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CANADA LANDS SURVEYS RECORDS
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SURVEY POSITIONING REPORT

FOR

PANARCTIC ET AL SKATE C-59

FEBRUARY, 1984

NORTECH SURVEYS (CANADA) INC.
CENTURY SQUARE III, 2ND FLOOR
309 - 2ND AVENUE S.W.
CALGARY, ALBERTA, T2P 0C5

s1973

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OFFSHORE EXPLORATORY DRILLING SURVEY POSITIONING REPORT FOR:

Panarctic et al Skate C-59
Latitude: 77° 48' 15".124
Longitude: 104° 51' 28".133
Grid Area: 77° 50' 104° 30'
Unit & Section: C-59
Permit: ~~A-3093~~
Exploration Agreement 138 wwc

OPERATOR AND/OR PERMITTEE:

Panarctic Oils Ltd.

SURVEYOR ACCOUNTABLE:

Tim J. Crago, C.L.S.

DATE OF SURVEY:

January 15 to January 17, 1984

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INTRODUCTION

Panarctic Oils Limited contracted Nortech Surveys to provide the legal rig position confirmation in support of their drilling operations in the Canadian High Arctic. Doppler satellite positioning techniques were utilized to fulfill these requirements.

This report, for Panarctic et al Skate C-59, includes data processing procedures, adjustment constants and constraints, analysis of results and copies of the final computer runs.

FIELD PROCEDURES

As stated, all positioning was accomplished using Doppler Satellite techniques. JMR-1 Receivers were used on the project along with standard JMR antennae with preamplifier.

Rea Point was used as the shore-based monitor station, with the antenna located on top of the base camp at a permanent antenna fixture. The antenna at the rig was located over a monumented point on sea ice and thus was not permanent.

The Satellite Receiver at the rig was mobilized several days prior to spud in order to evaluate the quality of the data. The quality control check on the data was carried out on-site using JMR's, SP-7 single station doppler reduction program prior to the data being shipped to Calgary for final processing.

The receivers at both the rig and Rea Point were pass programmed to ensure collection of common data. Receivers were checked frequently by field personnel with more intense receiver evaluation carried out in Rea Point after receiving the data.

CONSTANTS & CONSTRAINTS

The GEODOP System of processing Doppler Satellite data requires manual input of some constants and constraints. Those used for the positioning of Panarctic et al Skate C-59 are given below:

1) Passes with maximum elevation less than 14.5 degrees not used.
2) Doppler counts recorded below 7.5 degrees not used.
3) Passes with less than 3 dopplers not used.
4) Hopfield refraction model used.
5) Apriori variance factor for statistical testing - 1.4 cycles^2.
6) Orbital constraints: along track = 26m 1σ
   across track = 5m 1σ
   out of plane = 10m 1σ
7) Standard deviation of a 30 second doppler count = .22 counts (1σ).
8) Receiver delay - the receiver was calibrated by JMR and the delay at -135 dbm was used.
9) Average meteorological data for the survey area was used.

DATA PROCESSING

The doppler data reductions were performed using the GEODOP system of programs. The following is the logical sequence of data reduction to a final position.

1) Majority Voting

The majority vote process reads each recorded satellite pass from field digital cassettes. Redundant information and passes with insufficient or erroneous data are rejected. The remaining data is reformatted and transferred to magnetic tape cartridges for later input to the Univac 1100/40 System.

At the same time, data quality is further confirmed by solving single passes using the SP-7 Program.

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2) PREDOP

Reads and decodes the formatted majority voted input data (a series of satellite passes). A first order ionospheric refraction correction is done on the doppler counts and variable and fixed parameters are decoded. A curve is fitted to each of the three variable parameters, then these smoothed functions and fixed parameters are used to compute the satellite orbit which is transformed into a terrestrial coordinate system. An eighth order polynomial is fitted to represent the x, y, z's. Finally, the dopplers were compared to theoretical values and edited appropriately before being written out with the interpolated meteorological data.

3) MERGE

The MERGE Program consolidated PREDOP outputs from the rig site and from the monitor station at Rea Point that were observed simultaneously.

4) GEODOP

This program accepted satellite receiver data in the form of doppler counts and associated satellite positions. The rig and monitor positions were processed simultaneously for a solution of station position, frequency offsets, receiver delays and orbital and refraction biases.

Program GEODOP was design to yeild the most reliable relative positions for station occupied simultaneously and this is the mode in which it was used. GEODOP employs a phase adjustment approach whereby each pass is added to the cumulative solution of all preceeding passes after surviving the built-in statistical tests.

ADJUSTMENT PROCEDURES

The monitor station occupied at Rea Point was established with doppler satellite techniques by Shell Canada Resources Limited in 1976 and is registered as C.L.S.R. Plan #64910.

As suggested in the sample plan for offshore doppler surveys distributed by the Department of Energy, Mines & Resources, all doppler processing was carried out using Geocentric Cartesian coordinates.

The final output Geocentric Cartesian coordinates for Rea Point were compared to published 1927 NAD values and total offsets (x, y, z) were obtained:

$$\Delta x = -17.61\text{m}$$
$$\Delta y = +167.84$$
$$\Delta z = +186.02$$

These offsets were applied to the observed Geocentric coordinates at the Panarctic et al Skate C-59 satellite antenna location.

Conventional surveying techniques as shown on the wellsite plan, were used to relate the antenna position to the center of the derrick.

ANALYSIS OF RESULTS

Approximately 2 days of data was selected and processed for a final position. The data was selected such that the time of commencement of drilling occurred halfway through the Doppler observations.

A total of 39 accepted, common passes were used in the final GEODOP solution. As is traditionally evidenced with Doppler observations in the Arctic, the weighting of the Doppler observations was lowered to produce an apriori standard deviation on a doppler count of 0.22 counts compared with an expected value of 0.17 counts. However, high statistical correlation was maintained between the monitor station and the rig location (> than 90% correlation). It is therefore estimated that the relative accuracy (one sigma) between Rea Satellite Antenna (#64910) and Skate C-59 is better than one metre.

G E O D O P P H A S E

OPTIONS USED FOR THIS RUN ARE

ITG = 1

HOR = 7.5 DEGREES HORIZON CUT-OFF CRITERIA

ACC = 25.0 INITIAL COORDINATE ESTIMATION ACCURACY

SIGM = 1.4 APRIORI VARIANCE FACTOR

TE = 14.5 PASS ELEV CUTOFF

RT = 0.00 CORRELATION COEFFICIENT

ALONG= 26.0 ORBIT CONSTRAINTS 1 SIG.(METRES)

ACCRS= 5.0 METRES

OUT = 10.0 METRES

REFERENCE ELLIPSOID

SEMI-MAJ. A =6378206.40 M SEMI-MIN. B =6356583.80

DATUM SHIFT (METRES)

DX= -16.00

DY= 165.00

DZ= 195.00

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ST.NAME  CODE WGHT DELY T.B.  FREQ. STD. DRIFT   LATITUDE    LONGITUDE    HEIGHT LAT/LONG/HGT ANT SHIFT    X
 REACH    0 20.0   350  1.0   -22.3   1.0   0.0 75 21 37.177 254 16 31.896    22.3 33.7  8.0 -4.1   -438269.4 -15
 SKATE    0 20.0   350  1.0   -34.5   1.0   0.0 77 48 15.630 255  8 31.490     -.0-224.-340.  0.0   -346627.1 -13


VPV =      0.000
DEGREES OF FREEDOM =     -6

20      15     1 34      PASS=    1 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   138   1020.-40.0 -3.1    -22.68   350    .9   23.0  -438250.0 -1556619.6  6148900.3 0234 1234 1234 0034
KATE   138   1020.-40.0 -3.1    -34.76   349   3.9   28.6  -347016.0 -1306717.4  6212127.8 1234 1234 0204 1234

RB BIASES(M)  ACCR=     .9 ALG=   -5.1 OUT=   -3.1      VPV=     34.1119 DTVPV=   34.11  DF=     27  SO=   1.124

48      15     2  6      PASS=    2 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   210   1020.-40.0 -3.1    -22.55   364   41.8  61.6  -438226.5 -1556640.8  6148921.1 0000 1234 0234 1234
KATE   210   1020.-40.0 -3.1    -34.64   334   56.5  64.8  -346991.1 -1306743.6  6212153.1 0000 1234 1034 1234


++++ ABOVE PASS REJECTED AT 99% PROB.LEVEL - REJECTION NO. =    1

RB BIASES(M)  ACCR=   28.5 ALG=  -15.9 OUT=   23.9      VPV=     34.1119 DTVPV= 208.85  DF=     27  SO=   1.060

18      15     3 38      PASS=    3 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   344   1020.-40.0 -3.1    -22.40   366   10.2  36.2  -438250.3 -1556610.9  6148893.9 1000 0000 1234 1234
KATE   342   1020.-40.0 -3.1    -34.50   332    4.5  42.7  -347015.2 -1306727.5  6212134.0 1230 1000 1234 1234

RB BIASES(M)  ACCR=     .2 ALG=   -7.5 OUT=     .6      VPV=     55.3307 DTVPV=   21.22  DF=     68  SO=    .902

14      15     4 14      PASS=    4 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   418   1020.-40.0 -3.1    -22.45   372    -.3  48.4  -438247.9 -1556605.5  6148889.6 1234 0234 1234 1230
KATE   420   1020.-40.0 -3.1    -34.56   326    -.2  50.4  -347012.2 -1306719.6  6212128.2 0230 0034 1234 1234

RB BIASES(M)  ACCR=    1.5 ALG=    2.8 OUT=   -1.4      VPV=     91.8540 DTVPV=   36.52  DF=    104  SO=    .940

19      15     5 26      PASS=    5 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   530   1020.-40.0 -3.1    -22.39   330   10.6  56.9  -438249.9 -1556607.6  6148890.9 0234 1234 1234 1234
KATE   530   1020.-40.0 -3.1    -34.51   368   12.9  64.1  -347014.0 -1306721.0  6212129.3 1234 1234 1234 1234

RB BIASES(M)  ACCR=     .5 ALG=   -8.0 OUT=     .8      VPV=    112.2352 DTVPV=   20.38  DF=    156  SO=    .848

48      15     7 38      PASS=    6 IEND=    0

ST.NO H MM    PRESS TEMP PWP      FREQ. DELAY TROP&  ELEV          X              Y              Z          USED DOPPLER
EACH   742   1020.-40.0 -3.1    -22.91   418   11.3  28.9  -438238.9 -1556543.5  6148906.1 0000 0000 1200 0034
KATE   742   1020.-40.0 -3.1    -35.06   266   14.4  33.2  -346998.0 -1306655.2  6212143.4 0000 0004 0000 0030
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19      15   12 30      PASS=   9 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  1256    1020. -40.0 -3.1    -22.23    326    5.8   27.0   -438253.0 -1556612.4   61
SKATE 1234    1020. -40.0 -3.1    -34.44    278    6.8   33.3   -347014.7 -1306724.7   62

ORB BIASES(M)  ACCR=    2.5 ALG=   14.4 OUT=    -.3      VPV=    201.9671 DTVPV=   26.37

19      15   14 16      PASS=  10 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  1420    1020. -40.0 -3.1    -22.28    294    1.9   29.7   -438251.7 -1556611.3   61
SKATE 1420    1020. -40.0 -3.1    -34.44    406    3.5   36.2   -347013.0 -1306723.9   62

ORB BIASES(M)  ACCR=     .1 ALG=   13.4 OUT=    6.7      VPV=    236.8942 DTVPV=   34.93

19      15   16  0      PASS=  11 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  16 4    1020. -40.0 -3.1    -22.25    356    5.9   41.4   -438252.6 -1556611.9   61
SKATE 16 6    1020. -40.0 -3.1    -34.41    346    3.6   48.0   -347013.8 -1306724.5   62

ORB BIASES(M)  ACCR=    -.1 ALG=   12.0 OUT=   -9.4      VPV=    255.6967 DTVPV=   18.80

19      15   17 46      PASS=  12 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  1750    1020. -40.0 -3.1    -22.23    417   21.3   68.0   -438251.9 -1556610.4   61
SKATE 1752    1020. -40.0 -3.1    -34.39    280    3.0   72.7   -347012.9 -1306722.4   62

ORB BIASES(M)  ACCR=    5.0 ALG=    -.1 OUT=   -1.5      VPV=    314.1762 DTVPV=   58.48

19      15   19 34      PASS=  13 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  1935    1020. -40.0 -3.1    -22.24    357   19.9   71.2   -438257.7 -1556614.6   61
SKATE 1938    1020. -40.0 -3.1    -34.42    342   27.9   72.9   -347018.2 -1306726.1   62

ORB BIASES(M)  ACCR=    8.3 ALG=    1.4 OUT=   -2.7      VPV=    385.0107 DTVPV=   76.83

20      15   21  0      PASS=  14 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
SKATE 21 4    1020. -40.0 -3.1    -34.59    351  -29.7   85.1   -347016.6 -1306720.5   62

++++ ABOVE PASS REJECTED AT 99% PROB.LEVEL - REJECTION NO. =   3

ORB BIASES(M)  ACCR=   28.8 ALG=   15.5 OUT=    6.1      VPV=    385.0107 DTVPV=  106.44

19      15   21 20      PASS=  15 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  2124    1020. -40.0 -3.1    -22.20    356   19.7   42.5   -438256.9 -1556615.3   61
SKATE 2128    1020. -40.0 -3.1    -34.37    343   -7.5   47.5   -347017.3 -1306726.7   62

ORB BIASES(M)  ACCR=    3.0 ALG=   -6.9 OUT=    7.3      VPV=    415.5124 DTVPV=   30.50

20      15   22 40      PASS=  16 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  2254    1020. -40.0 -3.1    -22.45    326    8.6   49.7   -438254.7 -1556615.0   61
SKATE 2244    1020. -40.0 -3.1    -34.63    375   11.5   54.3   -347015.3 -1306726.4   62

ORB BIASES(M)  ACCR=    2.7 ALG=   16.9 OUT=  -15.8      VPV=    468.5105 DTVPV=   53.00

19      15   23 10      PASS=  17 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH  2314    1020. -40.0 -3.1    -22.18    336    4.1   29.4   -438254.7 -1556613.9   61
SKATE 2314    1020. -40.0 -3.1    -34.37    363   10.7   35.3   -347015.4 -1306725.2   62

ORB BIASES(M)  ACCR=    -.2 ALG=   -4.8 OUT=   -6.9      VPV=    483.5249 DTVPV=   15.01

20      16   0 26      PASS=  18 IEND=   0

ST.NO H MN    PRESS  TEMP  PWP      FREQ.  DELAY  TROP&   ELEV          X             Y
EACH   030    1020. -40.0 -3.1    -22.41    357   -4.9   28.9   -438254.2 -1556613.9   61
SKATE  030    1020. -40.0 -3.1    -34.61    342   -9.7   34.4   -347015.0 -1306725.2   62
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ORB BIASES(M)  ACCR=   -3.2 ALG=    4.4 OUT=   -8.1      VPV=    524.0837 DTVPV=   40.56

 19      16     0 36      PASS=  19 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH    1 6   1020.-40.0 -3.1   -22.17     349   9.8  26.2  -438254.3 -1556612.7   61
SKATE    1 2   1020.-40.0 -3.1   -34.77     355   6.7  32.4  -347015.1 -1306724.0   62

ORB BIASES(M)  ACCR=    1.4 ALG=    4.0 OUT=   -9.0      VPV=    558.9832 DTVPV=   34.90

 14      16     1 36      PASS=  20 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  140     1020.-40.0 -3.1   -22.23     363  14.1  25.2  -438254.4 -1556613.5   61
SKATE  140     1020.-40.0 -3.1   -34.44     337   4.8  31.2  -347015.4 -1306724.8   62

ORB BIASES(M)  ACCR=    3.5 ALG=   16.5 OUT=   -4.9      VPV=    578.6470 DTVPV=   19.86

 20      16     2 10      PASS=  21 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  214     1020.-40.0 -3.1   -22.39     431 -10.5  21.1  -438254.3 -1556613.1   61
SKATE  214     1020.-40.0 -3.1   -34.63     267 -16.3  26.8  -347015.7 -1306724.3   62

ORB BIASES(M)  ACCR=   -2.8 ALG=   -6.6 OUT=    4.5      VPV=    623.8661 DTVPV=   45.02

 19      16     2 48      PASS=  22 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  254     1020.-40.0 -3.1   -22.14     362   2.6  31.0  -438254.8 -1556613.3   61
SKATE  252     1020.-40.0 -3.1   -34.36     338  10.1  37.4  -347016.2 -1306724.6   62

ORB BIASES(M)  ACCR=    1.5 ALG=    6.7 OUT=    6.1      VPV=    674.2215 DTVPV=   50.36

 14      16     3 20      PASS=  23 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  324     1020.-40.0 -3.1   -22.22     394  -7.0  35.6  -438254.8 -1556613.9   61
SKATE  326     1020.-40.0 -3.1   -34.43     365    .2  41.8  -347016.3 -1306724.8   62

ORB BIASES(M)  ACCR=     .8 ALG=   -3.1 OUT=    -.1      VPV=    700.8684 DTVPV=   28.85

 20      16     3 54      PASS=  24 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  350     1020.-40.0 -3.1   -22.28     359   7.4  40.8  -438254.4 -1556613.1   61
SKATE  348     1020.-40.0 -3.1   -34.60     349 -11.6  36.6  -347016.8 -1306724.2   62

ORB BIASES(M)  ACCR=     .1 ALG=   -3.9 OUT=    8.1      VPV=    730.0423 DTVPV=   29.17

 19      16     4 36      PASS=  25 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  440     1020.-40.0 -3.1   -22.14     412  -3.8  46.8  -438254.5 -1556612.4   61
SKATE  440     1020.-40.0 -3.1   -34.35     289   -.2  52.9  -347015.9 -1306723.8   62

ORB BIASES(M)  ACCR=   -2.8 ALG=   14.9 OUT=     .3      VPV=    763.4547 DTVPV=   33.41

 14      16     5 10      PASS=  26 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  514     1020.-40.0 -3.1   -22.17     370  -7.5  60.4  -438255.1 -1556610.3   61
SKATE  512     1020.-40.0 -3.1   -34.33     328  -3.3  65.3  -347016.5 -1306721.9   62

ORB BIASES(M)  ACCR=    2.2 ALG=   -9.5 OUT=  -18.3      VPV=    785.0953 DTVPV=   21.64

 20      16     5 36      PASS=  27 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  540     1020.-40.0 -3.1   -22.36     260   3.9  27.7  -438254.9 -1556610.1   61
SKATE  542     1020.-40.0 -3.1   -34.58     438   1.3  34.1  -347016.1 -1306721.9   62

ORB BIASES(M)  ACCR=   -2.2 ALG=   -2.3 OUT=    3.8      VPV=    819.6505 DTVPV=   34.56

 14      16     6 52      PASS=  28 IEND=    0

 ST.NO  H MN    PRESS TEMP PWP      FREQ   DELAY TROP%  ELEV          X             Y
REACH  656     1020.-40.0 -3.1   -22.17     380   3.5  75.7  -438253.5 -1556608.8   61
SKATE  658     1020.-40.0 -3.1   -34.39     321  -6.2  78.2  -347014.7 -1306720.6   62
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E BIASES(M)  ACCR=    2.8 ALG=   -1.8 OUT=    7.2      VPV=   860.9520 DTVPV=   49.30

9      16     3 10      PASS=  29 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH   814   1020.-46.0 -3.1   -22.15    396   13.1  44.1  -438254.4 -1556609.2   614
SKATE   814   1020.-46.0 -3.1   -34.53    307    2.1  52.5  -347015.7 -1306721.0   621

RB BIASES(M)  ACCR=   -3.2 ALG=    1.7 OUT=   12.4      VPV=   913.7119 DTVPV=   44.76

14      16     8 40      PASS=  30 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH   844   1020.-46.0 -3.1   -22.19    396   13.1  44.1  -438254.5 -1556609.4   614
SKATE   848   1020.-46.0 -3.1   -34.41    301     .5  49.7  -347015.6 -1306721.1   621

RB BIASES(M)  ACCR=    7.1 ALG=    2.6 OUT=    3.5      VPV=   943.7392 DTVPV=   30.03

13      16     9 24      PASS=  31 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH   928   1020.-40.0 -3.1   -22.39    315    4.5  39.9  -438254.7 -1556609.6   614
SKATE   930   1020.-40.0 -2.1   -34.62    386    2.9  37.3  -347015.7 -1306721.4   621

RB BIASES(M)  ACCR=    -.8 ALG=    9.1 OUT=   -6.5      VPV=   977.0896 DTVPV=   33.35

9      16     9 56      PASS=  32 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  10 0   1020.-40.0 -3.1   -22.08    394     .3  37.1  -438255.0 -1556608.0   614
SKATE  10 0   1020.-40.0 -3.1   -34.32    305   -7.8  42.9  -347016.2 -1306720.9   621

RB BIASES(M)  ACCR=   -3.2 ALG=    2.2 OUT=   10.9      VPV=  1009.5733 DTVPV=   32.48

4      16    10 28      PASS=  33 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  1032   1020.-40.0 -3.1   -22.15    356    -.4  29.9  -438255.9 -1556609.0   614
SKATE  1032   1020.-40.0 -3.1   -34.38    345    -.2  36.3  -347016.1 -1306720.8   621

RB BIASES(M)  ACCR=   -1.5 ALG=   -7.6 OUT=   -2.0      VPV=  1036.0856 DTVPV=   26.51

19      16    12 26      PASS=  34 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  1330   1020.-40.0 -3.1   -22.10    281   12.5  27.5  -438254.6 -1556608.8   614
SKATE  1330   1020.-40.0 -3.1   -34.35    320    -4.4  35.9  -347015.9 -1306720.6   621

RB BIASES(M)  ACCR=     .5 ALG=   16.4 OUT=    8.2      VPV=  1083.9819 DTVPV=   47.90

14      16    14  6      PASS=  35 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  1412   1020.-40.0 -3.1   -22.15    397   -8.6  31.5  -438254.6 -1556608.2   614
SKATE  1410   1020.-40.0 -3.1   -34.40    306   -8.3  38.4  -347015.8 -1306720.2   621

RB BIASES(M)  ACCR=   -2.7 ALG=    -.3 OUT=   -7.8      VPV=  1163.9278 DTVPV=   79.95

48      16    14 34      PASS=  36 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  1428   1020.-40.0 -3.1   -22.19    273   20.2  51.7  -438254.7 -1556609.7   614
SKATE  1438   1020.-40.0 -3.1   -34.41    427   80.6  56.3  -347015.8 -1306721.5   621


+++ ABOVE PASS REJECTED AT 99% PROB LEVEL - REJECTION NO. =   4

ORB BIASES(M)  ACCR=   16.0 ALG=    5.8 OUT=    -.1      VPV=  1163.9278 DTVPV=  203.42

9      16    15 12      PASS=  37 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
REACH  1516   1020.-40.0 -3.1   -22.01    320   14.9  34.9  -438254.5 -1556608.3   614
SKATE  1516   1020.-40.0 -3.1   -34.31    379    5.1  41.6  -347015.6 -1306720.3   621

RB BIASES(M)  ACCR=    1.1 ALG=      5 OUT=    3.5      VPV=  1210.7180 DTVPV=   46.78

14      16    15 54      PASS=  38 IEND=    0

ST.NO H MN    PRESS TEMP PWP      FREQ. DELAY TROPS  ELEV          X             Y
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REACH  1558   1020.-40.0 -3.1   -22.10   334   0.5   46.1   -438254.8 -1556607.9   614
SKATE  1558   1020.-40.0 -3.1   -34.33   [illegible]   [illegible]   [illegible]   -347015.8 -1306720.0   621

ORB BIASES(M)  ACCR=  -6.3 ALG=  [illegible] OUT= [illegible]   VPV=  1267.5350 DTVPV=  56.56

 19     16   16 56     PASS=  39 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  17 0   1020.-40.0 -3.1   -22.08   506  16.6  54.2  -438255.6 -1556608.4   614
SKATE  17 2   1020.-40.0 -3.1   -34.32   209   6.7  60.2  -347016.6 -1306720.3   621

+++ ABOVE PASS REJECTED AT 99% PROB.LEVEL - REJECTION NO. =   5

ORB BIASES(M)  ACCR=   1.5 ALG=   1.7 OUT= -26.4     VPV=  1267.5350 DTVPV= 107.86

 0      16   18  0     PASS=  40 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  18 6   1020.-40.0 -3.1   -22.29   394   8.5  31.4  -438254.7 -1556607.6   614
SKATE  18 4   1020.-40.0 -3.1   -34.55   308  -2.2  37.7  -347015.7 -1306719.7   621

ORB BIASES(M)  ACCR=  -1.5 ALG=  21.7 OUT=  -4.7     VPV=  1287.5805 DTVPV=  20.05

 4      16   19 20     PASS=  41 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  1932   1020.-40.0 -3.1   -22.08   363   1.9  55.0  -438254.4 -1556607.4   614
SKATE  1932   1020.-40.0 -3.1   -34.34   336    .9  58.5  -347015.5 -1306719.6   621

ORB BIASES(M)  ACCR=   -.3 ALG=  -4.4 OUT=  -4.6     VPV=  1300.9215 DTVPV=  13.34

 19     16   20 30     PASS=  42 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  2034   1020.-40.0 -3.1   -22.07   405  10.6  52.5  -438254.0 -1556607.3   614
SKATE  2036   1020.-40.0 -3.1   -34.31   297  -3.4  58.5  -347014.9 -1306719.4   621

ORB BIASES(M)  ACCR=   7.3 ALG= -11.7 OUT=   6.8     VPV=  1385.1401 DTVPV=  84.22

 14     16   21 14     PASS=  43 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  2118   1020.-40.0 -3.1   -22.06   395   8.1  33.8  -438254.2 -1556607.3   614
SKATE  2120   1020.-40.0 -3.1   -34.32   302  -3.0  38.8  -347015.1 -1306719.4   621

ORB BIASES(M)  ACCR=   1.9 ALG= -10.3 OUT=   4.9     VPV=  1409.1546 DTVPV=  24.01

 4      16   22 58     PASS=  44 IEND=   0

 ST.NO H MN   PRESS TEMP PWP     FREQ. DELAY TROP% ELEV        X             Y
REACH  23 4   1020.-40.0 -3.1   -22.05   411 -13.9  24.5  -438254.2 -1556607.4   614
SKATE  23 2   1020.-40.0 -3.1   -34.31   287  -2.2  30.1  -347015.3 -1306719.5   621

ORB BIASES(M)  ACCR=  -2.5 ALG= -18.2 OUT=  -4.7     VPV=  1468.8685 DTVPV=  59.71
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FB 33383

P H A S E S O L U T I O N - S U M M A R Y

COVARIANCE MATRIX OF X, Y, Z

```
3.18    .01  -.05  3.16  -.01  -.04  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
      4.91  -.55   .02  4.78  -.38  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
             .75  -.04  -.50   .63  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                  3.25  -.02  -.04  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                        4.78  -.38  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                               .61  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                    574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                           574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                  574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                         574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                574.1  0.00  0.00  0.00  0.00  0.00  0.00
                                                                       574.1  0.00  0.00  0.00  0.00  0.00
                                                                              574.1  0.00  0.00  0.00  0.00
                                                                                     574.1  0.00  0.00  0.00
                                                                                            574.1  0.00  0.00
                                                                                                   574.1  0.00
                                                                                                          574.1
```

CORRELATION MATRIX OF X,Y,Z

```
1.01   .00  -.03   .98  -.00  -.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  -.29   .00   .99  -.22  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.00  -.03  -.27   .94  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  -.01  -.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  -.22  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00  0.00
1.01  0.00  0.00  0.00
1.01  0.00  0.00
1.01  0.00
1.01
```

PASS SUMMARY

TOTAL PROCESSED	= 44	REJECTED ON 99 %	= 5
NUMBER REJECTED	= 5	REJECTED ON ZERO DEG FROM	= 0
NUMBER ACCEPTED	= 39	REJECTED ON 14.5 DEG ELEV	= 0
NUMBER OF STATIONS	= 2		
UNKNOWN STATIONS	= 2	DOPPLERS REJECTED ON 99 %	= 203

THE SQUARE SUM OF RESIDUALS VPV = 1468.86846
ACCUMULATED DEG. OF FREEDOM = 1598
EST. STD. DEV. OF UNIT WEIGHT SO = .958

NAME	CODE	WEIGHT	LATITUDE	LONGITUDE	ELLIPSOID HEIGHT	NAME
REACH	0	20.00	75 21 37.175	254 16 31.609	13.07	REACH
SKATE	0	20.00	77 48 15.136	255 8 31.519	-3.04	SKATE

NAME	X	Y	Z	STANDARD DEVIATIONS LAT	LONG	HEIGHT	NAME
REACH	-4382271.04	-1556637.65	6148887.94	2.065	1.817	1.126	REACH
SKATE	-2466301.57	-1306595.29	6212177.04	2.081	1.832	.970	SKATE

COVARIANCE MATRIX OF X, Y, Z

```
3.18    .01  -.05  3.16  -.01  -.04  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
      4.91  -.55   .02  4.78  -.38  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
             .75  -.04  -.50   .63  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                  3.25  -.02  -.04  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                        4.78  -.38  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                               .61  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                    574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                           574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                  574.1  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                         574.1  0.00  0.00  0.00  0.00  0.00  0.00
                                                                574.1  0.00  0.00  0.00  0.00  0.00
                                                                       574.1  0.00  0.00  0.00  0.00
                                                                              574.1  0.00  0.00  0.00
                                                                                     574.1  0.00  0.00
                                                                                            574.1  0.00
                                                                                                   574.1
```

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574.1 0.00
574.1

CORRELATION MATRIX OF X,Y,Z

```
1.01   .00 -.03   .98 -.00 -.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 -.29   .00   .99 -.22 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.00 -.03 -.27   .94 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 -.01 -.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 -.22 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00 0.00 0.00
1.01 0.00 0.00 0.00
1.01 0.00 0.00
1.01 0.00
1.01
```

ACS SUMMARY

TOTAL PROCESSED	= 44	REJECTED ON 99 %	= 5
NUMBER REJECTED	= 5	REJECTED ON ZERO DEG FRDM	= 0
NUMBER ACCEPTED	= 39	REJECTED ON 14.5 DEG ELEV	= 0
NUMBER OF STATIONS	= 2		
UNKNOWN STATIONS	= 2	DOPPLERS REJECTED ON 99 %	= 203

THE SQUARE SUM OF RESIDUALS VPV = 1468.86846
ACCUMULATED DEG. OF FREEDOM = 1599
STD. STD. DEV. OF UNIT WEIGHT SO = .958

NAME	CODE	WEIGHT	LATITUDE	LONGITUDE	ELLIPSOID HEIGHT	NAME
REACH	0	20.00	75 21 37.175	254 16 31.600	13.07	REACH
SKATE	0	20.00	77 48 15.136	255 8 31.519	-3.04	SKATE

NAME	X	Y	Z	STANDARD DEVIATIONS LAT	LONG	HEIGHT	NAME
REACH	-438271.04	-1556637.65	6148887.94	2.065	1.817	1.126	REACH
SKATE	-346630.57	-1306595.29	6212177.04	2.081	1.832	.970	SKATE

** SUMMARY ADJUSTED WITH RESPECT TO STATION 1, NAME = REACH

NAME	LATITUDE	LONGITUDE	HEIGHT	N	NAME
REACH	75 21 37.177	254 16 31.896	22.34	0.00	REACH
SKATE	77 48 15.124	255 8 31.867	6.22	0.00	SKATE

NAME	X	Y	Z	NAME
REACH	-438269.43	-1556640.49	6148896.92	REACH
SKATE	-346628.96	-1306598.13	6212186.02	SKATE

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OFFSHORE WELLSITE AND GRID UTM COORDINATES

WEST LONGITUDE OF CENTRAL MERIDIAN = 105 0 0.000
U.T.M. NORTH AMERICAN ZONE DESIGNATION = 13
SECTION 59
UNIT C

LOCATION		LATITUDE	W.LONGITUDE	U.T.M.NORTHING	U.T.M.EASTING
WELL SITE		77 48 15.124	104 51 28.133	8636381.472	503353.268
GRID CORNER	NE	77 49 60.000	104 29 60.000	8639678.852	511764.039
GRID CORNER	SE	77 39 60.000	104 29 60.000	8621078.942	511922.662
GRID CORNER	SW	77 39 60.000	105 0 0.000	8621028.120	500000.000
GRID CORNER	NW	77 49 60.000	105 0 0.000	8639628.674	500000.000
SECTION CORN	NE			8637787.460	504417.463
SECTION CORN	SE			8635927.428	504423.411
SECTION CORN	SW			8635921.140	502948.941
SECTION CORN	NW			8637781.179	502944.975
UNIT CORNER	NE			8636389.293	503684.937
UNIT CORNER	SE			8635924.284	503686.176
UNIT CORNER	SW			8635922.712	503317.558
UNIT CORNER	NW			8636387.722	503316.443

SECTION CORNER	BEARING	DISTANCE	SECTION CORNER
NE	179 49 .369	1860.04	SE
SE	269 45 20.330	1474.48	SW
SW	359 52 40.247	1860.04	NW
NW	89 45 20.274	1472.50	NE

UNIT CORNER	BEARING	DISTANCE	UNIT CORNER
NE	179 50 50.308	465.01	SE
SE	269 45 20.326	368.62	SW
SW	359 51 45.278	465.01	NW
NW	89 45 20.321	368.50	NE

RIGHT ANGLE TIES

FROM WELL SITE TO NW CORNER

BEARING	DISTANCE
269 51 45.28	36.81
359 51 45.28	6.34

BEARING	DISTANCE
359 45 20.32	6.41
269 45 20.24	36.80