10³
0
-1.0 10³
-2.0 10³
NX (lb/in)
1066
1620
2173
2727
3281
3835
4388
X-Station (in)

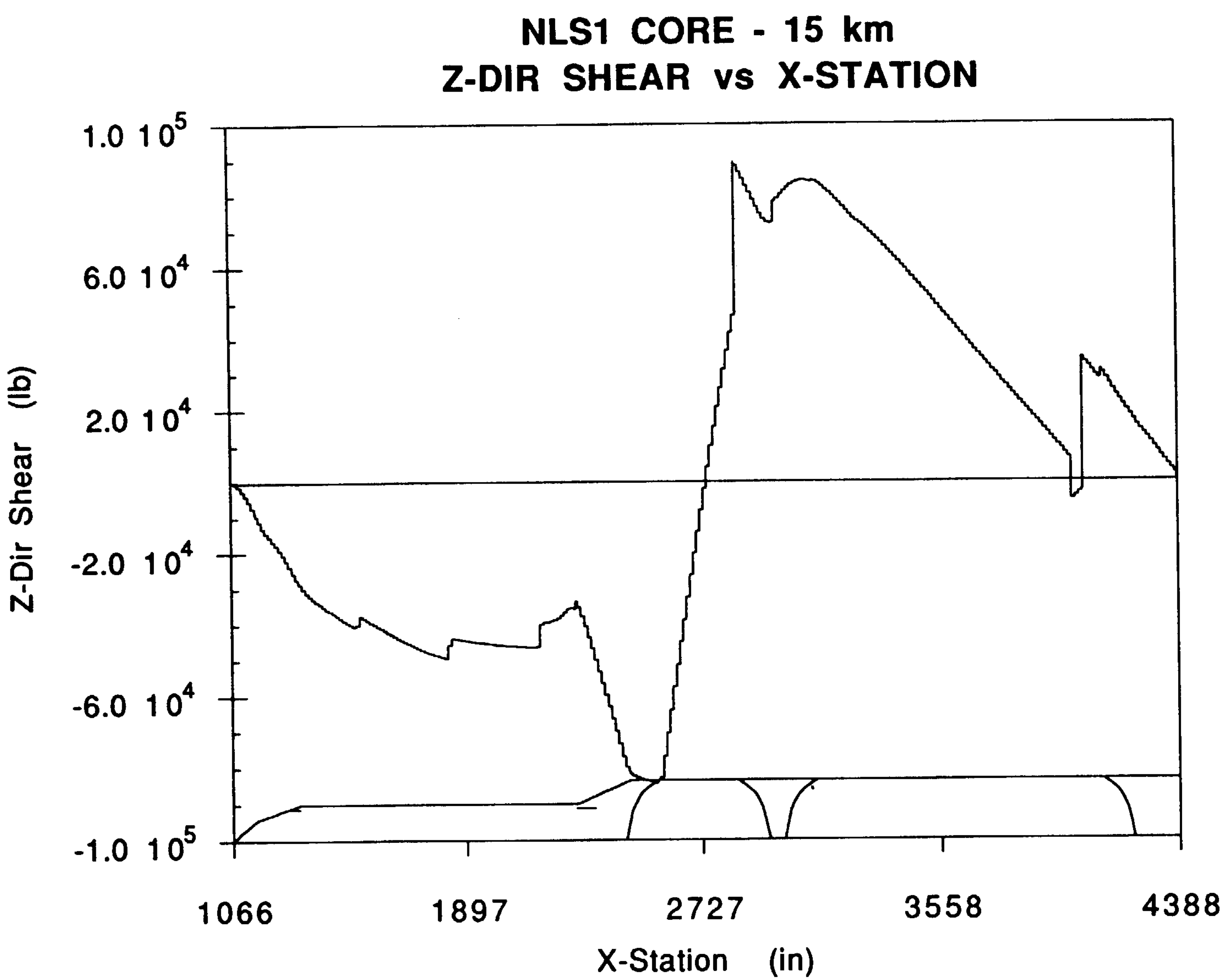


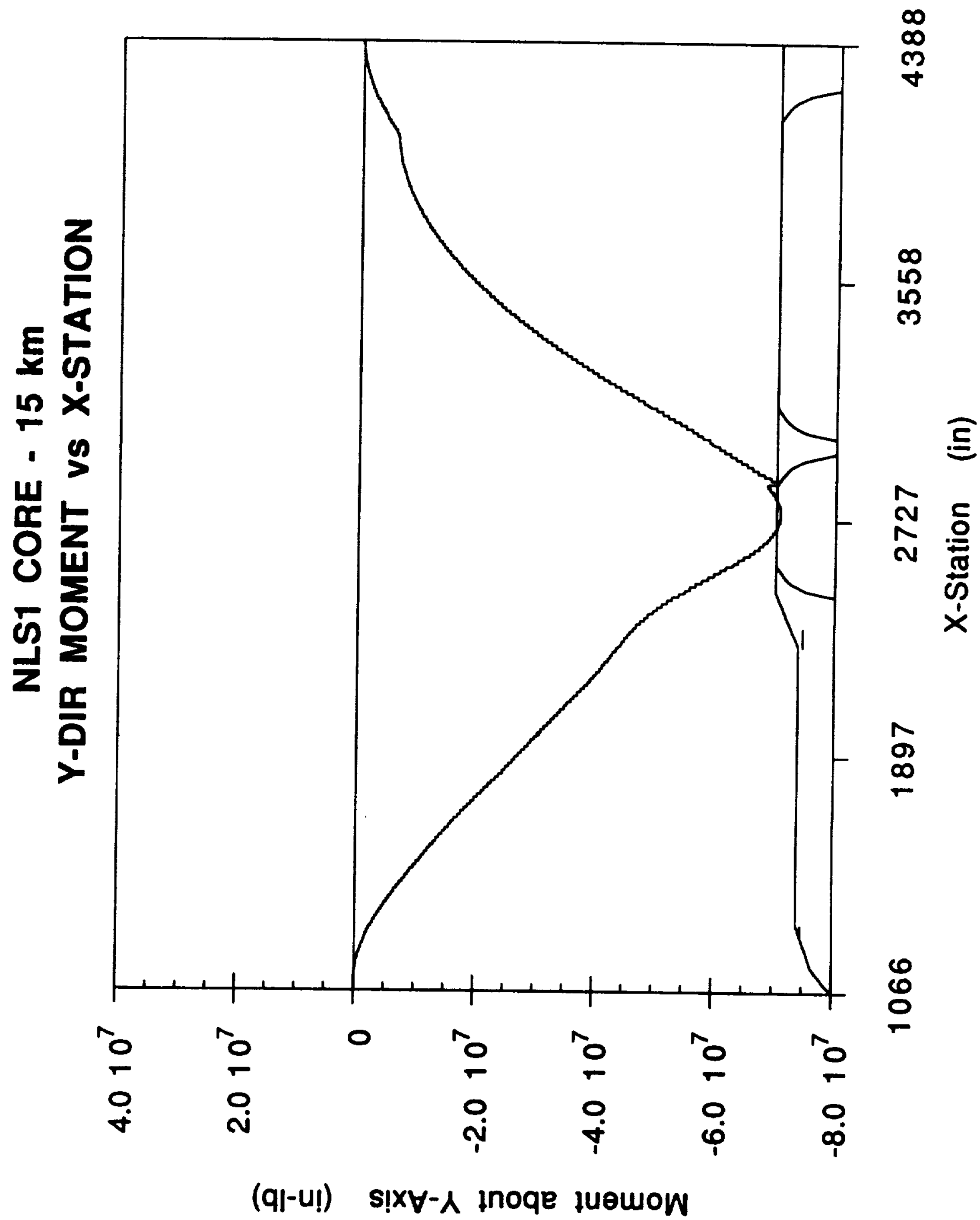
NLS1 CORE - 15 km
NV vs X-STATION
NV (lb/in)
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1066
1620
2173
2727
3281
3835
4388
X-Station (in)
MIN
MAX

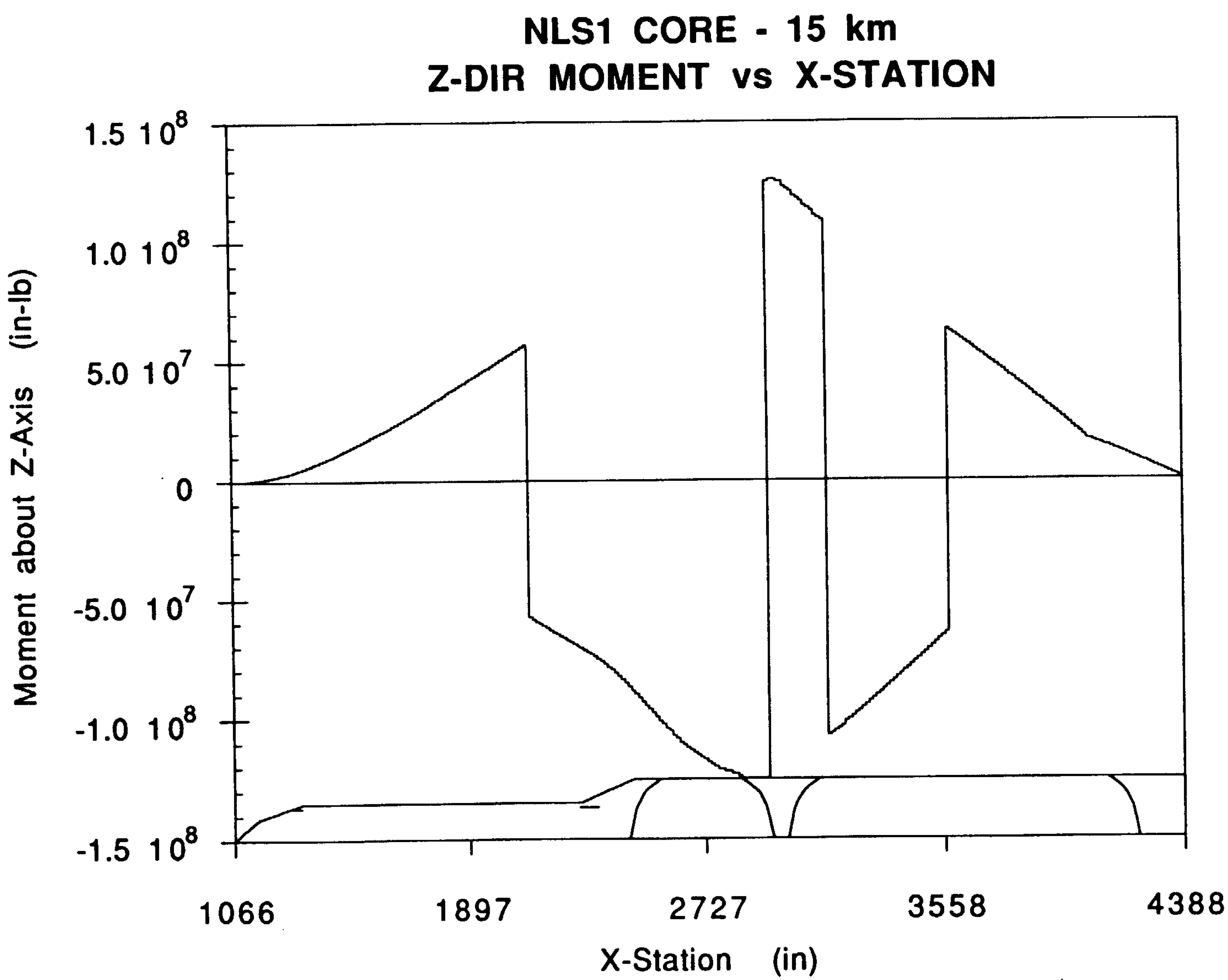
NLS1 CORE - 15 km
AXIAL SHEAR vs X-STATION




NLS1 CORE - 15 km
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lb)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1066
1897
2727
3558
4388
X-Station (in)

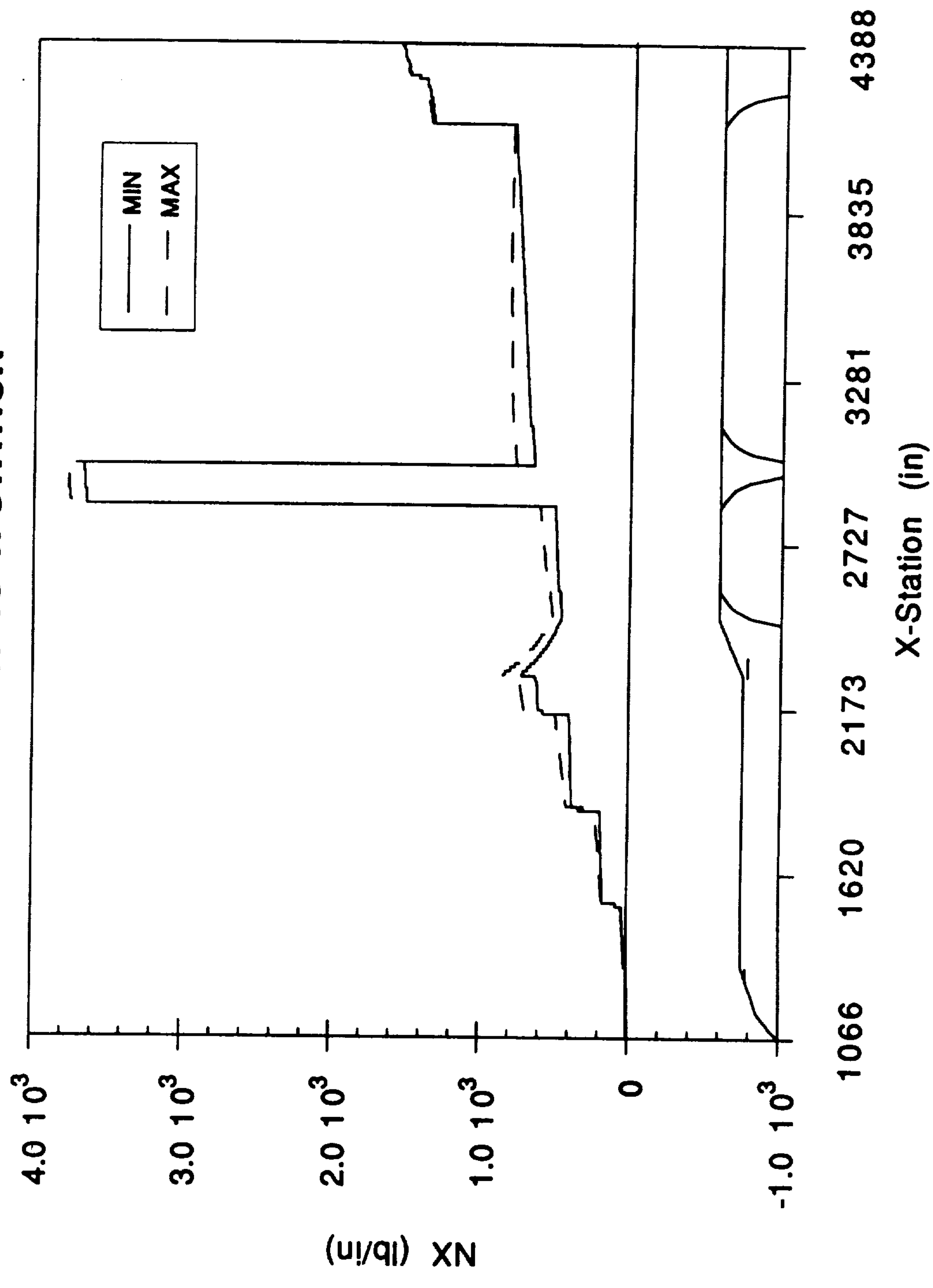

NLS1 CORE - 15 km
Z-DIR SHEAR vs X-STATION
1.0 10^5
6.0 10^4
2.0 10^4
-2.0 10^4
-6.0 10^4
-1.0 10^5
Z-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - 15 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lb)
4.0 10^7
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
-8.0 10^7
1066
1897
2727
3558
4388
X-Station (in)

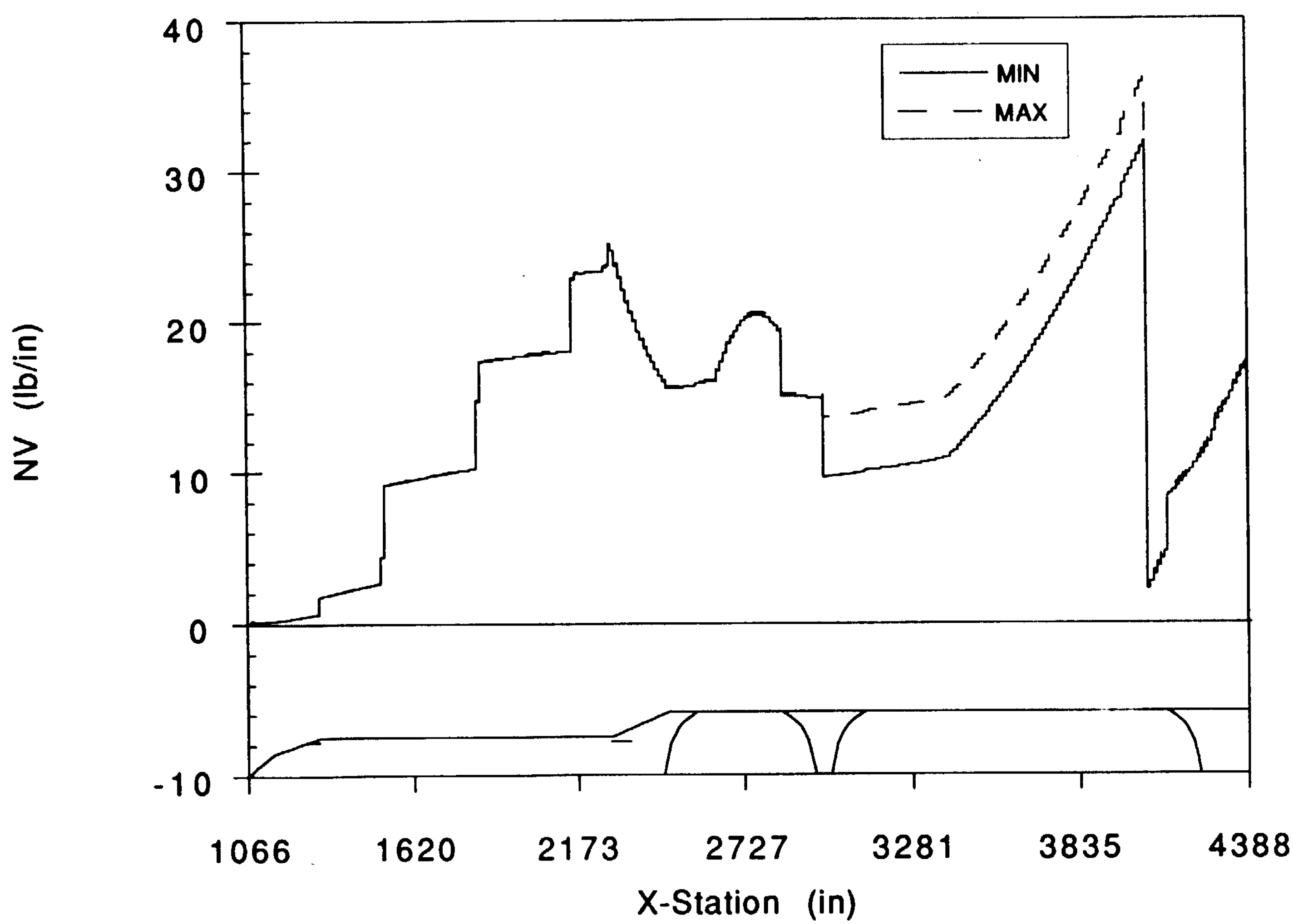


NLS1 CORE - 15 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lb)
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
-1.5 10^8
1066
1897
2727
3558
4388
X-Station (in)

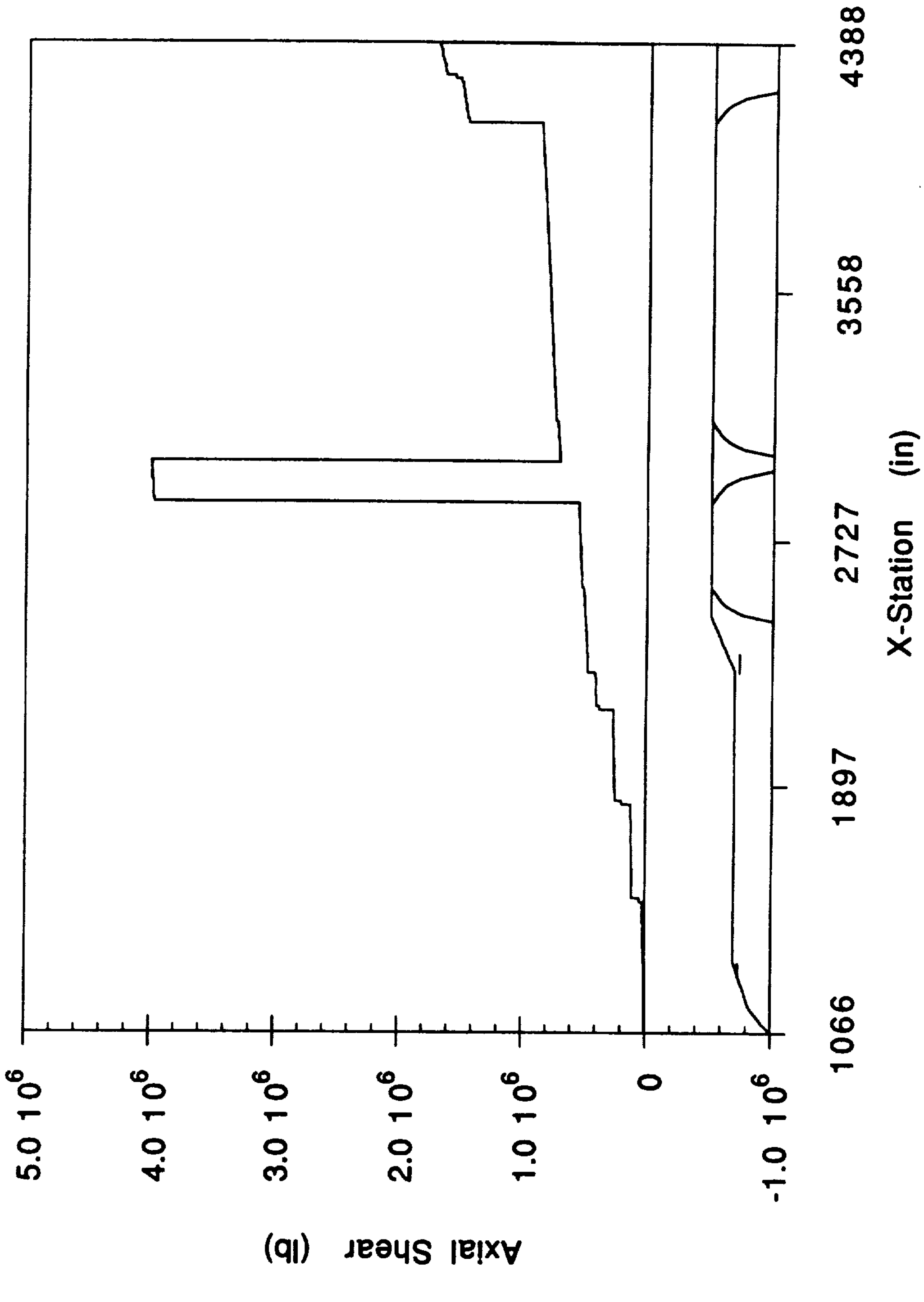
NLS1 CORE MAX-G 1ST STAGE NX vs X-STATION



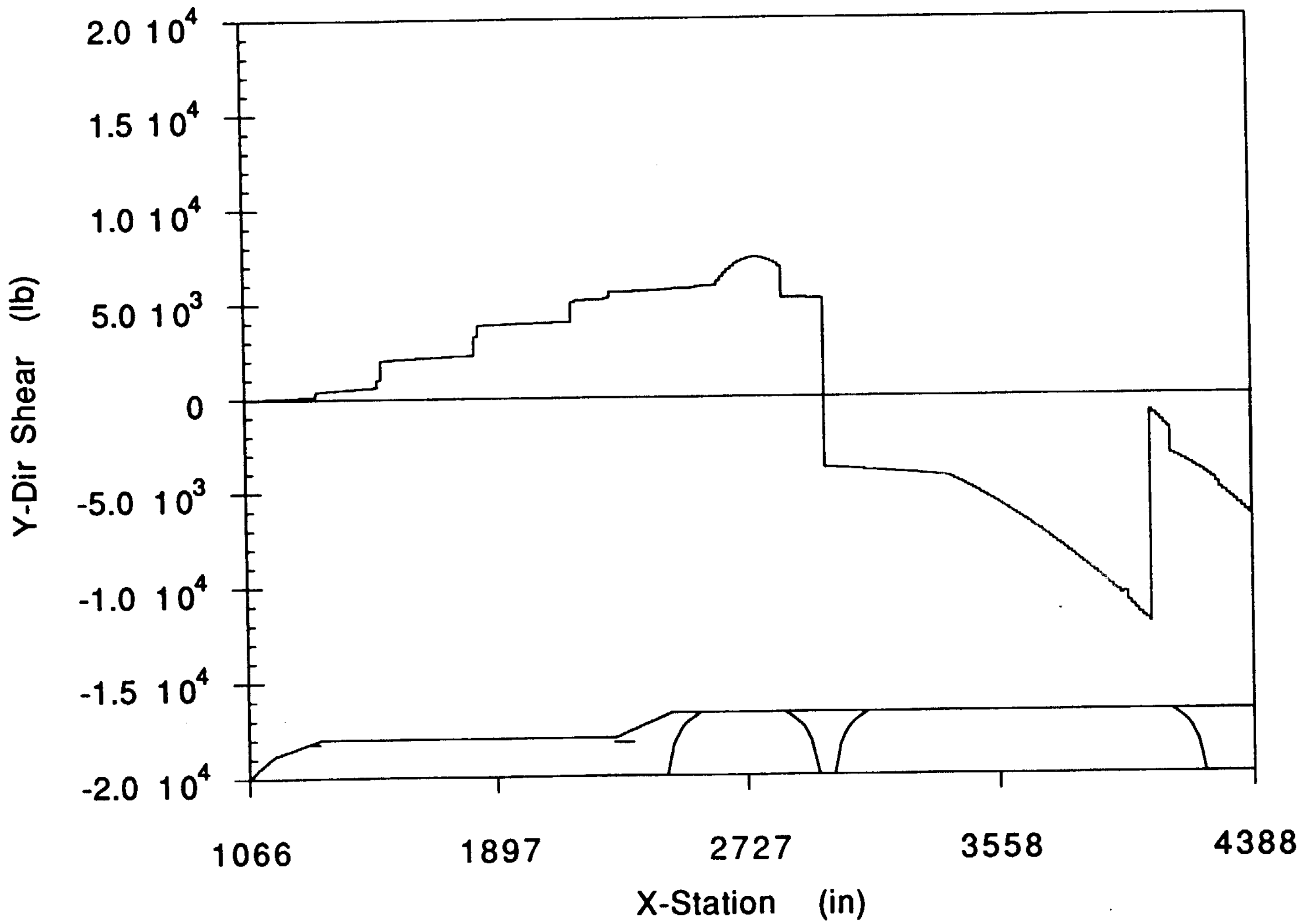
NLS1 CORE MAX-G 1ST STAGE
NV vs X-STATION

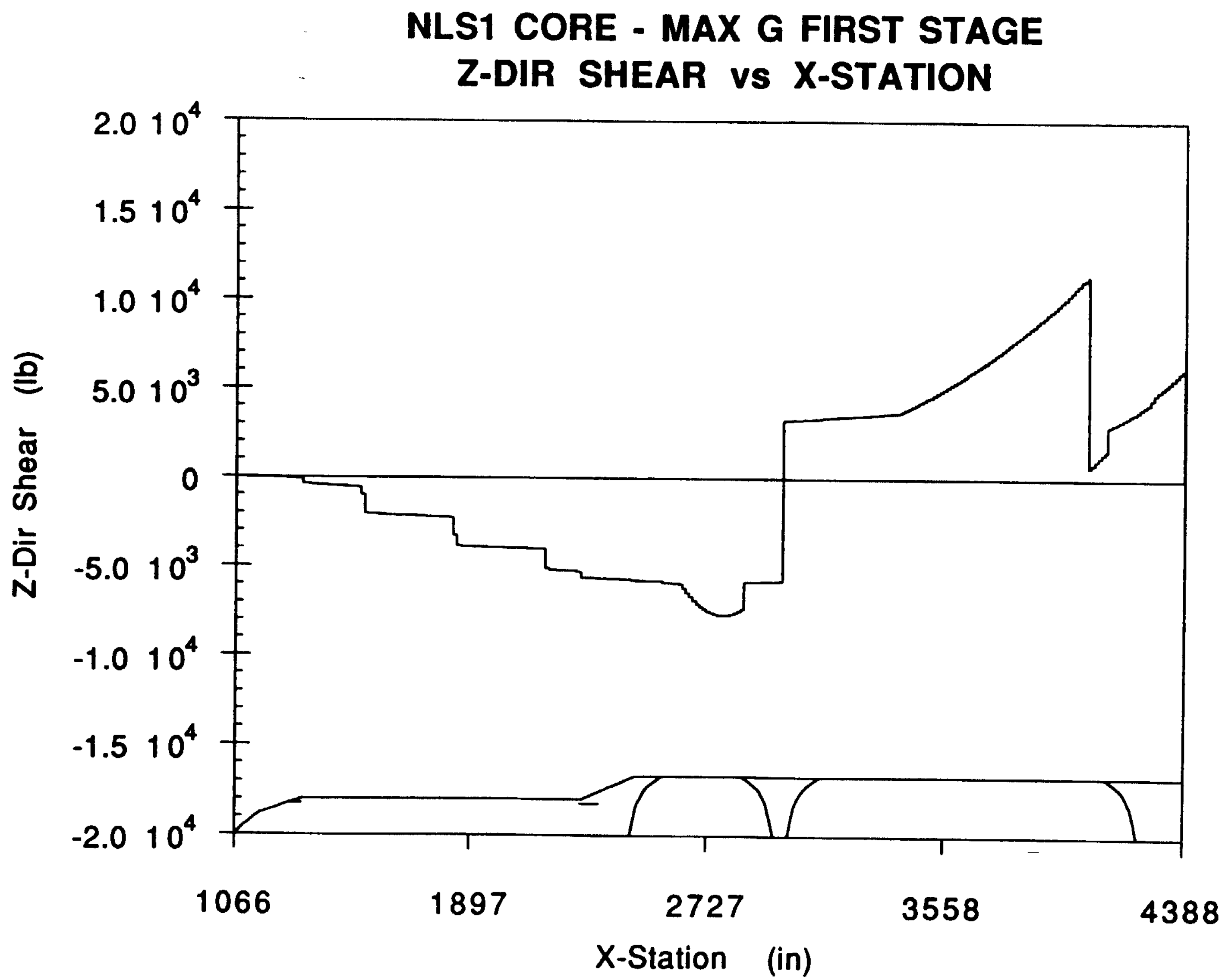


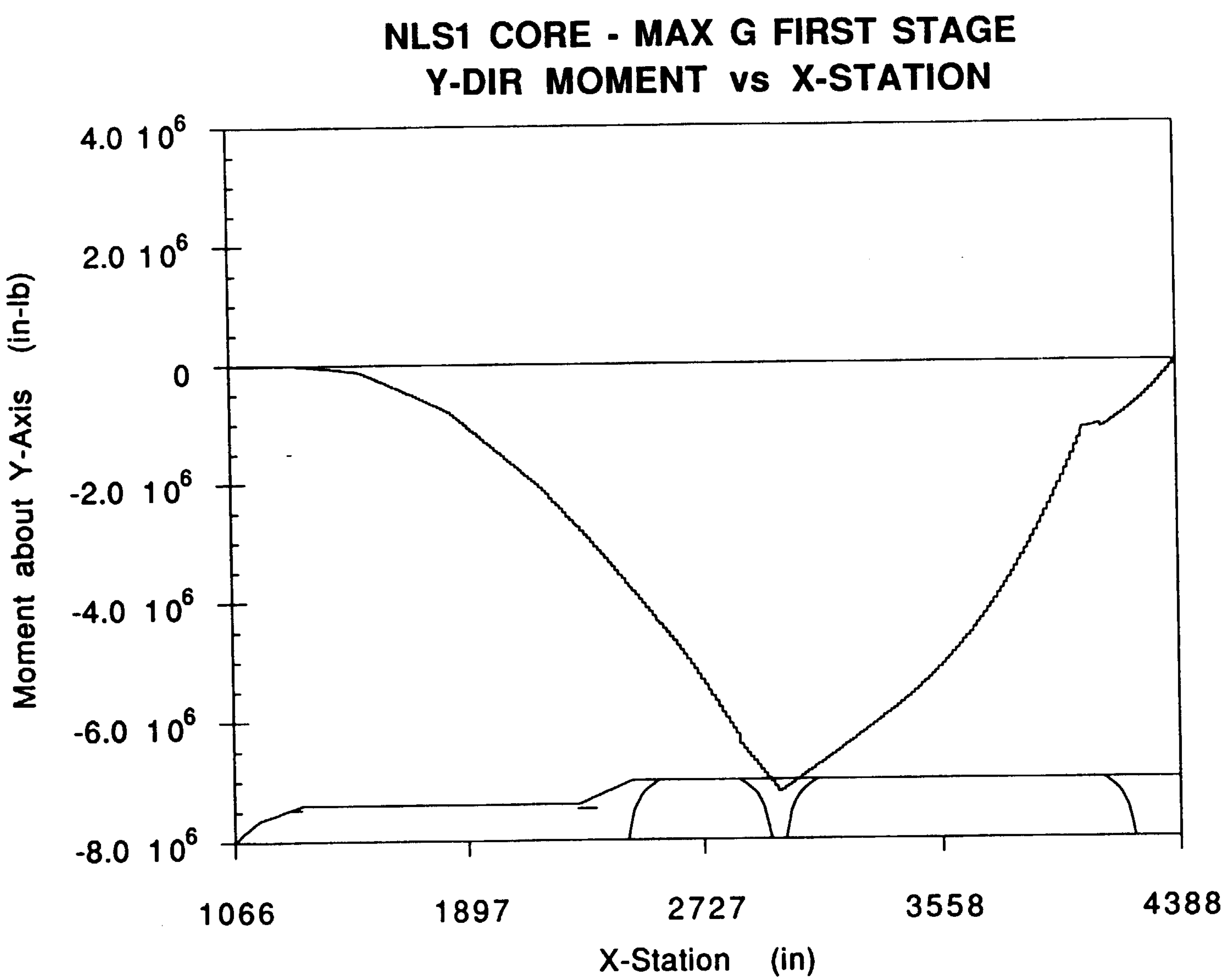
NLS1 CORE - MAX G FIRST STAGE
AXIAL SHEAR vs X-STATION



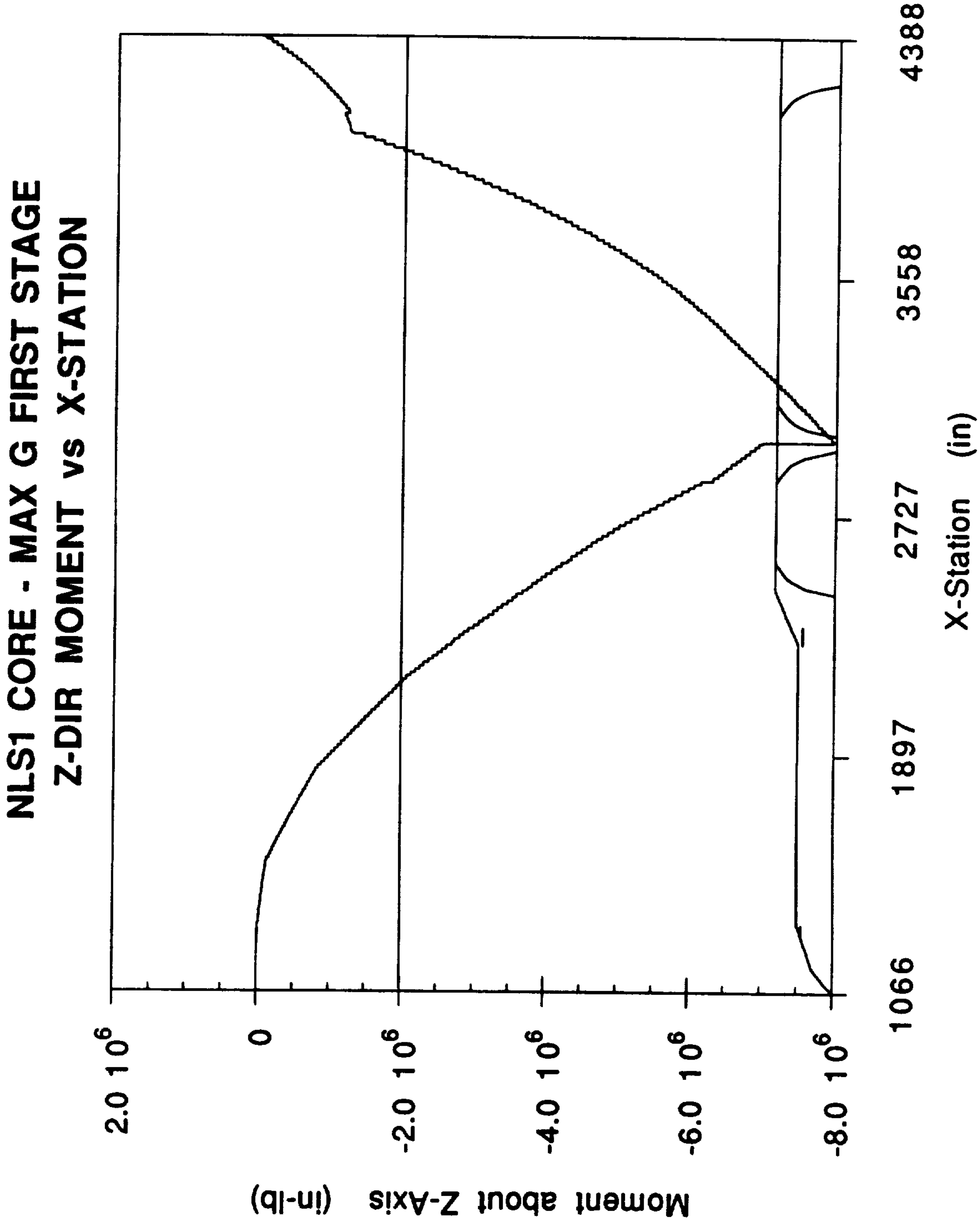
NLS1 CORE - MAX G FIRST STAGE
Y-DIR SHEAR vs X-STATION



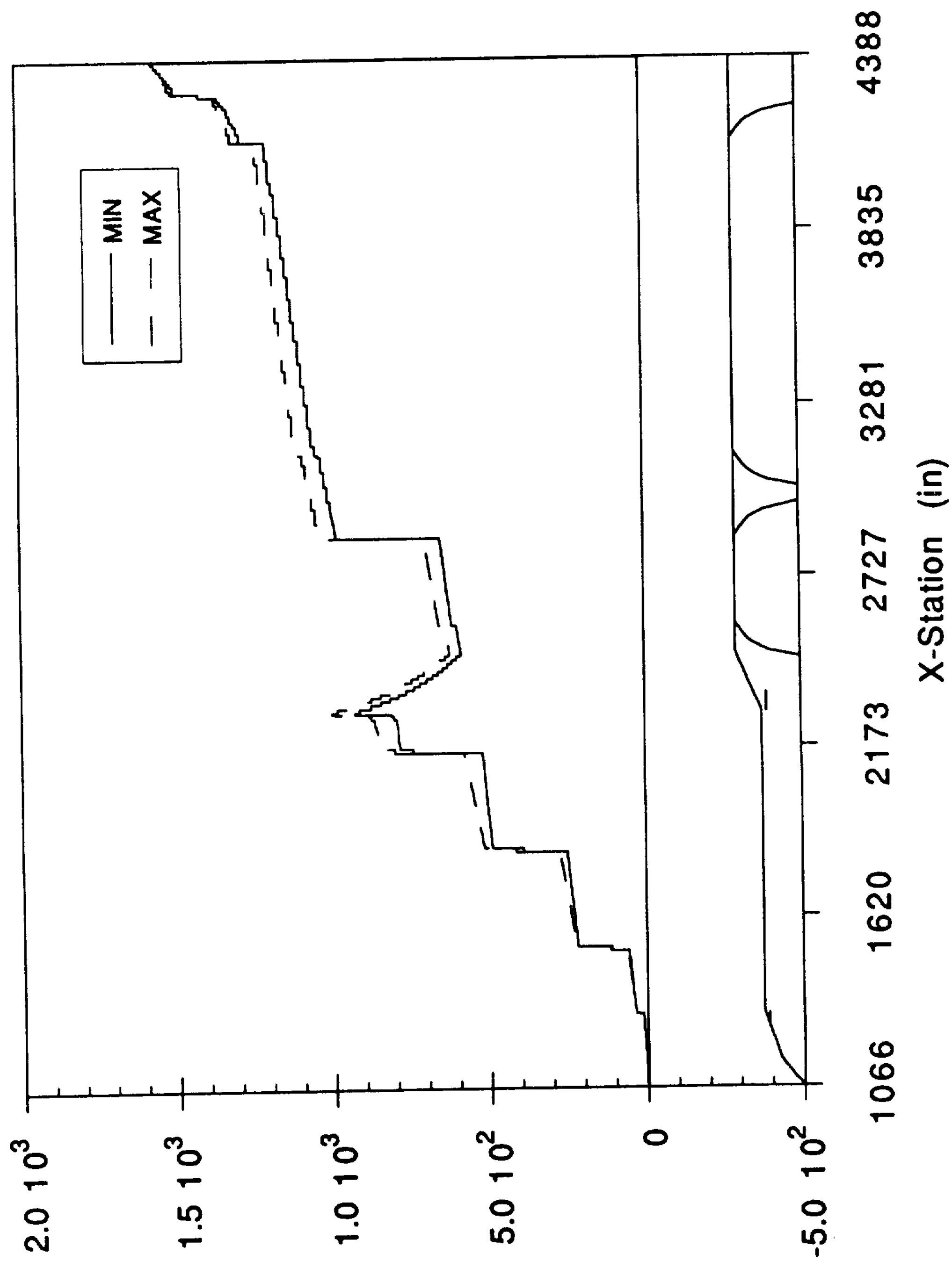

NLS1 CORE - MAX G FIRST STAGE
Z-DIR SHEAR vs X-STATION
2.0 10^4
1.5 10^4
1.0 10^4
5.0 10^3
0
-5.0 10^3
-1.0 10^4
-1.5 10^4
-2.0 10^4
Z-Dir Shear (lb)
1066
1897
2727
3558
4388
X-Station (in)



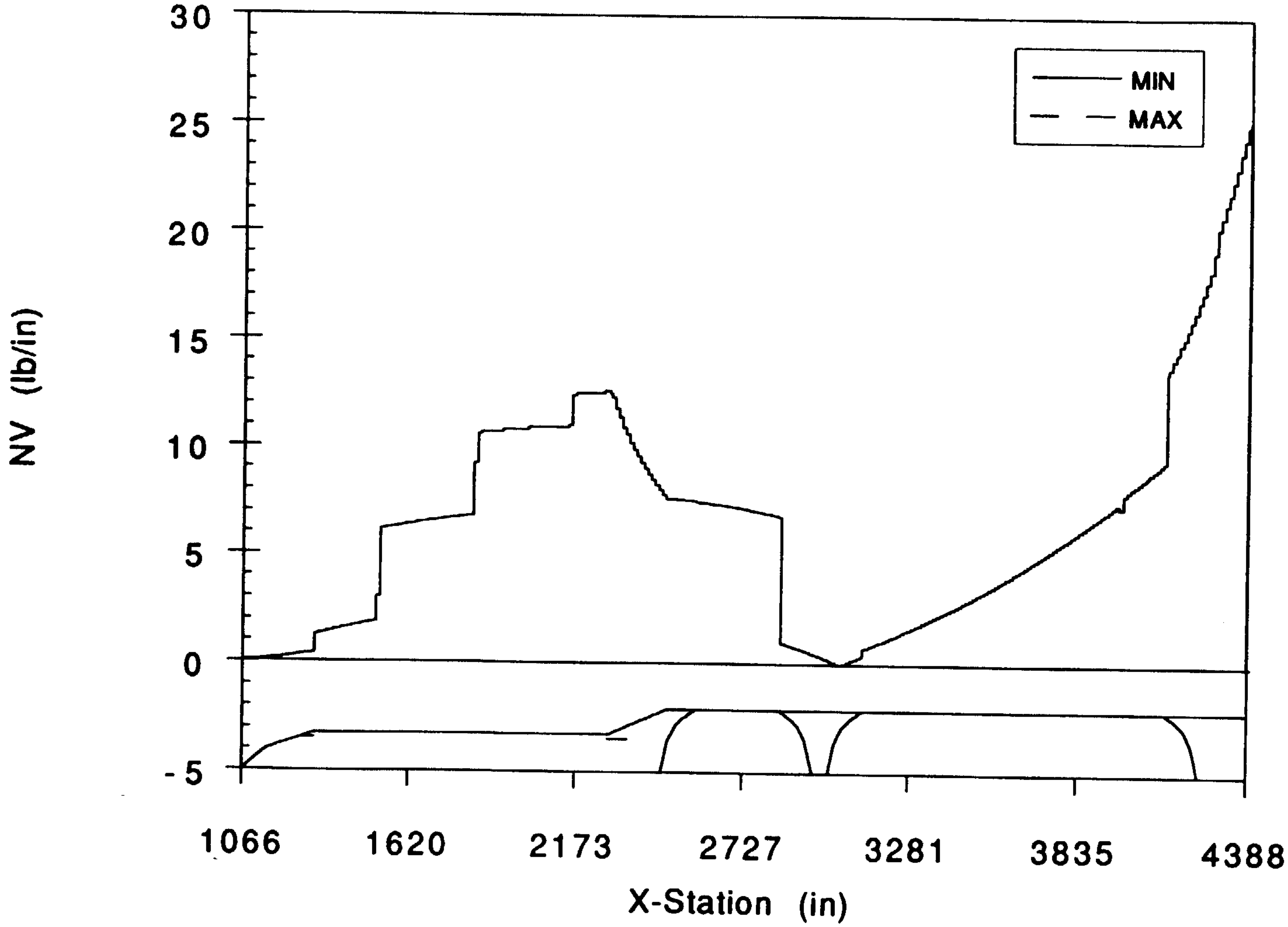
NLS1 CORE - MAX G FIRST STAGE
Y-DIR MOMENT vs X-STATION
4.0 10^6
2.0 10^6
0
-2.0 10^6
-4.0 10^6
-6.0 10^6
-8.0 10^6
Moment about Y-Axis (in-lb)
1066
1897
2727
3558
4388
X-Station (in)


NLS1 CORE - MAX G FIRST STAGE
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lb)
2.0 10^6
0
-2.0 10^6
-4.0 10^6
-6.0 10^6
-8.0 10^6
1066
1897
2727
3558
4388
X-Station (in)

NLS1 CORE MAX-G 2ND STAGE
NX vs X-STATION

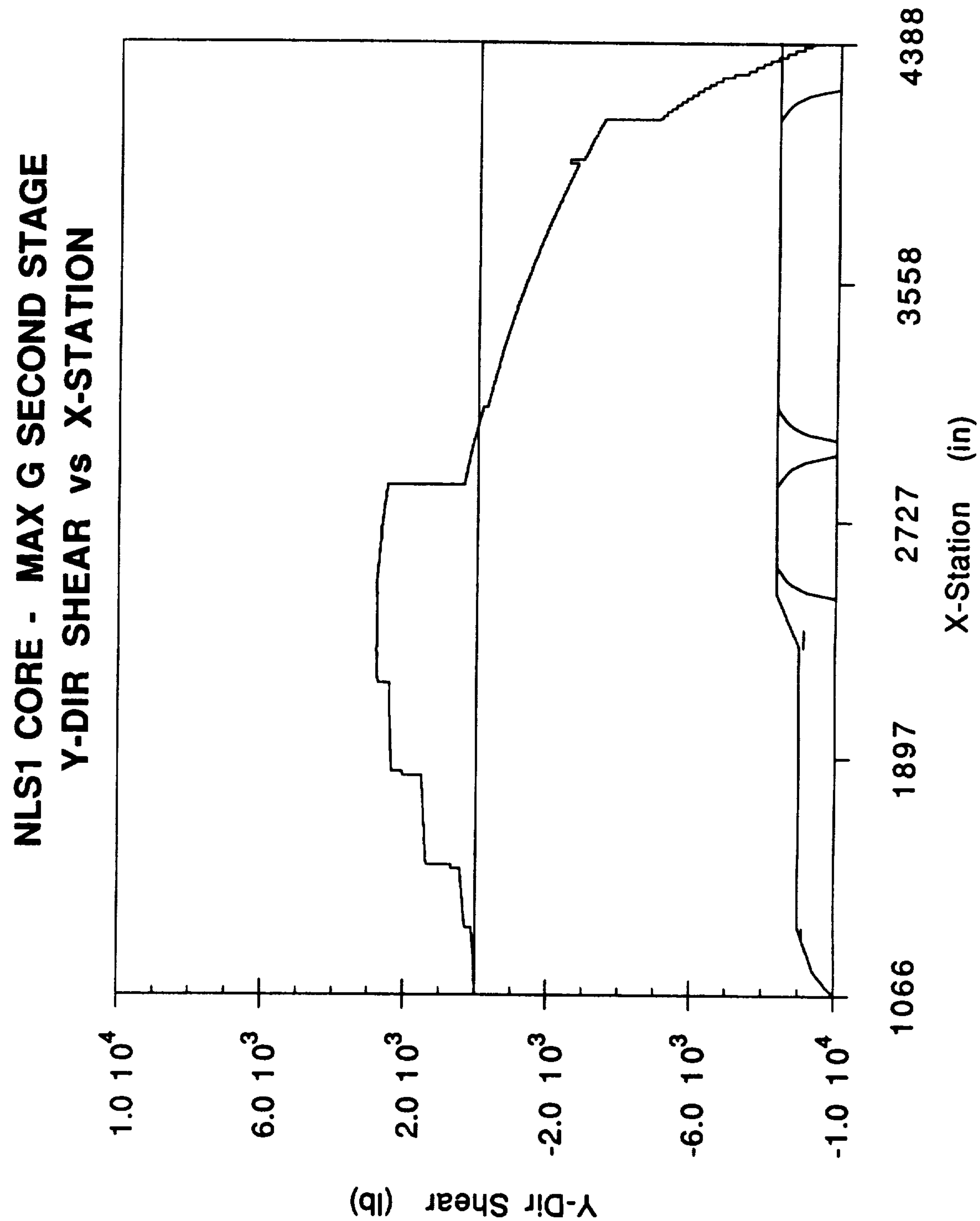


NLS1 CORE MAX-G 2ND STAGE
NV vs X-STATION

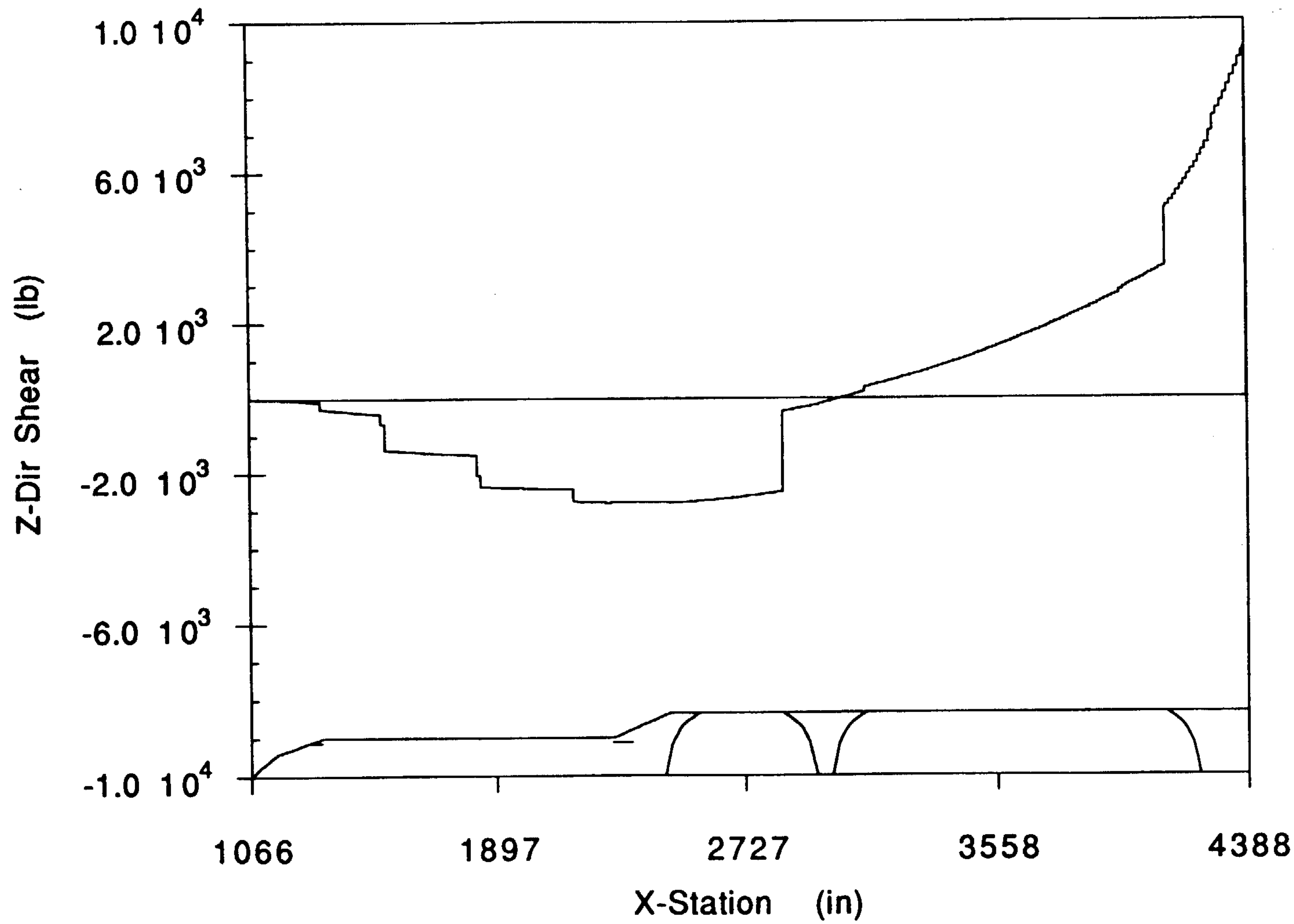


C-5

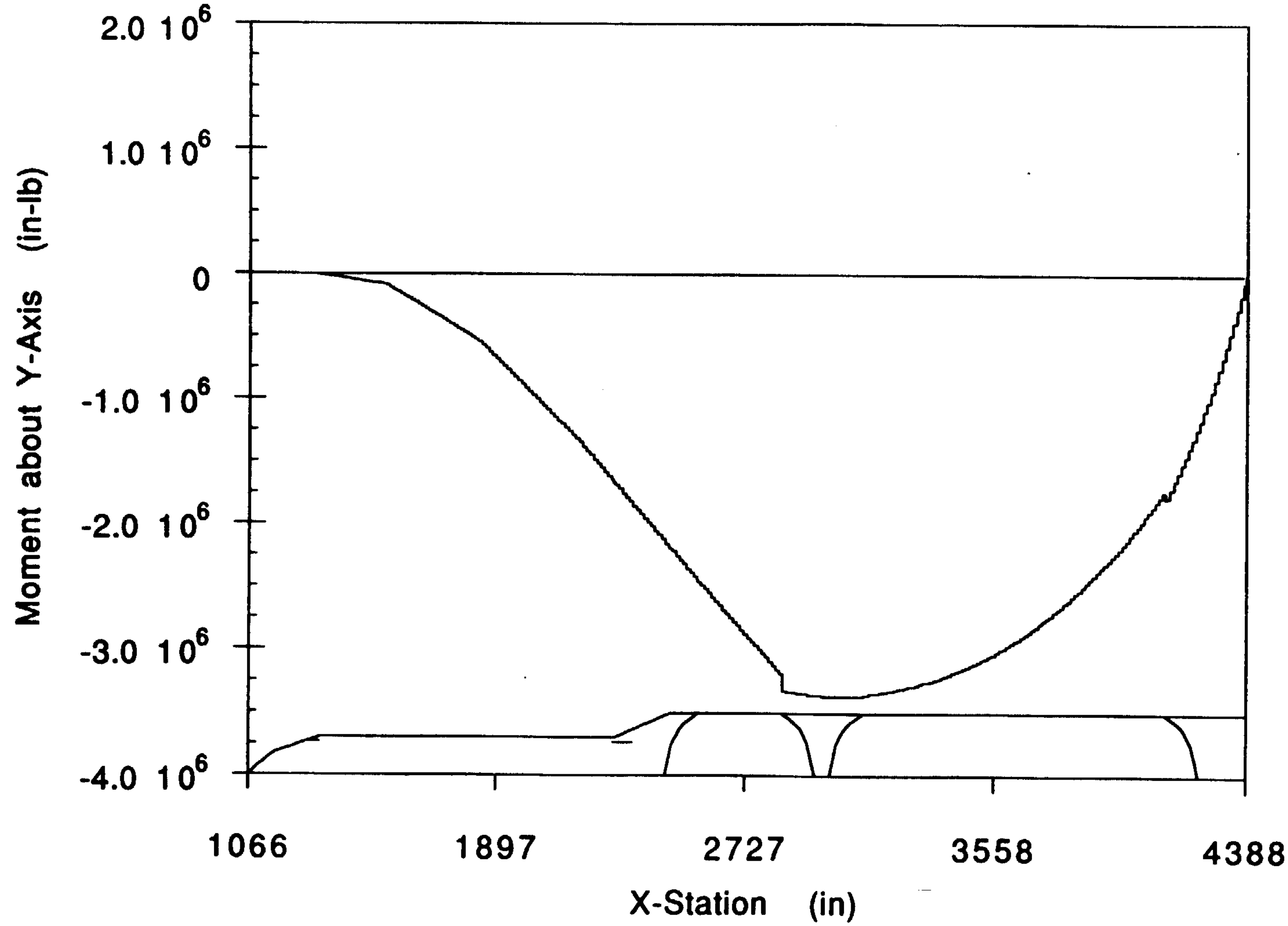
NLS1 CORE - MAX G SECOND STAGE
AXIAL SHEAR vs X-STATION


NLS1 CORE - MAX G SECOND STAGE
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lb)
1.0 10^4
6.0 10^3
2.0 10^3
-2.0 10^3
-6.0 10^3
-1.0 10^4
1066
1897
2727
3558
4388
X-Station (in)

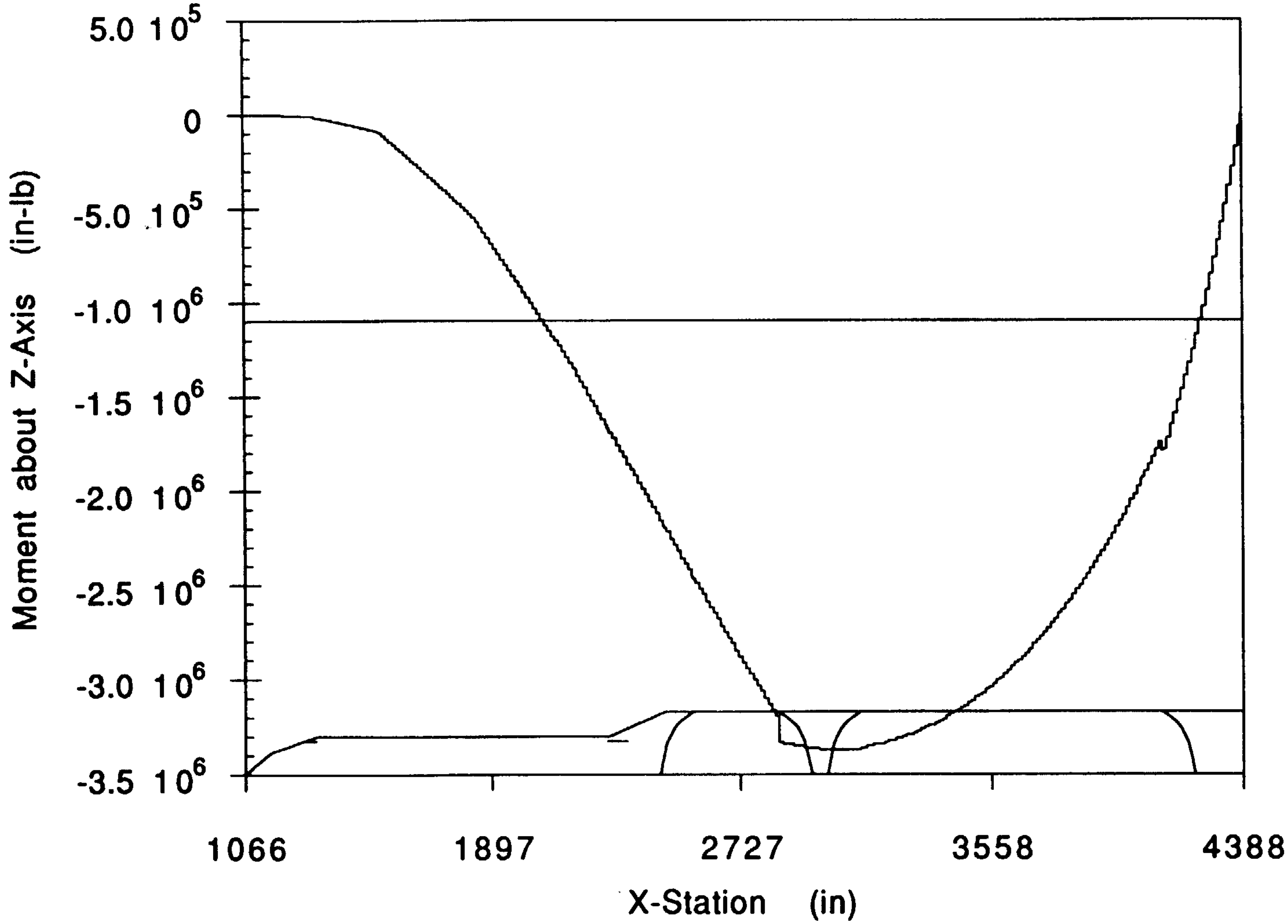
NLS1 CORE - MAX G SECOND STAGE
Z-DIR SHEAR vs X-STATION

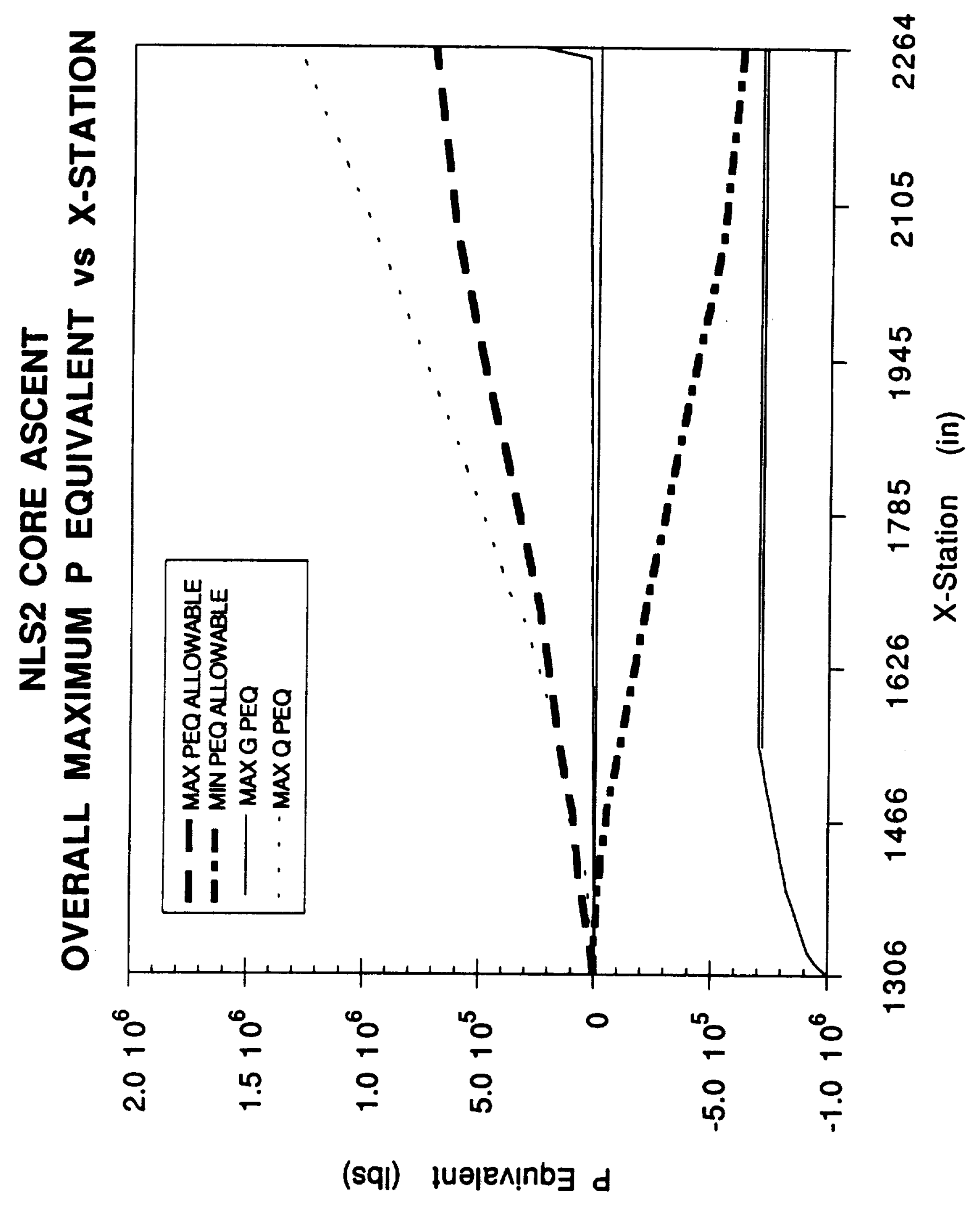


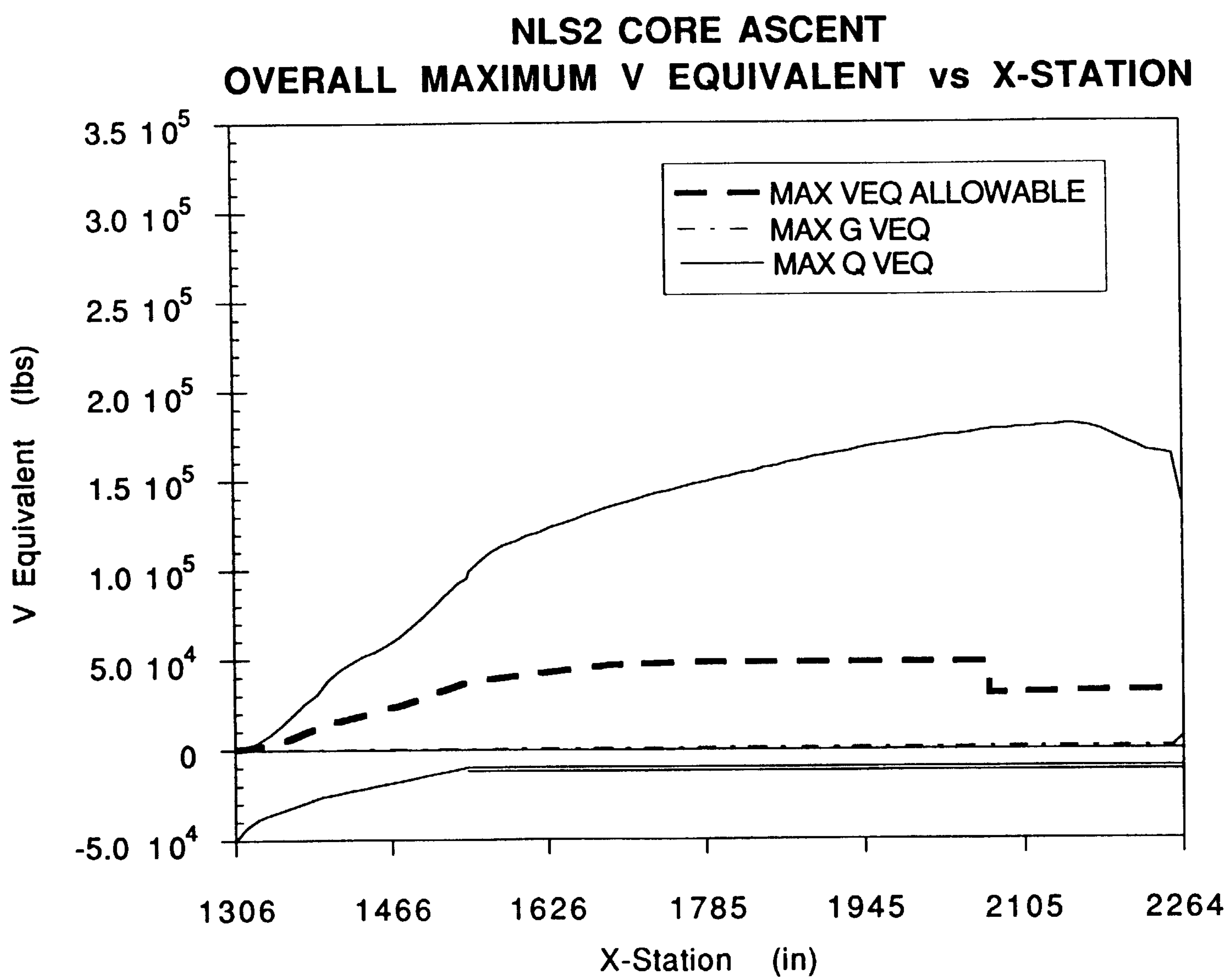
NLS1 CORE - MAX G SECOND STAGE
Y-DIR MOMENT vs X-STATION



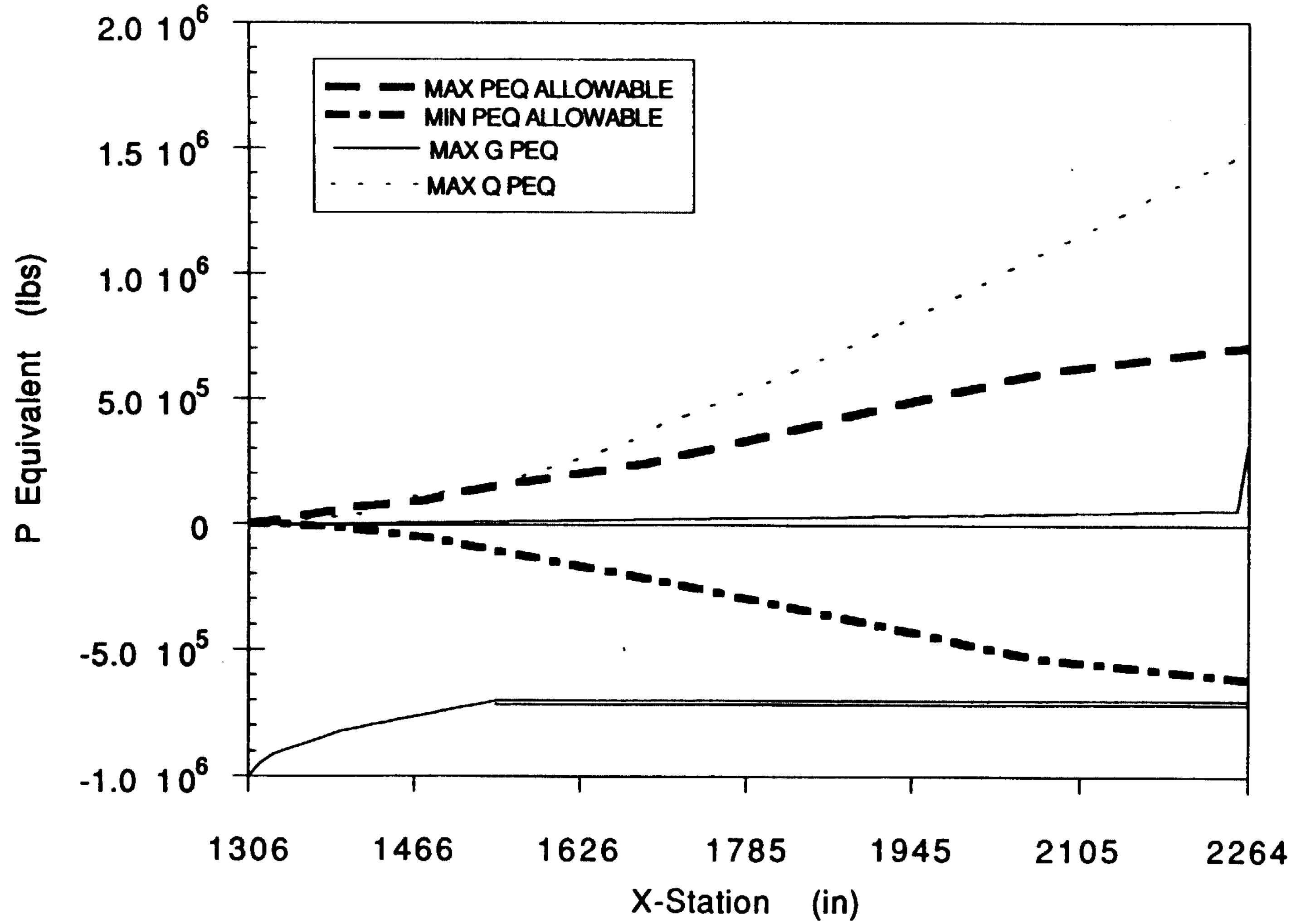
NLS1 CORE - MAX G SECOND STAGE
Z-DIR MOMENT vs X-STATION



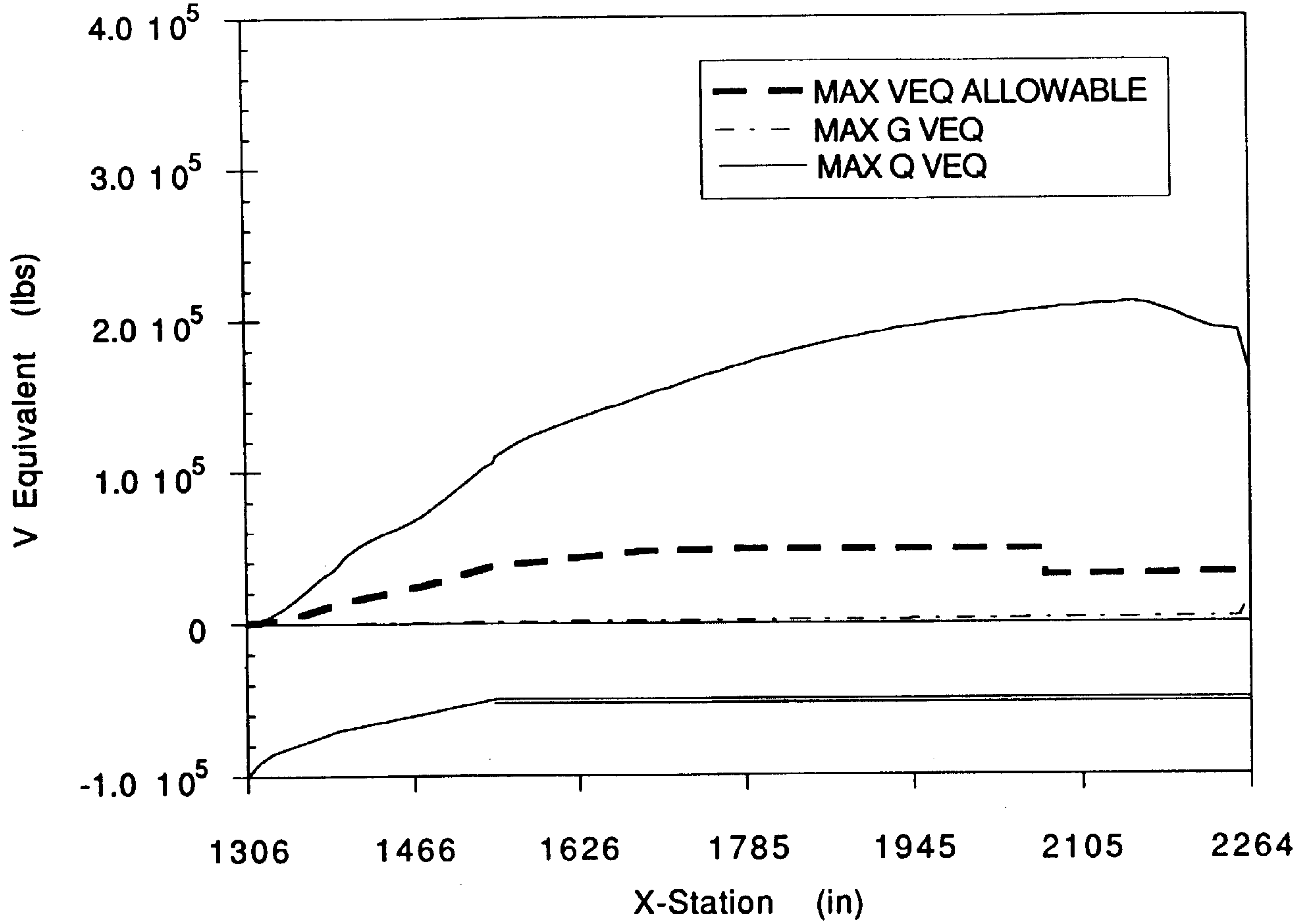

NLS2 CORE ASCENT
OVERALL MAXIMUM P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MAX G PEQ
MAX Q PEQ
P Equivalent (lbs)
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
-1.0 10^6
X-Station (in)
1306
1466
1626
1785
1945
2105
2264

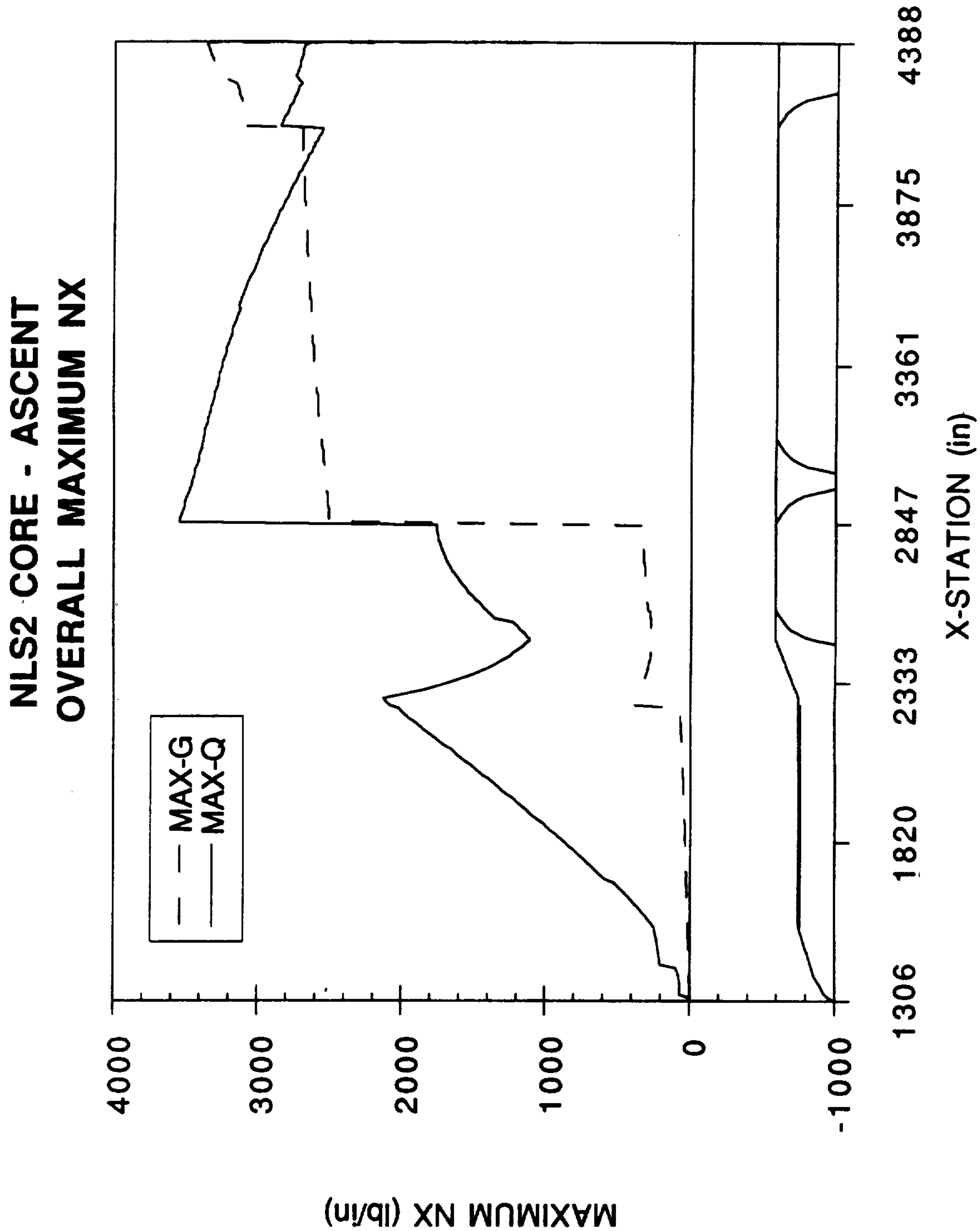

NLS2 CORE ASCENT
OVERALL MAXIMUM V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MAX G VEQ
MAX Q VEQ
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
V Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

NLS2 CORE ASCENT ENGINE OUT
OVERALL MAXIMUM P EQUIVALENT vs X-STATION

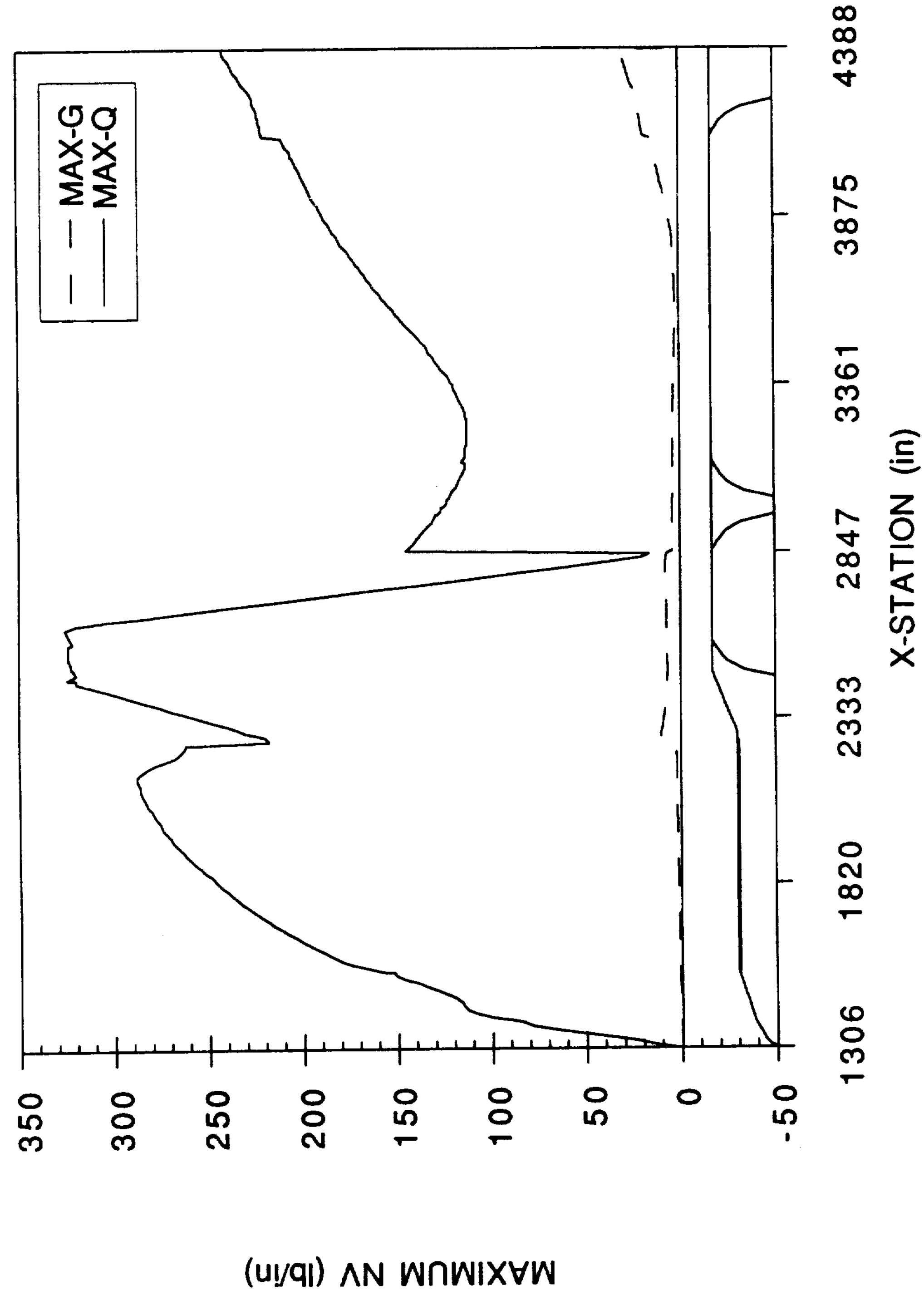


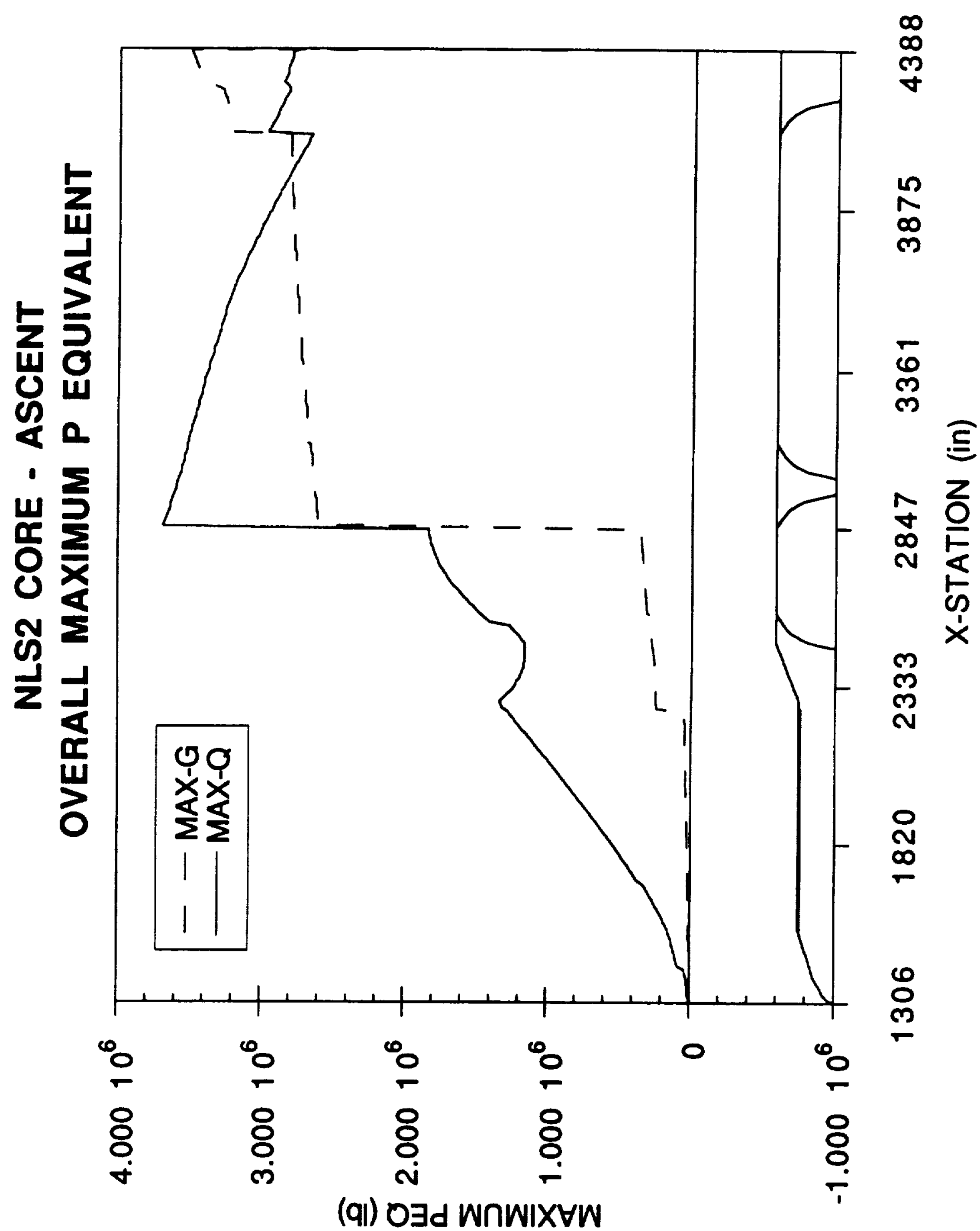
NLS2 CORE ASCENT ENGINE OUT
OVERALL MAXIMUM V EQUIVALENT vs X-STATION



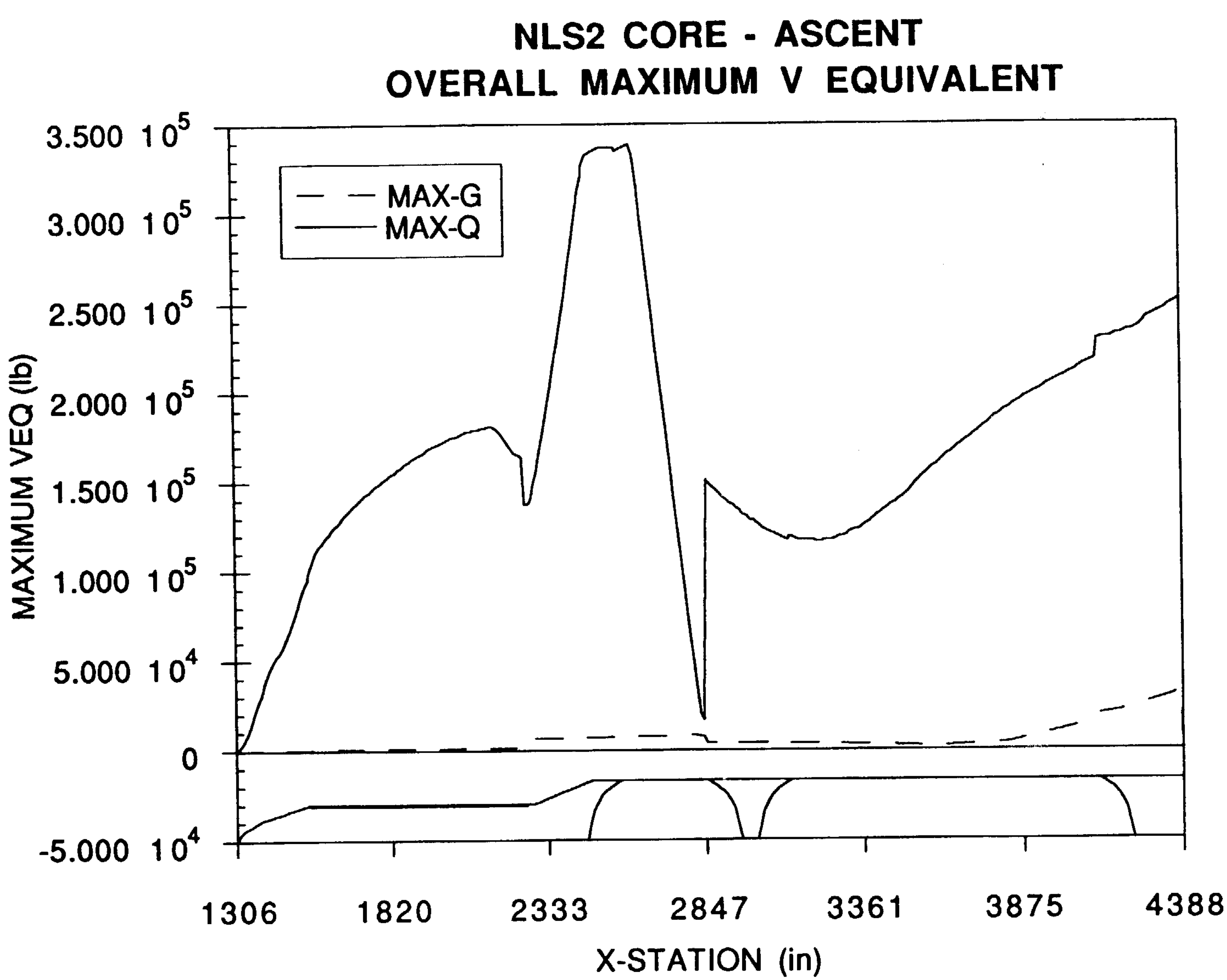

NLS2 CORE - ASCENT
OVERALL MAXIMUM NX
MAX-G
MAX-Q
MAXIMUM NX (lb/in)
4000
3000
2000
1000
0
-1000
X-STATION (in)
1306
1820
2333
2847
3361
3875
4388

NLS2 CORE - ASCENT
OVERALL MAXIMUM NV

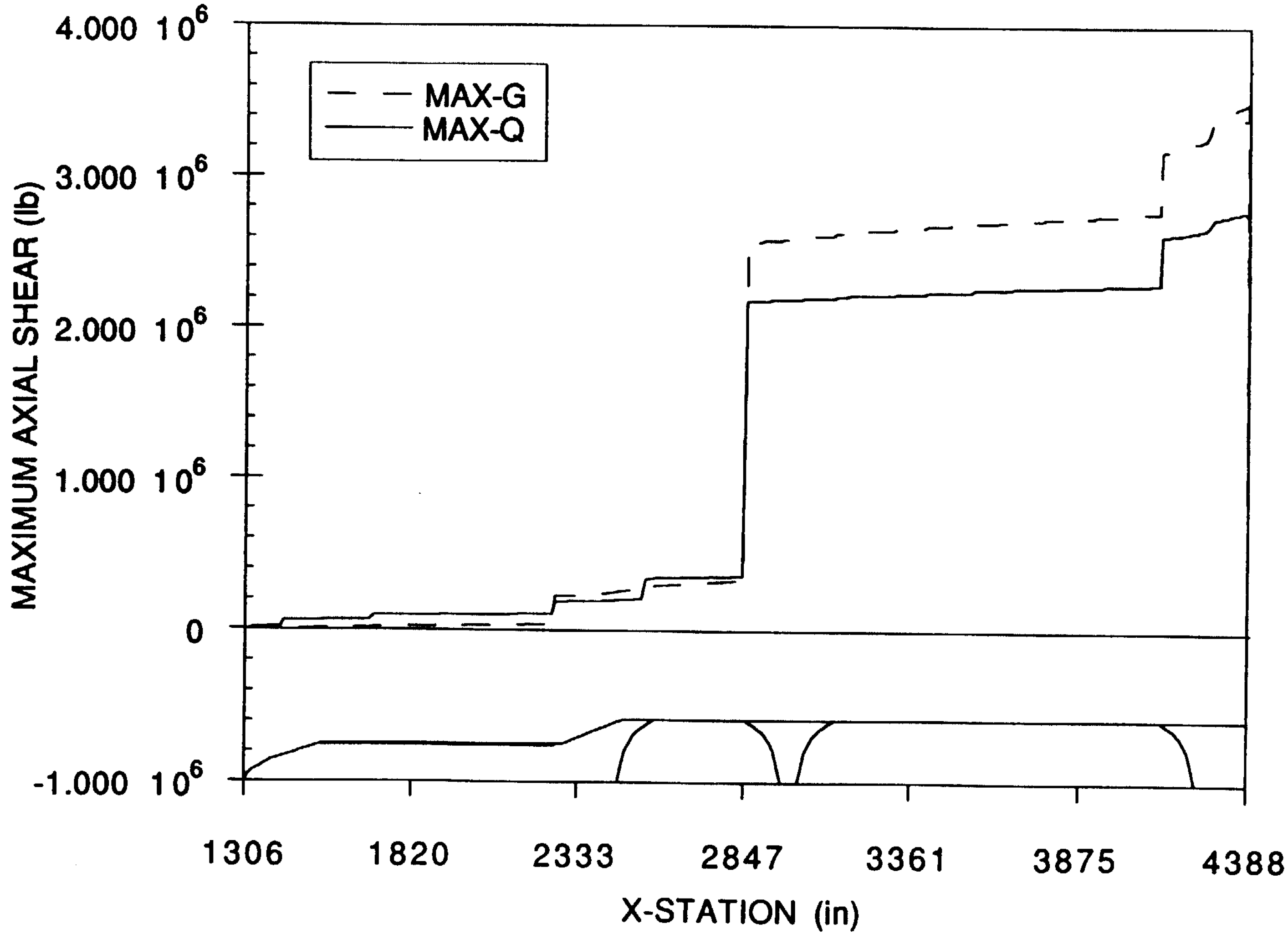




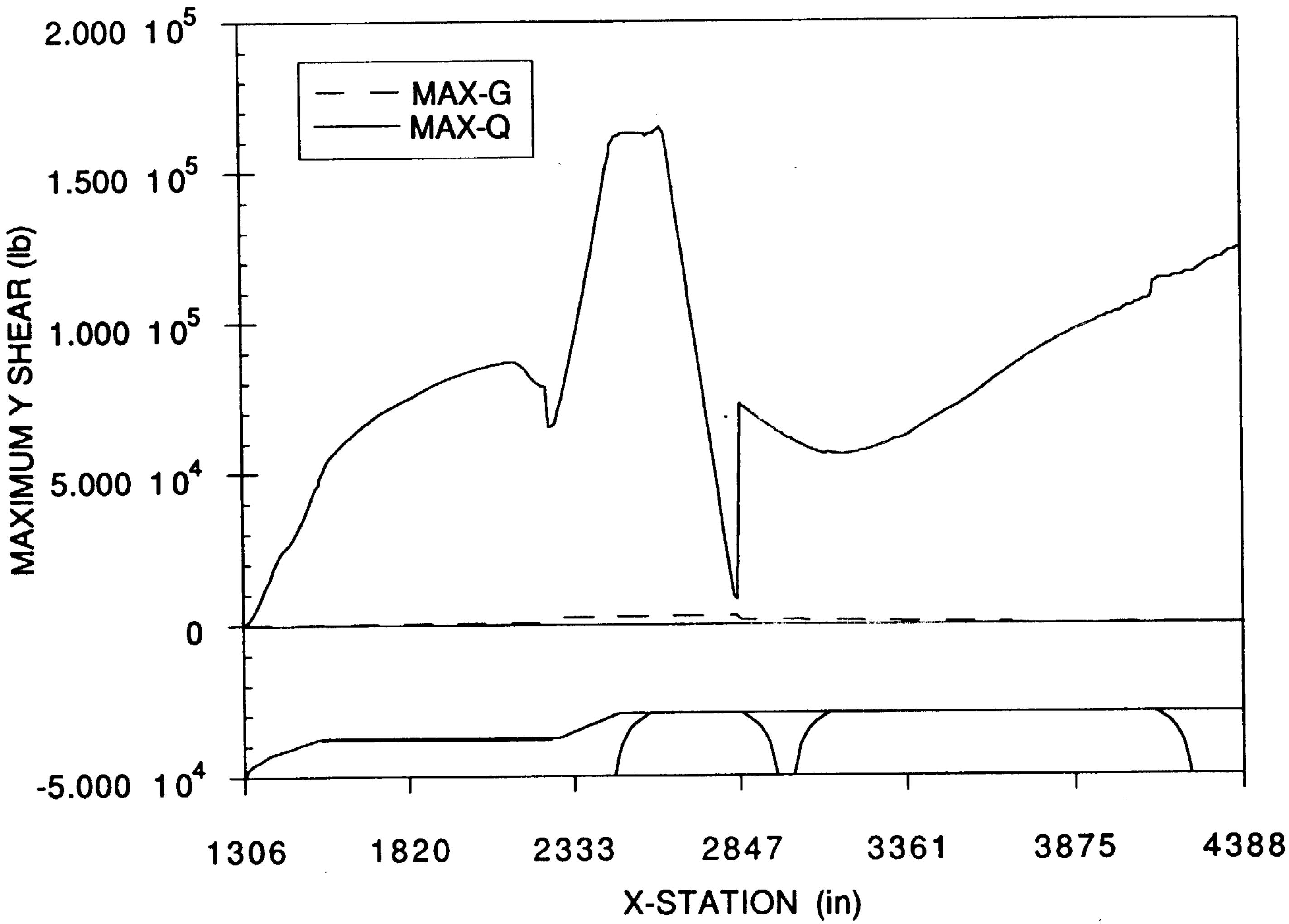
NLS2 CORE - ASCENT
OVERALL MAXIMUM P EQUIVALENT
MAX-G
MAX-Q
MAXIMUM PEQ (lb)
4.000 10^6
3.000 10^6
2.000 10^6
1.000 10^6
0
-1.000 10^6
X-STATION (in)
1306
1820
2333
2847
3361
3875
4388

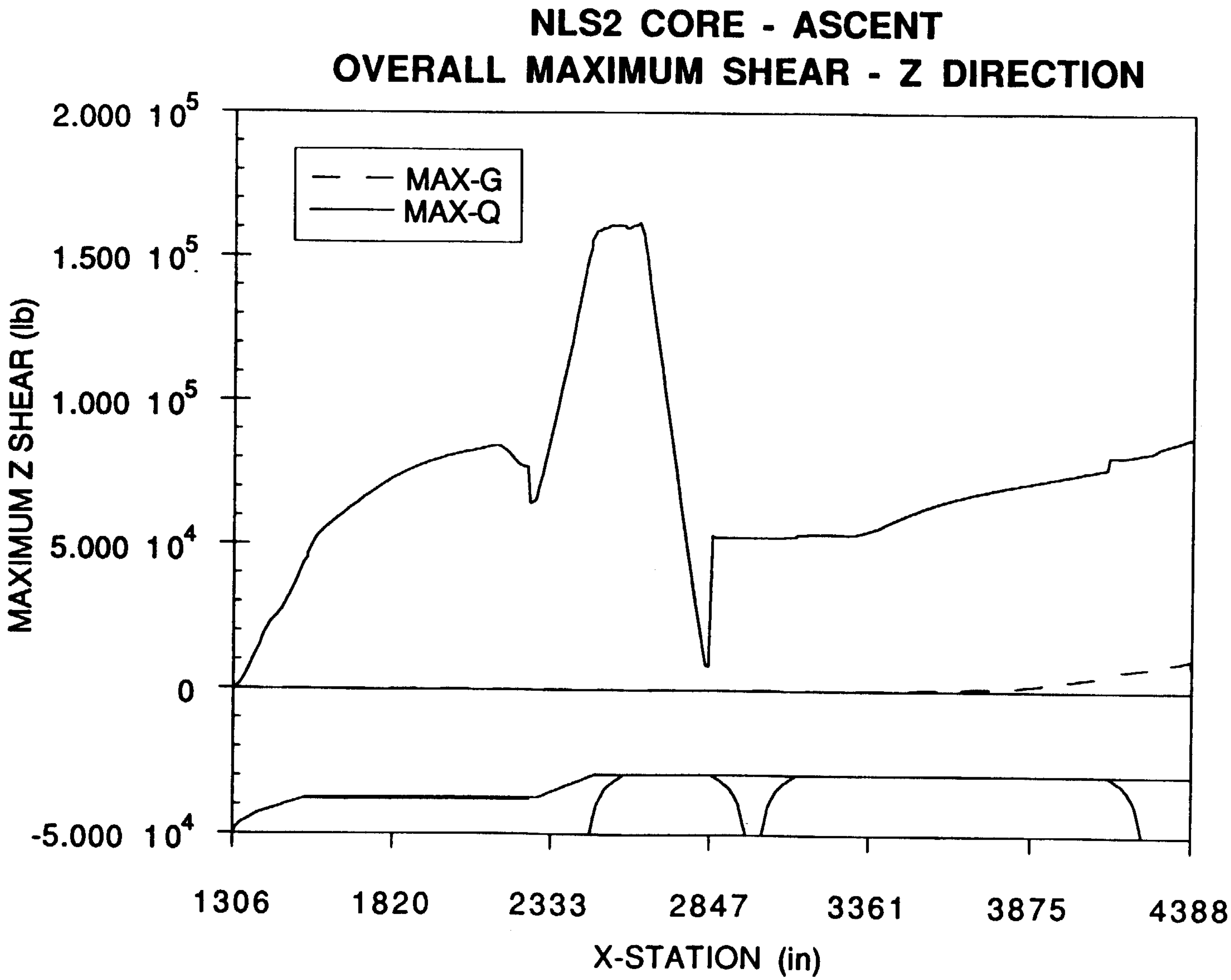

NLS2 CORE - ASCENT
OVERALL MAXIMUM V EQUIVALENT
MAX-G
MAX-Q
MAXIMUM VEQ (lb)
3.500 10^5
3.000 10^5
2.500 10^5
2.000 10^5
1.500 10^5
1.000 10^5
5.000 10^4
0
-5.000 10^4
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

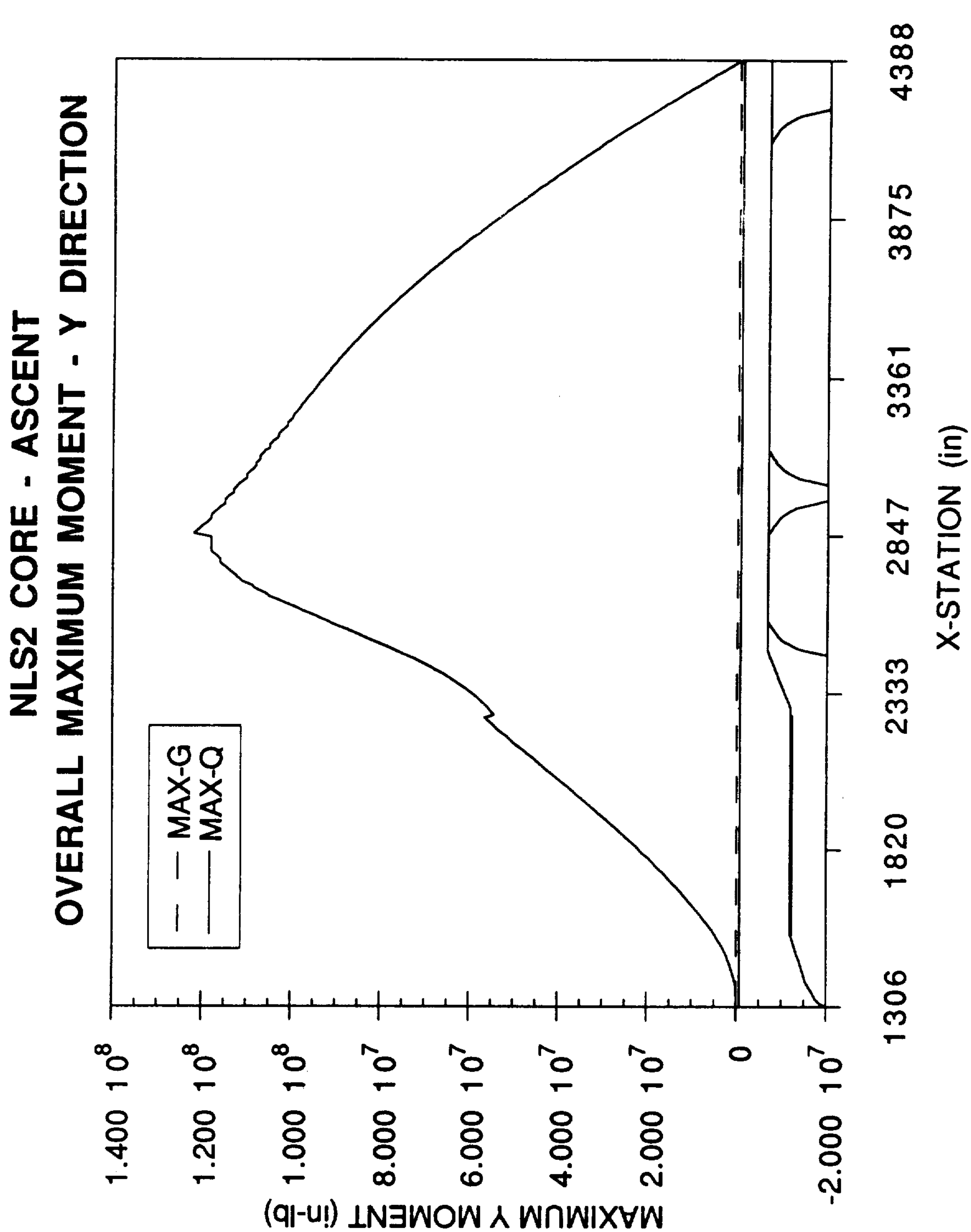
NLS2 CORE - ASCENT
OVERALL MAXIMUM AXIAL SHEAR

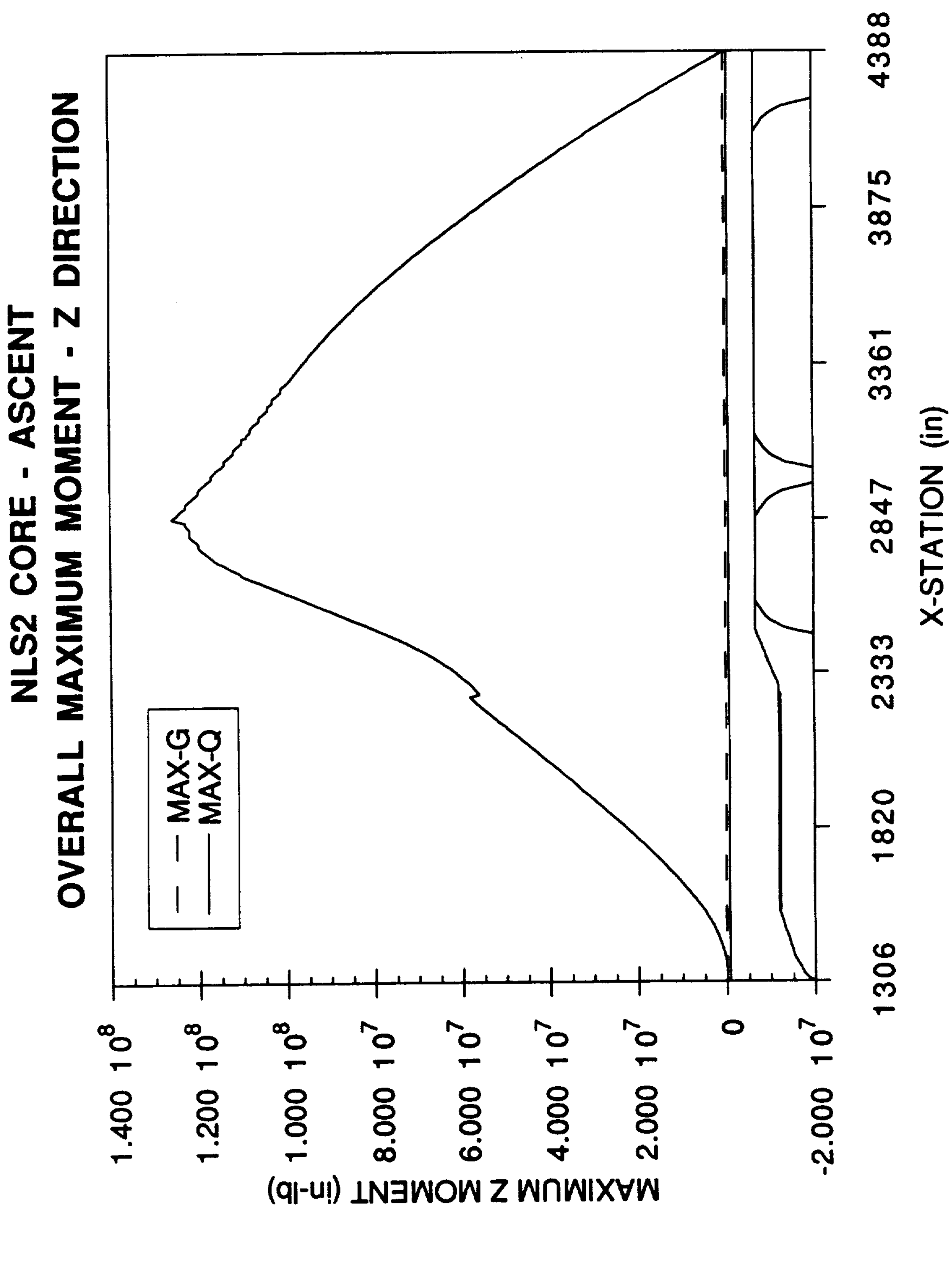


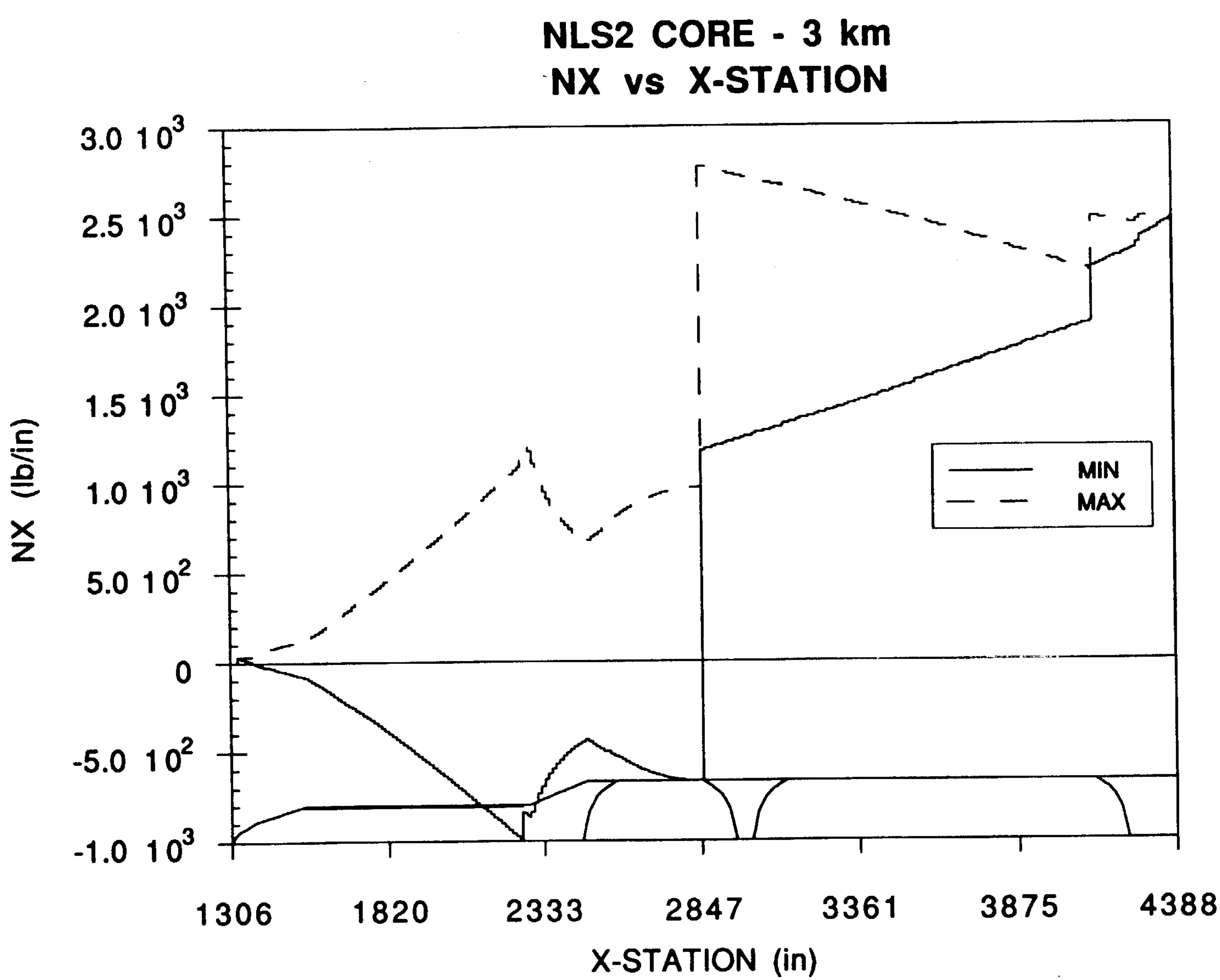
NLS2 CORE - ASCENT
OVERALL MAXIMUM SHEAR - Y DIRECTION

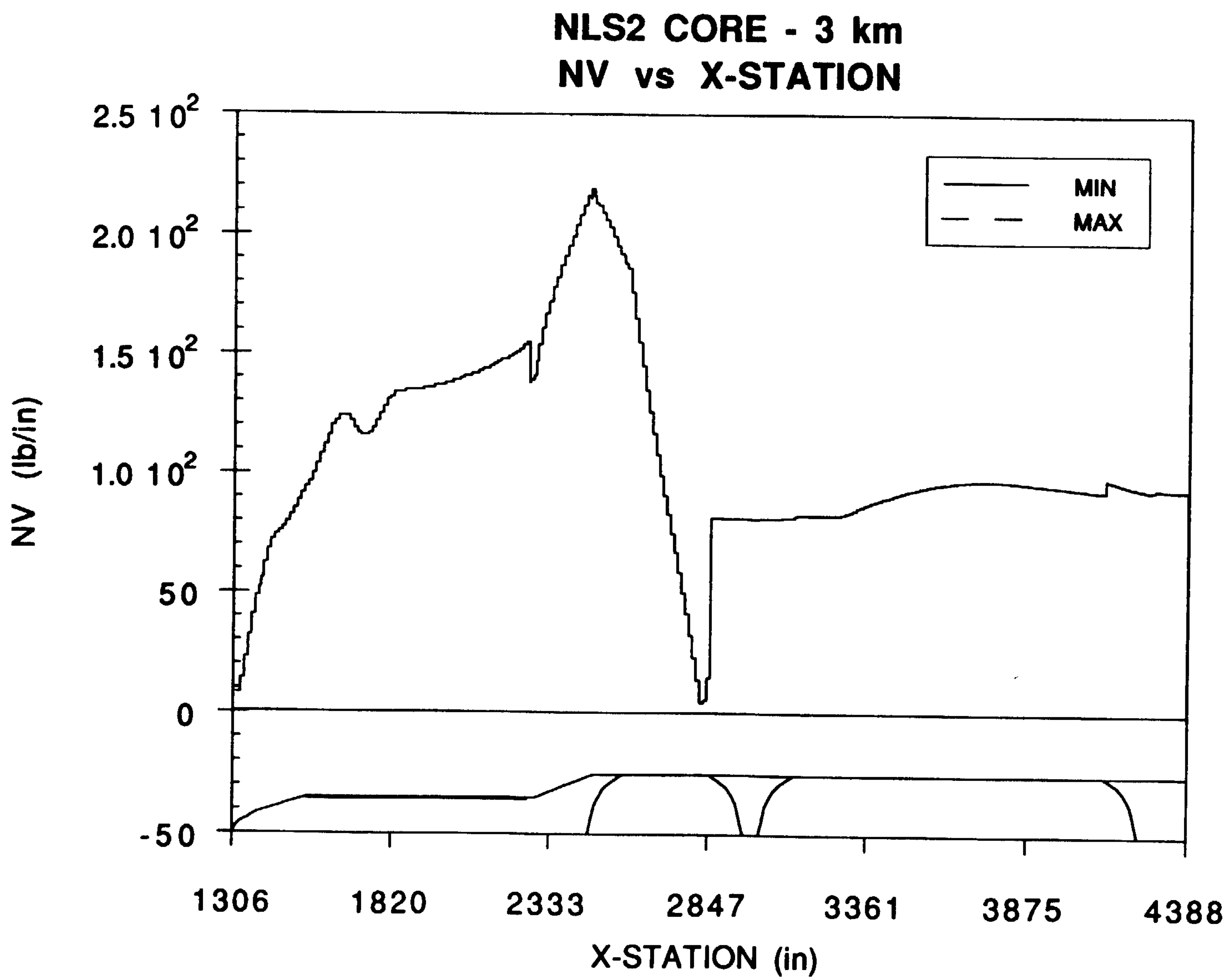



NLS2 CORE - ASCENT
OVERALL MAXIMUM SHEAR - Z DIRECTION
MAX-G
MAX-Q
MAXIMUM Z SHEAR (lb)
2.000 10^5
1.500 10^5
1.000 10^5
5.000 10^4
0
-5.000 10^4
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

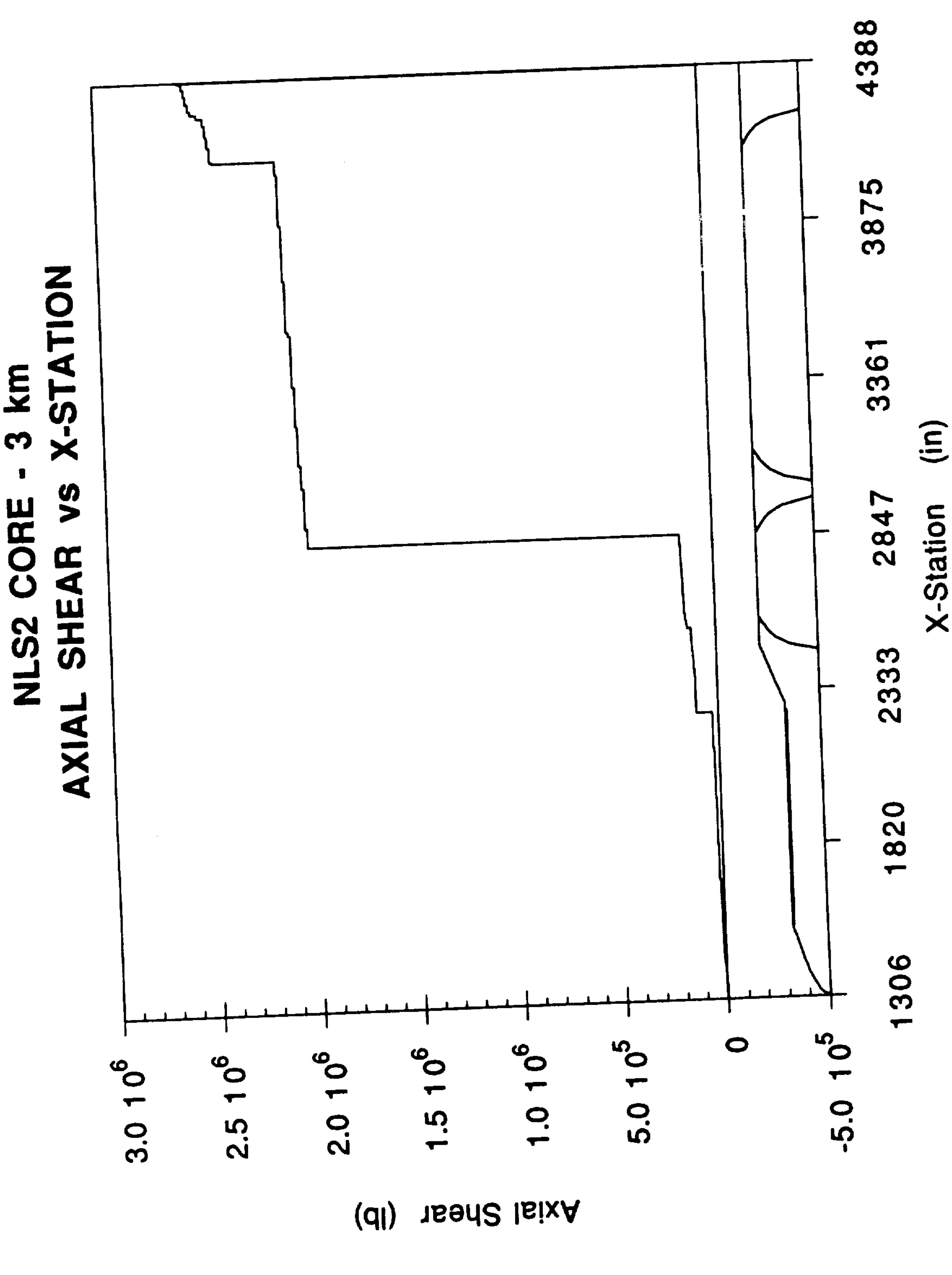

NLS2 CORE - ASCENT
OVERALL MAXIMUM MOMENT - Y DIRECTION
MAX-G
MAX-Q
MAXIMUM Y MOMENT (in-lb)
1.400 10^8
1.200 10^8
1.000 10^8
8.000 10^7
6.000 10^7
4.000 10^7
2.000 10^7
0
-2.000 10^7
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)


NLS2 CORE - ASCENT
OVERALL MAXIMUM MOMENT - Z DIRECTION
MAX-G
MAX-Q
MAXIMUM Z MOMENT (in-lb)
1.400 10^8
1.200 10^8
1.000 10^8
8.000 10^7
6.000 10^7
4.000 10^7
2.000 10^7
0
-2.000 10^7
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

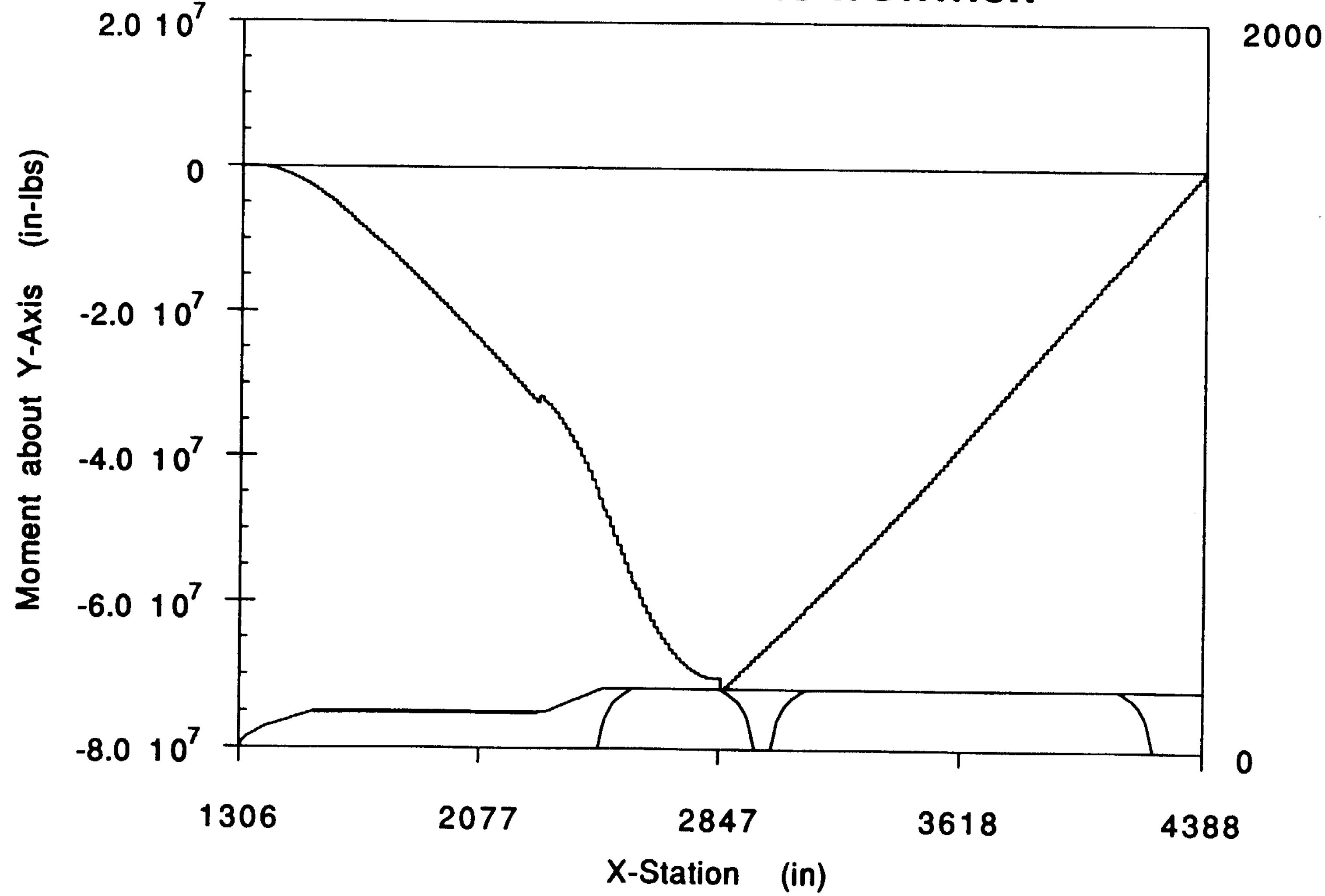

NLS2 CORE - 3 km
NX vs X-STATION
NX (lb/in)
3.0 10^3
2.5 10^3
2.0 10^3
1.5 10^3
1.0 10^3
5.0 10^2
0
-5.0 10^2
-1.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX



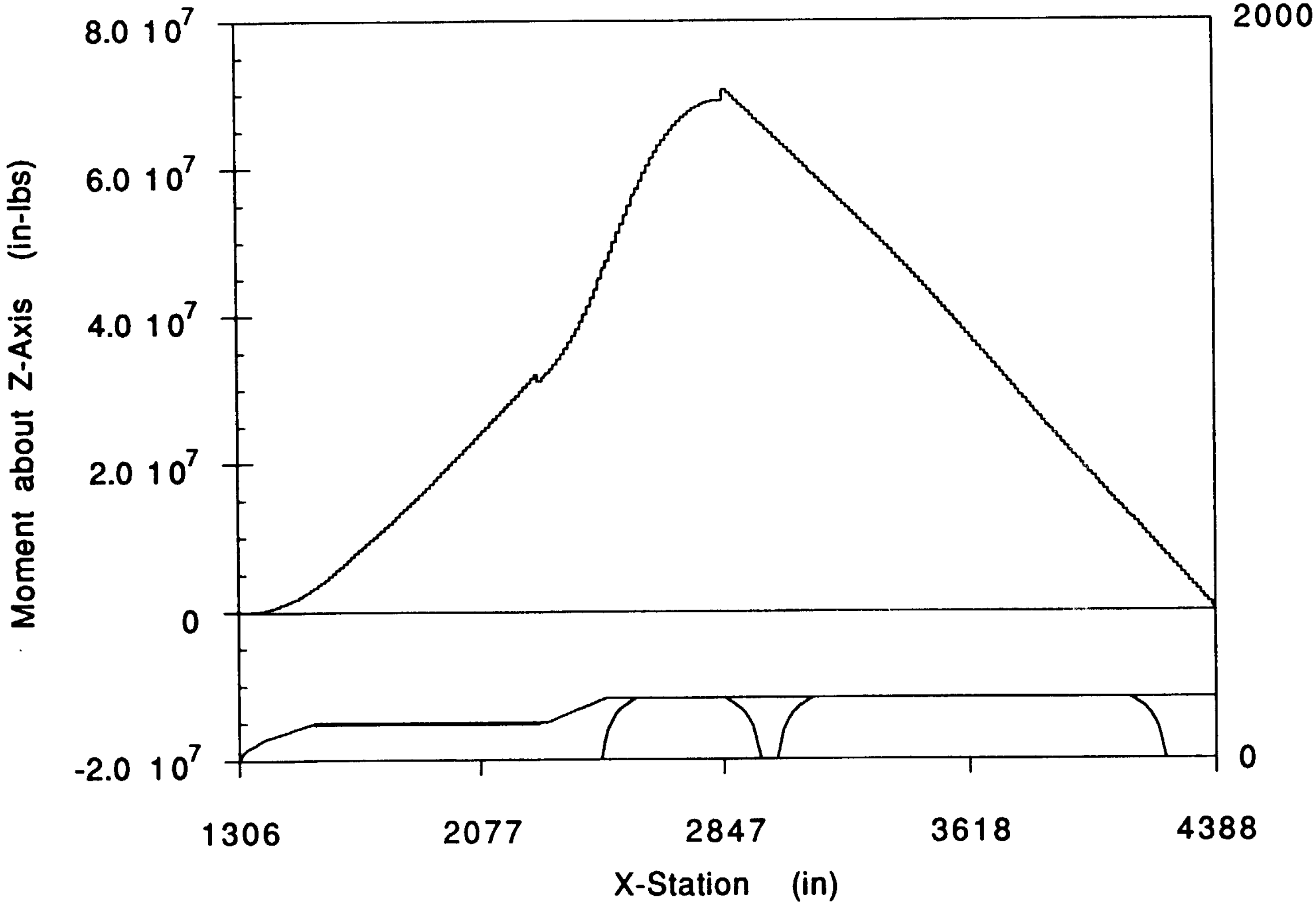
NLS2 CORE - 3 km
NV vs X-STATION
MIN
MAX
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
NV (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

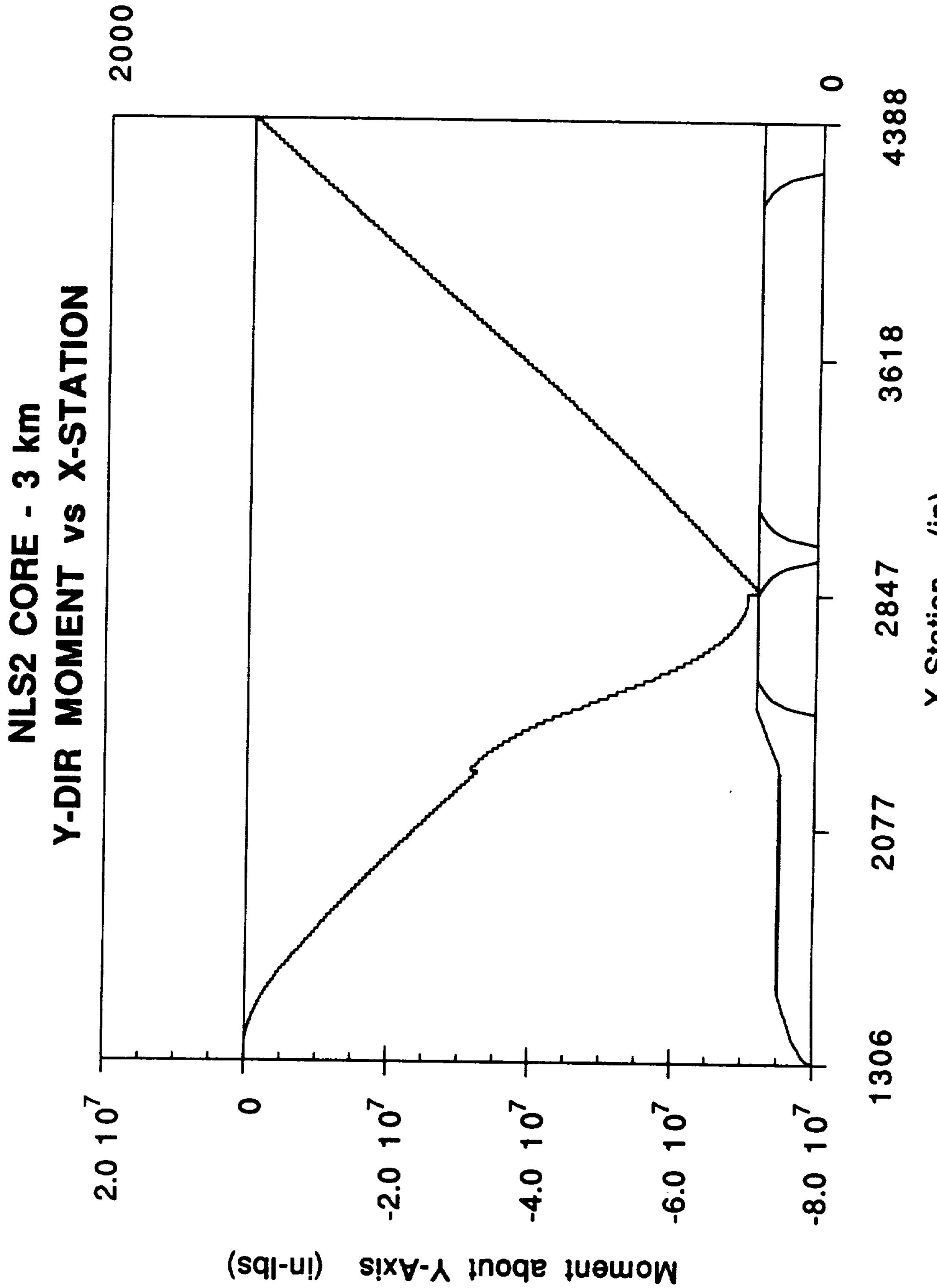

NLS2 CORE - 3 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

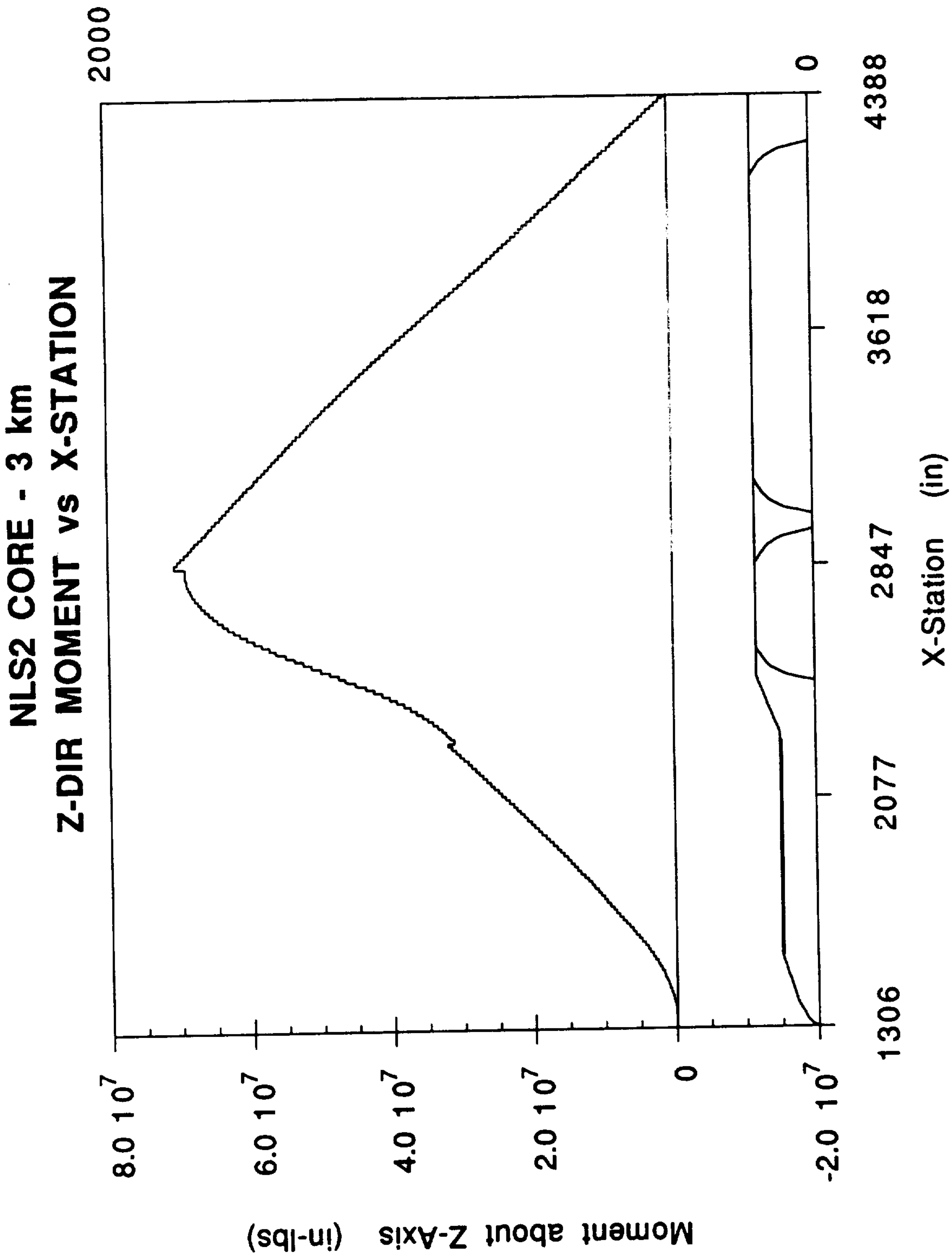
NLS2 CORE - 3 km
Y-DIR MOMENT vs X-STATION

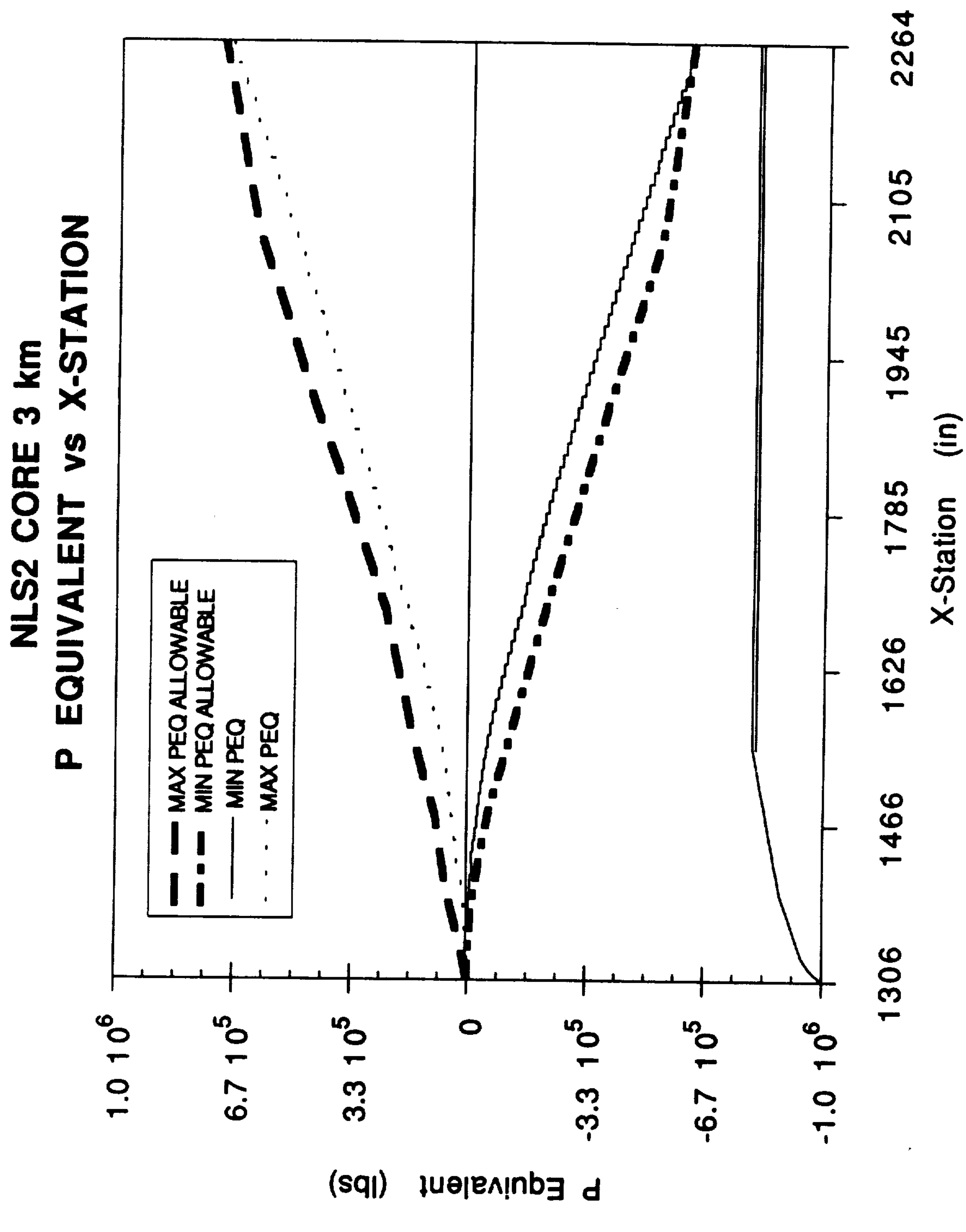


NLS2 CORE - 3 km
Z-DIR MOMENT vs X-STATION



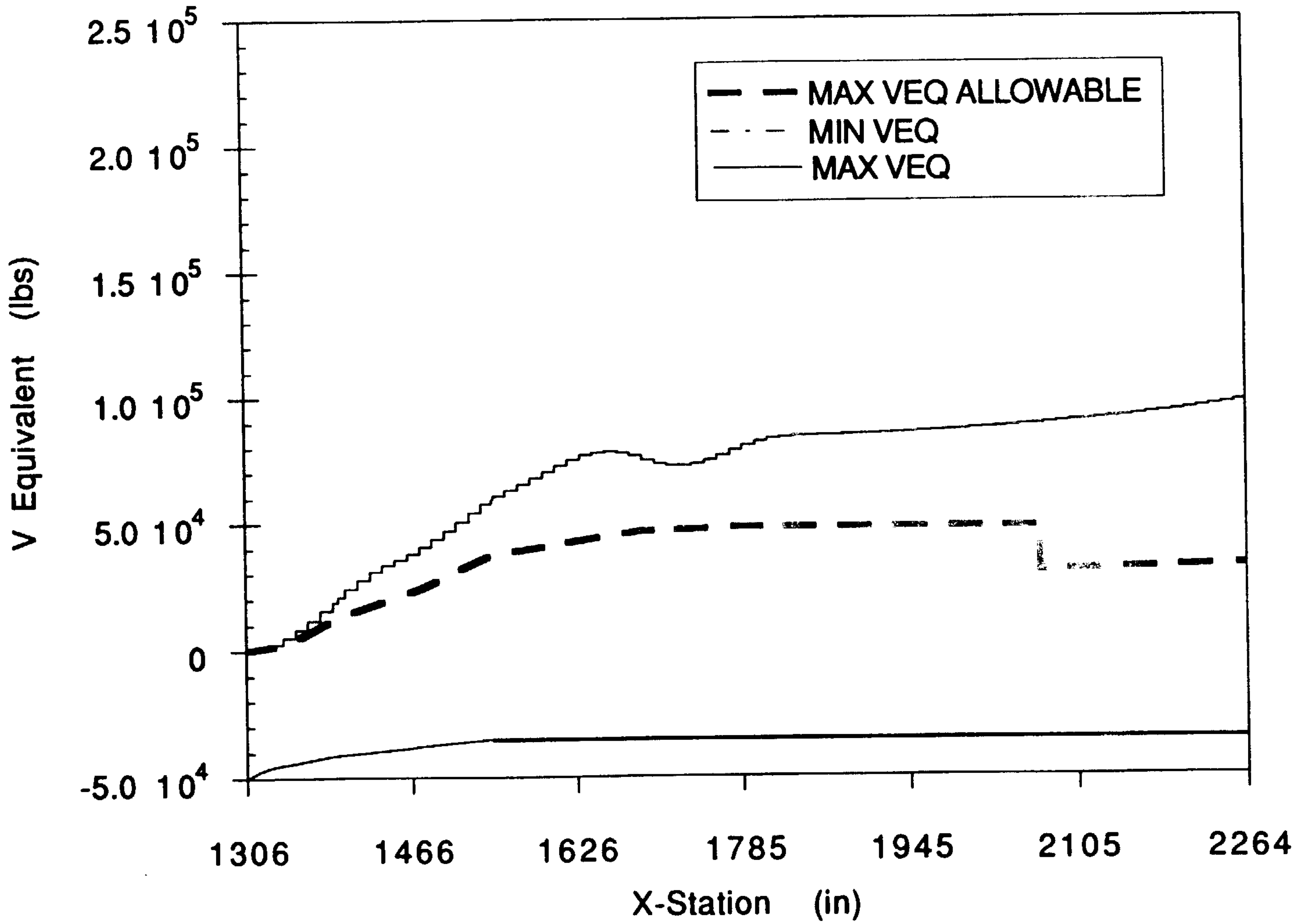

NLS2 CORE - 3 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
-8.0 10^7
2000
0
1306
2077
2847
3618
4388
X-Station (in)

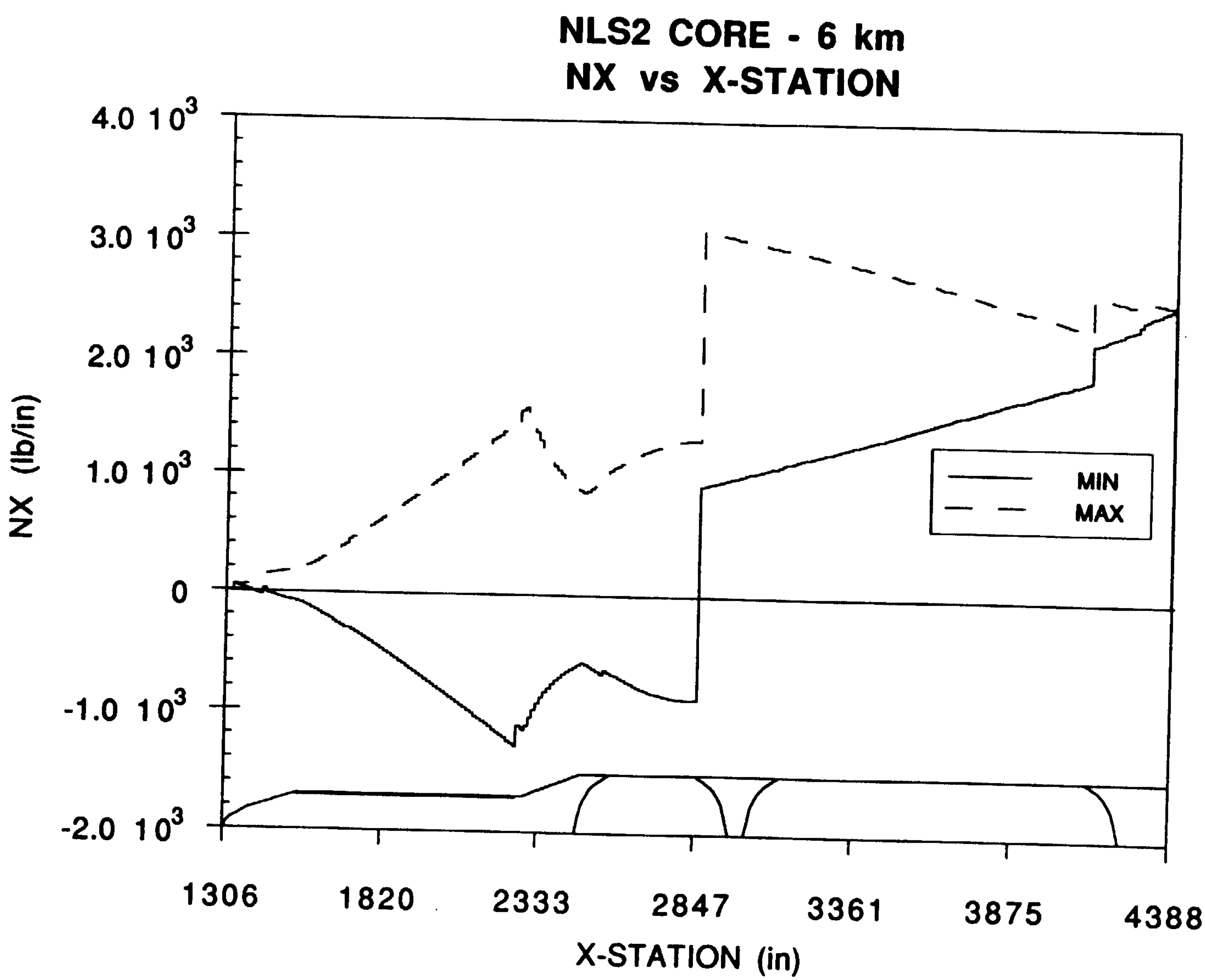

NLS2 CORE - 3 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)
2000
0



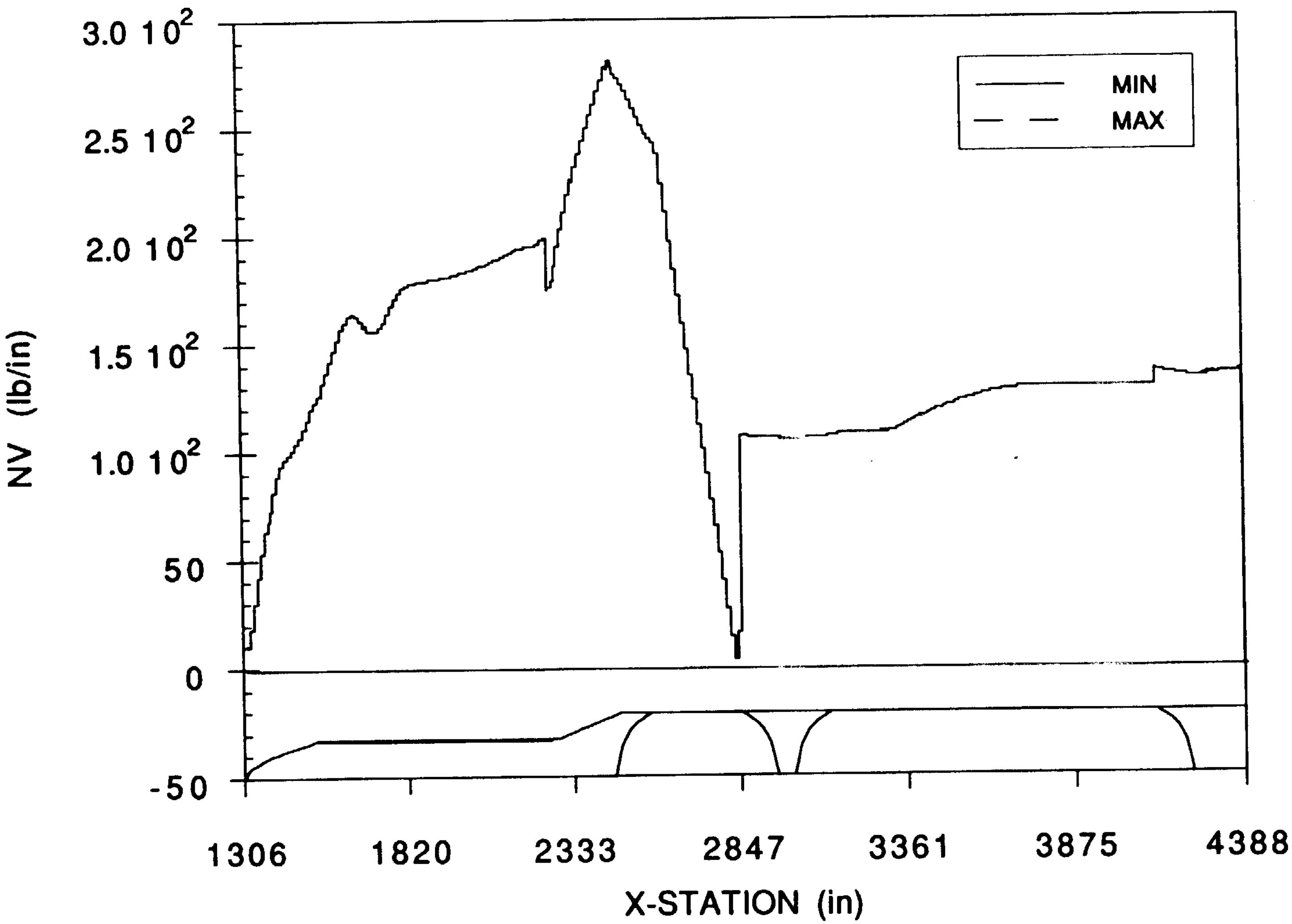
NLS2 CORE 3 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
P Equivalent (lbs)
1.0 10^6
6.7 10^5
3.3 10^5
0
-3.3 10^5
-6.7 10^5
-1.0 10^6
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

NLS2 CORE 3 km
V EQUIVALENT vs X-STATION

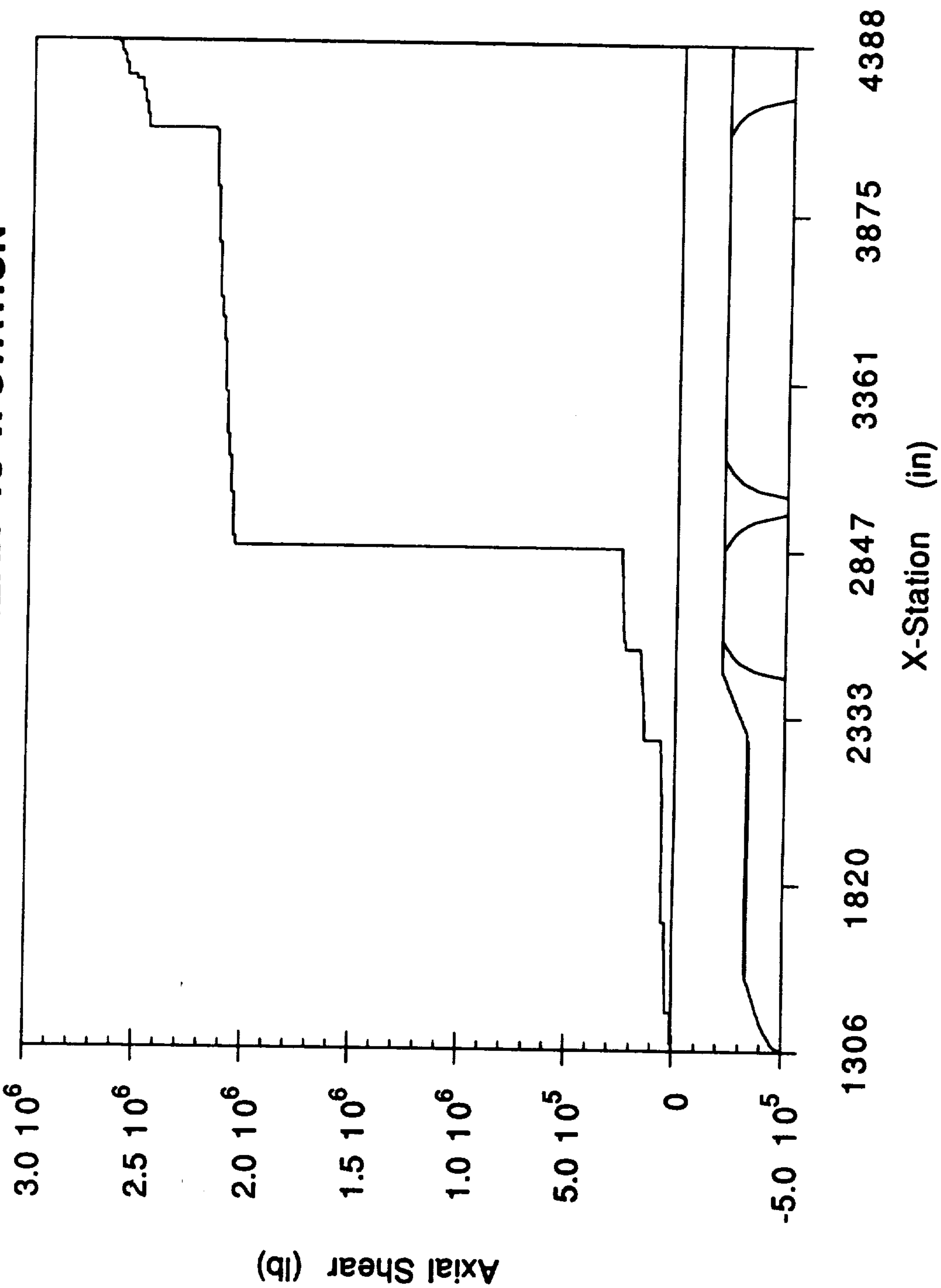



NLS2 CORE - 6 km
NX vs X-STATION
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
NX (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX

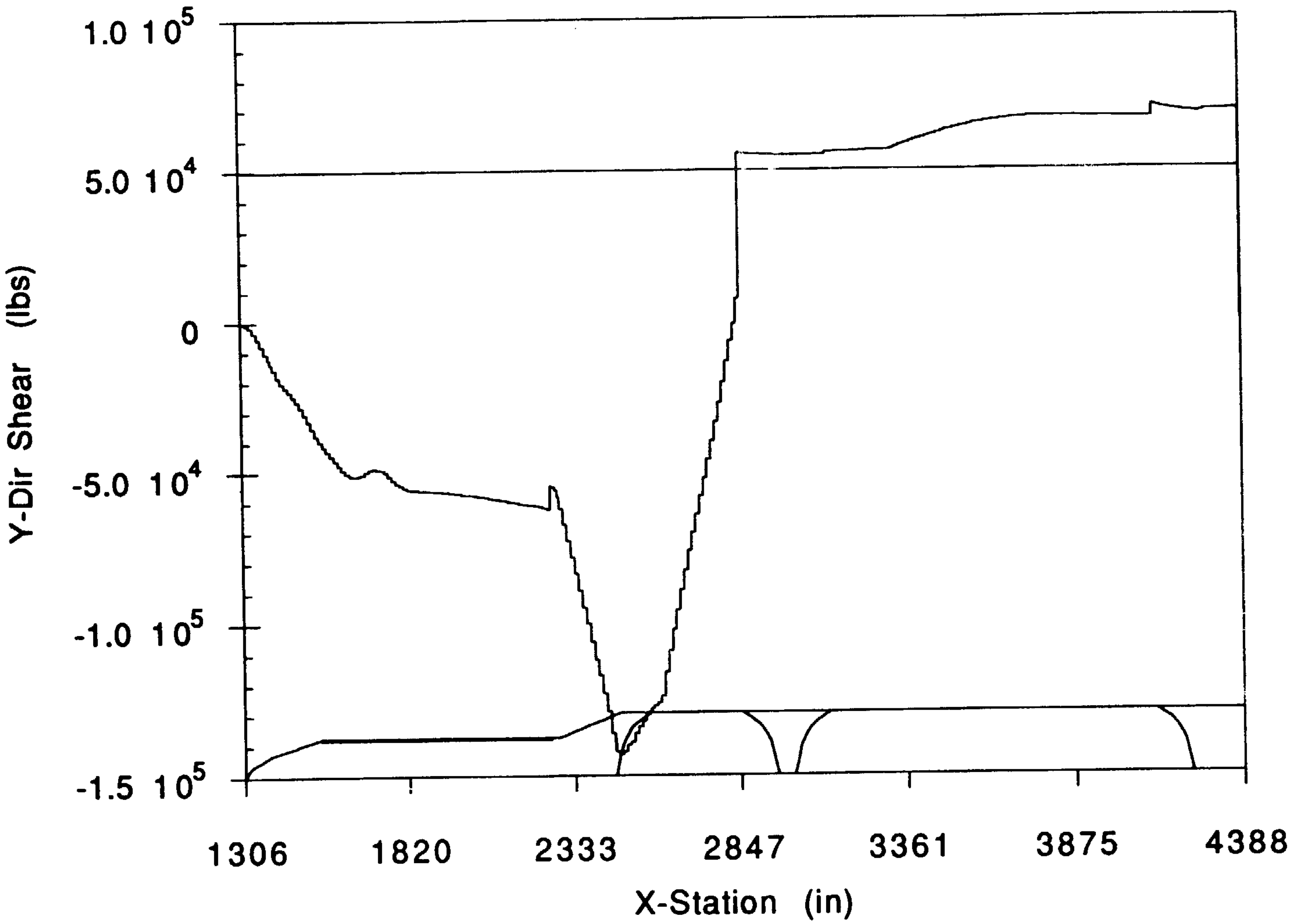
NLS2 CORE - 6 km
NV vs X-STATION

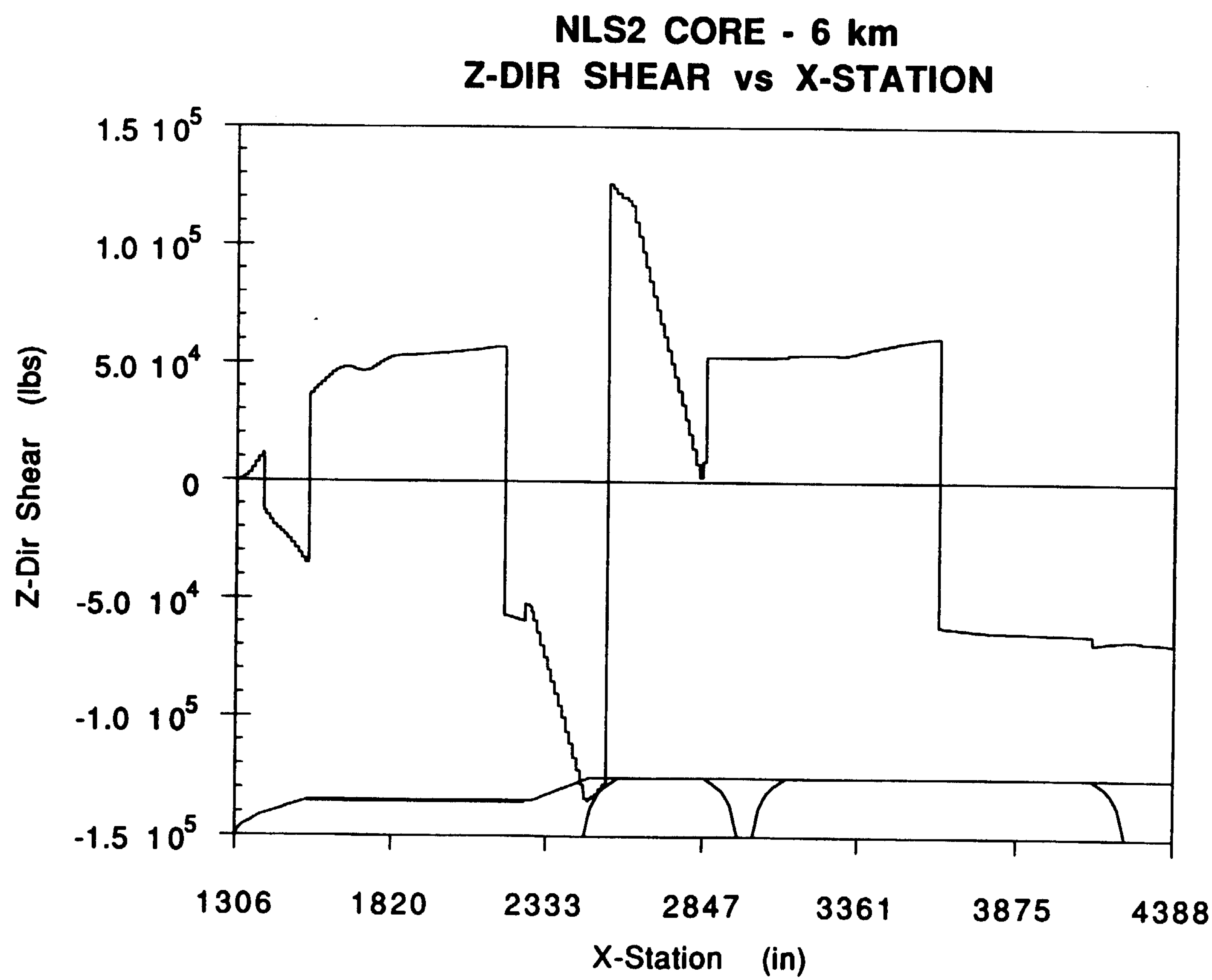


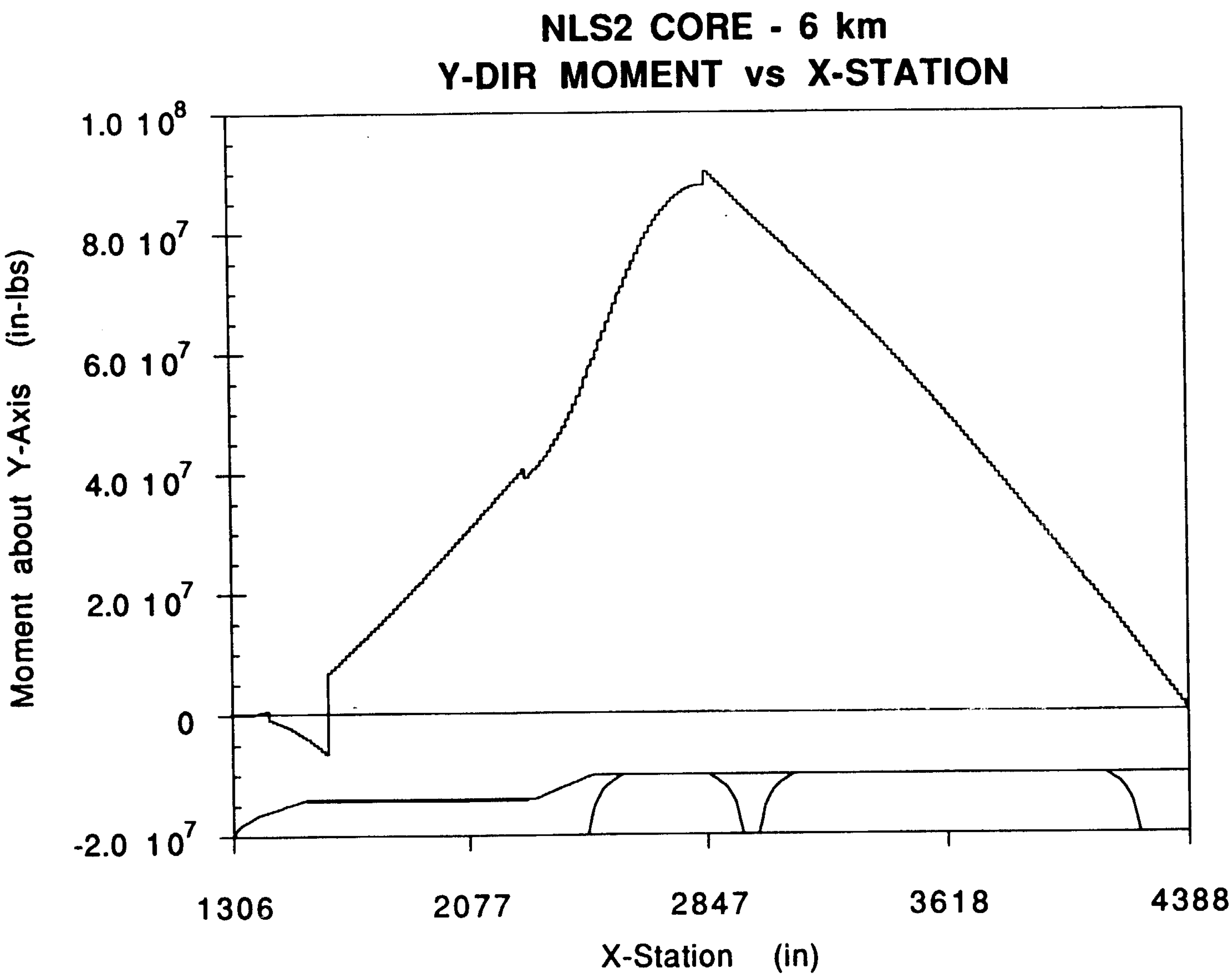
NLS2 CORE - 6 km
AXIAL SHEAR vs X-STATION



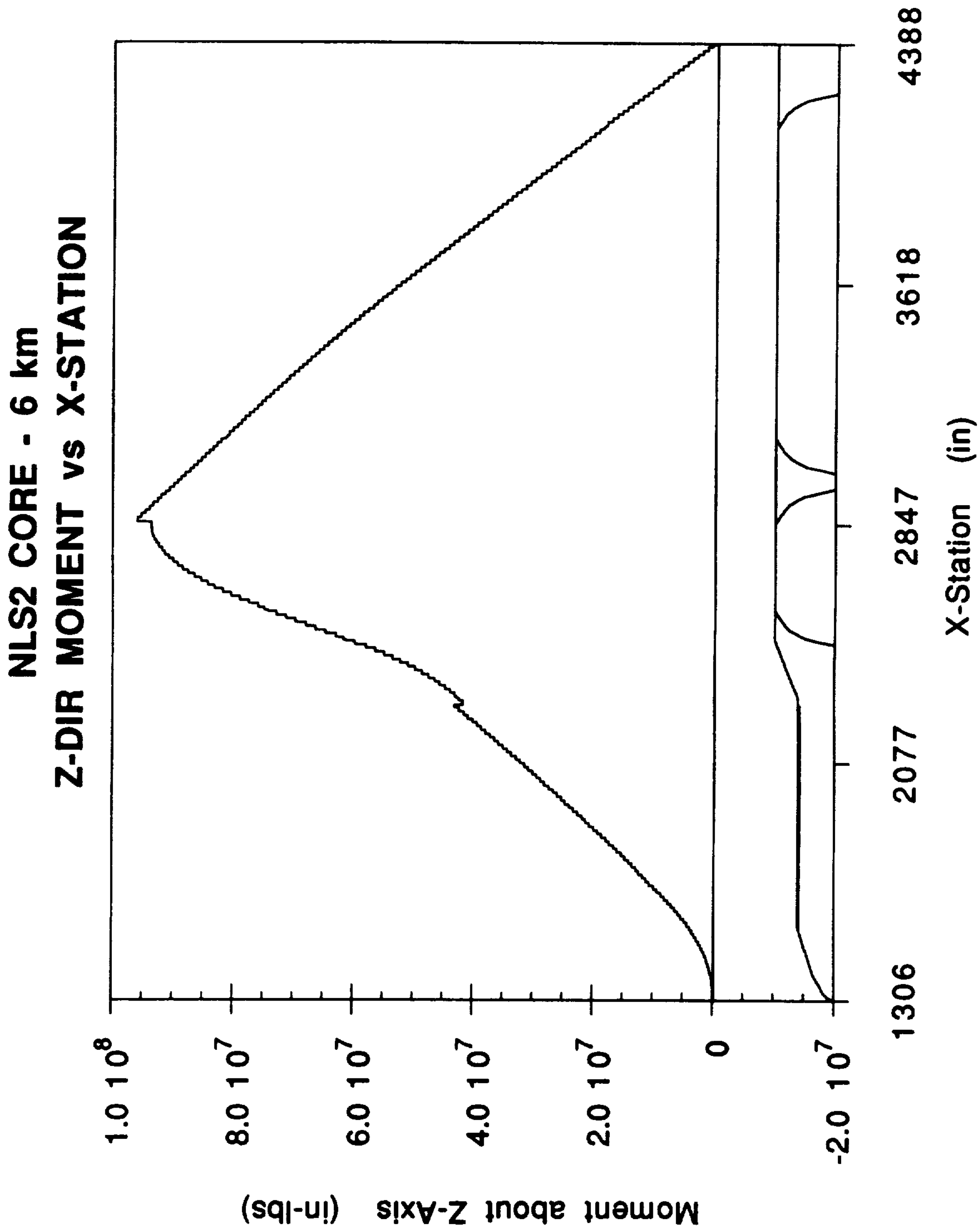
NLS2 CORE - 6 km
Y-DIR SHEAR vs X-STATION

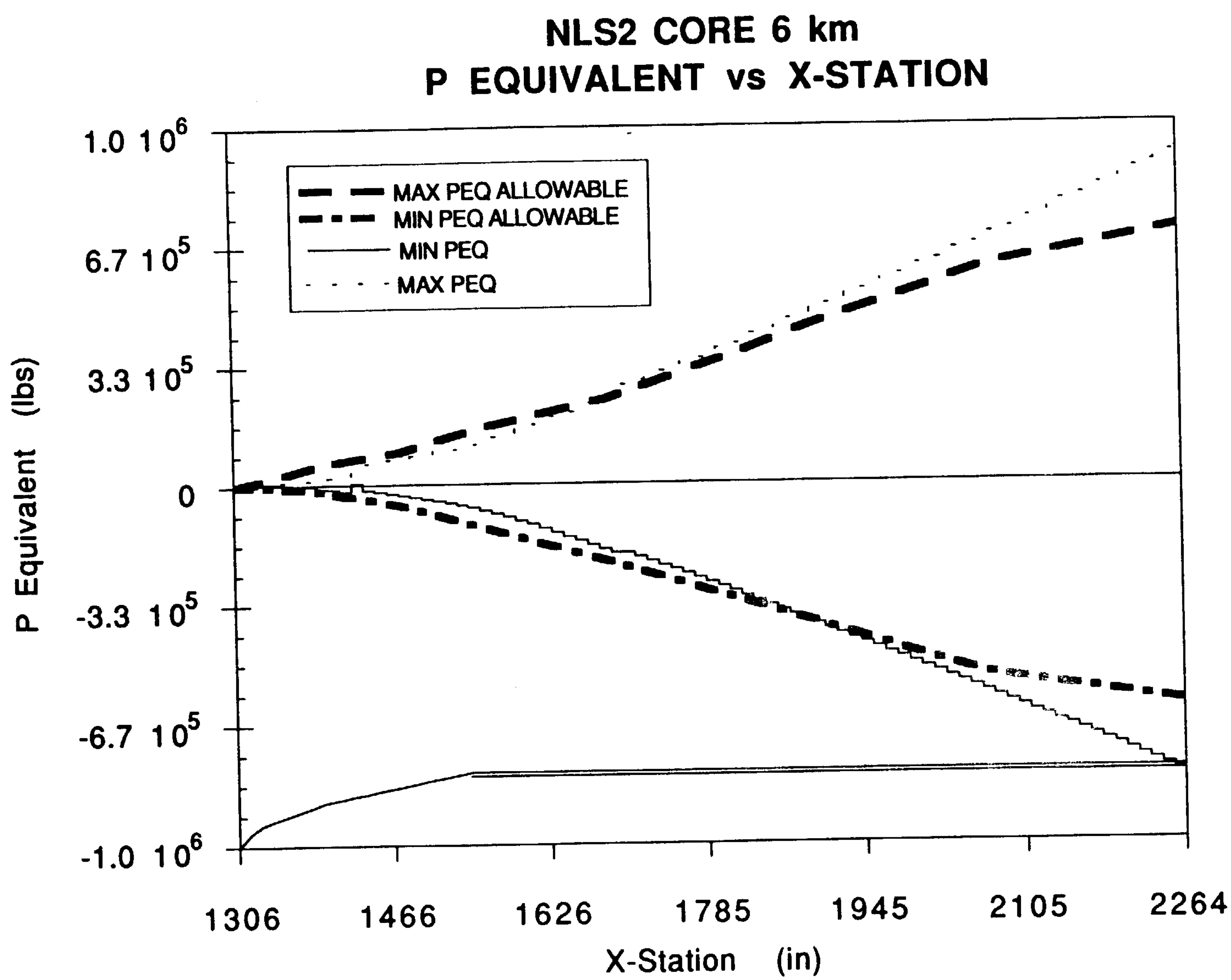


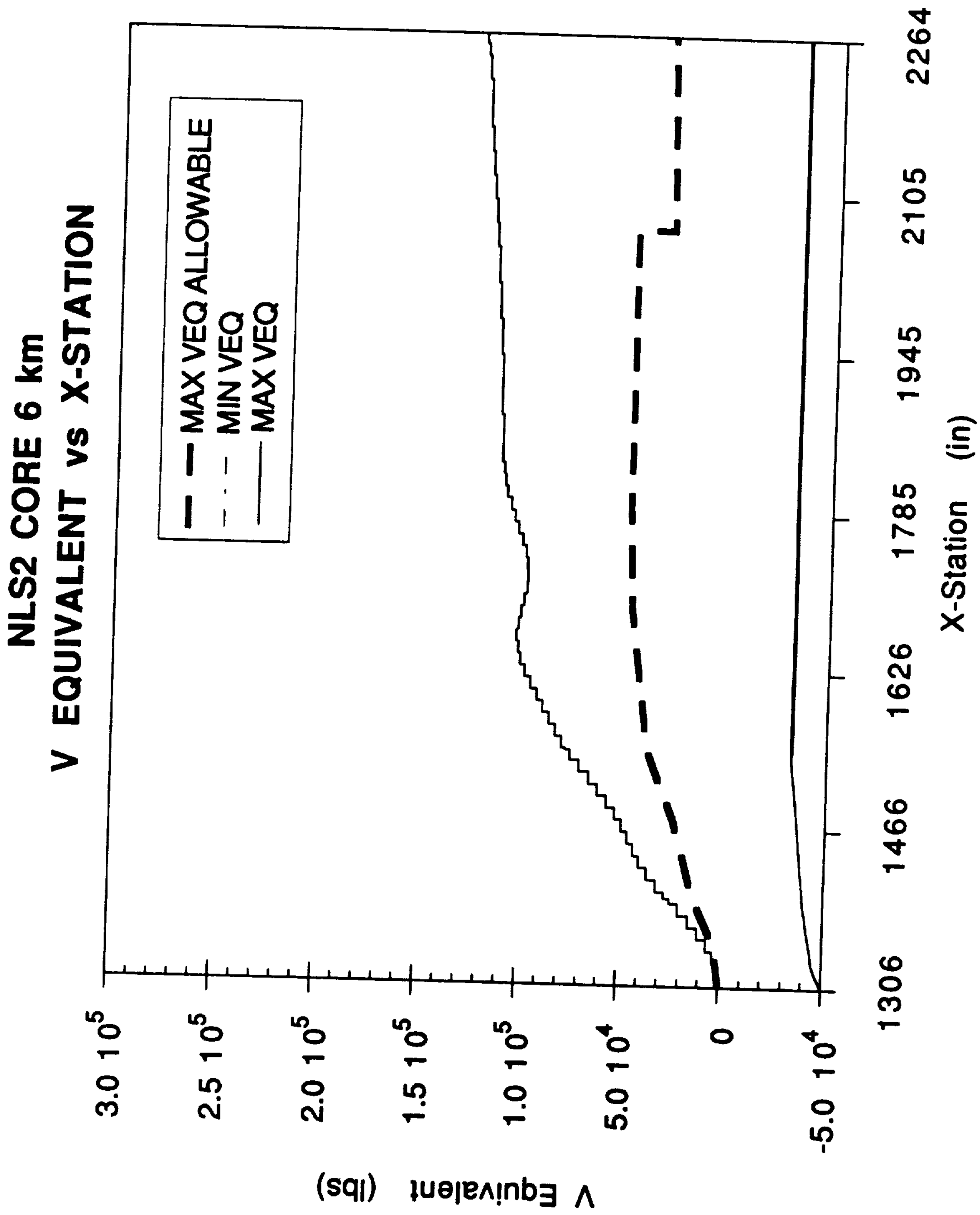

NLS2 CORE - 6 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

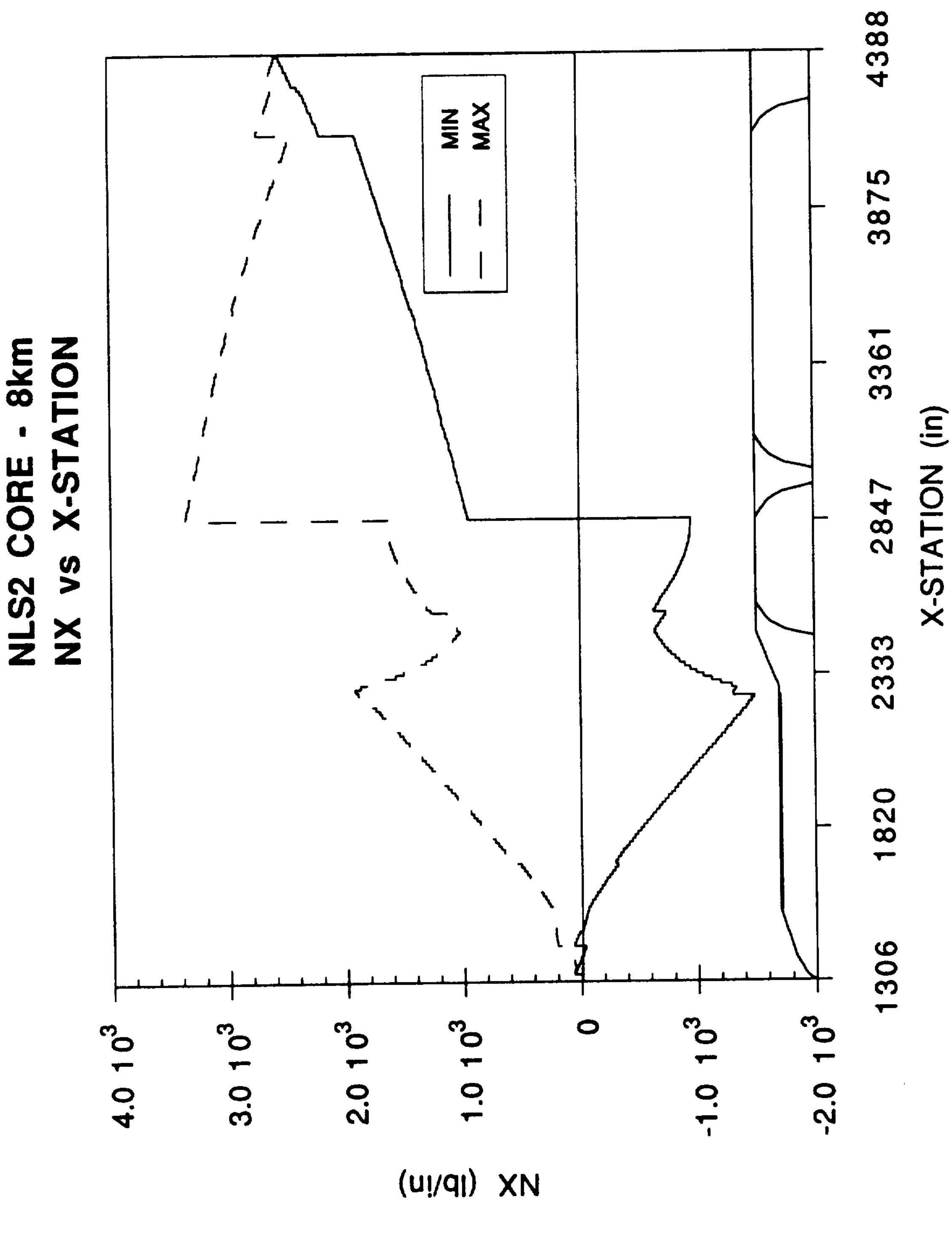


NLS2 CORE - 6 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)


NLS2 CORE - 6 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

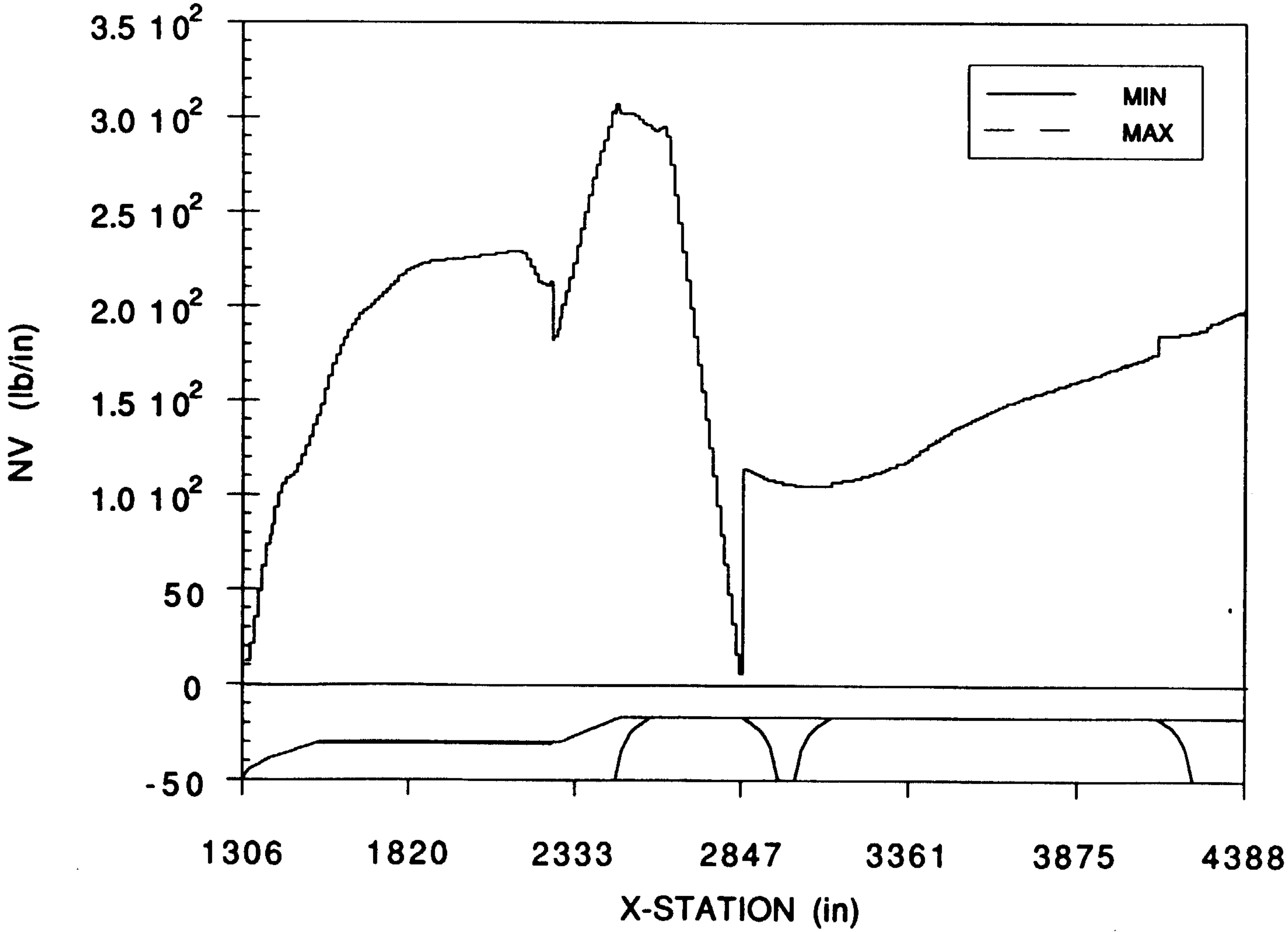

NLS2 CORE 6 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
1.0 10^6
6.7 10^5
3.3 10^5
0
-3.3 10^5
-6.7 10^5
-1.0 10^6
P Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

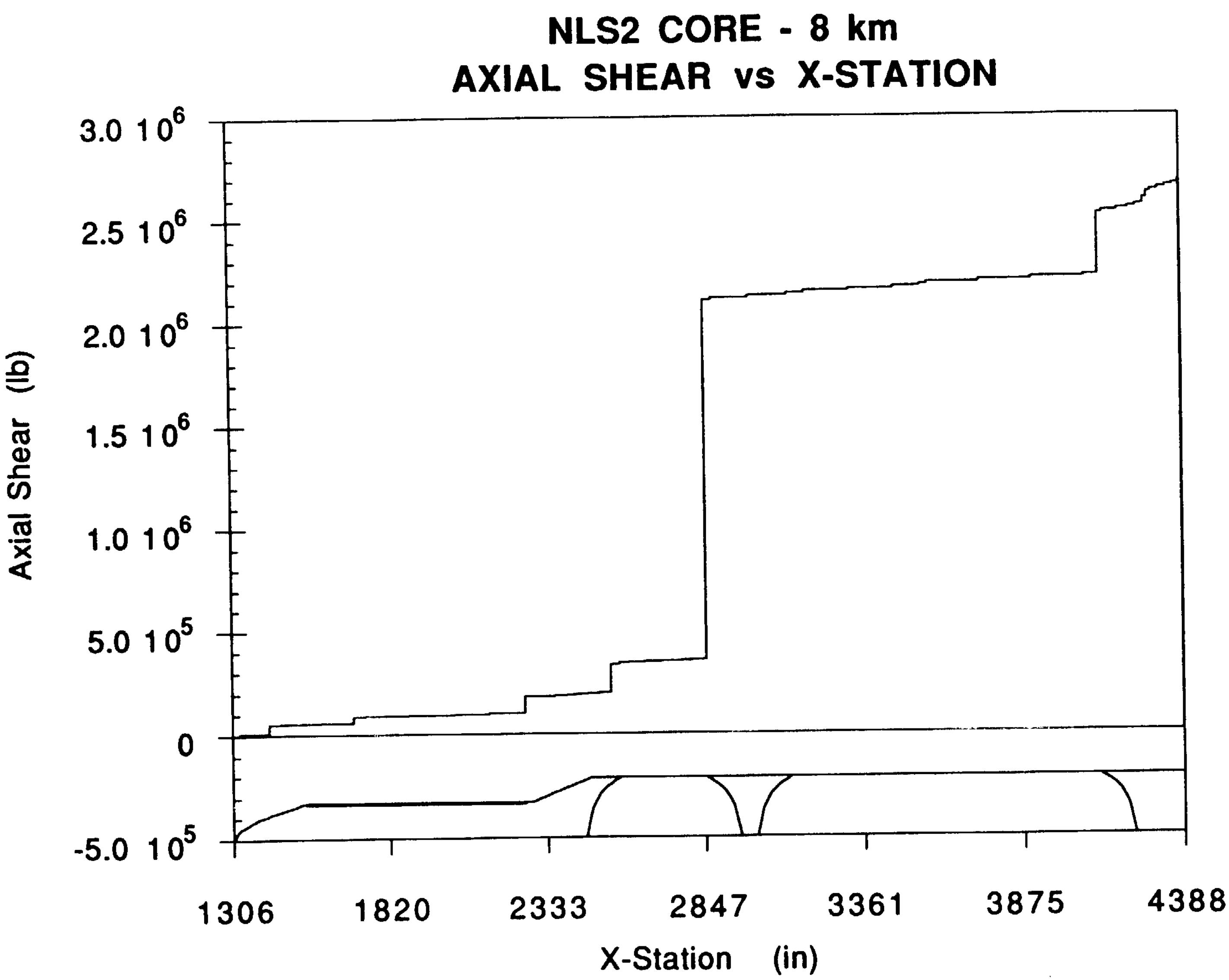

NLS2 CORE 6 km
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

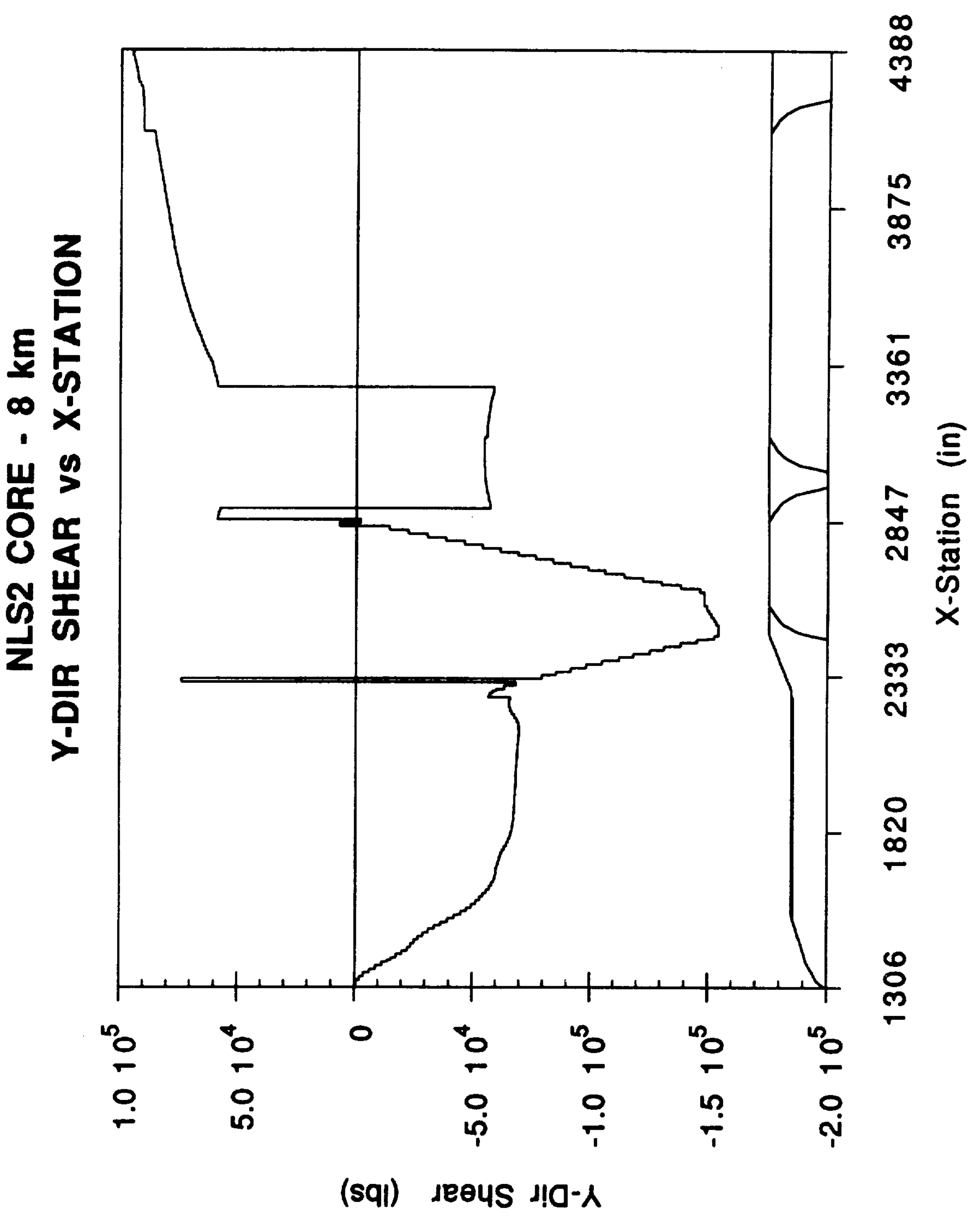


NLS2 CORE - 8km
NX vs X-STATION
MIN
MAX
NX (lb/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

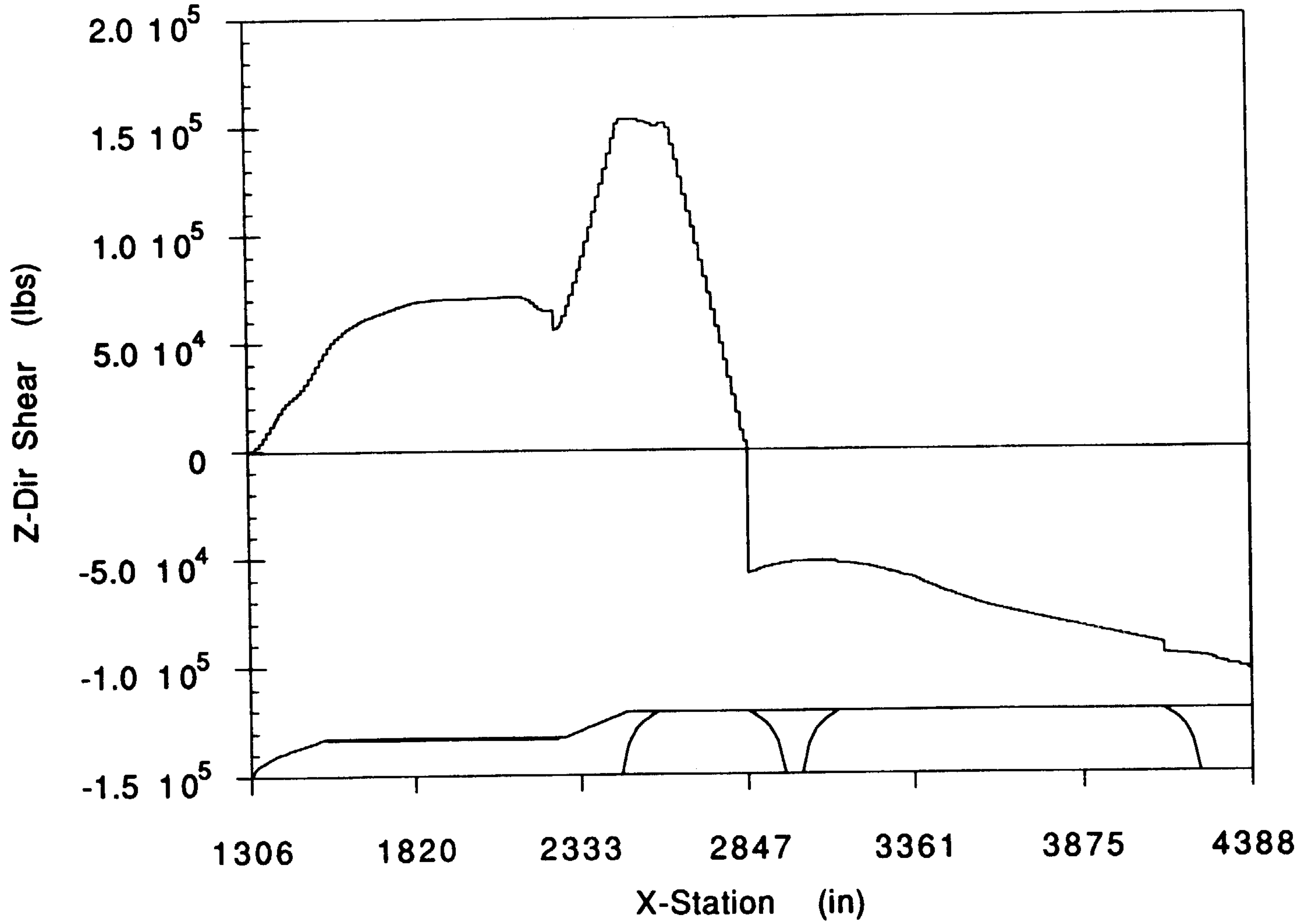
NLS2 CORE -8 km
NV vs X-STATION

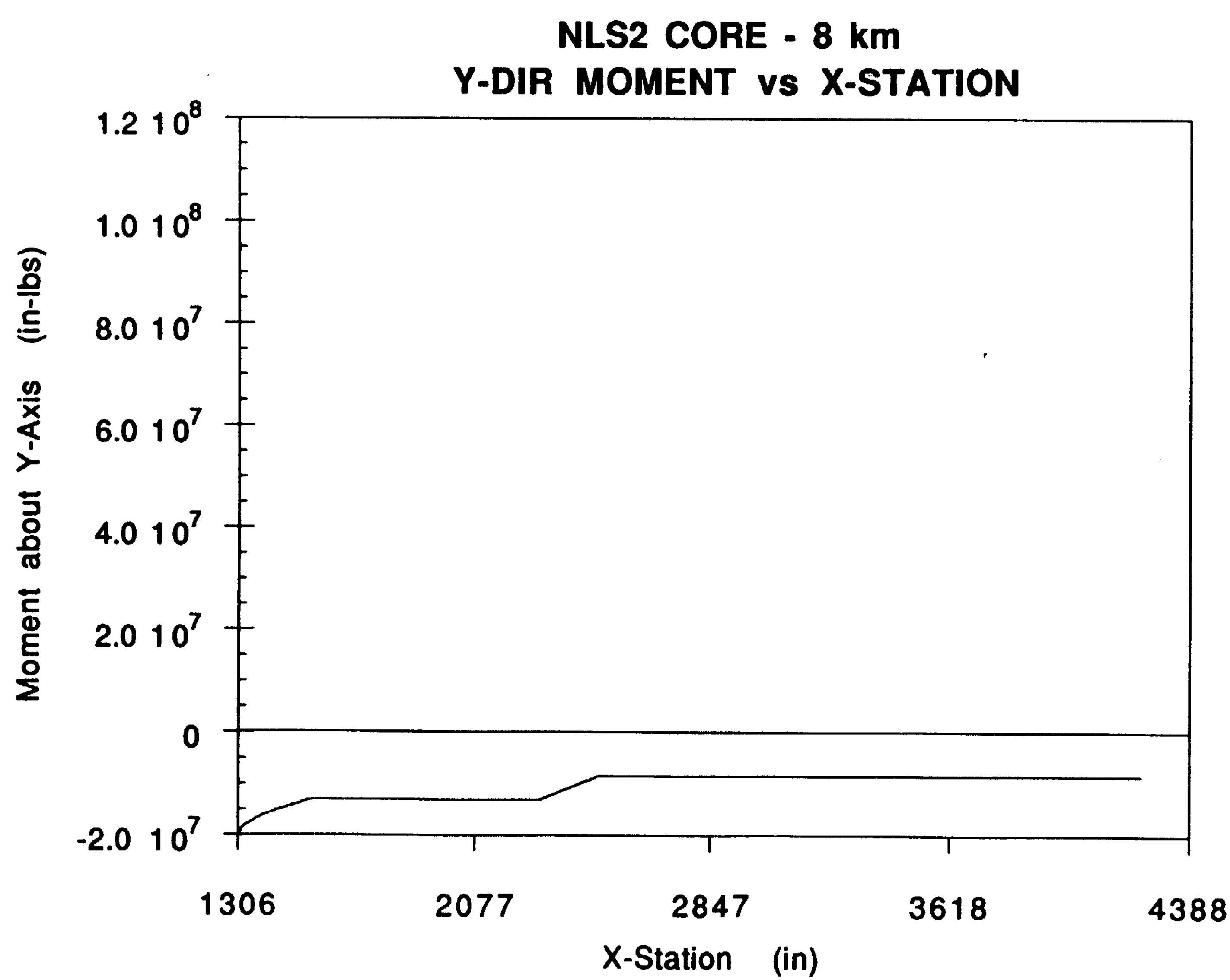



NLS2 CORE - 8 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 CORE - 8 km
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lbs)
X-Station (in)
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1306
1820
2333
2847
3361
3875
4388

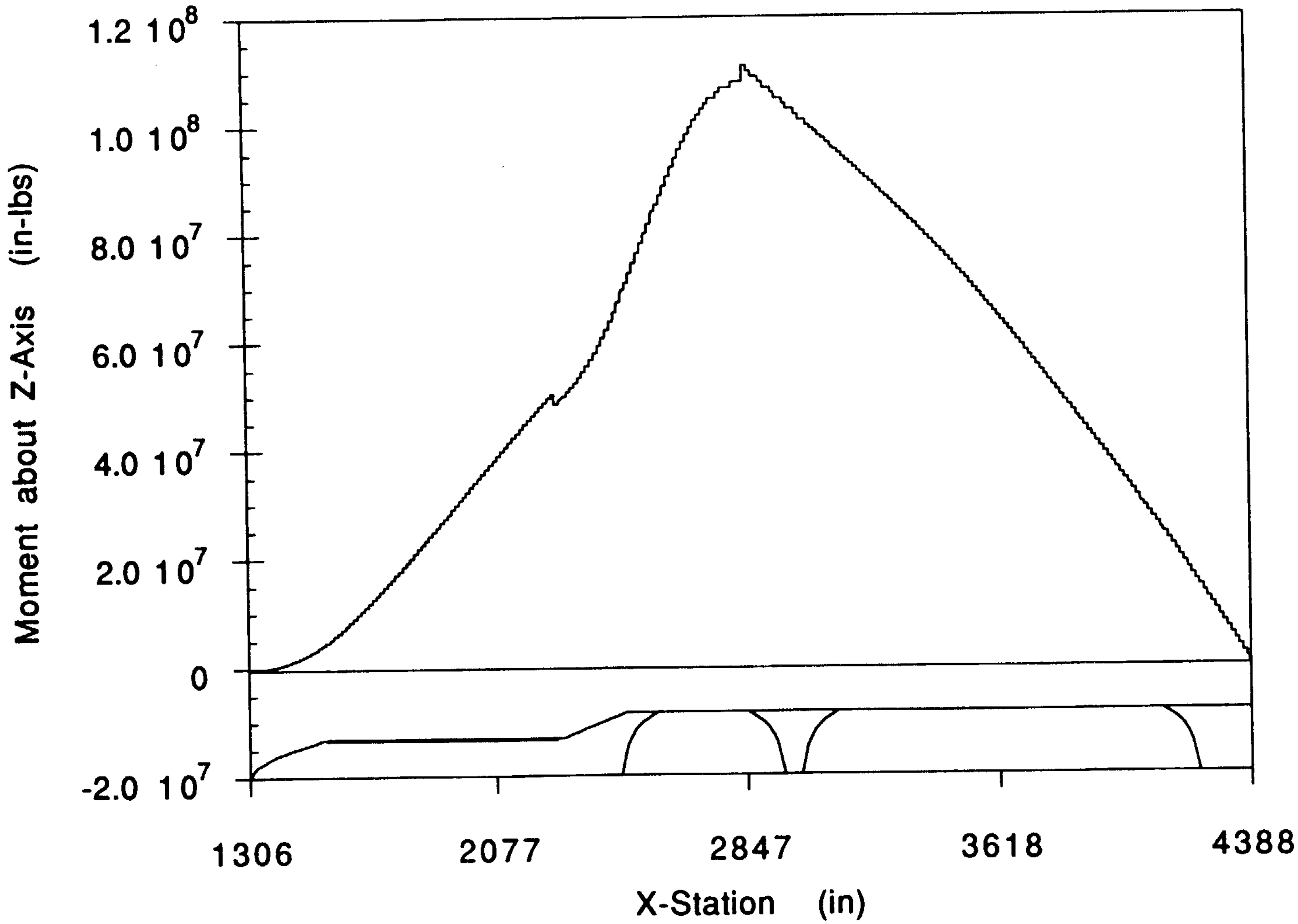
NLS2 CORE - 8 km
Z-DIR SHEAR vs X-STATION

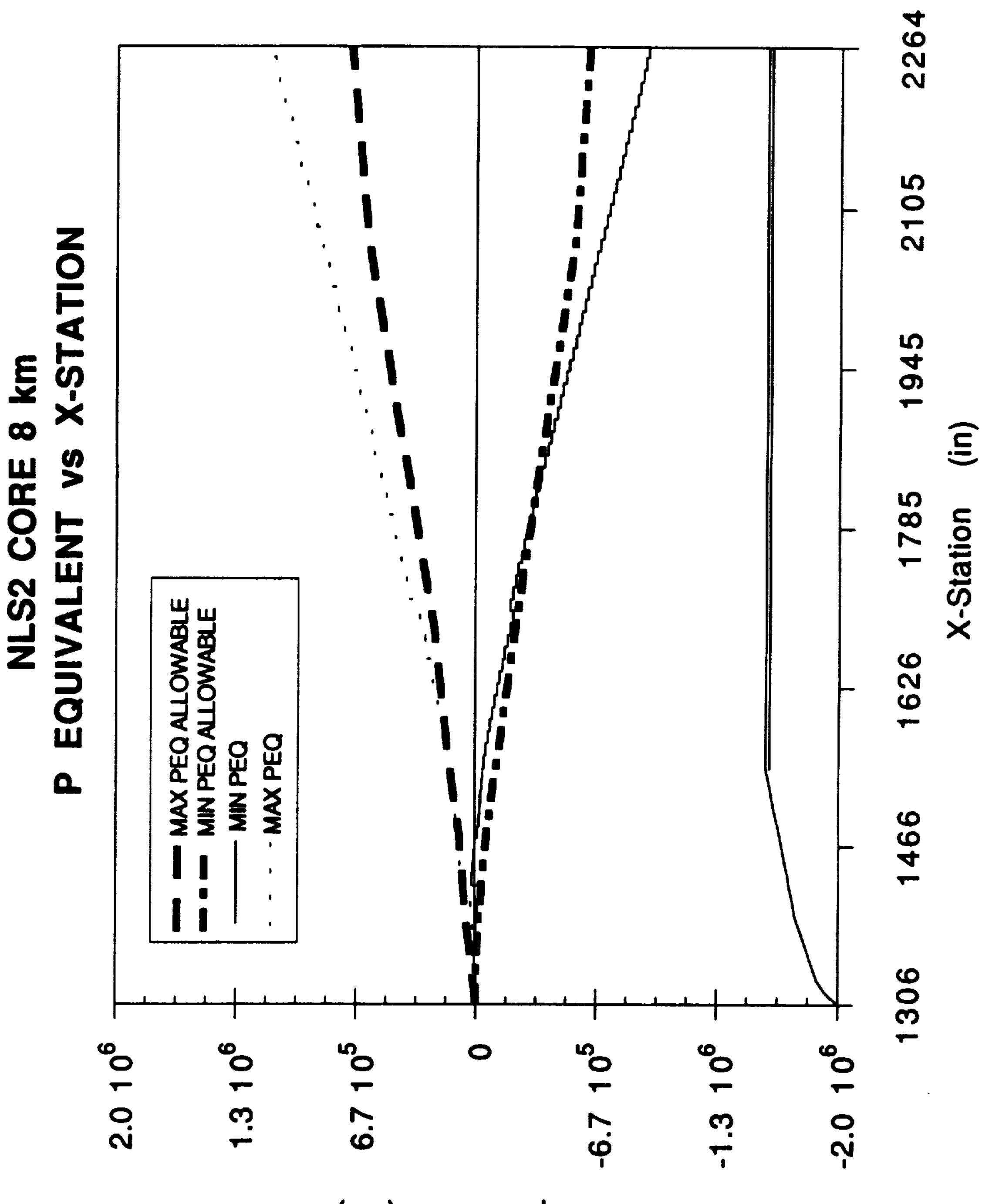




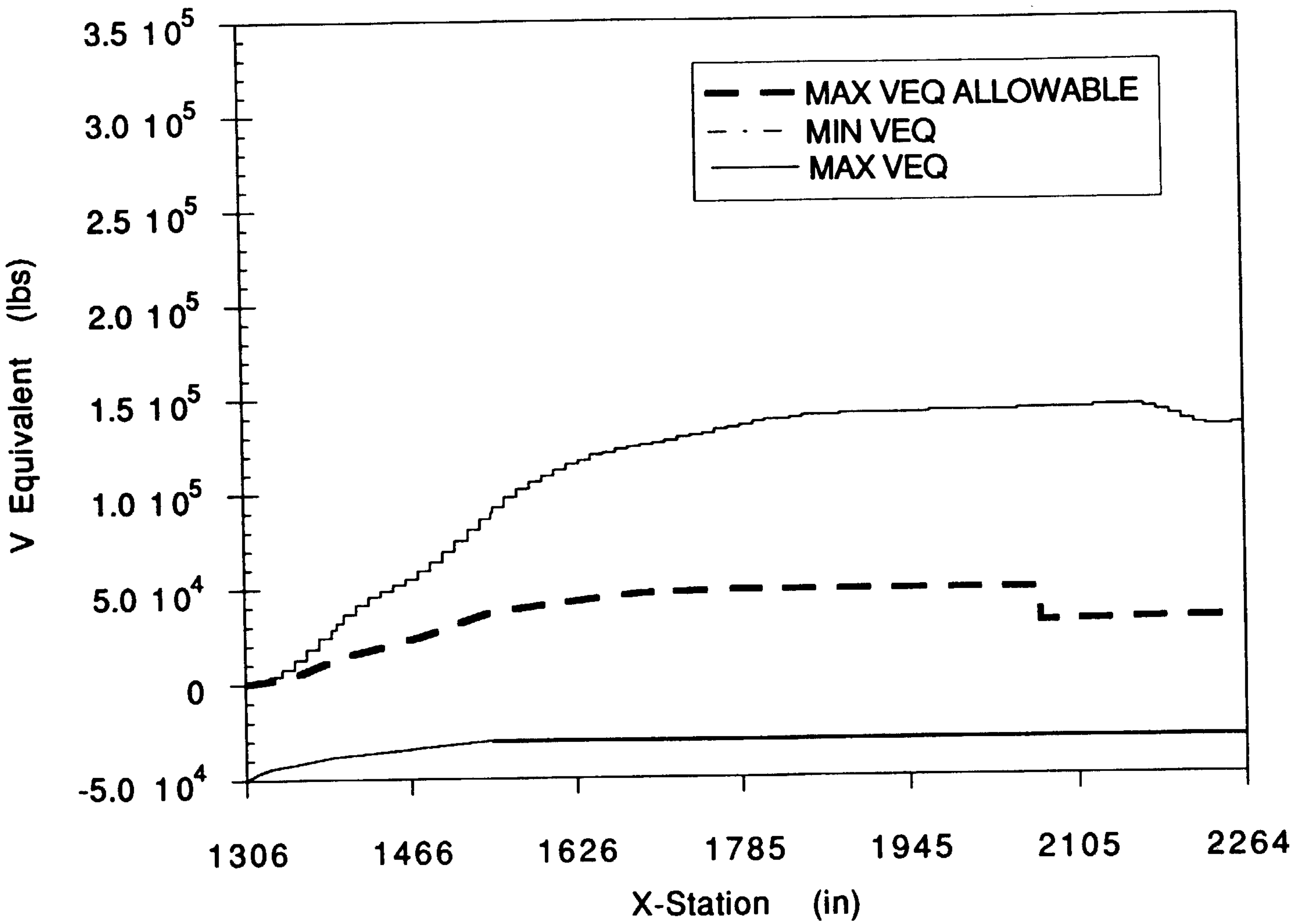
NLS2 CORE - 8 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

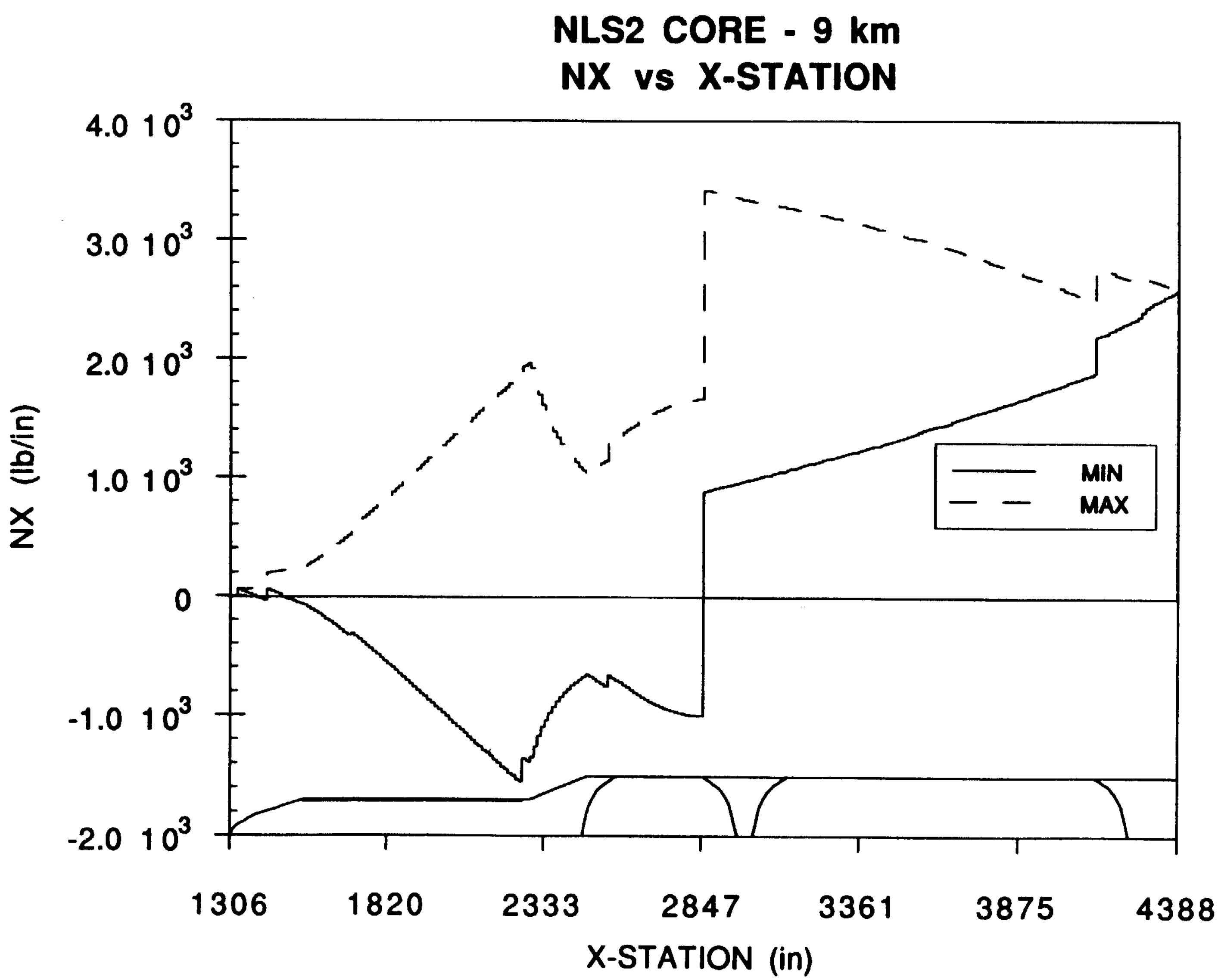
NLS2 CORE - 8 km
Z-DIR MOMENT vs X-STATION



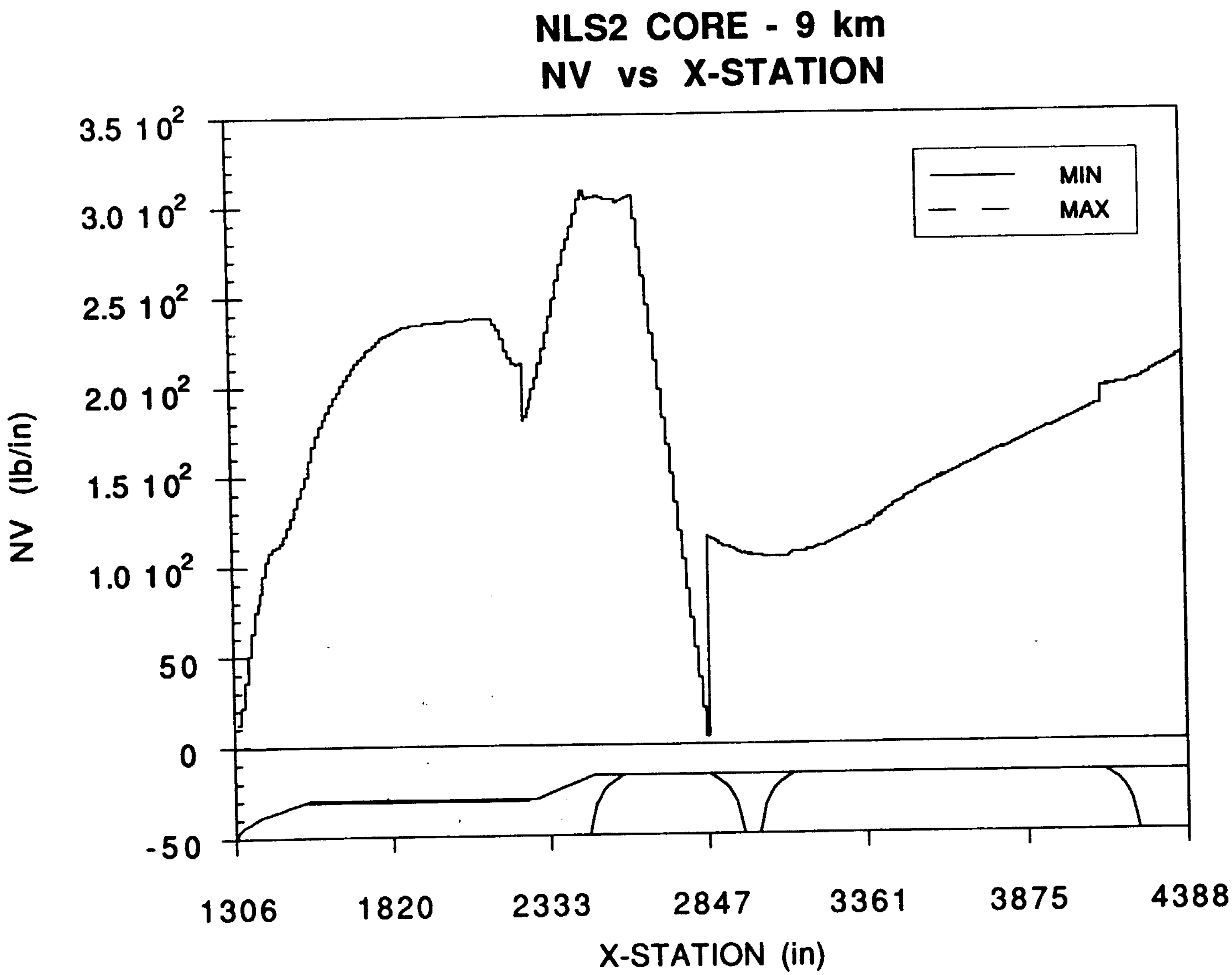

NLS2 CORE 8 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
P Equivalent (lbs)
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

NLS2 CORE 8 km
V EQUIVALENT vs X-STATION

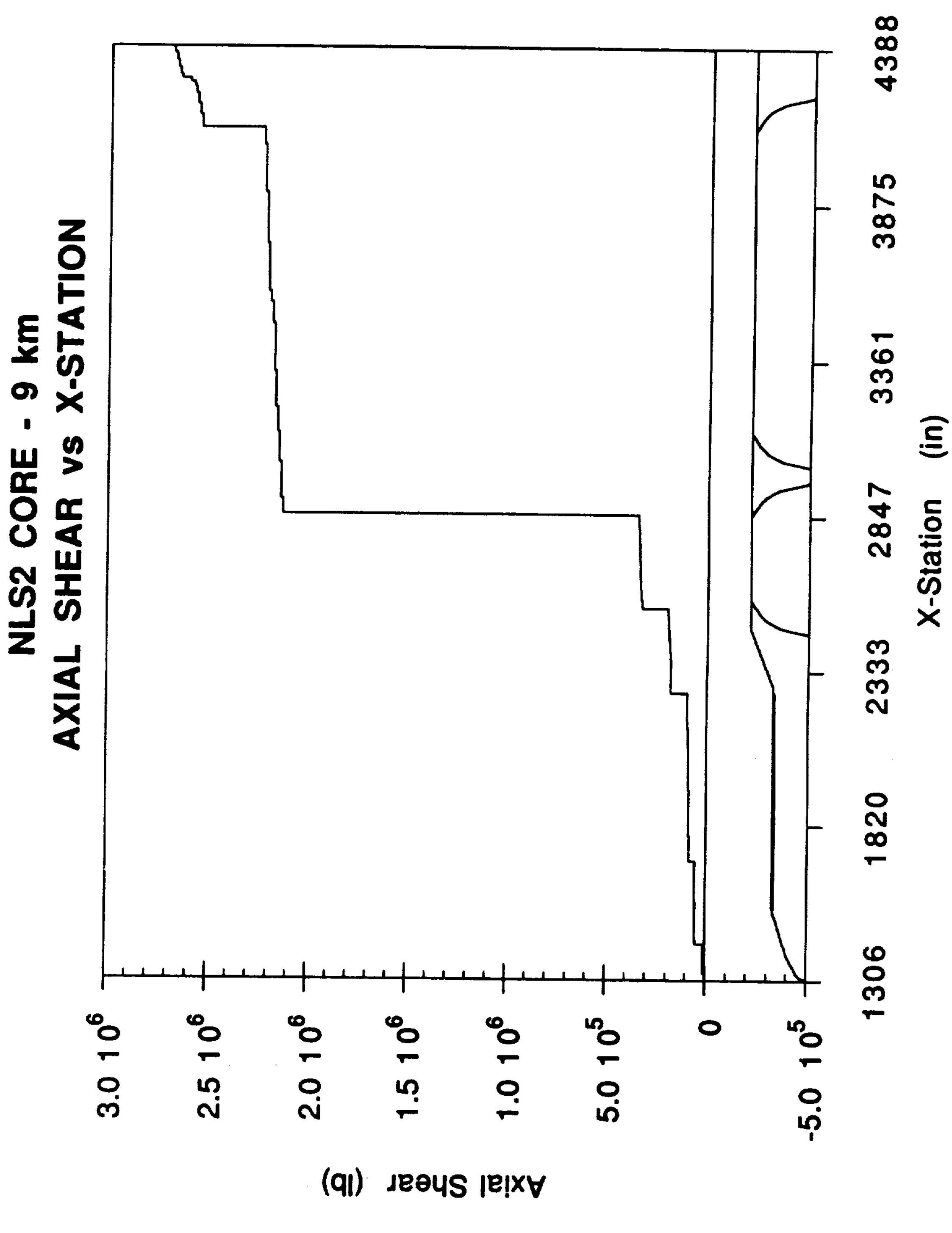




NLS2 CORE - 9 km
NX vs X-STATION
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
NX (lb/in)
MIN
MAX
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

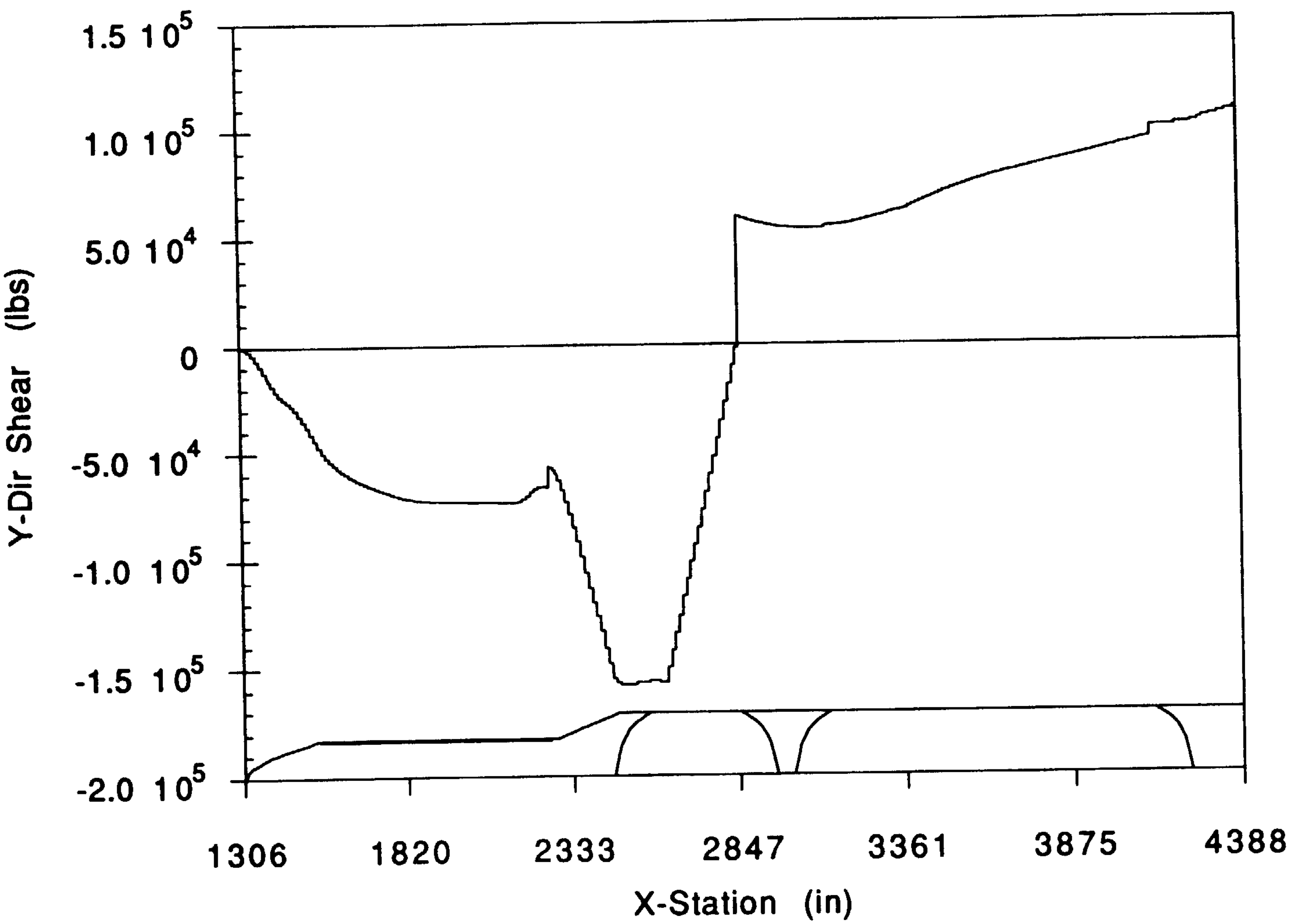


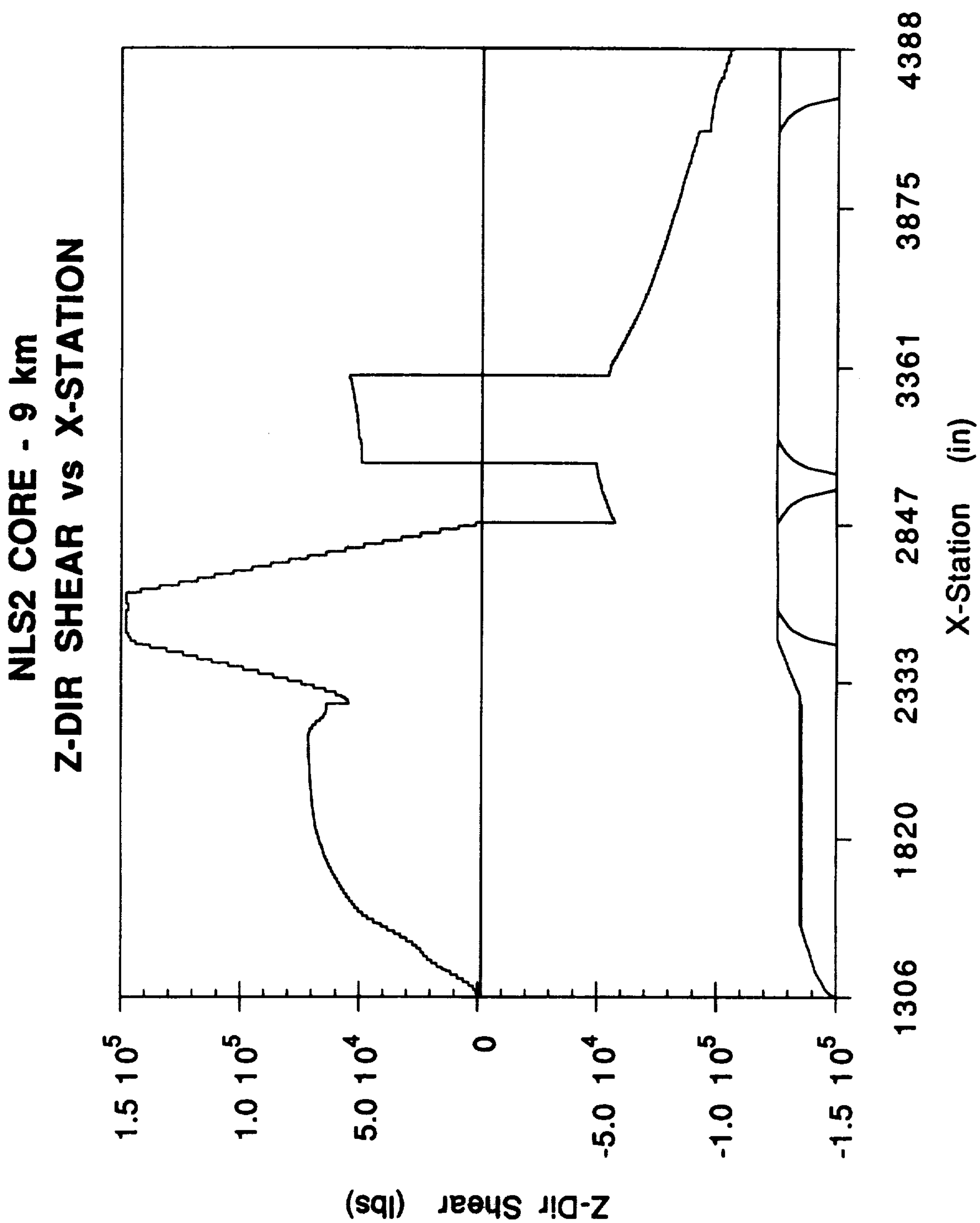
NLS2 CORE - 9 km
NV vs X-STATION
MIN
MAX
NV (lb/in)
3.5 10^2
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)



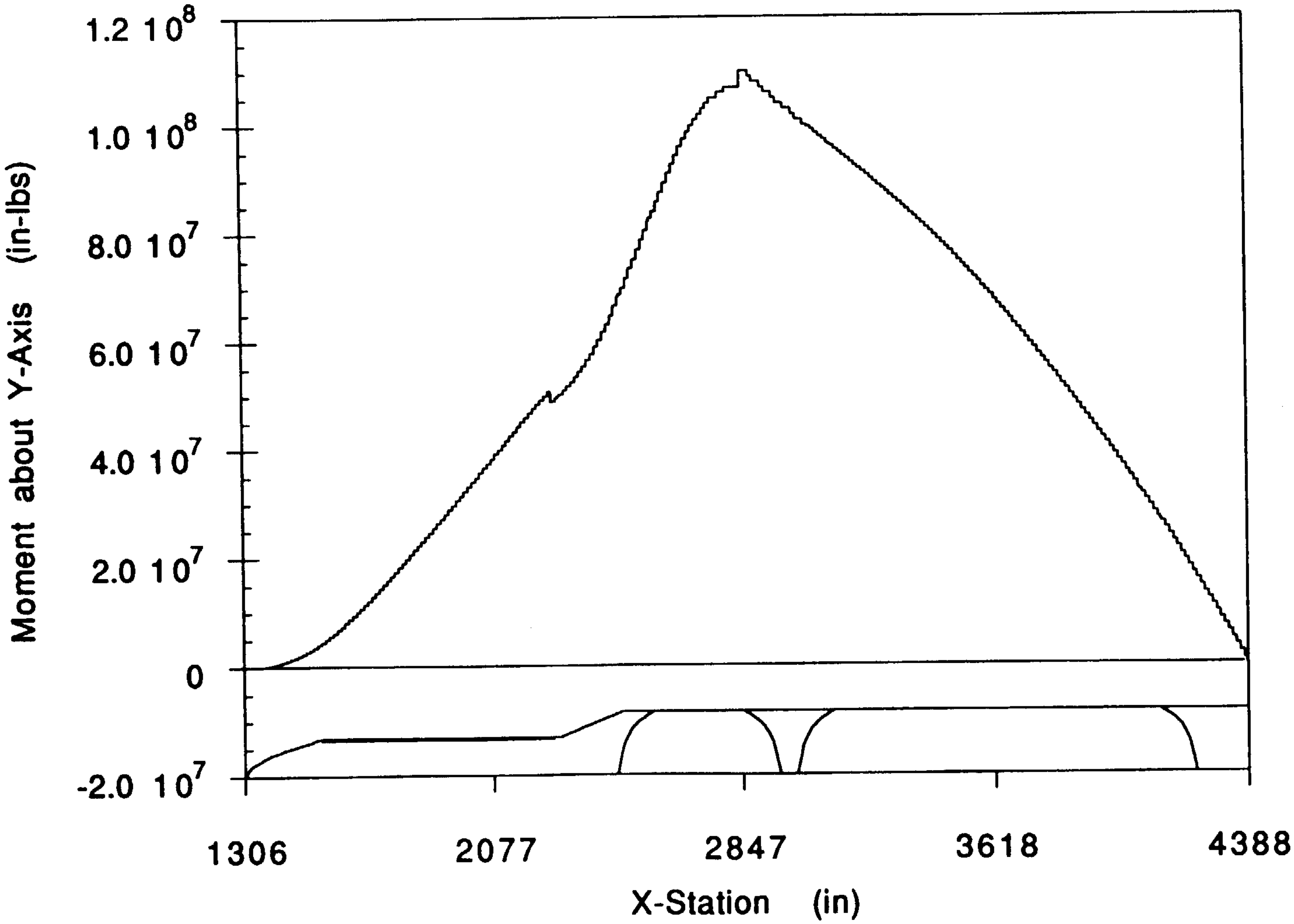
NLS2 CORE - 9 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
X-Station (in)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388

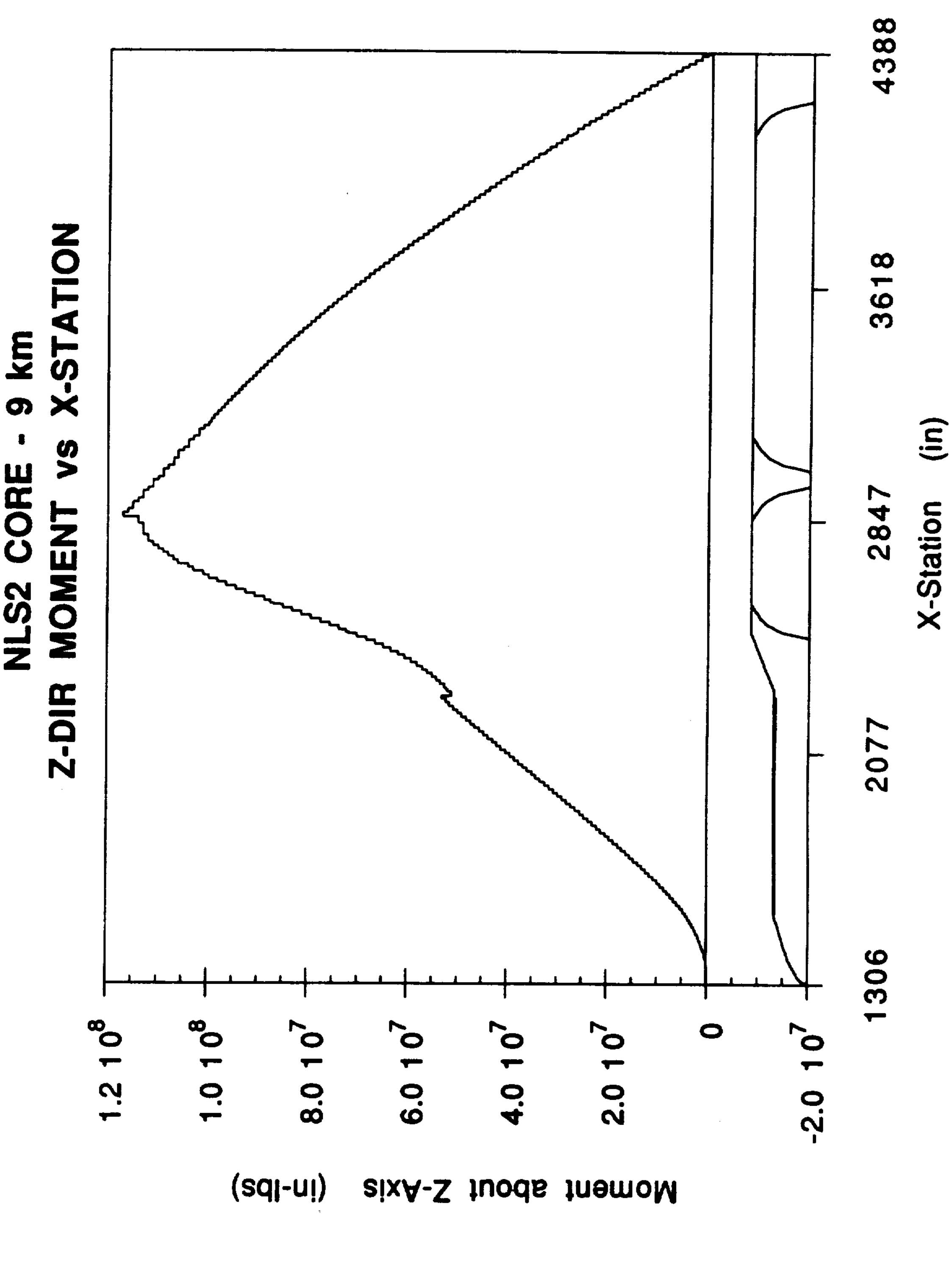
NLS2 CORE - 9 km
Y-DIR SHEAR vs X-STATION



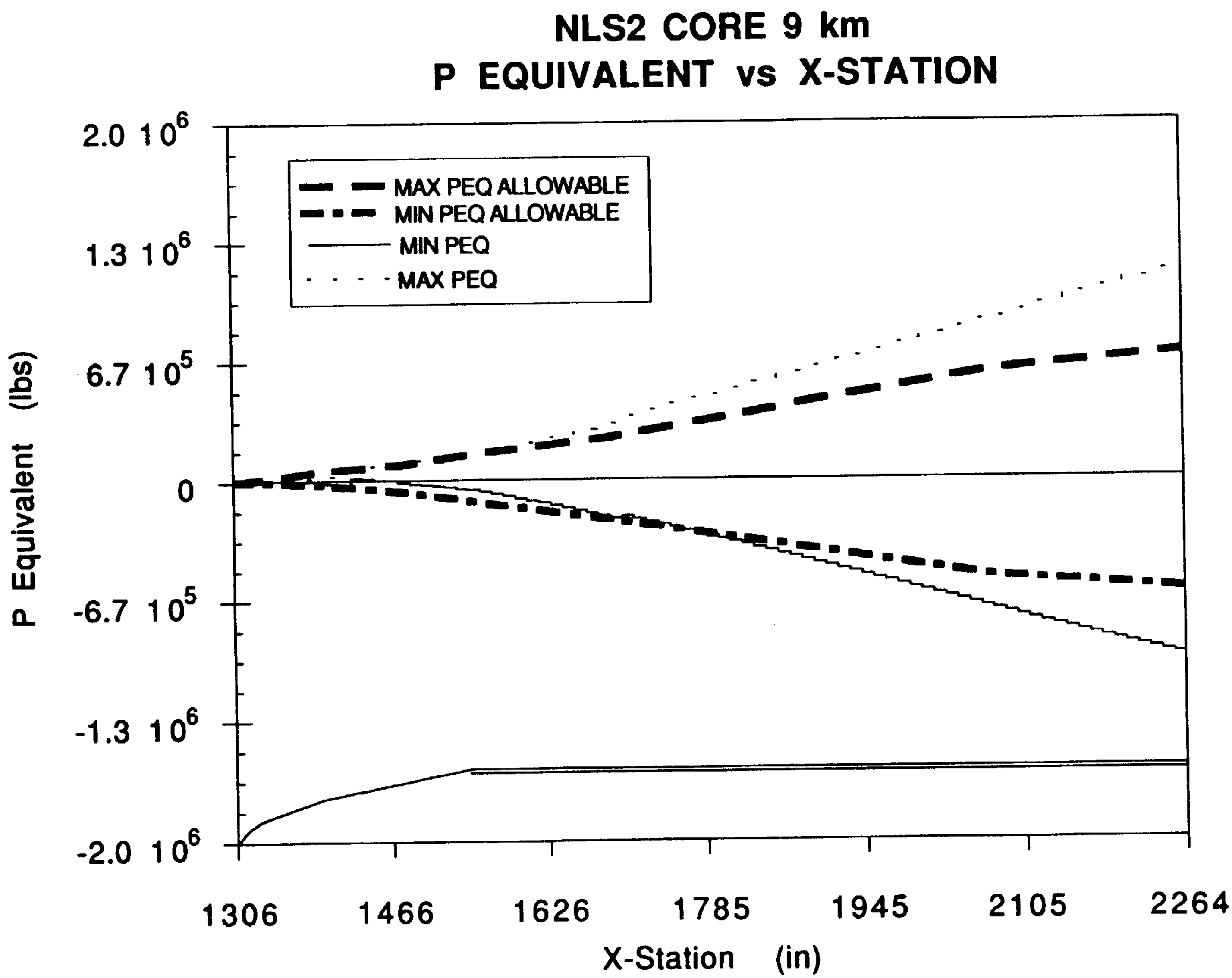

NLS2 CORE - 9 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 CORE - 9 km
Y-DIR MOMENT vs X-STATION





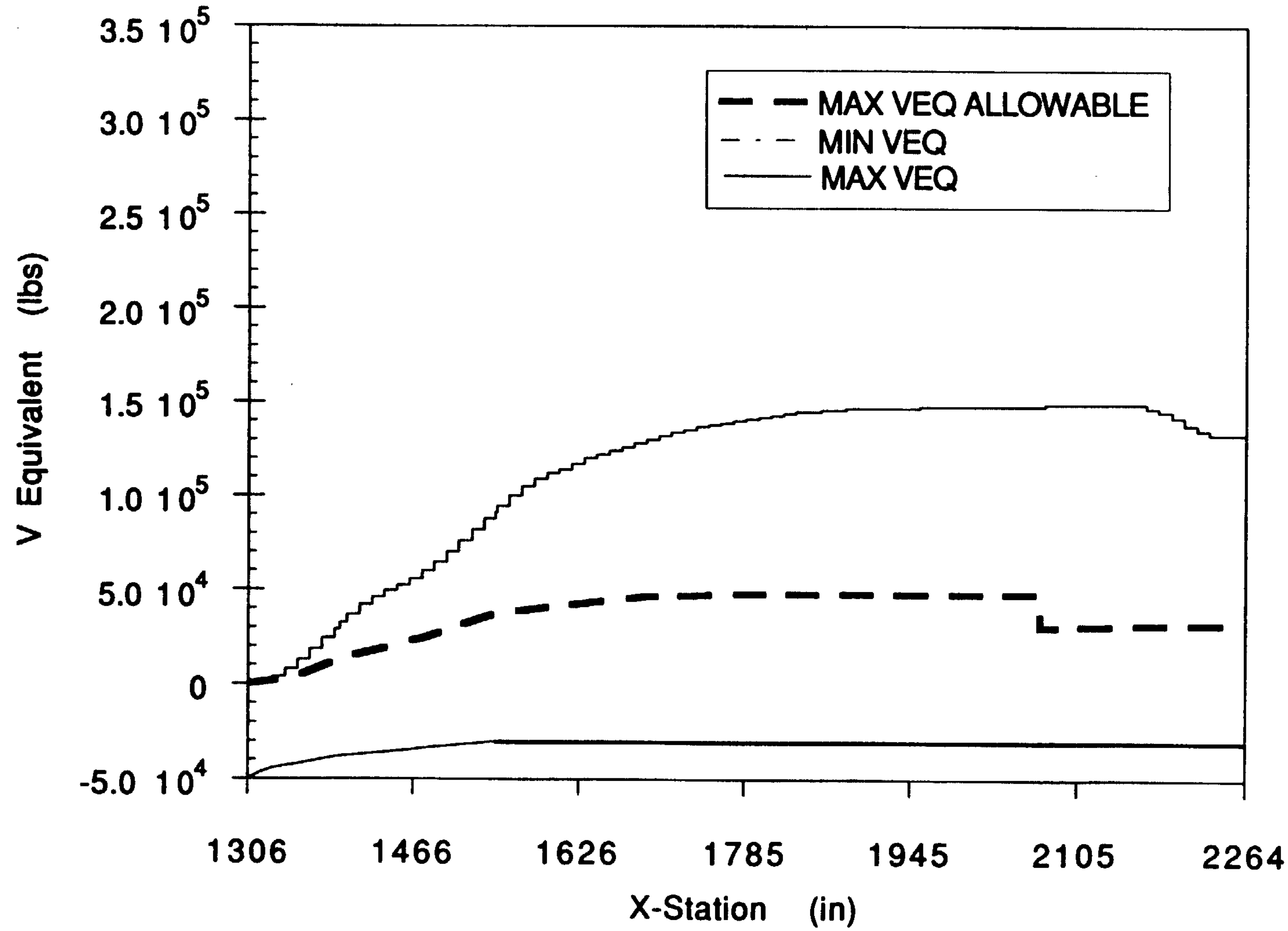
NLS2 CORE - 9 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)



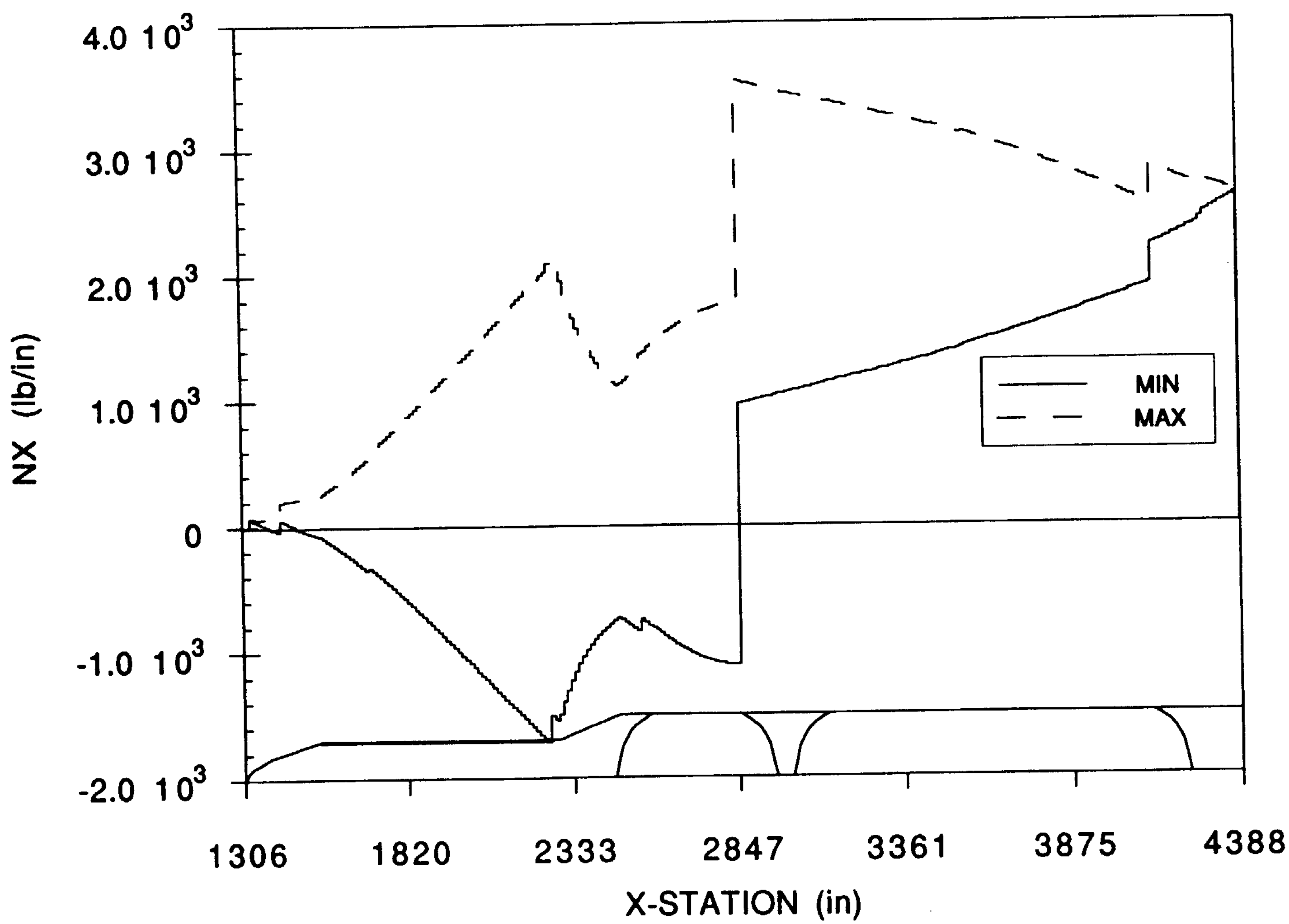
NLS2 CORE 9 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
P Equivalent (lbs)
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

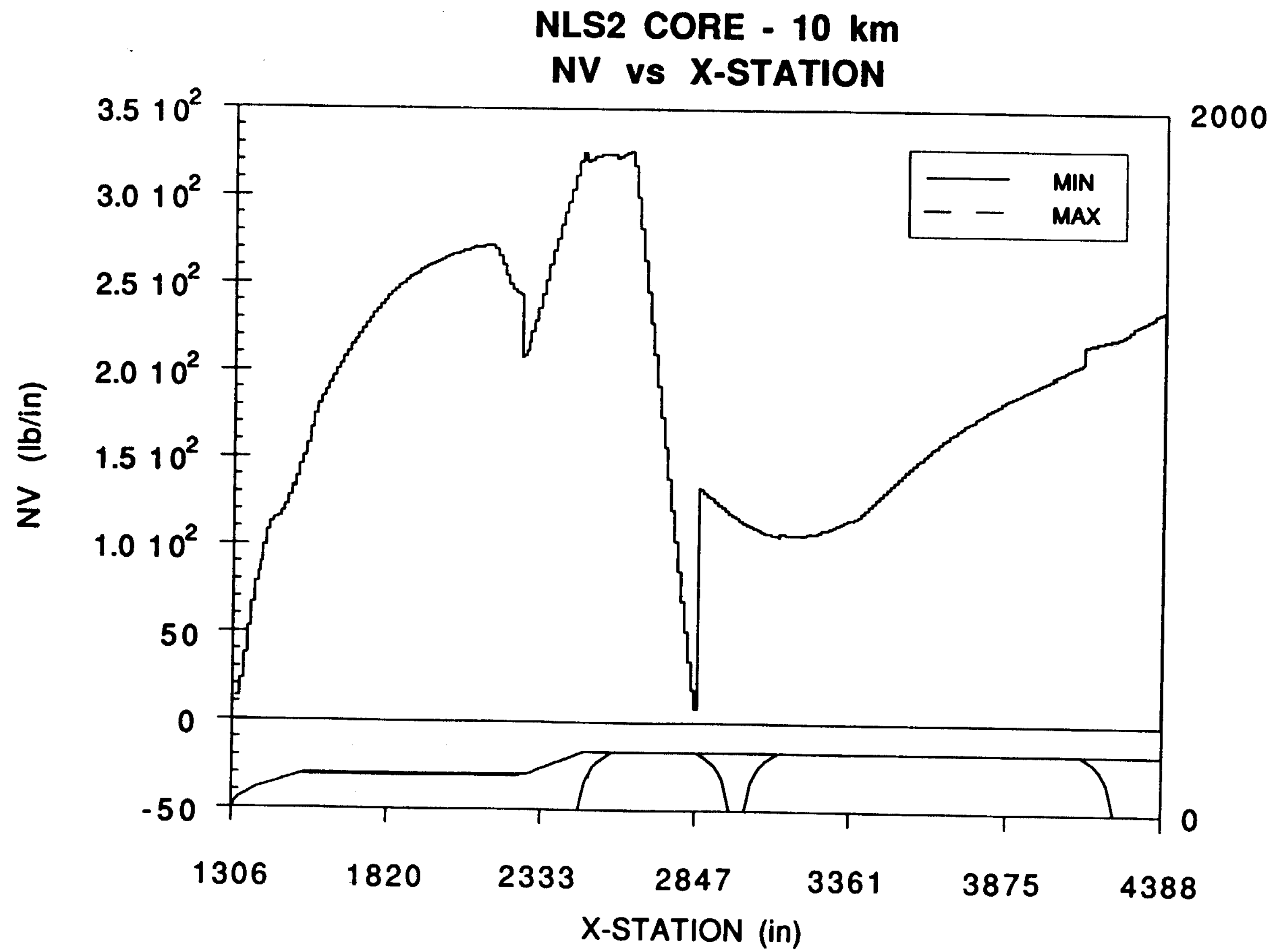
NLS2 CORE 9 km

V EQUIVALENT vs X-STATION

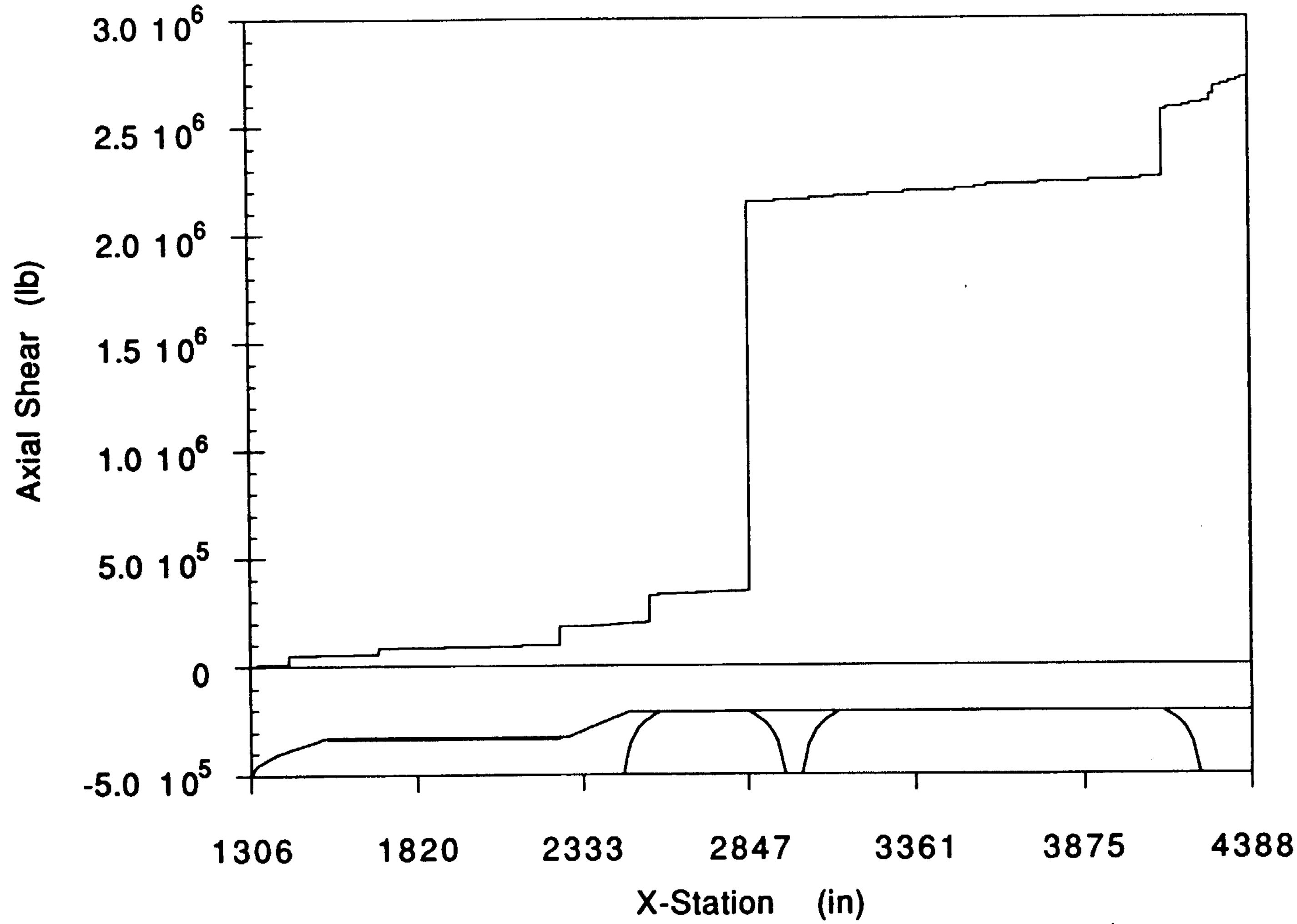


NLS2 CORE - 10 km
NX vs X-STATION

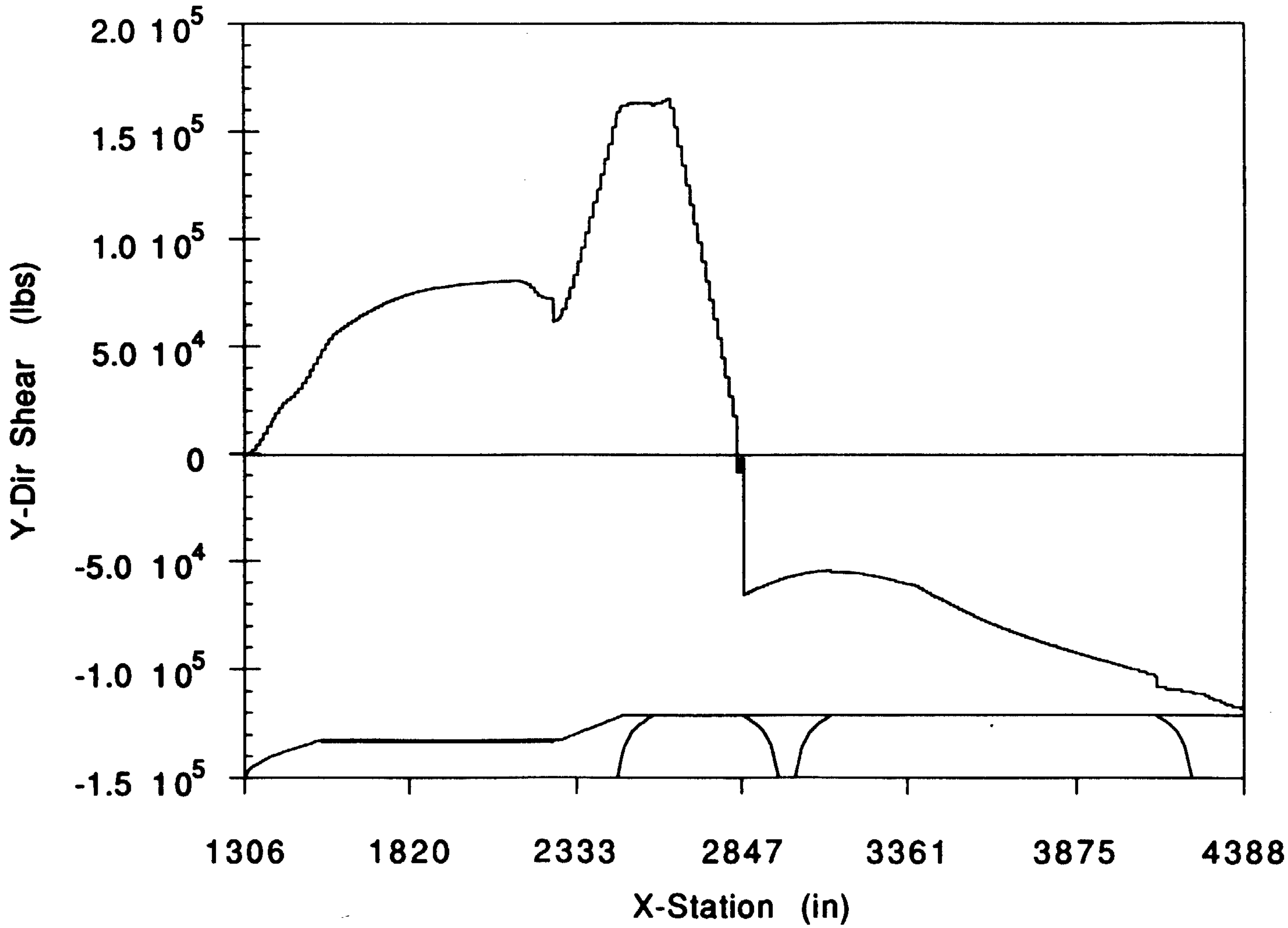


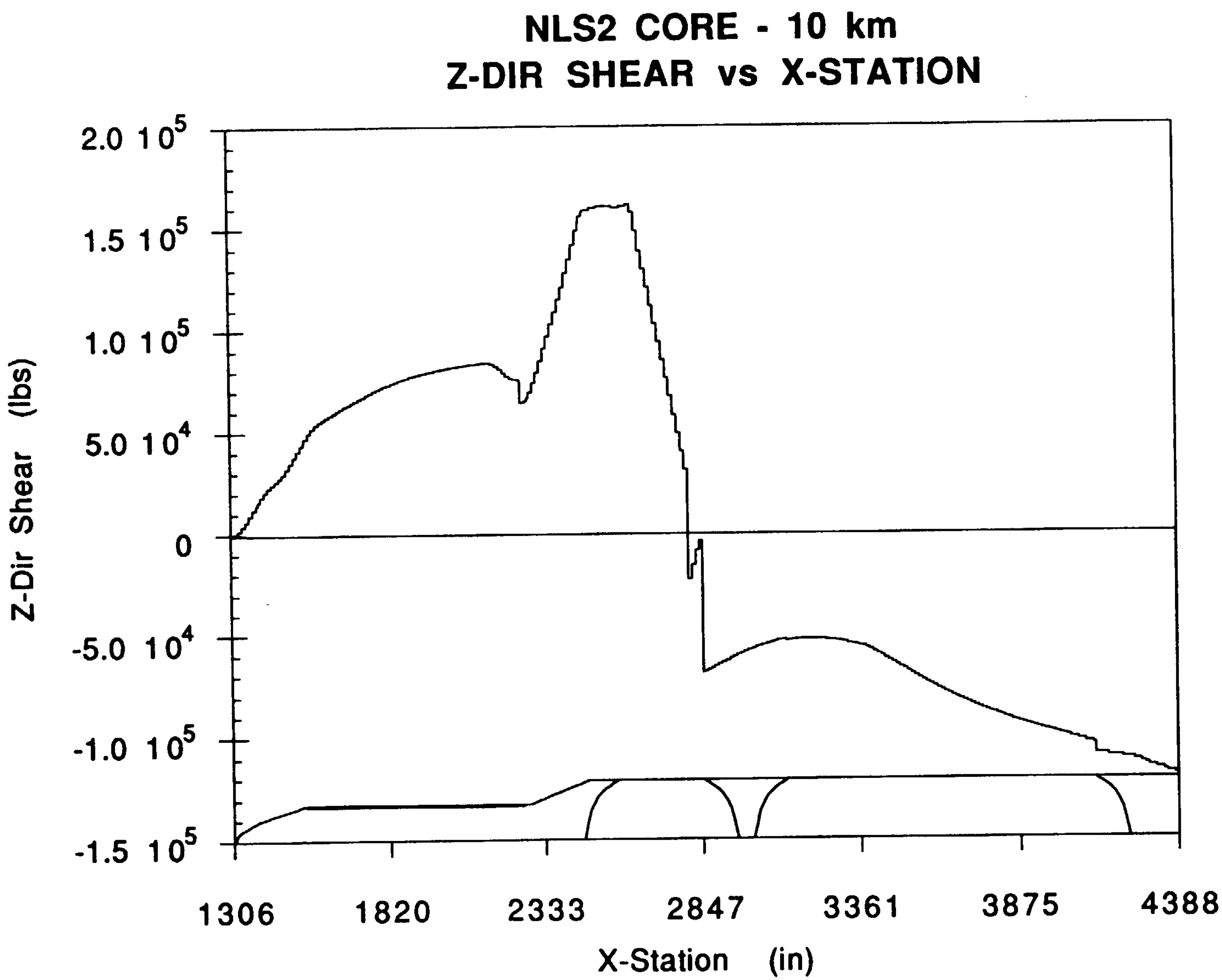

NLS2 CORE - 10 km
NV vs X-STATION
3.5 10^2
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
NV (lb/in)
2000
0
MIN
MAX
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

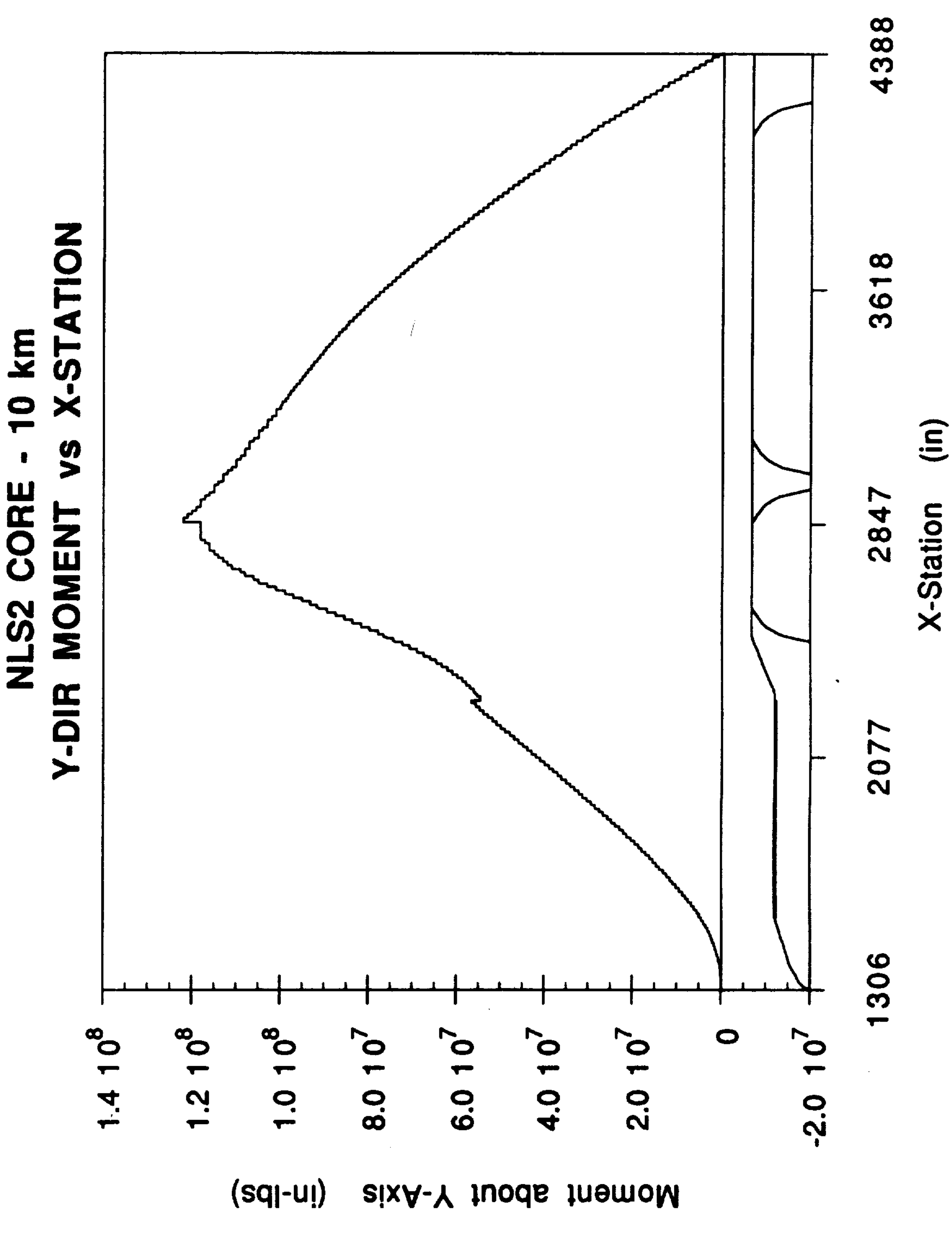
NLS2 CORE - 10 km
AXIAL SHEAR vs X-STATION

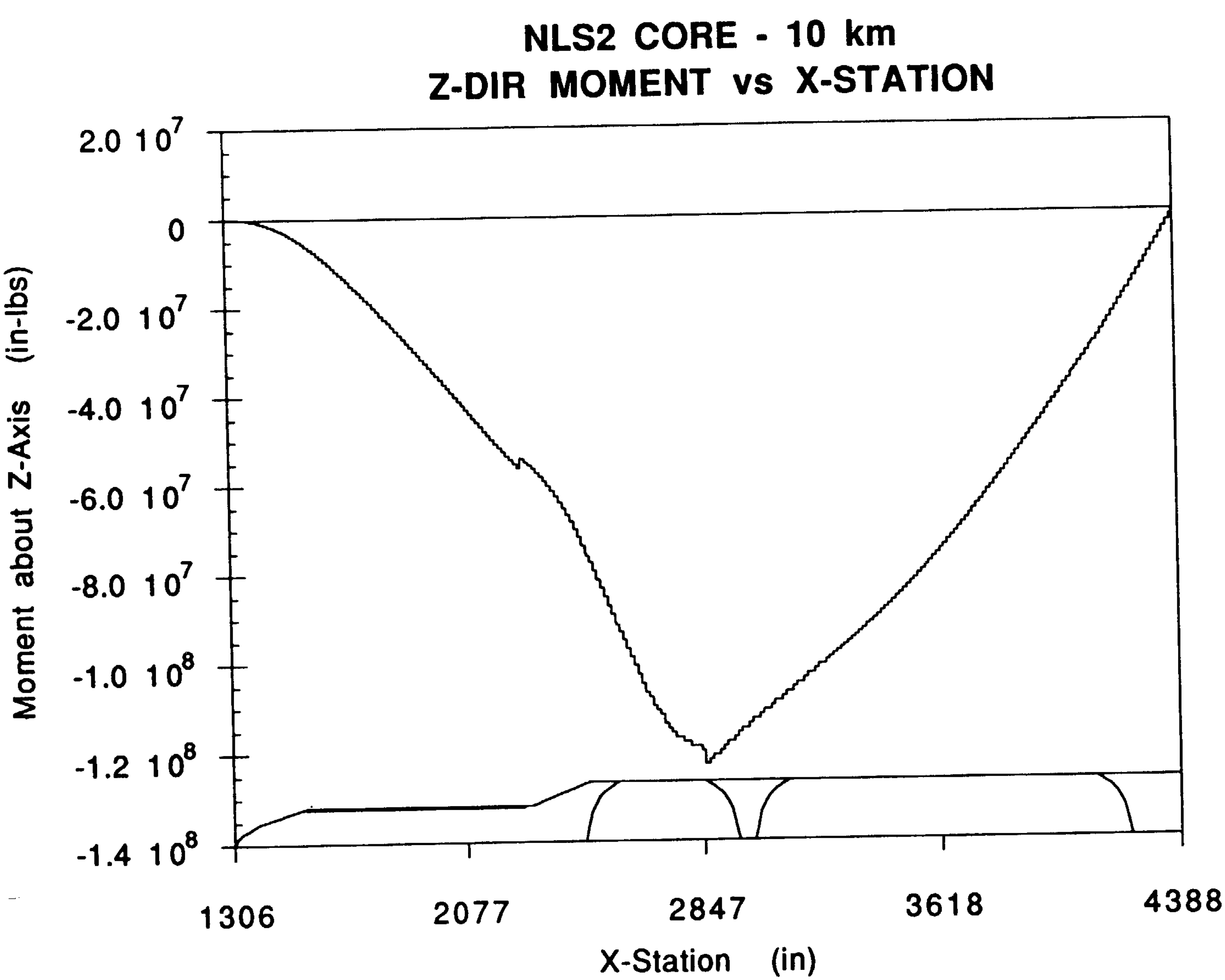


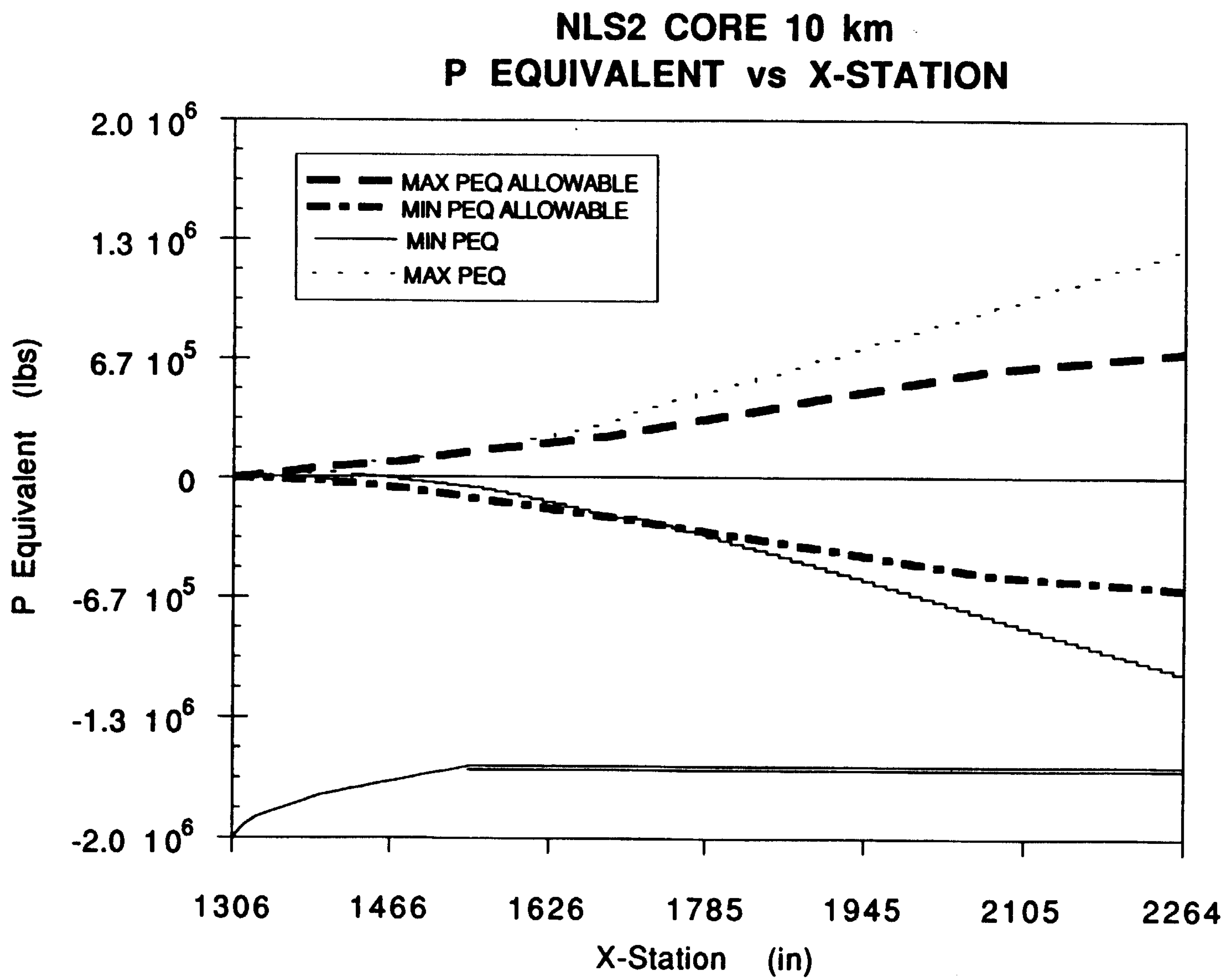
NLS2 CORE - 10 km
Y-DIR SHEAR vs X-STATION




NLS2 CORE - 10 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

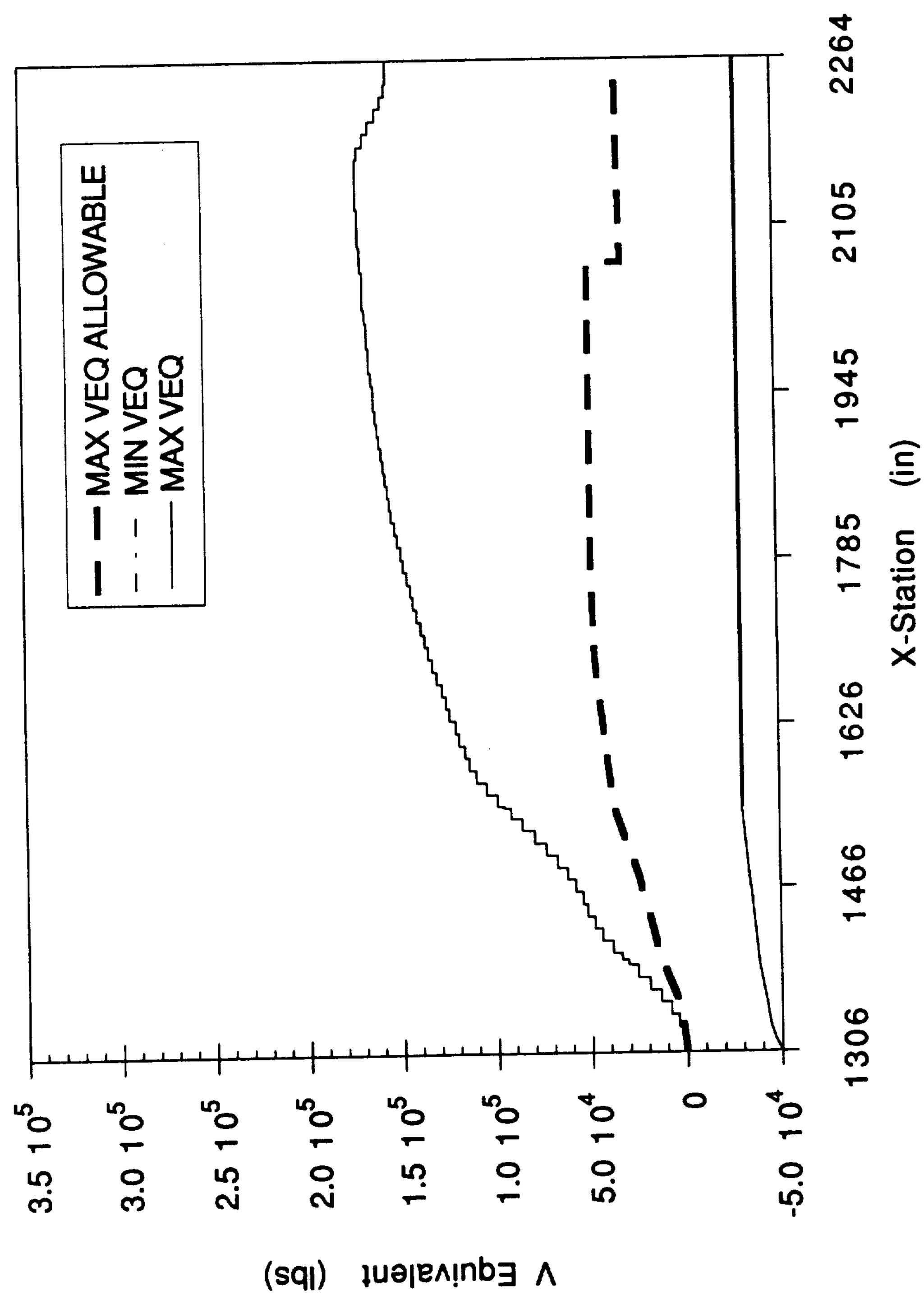

NLS2 CORE - 10 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.4 10^8
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)


NLS2 CORE - 10 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
-8.0 10^7
-1.0 10^8
-1.2 10^8
-1.4 10^8
1306
2077
2847
3618
4388
X-Station (in)

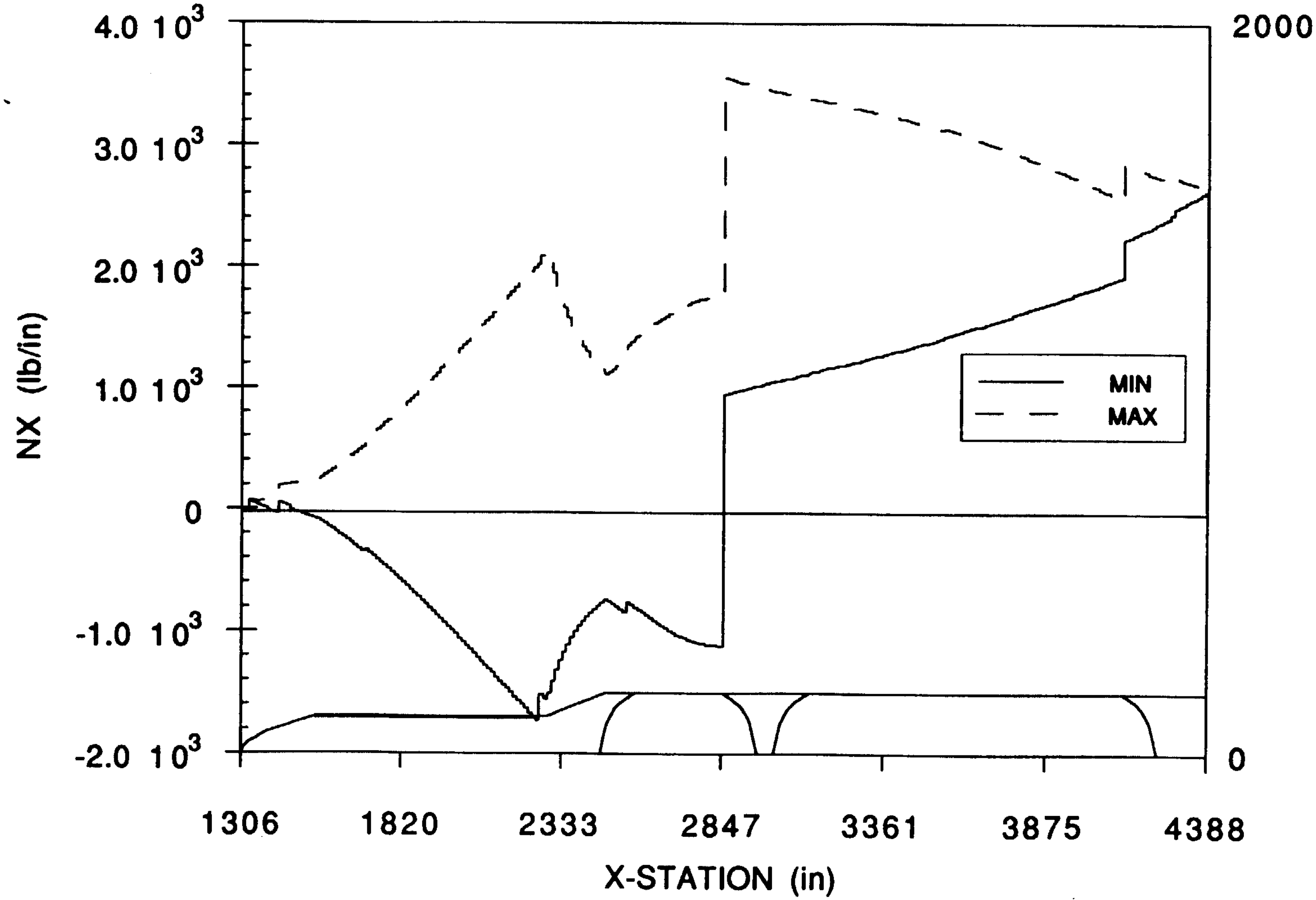


NLS2 CORE 10 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
P Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

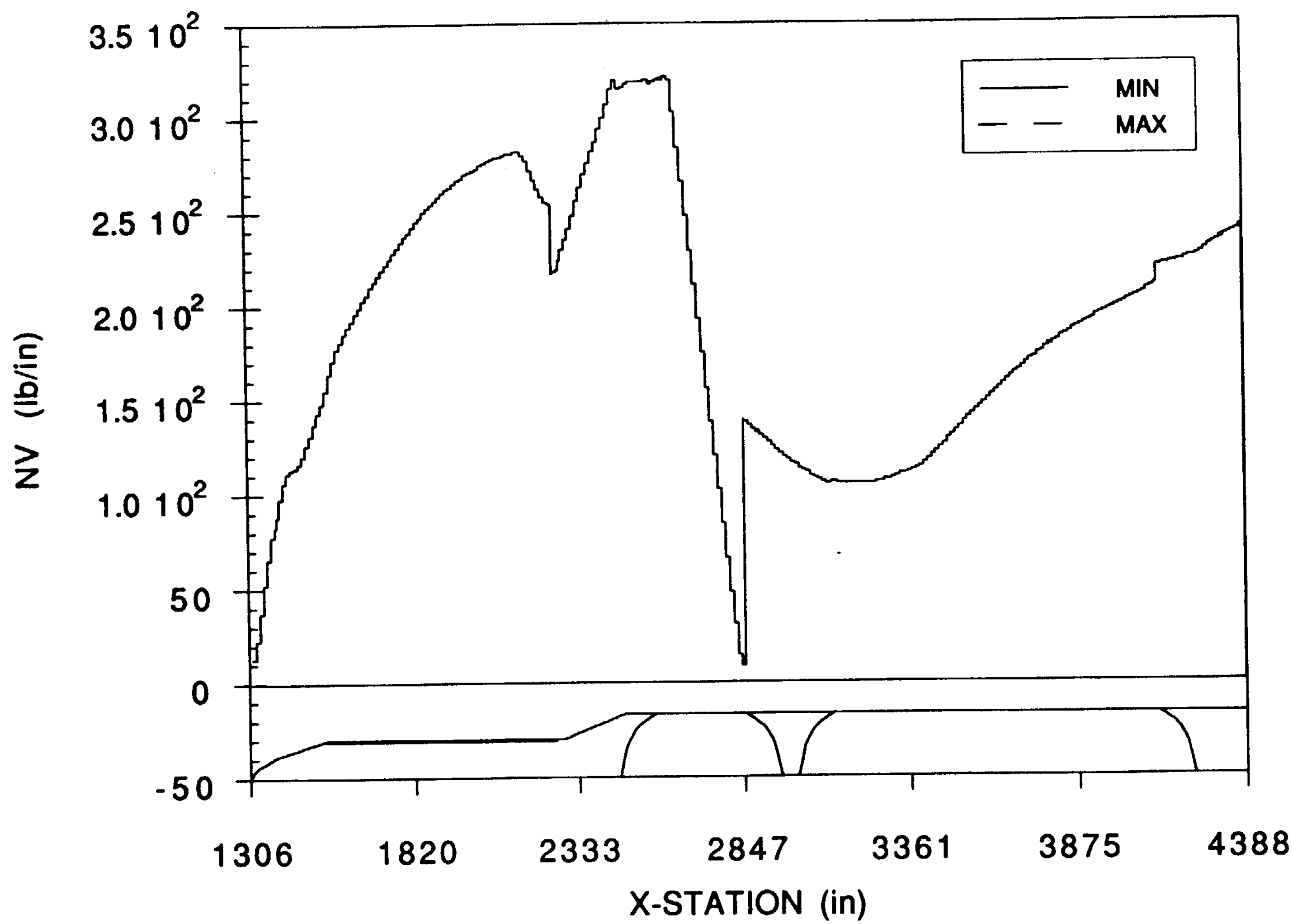
NLS2 CORE 10 km
V EQUIVALENT vs X-STATION



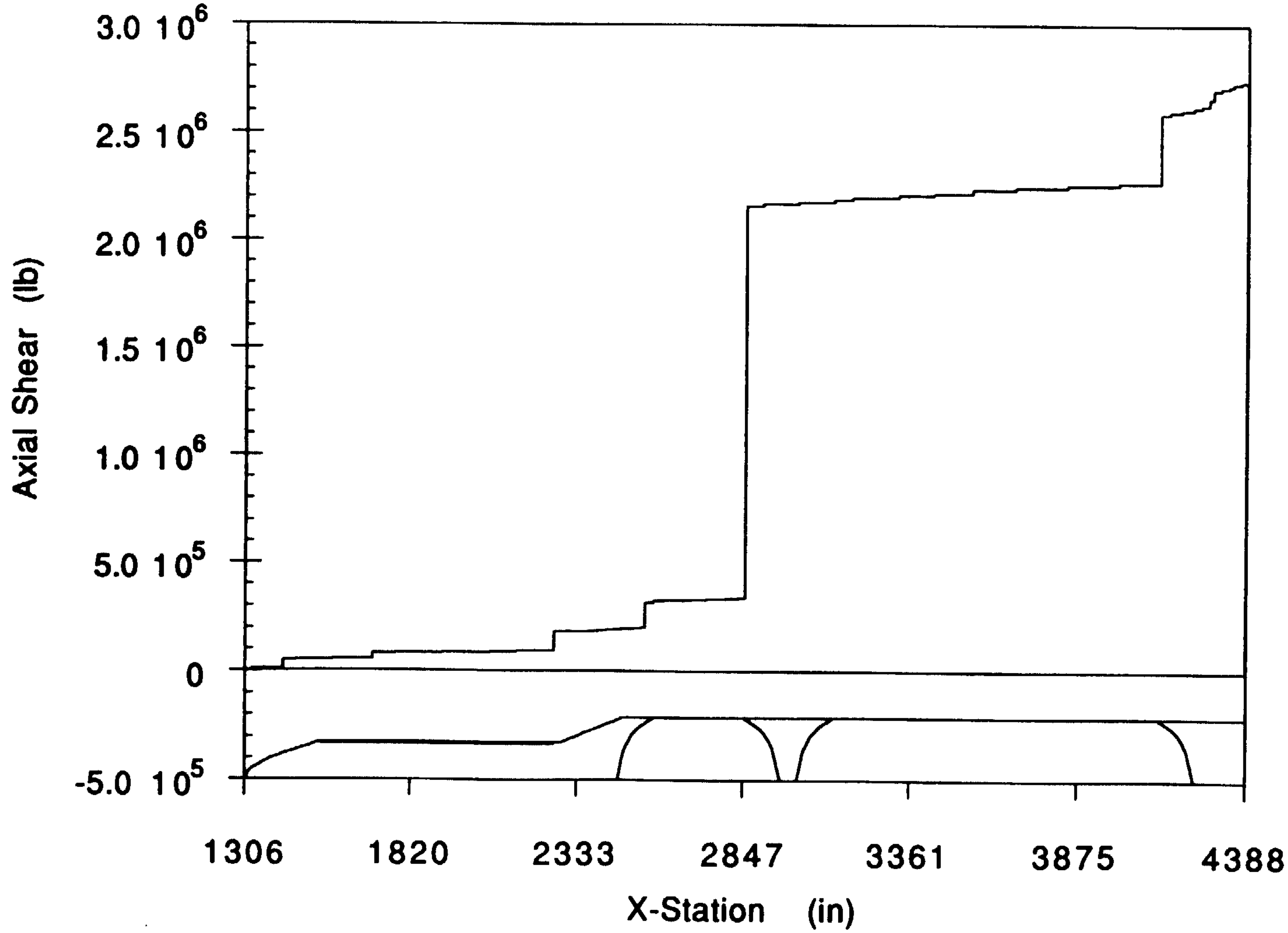
NLS2 CORE - 11 km
NX vs X-STATION



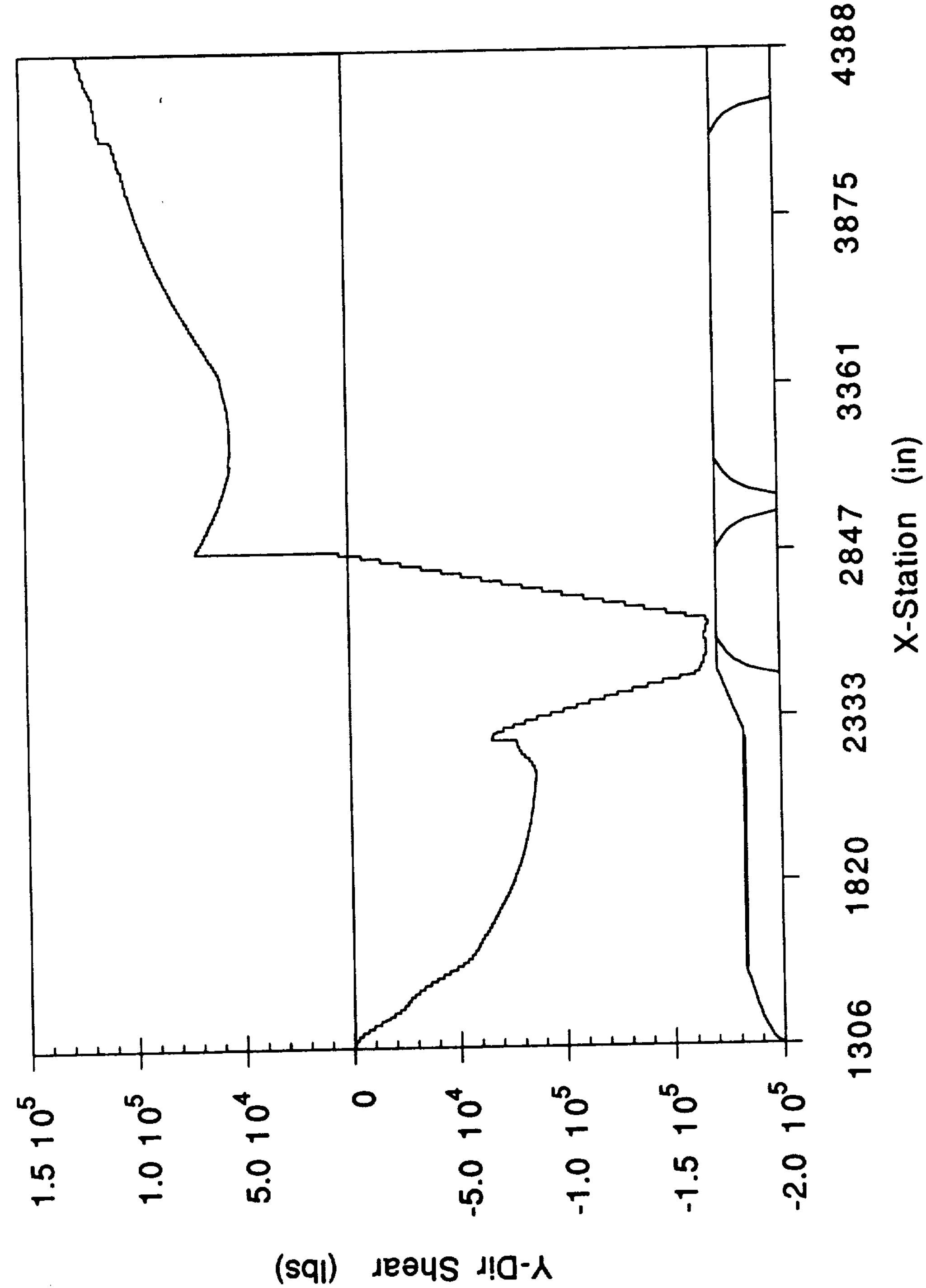
NLS2 CORE - 11 km
NV vs X-STATION



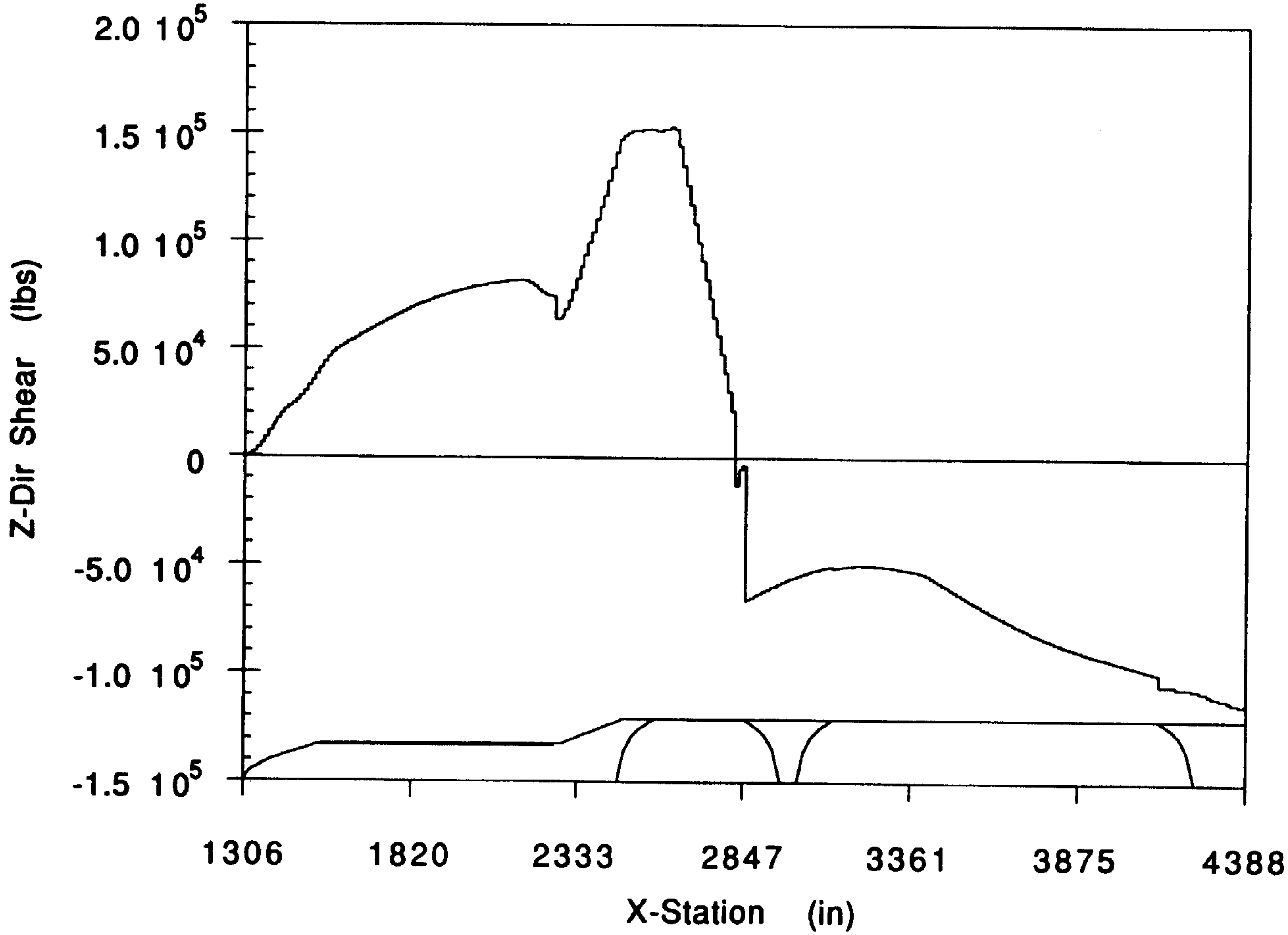
NLS2 CORE - 11 km
AXIAL SHEAR vs X-STATION



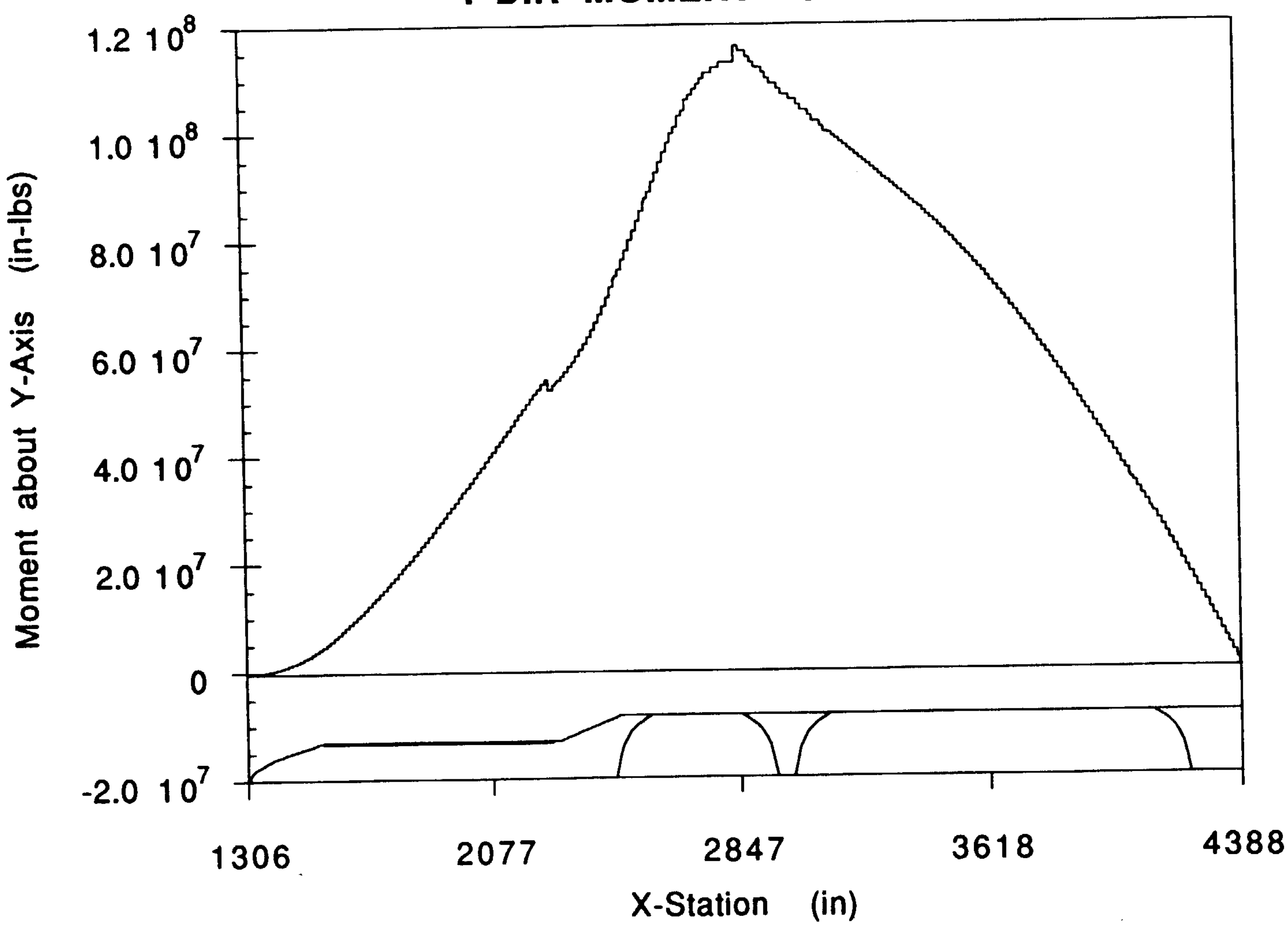
NLS2 CORE - 11 km
Y-DIR SHEAR vs X-STATION

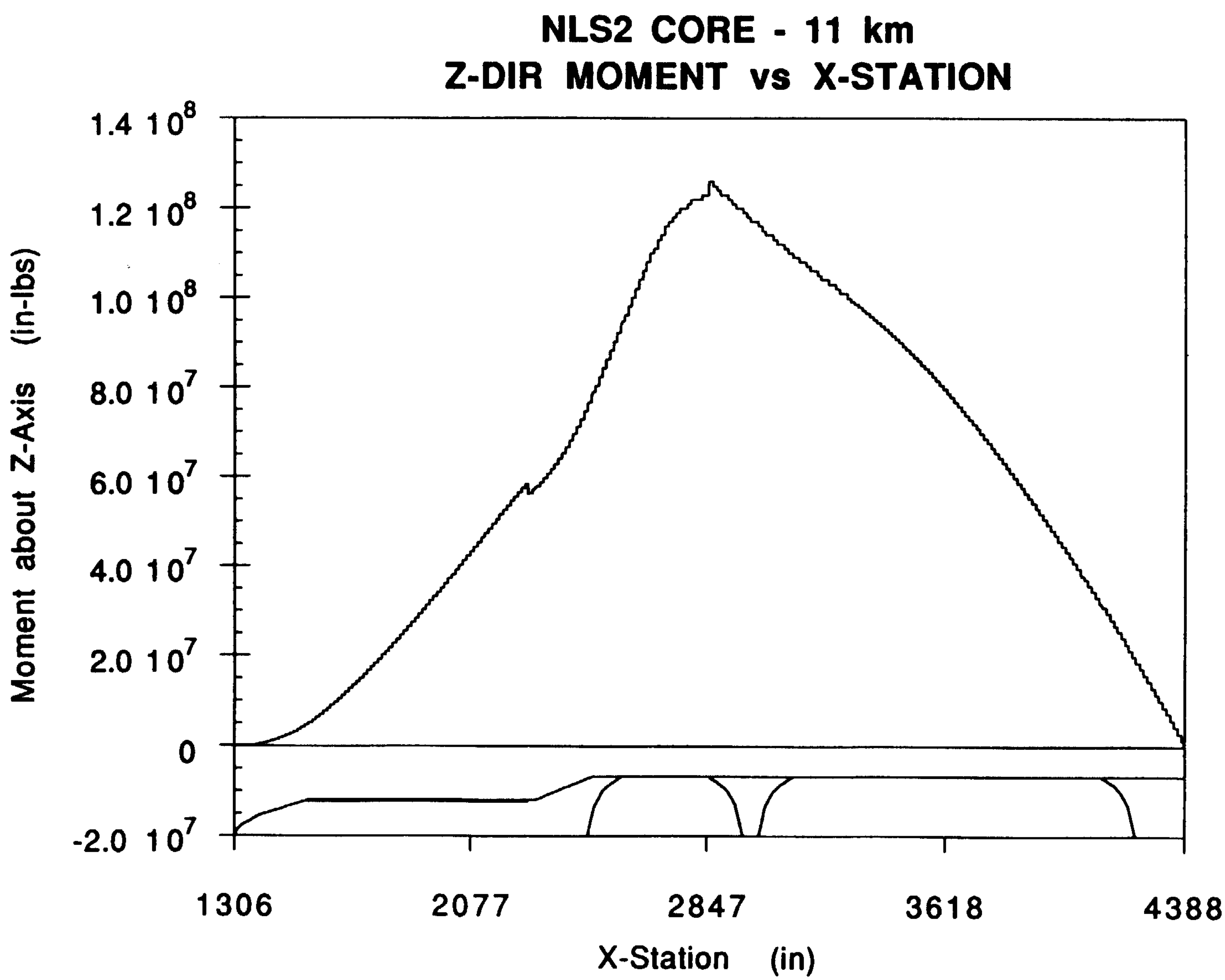


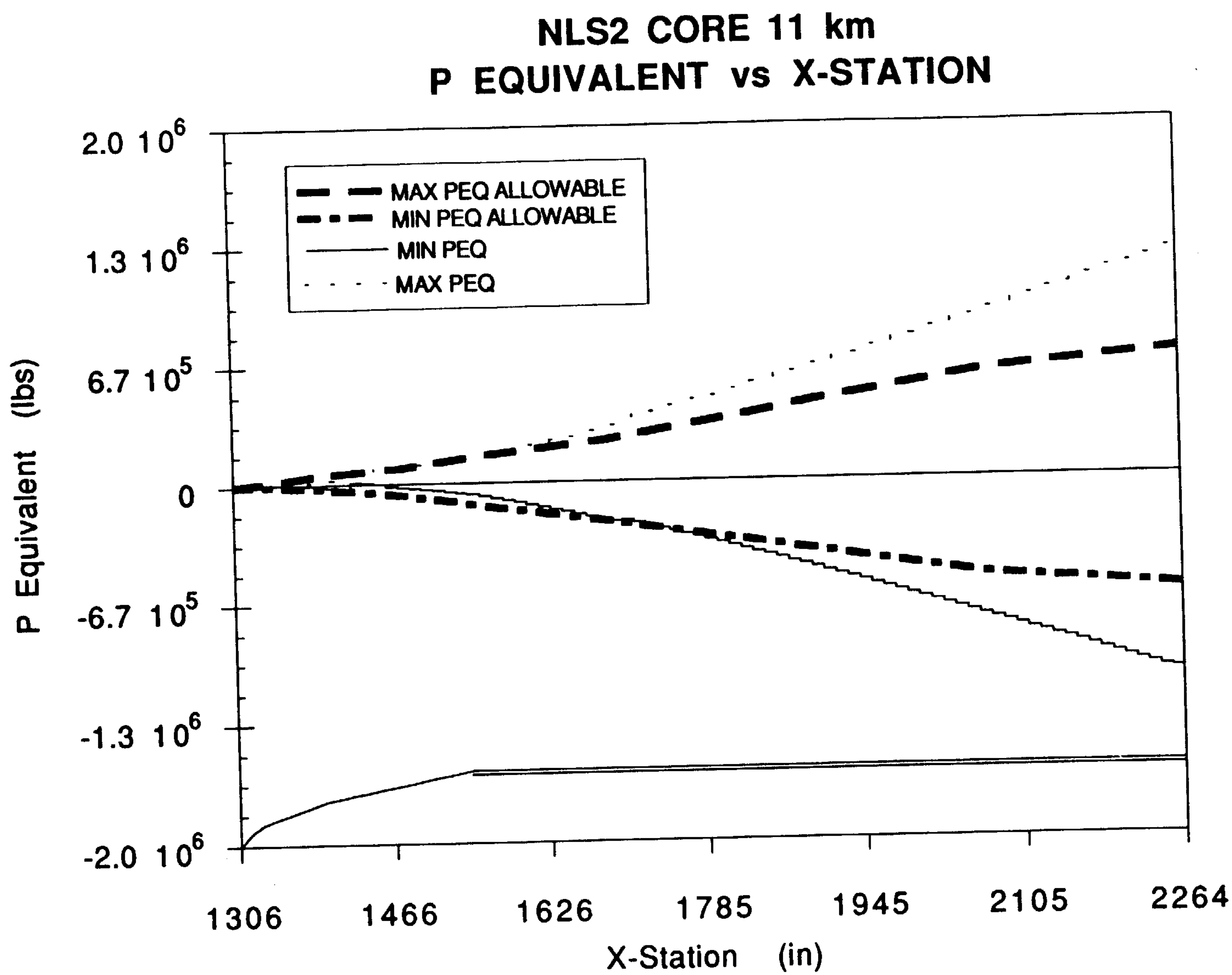
NLS2 CORE - 11 km
Z-DIR SHEAR vs X-STATION



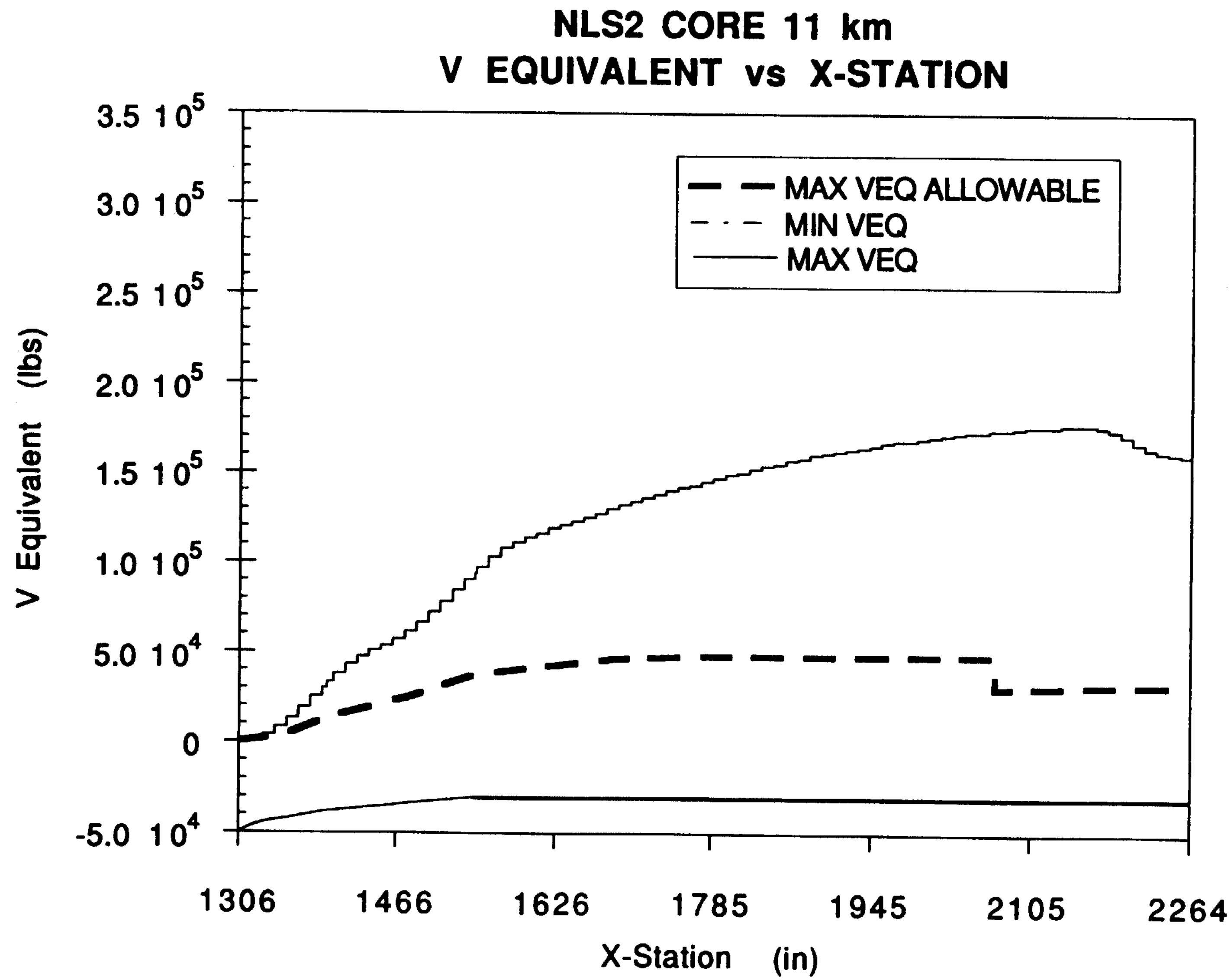
NLS2 CORE - 11 km
Y-DIR MOMENT vs X-STATION

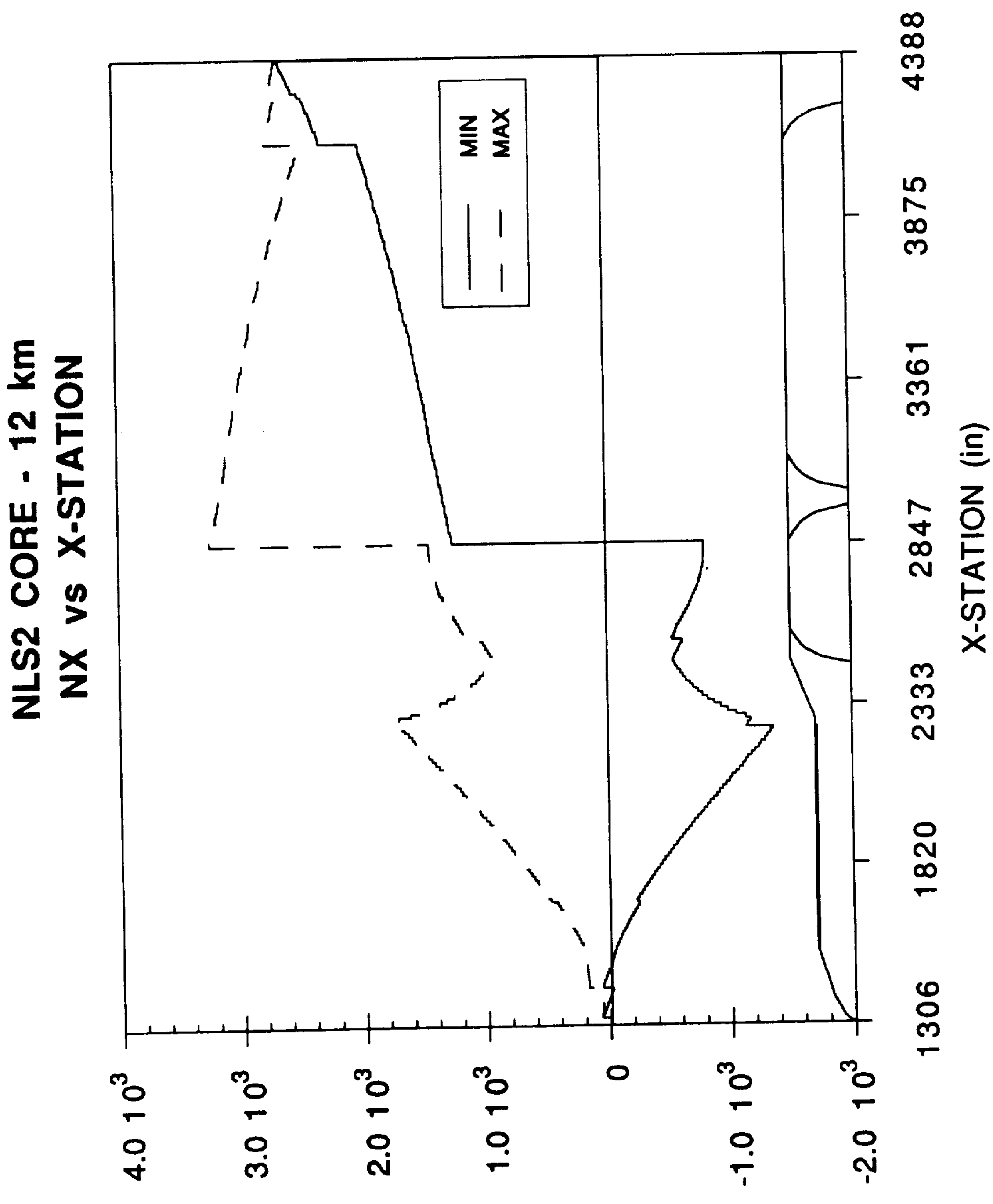



NLS2 CORE - 11 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.4 10^8
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

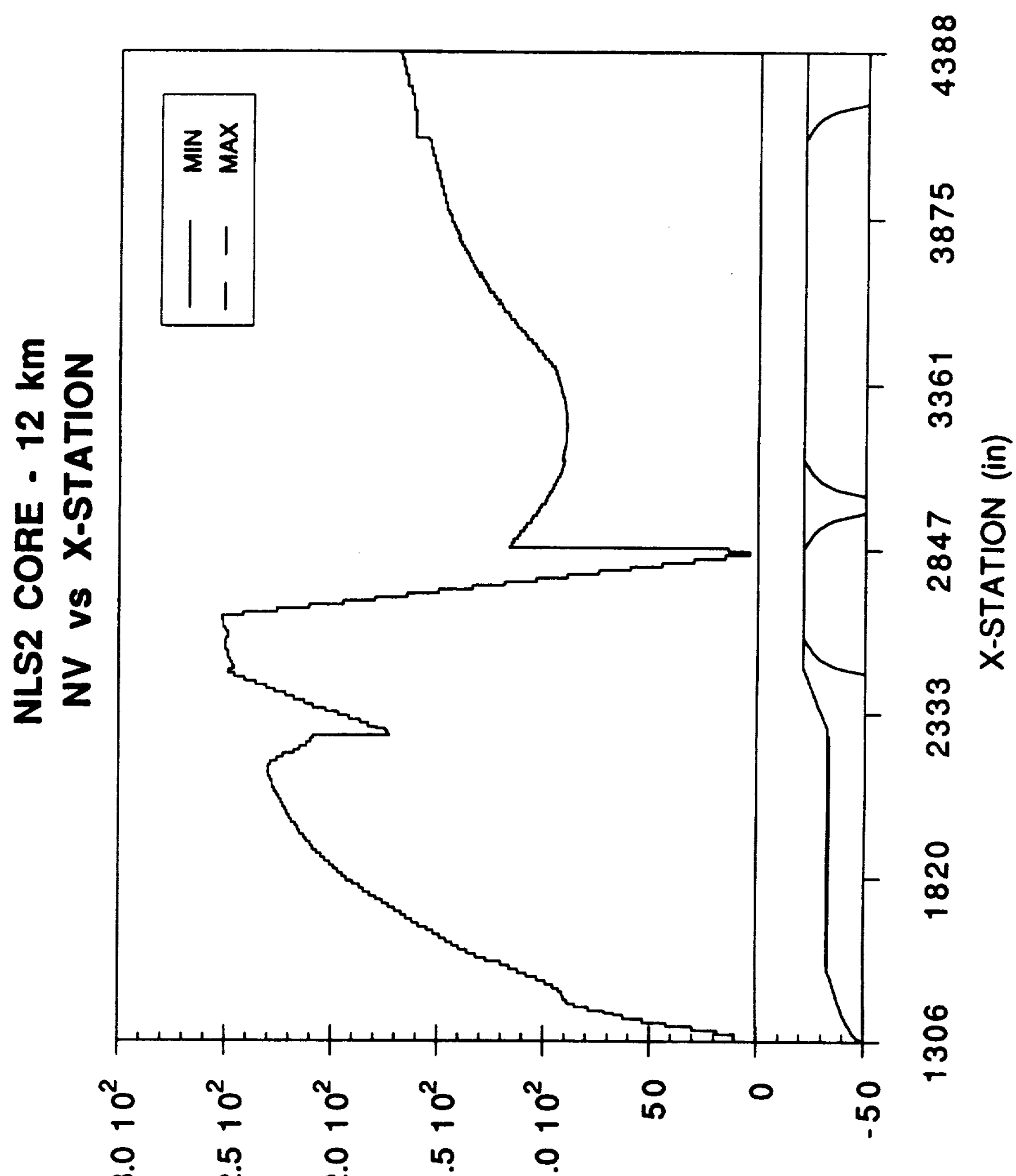


NLS2 CORE 11 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
P Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

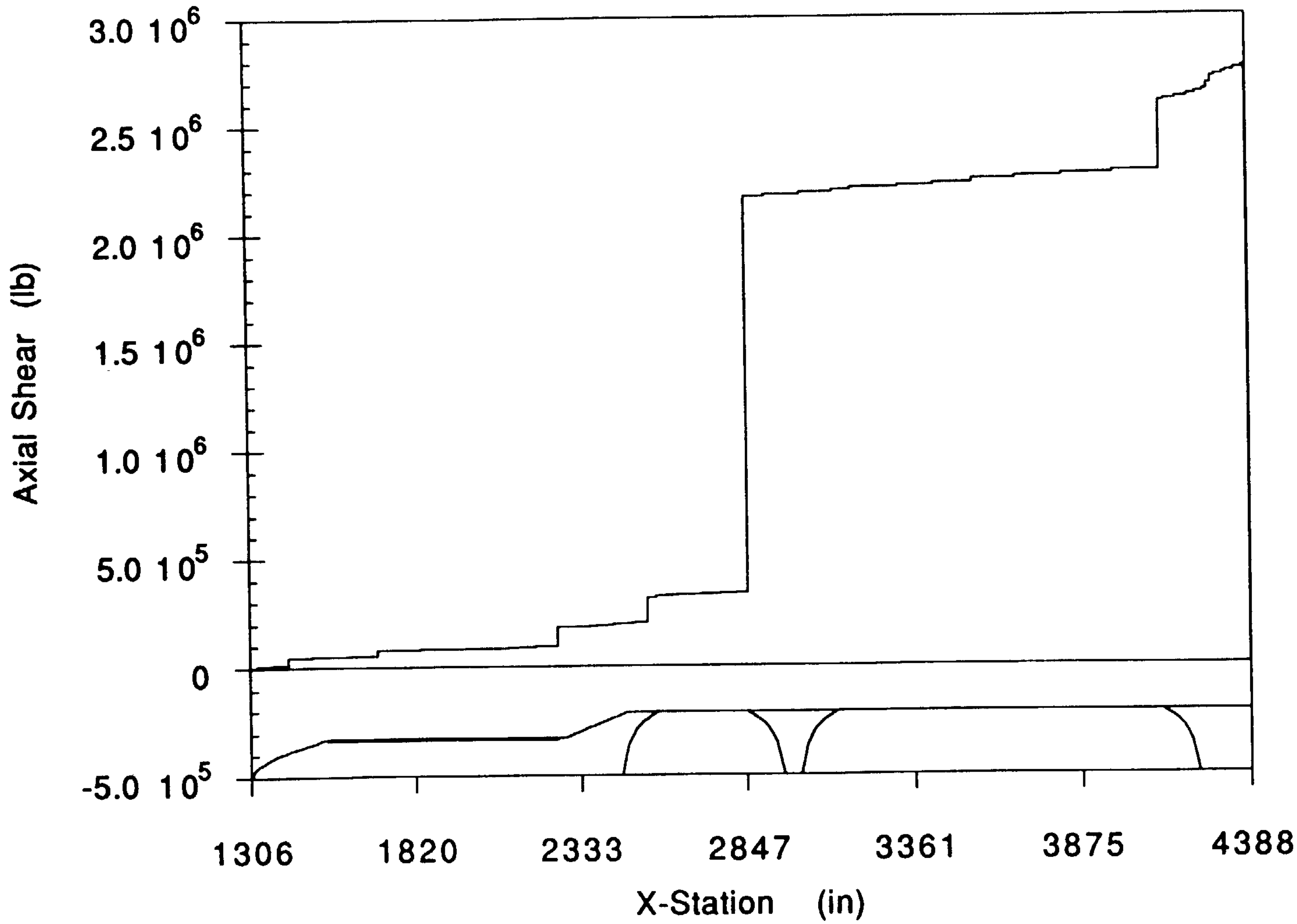

NLS2 CORE 11 km
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

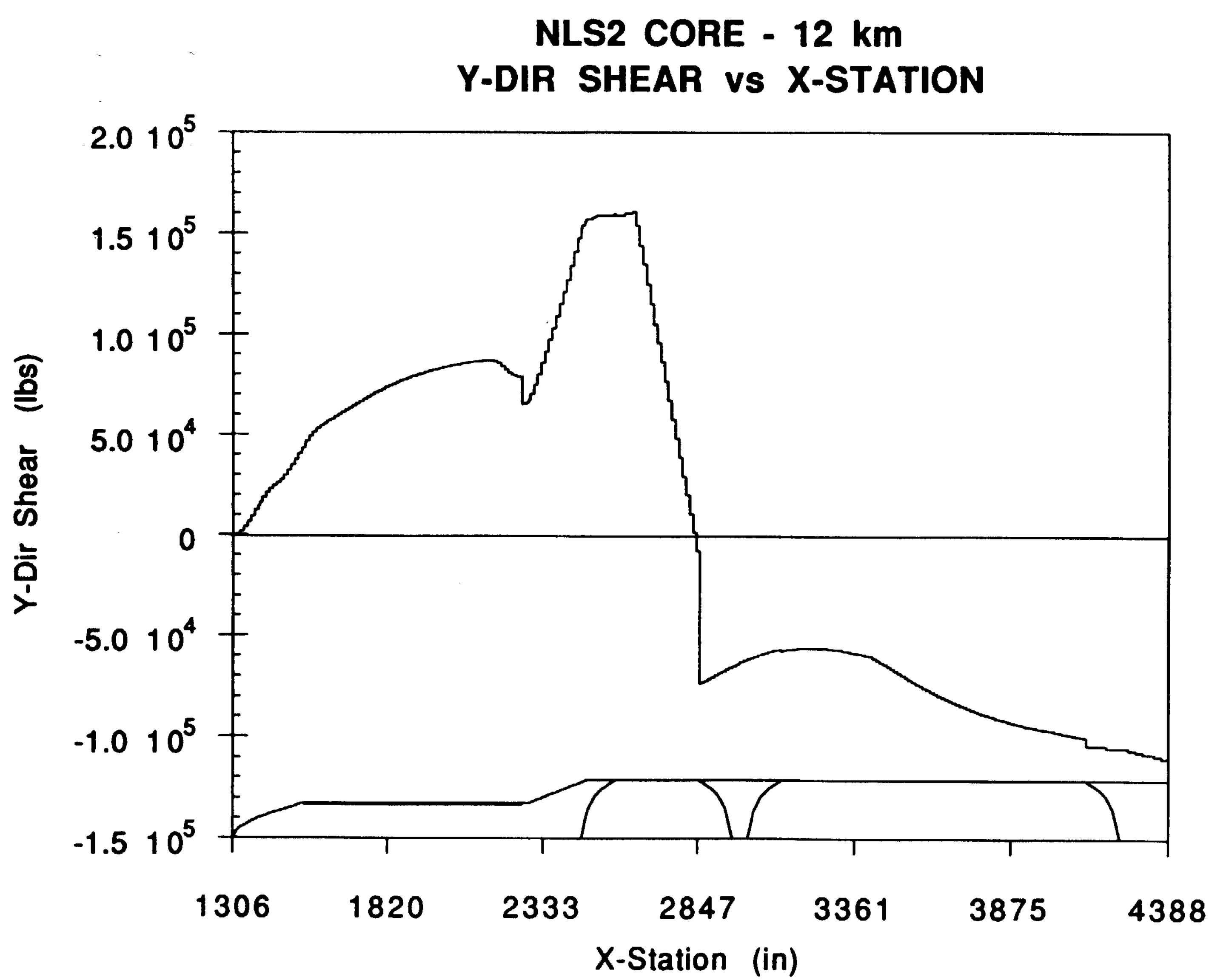


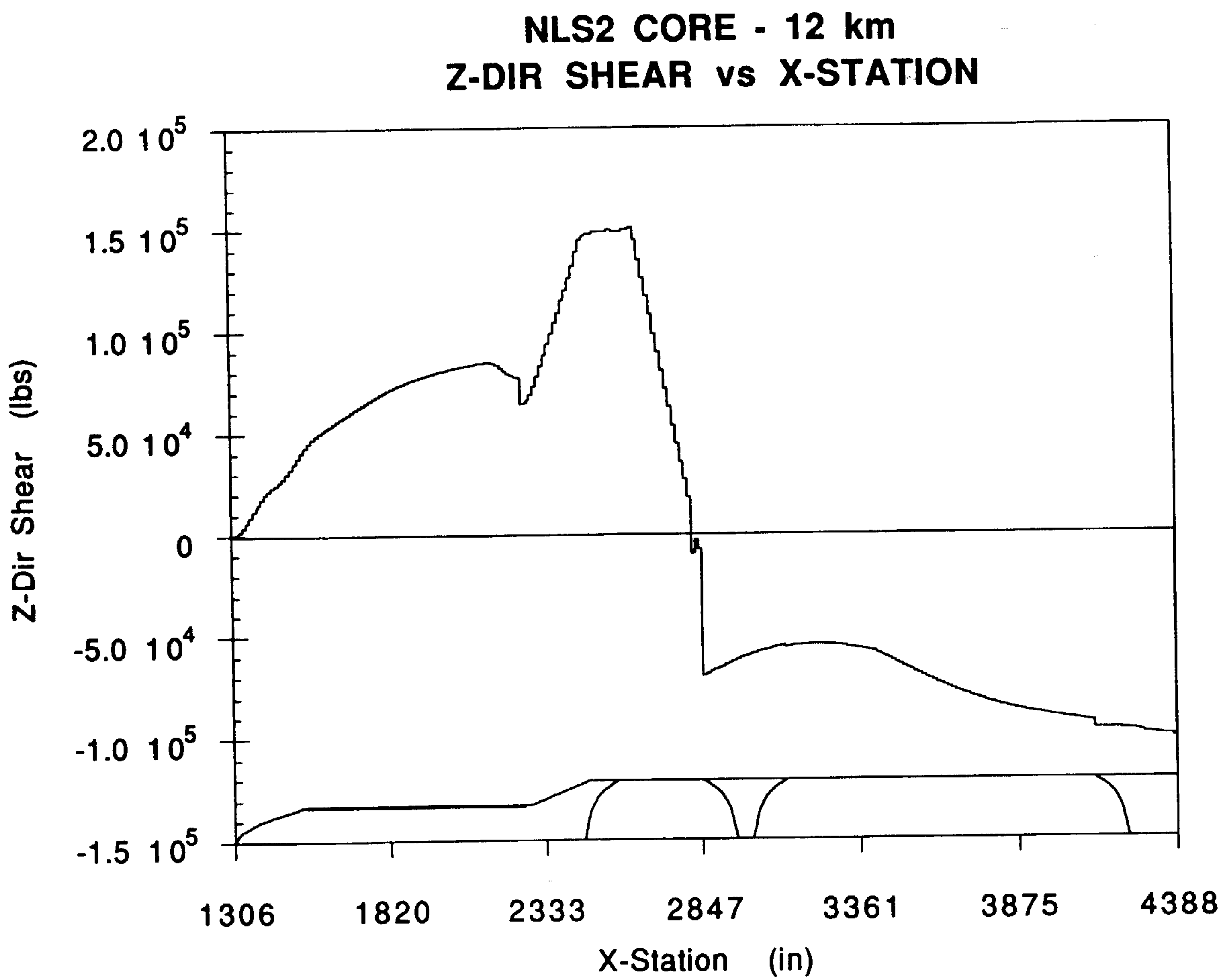
NLS2 CORE - 12 km
NX vs X-STATION
NX (lb/in)
X-STATION (in)
MIN
MAX
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1306
1820
2333
2847
3361
3875
4388

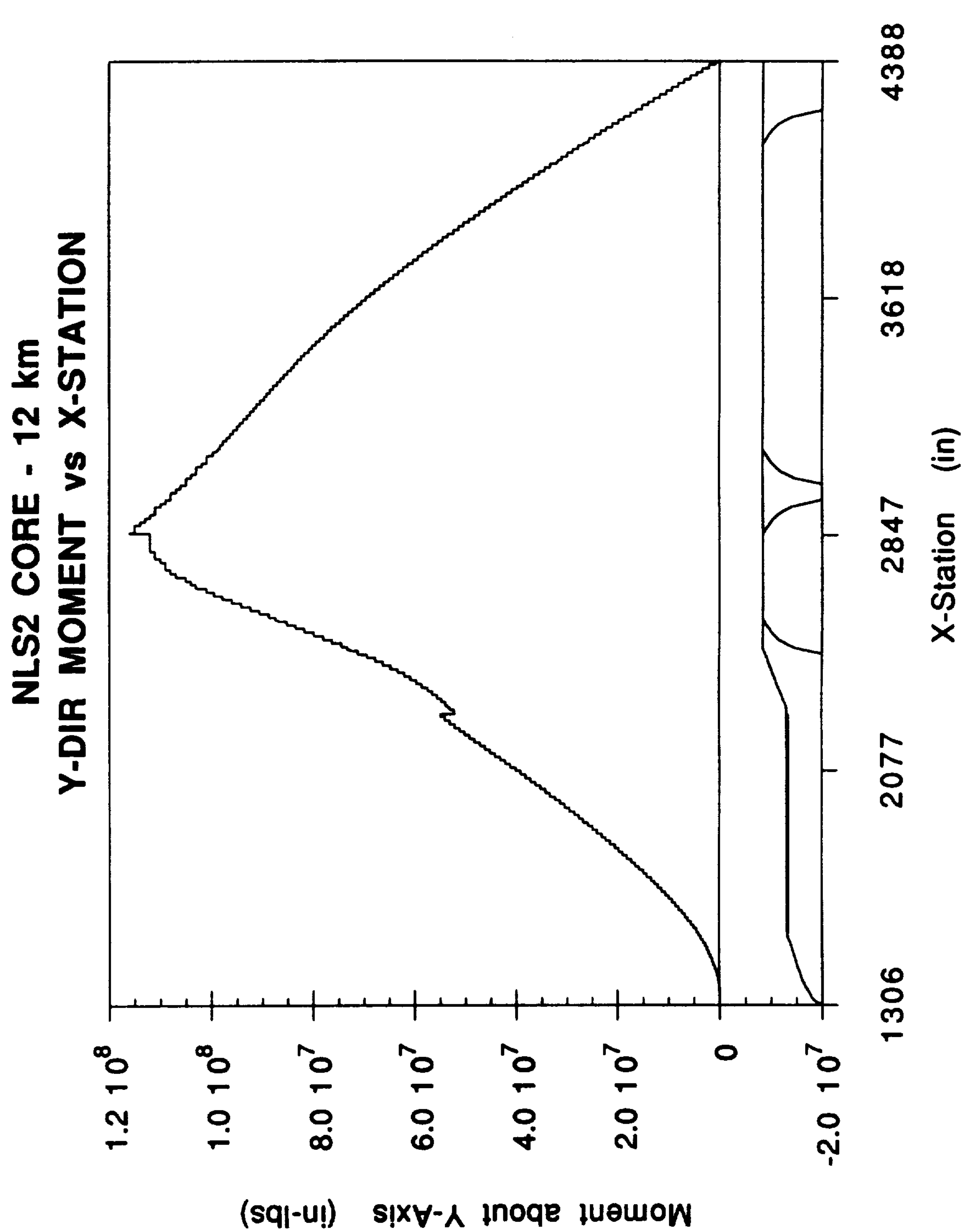

NLS2 CORE - 12 km
NV vs X-STATION
MIN
MAX
NV (lb/in)
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

NLS2 CORE - 12 km
AXIAL SHEAR vs X-STATION

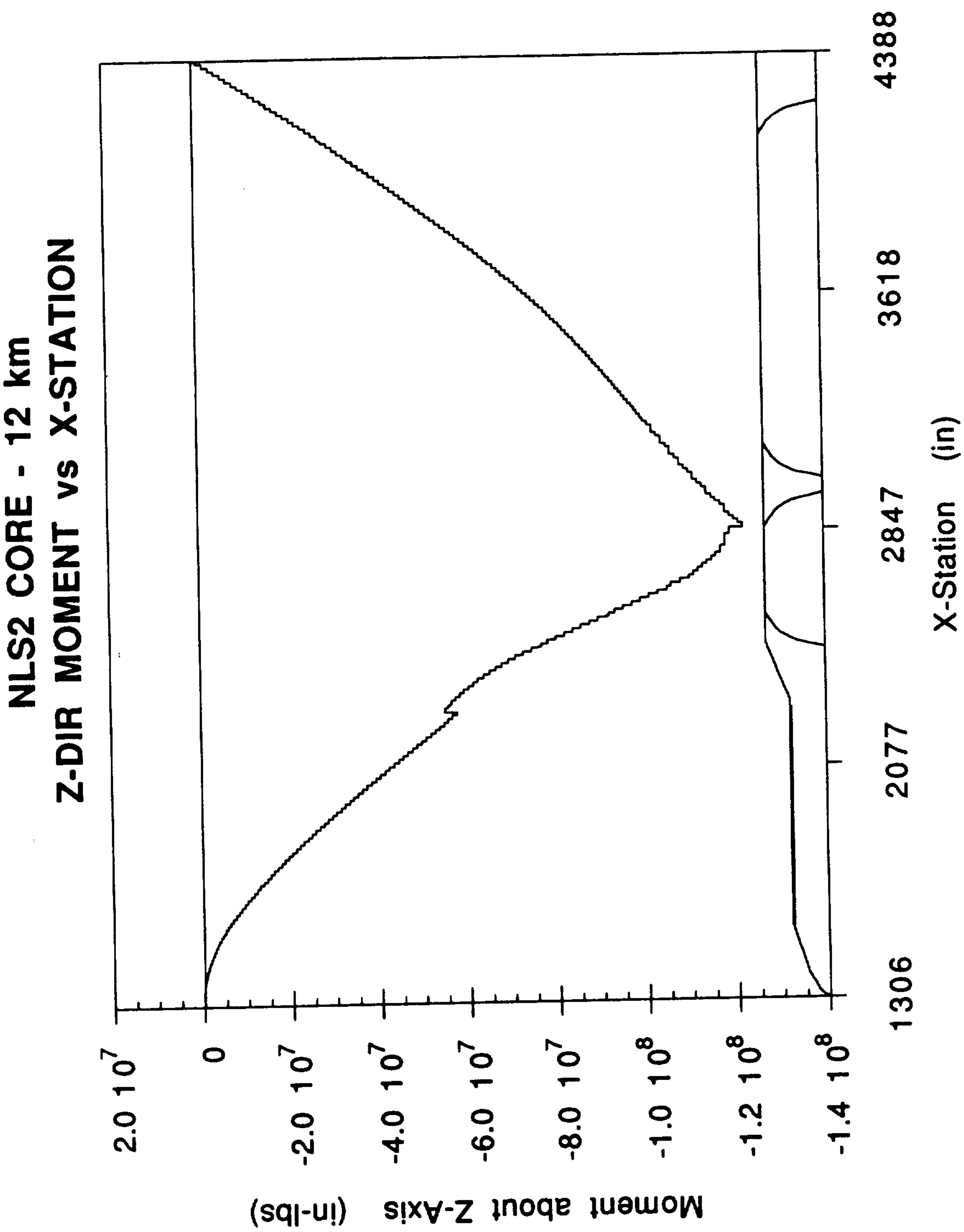



NLS2 CORE - 12 km
Y-DIR SHEAR vs X-STATION
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

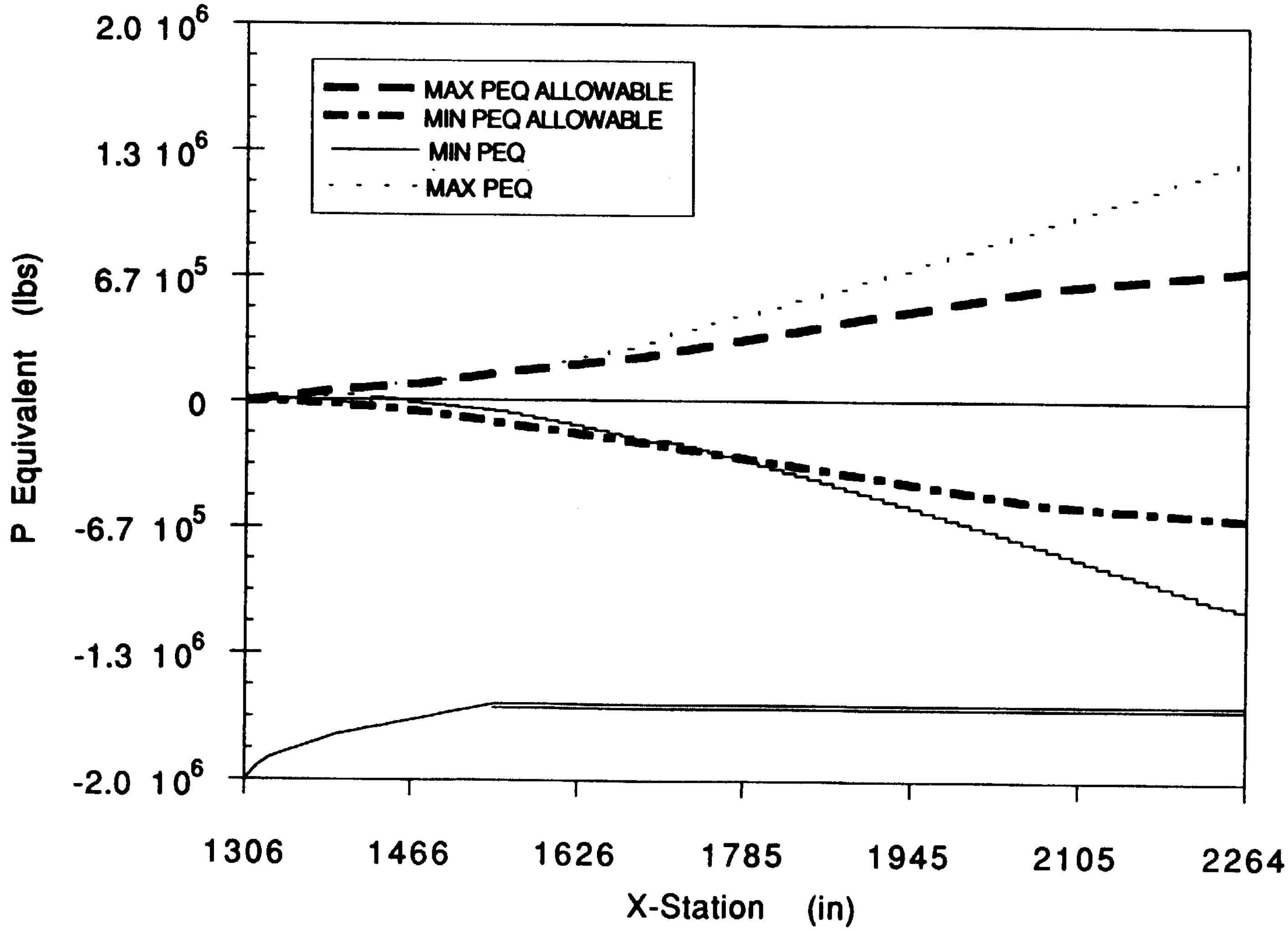

NLS2 CORE - 12 km
Z-DIR SHEAR vs X-STATION
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Z-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

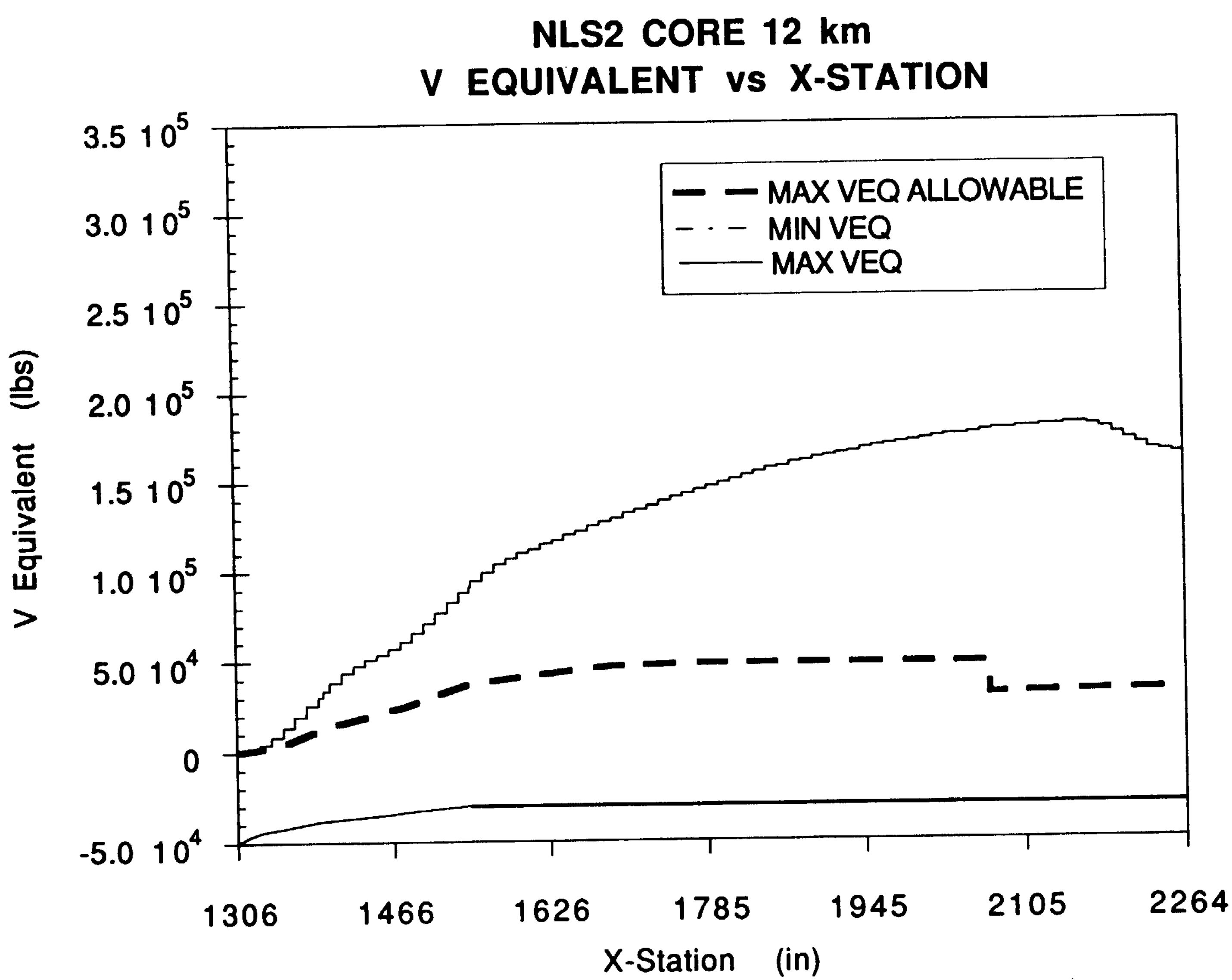


NLS2 CORE - 12 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

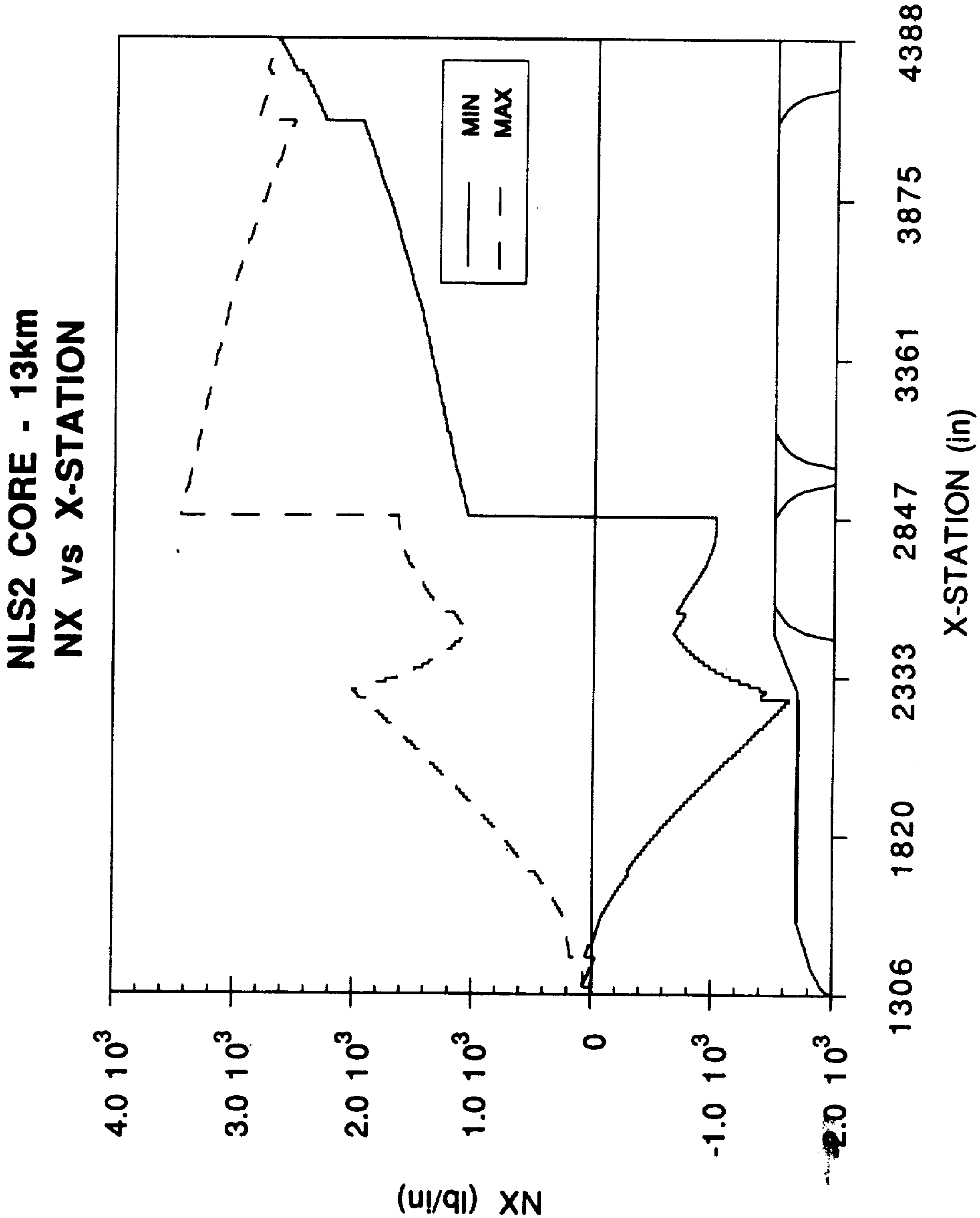

NLS2 CORE - 12 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
2.0 10^7
0
-2.0 10^7
-4.0 10^7
-6.0 10^7
-8.0 10^7
-1.0 10^8
-1.2 10^8
-1.4 10^8
1306
2077
2847
3618
4388
X-Station (in)

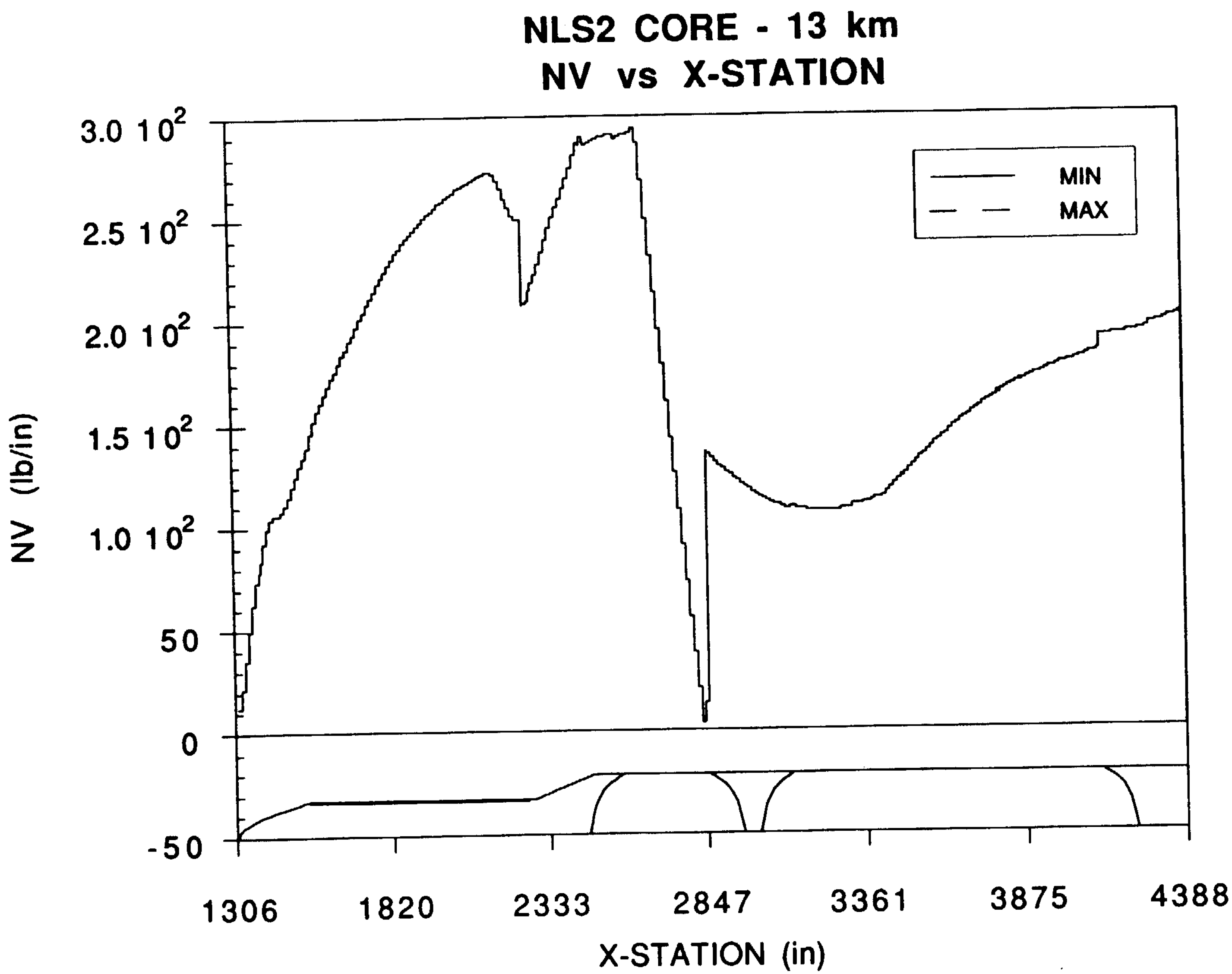
NLS2 CORE 12 km
P EQUIVALENT vs X-STATION

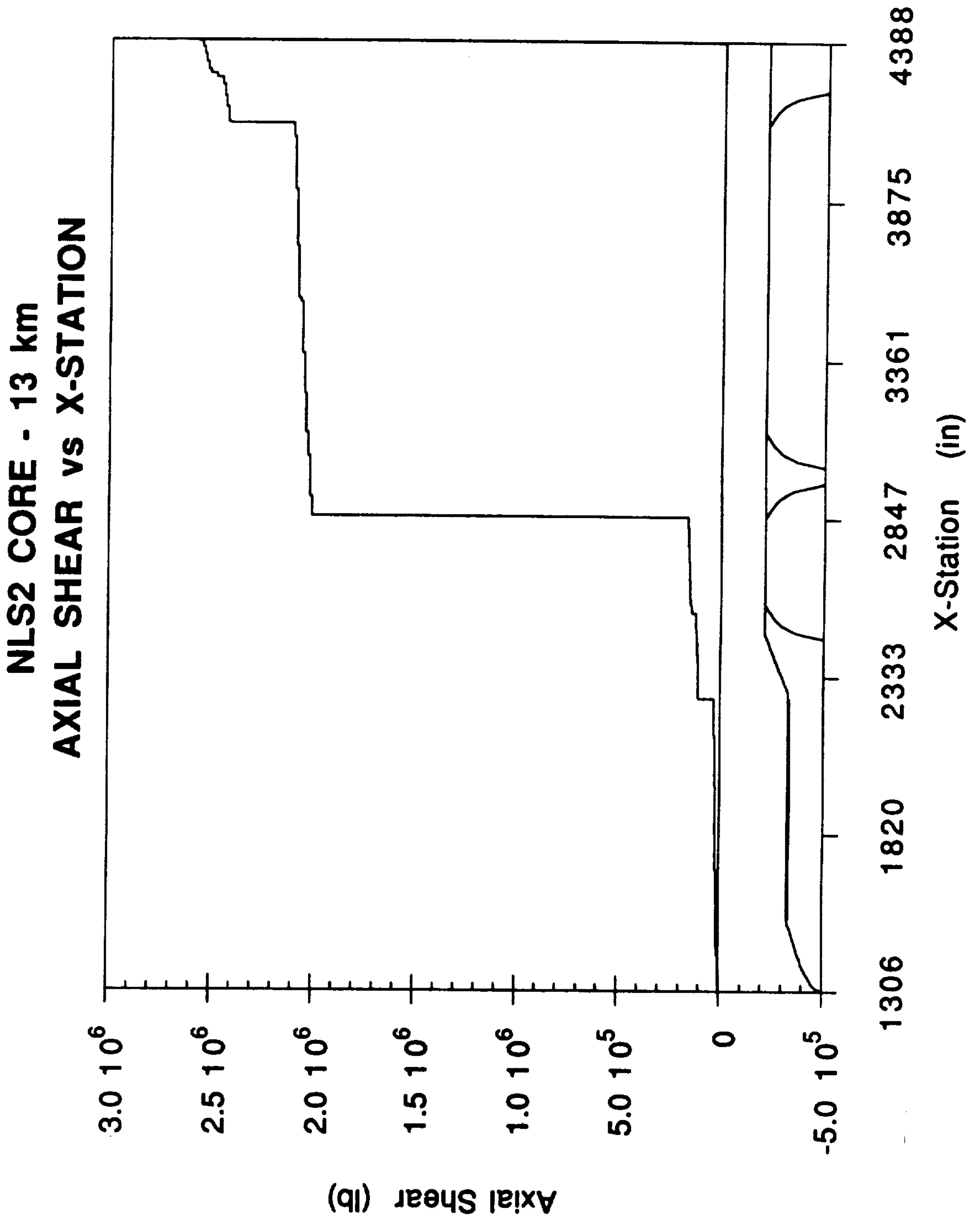




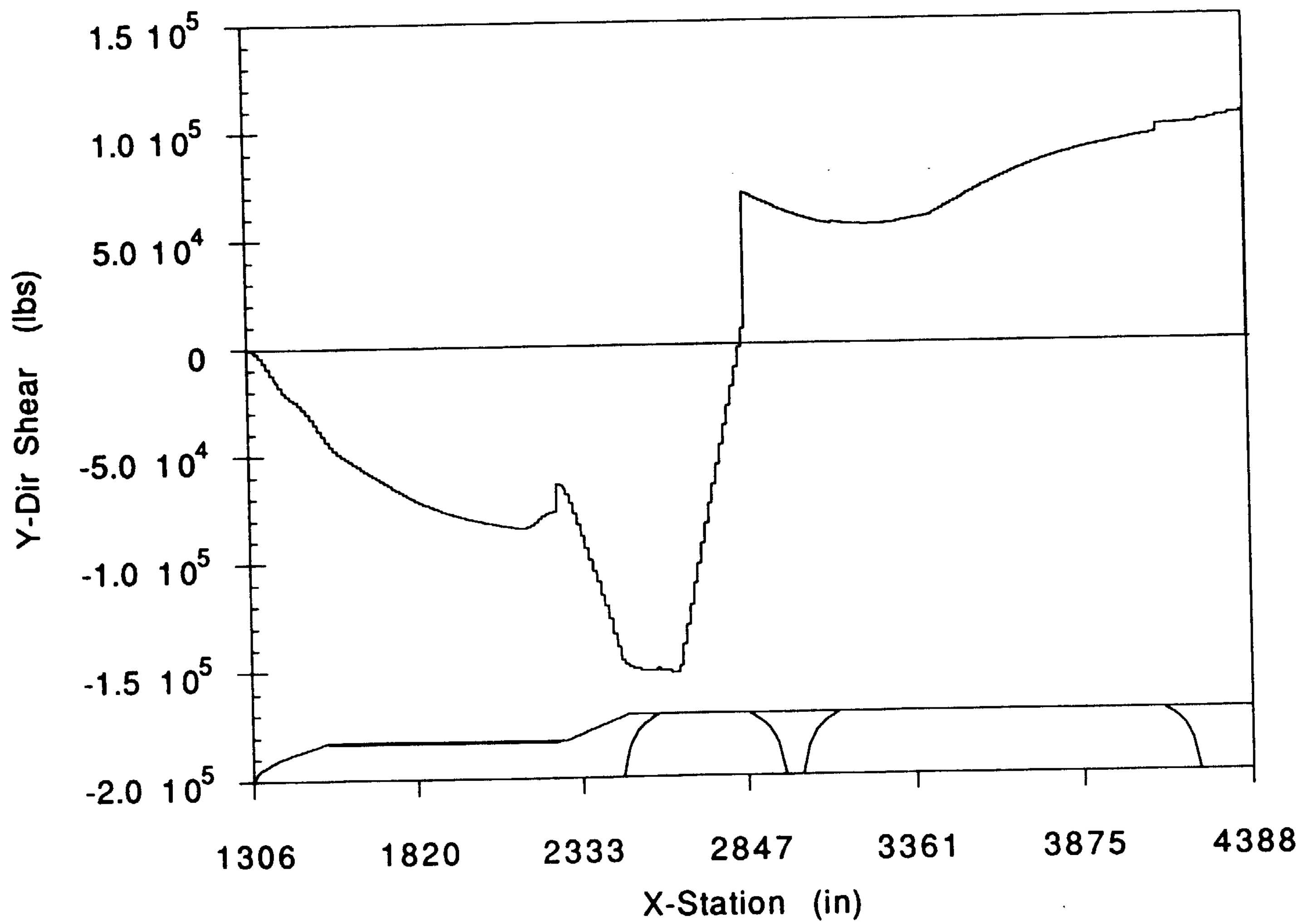
NLS2 CORE 12 km
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

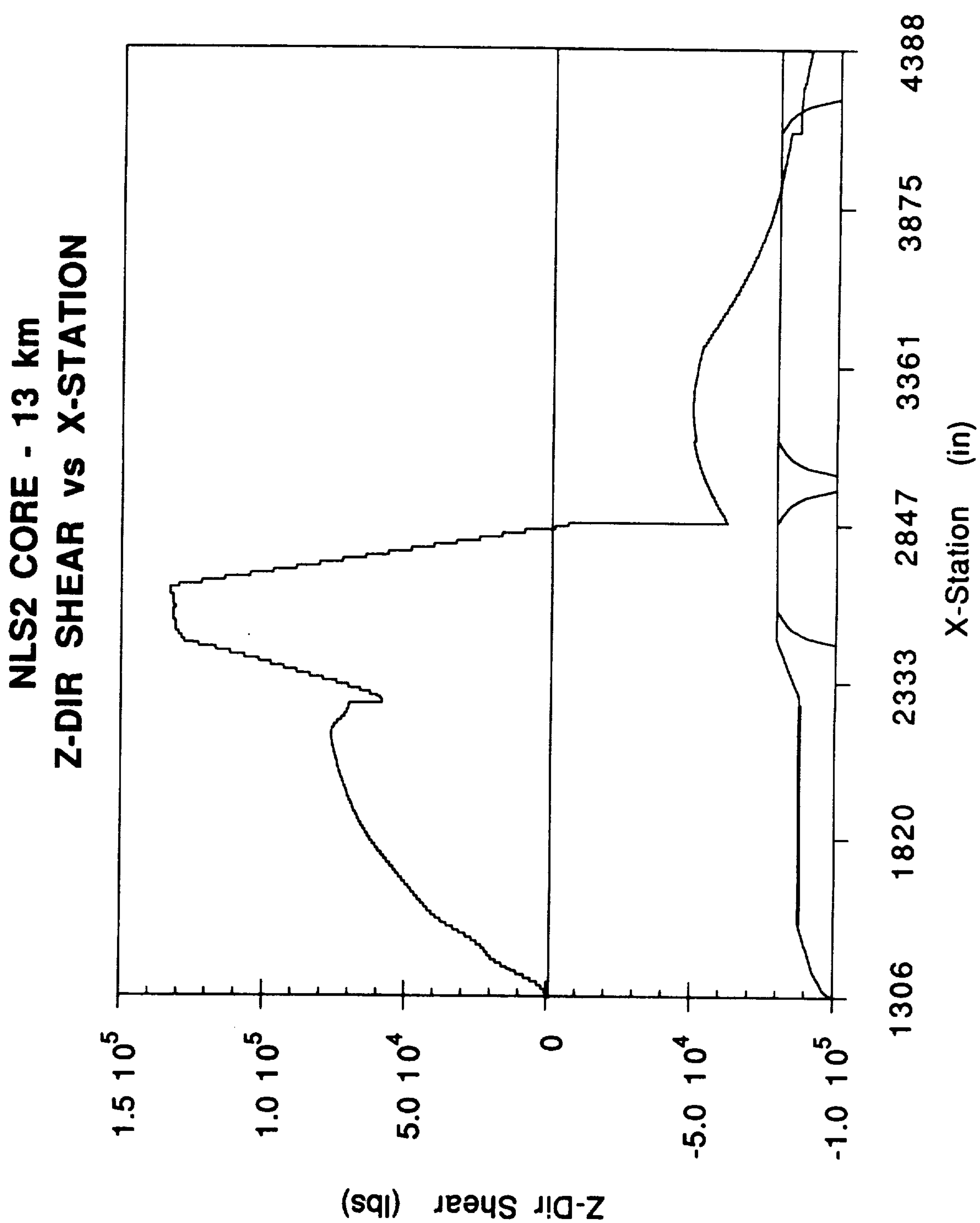

NLS2 CORE - 13km
NX vs X-STATION
NX (lb/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
X-STATION (in)
1306
1820
2333
2847
3361
3875
4388
MIN
MAX

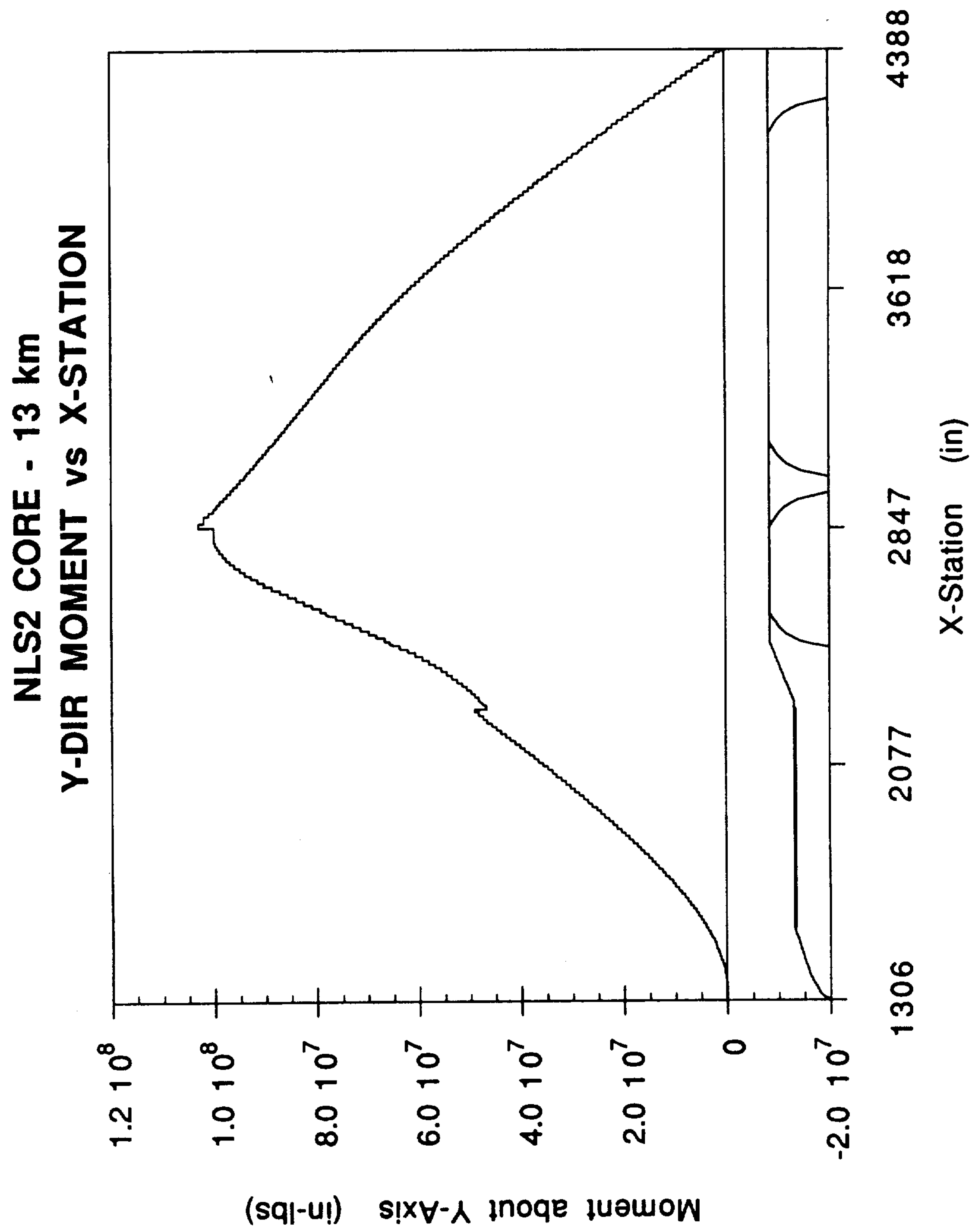

NLS2 CORE - 13 km
NV vs X-STATION
MIN
MAX
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
NV (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

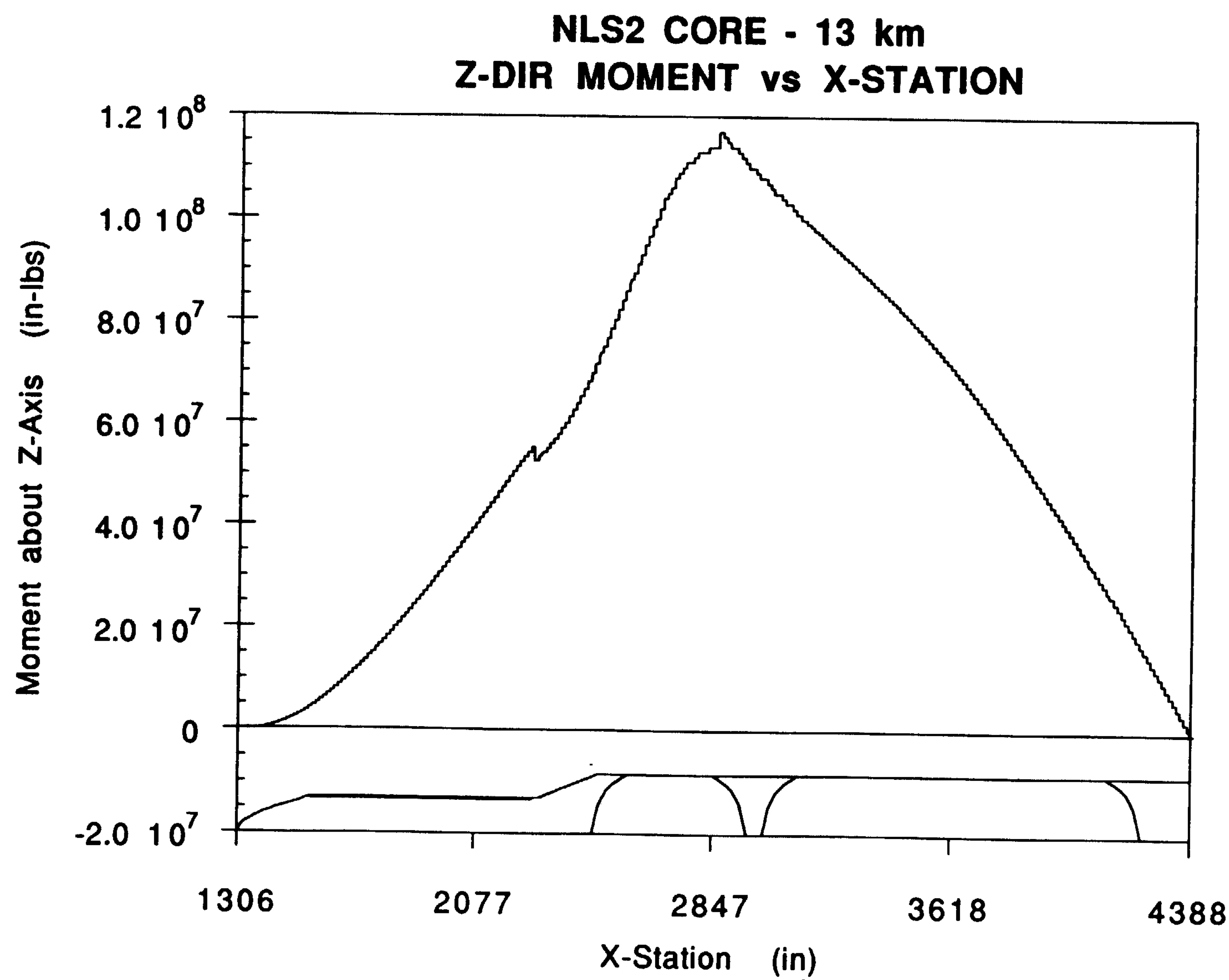

NLS2 CORE - 13 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
X-Station (in)
1306
1820
2333
2847
3361
3875
4388

NLS2 CORE - 13 km
Y-DIR SHEAR vs X-STATION



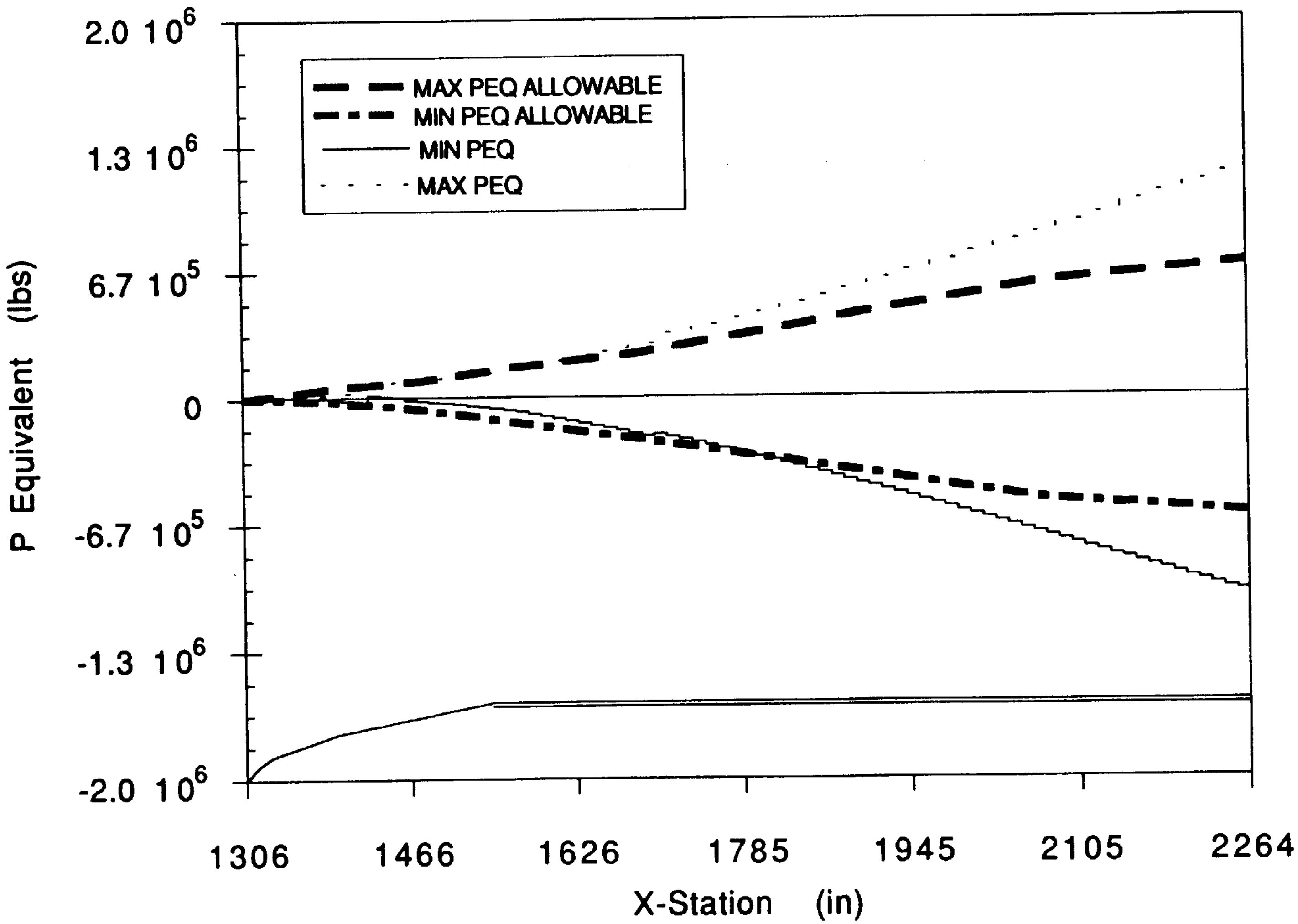

NLS2 CORE - 13 km
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

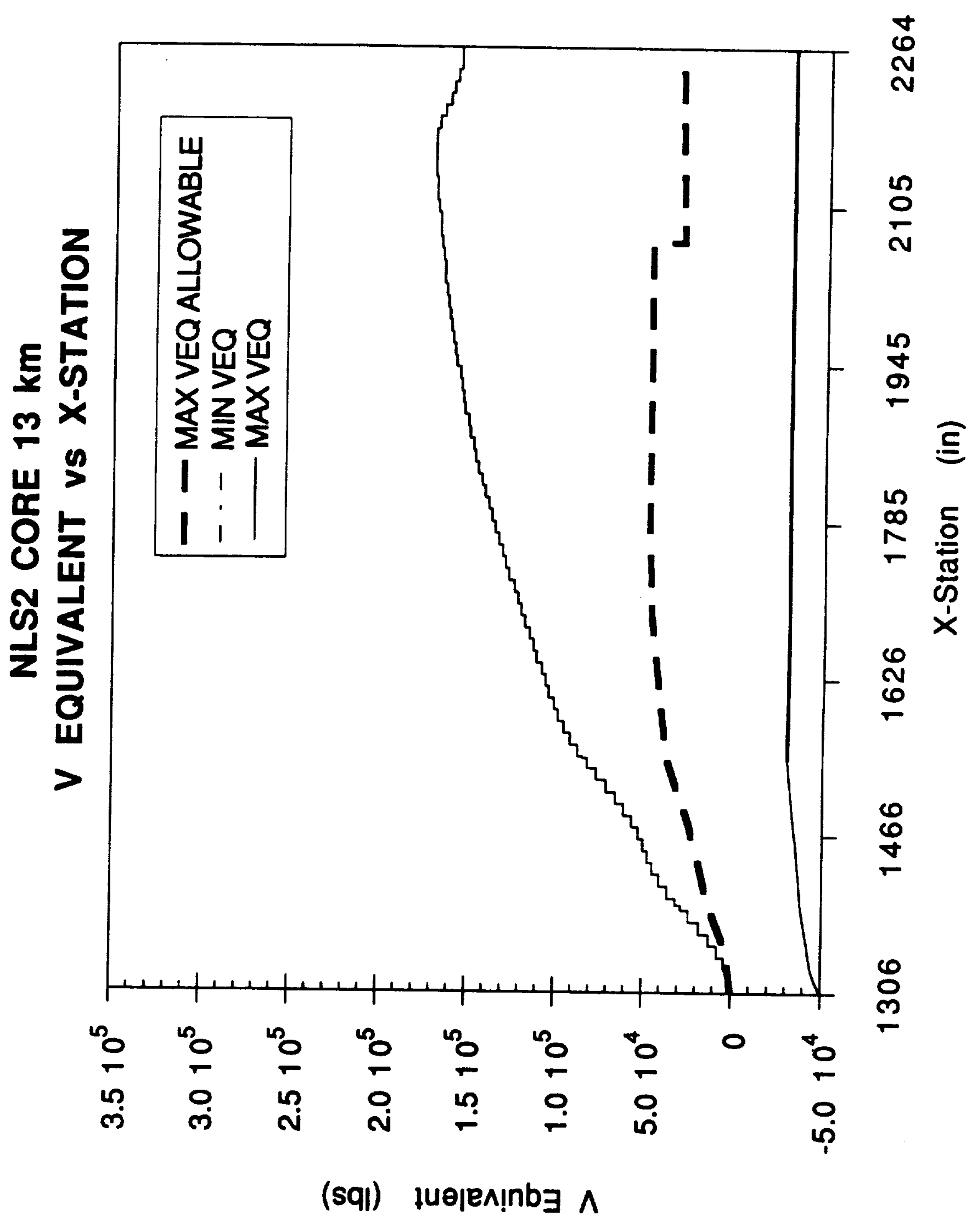

NLS2 CORE - 13 km
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)



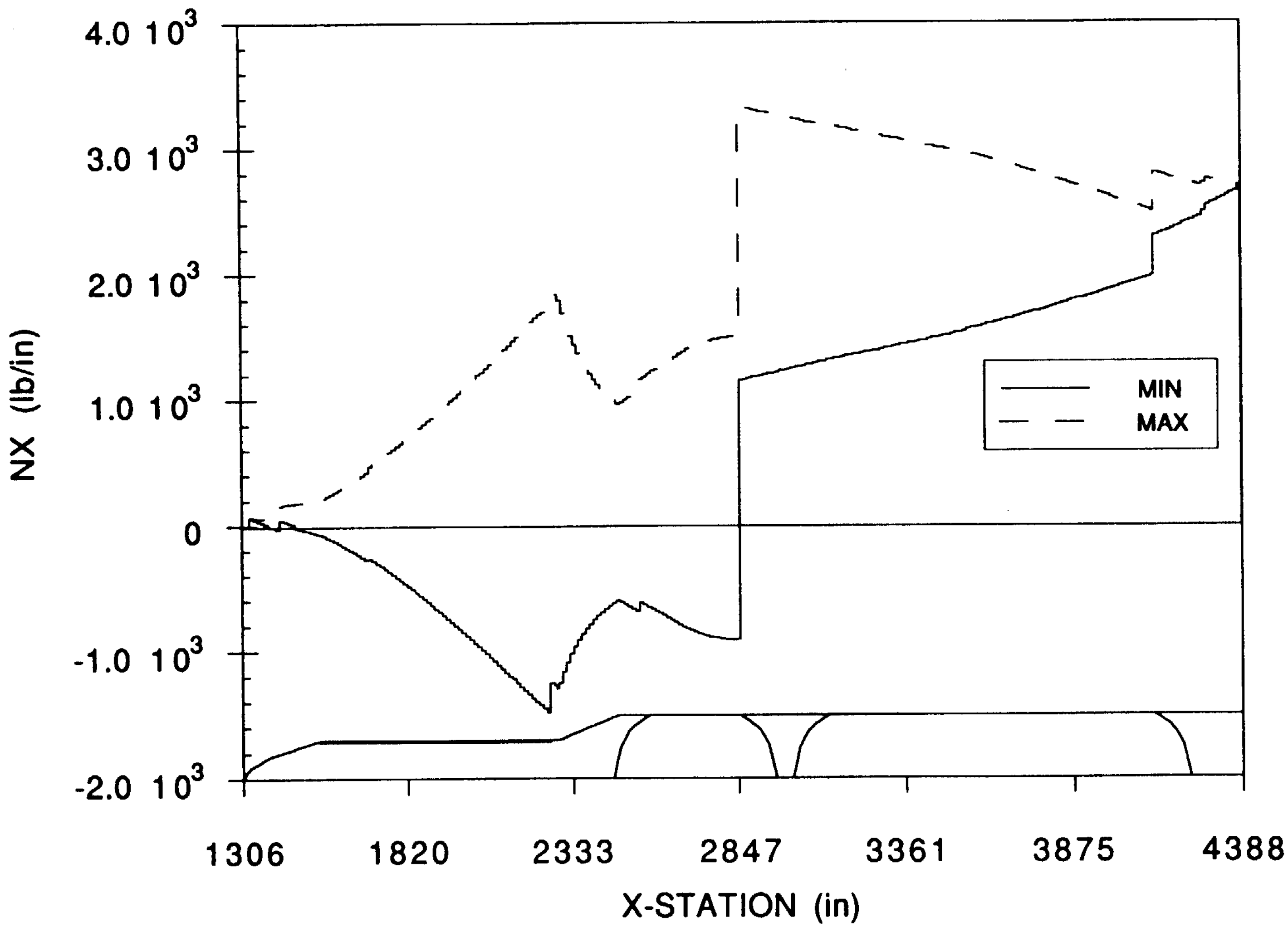
NLS2 CORE - 13 km
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

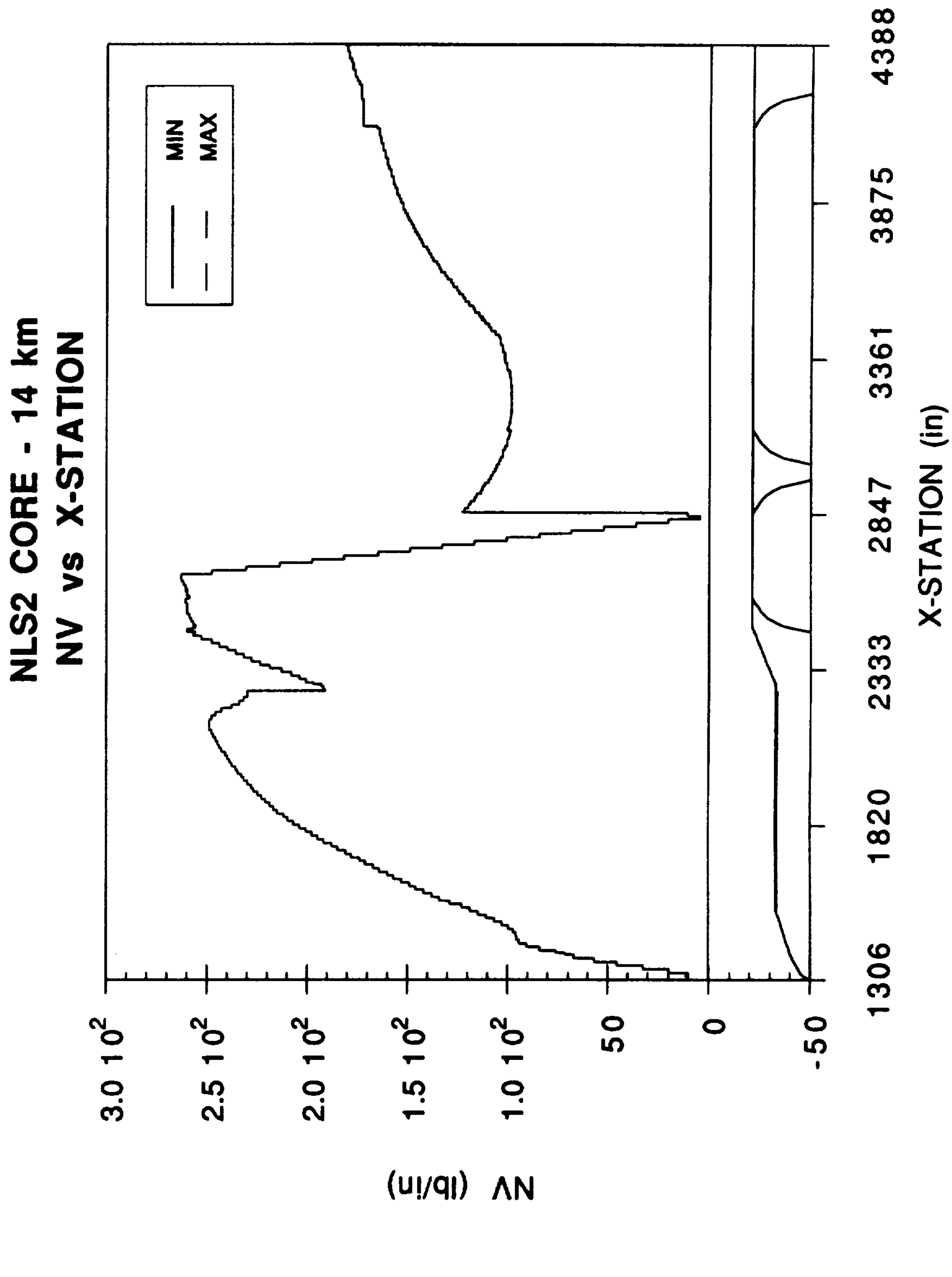
NLS2 CORE 13 km
P EQUIVALENT vs X-STATION

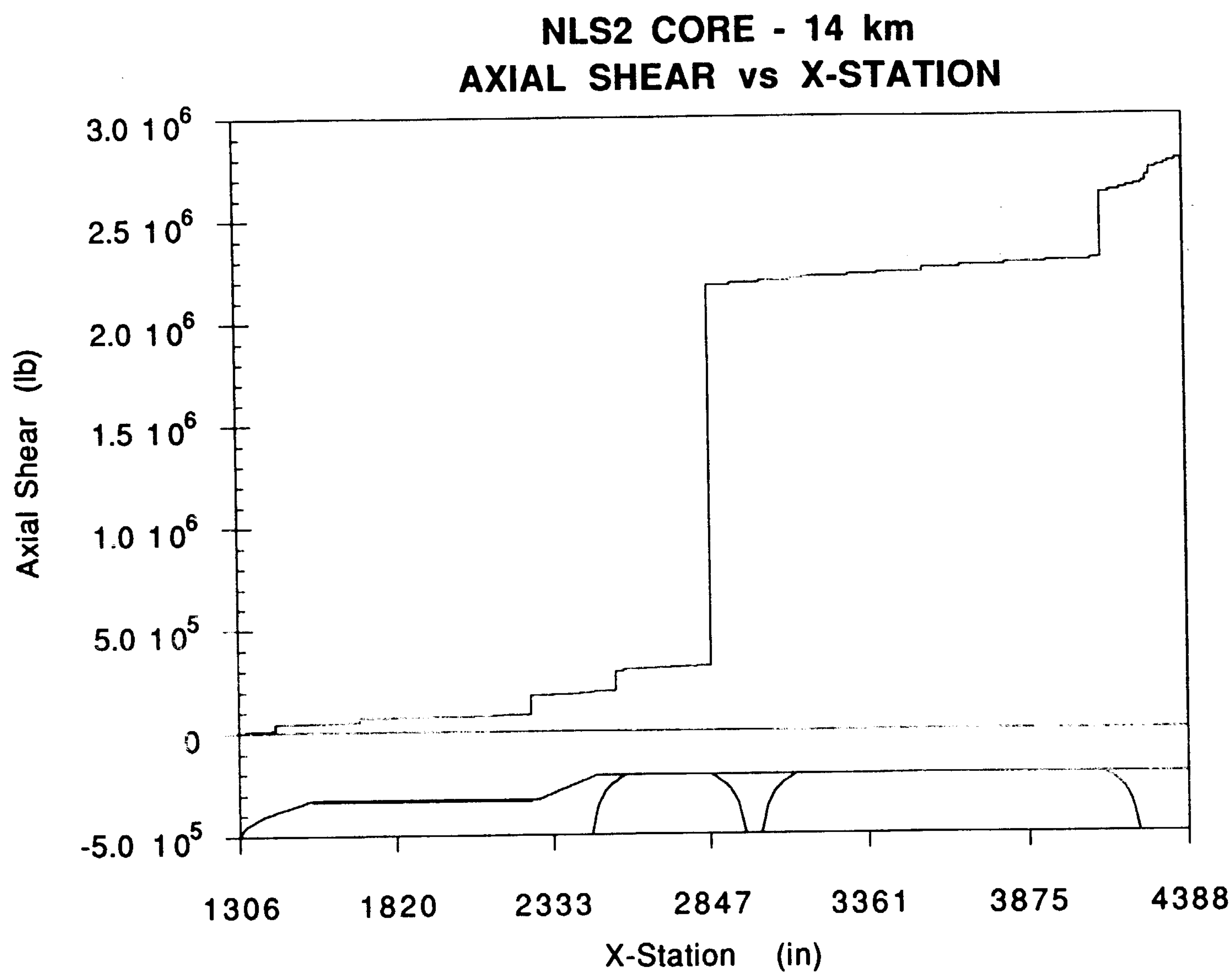



NLS2 CORE 13 km
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
X-Station (in)
1306
1466
1626
1785
1945
2105
2264

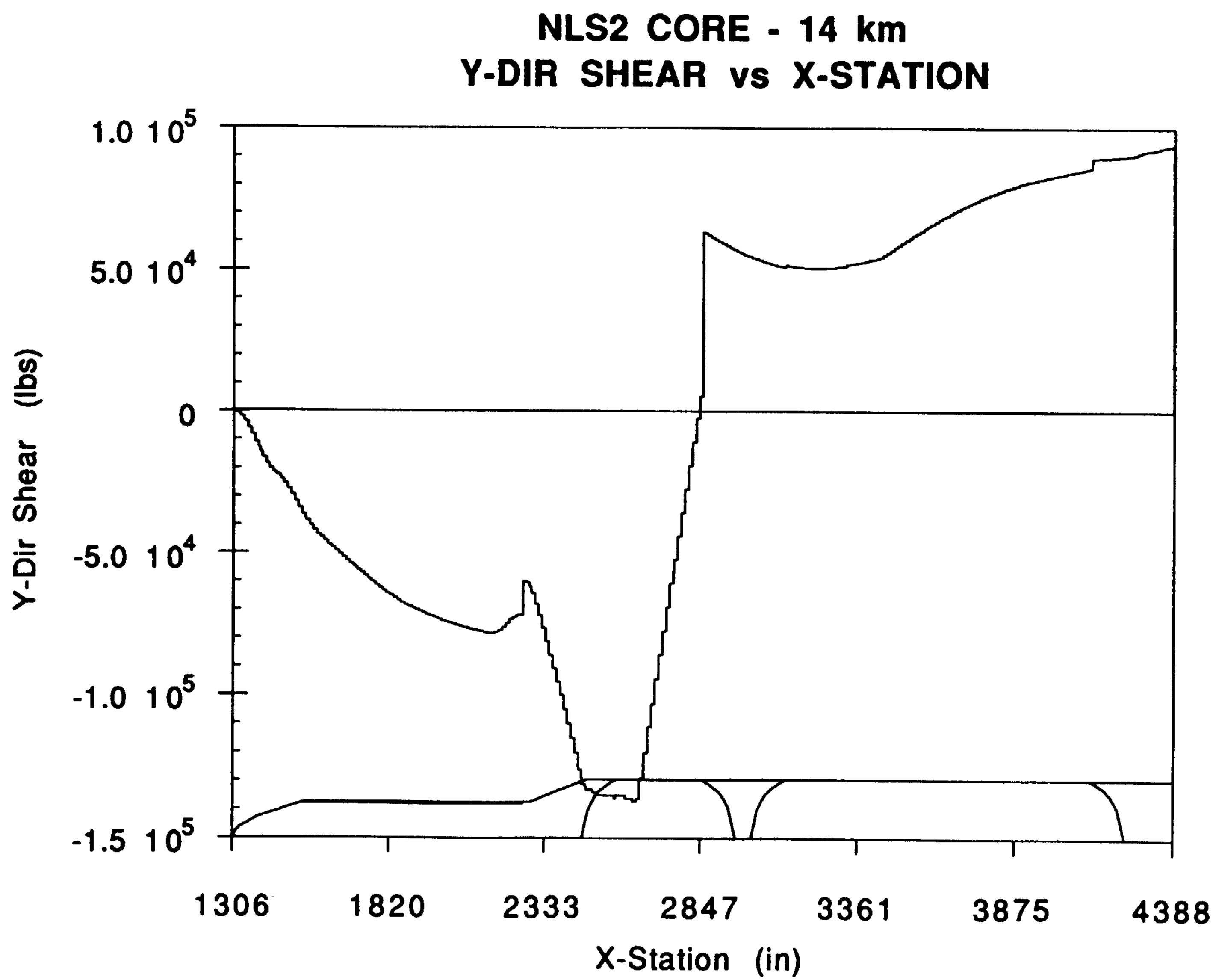
NLS2 CORE - 14 km
NX vs X-STATION

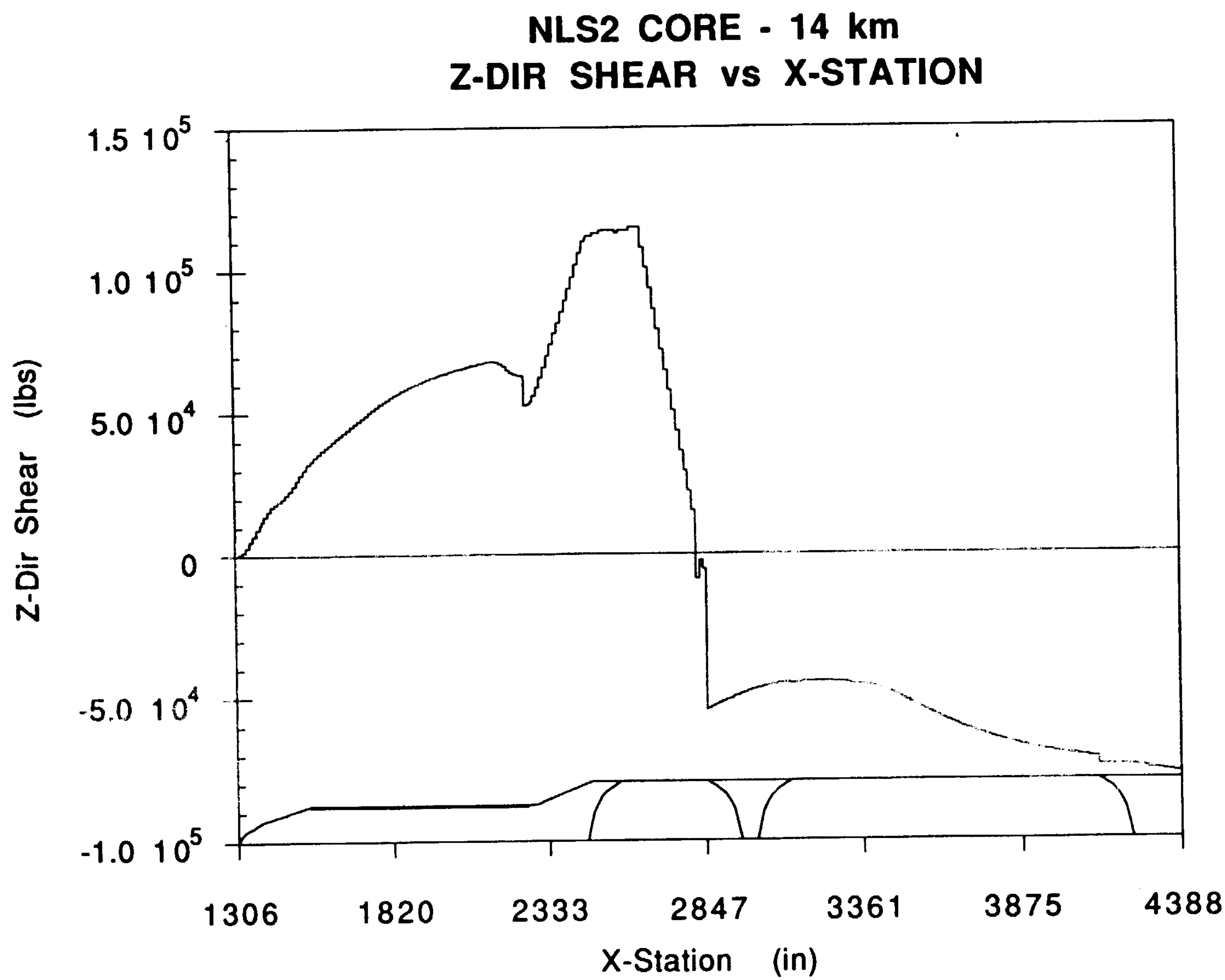



NLS2 CORE - 14 km
NV vs X-STATION
MIN
MAX
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
NV (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

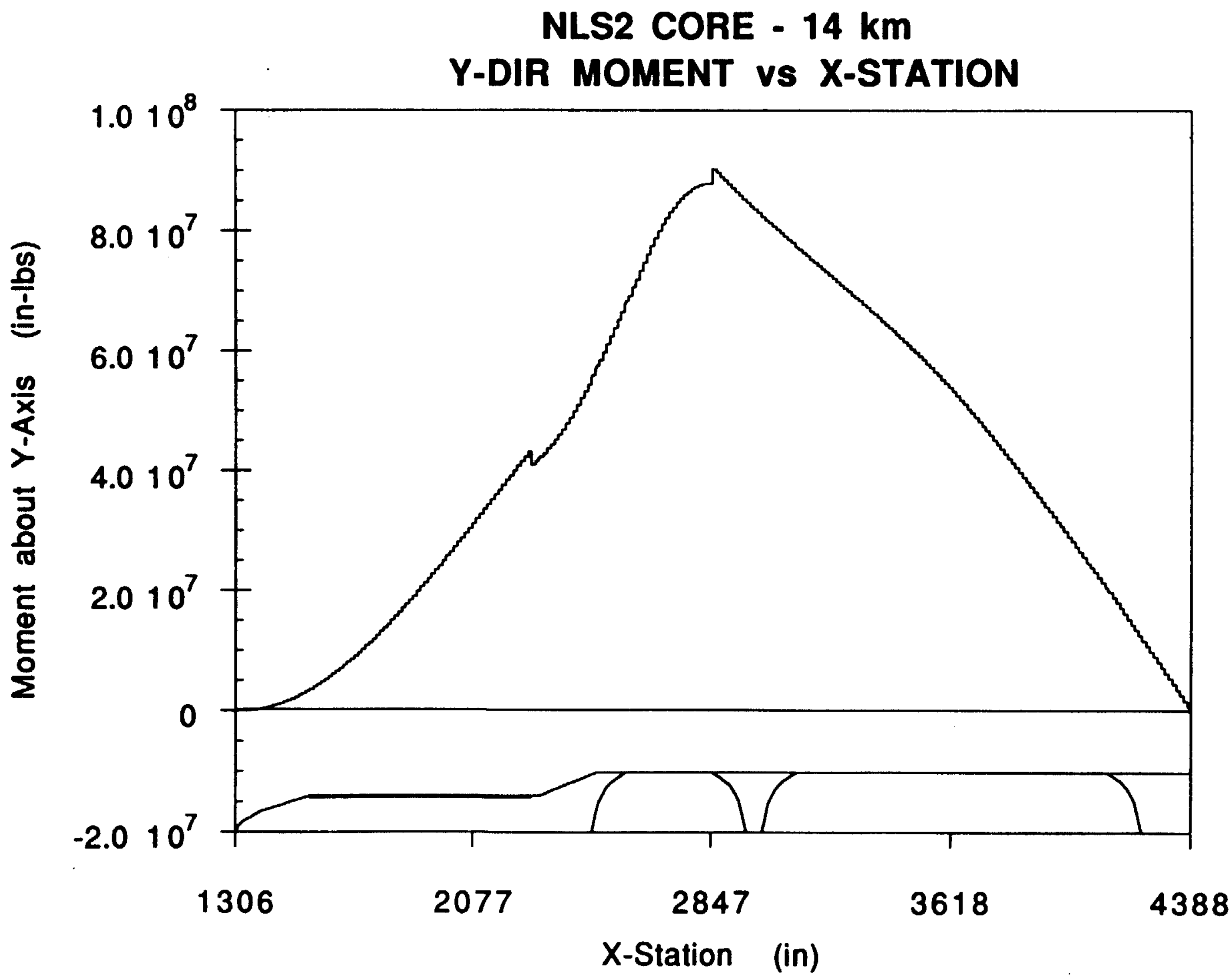


NLS2 CORE - 14 km
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

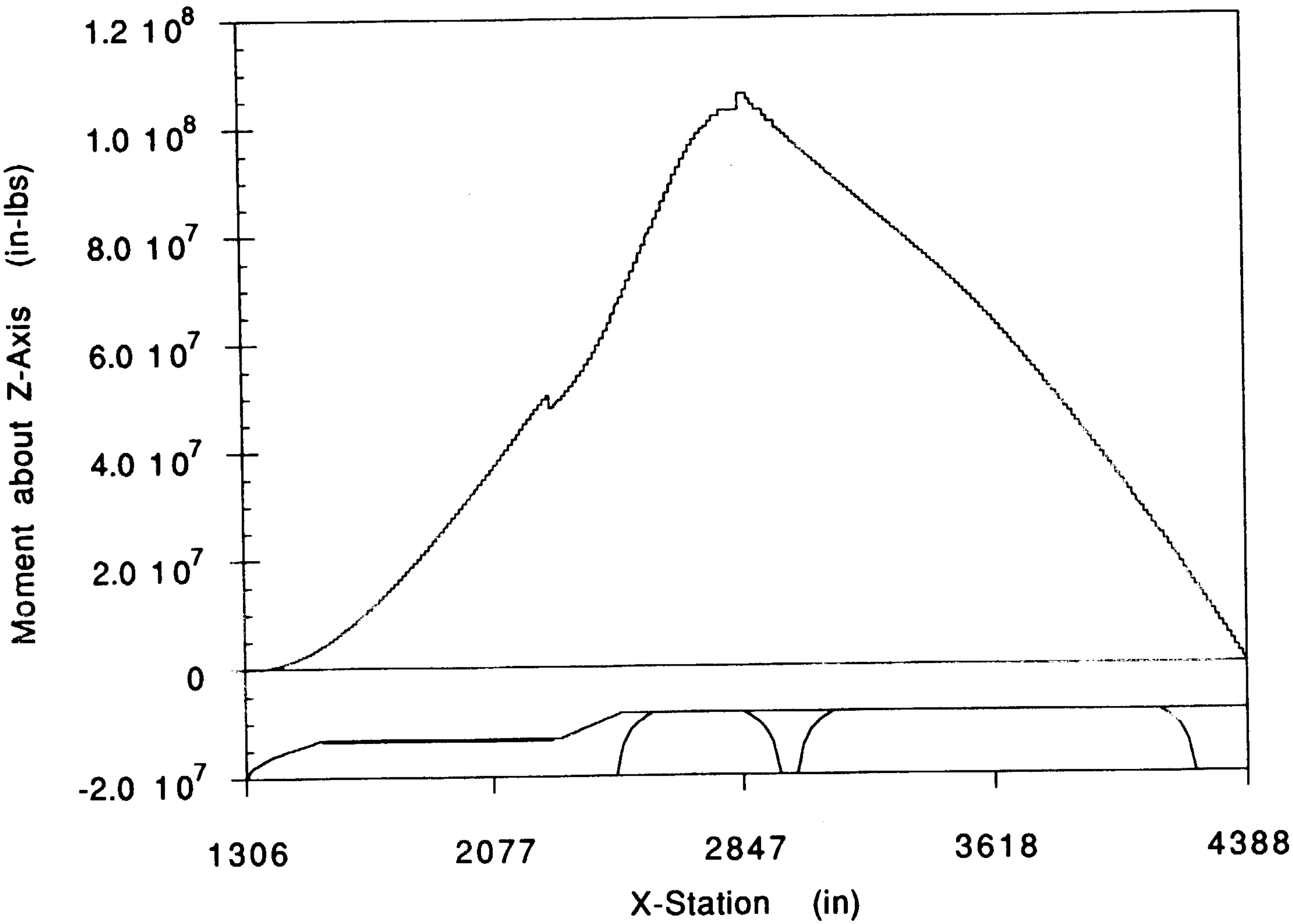

NLS2 CORE - 14 km
Y-DIR SHEAR vs X-STATION
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)



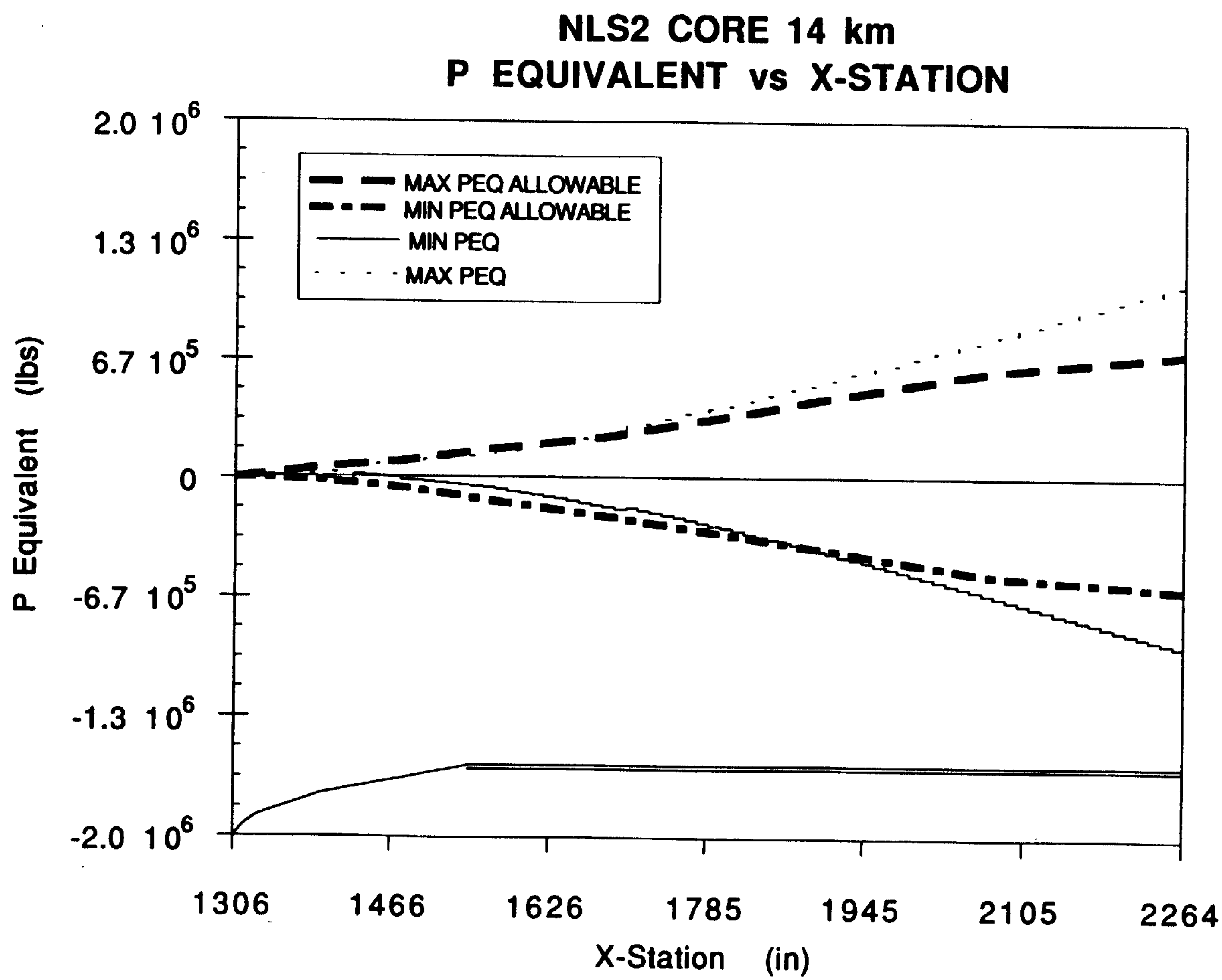
NLS2 CORE - 14 km
Z-DIR SHEAR vs X-STATION
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
Z-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 CORE - 14 km
Y-DIR MOMENT vs X-STATION
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
Moment about Y-Axis (in-lbs)
1306
2077
2847
3618
4388
X-Station (in)

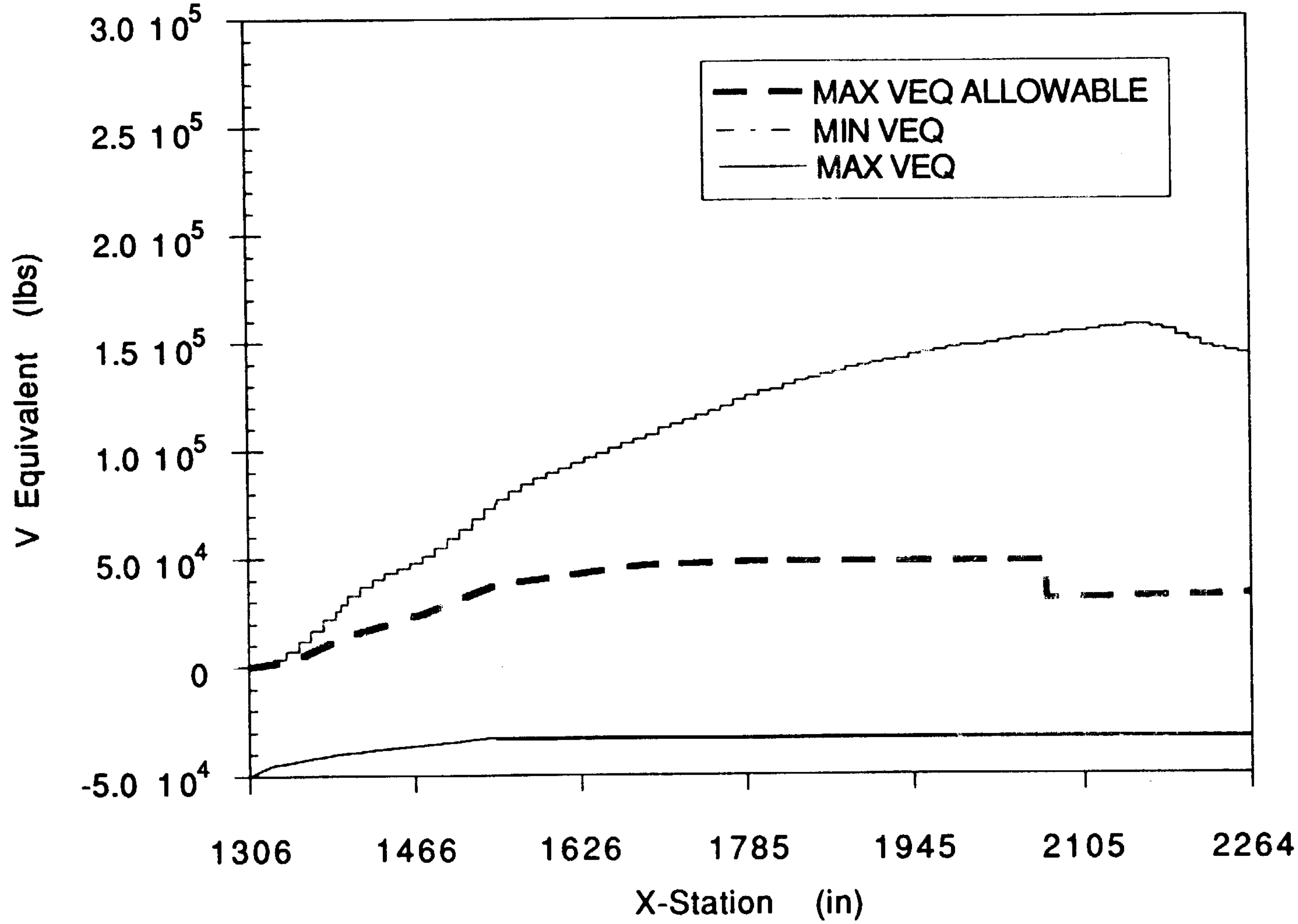
NLS2 CORE - 14 km
Z-DIR MOMENT vs X-STATION



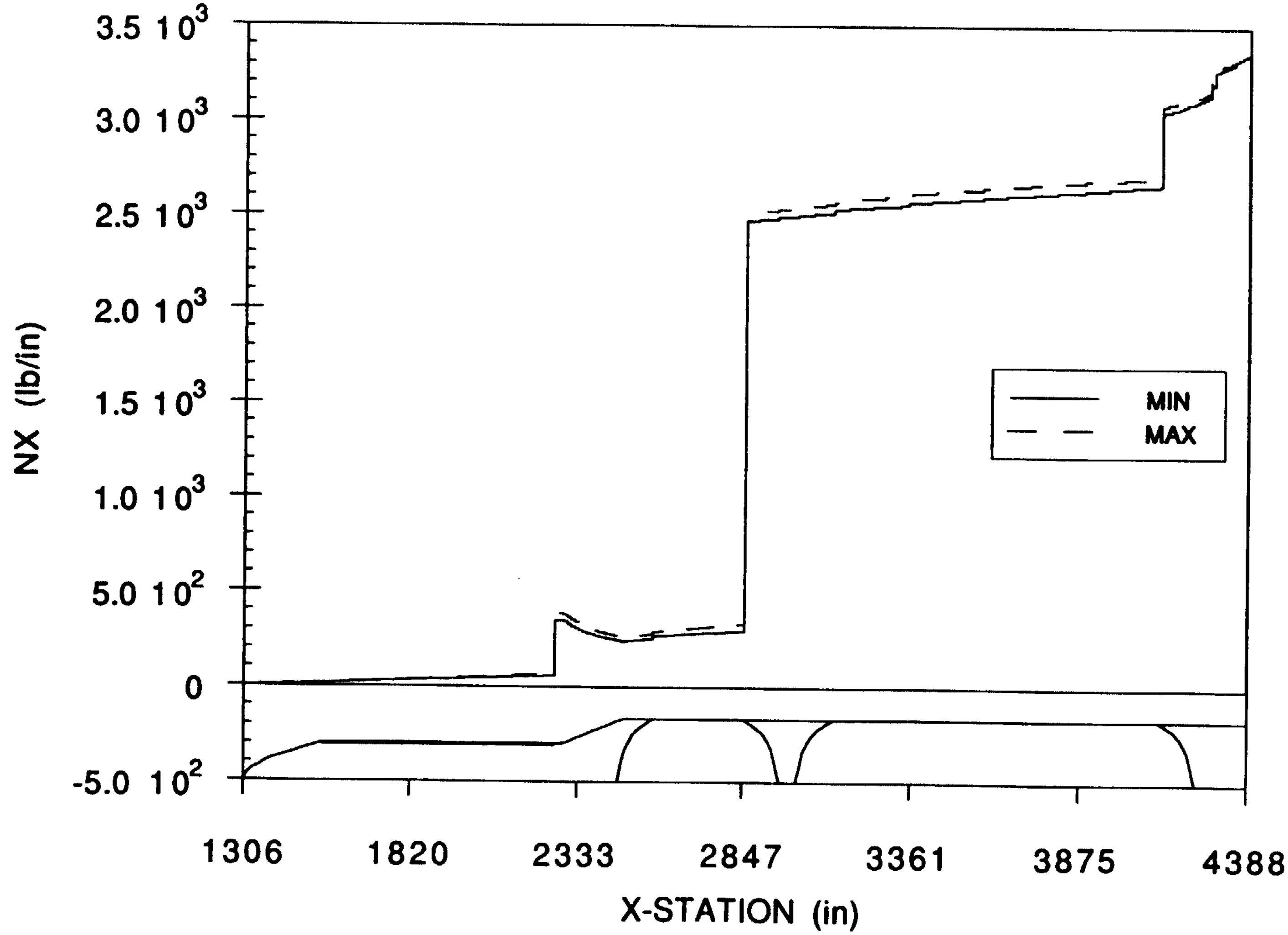
C-6

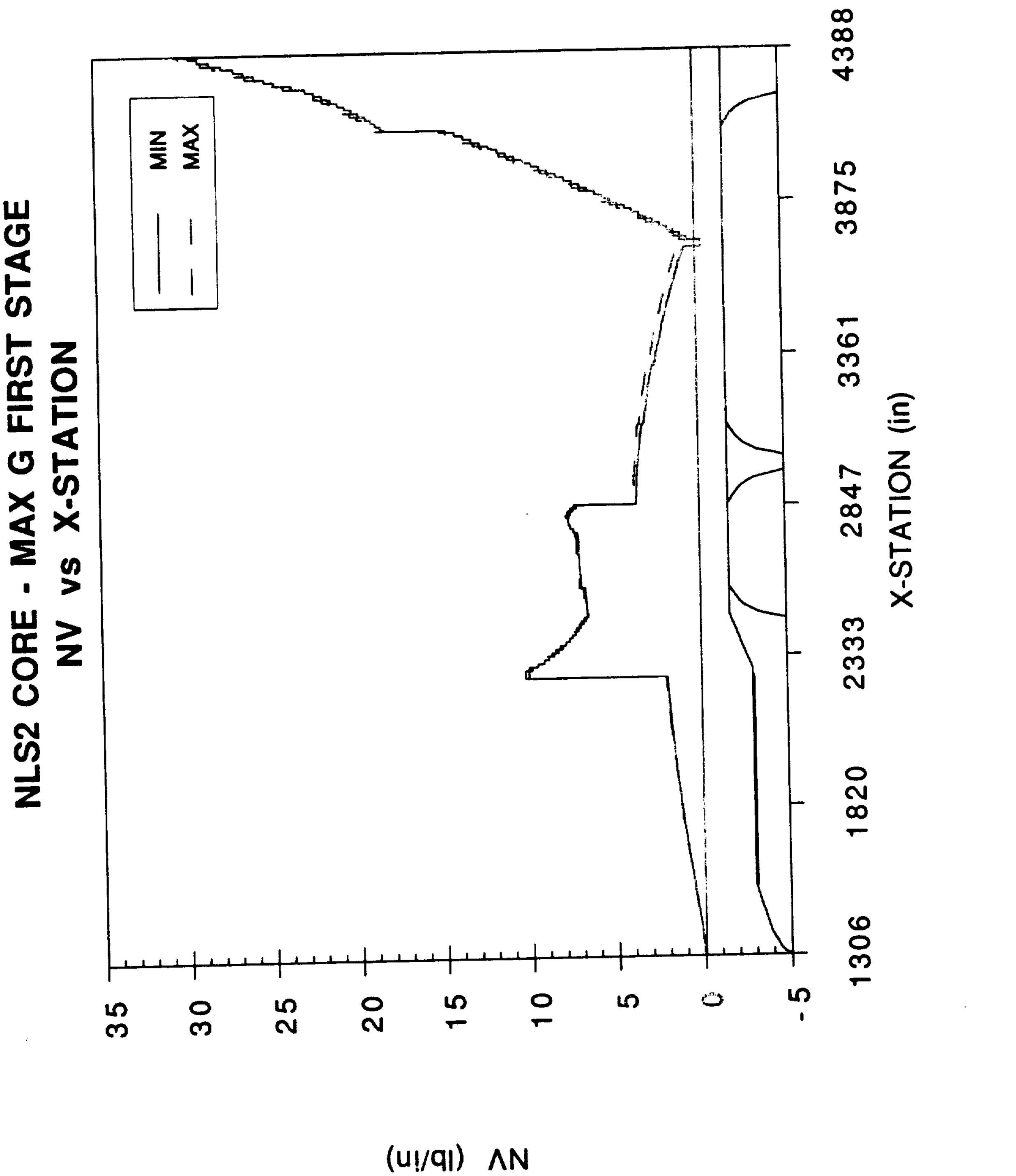

NLS2 CORE 14 km
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
P Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

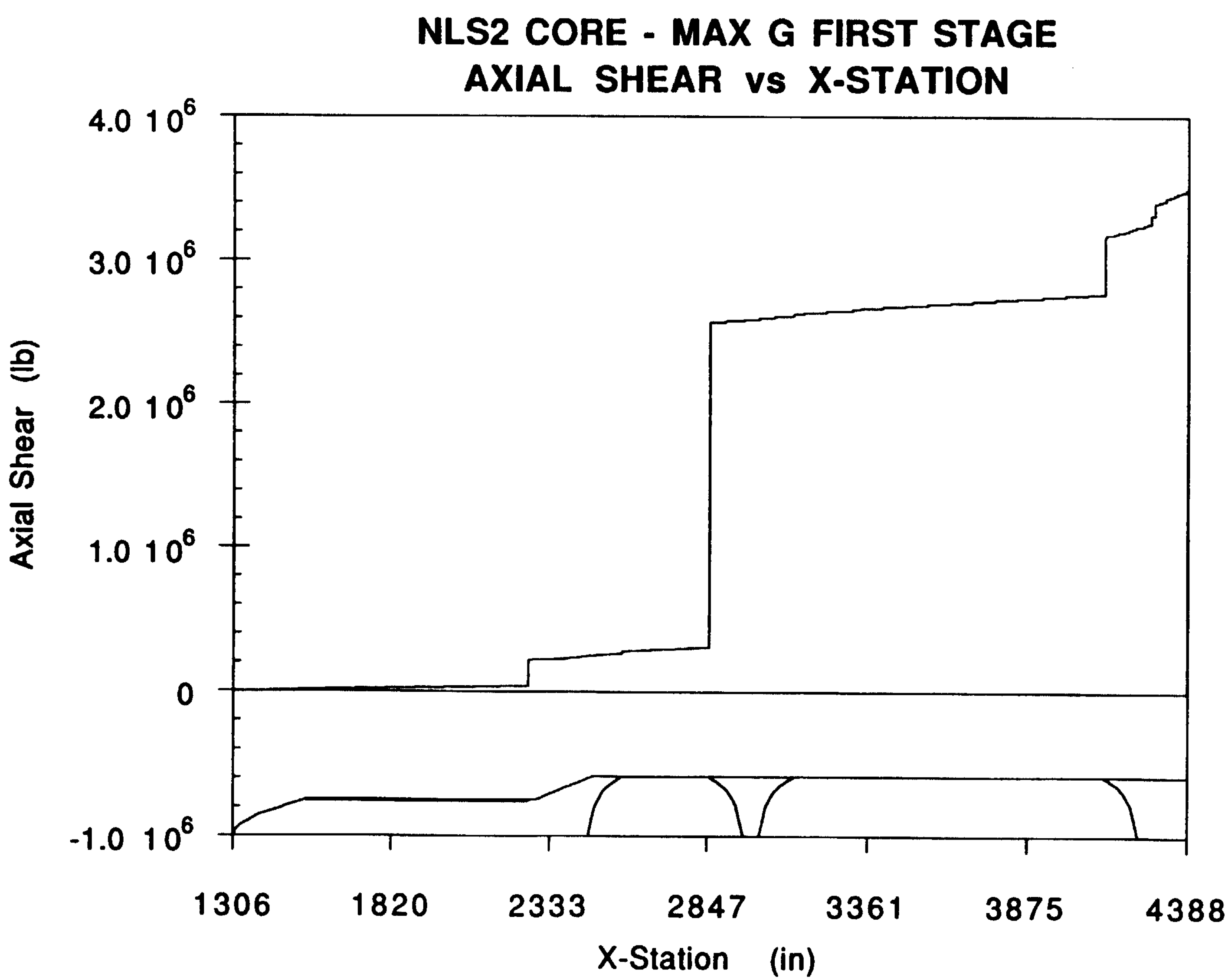
NLS2 CORE 14 km
V EQUIVALENT vs X-STATION

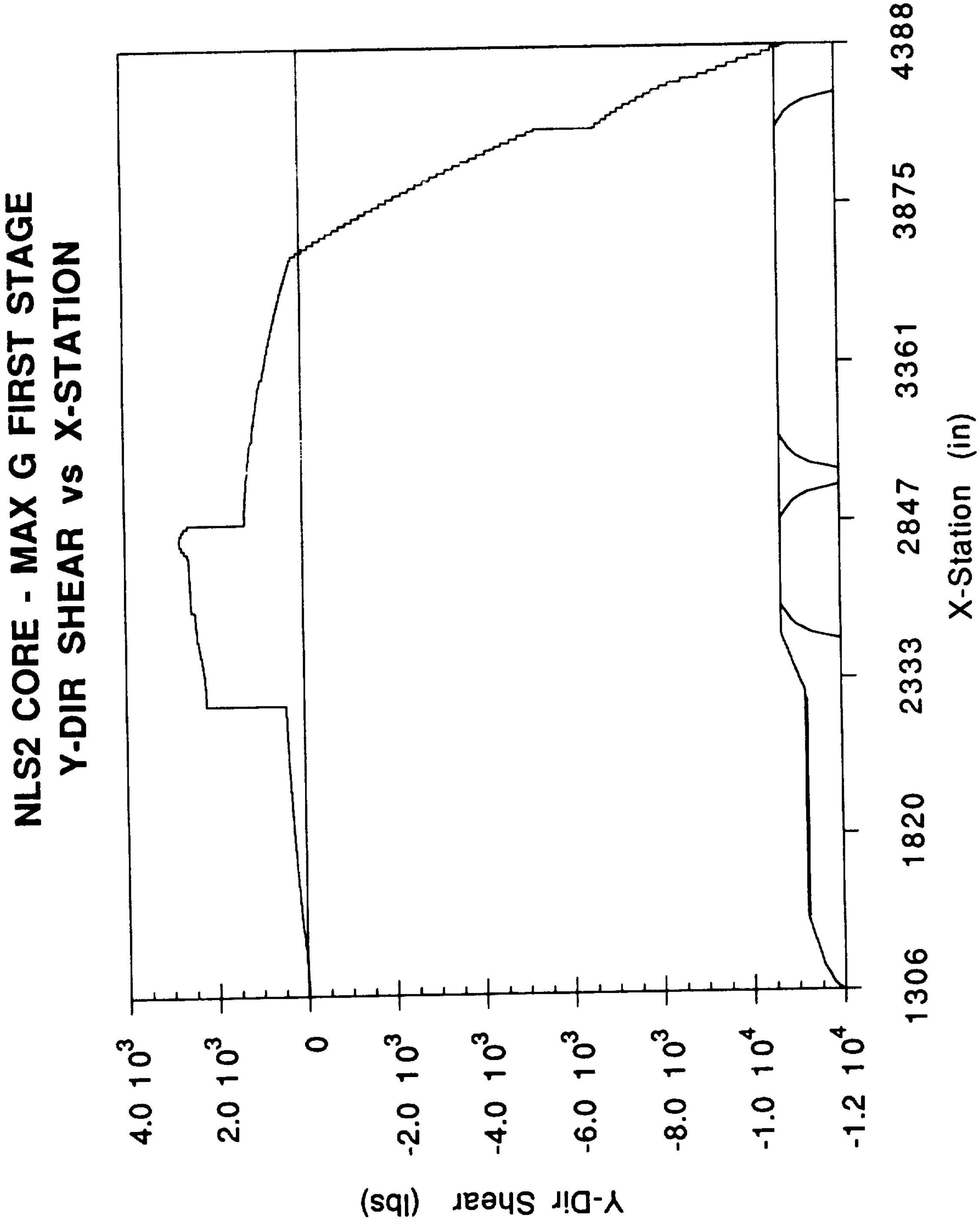


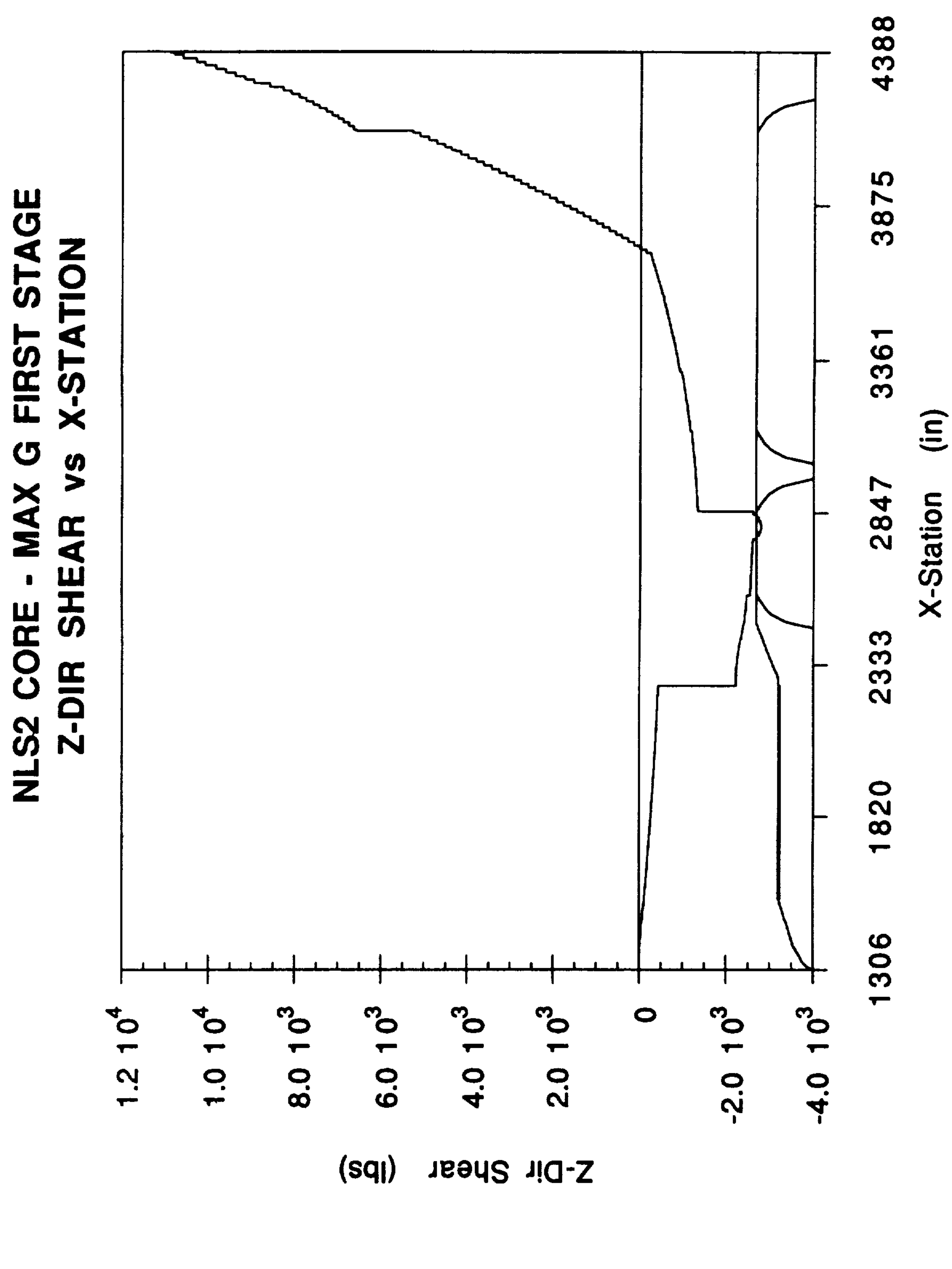
NLS2 CORE - MAX G FIRST STAGE
NX vs X-STATION

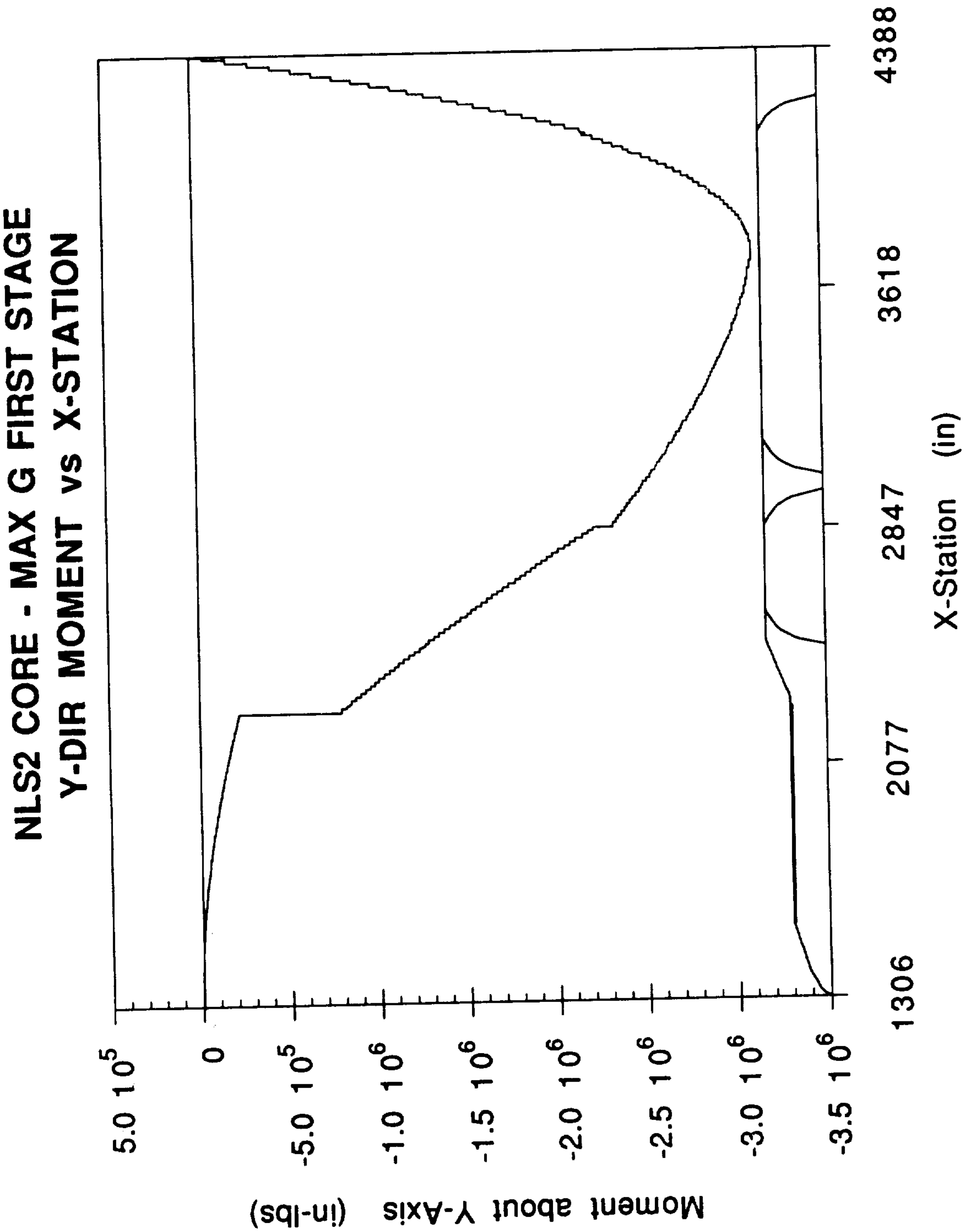


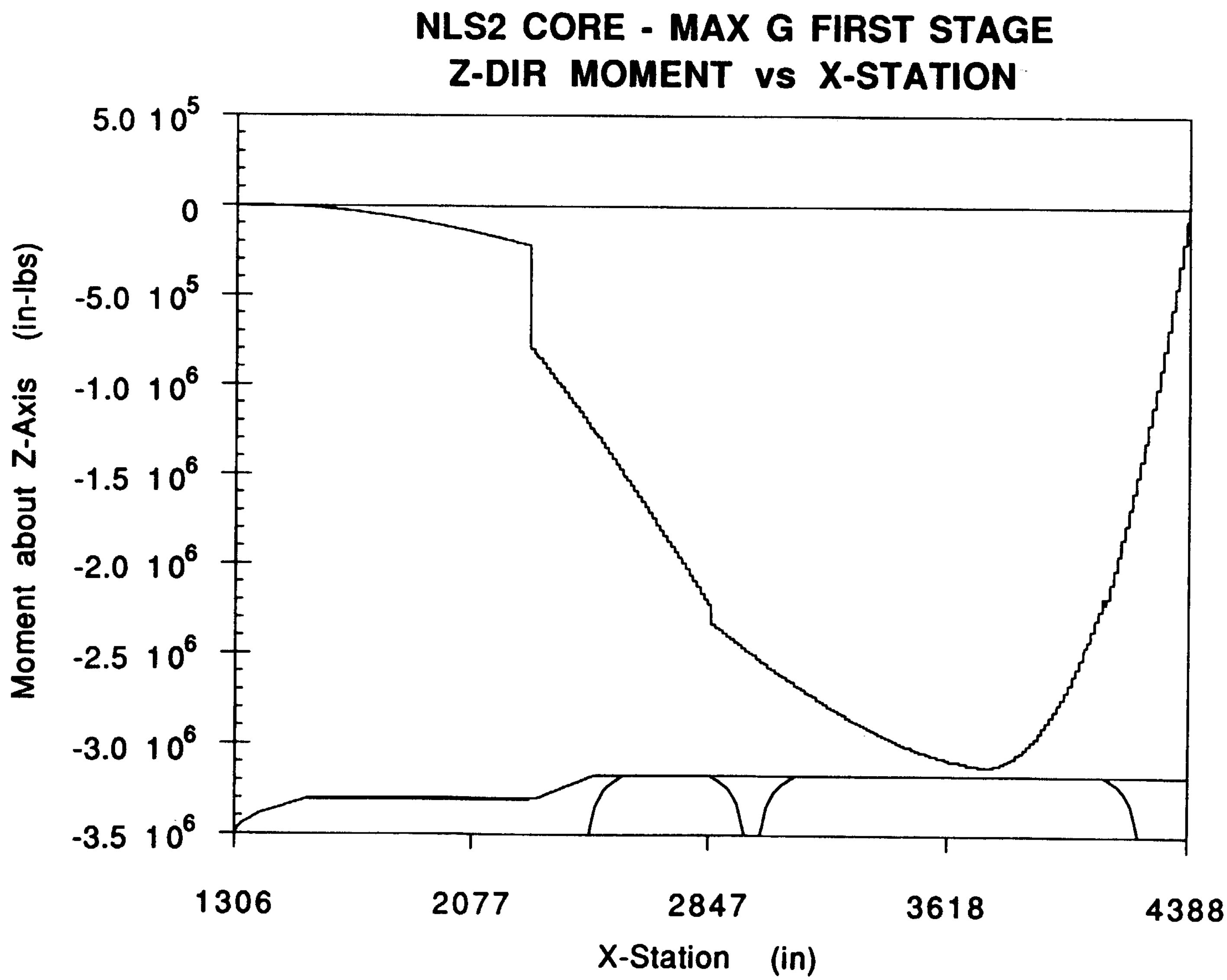

NLS2 CORE - MAX G FIRST STAGE
NV vs X-STATION
MIN
MAX
NV (lb/in)
35
30
25
20
15
10
5
0
-5
X-STATION (in)
1306
1820
2333
2847
3361
3875
4388


NLS2 CORE - MAX G FIRST STAGE
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
4.0 10^6
3.0 10^6
2.0 10^6
1.0 10^6
0
-1.0 10^6
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

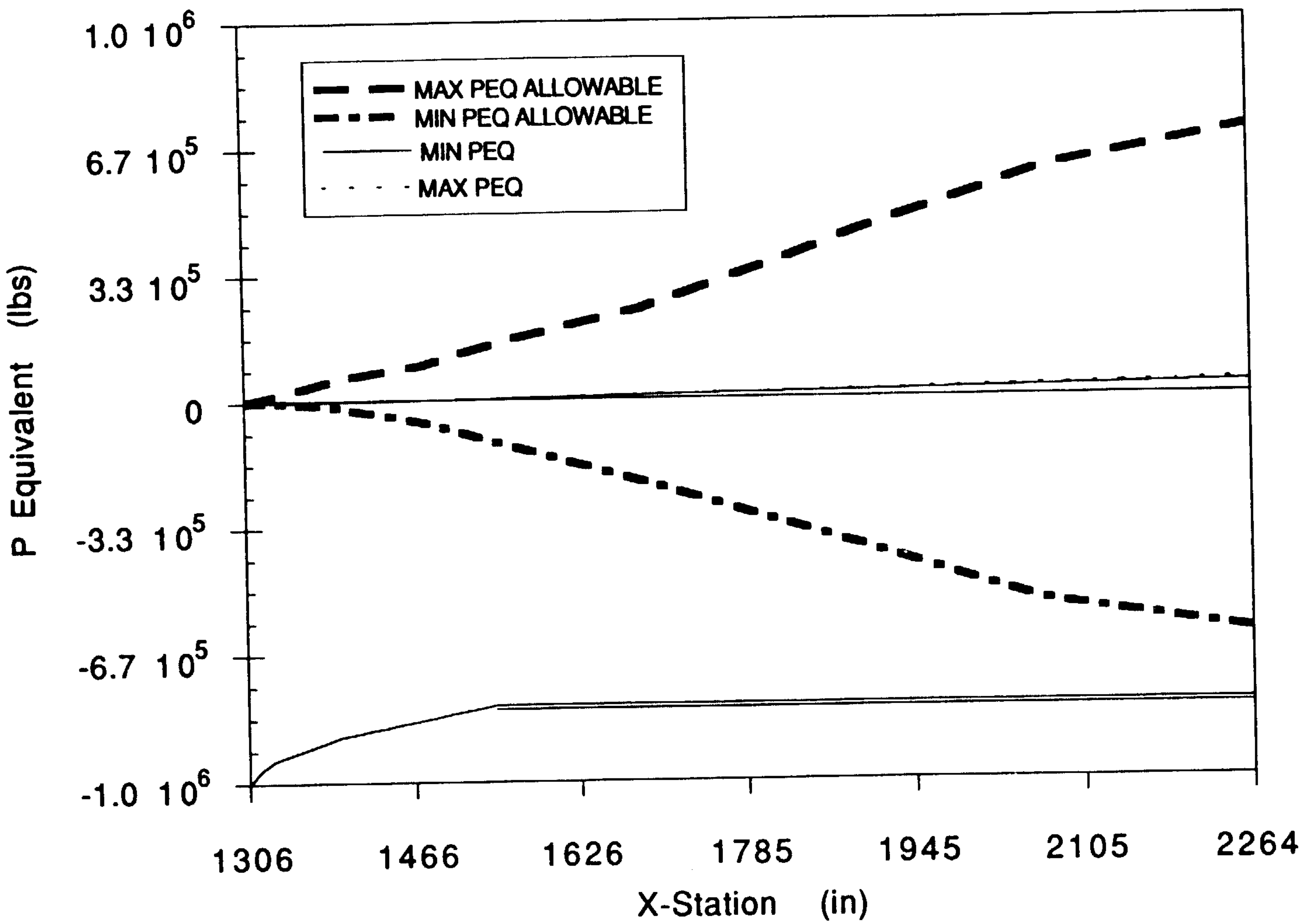

NLS2 CORE - MAX G FIRST STAGE
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lbs)
4.0 10^3
2.0 10^3
0
-2.0 10^3
-4.0 10^3
-6.0 10^3
-8.0 10^3
-1.0 10^4
-1.2 10^4
X-Station (in)
1306
1820
2333
2847
3361
3875
4388

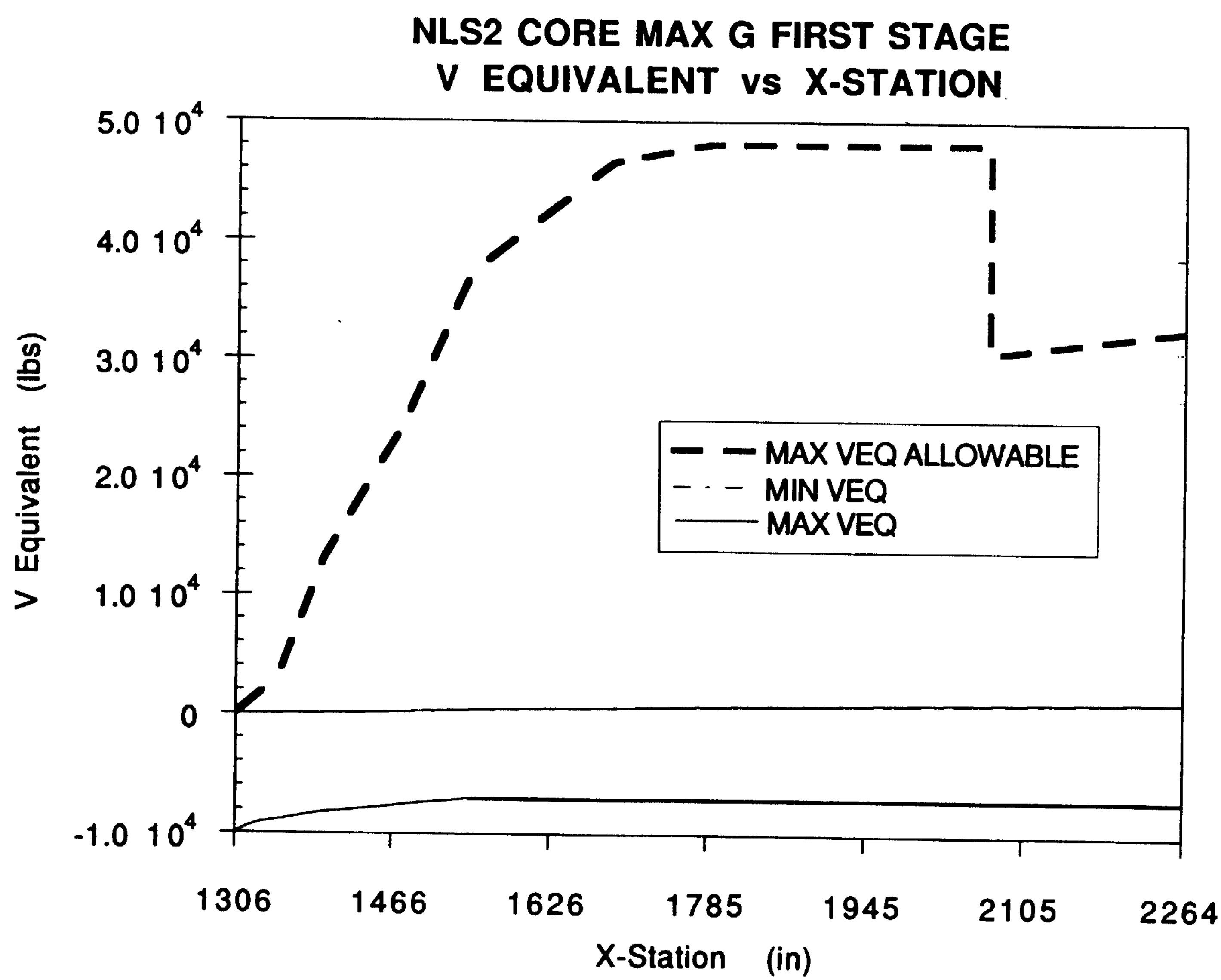

NLS2 CORE - MAX G FIRST STAGE
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
1.2 10^4
1.0 10^4
8.0 10^3
6.0 10^3
4.0 10^3
2.0 10^3
0
-2.0 10^3
-4.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 CORE - MAX G FIRST STAGE
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
5.0 10^5
0
-5.0 10^5
-1.0 10^6
-1.5 10^6
-2.0 10^6
-2.5 10^6
-3.0 10^6
-3.5 10^6
X-Station (in)
1306
2077
2847
3618
4388

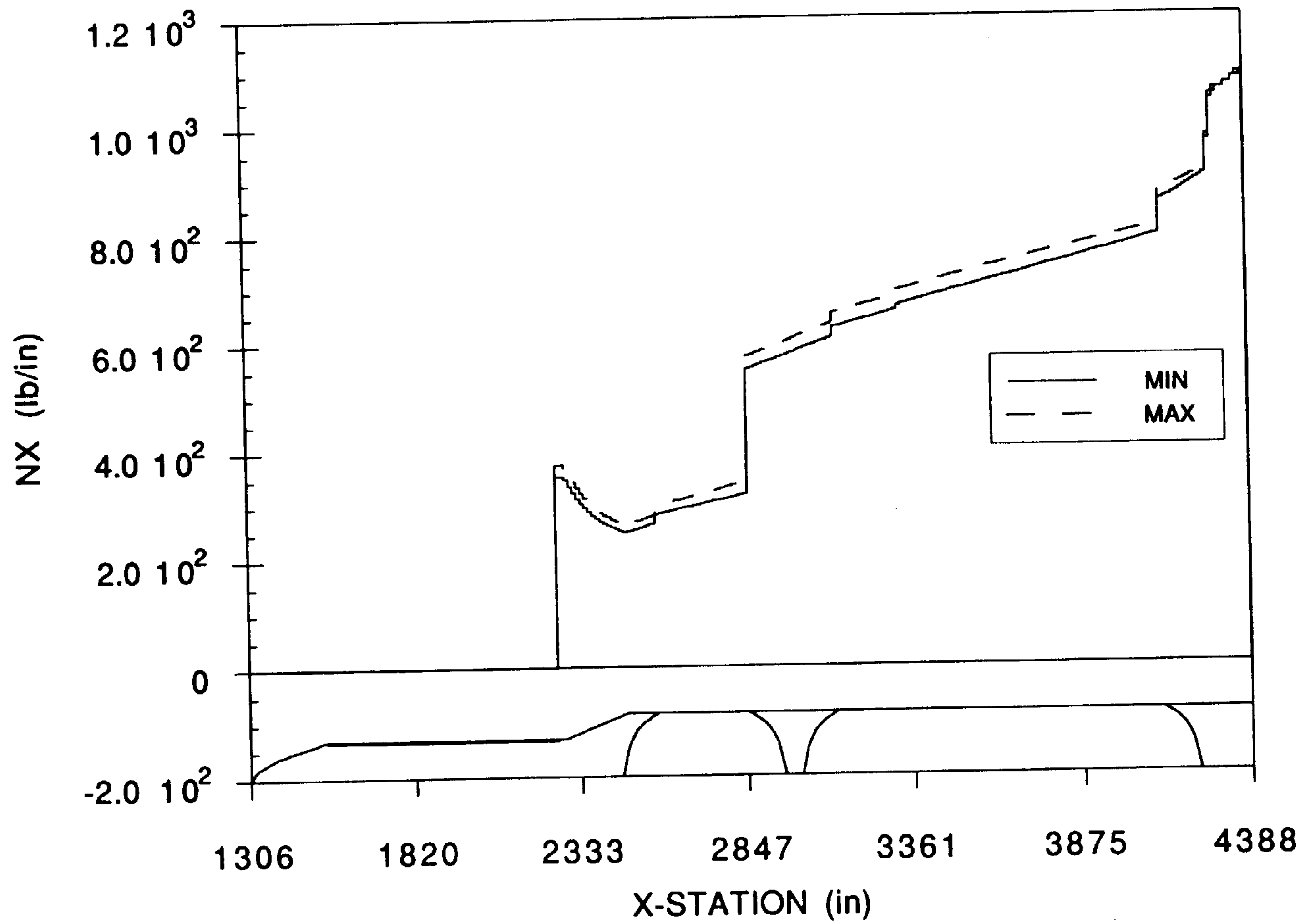

NLS2 CORE - MAX G FIRST STAGE
Z-DIR MOMENT vs X-STATION
5.0 10^5
0
-5.0 10^5
-1.0 10^6
-1.5 10^6
-2.0 10^6
-2.5 10^6
-3.0 10^6
-3.5 10^6
Moment about Z-Axis (in-lbs)
1306
2077
2847
3618
4388
X-Station (in)

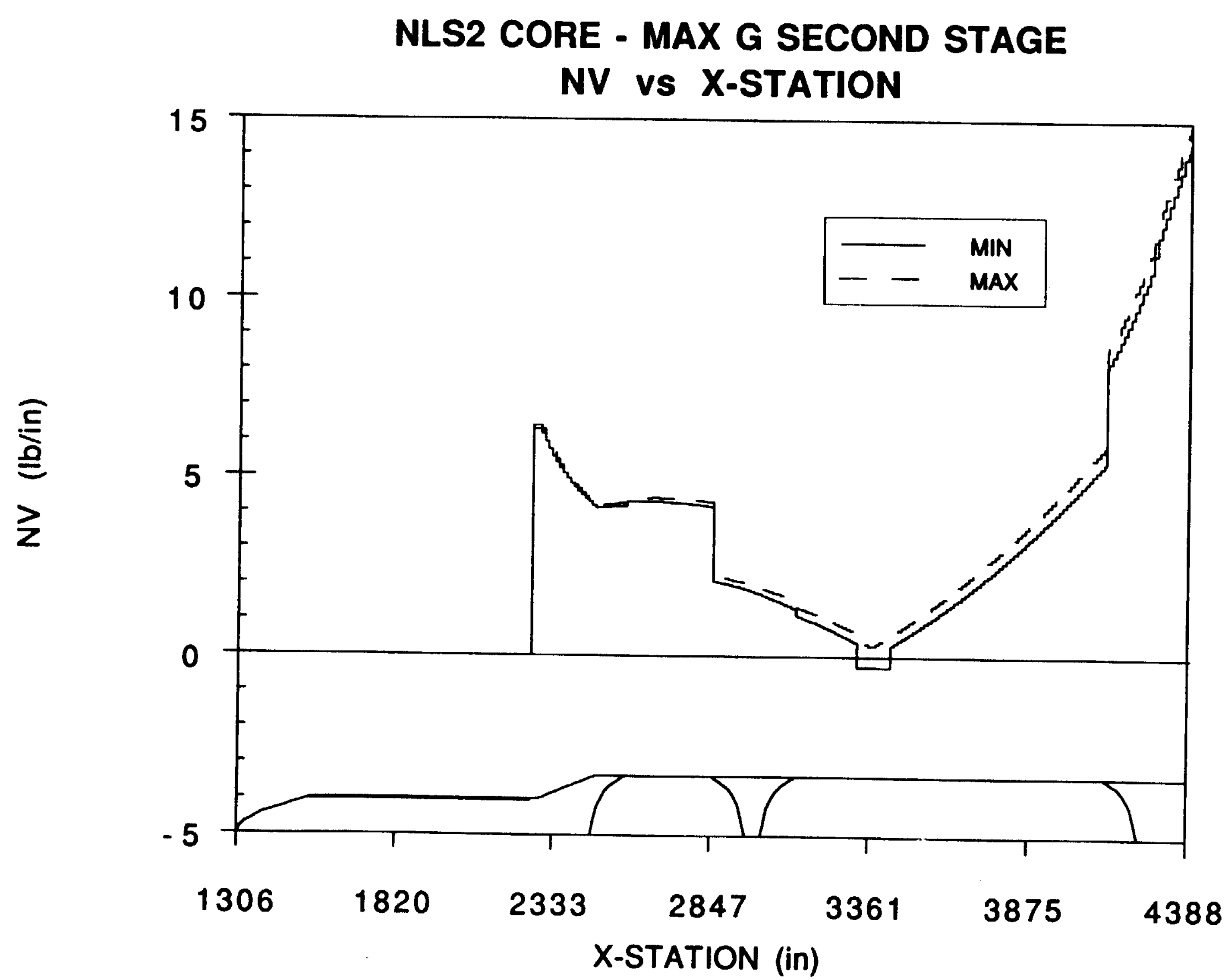
NLS2 CORE MAX G FIRST STAGE
P EQUIVALENT vs X-STATION



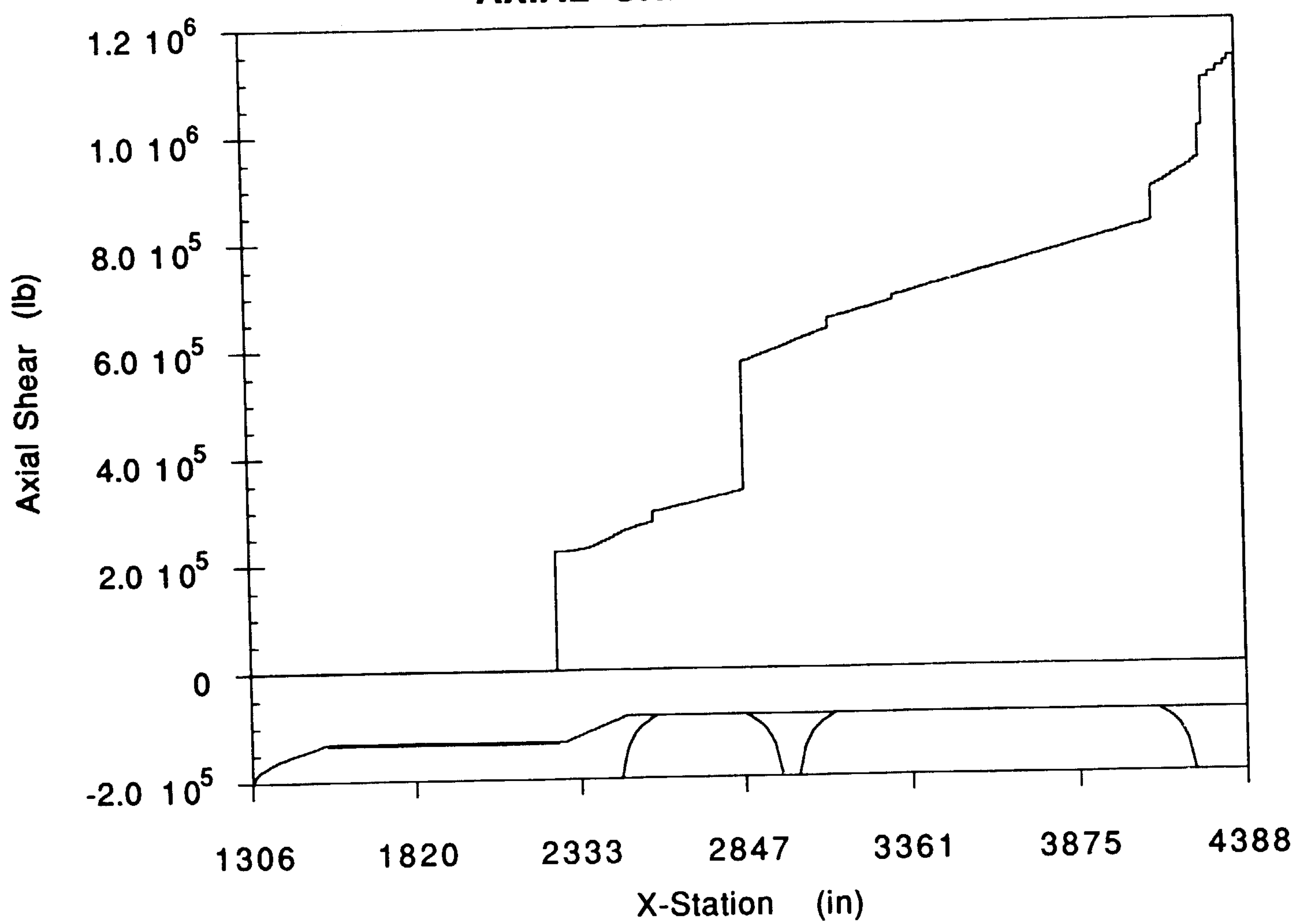

NLS2 CORE MAX G FIRST STAGE
V EQUIVALENT vs X-STATION
V Equivalent (lbs)
5.0 10^4
4.0 10^4
3.0 10^4
2.0 10^4
1.0 10^4
0
-1.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ

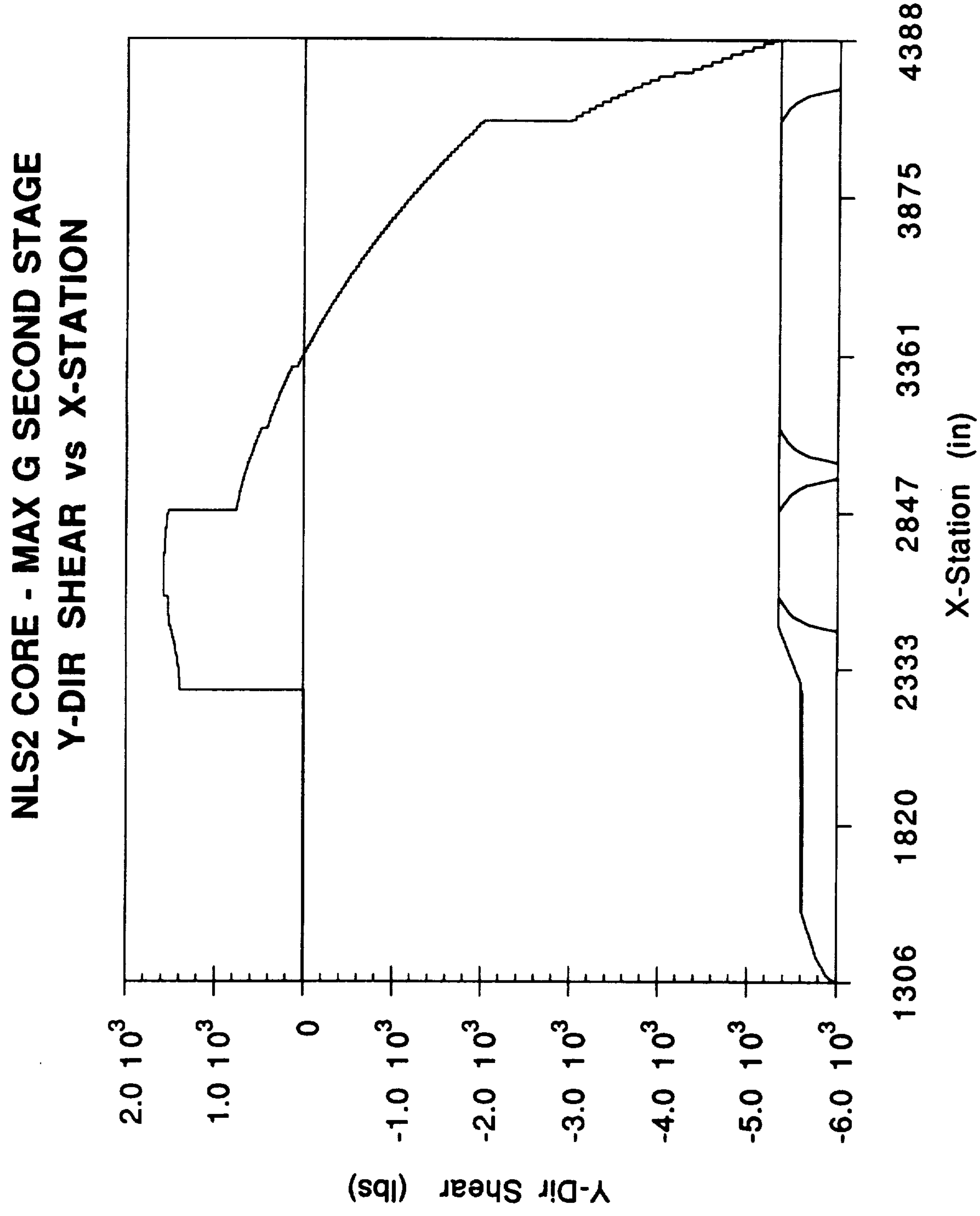
NLS2 CORE - MAX G SECOND STAGE
NX vs X-STATION



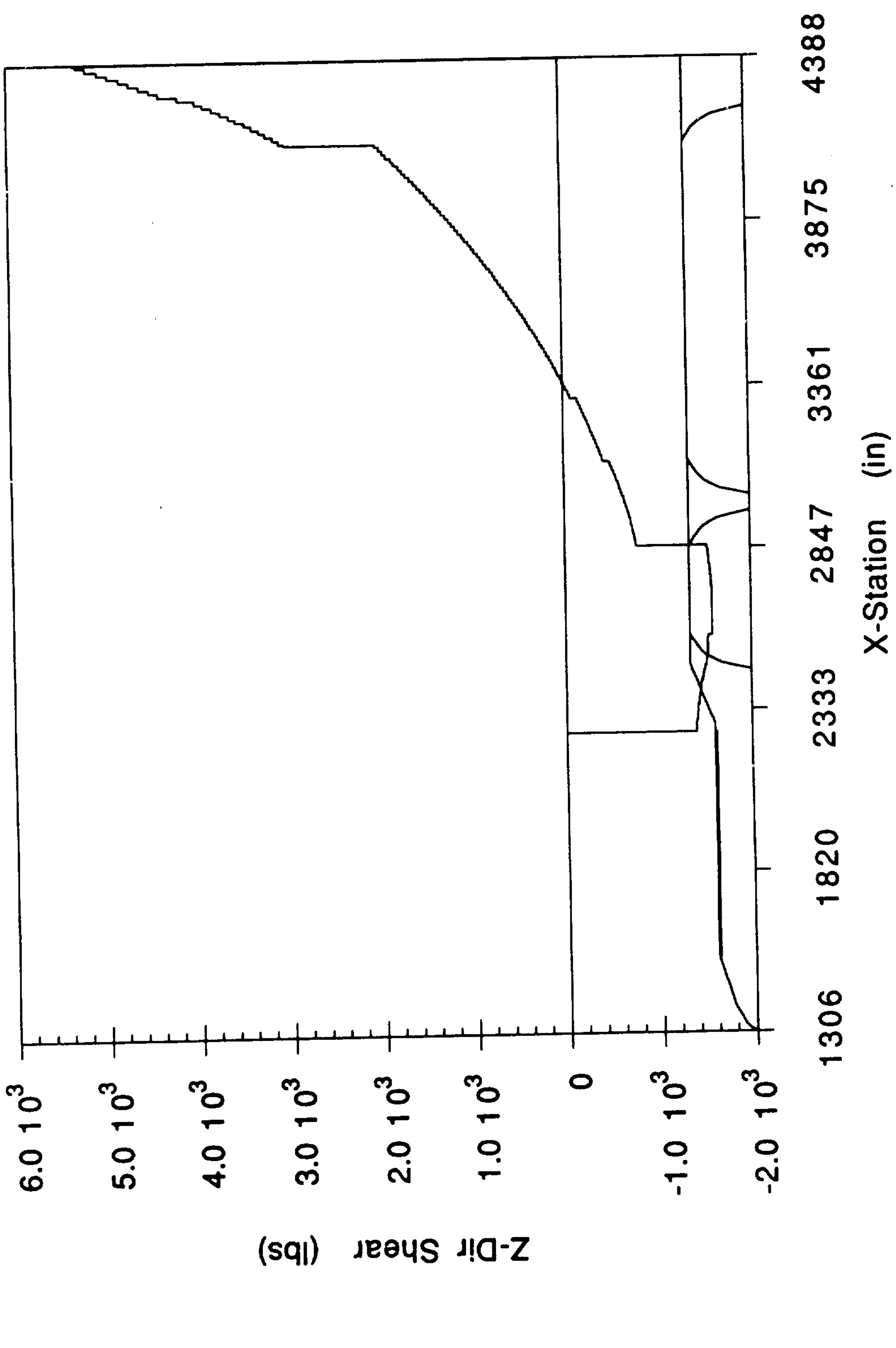

NLS2 CORE - MAX G SECOND STAGE
NV vs X-STATION
NV (lb/in)
15
10
5
0
-5
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX

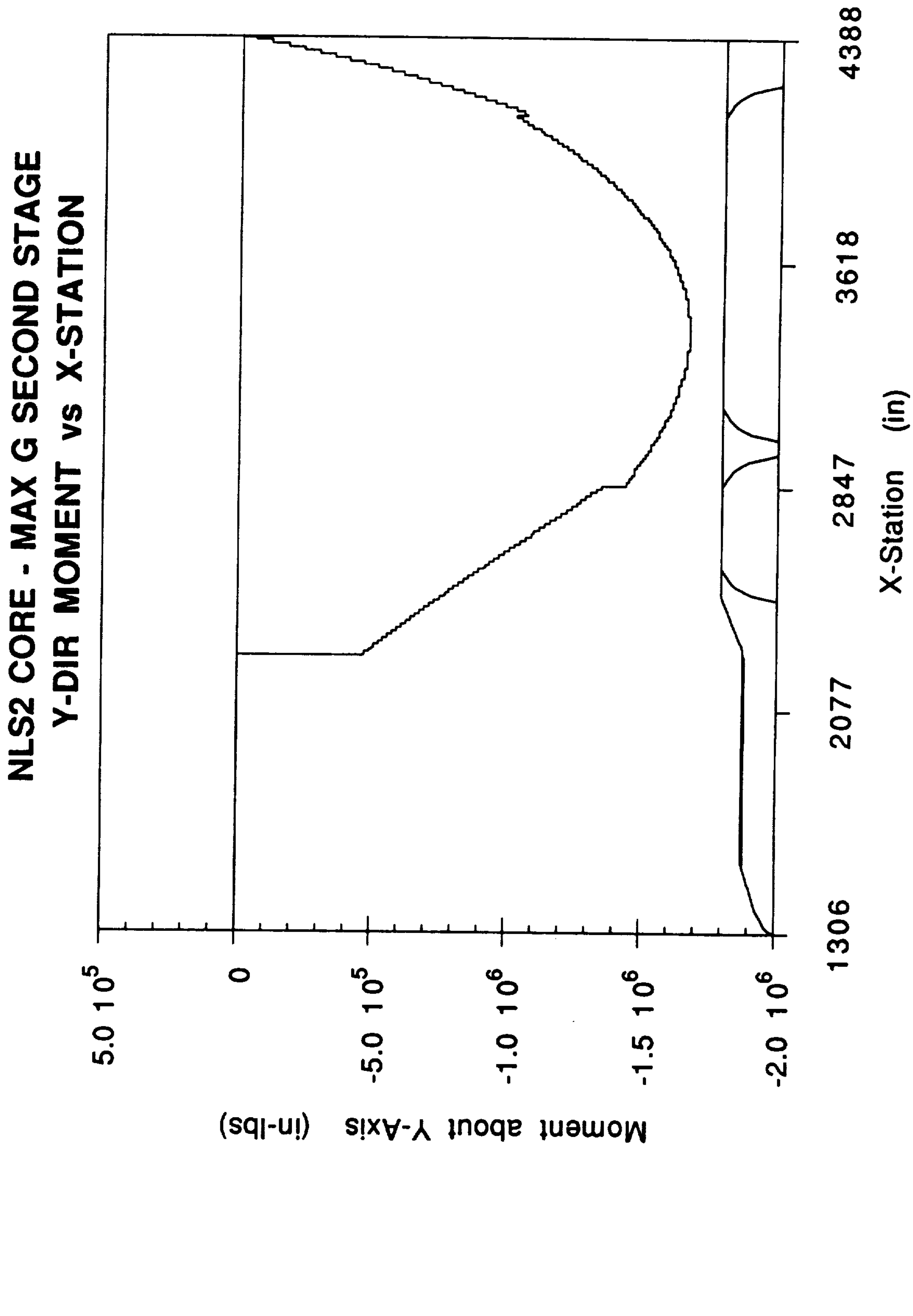
NLS2 CORE - MAX G SECOND STAGE
AXIAL SHEAR vs X-STATION




NLS2 CORE - MAX G SECOND STAGE
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lbs)
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
-3.0 10^3
-4.0 10^3
-5.0 10^3
-6.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

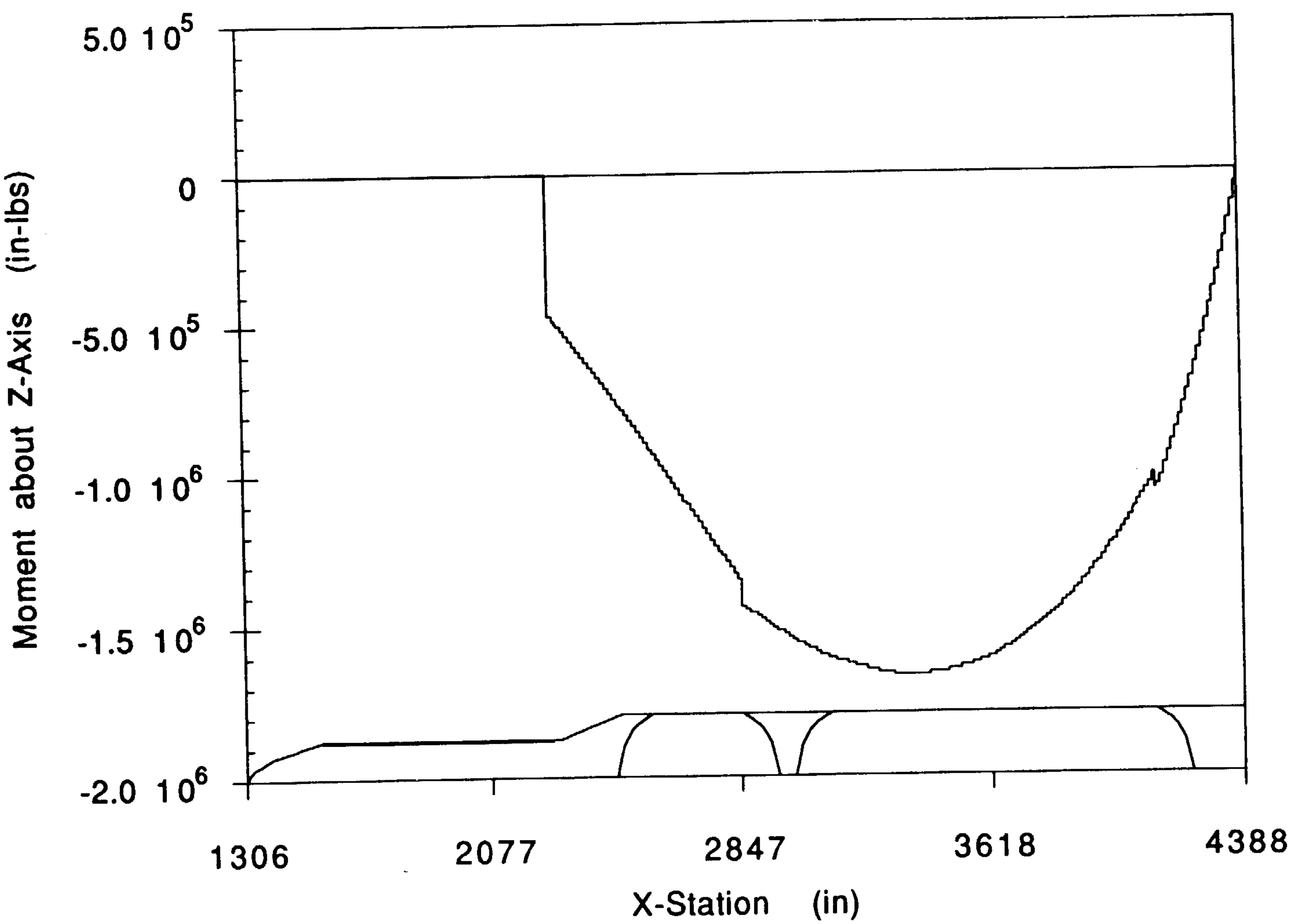
NLS2 CORE - MAX G SECOND STAGE
Z-DIR SHEAR vs X-STATION

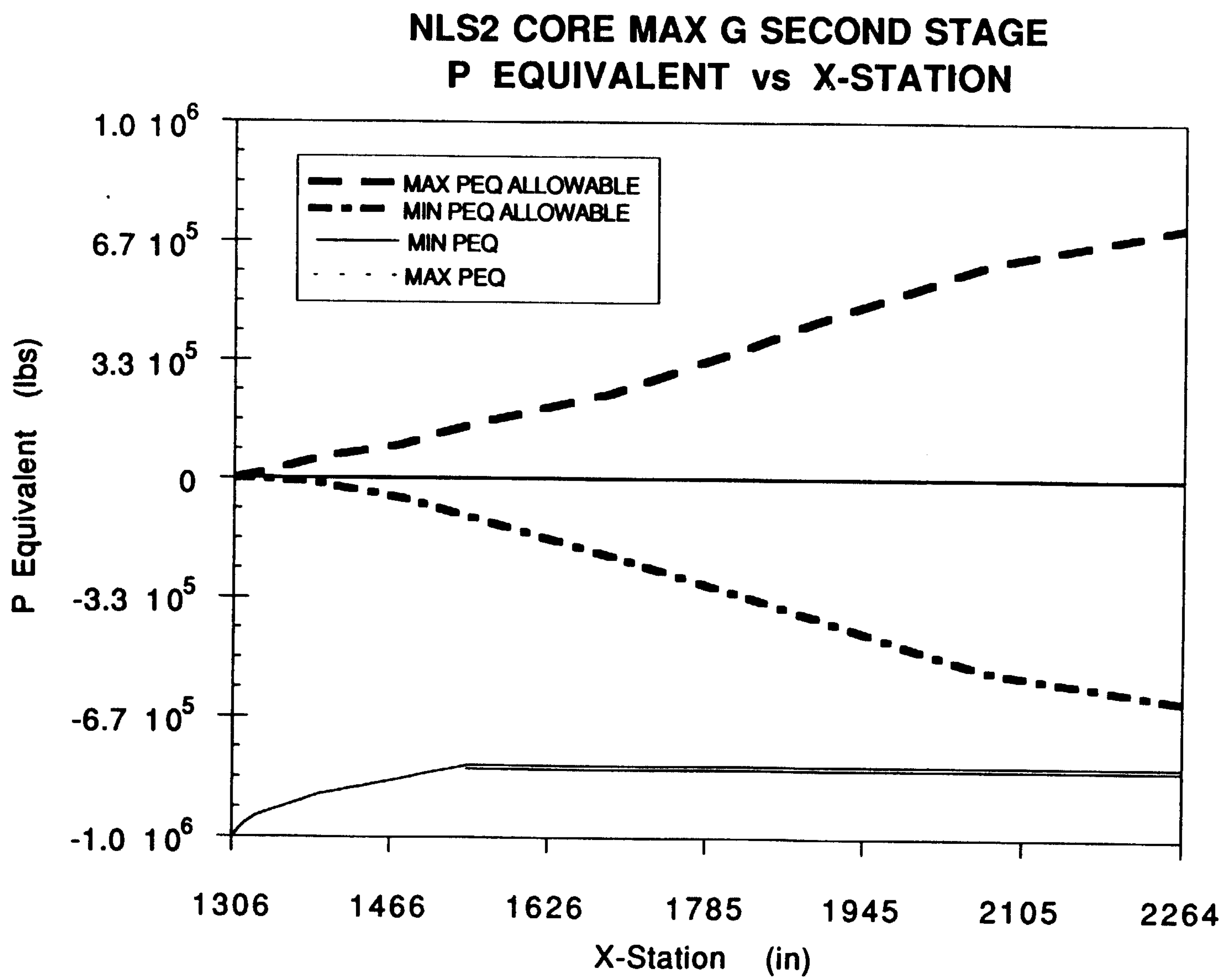




NLS2 CORE - MAX G SECOND STAGE
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
5.0 10^5
0
-5.0 10^5
-1.0 10^6
-1.5 10^6
-2.0 10^6
1306
2077
2847
3618
4388
X-Station (in)

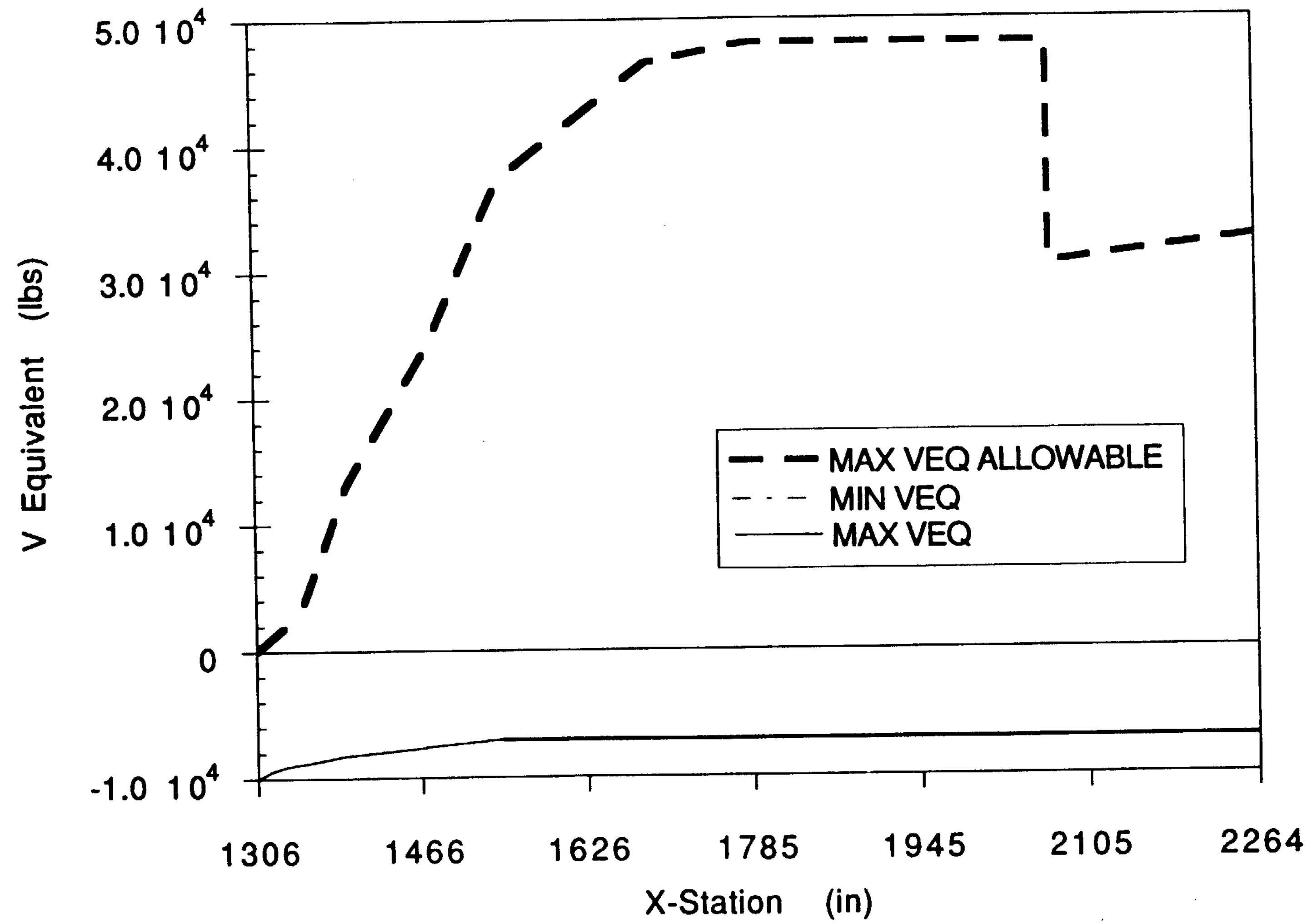
NLS2 CORE - MAX G SECOND STAGE
Z-DIR MOMENT vs X-STATION

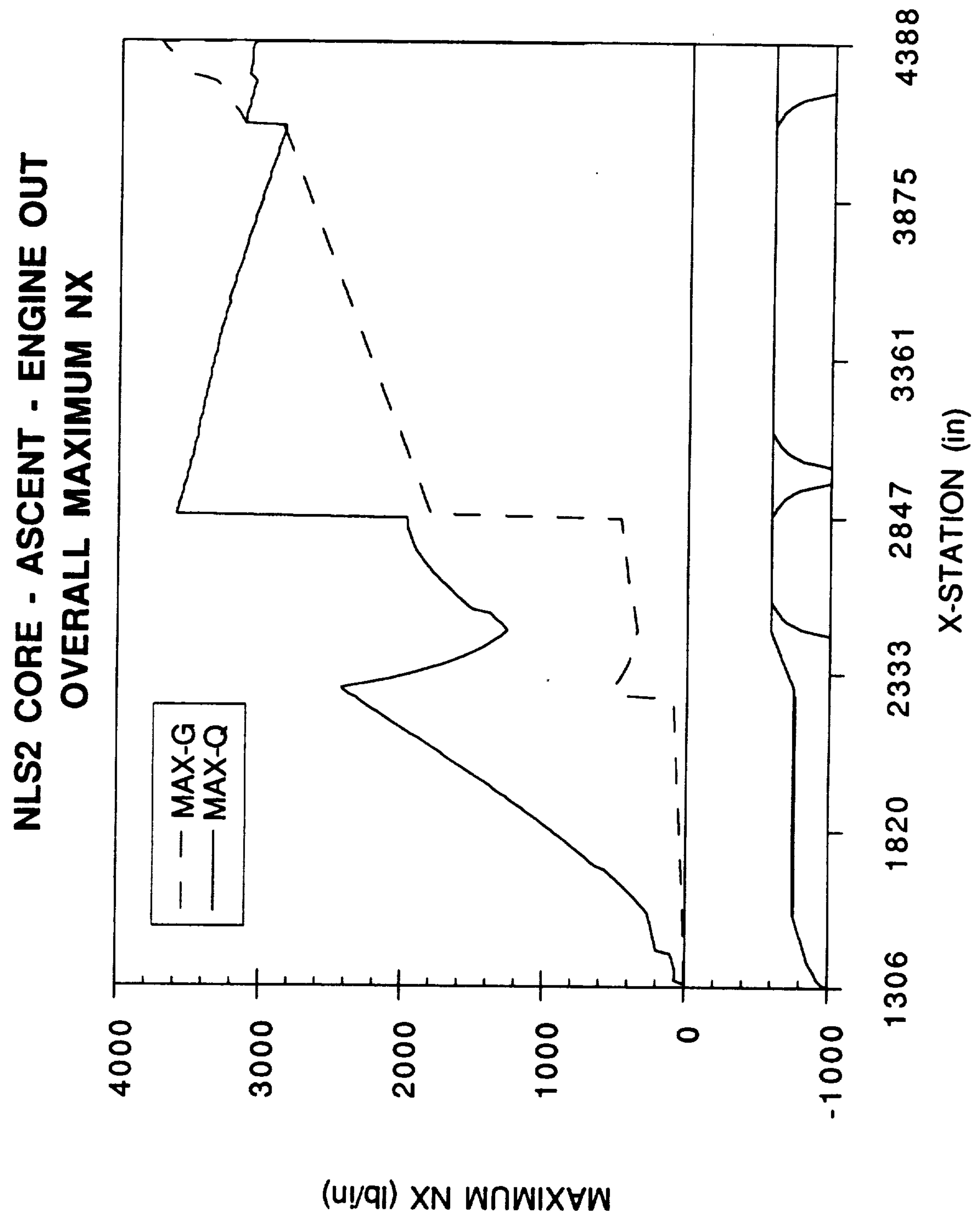


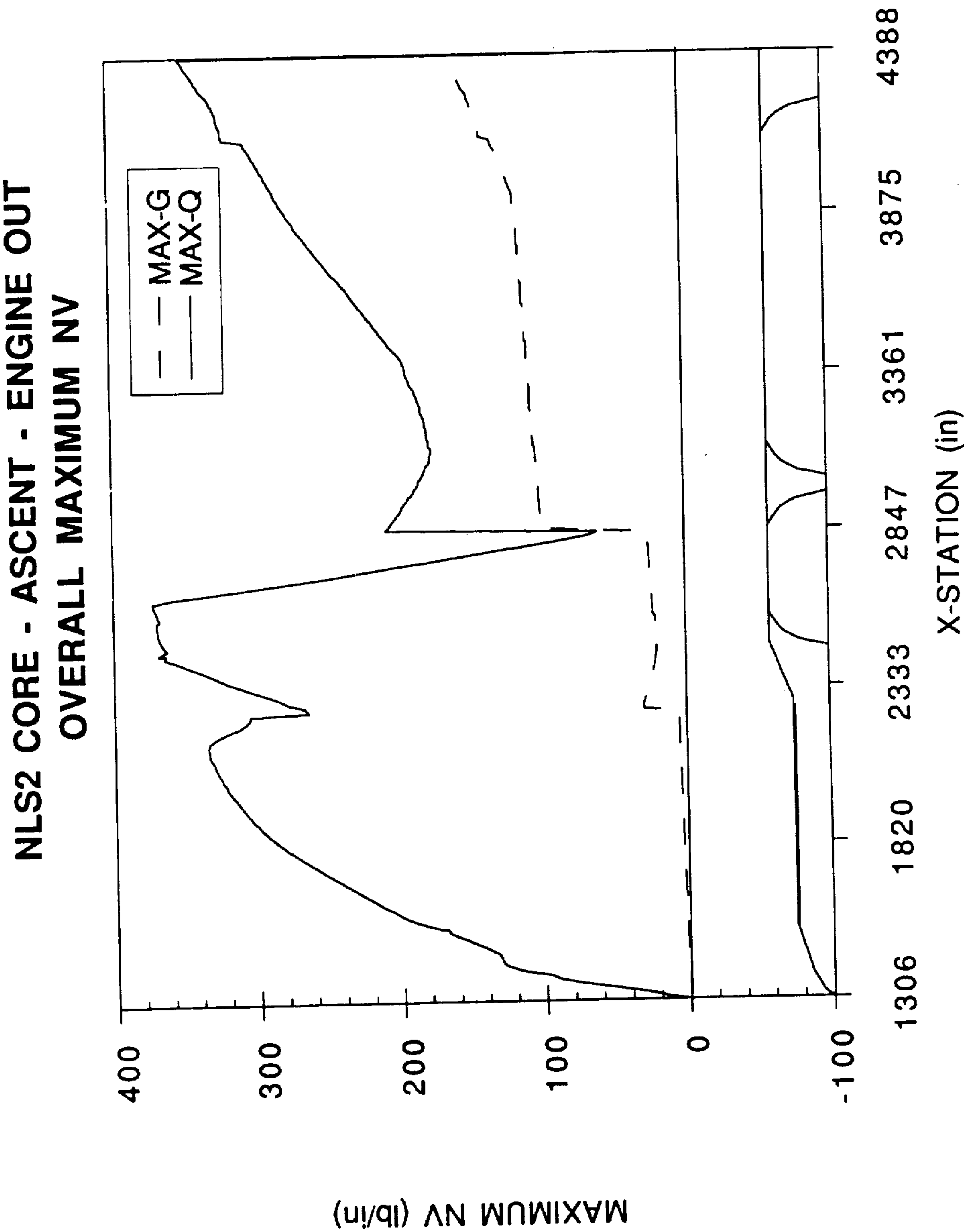


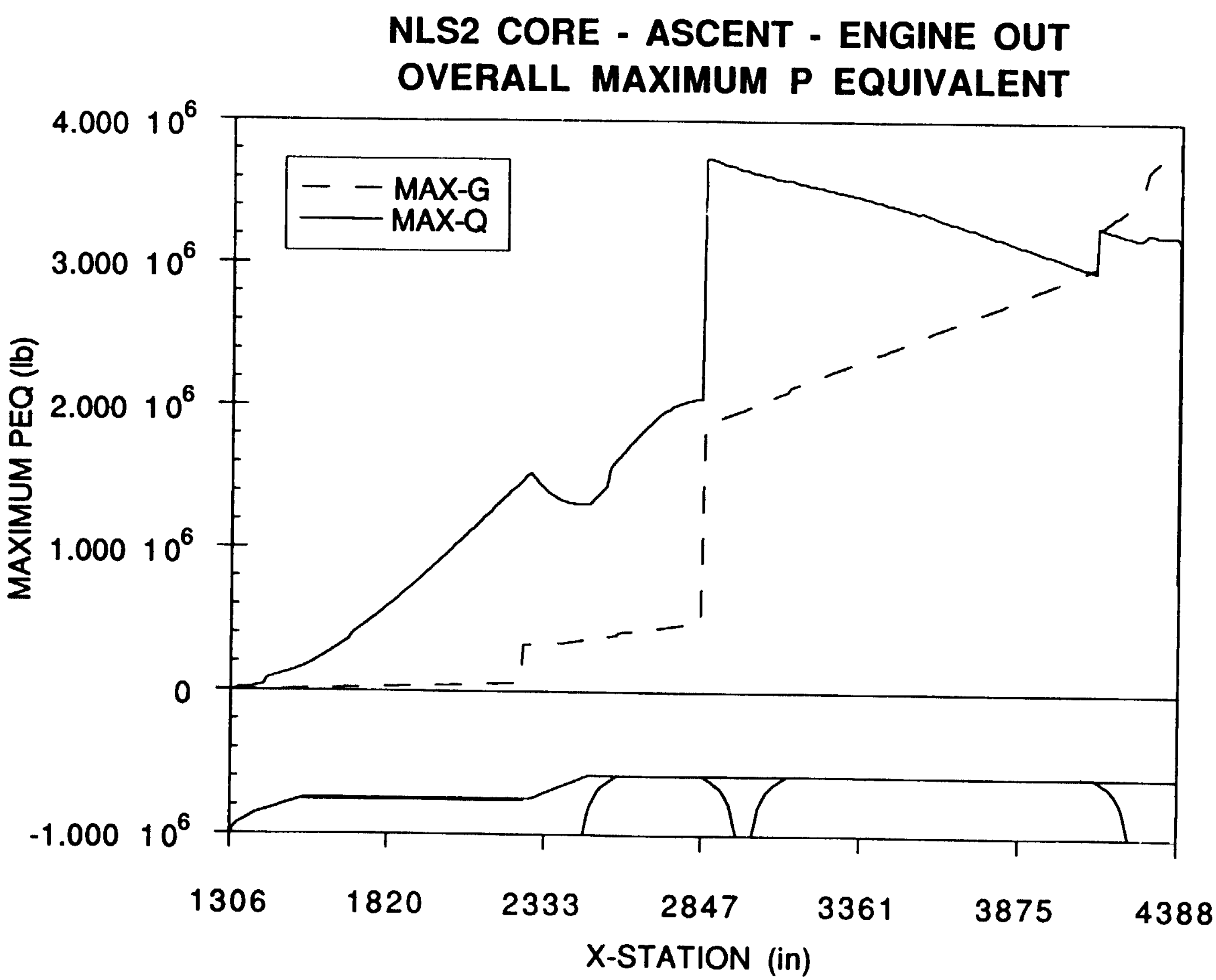
NLS2 CORE MAX G SECOND STAGE
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
1.0 10^6
6.7 10^5
3.3 10^5
0
-3.3 10^5
-6.7 10^5
-1.0 10^6
P Equivalent (lbs)
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

NLS2 CORE MAX G SECOND STAGE
V EQUIVALENT vs X-STATION

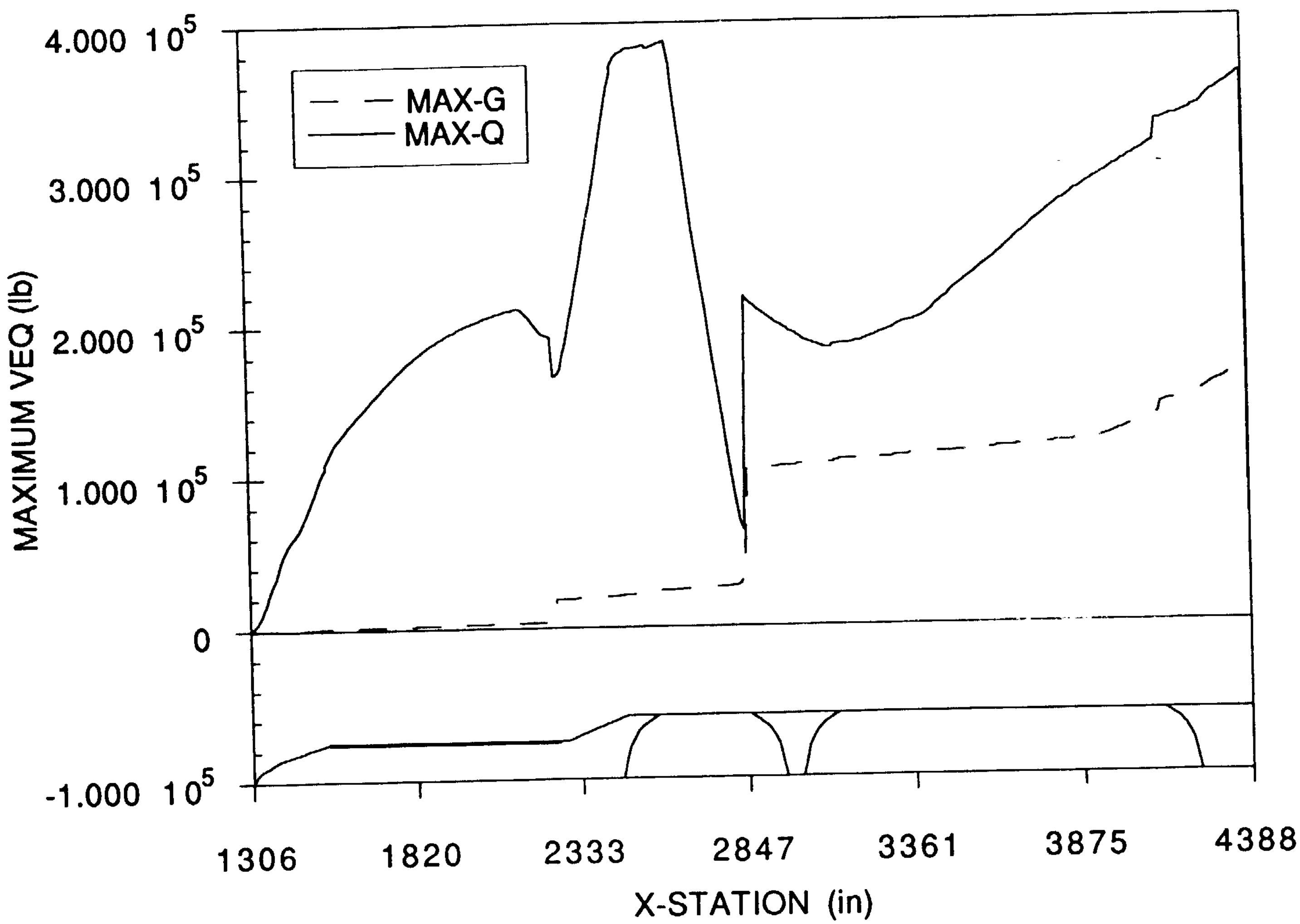


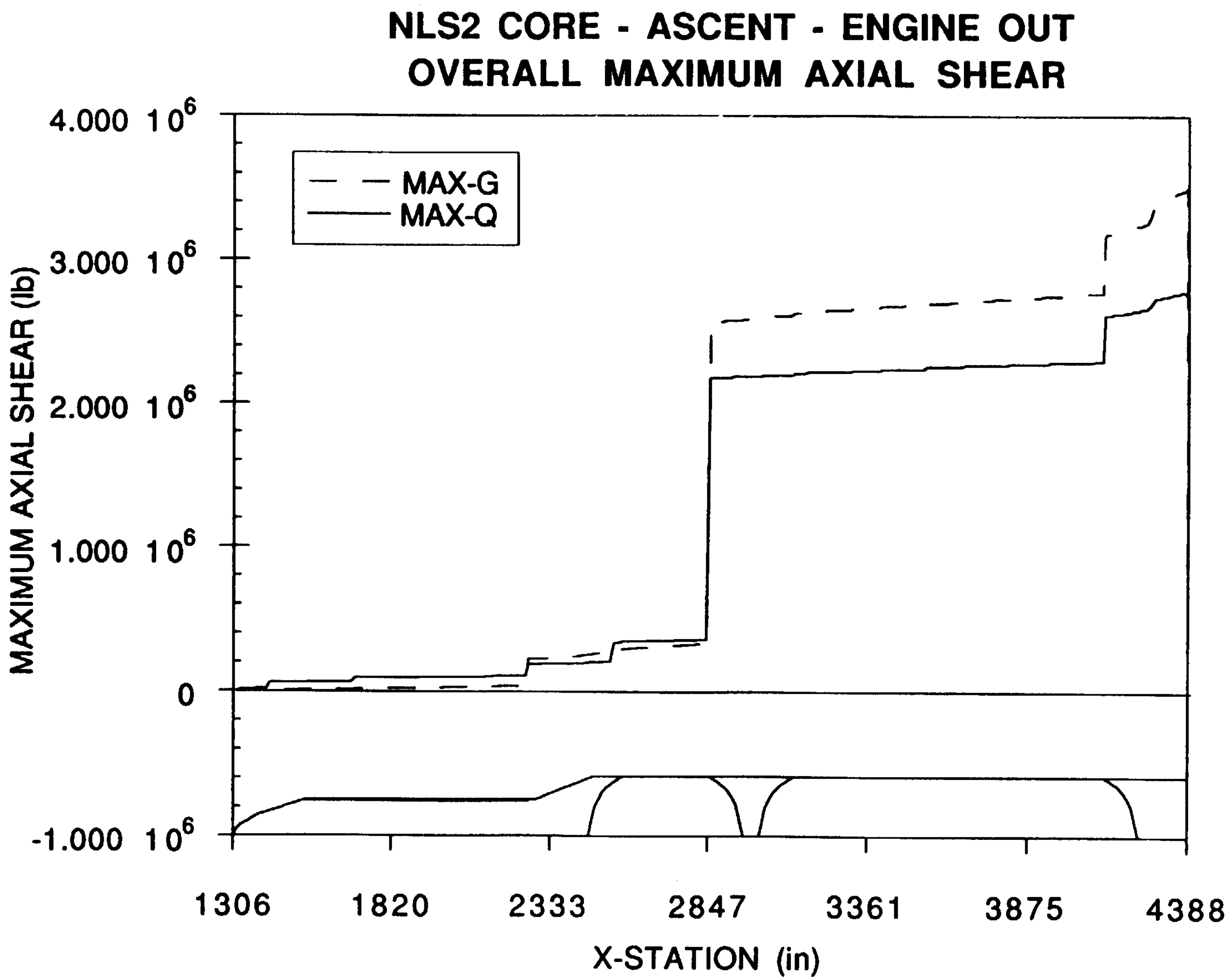

NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM NX
MAX-G
MAX-Q
4000
3000
2000
1000
0
-1000
MAXIMUM NX (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

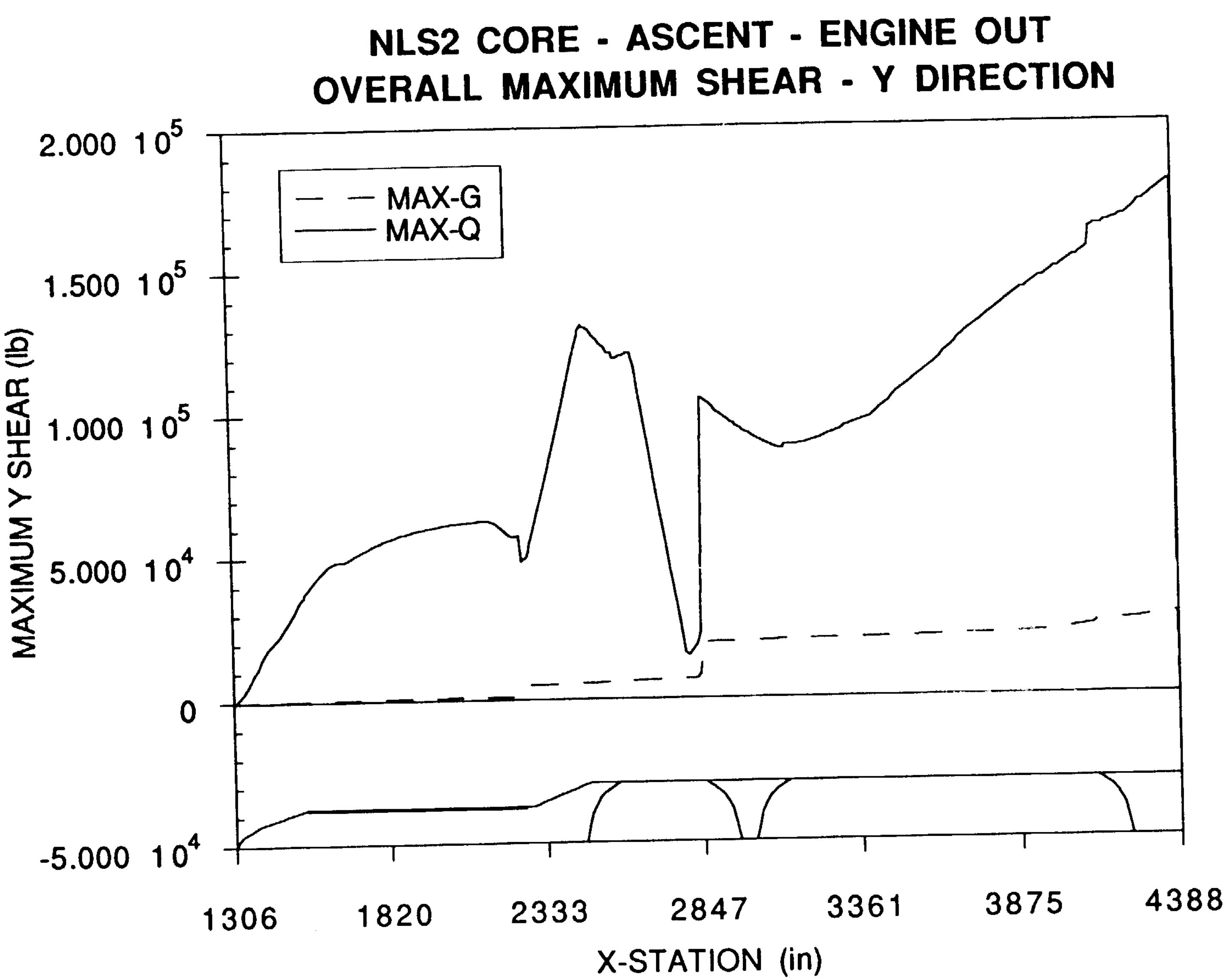

NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM NV
MAX-G
MAX-Q
MAXIMUM NV (lb/in)
400
300
200
100
0
-100
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)


NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM P EQUIVALENT
MAX-G
MAX-Q
MAXIMUM PEQ (lb)
4.000 10^6
3.000 10^6
2.000 10^6
1.000 10^6
0
-1.000 10^6
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

NLS2 CORE - ASCENT- ENGINE OUT
OVERALL MAXIMUM V EQUIVALENT

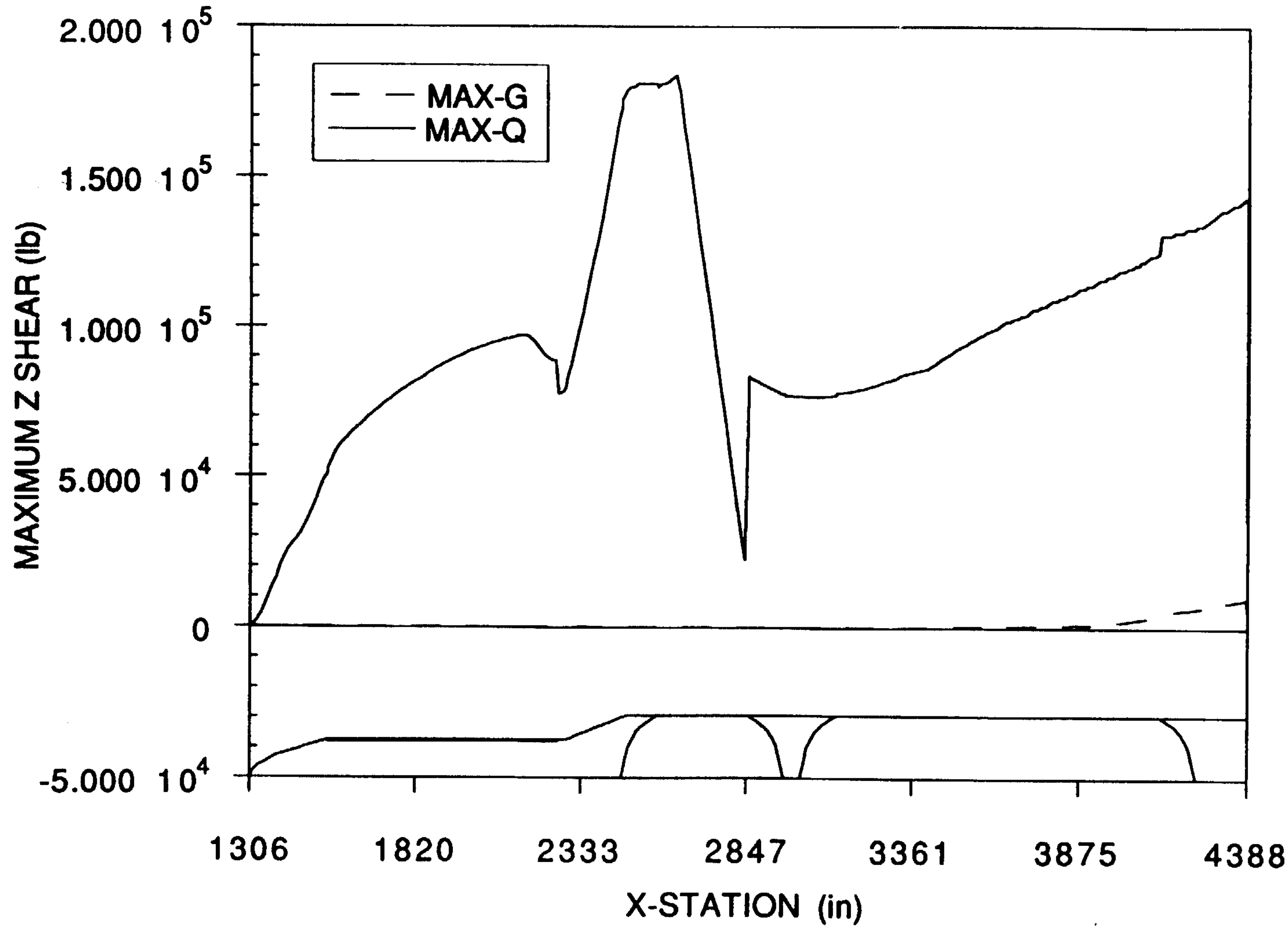



NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM AXIAL SHEAR
MAX-G
MAX-Q
4.000 10^6
3.000 10^6
2.000 10^6
1.000 10^6
0
-1.000 10^6
MAXIMUM AXIAL SHEAR (lb)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

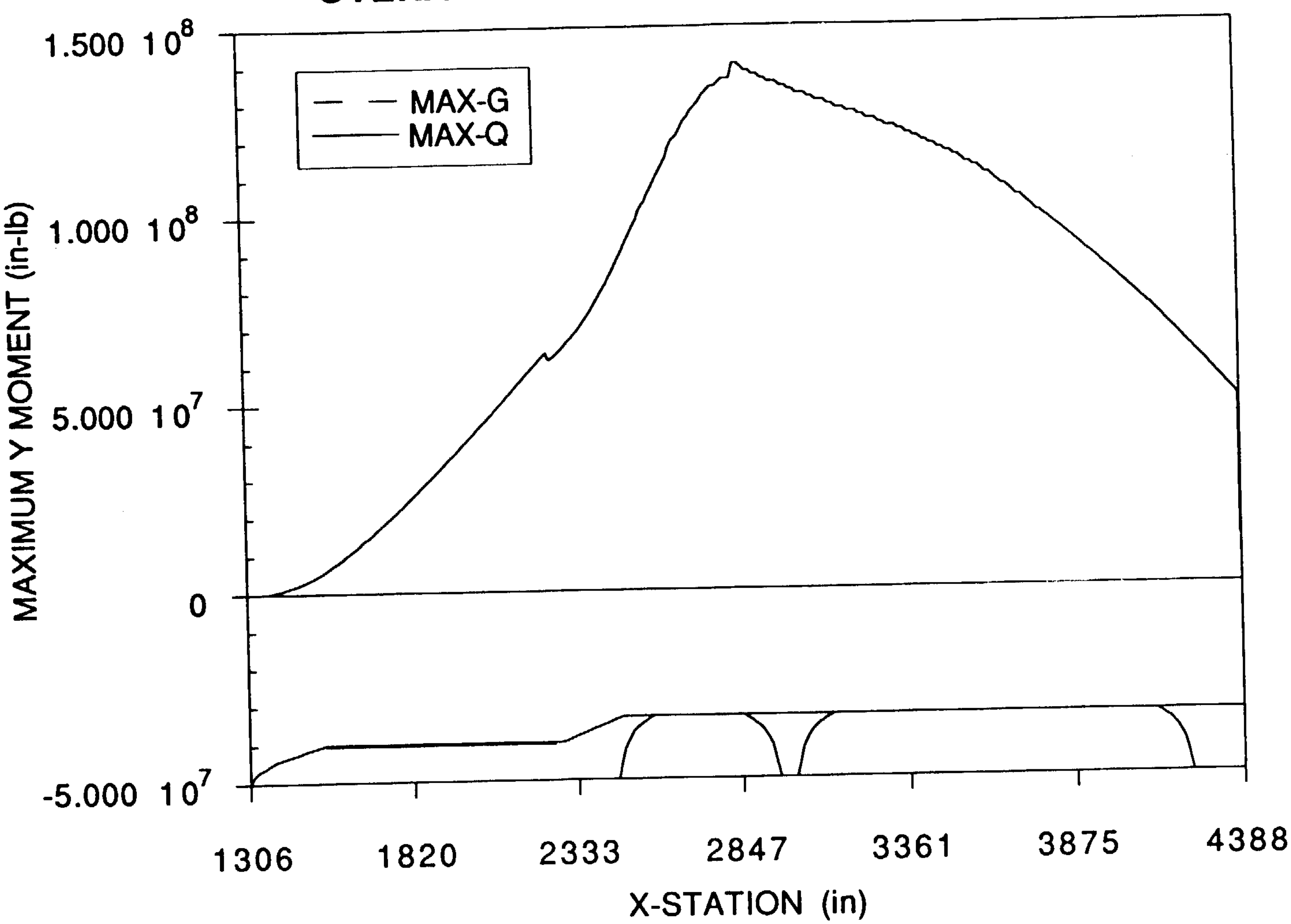


NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM SHEAR - Y DIRECTION
MAX-G
MAX-Q
MAXIMUM Y SHEAR (lb)
2.000 10^5
1.500 10^5
1.000 10^5
5.000 10^4
0
-5.000 10^4
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

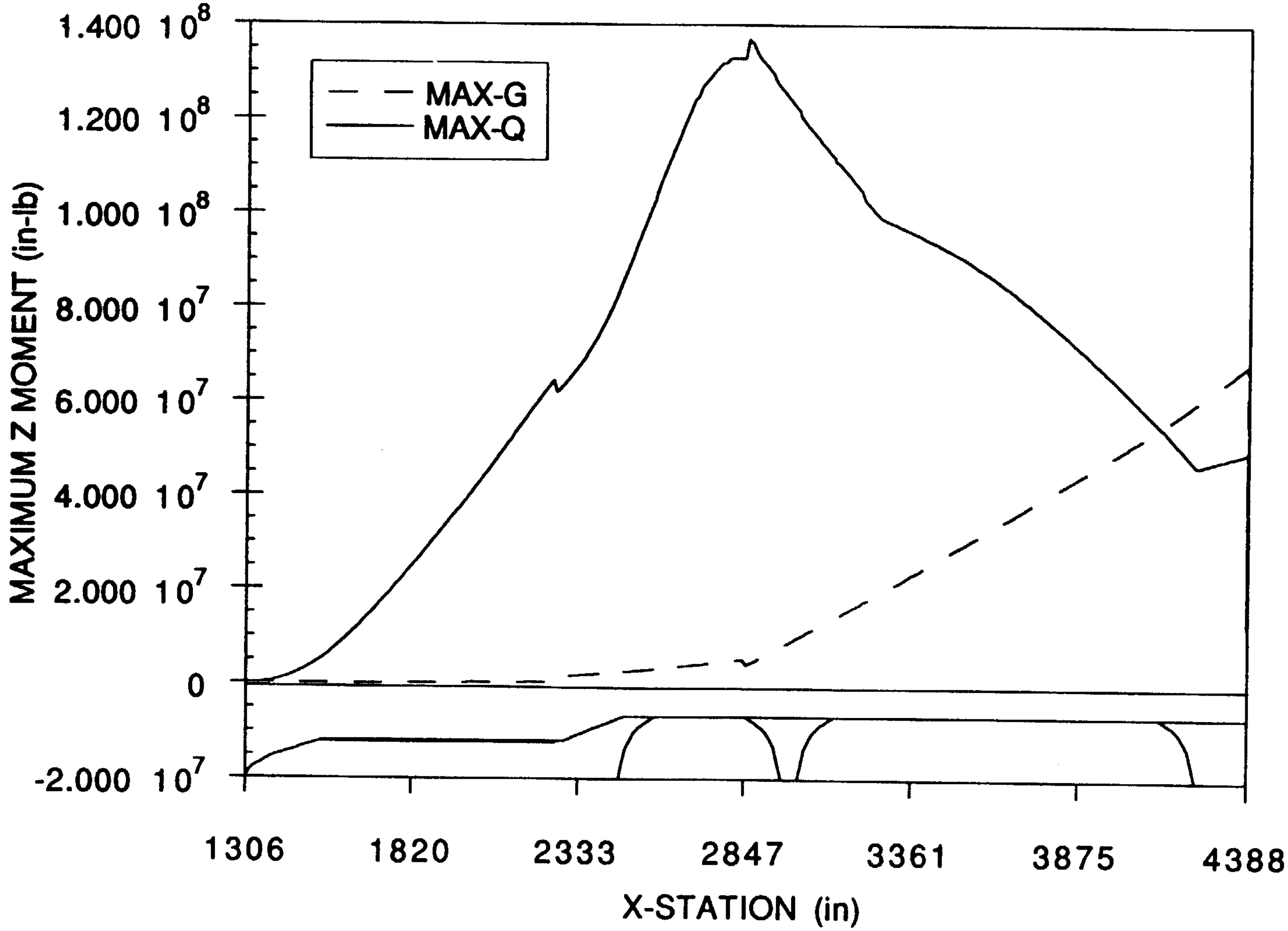
NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM SHEAR - Z DIRECTION

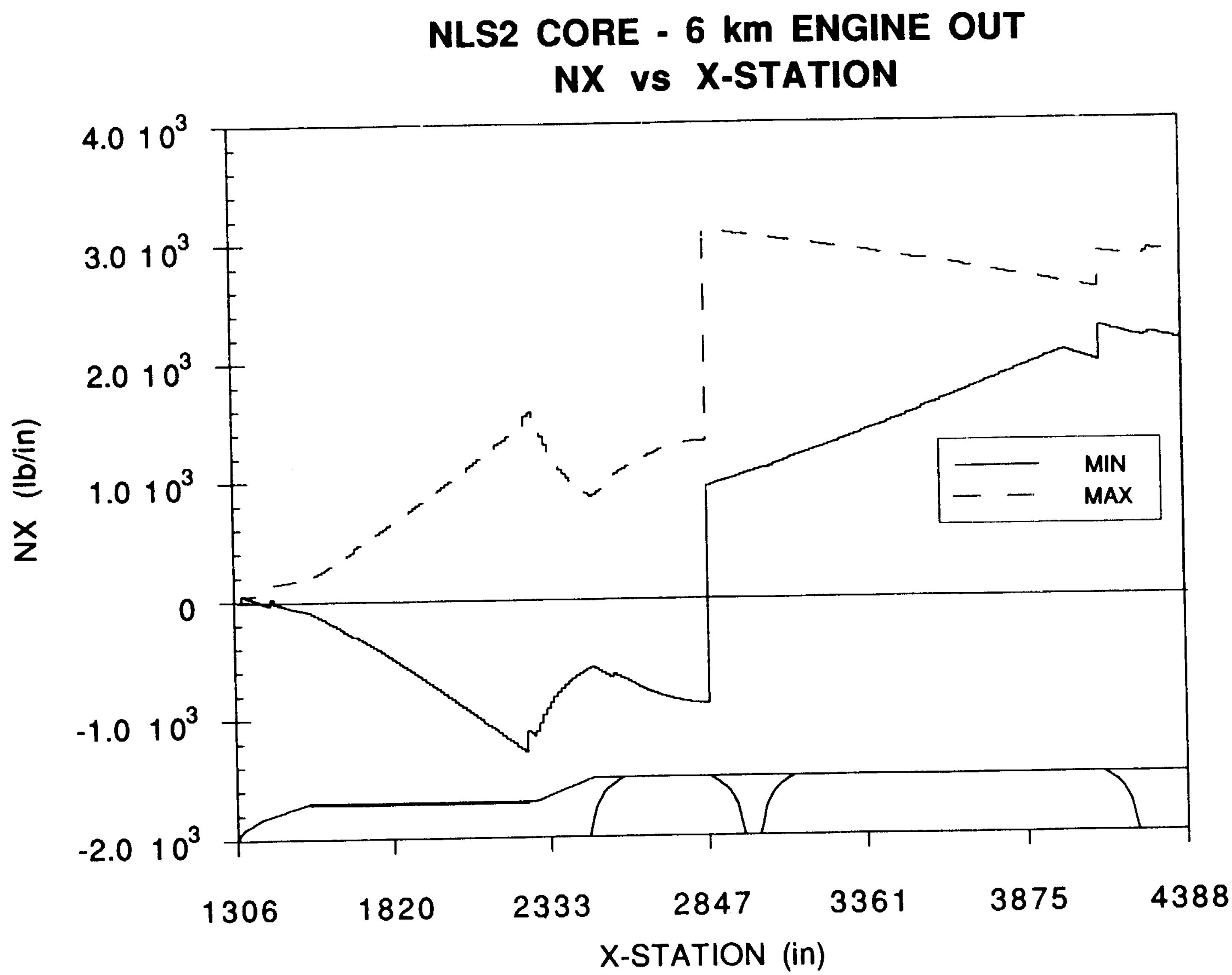


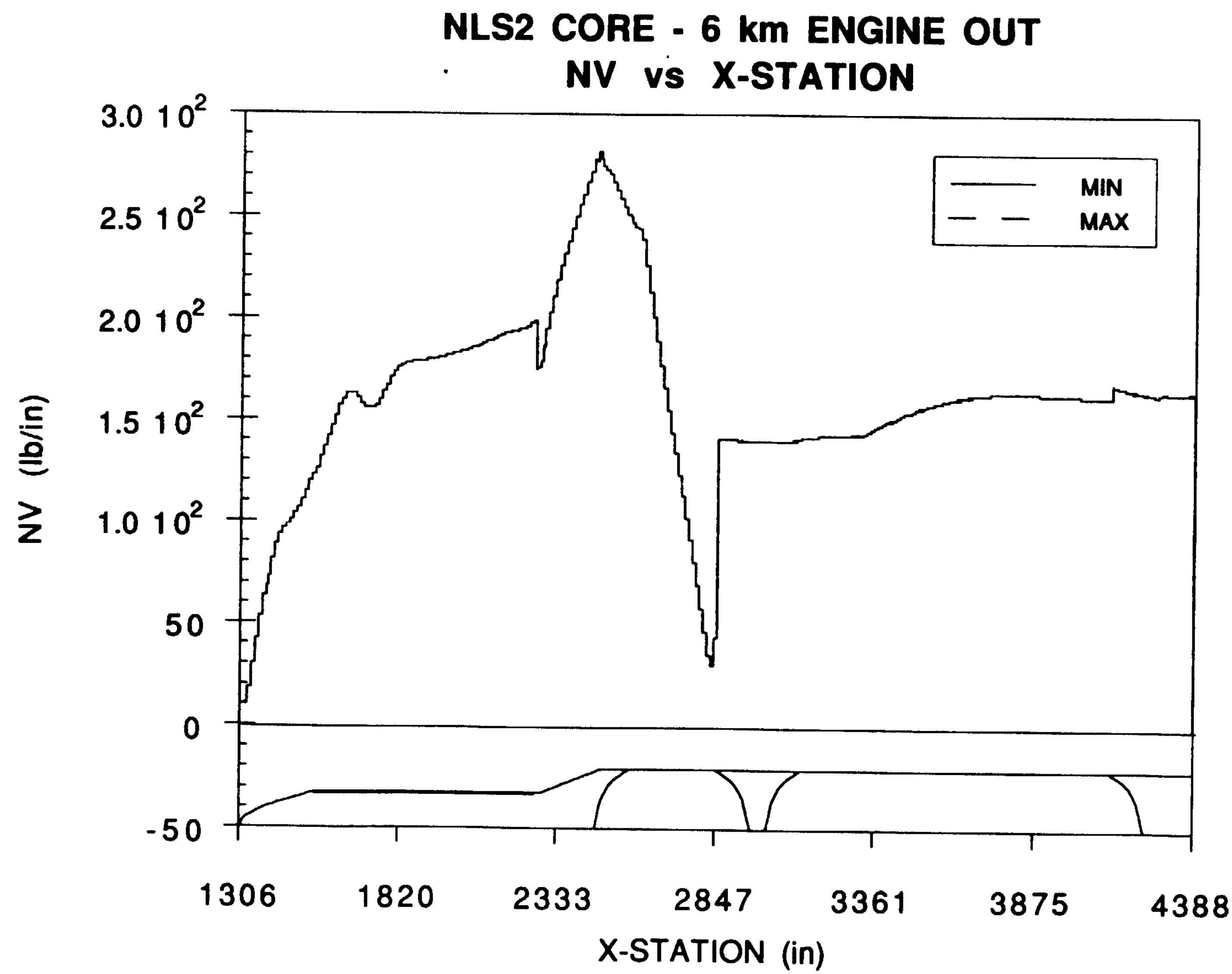
NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM MOMENT - Y DIRECTION

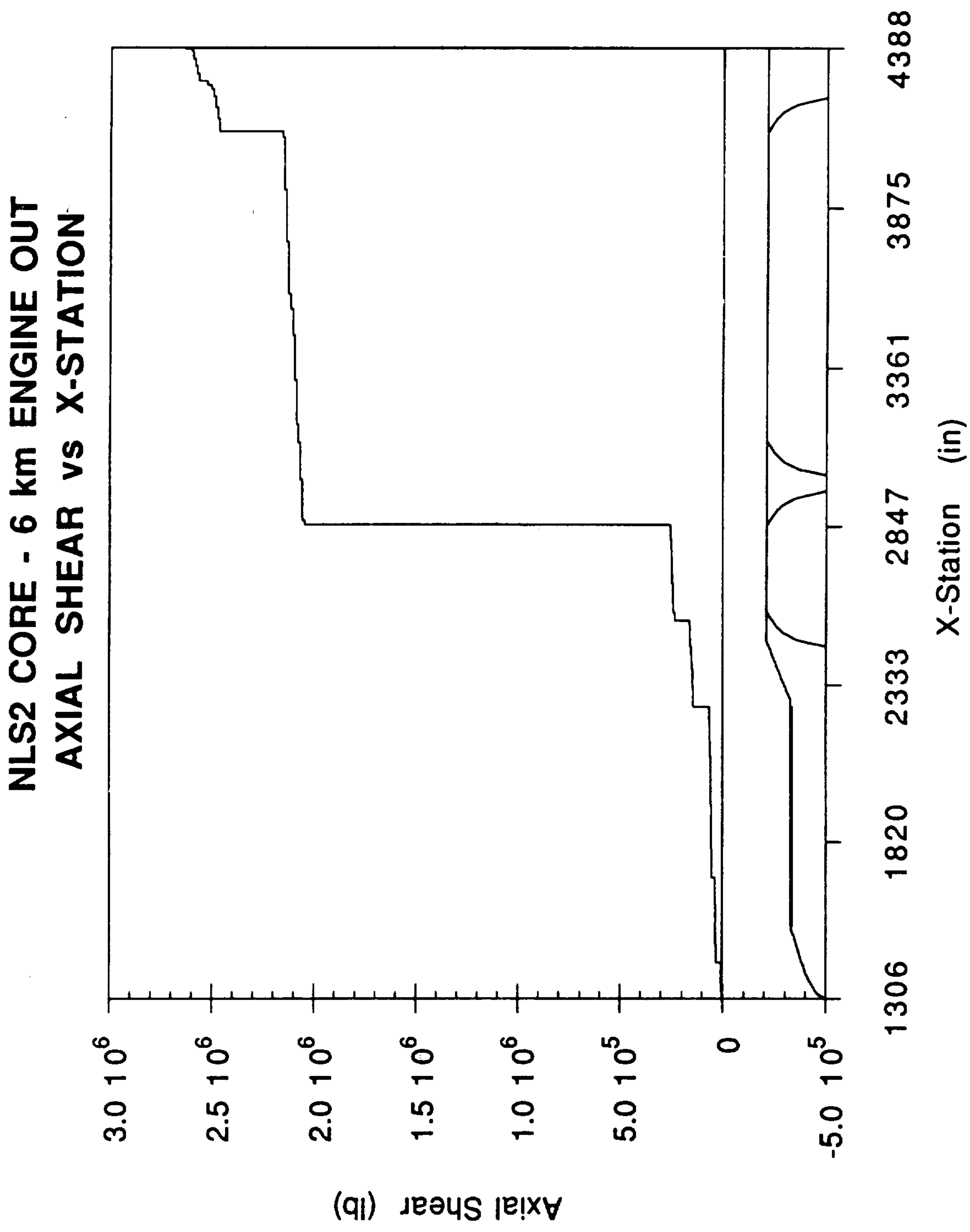


NLS2 CORE - ASCENT - ENGINE OUT
OVERALL MAXIMUM MOMENT - Z DIRECTION

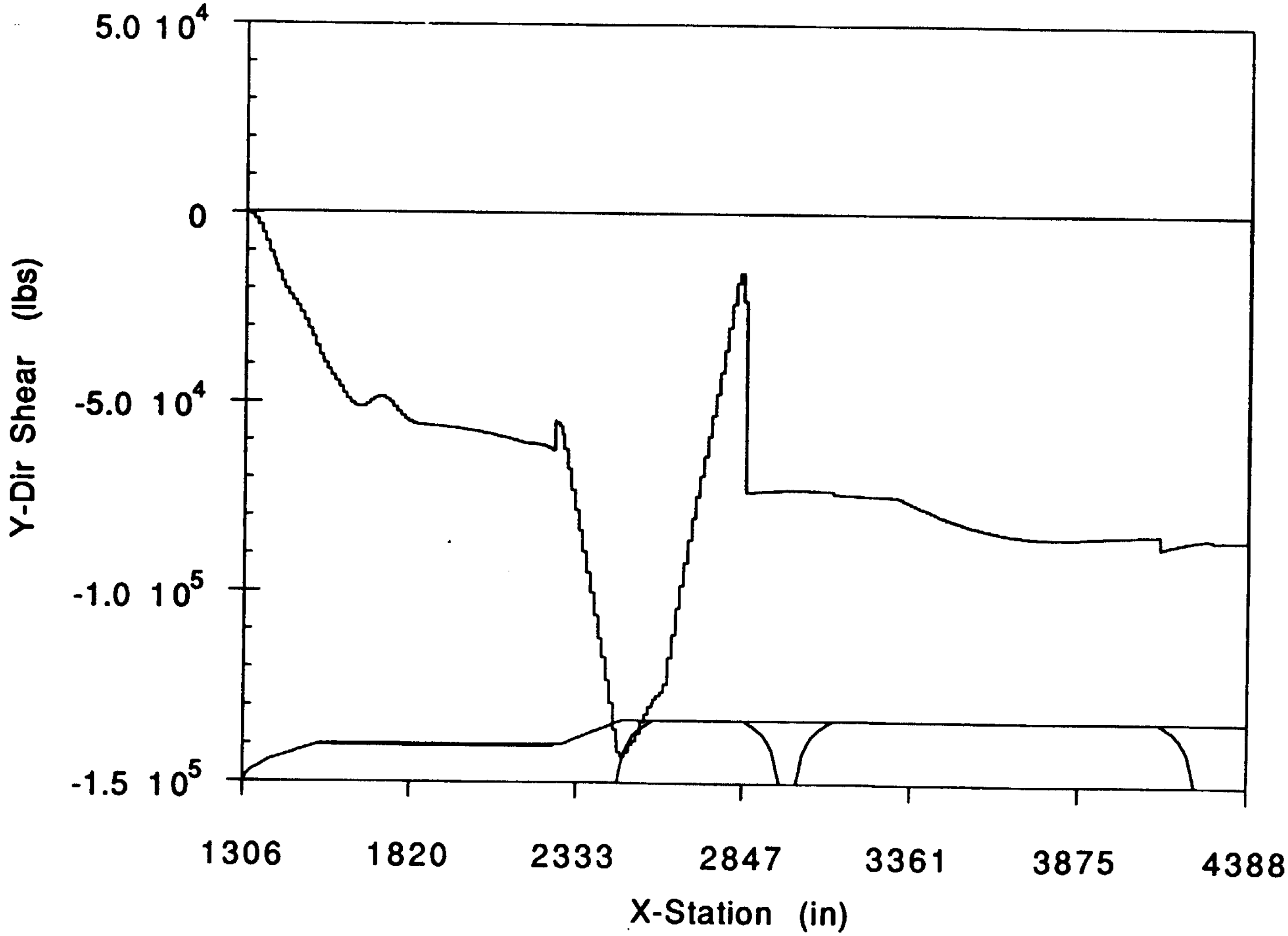



NLS2 CORE - 6 km ENGINE OUT
NX vs X-STATION
NX (lb/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX

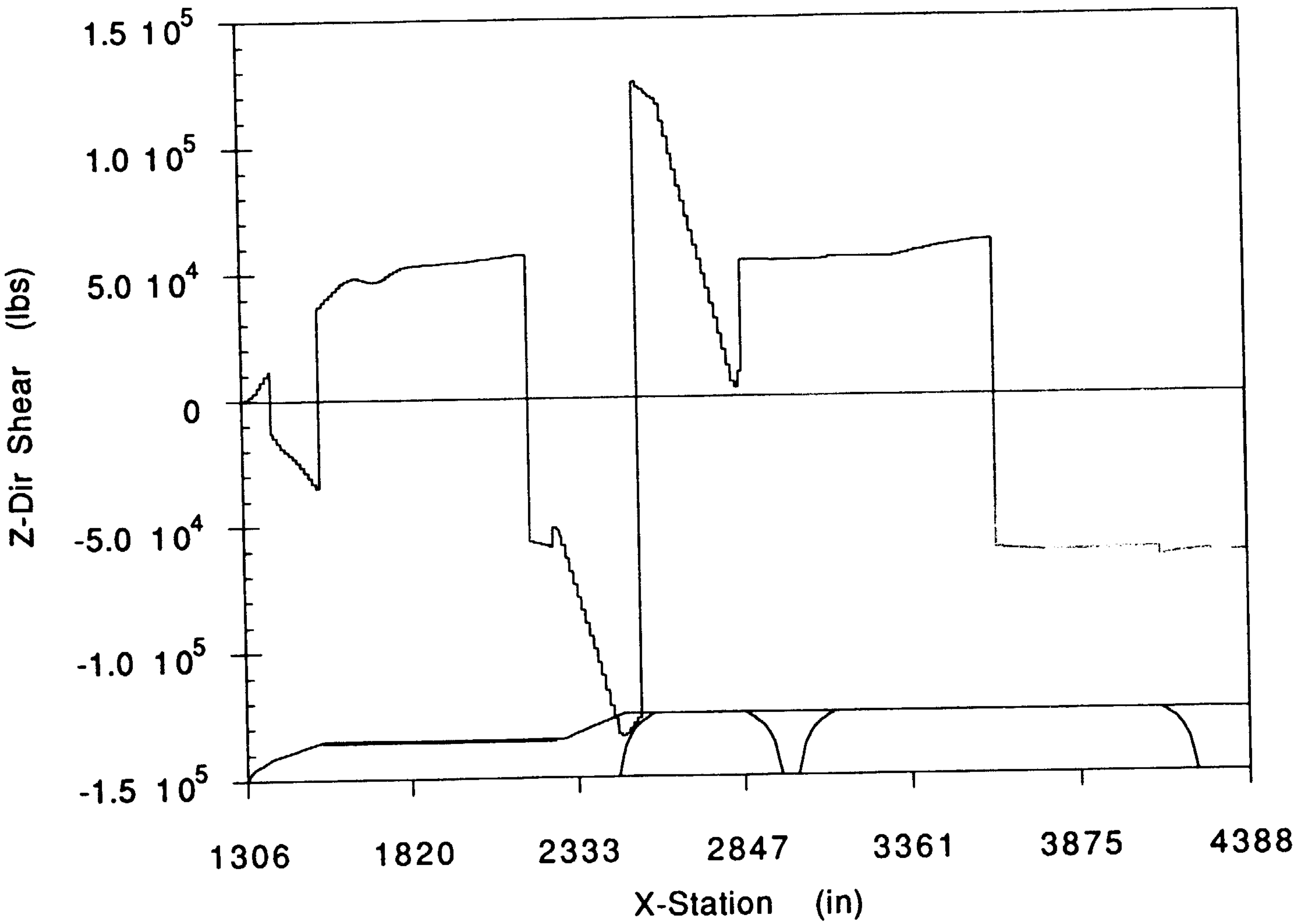

NLS2 CORE - 6 km ENGINE OUT
NV vs X-STATION
MIN
MAX
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
NV (lb/in)
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

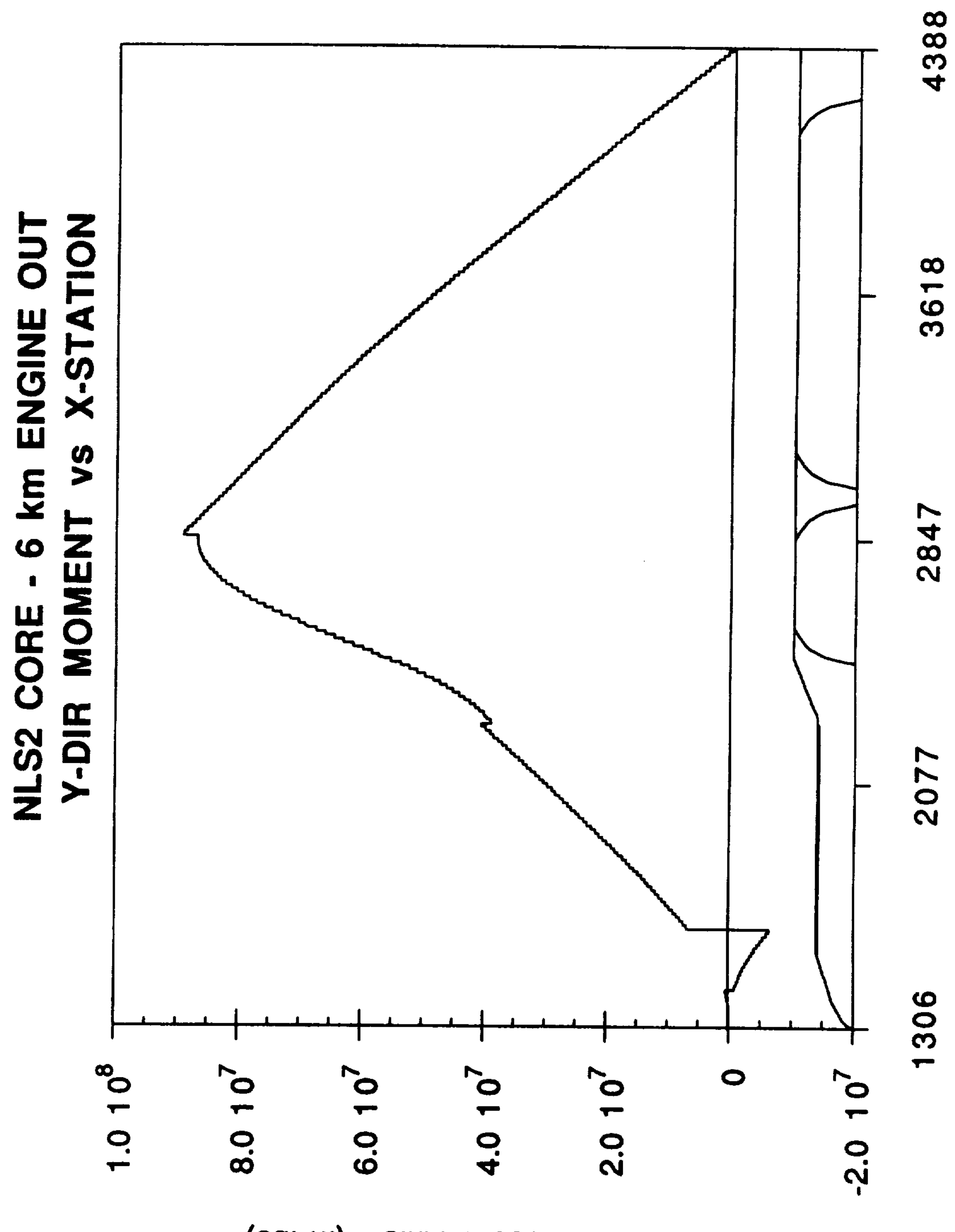

NLS2 CORE - 6 km ENGINE OUT
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

NLS2 CORE - 6 km ENGINE OUT
Y-DIR SHEAR vs X-STATION



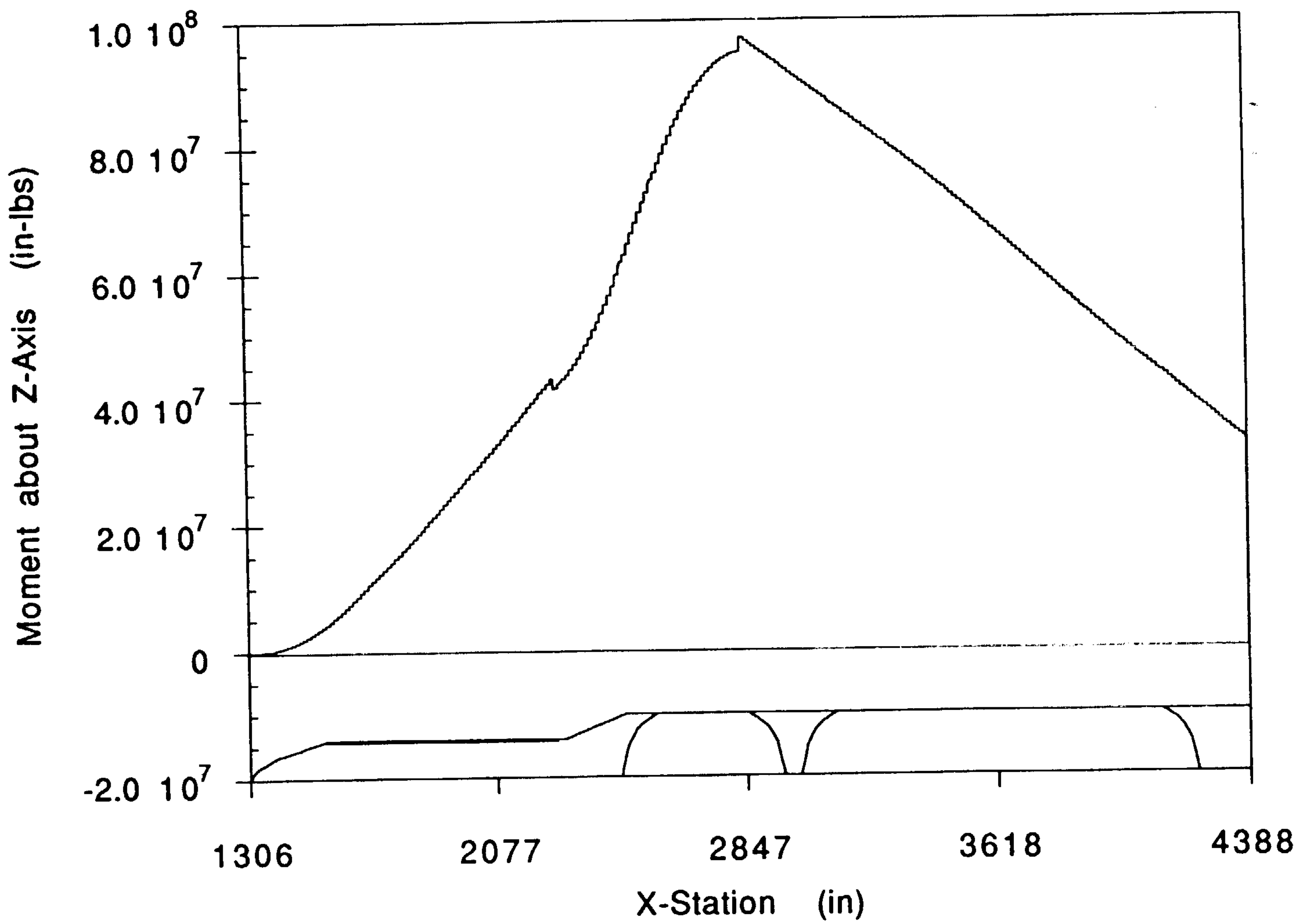
NLS2 CORE - 6 km ENGINE OUT
Z-DIR SHEAR vs X-STATION



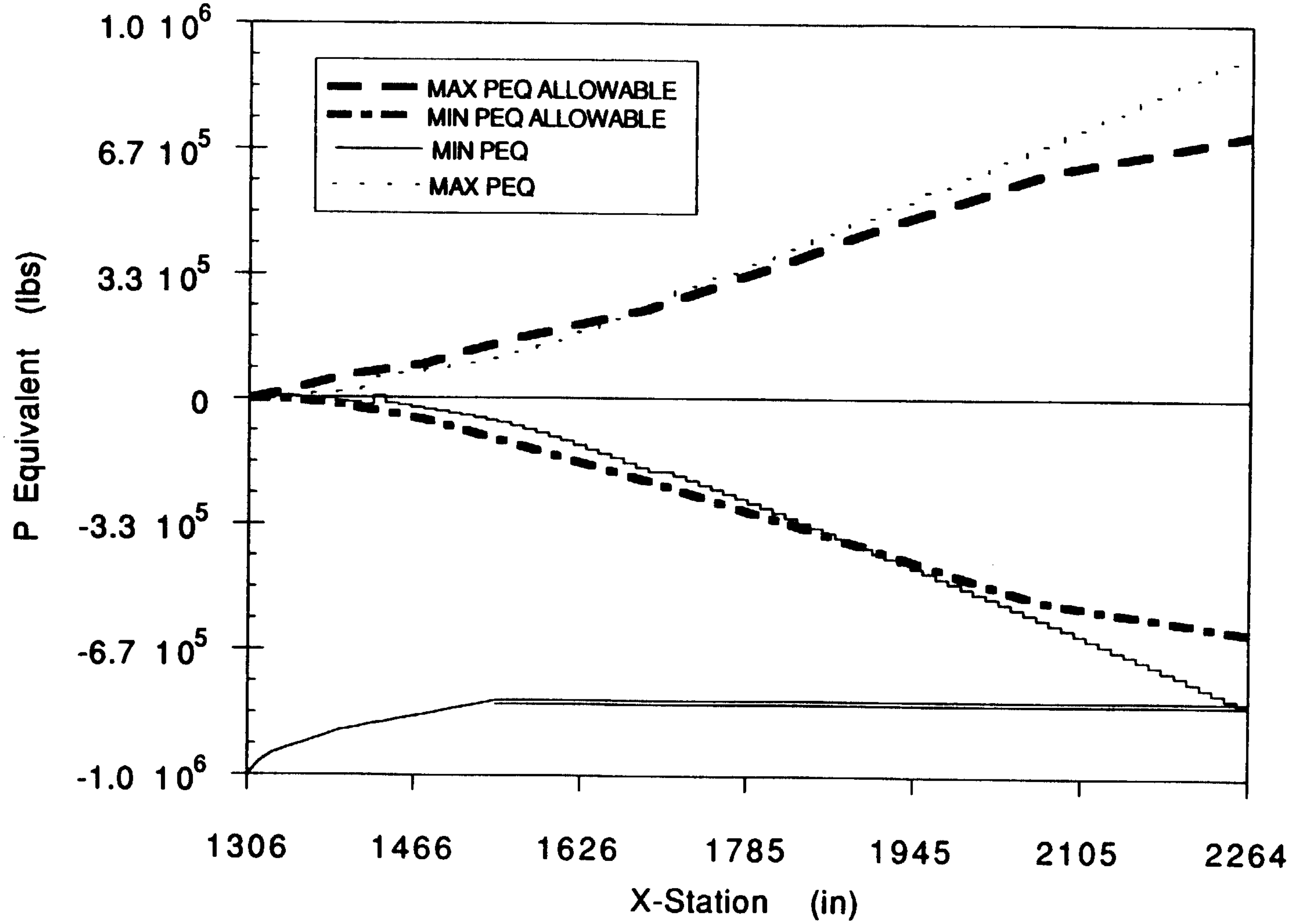


NLS2 CORE - 6 km ENGINE OUT
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

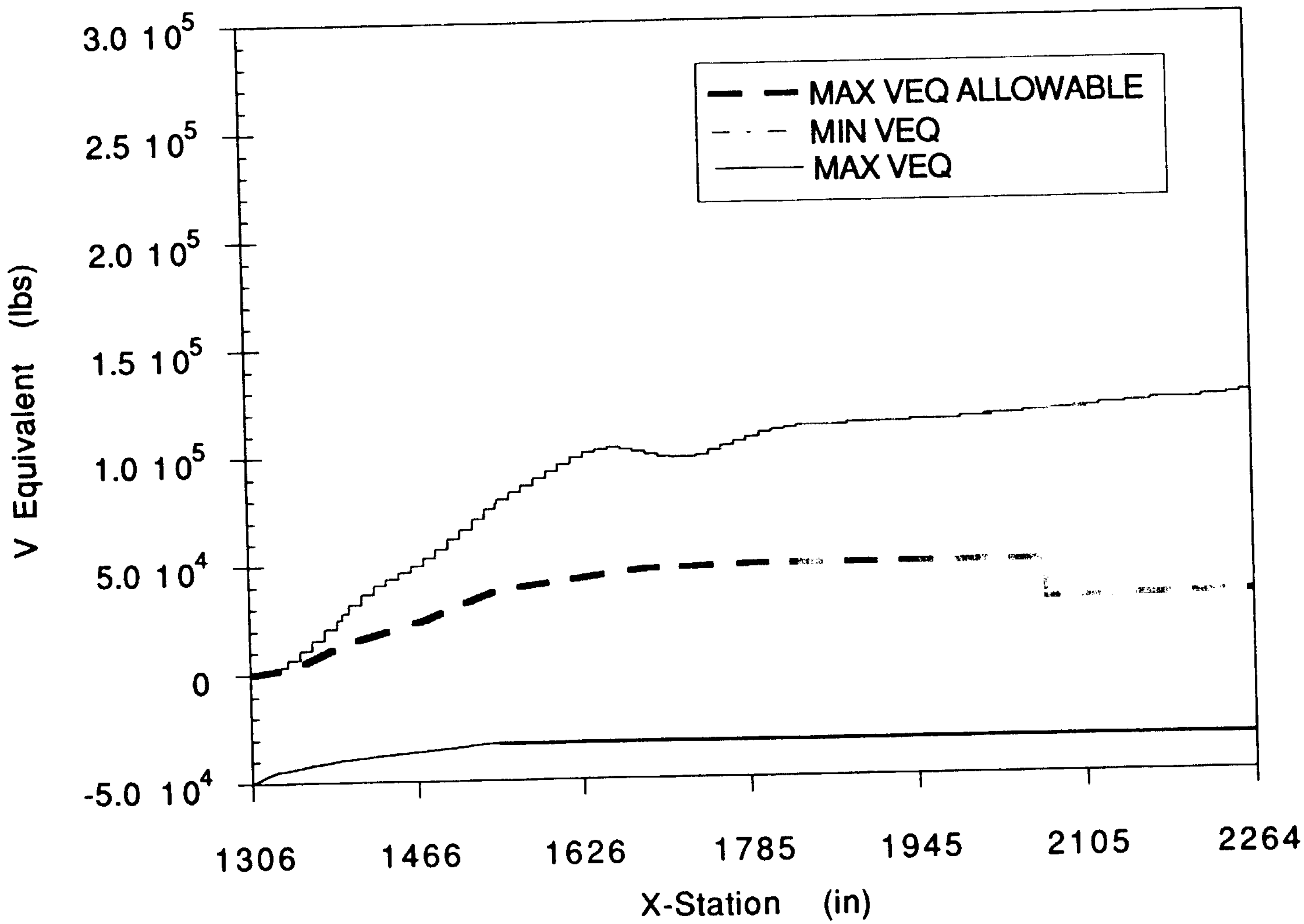
NLS2 CORE - 6 km ENGINE OUT
Z-DIR MOMENT vs X-STATION



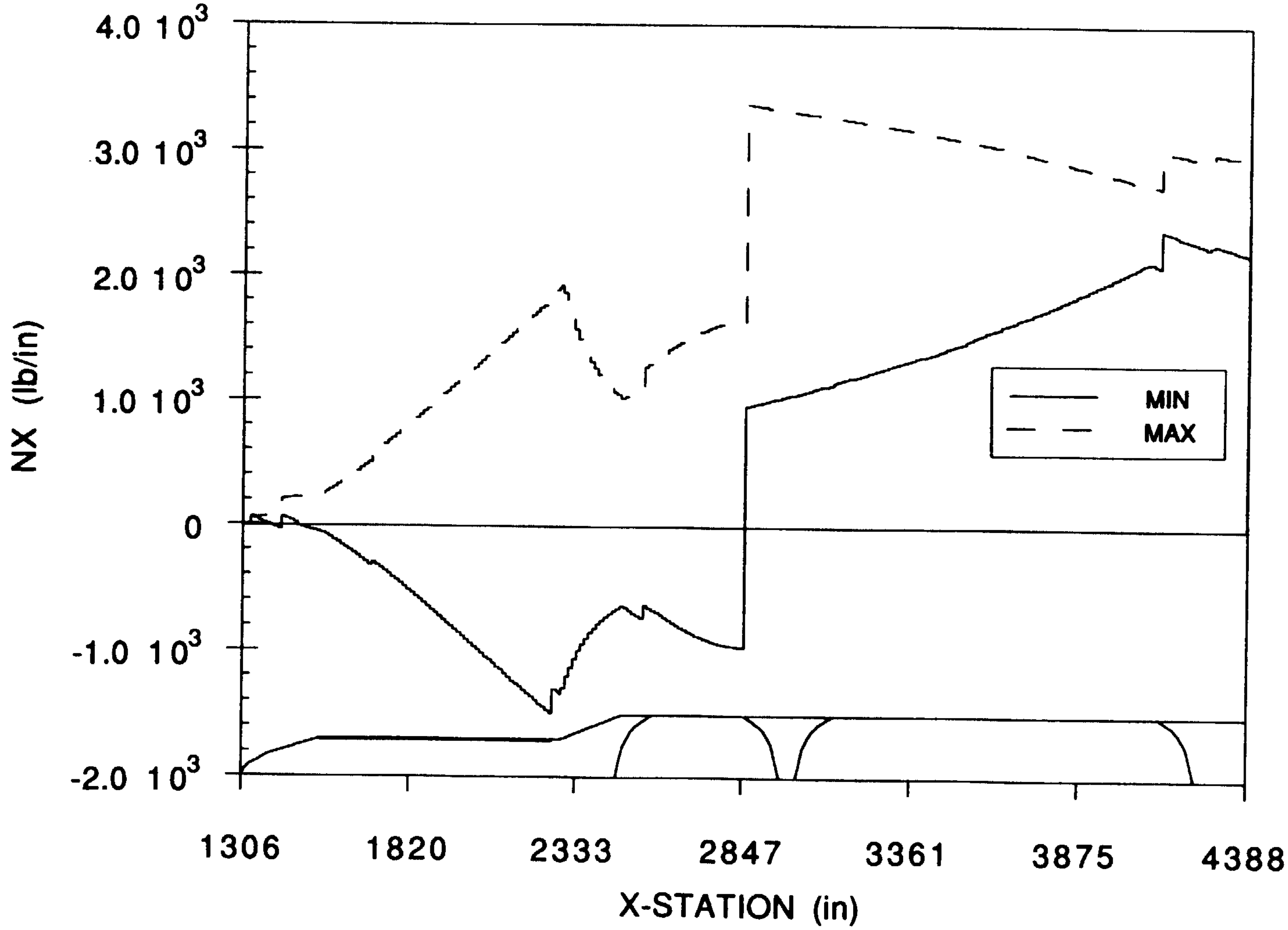
NLS2 CORE 6 km ENGINE OUT
P EQUIVALENT vs X-STATION



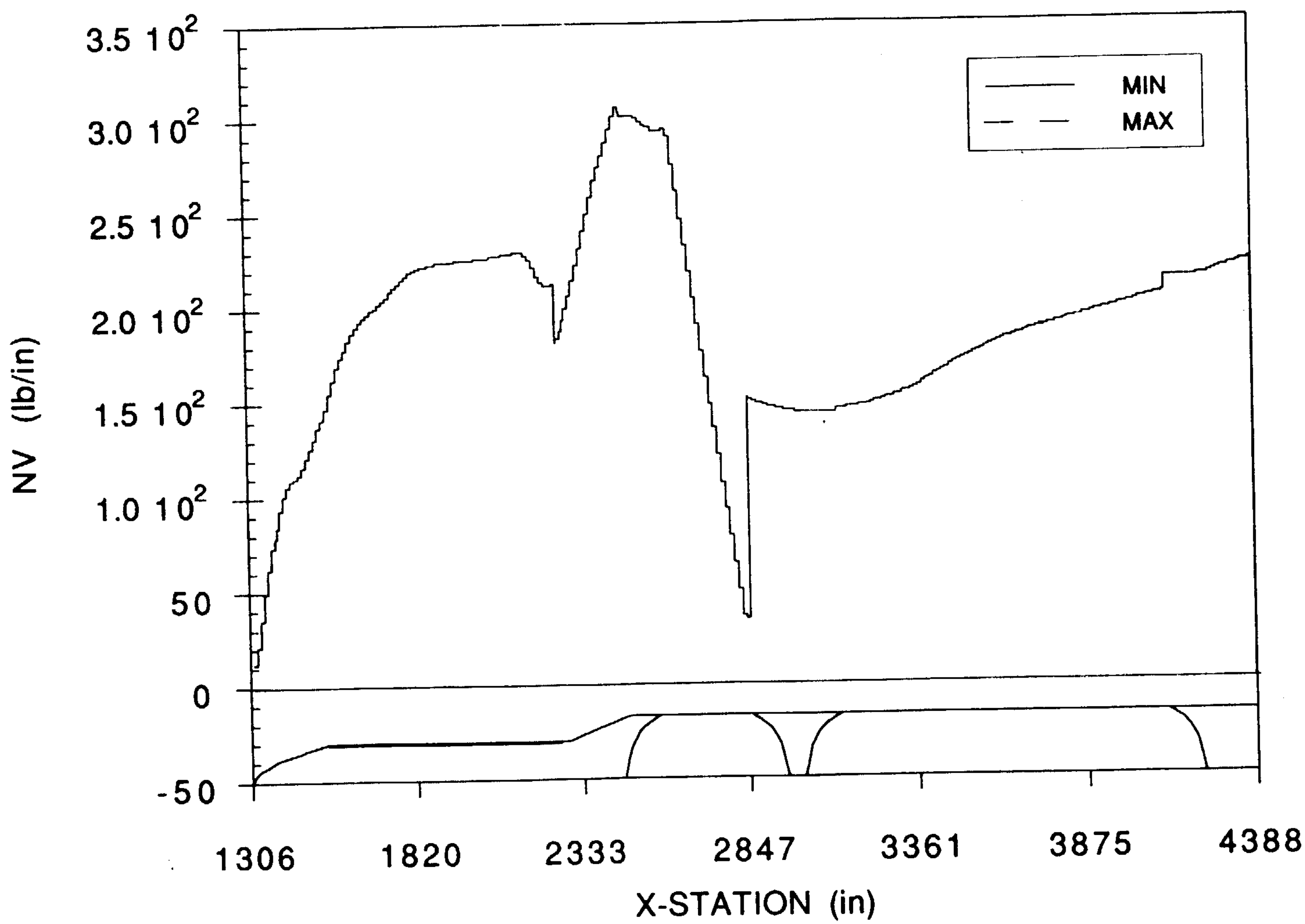
NLS2 CORE 6 km ENGINE OUT
V EQUIVALENT vs X-STATION

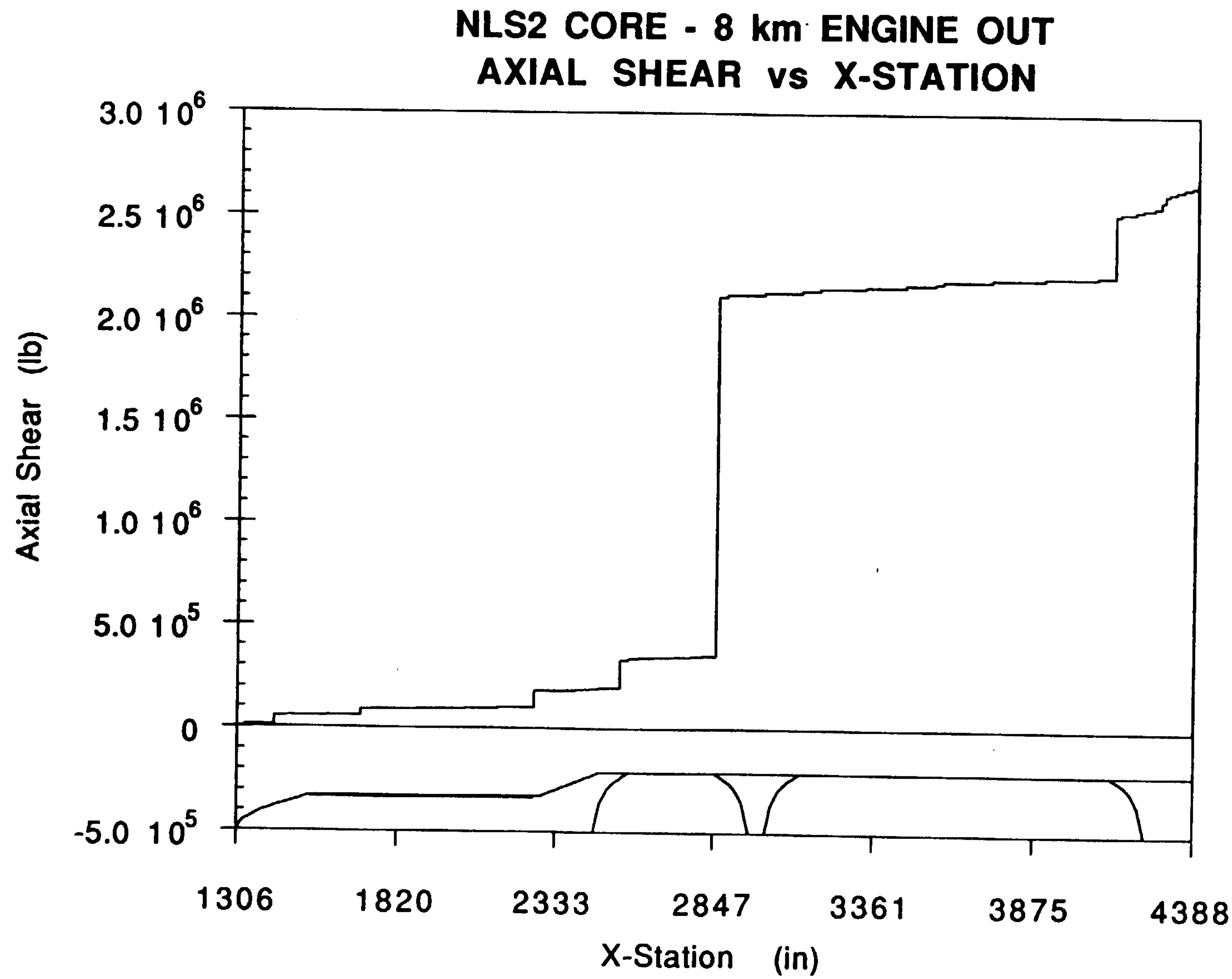


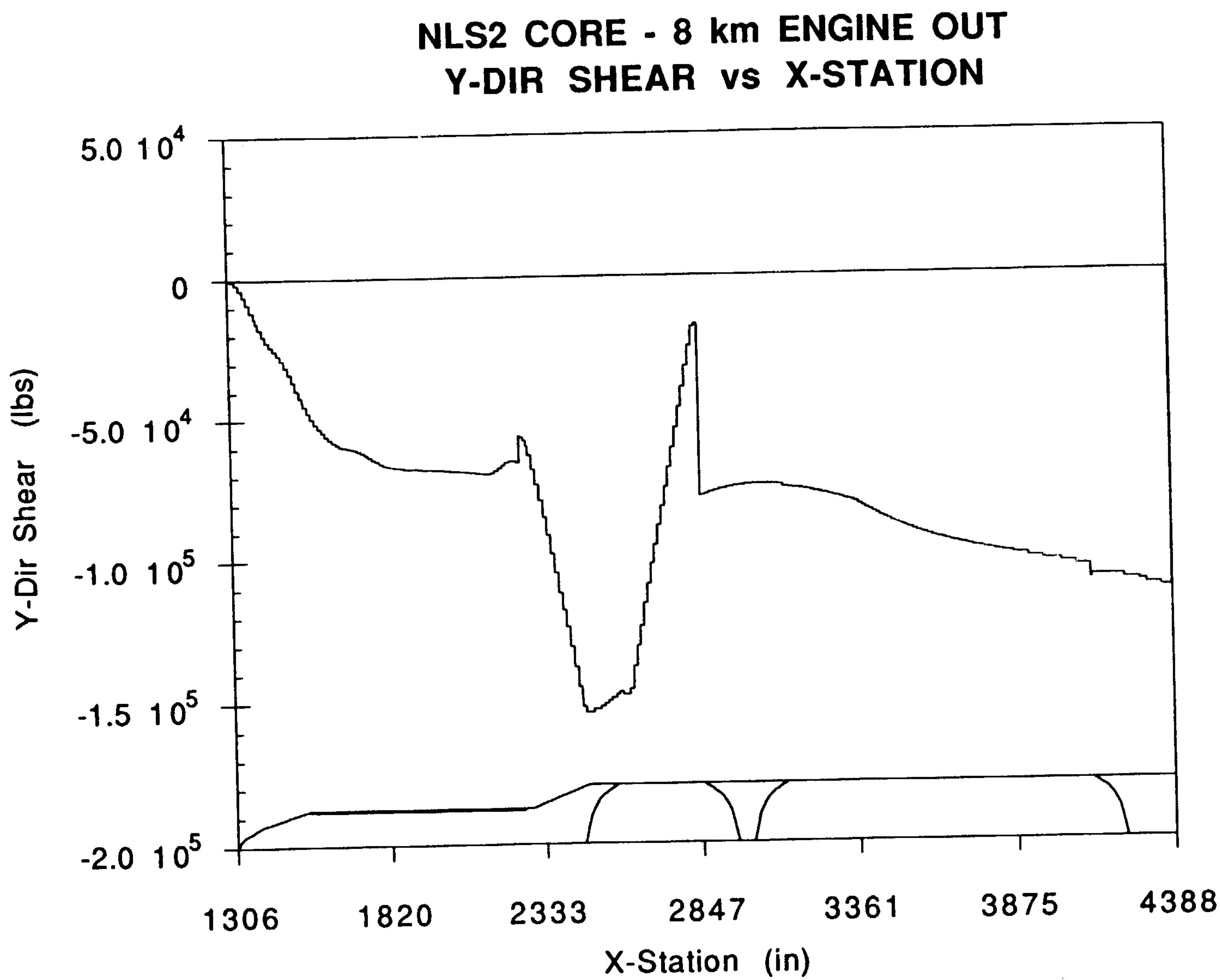
NLS2 CORE - 8km ENGINE OUT
NX vs X-STATION



NLS2 CORE -8 km ENGINE OUT
NV vs X-STATION

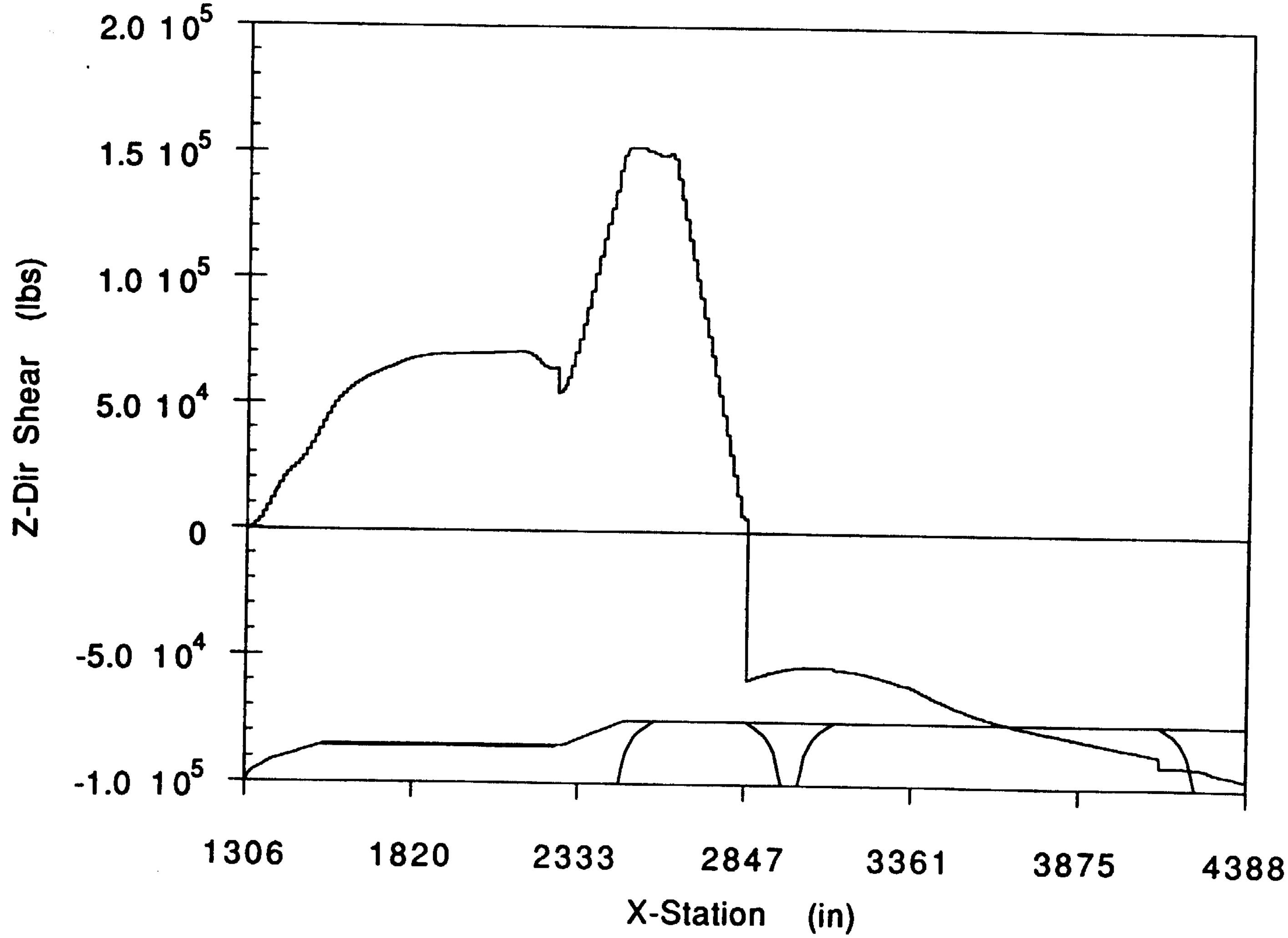


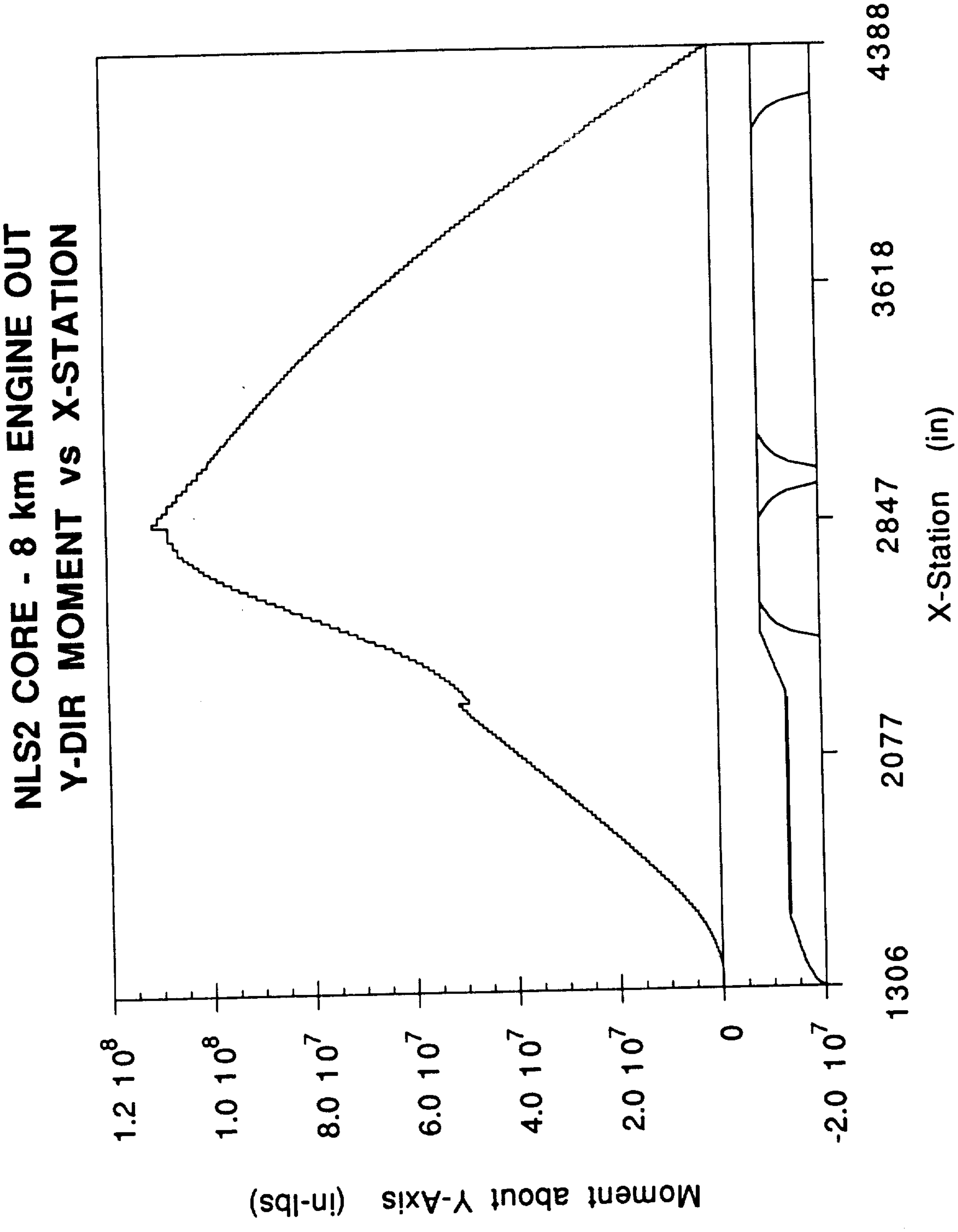

NLS2 CORE - 8 km ENGINE OUT
AXIAL SHEAR vs X-STATION
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
Axial Shear (lb)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

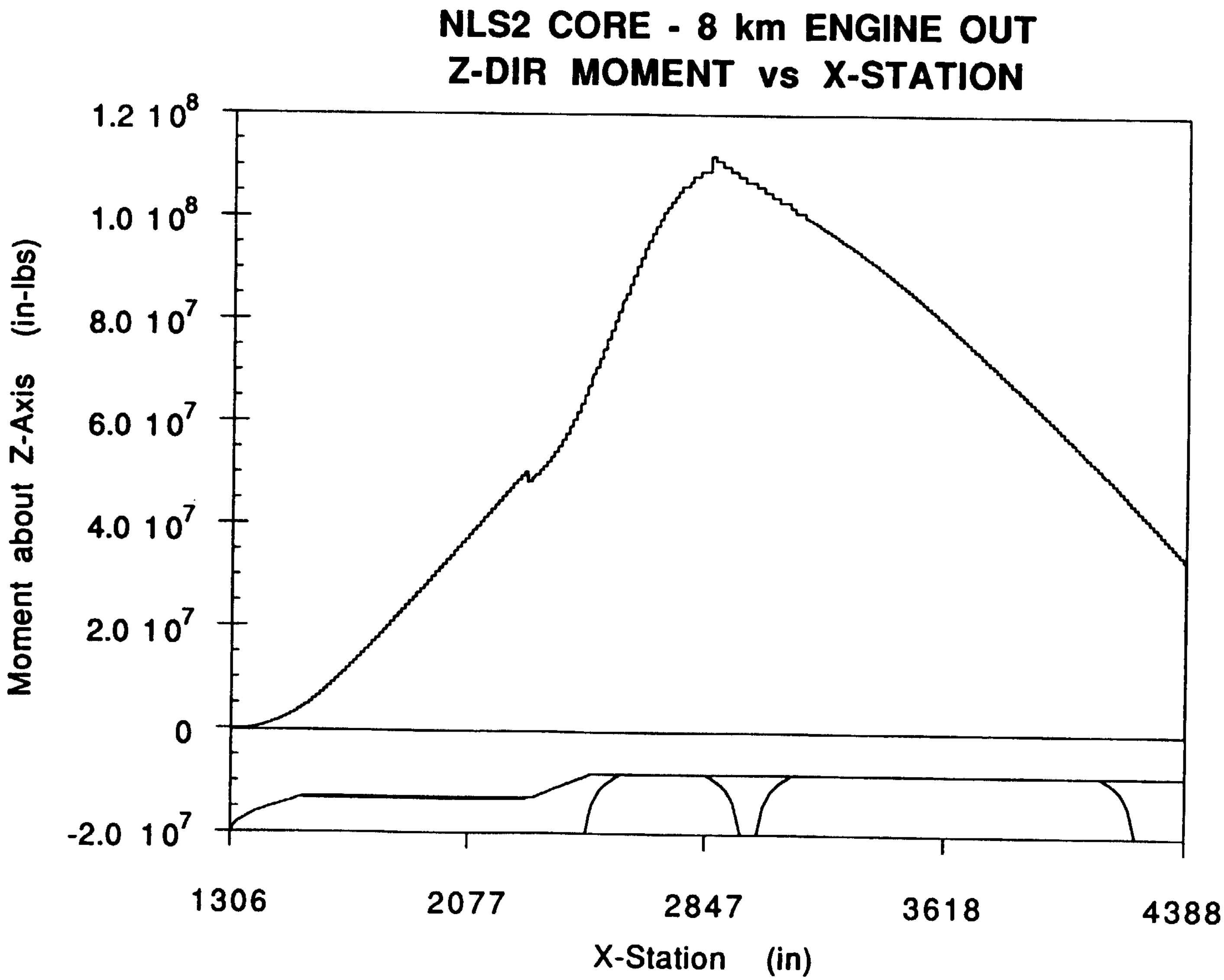


NLS2 CORE - 8 km ENGINE OUT
Y-DIR SHEAR vs X-STATION
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

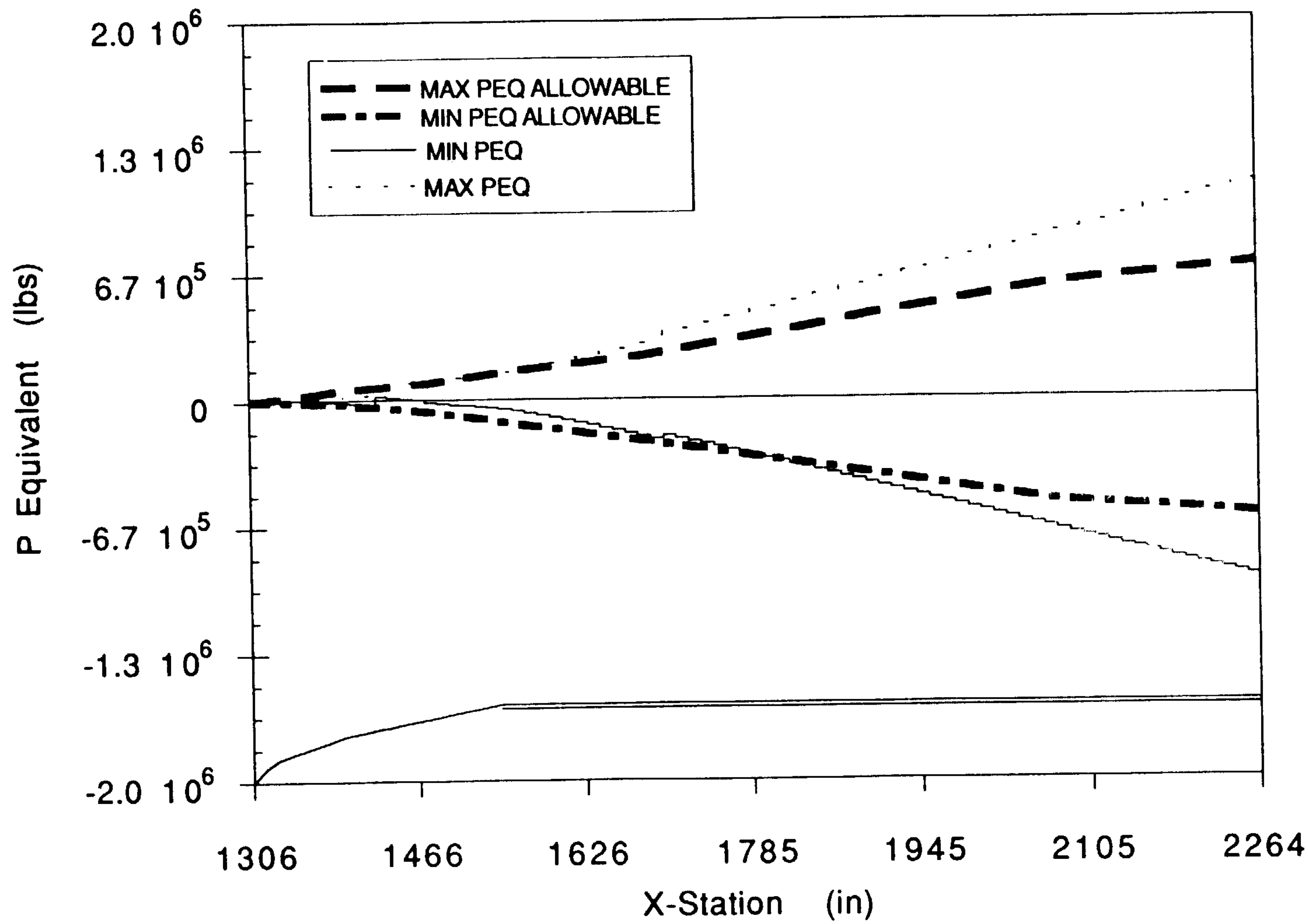
NLS2 CORE - 8 km ENGINE OUT
Z-DIR SHEAR vs X-STATION



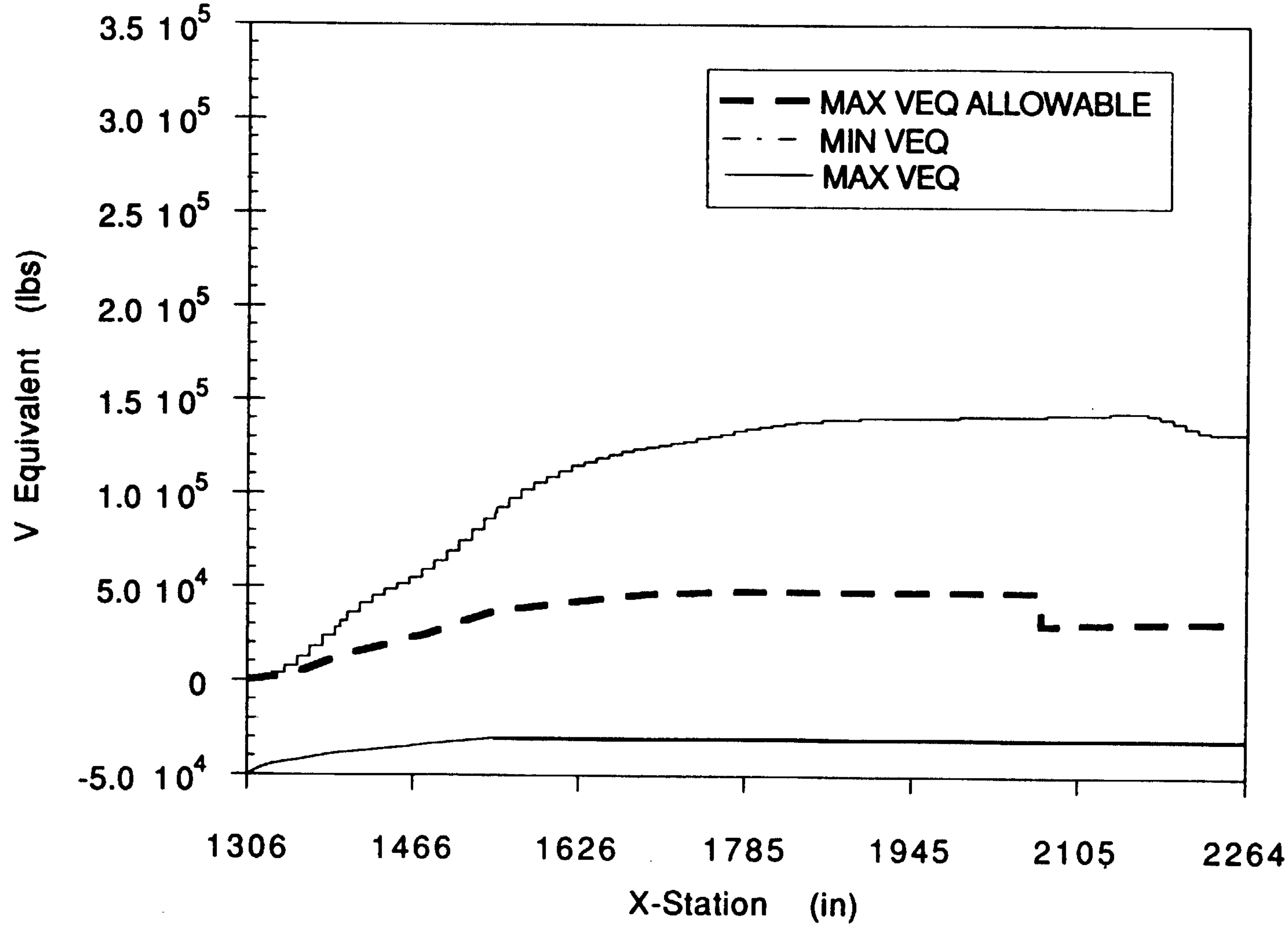

NLS2 CORE - 8 km ENGINE OUT
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
X-Station (in)
1306
2077
2847
3618
4388


NLS2 CORE - 8 km ENGINE OUT
Z-DIR MOMENT vs X-STATION
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
Moment about Z-Axis (in-lbs)
1306
2077
2847
3618
4388
X-Station (in)

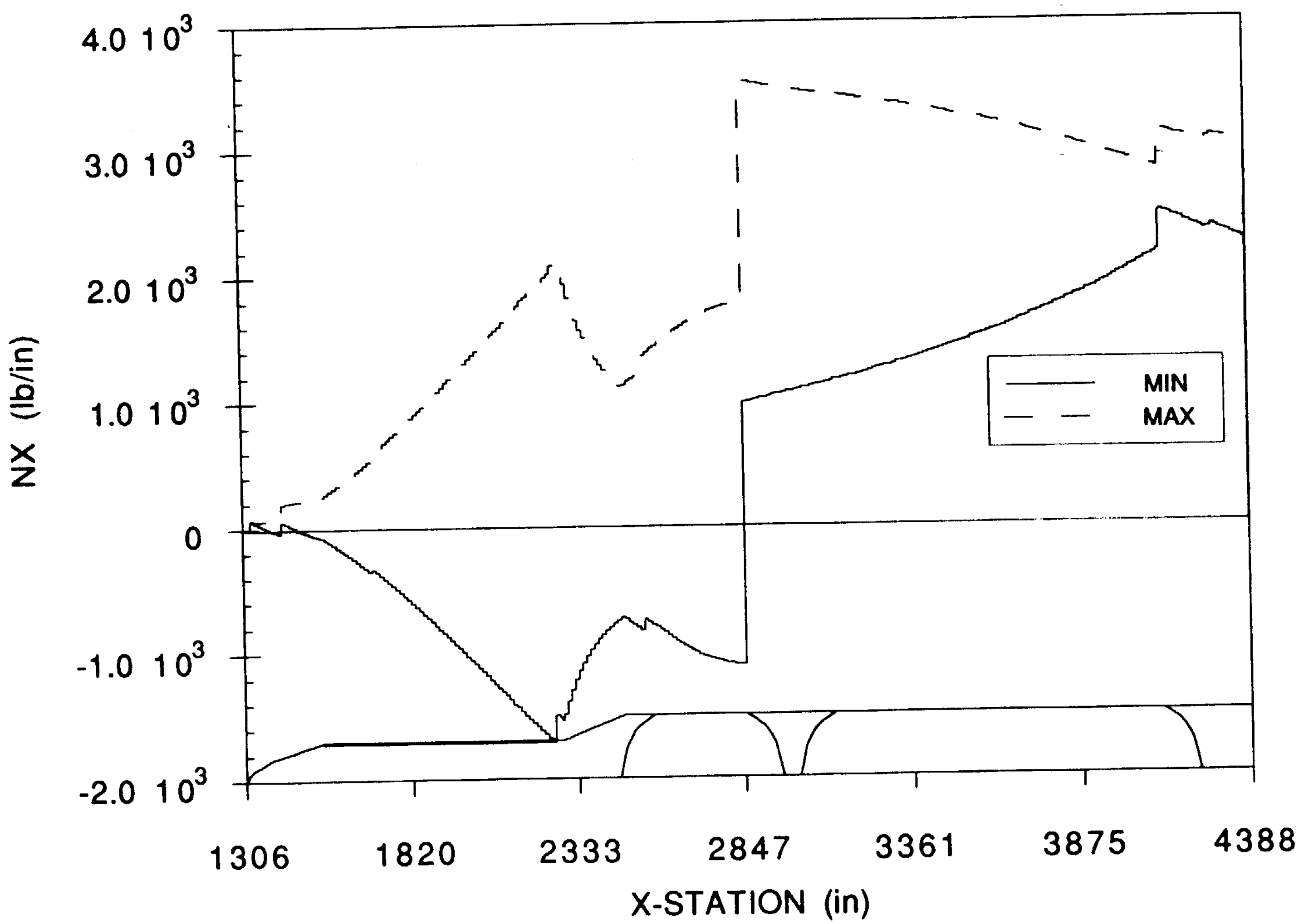
NLS2 CORE 8 km ENGINE OUT
P EQUIVALENT vs X-STATION

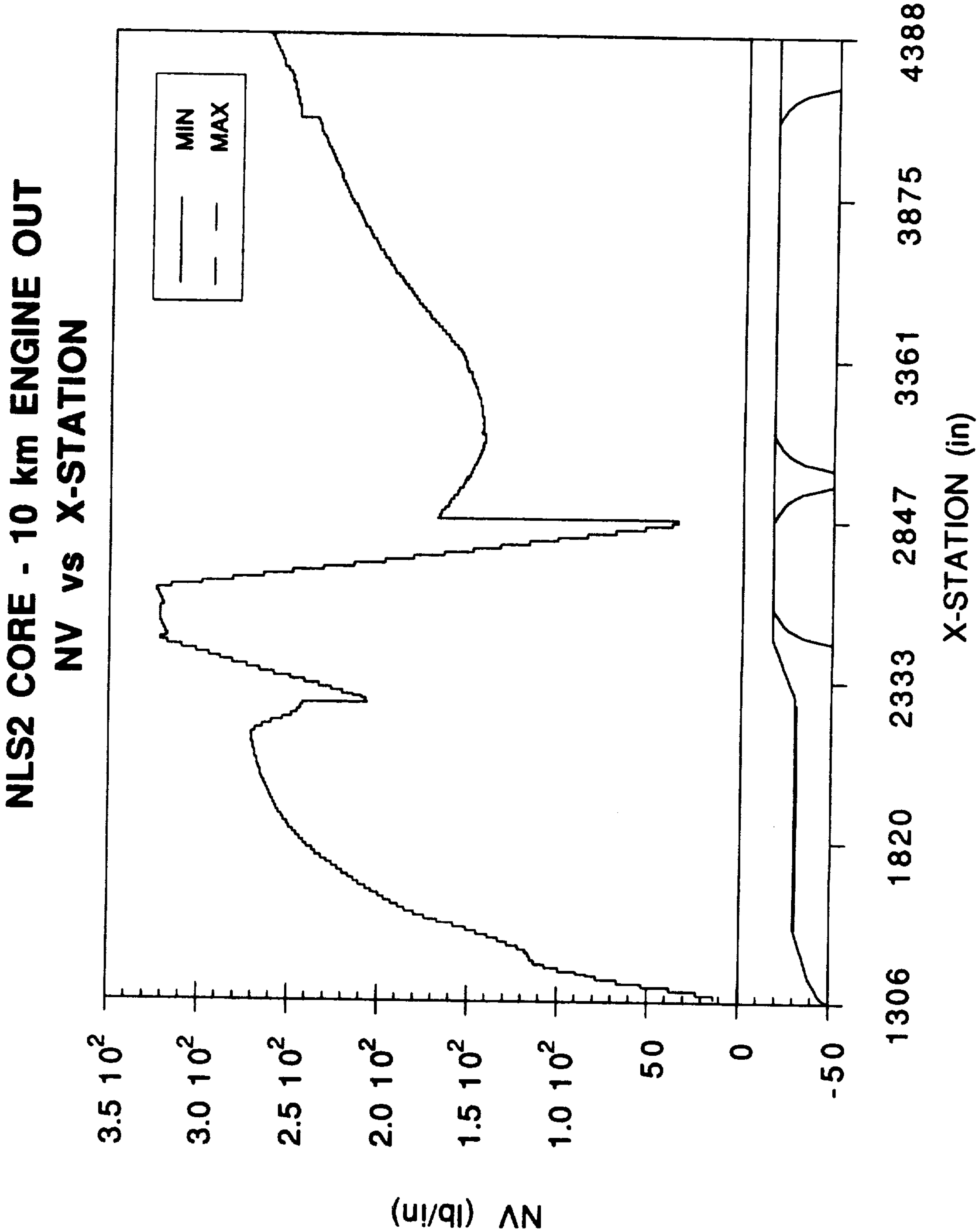


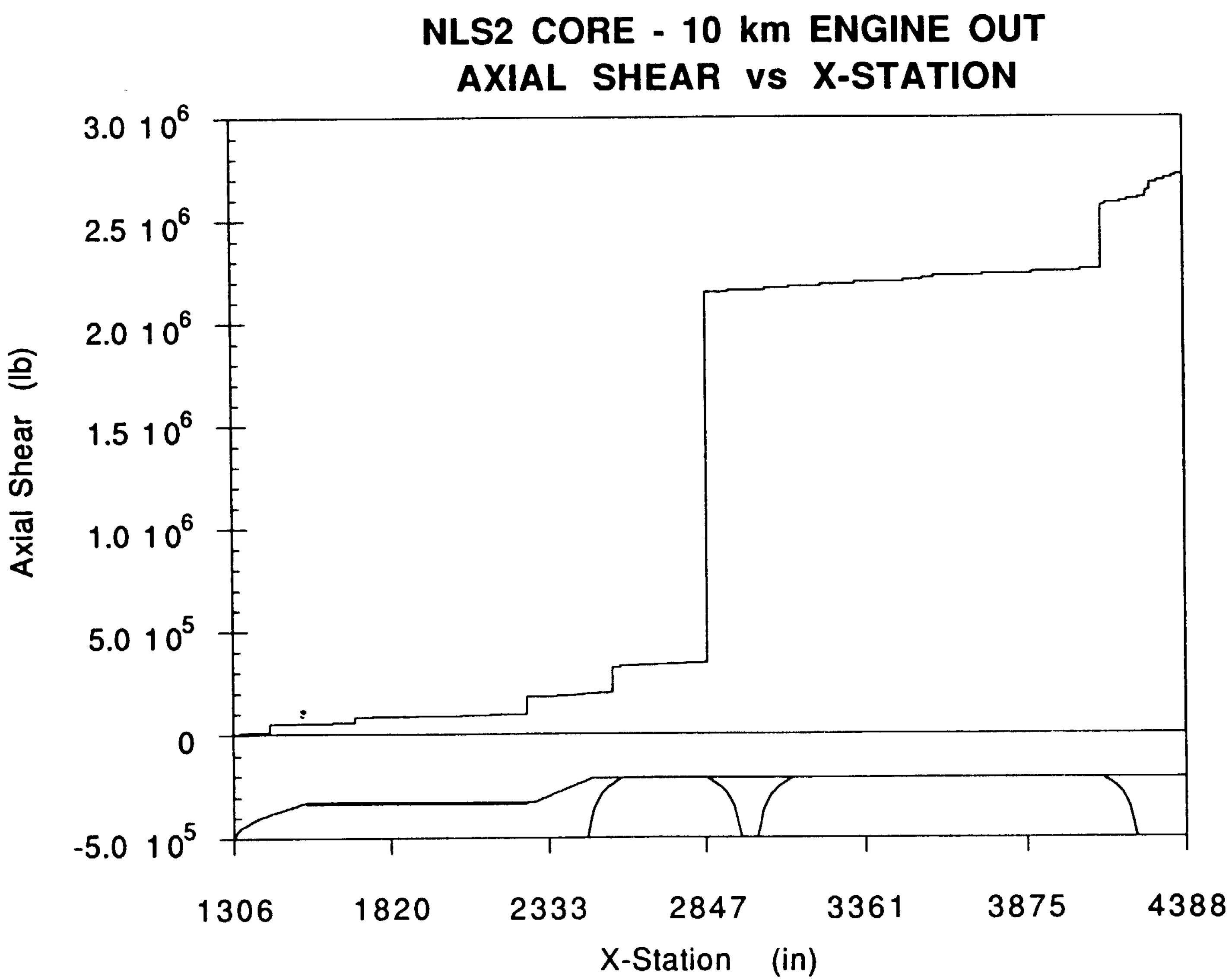
NLS2 CORE 8 km ENGINE OUT
V EQUIVALENT vs X-STATION



NLS2 CORE - 10 km ENGINE OUT
NX vs X-STATION

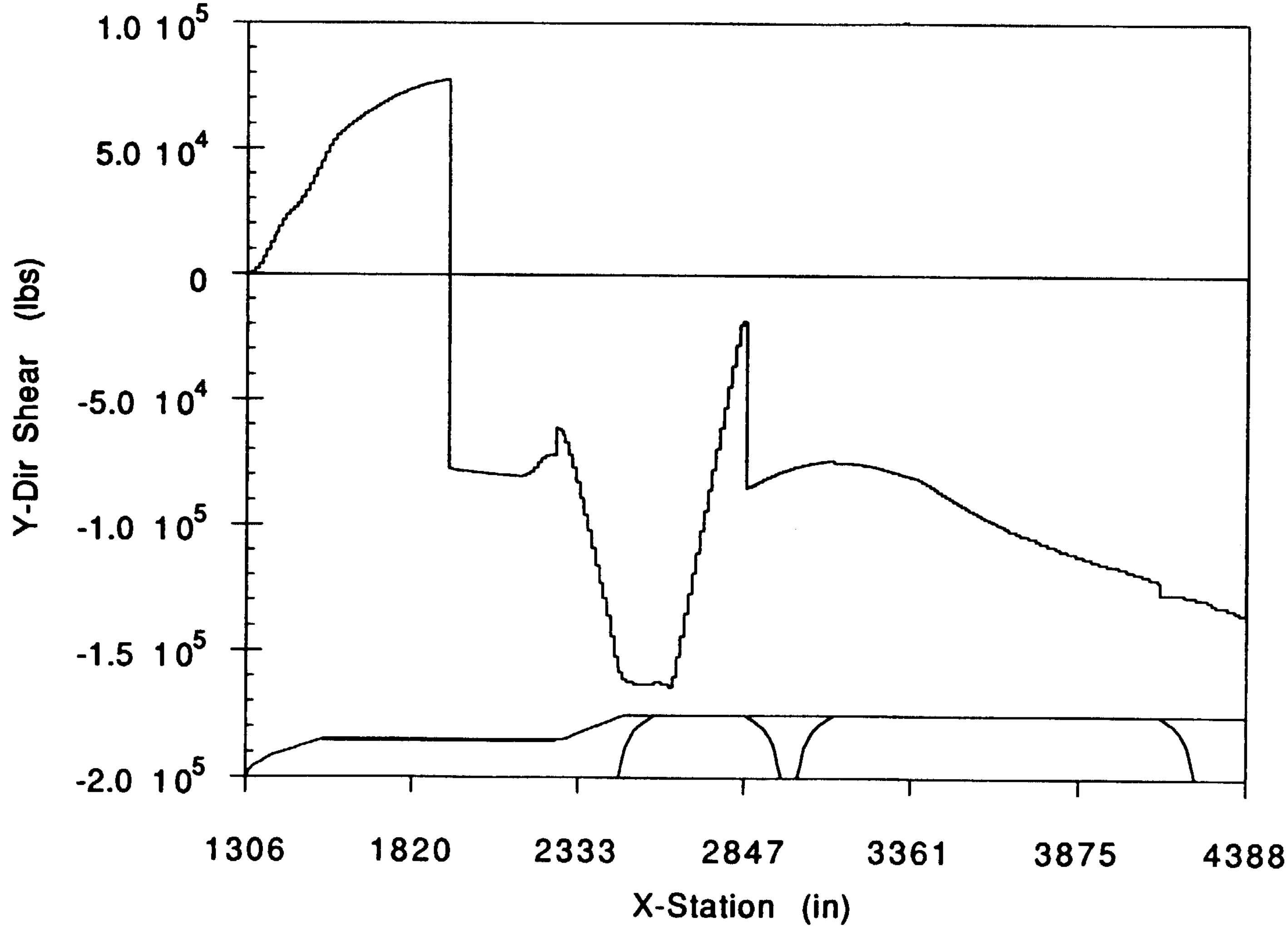


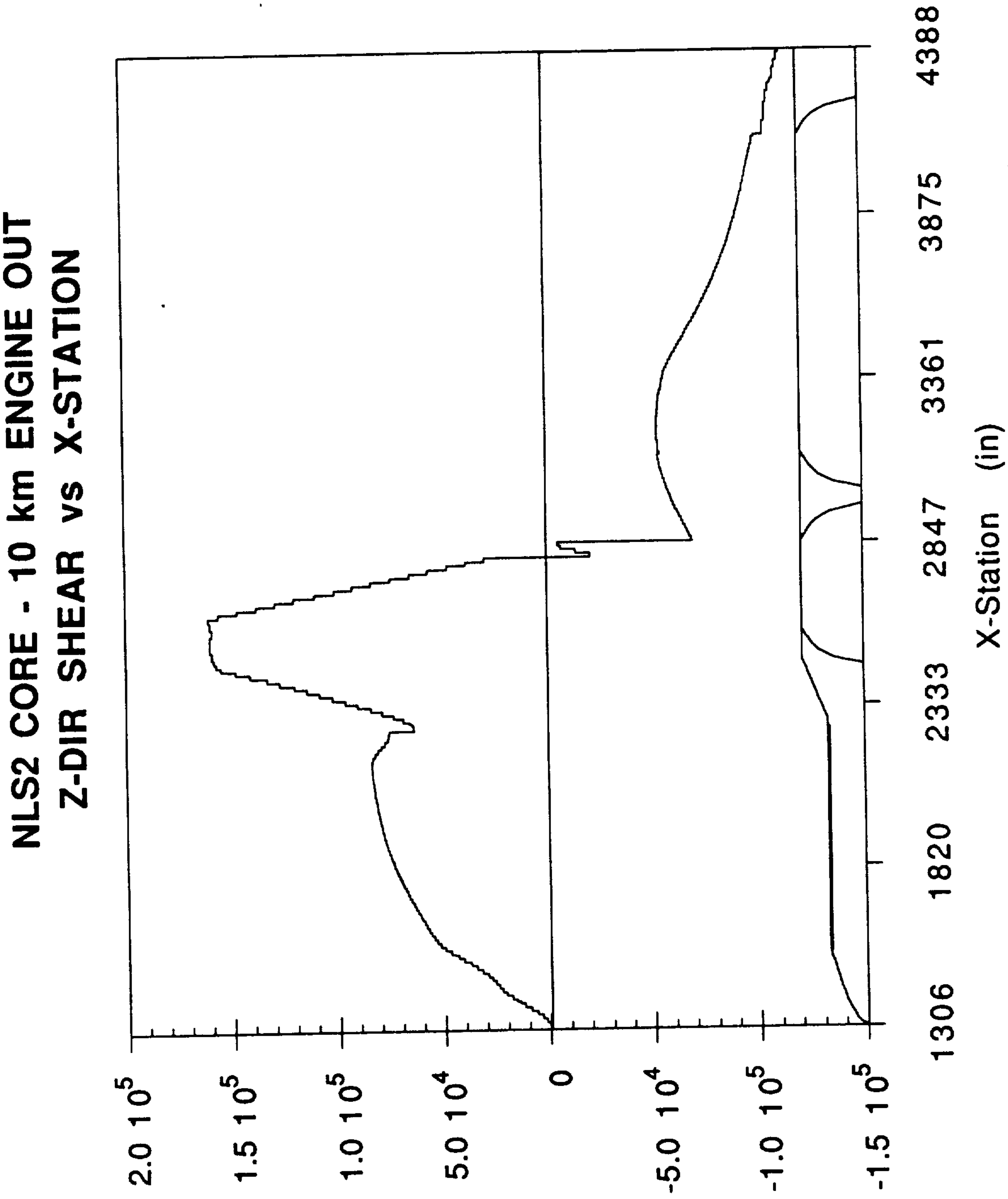

NLS2 CORE - 10 km ENGINE OUT
NV vs X-STATION
MIN
MAX
NV (lb/in)
3.5 10^2
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)



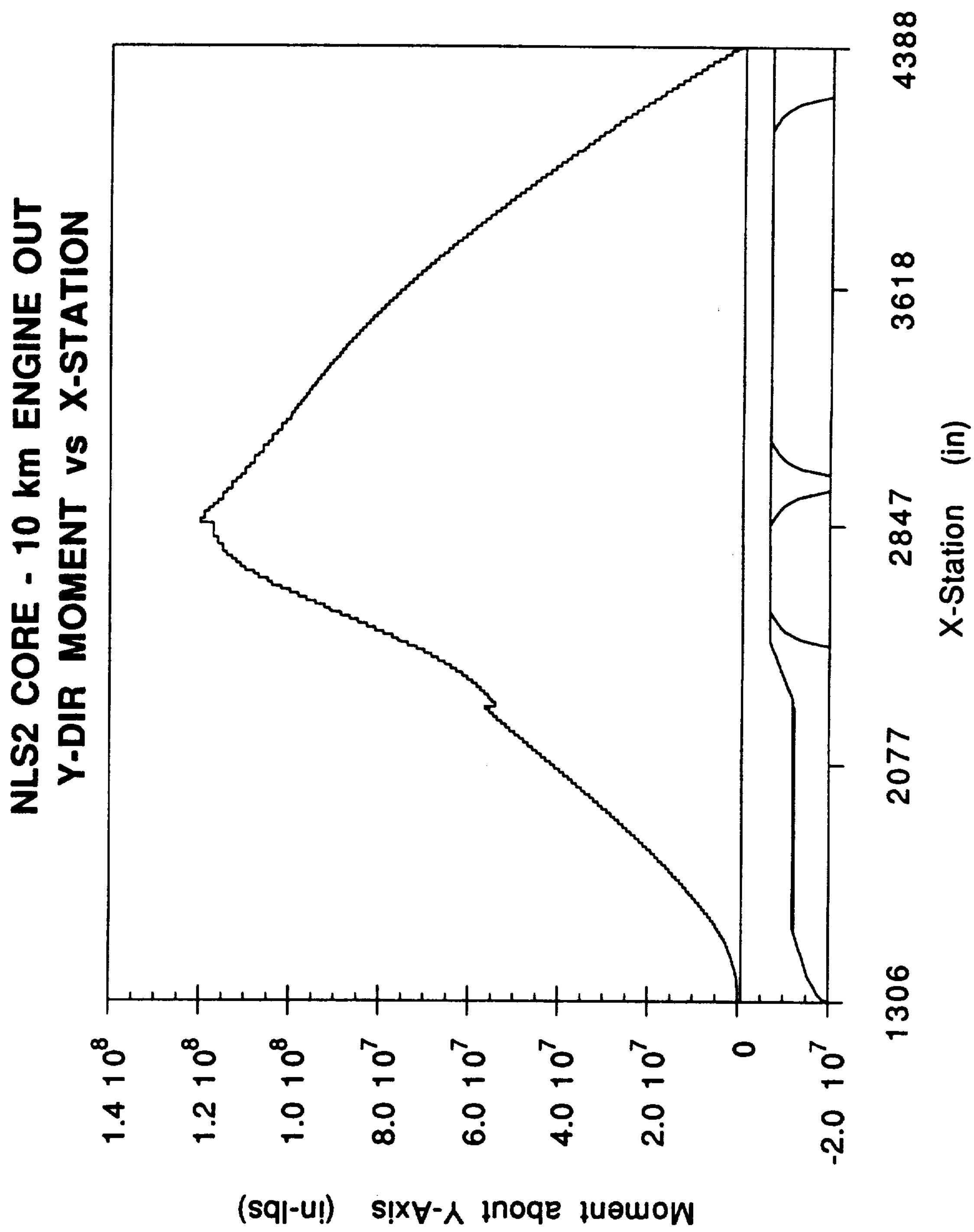
NLS2 CORE - 10 km ENGINE OUT
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

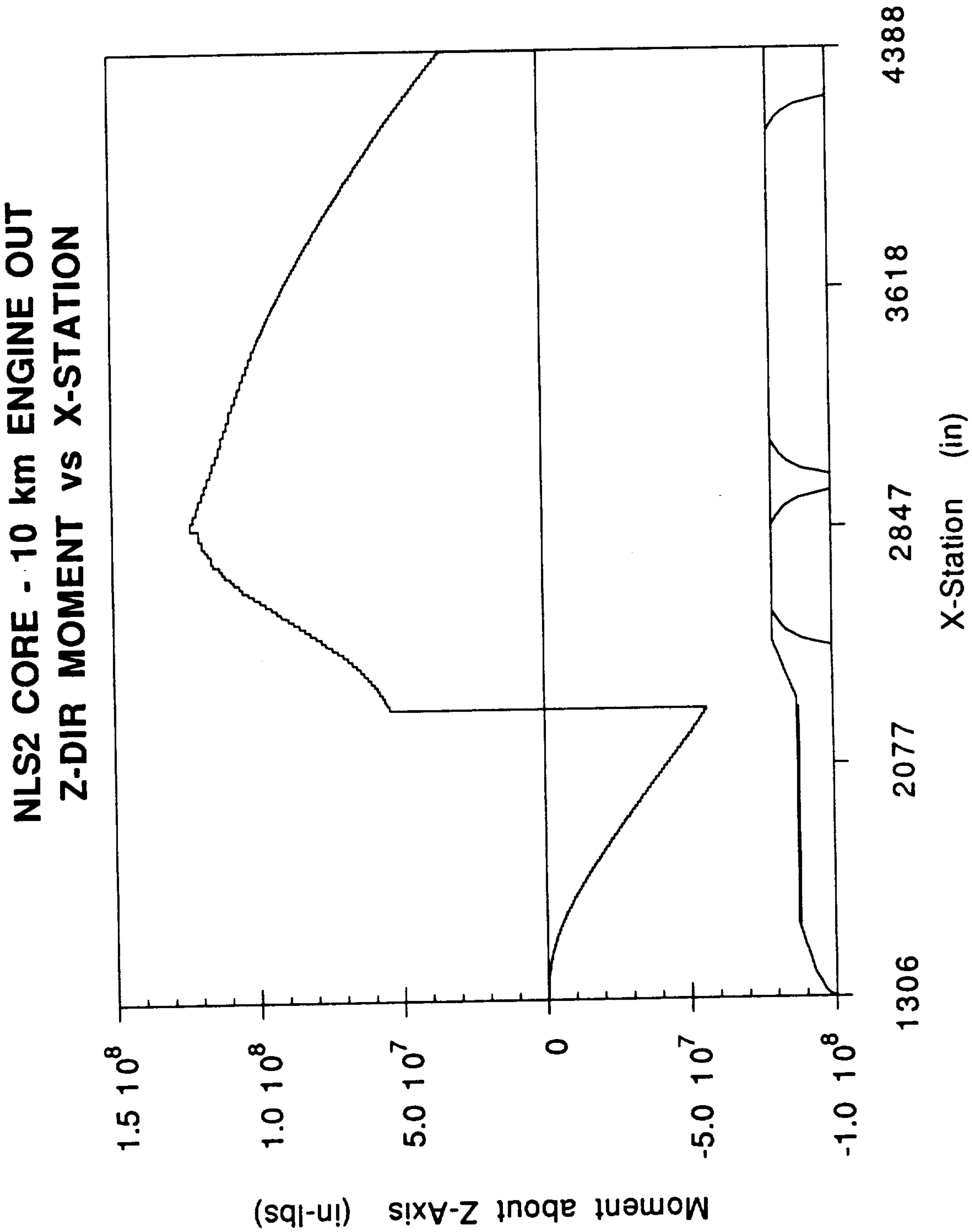
NLS2 CORE - 10 km ENGINE OUT
Y-DIR SHEAR vs X-STATION



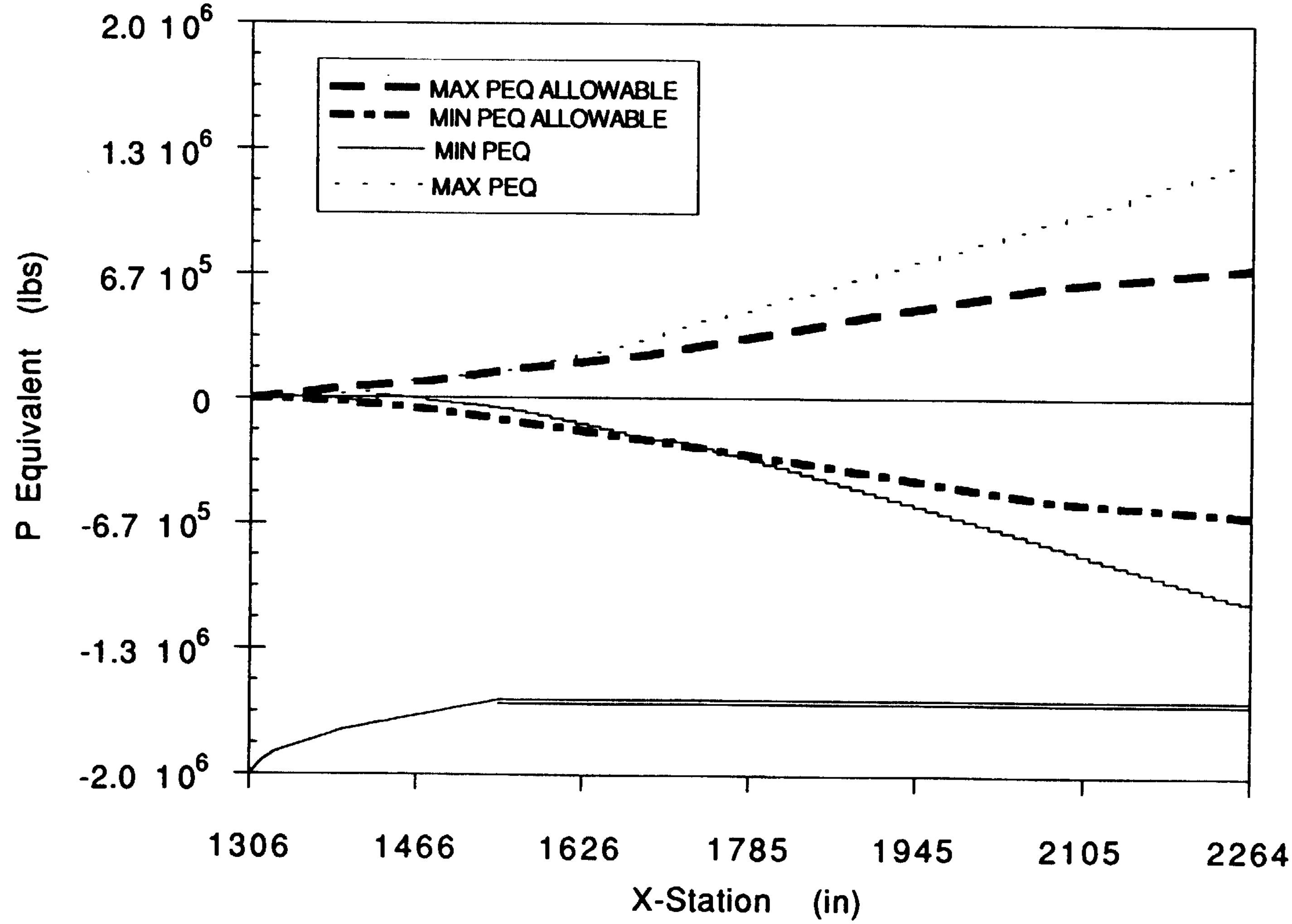


NLS2 CORE - 10 km ENGINE OUT
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
X-Station (in)
1306
1820
2333
2847
3361
3875
4388

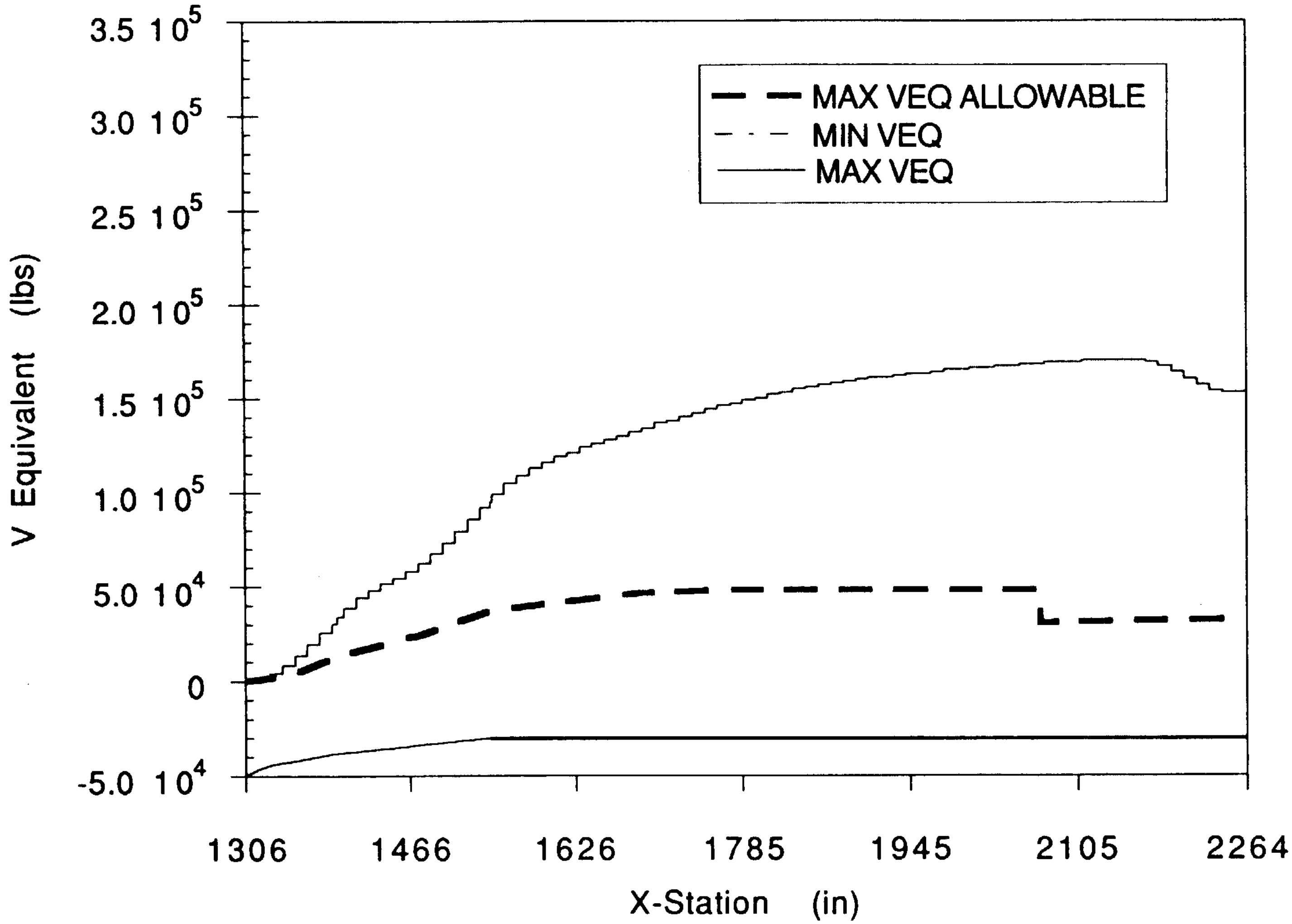

NLS2 CORE - 10 km ENGINE OUT
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.4 10^8
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)


NLS2 CORE - 10 km ENGINE OUT
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.5 10^8
1.0 10^8
5.0 10^7
0
-5.0 10^7
-1.0 10^8
1306
2077
2847
3618
4388
X-Station (in)

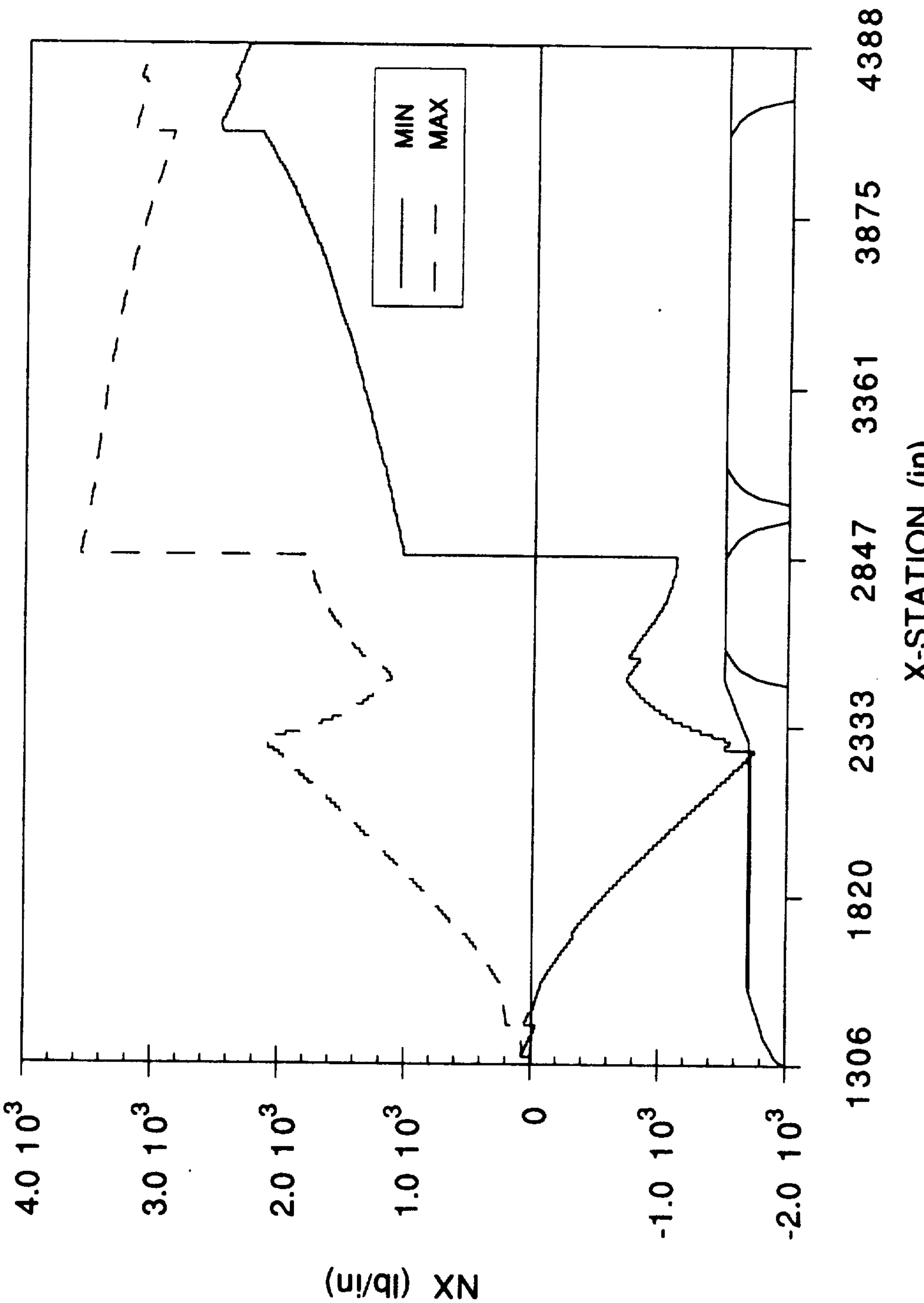
NLS2 CORE 10 km ENGINE OUT
P EQUIVALENT vs X-STATION



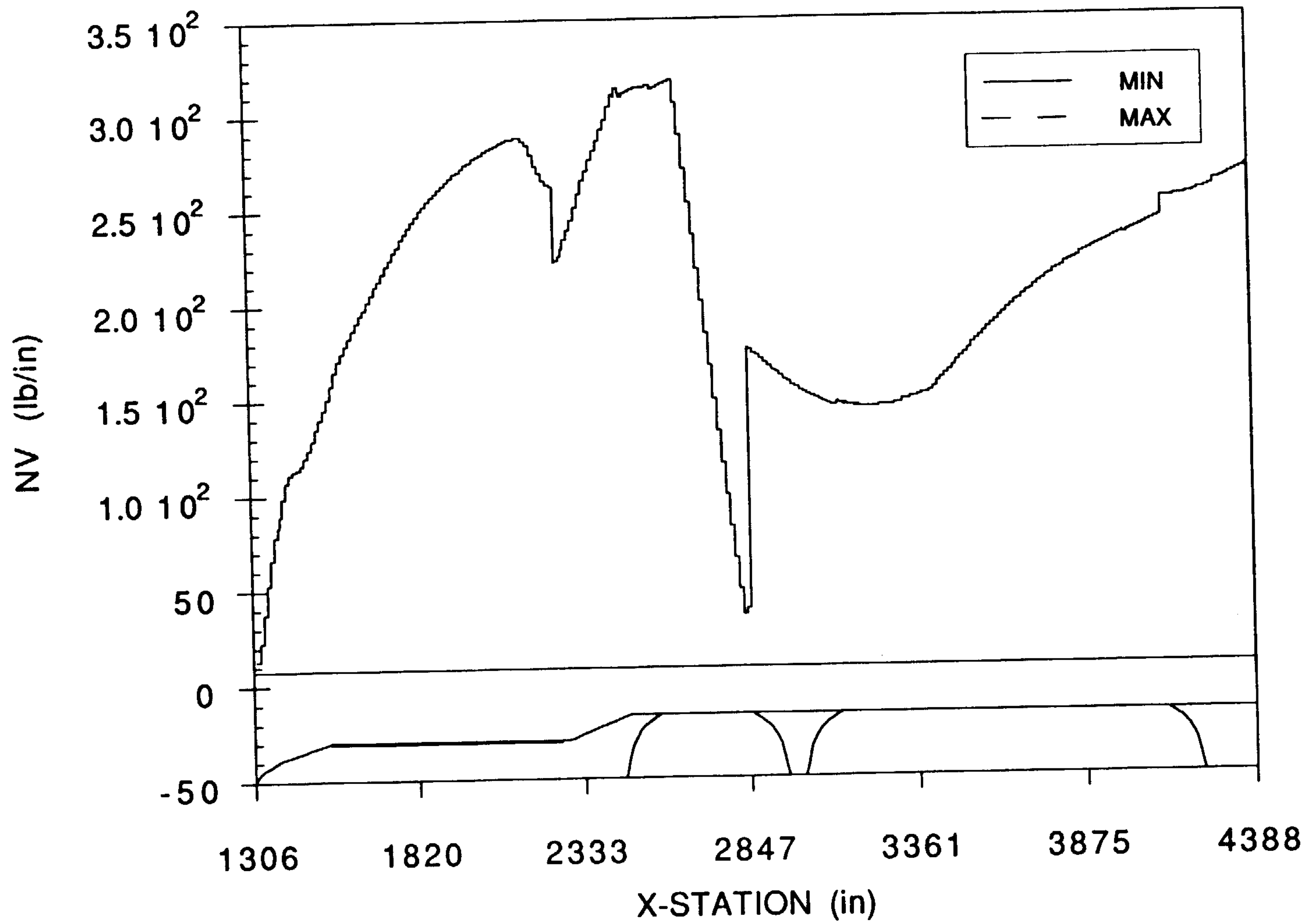
NLS2 CORE 10 km ENGINE OUT
V EQUIVALENT vs X-STATION

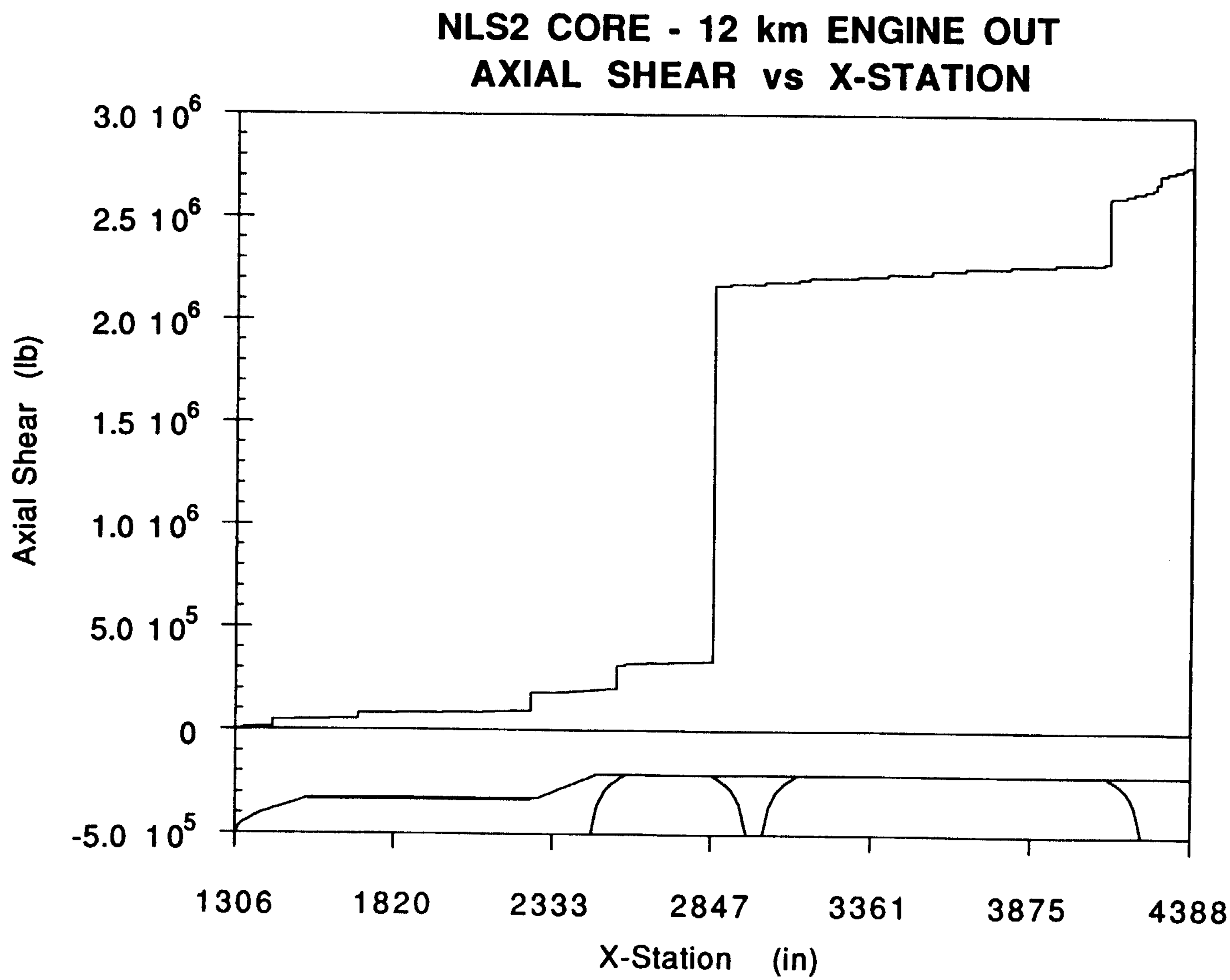


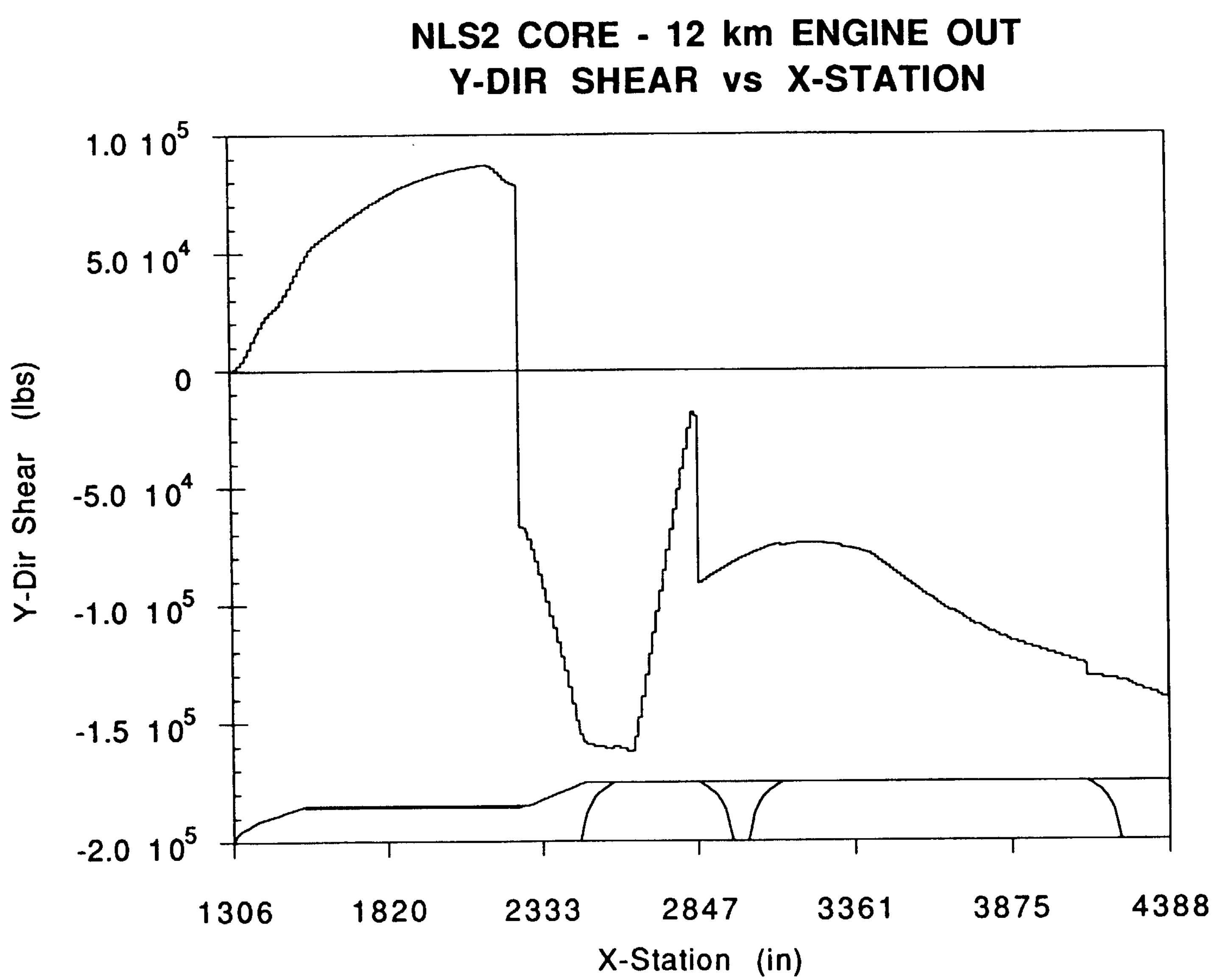
NLS2 CORE - 12 km ENGINE OUT
NX vs X-STATION

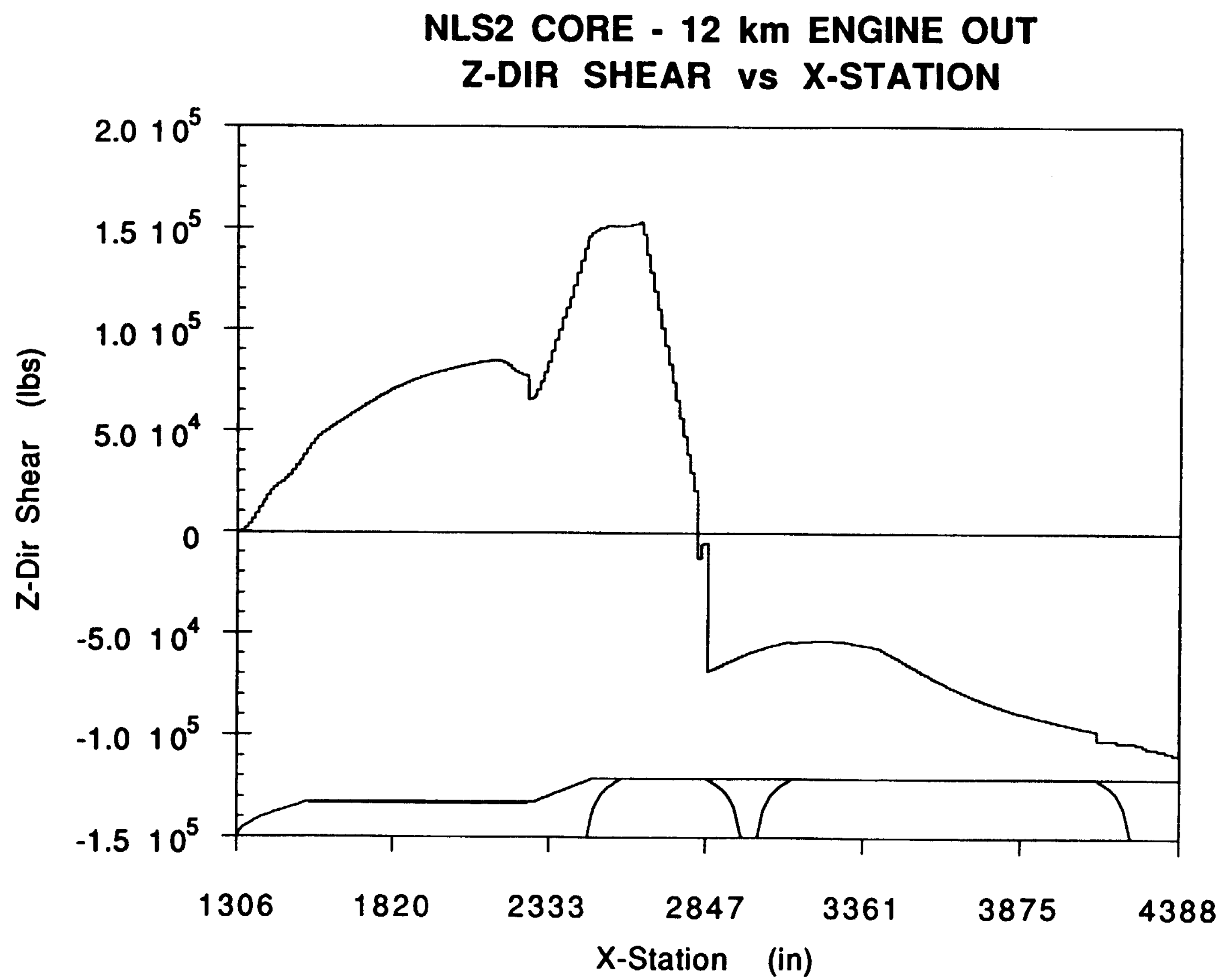


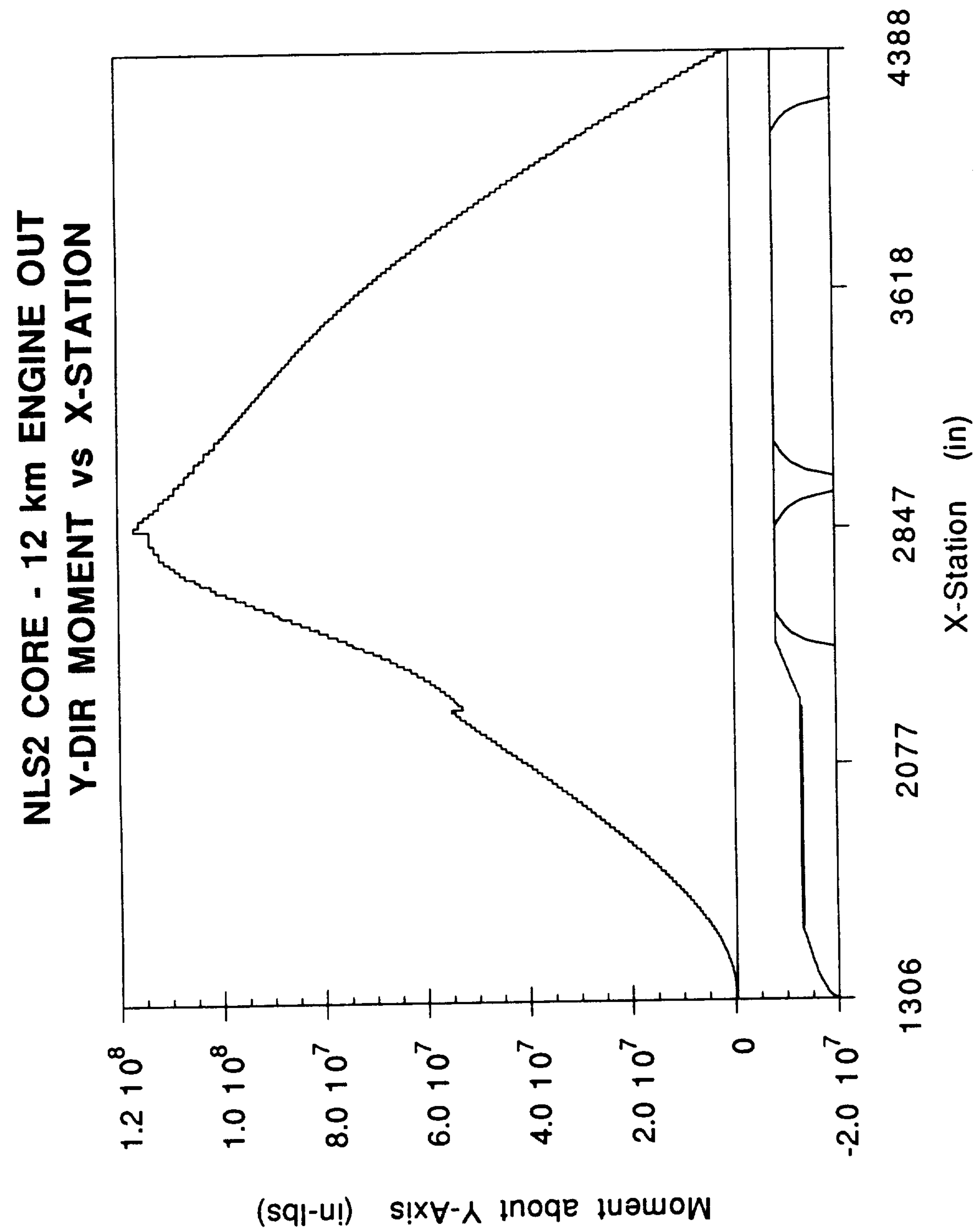
NLS2 CORE - 12 km ENGINE OUT
NV vs X-STATION



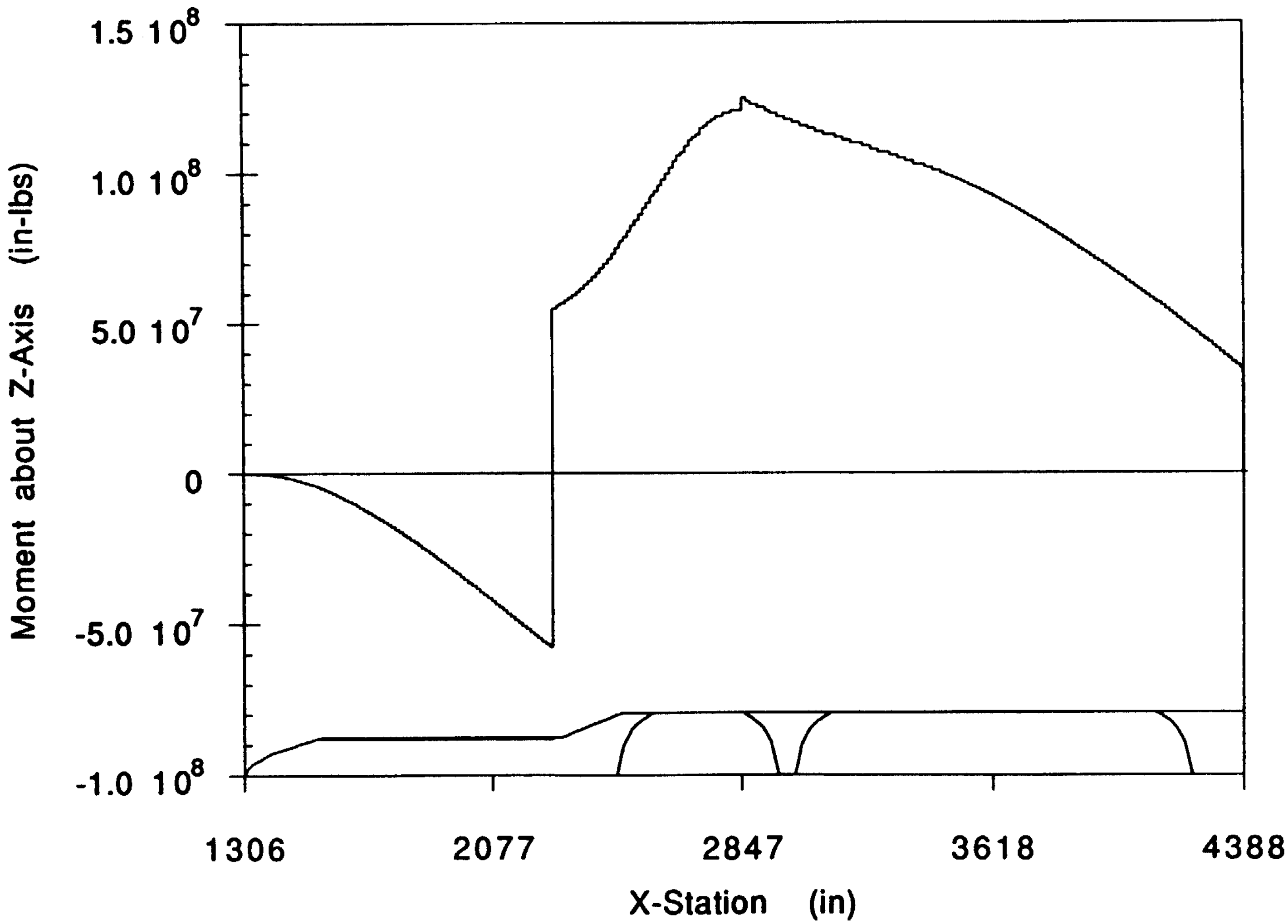

NLS2 CORE - 12 km ENGINE OUT
AXIAL SHEAR vs X-STATION
Axial Shear (lb)
3.0 10^6
2.5 10^6
2.0 10^6
1.5 10^6
1.0 10^6
5.0 10^5
0
-5.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

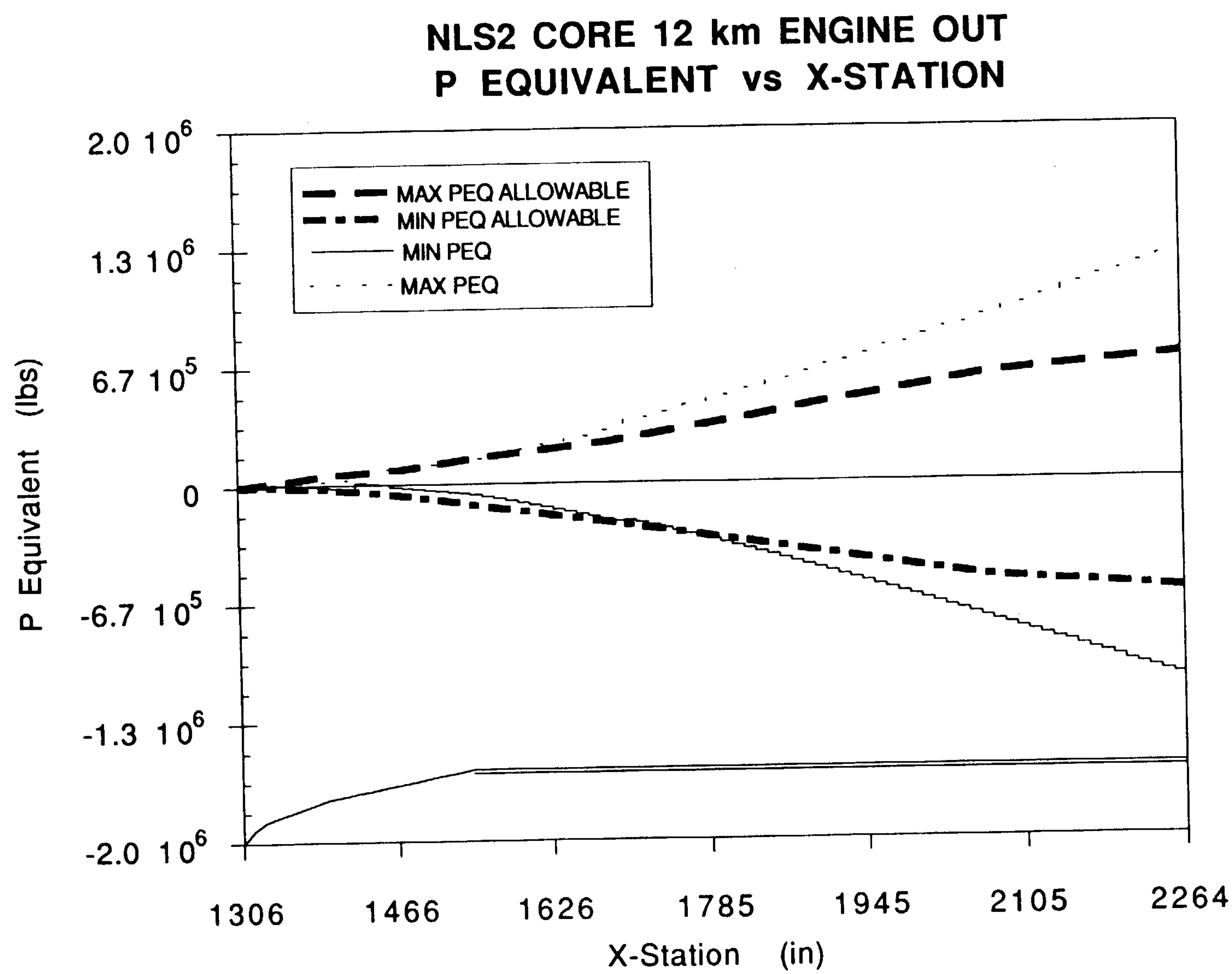

NLS2 CORE - 12 km ENGINE OUT
Y-DIR SHEAR vs X-STATION
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

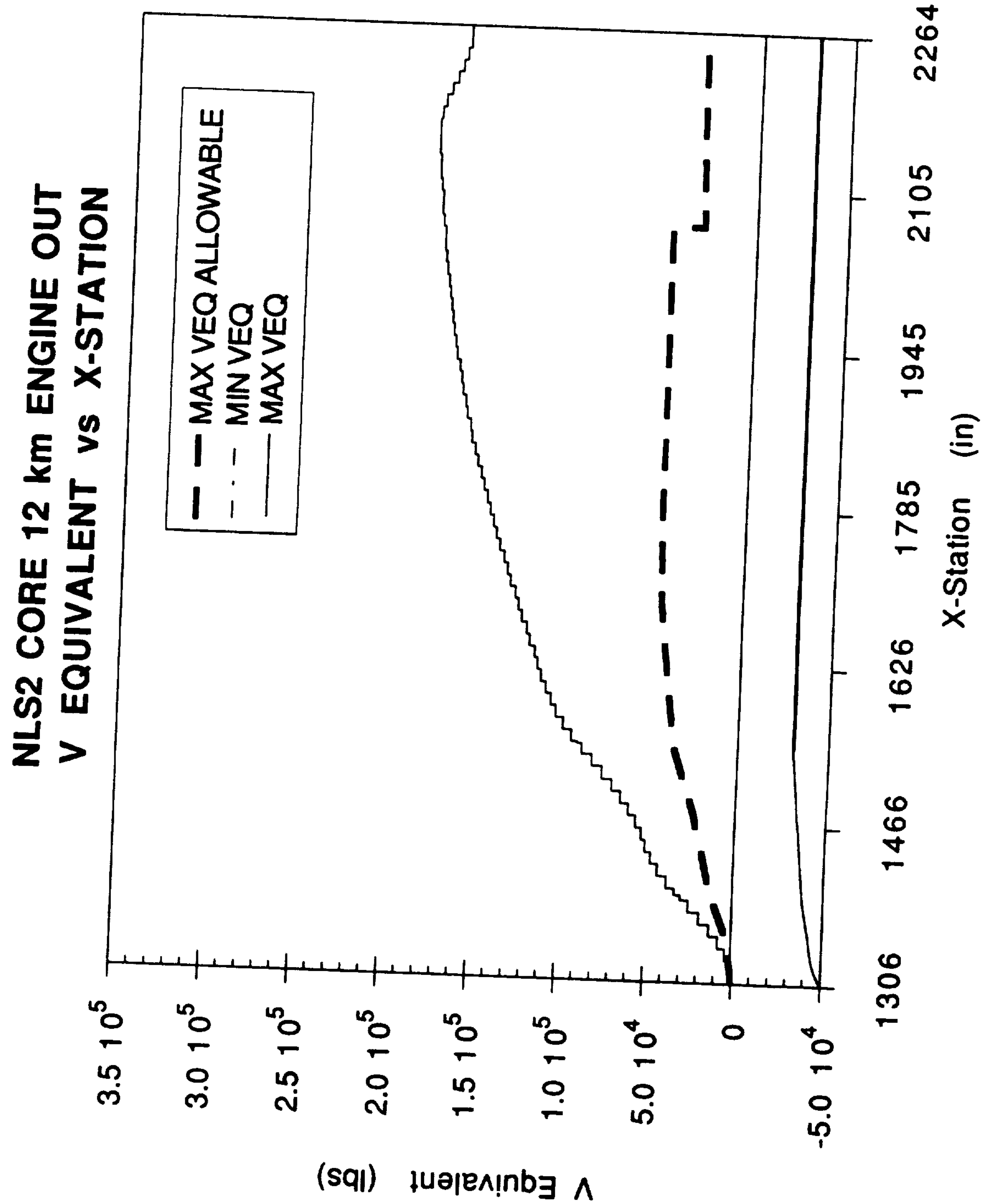

NLS2 CORE - 12 km ENGINE OUT
Z-DIR SHEAR vs X-STATION
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Z-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

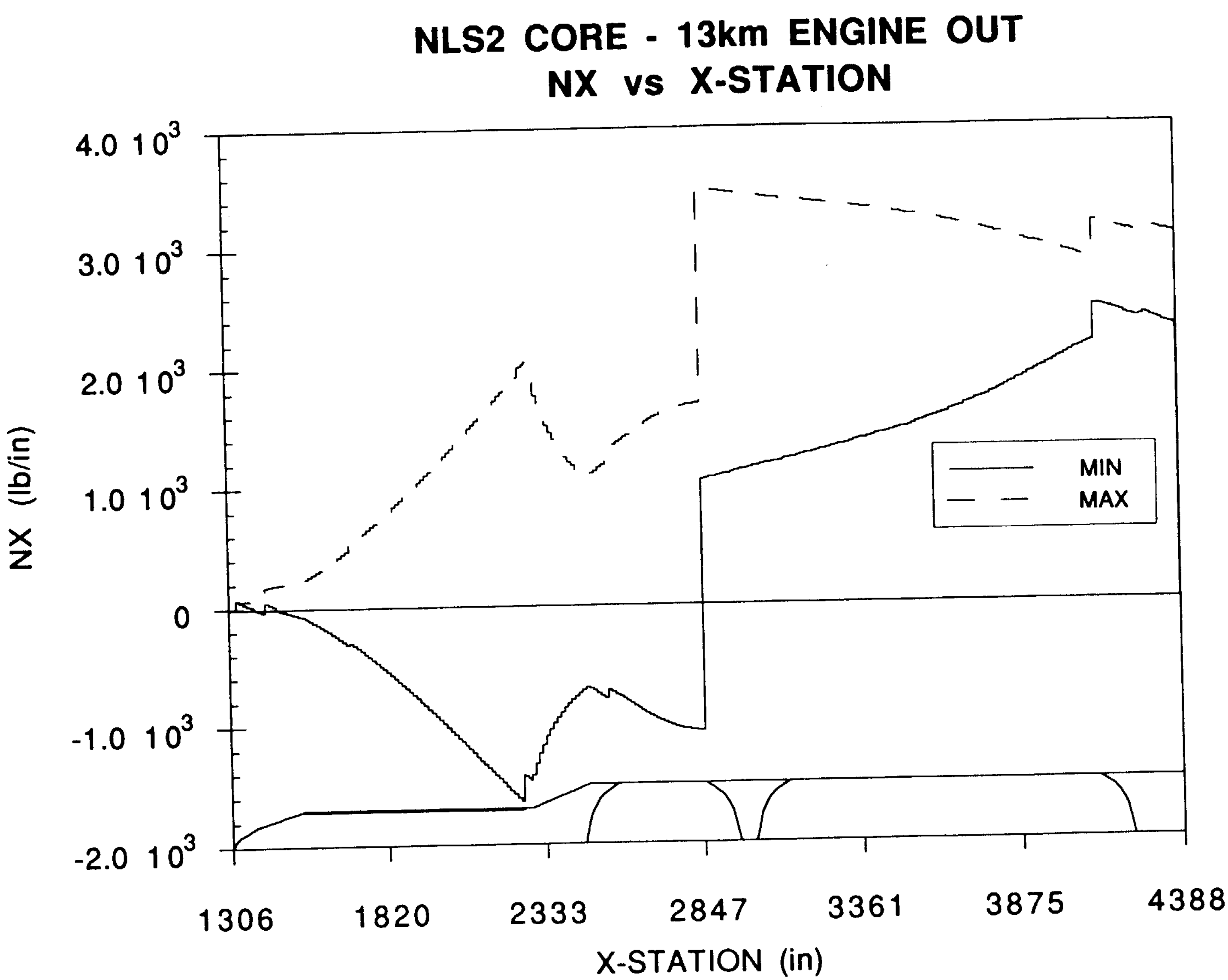

NLS2 CORE - 12 km ENGINE OUT
Y-DIR MOMENT vs X-STATION
Moment about Y-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)

NLS2 CORE - 12 km ENGINE OUT
Z-DIR MOMENT vs X-STATION

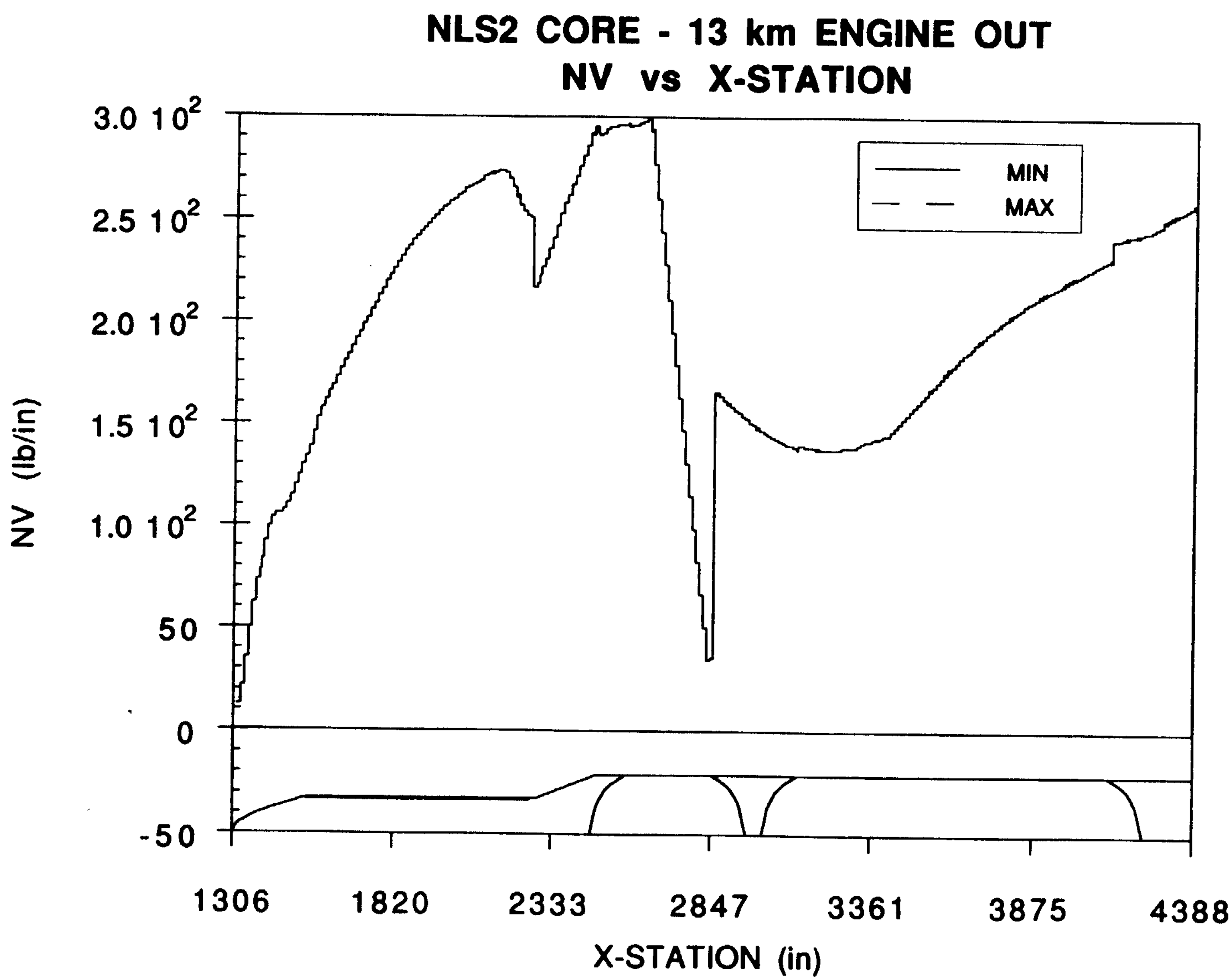



NLS2 CORE 12 km ENGINE OUT
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
P Equivalent (lbs)
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

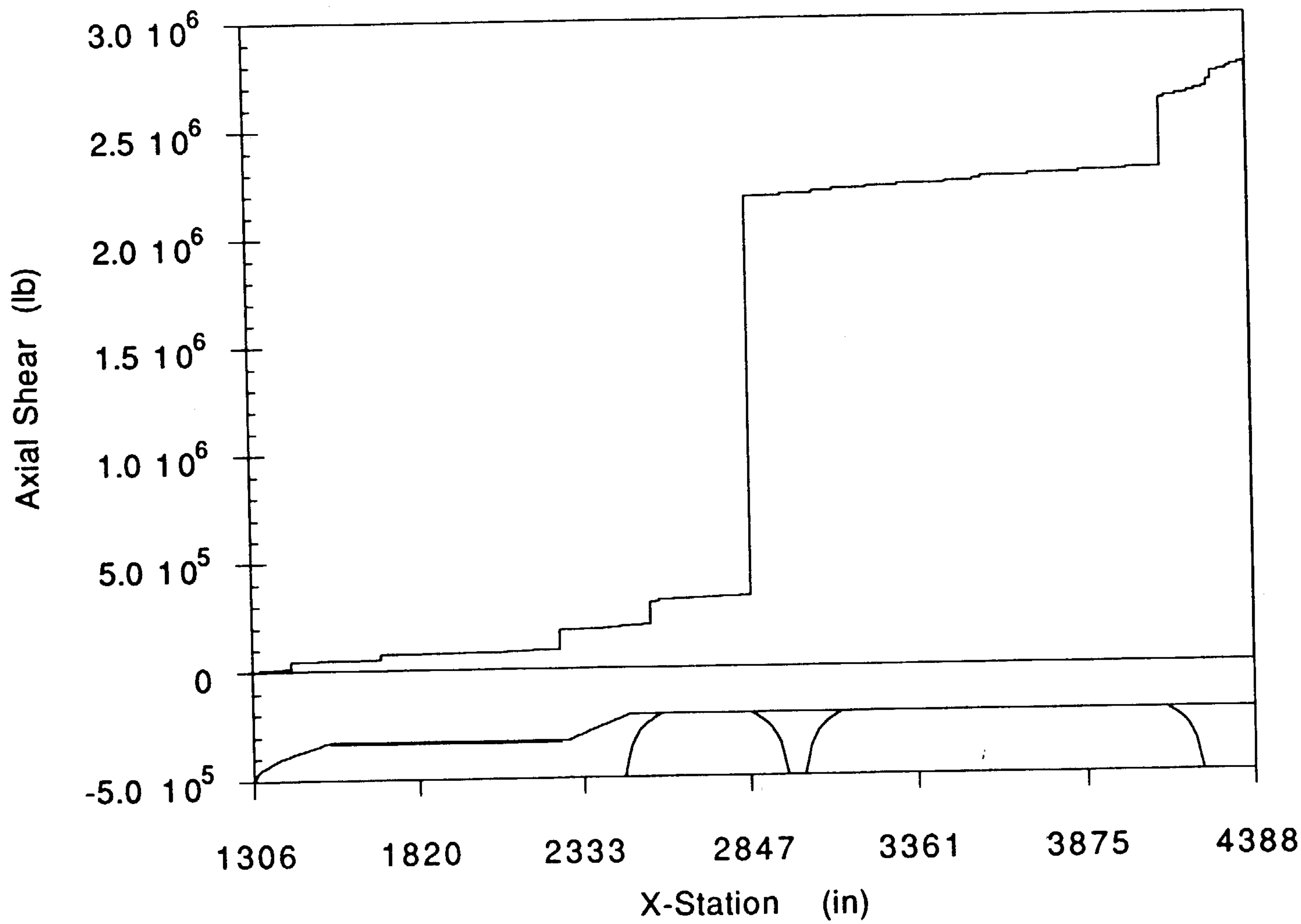

NLS2 CORE 12 km ENGINE OUT
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

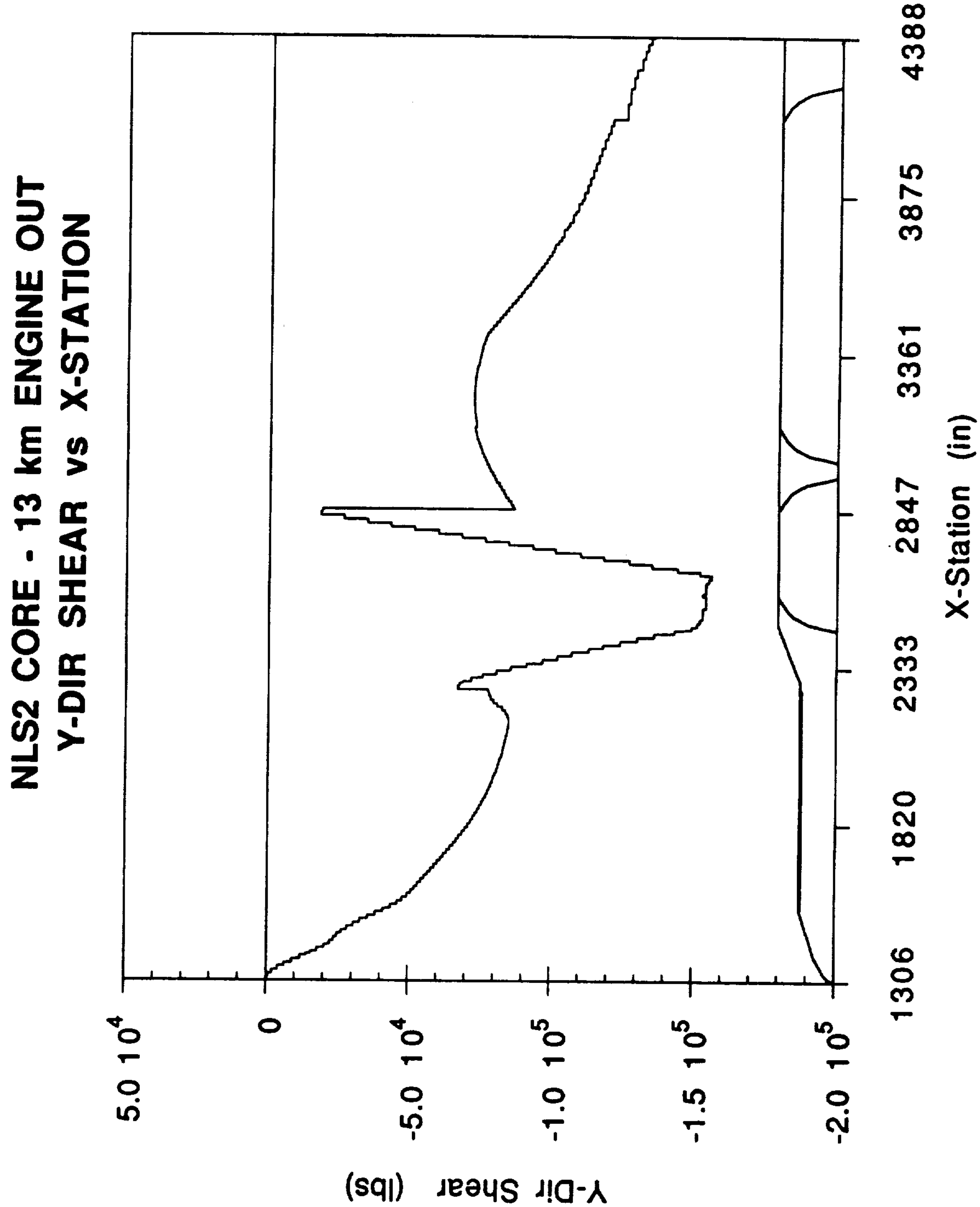


NLS2 CORE - 13km ENGINE OUT
NX vs X-STATION
NX (lb/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX

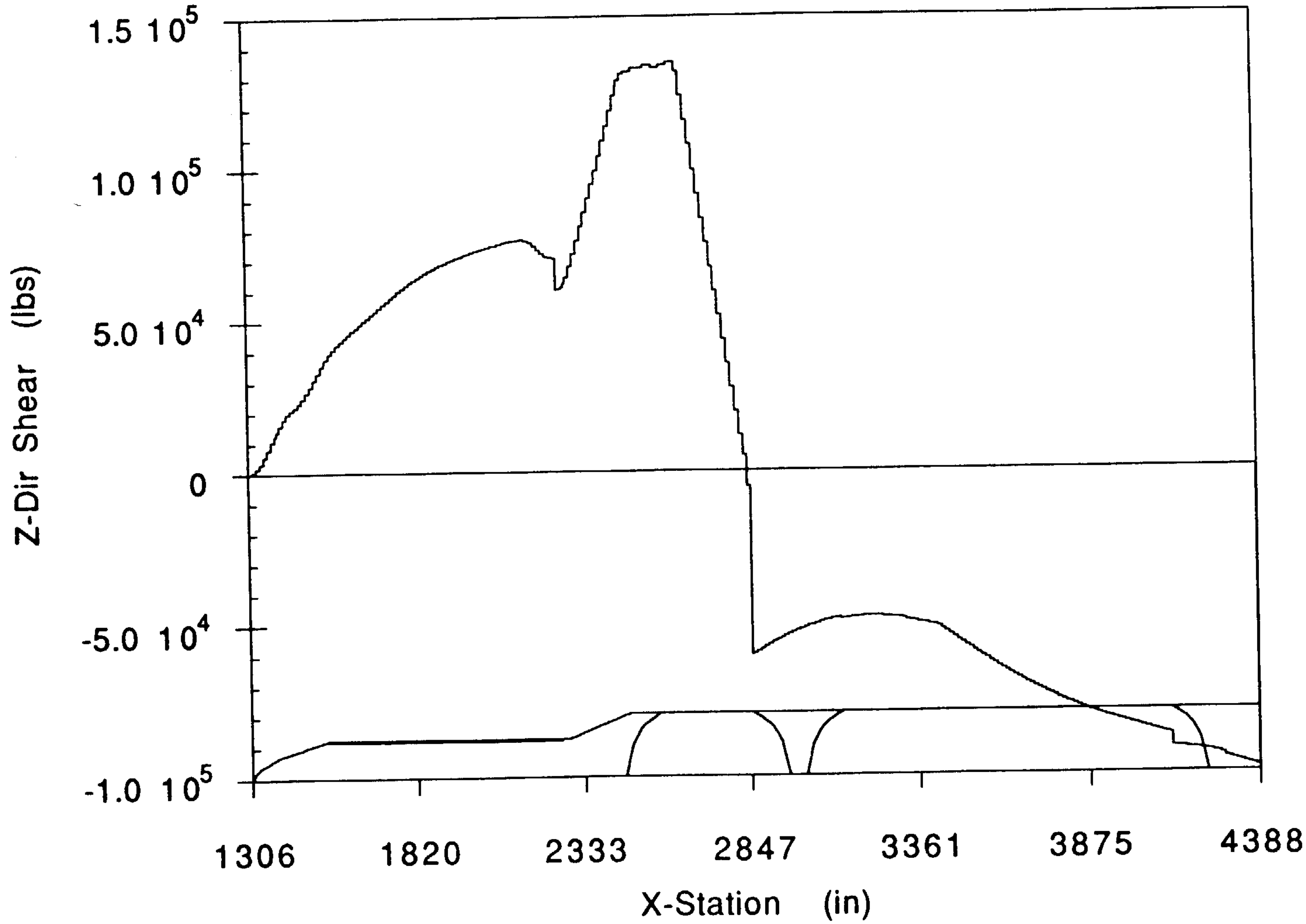

NLS2 CORE - 13 km ENGINE OUT
NV vs X-STATION
MIN
MAX
NV (lb/in)
3.0 10^2
2.5 10^2
2.0 10^2
1.5 10^2
1.0 10^2
50
0
-50
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)

NLS2 CORE - 13 km ENGINE OUT
AXIAL SHEAR vs X-STATION

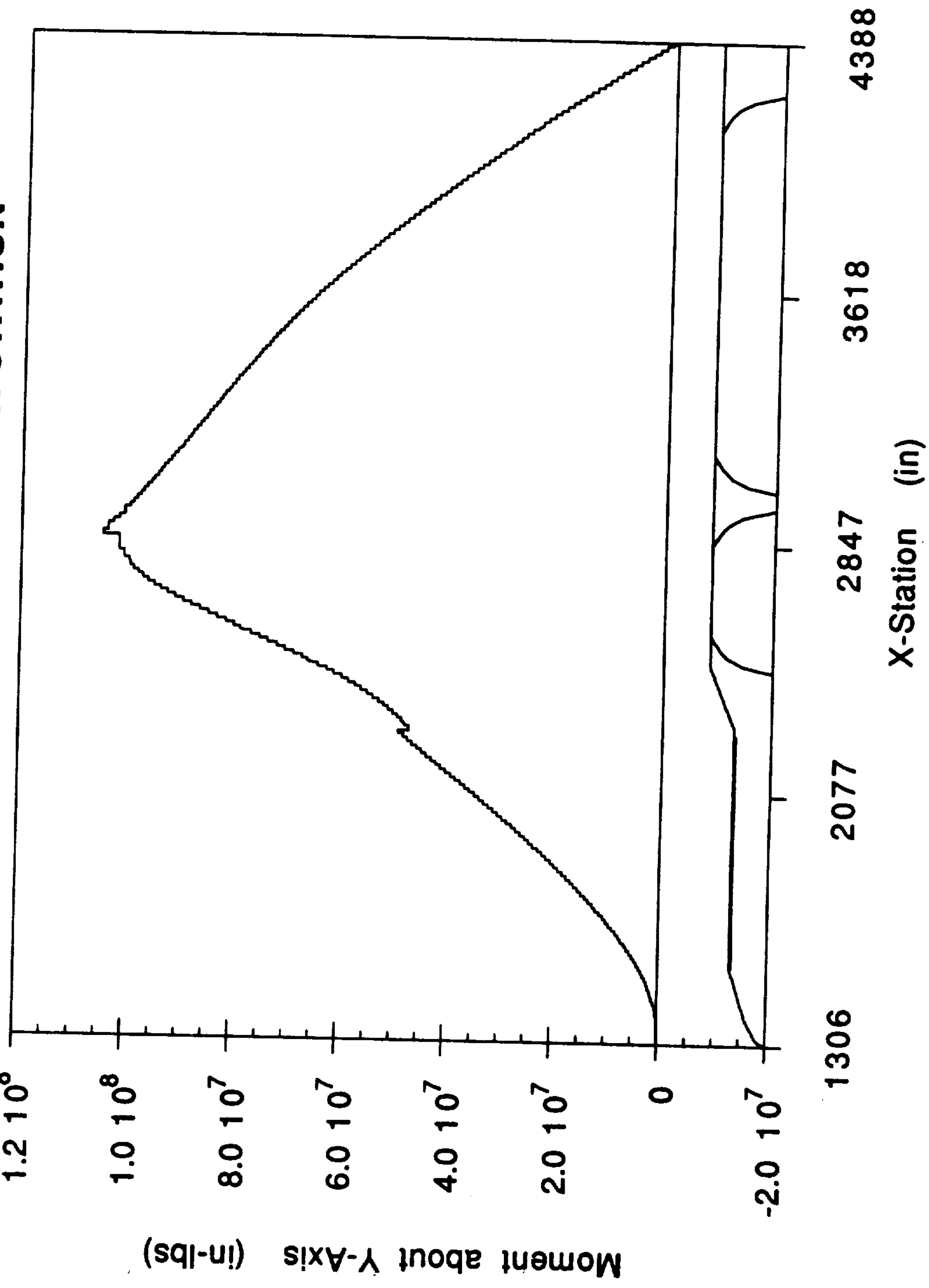



NLS2 CORE - 13 km ENGINE OUT
Y-DIR SHEAR vs X-STATION
Y-Dir Shear (lbs)
X-Station (in)
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
-2.0 10^5
1306
1820
2333
2847
3361
3875
4388

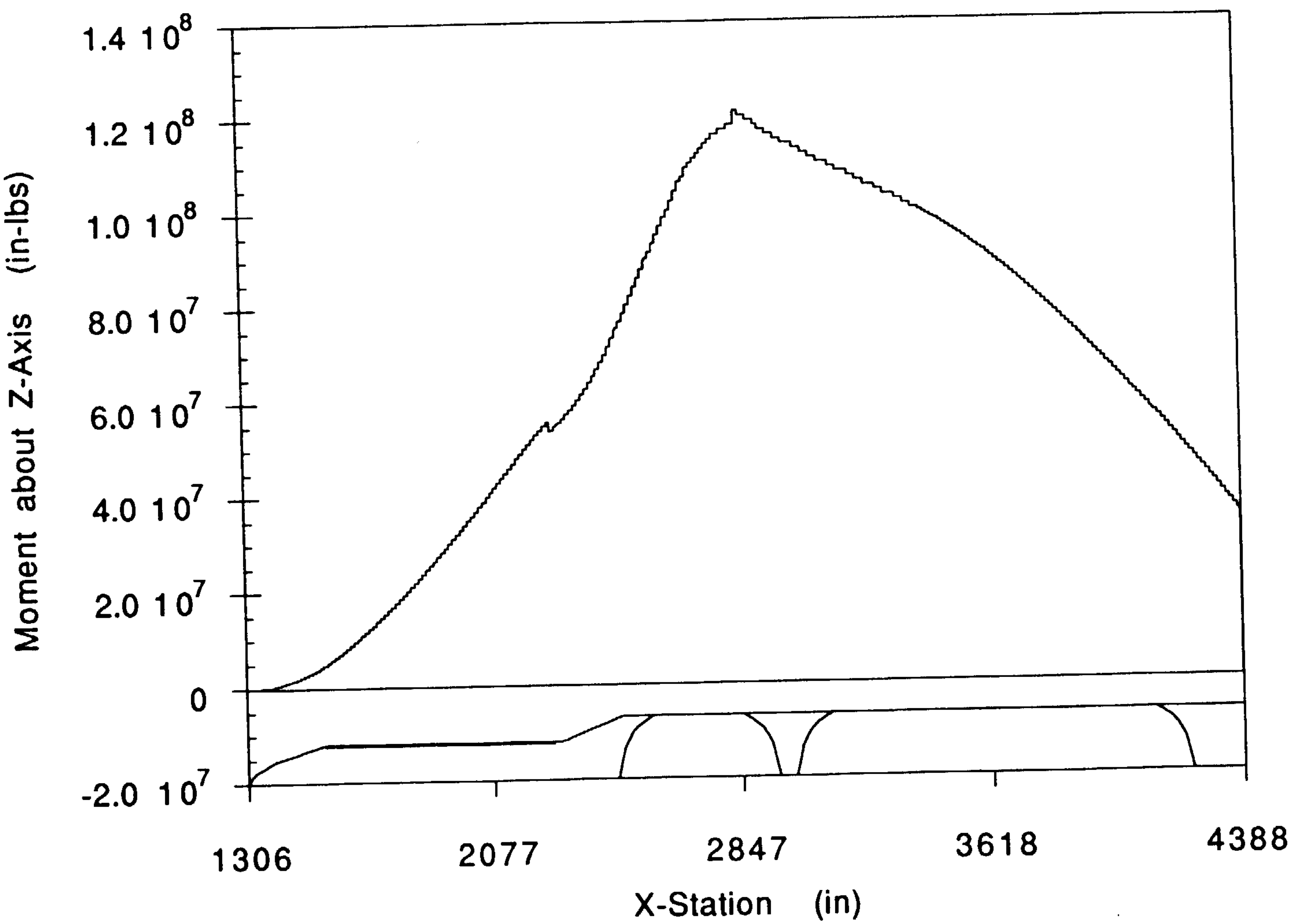
NLS2 CORE - 13 km ENGINE OUT
Z-DIR SHEAR vs X-STATION



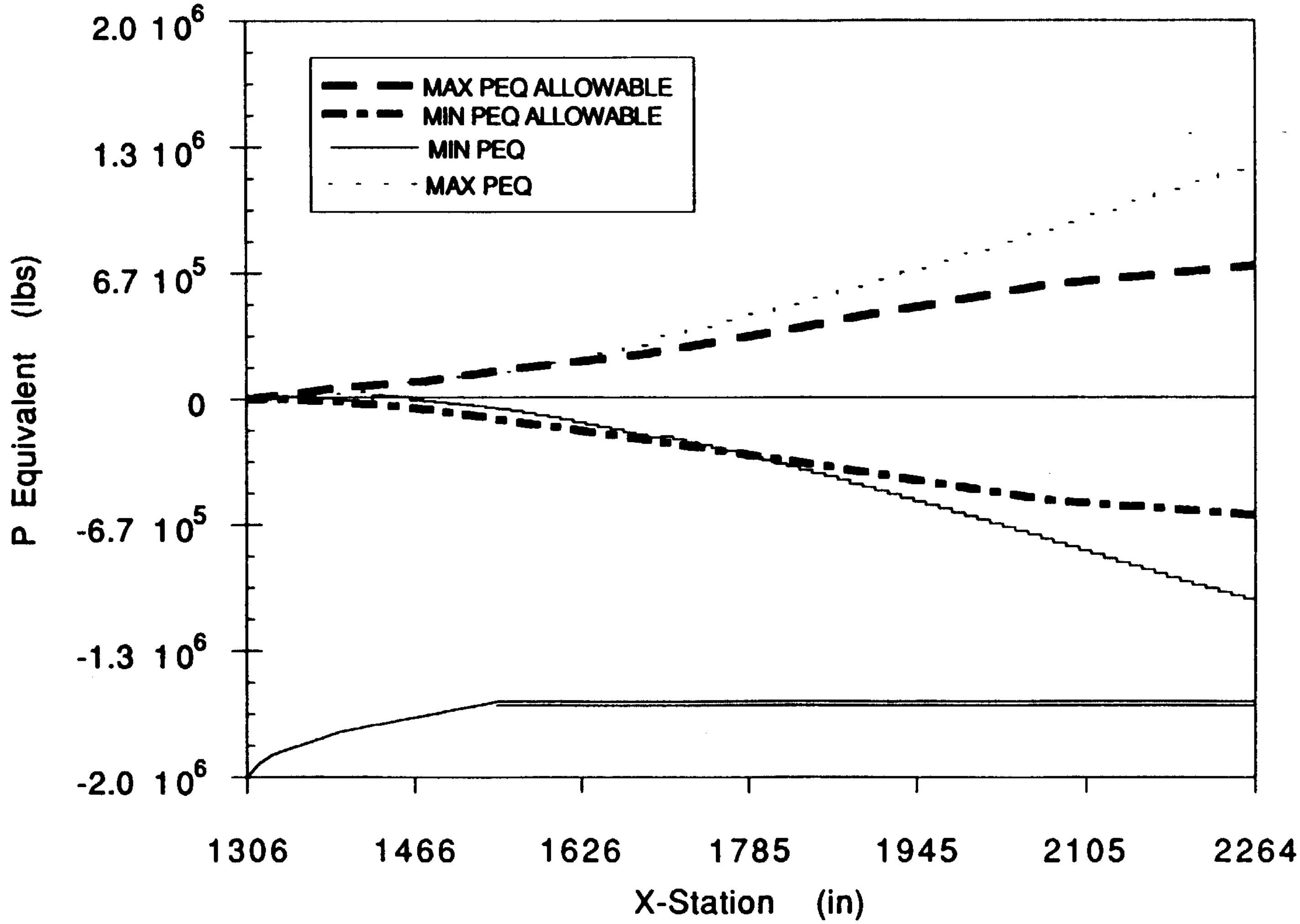
NLS2 CORE - 13 km ENGINE OUT
Y-DIR MOMENT vs X-STATION

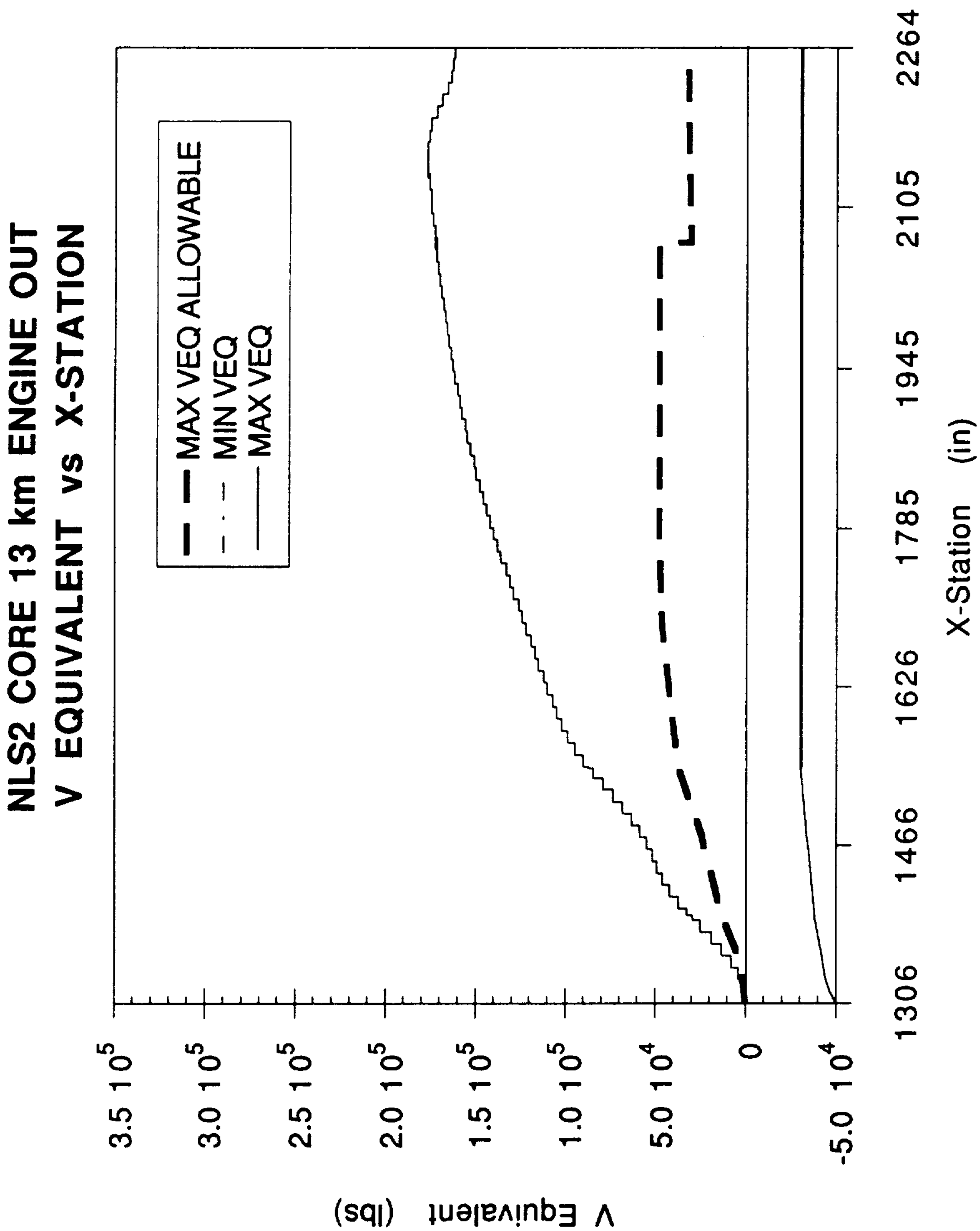


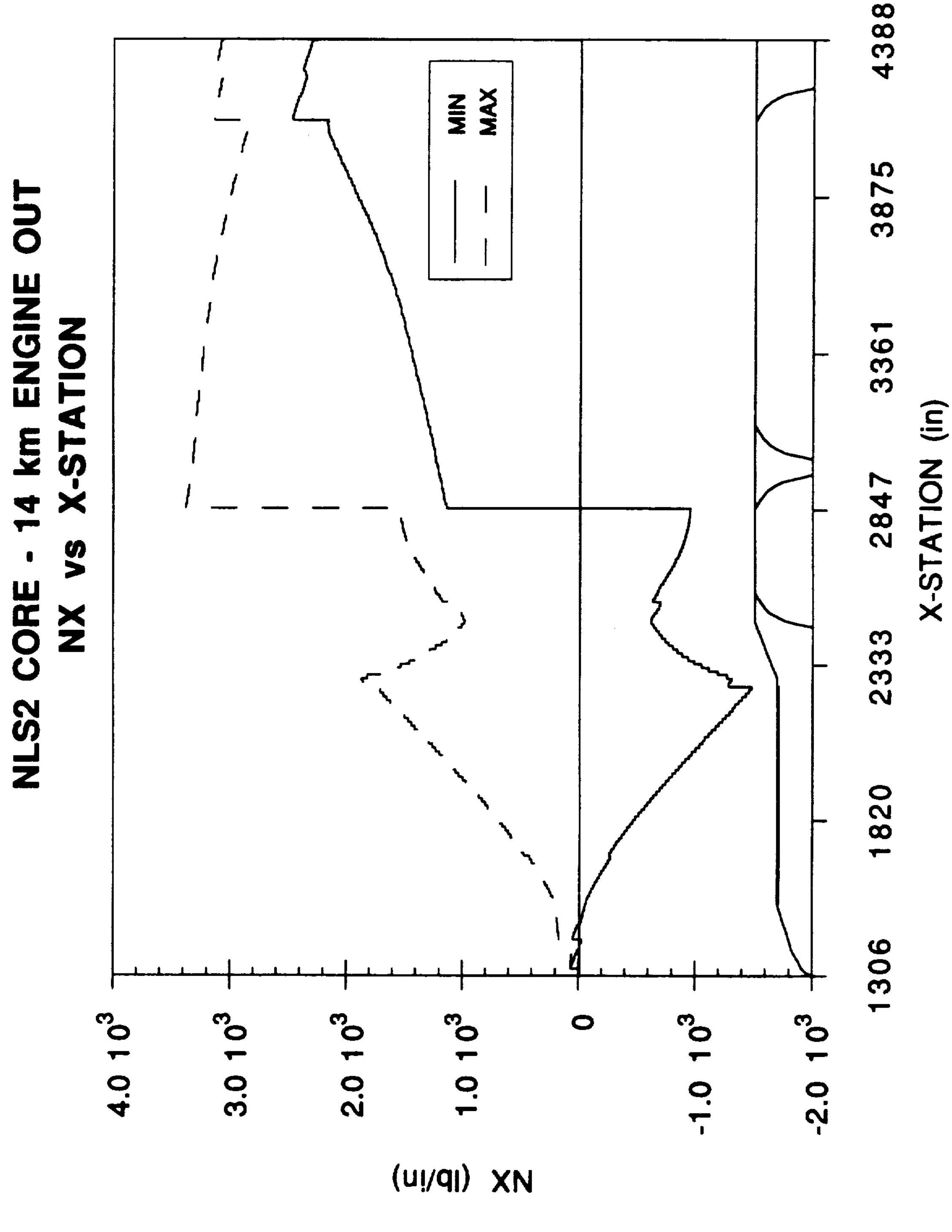
NLS2 CORE - 13 km ENGINE OUT
Z-DIR MOMENT vs X-STATION



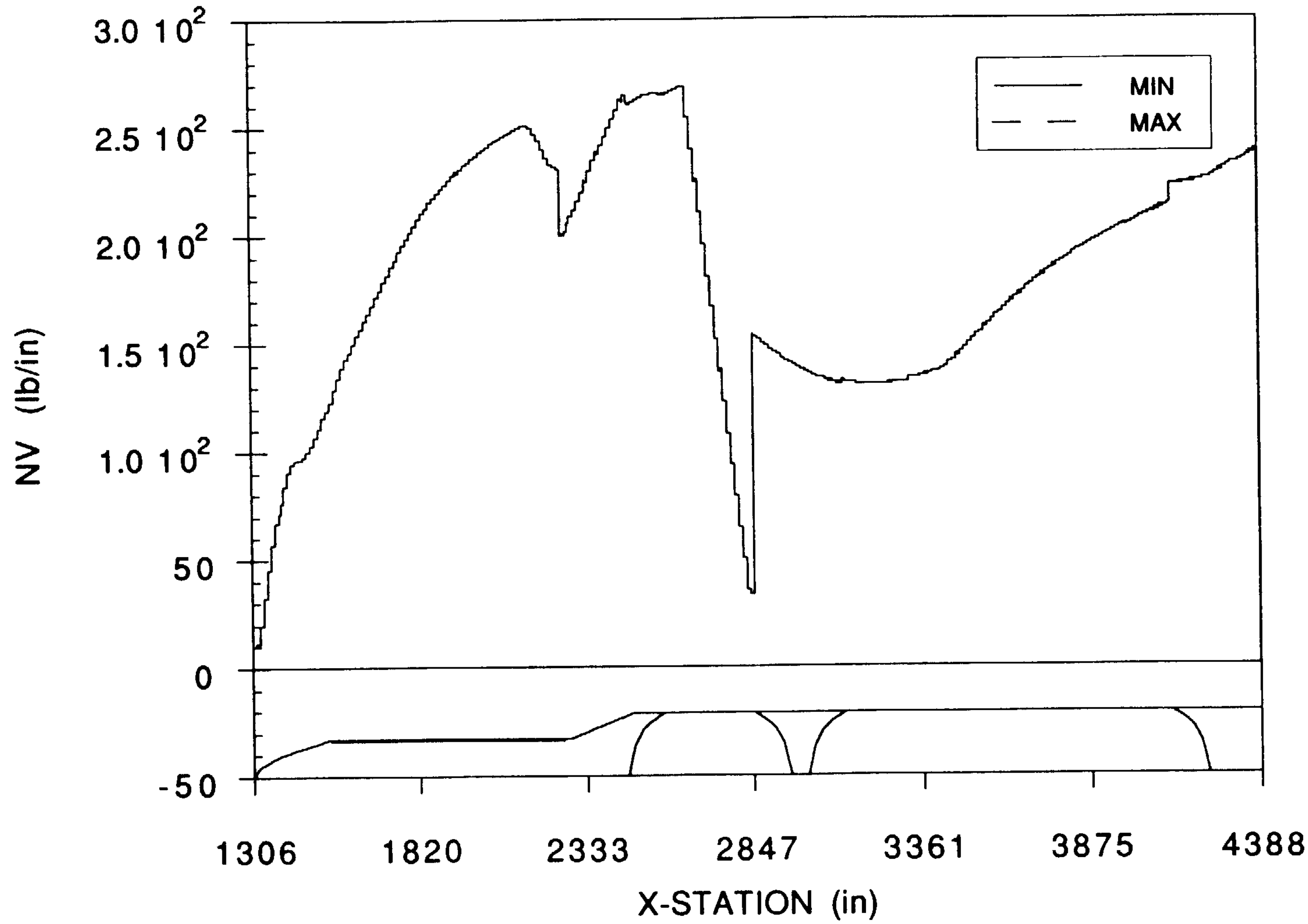
NLS2 CORE 13 km ENGINE OUT
P EQUIVALENT vs X-STATION



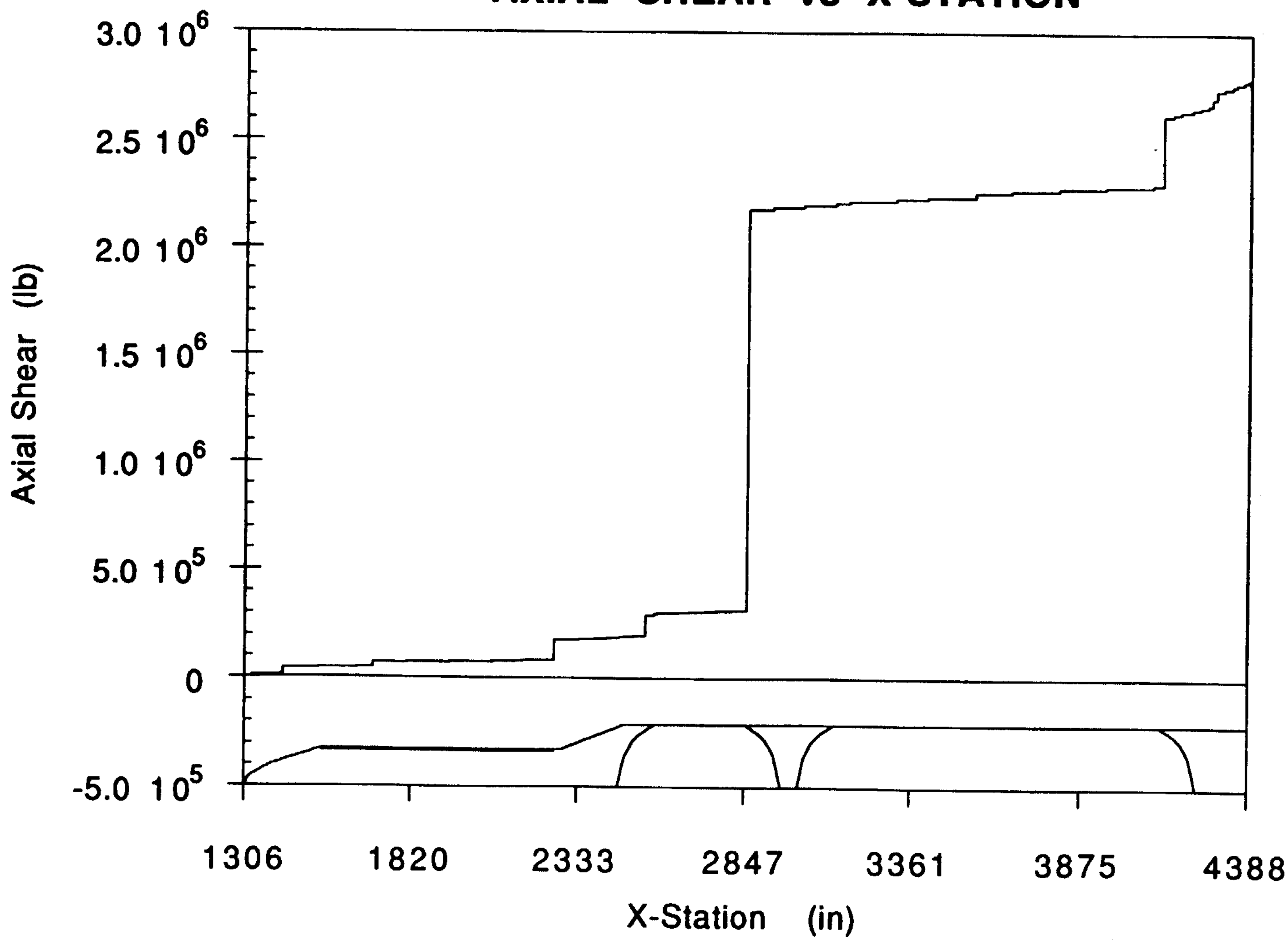

NLS2 CORE 13 km ENGINE OUT
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.5 10^5
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
X-Station (in)
1306
1466
1626
1785
1945
2105
2264

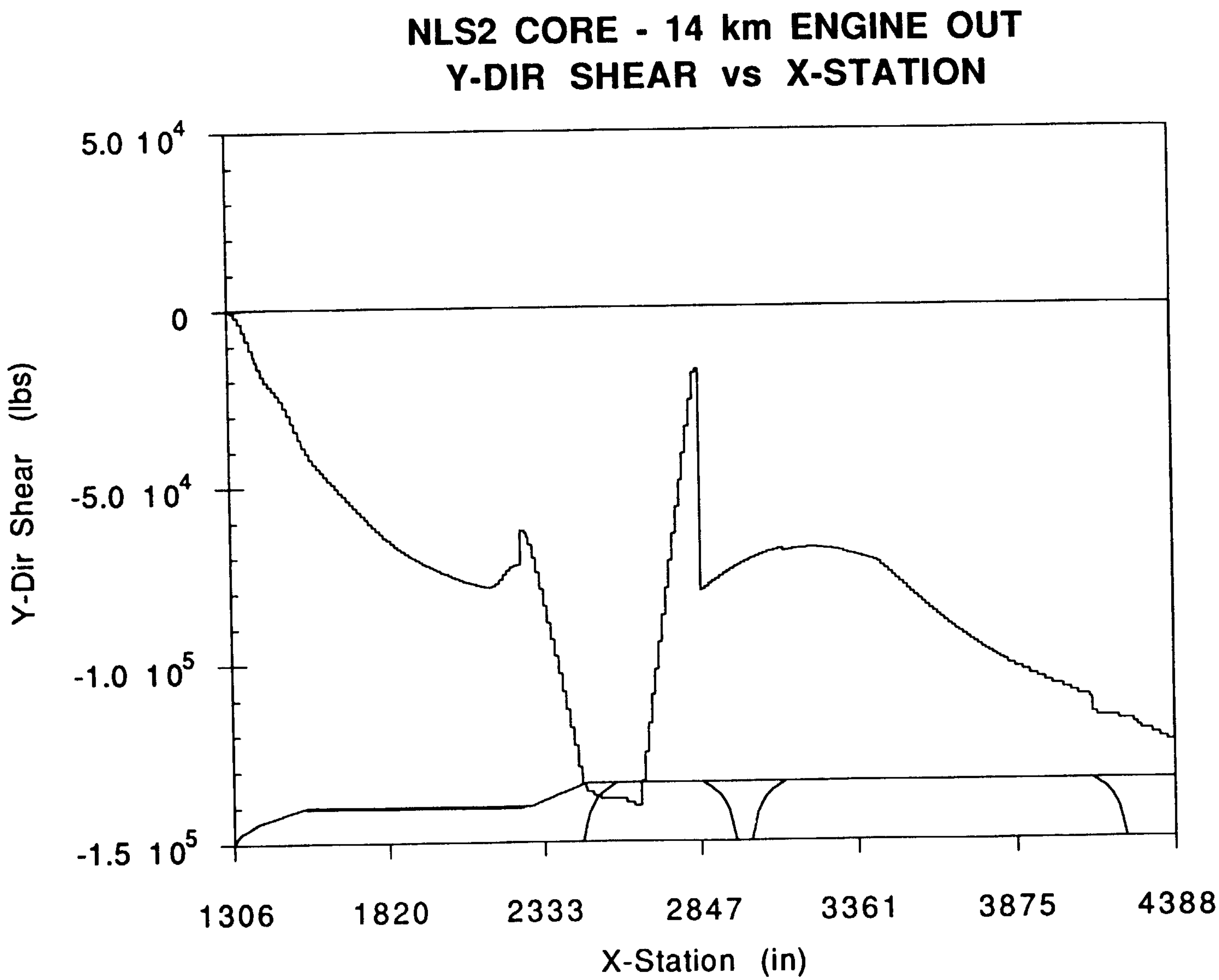

NLS2 CORE - 14 km ENGINE OUT
NX vs X-STATION
NX (lb/in)
4.0 10^3
3.0 10^3
2.0 10^3
1.0 10^3
0
-1.0 10^3
-2.0 10^3
1306
1820
2333
2847
3361
3875
4388
X-STATION (in)
MIN
MAX

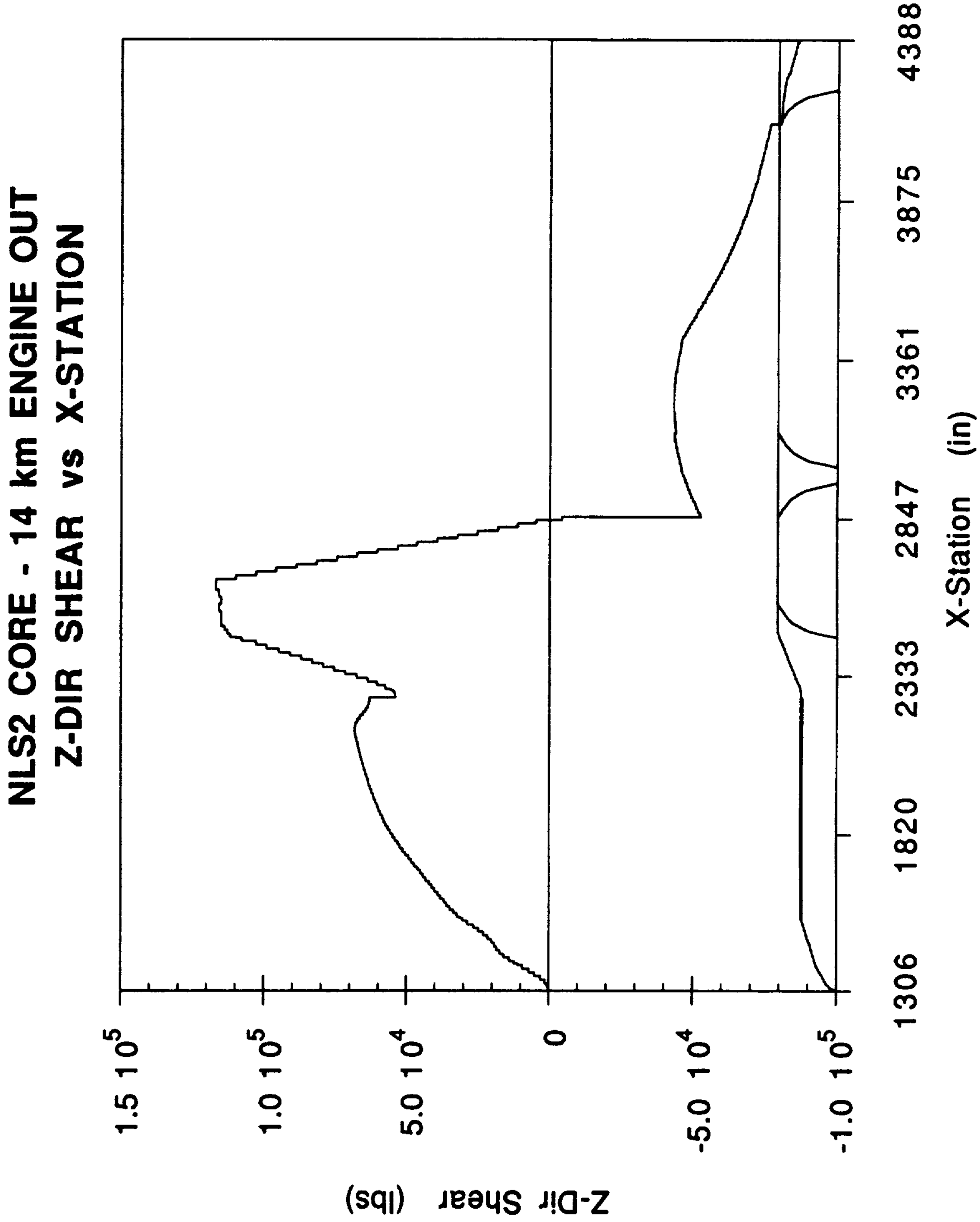
NLS2 CORE - 14 km ENGINE OUT
NV vs X-STATION



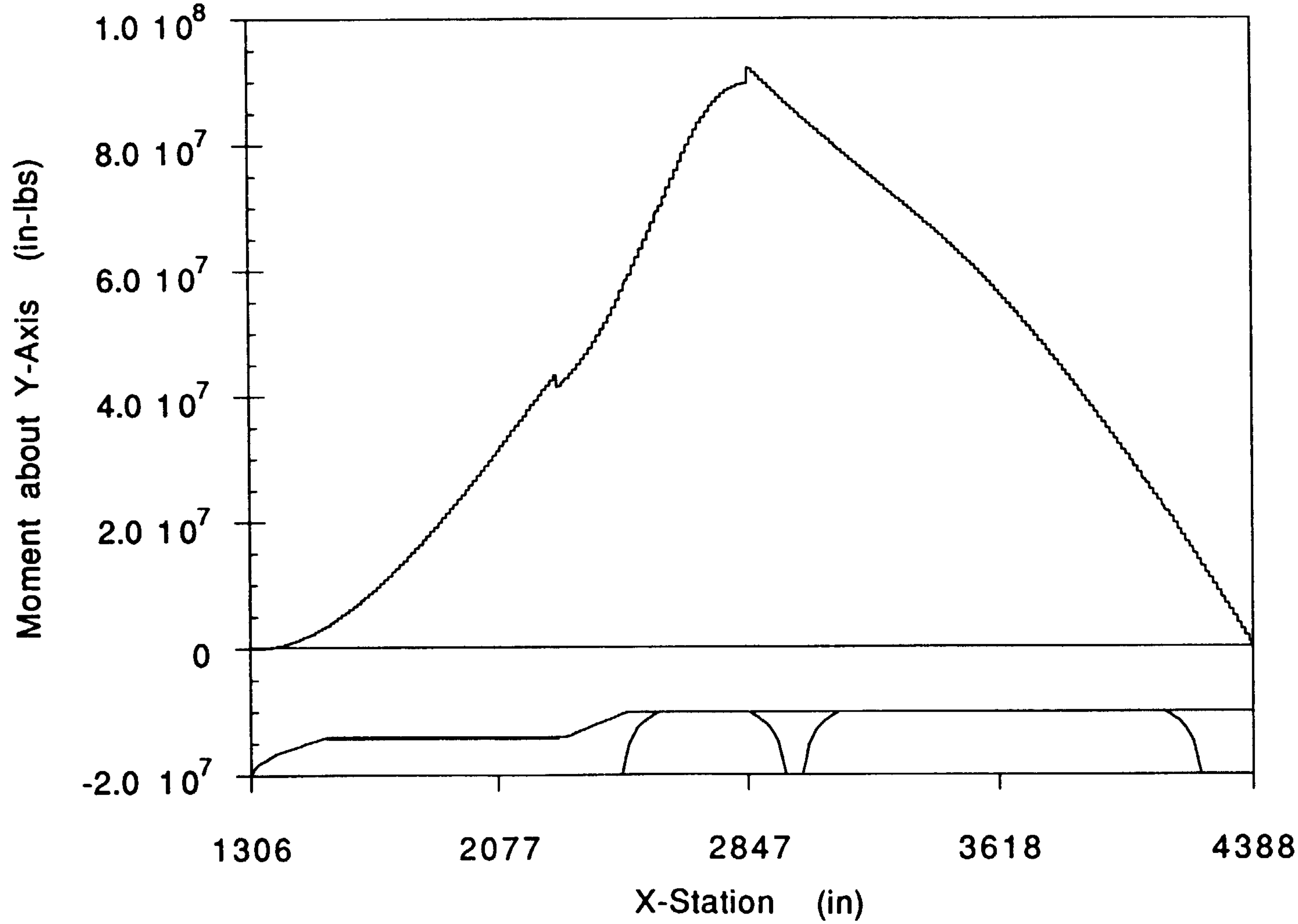
NLS2 CORE - 14 km ENGINE OUT
AXIAL SHEAR vs X-STATION

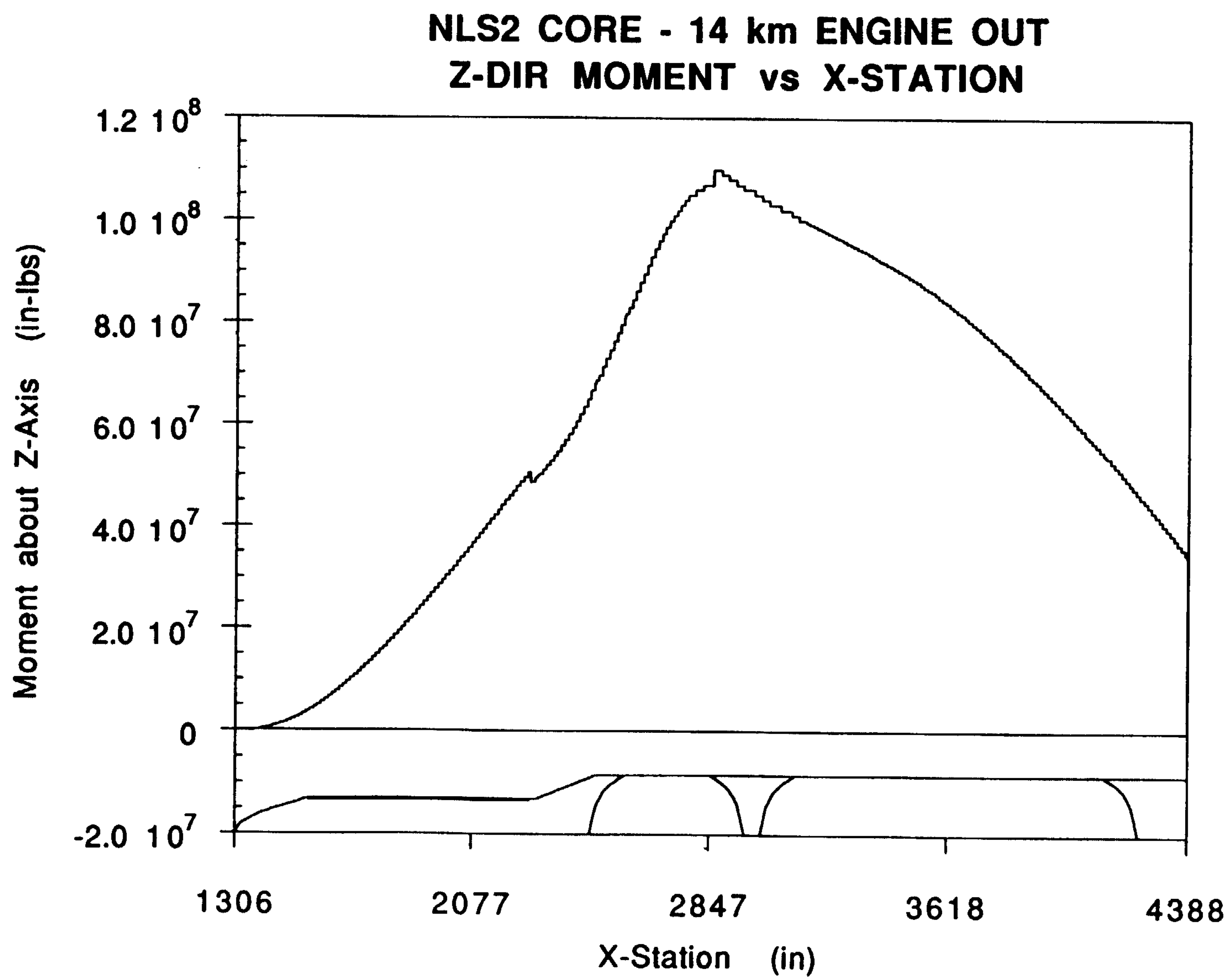


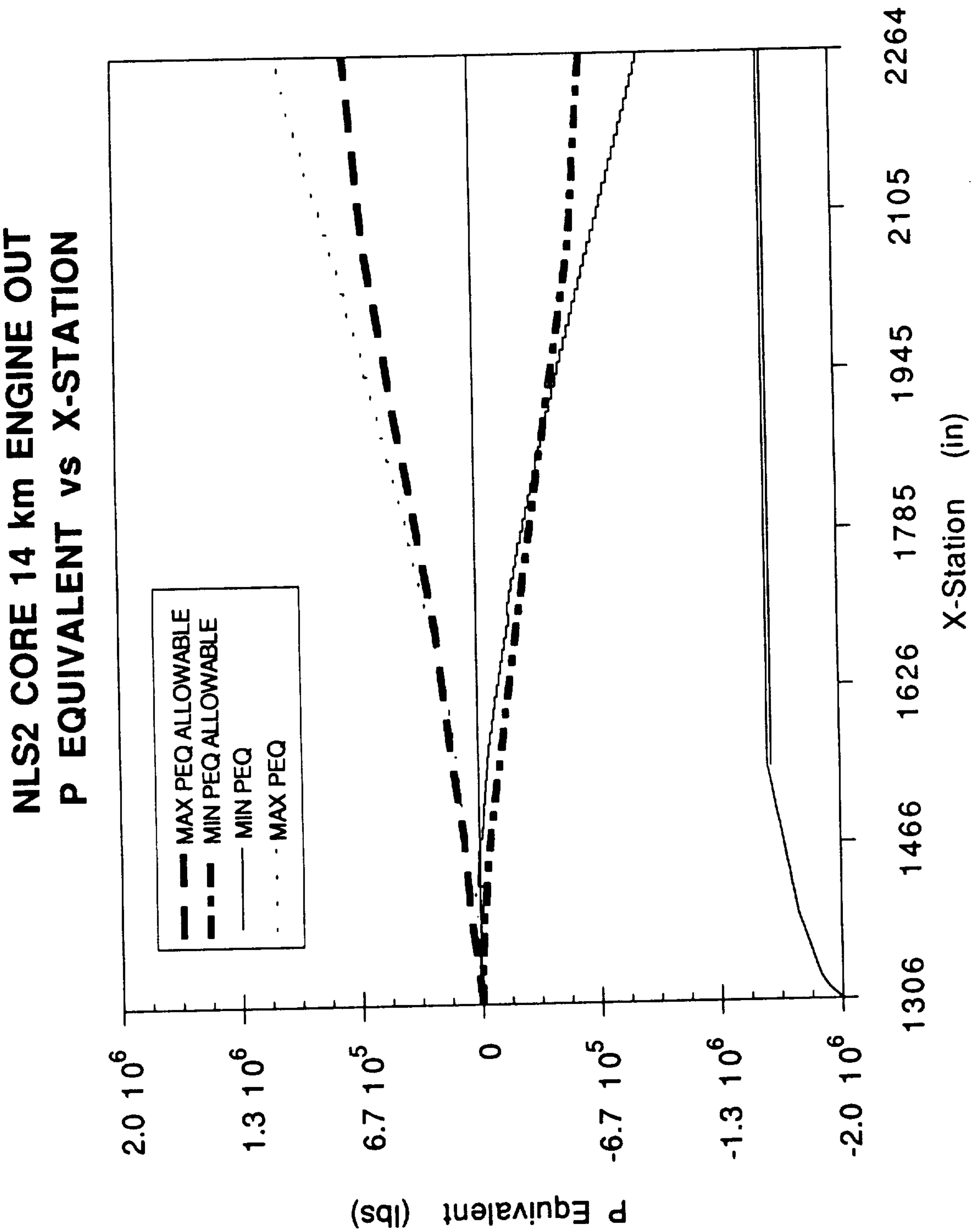

NLS2 CORE - 14 km ENGINE OUT
Y-DIR SHEAR vs X-STATION
5.0 10^4
0
-5.0 10^4
-1.0 10^5
-1.5 10^5
Y-Dir Shear (lbs)
1306
1820
2333
2847
3361
3875
4388
X-Station (in)


NLS2 CORE - 14 km ENGINE OUT
Z-DIR SHEAR vs X-STATION
Z-Dir Shear (lbs)
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
-1.0 10^5
1306
1820
2333
2847
3361
3875
4388
X-Station (in)

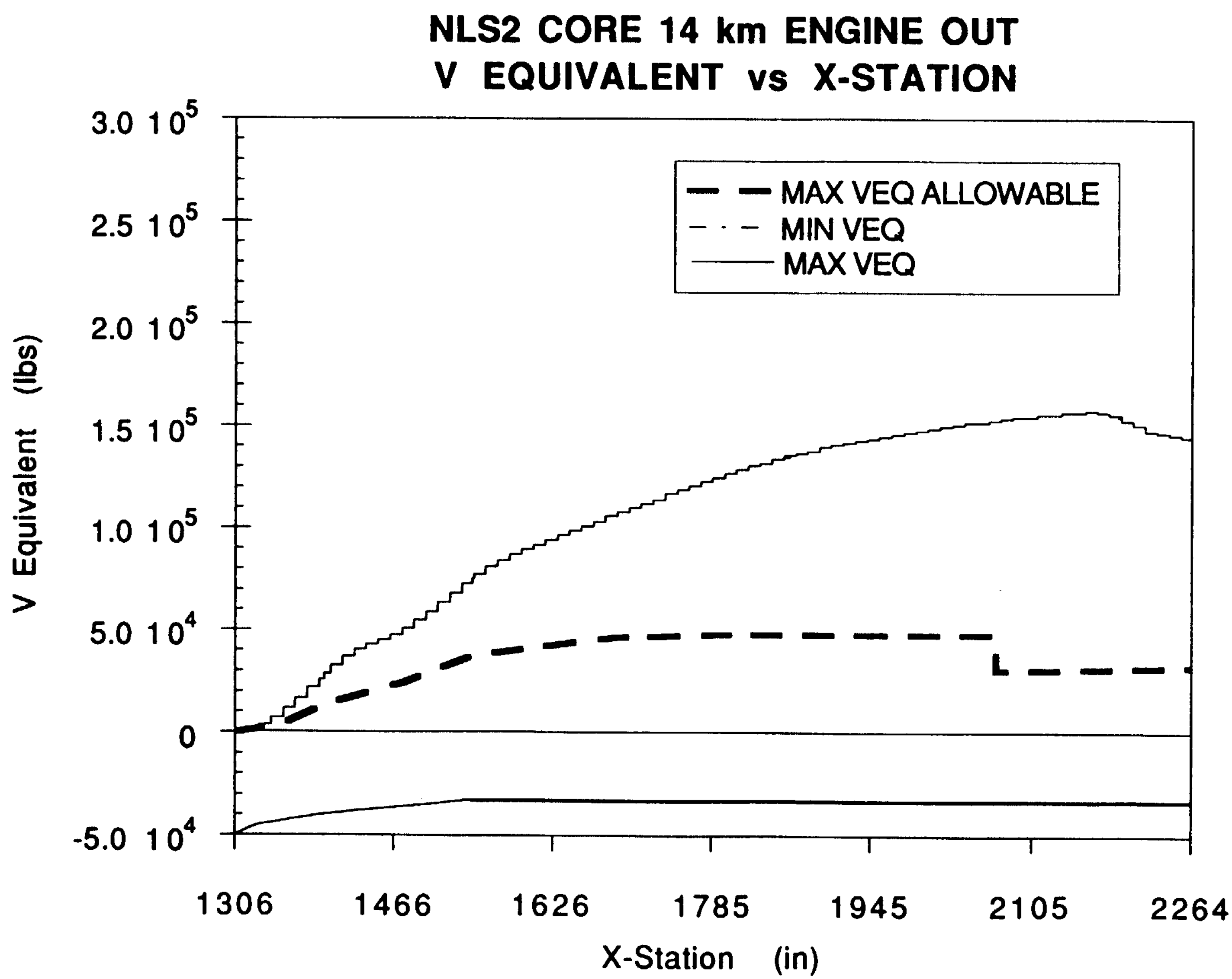
NLS2 CORE - 14 km ENGINE OUT
Y-DIR MOMENT vs X-STATION




NLS2 CORE - 14 km ENGINE OUT
Z-DIR MOMENT vs X-STATION
Moment about Z-Axis (in-lbs)
1.2 10^8
1.0 10^8
8.0 10^7
6.0 10^7
4.0 10^7
2.0 10^7
0
-2.0 10^7
1306
2077
2847
3618
4388
X-Station (in)



NLS2 CORE 14 km ENGINE OUT
P EQUIVALENT vs X-STATION
MAX PEQ ALLOWABLE
MIN PEQ ALLOWABLE
MIN PEQ
MAX PEQ
P Equivalent (lbs)
2.0 10^6
1.3 10^6
6.7 10^5
0
-6.7 10^5
-1.3 10^6
-2.0 10^6
1306
1466
1626
1785
1945
2105
2264
X-Station (in)


NLS2 CORE 14 km ENGINE OUT
V EQUIVALENT vs X-STATION
MAX VEQ ALLOWABLE
MIN VEQ
MAX VEQ
V Equivalent (lbs)
3.0 10^5
2.5 10^5
2.0 10^5
1.5 10^5
1.0 10^5
5.0 10^4
0
-5.0 10^4
1306
1466
1626
1785
1945
2105
2264
X-Station (in)

APPROVAL

NATIONAL LAUNCH SYSTEM CYCLE I LOADS AND MODELS DATA BOOK

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

J.C. BLAIR
Director, Structures and Dynamics Laboratory