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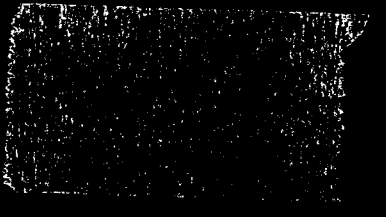
Holmes & Narver, Inc.
Engineers - Constructors

1949-50 HORIZONTAL CONTROL SURVEY
ENIWETOK ATOLL, MARSHALL ISLANDS

T/S No. 3



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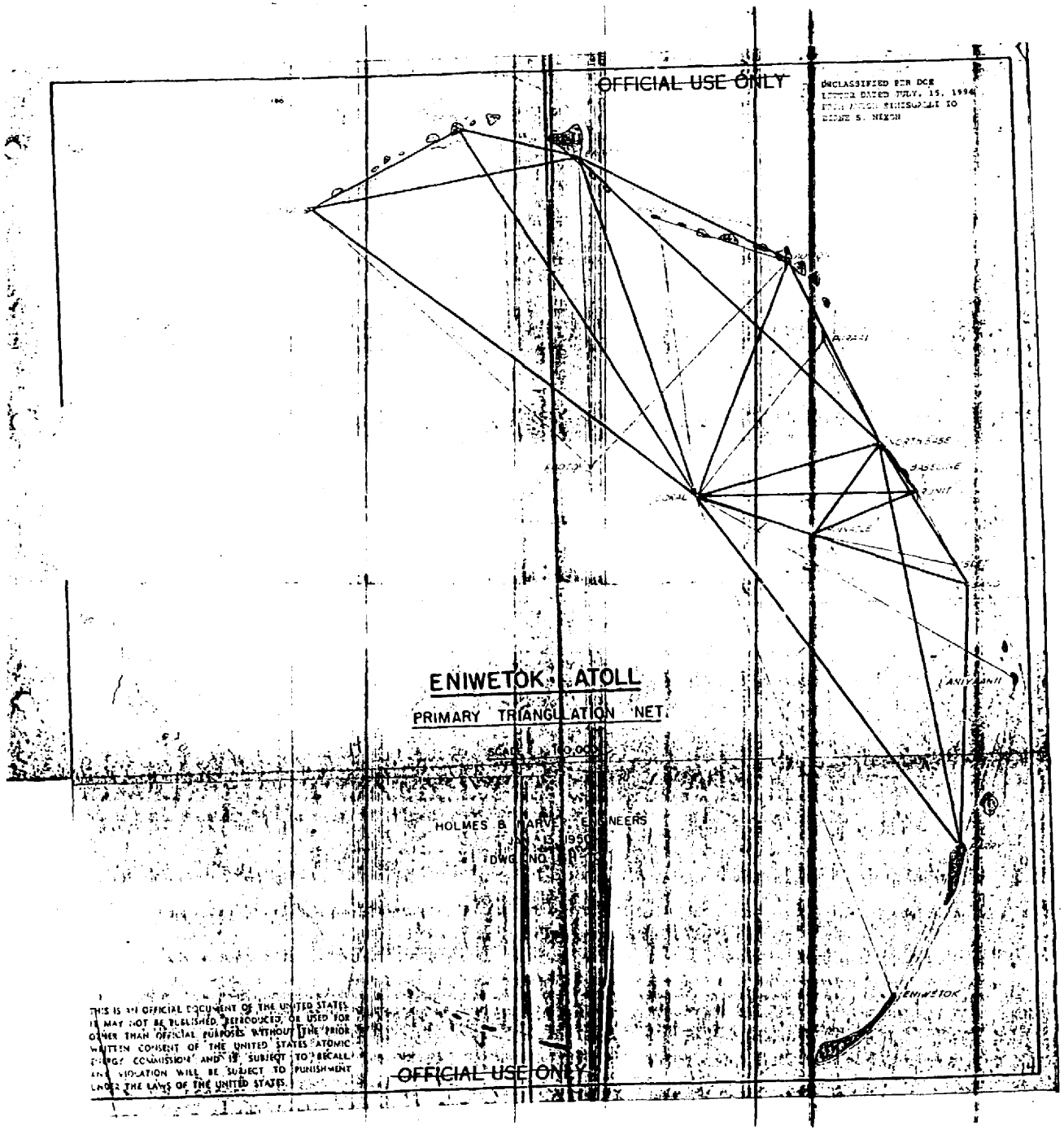
OFFICIAL USE ONLY
DECLASSIFIED PER DOE
LETTER DATED JULY, 15, 1994
FROM ANTON SINISGALLI TO
DIANE S. NIXON
NORTH BASE
BASELINE
RUNIT
CORAL
ANIYAANII
ENIWETOK
ENIWETOK ATOLL
PRIMARY TRIANGULATION NET
HOLMES & NARVER, ENGINEERS
JAN 13, 1950
DWG. NO.
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HORIZONTAL CONTROL SURVEY
ENIWETOK ATOLL
MARSHALL ISLANDS
1949-50

NATIONAL ARCHIVES
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HOLMES - NARVER
FOLDER 1949-50 HORIZONTAL CONTROL SURVEY ENIWETOK ATOLL, MARSHALL ISLANDS J/S No. 3

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Vertical control

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A scheme of second order triangulation composed of check figures was executed from a second order base line on Runit Island. The scheme extends northward to Bogallua Island and southward to Eniwetok Island. The survey was for the purpose of coordinating local surveys on project islands and to establish distances and azimuths between certain installations.

Standard procedure and specifications of the U.S. Coast and Geodetic Survey for second order triangulation was the criteria for this survey. The geometry of the scheme was checked by the Los Angeles Office of that organization before field work started and the results of observing the scheme were checked as to procedure in January of this year.

The scheme was so executed that it can be expanded to include the complete atoll and where possible the permanency of station locations was considered. All station markers on project islands were referenced. Referencing of the two stations in the lagoon and on the sand spits south of Runit Were not pratical.

Two previous surveys have been made of the eastern portions of the atoll. As stated in the reconnaissance report of January 7, 1949 these surveys were not readily adapted to the requirements of this project and were necessarily reoccupied to expand the present scheme.

The U.S.S. BOWDITCH SURVEY made in 1944 was of third order accuracy and covered the eastern portion of the atoll from Igurin to Bogumbogo. The apparent purpose was hydrographic charts of the atoll. It included a base line on Runit Island and control points on eleven other islands, also a station in the lagoon in the vicinity of the existing station, Coral. The geographical position of station North Base on Runit Island and the azimuth of the base line between stations North Base and South Base were determined by astronomical observations. As most of the stations on this survey were not on project islands and the reoccupation of its stations would have been necessary in any case for system expansion the values found in th e U.S.S. Bowditch Survey were not incorporated into the present survey, except that the Joint Task Force Seven Survey determination of the latitude and longitude of station Runit was based on the original geographical position of station North

Base as established by this survey. Also, the azimuth of the line North Base-Sand was accepted.

The JOINT TASK FORCE SEVEN SURVEY made in 1947-48 and covering the eastern portion of the lagoon from Aniyaanii to Engebi, consisted of a limited scheme with stations on Engebi, Aoman, Runit and Aniyaanii and station Coral in the lagoon.

The scheme was stated to be of first order accuracy and first order procedure was used. However, the base expansion figure was not consistant with specifications of the U.S. Coast and Geodetic Survey and it was only because of the limited extent of the scheme that it could be considered of a high order of accuracy.

Of the seven stations included in this survey, station Graflex on Aoman Island had been destroyed and the station on Aniyaanii was of little value in expanding the scheme. To establish a new station on Aoman for the present survey required reoccupying three of the five remaining stations. It thus was apparent that the expanded requirements of the present survey involved re-establishment of a complete triangulation network.

Station South Base of the U.S.S. Bowditch Survey was not recovered and a new station "Runit" was established at the south end of the island. The line North Base-Runit became the base line of this survey.

The geographical position of station North Base and the azimuth of the line North Base-Sand as established by the U.S.S. Bowditch Survey were accepted and became the origin of position and azimuth. Although the original azimuth observations were made from station North Base to station South Base an examination of the corrections obtained for the angle in the U.S.S. Bowditch triangulations showed that but little accuracy would be lost by accepting the azimuth of the line from station North Base to station Sand as the basis of azimuths for the survey. Therefore it was considered that reobservation for azimuth was not justified.

The line North Base-Runit was measured to first order accuracy and the azimuth of the line was computed from its relation to the line N. Base-Sand.

The computations involved in establishing the azimuth of this new base line have been checked and are included here for reference purposes.

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A copy of the Report of the Engineer, Joint Task Force Seven, Part 2 was made available to us and has been of great assistance in planning and executing this survey.

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Location of Control Points

To meet the requirements of the present project, a horizontal net has been established consisting of fifteen stations, including five stations of the Joint Task Force Seven Survey. Two of these five were original stations of the U.S.S. Bowditch Survey, and an additional station of that survey on Eniwetok is also included. Stations are located so that all project islands are tied in directly to the scheme or can be tied in by local triangulation. A new station in the lagoon off the south end of Runit Island was established to strengthen the base expansion quadrangle.

Where practical, stations have been given the name of the island on which they are located. This was done to simplify reference to these stations. Some of the U.S.S. Bowditch and Joint Task Force Seven stations have been renamed and reference to this is made in the station recovery notes. The stations of the survey and location are as follows:

BOGA -------- Bogallua Island
Teiteir ----- Teiteiripucchi Island
Engebi ------ Engebi Island
Bokon ------- Bokonaarappu Island
Aomon ------- Aomon Island
Piiraai ----- Piiraai Island
North Base -- Runit Island
Runit ------- Runit Island
Coral ------- In lagoon
Pinnacle ---- In lagoon
Photo ------- Photo tower in lagoon
Islet ------- First sand island south of Runit
Sand -------- Third sand island south of Runit
Aniyaanii --- Aniyaanii Island
Parry ------- Parry Island
Eniwetok ---- Eniwetok Island

The islands of Muzinbaarikku, Kirinian and Aaraaubiru will be tied in by local triangulation. Japtan is not included in present control requirements but can be tied in by the same method if desired.

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Geographic Position and Azimuth

In the interests of economy and because we concurred with the Joint Task Force Seven Survey that little accuracy would be lost, it was our intention to accept the geographical position of station North Base and the azimuth of the new base line as the origin of position and azimuth for the present survey. Also the length of the base line would be accepted.

In observing for the present survey the base expansion quadrangle was observed last due to the necessity of constructing the new station, Pinnacle, in the lagoon. The results obtained indicated that the present location of the marker was eccentric to the position from which the Task Force Seven observations were taken and could not be accepted as the point of origin of the present survey. A computed difference of approximately four tenths of a foot in a northeasterly direction was found. This difference may have been caused by physical displacement of the monument.

The Los Angeles office of the U.S.C.& G.S. concurred in the conclusion that station North Base could not be accepted as being in its true position, also in the decision to measure the line from the present position of station North B ase to station Runit to establish a base line for the present survey. The geographical position of station Runit and the azimuth of the line from station Runit to station Coral would be accepted for position and azimuth as the limited extent of the adjustments involved would not appreciably effect the accuracy requirements of this project.

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Field Procedure

A reconnaissance of all locations involved was made and markers set for the triangulation stations. Actual observing on this survey started in October, 1949.

The observing party consisted of an observer, recorder and a varying number of light tenders. The party was quartered on an L.C.T. which moved to convenient points in the lagoon as required. An L.C.M. and a DUKW were used for transportation to the stations, and when practical, planes were used between the islands having landing strips.

Four Bilby steel towers were available for the survey and were moved to new stations as the survey progressed. Where low towers could be used they were constructed of wood. The towers were adequately braced and little vibration was experienced. All observing was at night using lights for targets. A Wild T-2 theodolite was used for observing and found to be very satisfactory. Some difficulty was experienced with the exterior lighting probably due to moisture. Station lights were constructed from U.S. Navy battle lamps by installing a reostat. This made it possible to dim the lights to correct intensity and they made a satisfactory target.

Continuous inter-station communications were considered necessary due to the remote location of the stations. This was realized by using U.S. Army Type 619 portable radios. Considerable time was saved by this means of communication as the light intensity could be adjusted instantly and changes in plans could be transmitted to all personnel involved. This was often necessary due to weather conditions.

The observing was done at a period of the year when considerable rain and high wind velocity was experienced. Some time was lost due to weather both in being unab le to get to the stations and poor visibility while occupying the stations.

Water transportation was adequate but necessarily slow and the personnel were usually away from the base of operations fourteen to sixteen hours.

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Travel after dark in the lagoon was considered dangerous and the personnel were distributed before dark and picked up after sunrise in the morning.

Observing procedure consisted of adjusting the intensity of the station lights to the minimum which could be observed thereby obtaining a small targer considering the distance involved. This was done as early in the evening as sufficient darkness was obtained and from one to three sets of six positions each were observed. Due to weather it was sometimes only possible to complete one satisfactory set in an evening. From two to five hours were spent in observing. When results obtained were within the specifications of the U.S. Coast and Geodetic Survey no attempt was made to obtain further refinement.

The strength of figures obtained for the net was an RI of 74.4 with a maximum of 130 allowed.

A maximum triangle closure of 2.5 seconds and an average closure of 1.3 seconds was obtained with the maximum of 8 seconds for one triangle and 3 seconds for the average closure allowed by specifications.

The RUNIT BASE LINE is a broken base consisting of four sections connecting the two stations, North Base and Runit. This was necessary due to the configuration of the island. Traverse Station Runit of the Joint Task Force Seven Survey is an angle point in this traverse and was also included in the former traverse.

Standard procedure of the U.S. Coast and Geodetic Survey for second order base line measurement was used. Angles were measured with the Wild T-2 theodolite and the measurement was made with three Lovar tapes using thermometers and stretcher apparatus of an approved type. The calibration certificates of these tapes are included in the record of the survey.

Stakes were set at fifty meter intervals for chaining points and the tapes were alternated so that in completing the forward and backward measurement all three tapes were used in each direction.

Due to the velocity of the wind at this period of the year it was necessary to use a wind break in order to obtain accurate results. This consisted of a thirty

six inch strip of canvas approximately fifty five meters long which was held parallel to the line as each measurement was made.

The computed probable error of the total measurement is 1 part in 648,000. The allowable maximum probable error is one part in 500,000.

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GEOGRAPHIC POSITIONS

LOCALITY *Eniwetok Atoll Marshall Islands* DATUM *Eniwetok Astronomic 1944* *Second* ORDER TRIANGULATION

STATION	LATITUDE AND LONGITUDE	SECONDS IN METERS	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE		
						LOGARITHM METERS	METERS	FEET
North Base	11-33-23.267N		322-47-25.7	142-47-36.1	Runit	3.4136308	2591.9749	8503.84
	162-21-09.893E		327-56-56.1	147-56-19.5	Sand	3.8247895	6680.20	21916.6
			35-25-51.4	215-25-34.5	Pinnacle	3.6455679	4421.48	14506.1
			75-02-07.9	255-01-20.1	Coral	3.8747533	7494.68	24588.8
			156-30-13.8	336-29-53.3	Aoman	3.8906165	7773.50	25503.6
			154-55-56.7	334-55-44.2	Piiraai	3.6491067	4457.66	14624.8
Runit	11-32-16.080N		331-25-38.2	151-25-48.3	Islet	3.5087376	3226.54	10585.7
	162-22-01.621E		69-34-34.8	249-34-07.5	Pinnacle	3.6442259	4407.84	14461.4
			142-47-36.1	322-47-25.7	North Base	3.4136308	2591.9749	8503.84
Coral	11-32-20.254N		255-01-20.1	75-02-07.9	North Base	3.8747533	7494.68	24588.8
	162-17-10.944E		289-02-53.4	109-04-04.5	Sand	4.0573318	11411.21	37438.3
			289-36-26.8	109-36-57.6	Pinnacle	3.6959722	4965.61	16291.3
			300-55-07.4	120-56-28.8	Aniyaanii	4.1585639	14406.68	47265.9
			324-04-06.6	144-05-13.0	Parry	4.2360560	17220.90	56498.9
			339-03-46.6	159-04-35.0	Eniwetok	4.3156485	20684.66	67862.9
			129-41-52.8	309-40-17.6	Boga	4.2705251	18643.40	61165.9
			148-59-31.2	328-58-32.4	Teiteir	4.2344911	17158.96	56295.7
			163-08-27.9	343-08-00.5	Engebi	4.1517262	14181.63	46527.6
			174-25-39.0	354-25-31.8	Bokon	4.0480178	11169.09	36643.9
			204-32-29.8	24-32-57.2	Aoman	3.9984988	9965.49	32695.1
			221-50-49.3	41-51-24.7	Piiraai	3.9041724	8019.96	26312.2

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DIRECTION COMPUTATIONS

HOLMES & NARVER ENGINEERS JOB No. 640

LIST OF DIRECTIONS

STATION ANIYAANII (Kodak) DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Parry	0° 00' 00.00"			0° 00' 00.00"	
Coral	101-54-26.6	-			
R.M. No. I 17.495 M	214-55-42.6	-			
Photo Tower 21.425 M	304-50-46.2	-			
R.M. No. 2 33.778 M	326-01-28.6	-			

No eccentricity of lights or instrument at this station

Observations made from a 16 foot wood tower

Reference marks were established by the Joint Task Force Seven Survey

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LIST OF DIRECTIONS

STATION AOMON (Aomon Trav. Sta.) DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LSH

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Photo	21-49-02.8	-			
Bokon	86-53-44.1	-			
Engebi	94-05-58.5	-			
R.M. No. I 22.860 M	188-08-10.0	-			
R.M. No. 2 22.860 M	278-08-10.0	-			
N. Base	311-56-56.4	-			

No eccentricity of lights or instrument at this station

Observations taken from 40 foot steel tower

Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION BOGA DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Photo	6-48-04.0	-			
R.M. No. I 59.015 M	94-53-50.0	-			
R.M. No. 2 36.576 M	154-54-00.0	-			
Teiteir	293-21-24.7	-			
Engebi	311-03-56.3	-			

No eccentricity of lights or instrument at this station

Observations made from 40 foot steel tower

Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION BOKON DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Aomon	0° 00' 00.00"			0° 00' 00.00"	
Coral	62-59-24.7	-			
R.M. No. I 15.240 M	207-24-12.2	-			
R.M. No. 2 15.240 M	279-24-12.2	-			

No eccentricity of lights or instrument at this station

Observations made from a 15 foot wood tower

Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION CORAL DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
N. Base	0° 00' 00.00"			0° 00' 00.00"	
Runit	15-48-14.6	-			
Sand	34-01-32.5	-			
Pinnacle	34-35-07.2	-			
Aniyaanii	45-53-47.1	-			
Parry	69-02-46.3	-			
Eniwetok	84-03-20.2	-54.0			82-26.2
Boga	234-40-334	-			
Teiteir	253-58-12.8	-			
Engebi	268-07-08.7	-			
Bokon	279-24-194	-			
Aomon	309-31-10.1	-			
Piiraai	326-49-29.3	-			

No eccentricity of lights or instrument at this station

Observations made from a 14 foot wood tower set on existing circular concrete cell

No reference marks set

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LIST OF DIRECTIONS

STATION ENGEBI (Elgin) DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY FPC

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Photo	17-01-02.5	-			
Boga	97-37-22.0	-			
Teiteir	120-21-30.3	-			
R.M. No. I 15.240 M	105-11-10.0	-			
R.M. No. 2 15.240 M	195-11-10.0	-			
Aomon	315-30-01.4	-			
N. Base	322-33-45.3	-			

No eccentricity of lights or instrument at this station

Observations made from 40 foot steel tower

Reference marks are bronze disks in concrete blocks

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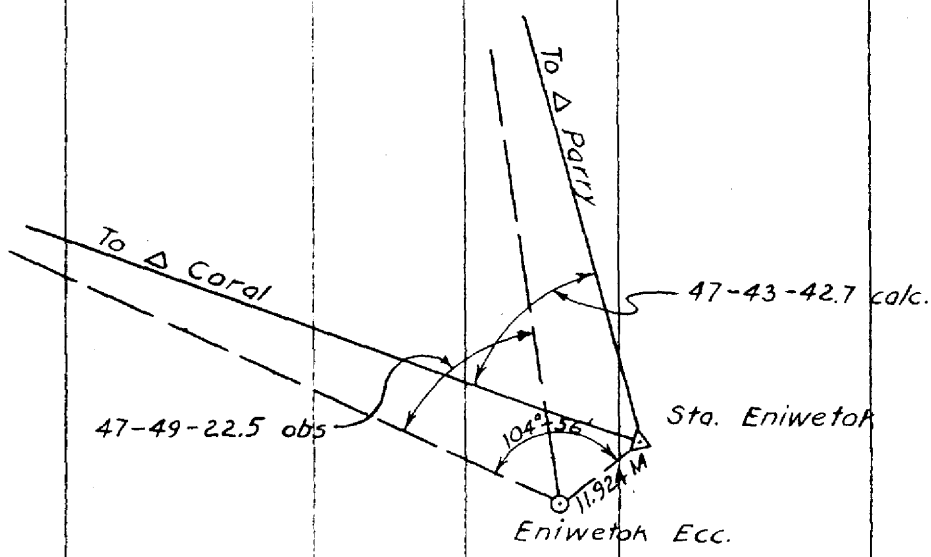
LIST OF DIRECTIONS

STATION ENIWETOK (Privilege) DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Parry	47-49-22.5	05'-39.8"			43-42.7
R.M. No. I 11.924 M	62-46-17.4	-			
R.M. No. 2 11.924 M	332-46-17.4	-			



Observations taken from eccentric station

Light was eccentric for observation from Coral
Light was at true station for observation from Parry
Observation was made from a 40 foot steel tower
Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION ISLET DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0°00'00.00"			0°00'00.00"	
Runit	48-33-58.9	-			

No eccentricity of lights or instrument at this station

Observations made from 11 foot wood tower

No reference monuments set

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LIST OF DIRECTIONS

STATION NORTH BASE DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Engebi	60-40-51.5	-			
Piiraai	79-53-48.5	-			
Aomon	81-28-05.5	-			
R.M. No. 3 45.686 M	101-59-20.0	-			
Runit	247-45-17.2	-			
Sand	252-54-49.1	-			
R.M. No. I 31.992 M	267-33-20.0	-			
Parry	274-44-59.7	-			
Pinnacle	320-23-43.0	-			
R.M. No. 2 25.233 M	340-35-50.0	-			

No eccentricity of lights or instrument at this station

Observations made from 40 foot steel tower

Reference marks are bronze disks set in reef ledge

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LIST OF DIRECTIONS

STATION PARRY DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
N. Base	25-42-13.5	-			
Sand	39-44-35.3	-			
R.M. No. I 15.246 M	46-34-25.4	-			
Aniyaanii	54-56-34.4	-			
R.M. No. 2 15. 224 M	181-37-20.4	-			
Eniwetok	242-43-22.6	-			

No eccentricity of lights or instrument at this station

Observations made from 25 foot wood tripod in existing steel tower

Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION PIIRAAI DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
N. Base	0° 00' 00.00"			0° 00' 00.00"	
R.M. No. 2 22.860 M	0-31-55.0	-			
Coral	66-55-40.3	-			
R.M. No. I 22.860 M	270-31-55.0	-			

No eccentricity of lights or instrument at this station

Observations taken from 16 foot wood tower

Reference marks are bronze disks in concrete blocks

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LIST OF DIRECTIONS

STATION PINNACLE DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
N. Base	105-48-37.3	-			
Runit	139-57-10.4	-			
Islet	173-14-14.9	-			

No eccentricity of lights or instrument at this station

Observations made from a steel tripod 10 feet above tide level

No reference marks set at this station

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LIST OF DIRECTIONS

STATION RUNIT DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
N. Base	0° 00' 00.00"			0° 00' 00.00"	
R.M. No. I 15.520 M	8-37-19.4	-			
R.M. No. 2 14.650 M	107-02-33.4	-			
Islet	188-38-01.9	-			
Pinnacle	286-46-58.5	-			
Coral	308-02-56.2	-			

No eccentricity of lights or instrument at this station

Observations made from 20 foot wood tower

Reference marks shown were established by the Joint Task Force Seven Survey

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HOLMES & NARVER ENGINEERS JOB Nº. 640

LIST OF DIRECTIONS

STATION SAND DATE 3/17/90

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Parry	0° 00' 00.00"			0° 00' 00.00"	
Coral	105-14-13.1	-			
N. Base	144-07-27.3	-			

No eccentricity of lights or instrument at this station

Observations made from 15 foot wood tower

No reference marks set at this station

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LIST OF DIRECTIONS

STATION TEITEIR DATE 3/17/50

CHIEF OF PARTY LSH COMPUTED BY LSH

OBSERVER FPC CHECKED BY LMP

OBSERVED STATION	OBSERVED DIRECTION	ECC. RED.	SEA LEVEL RED.	CORRECTED DIR. ZERO INITIAL	ADJ. DIR.
Coral	0° 00' 00.00"			0° 00' 00.00"	
Boga	94-03-47.5	-			
R.M. No. I 15.240M	125-23-00.0	-			
R.M. No. 2 15.240M	215-23-00.0	-			
Engebi	314-30-28.4	-			

No eccentricity of lights or instrument at this station

Observations made from 40 foot steel tower

Reference marks are bronze disks in concrete block

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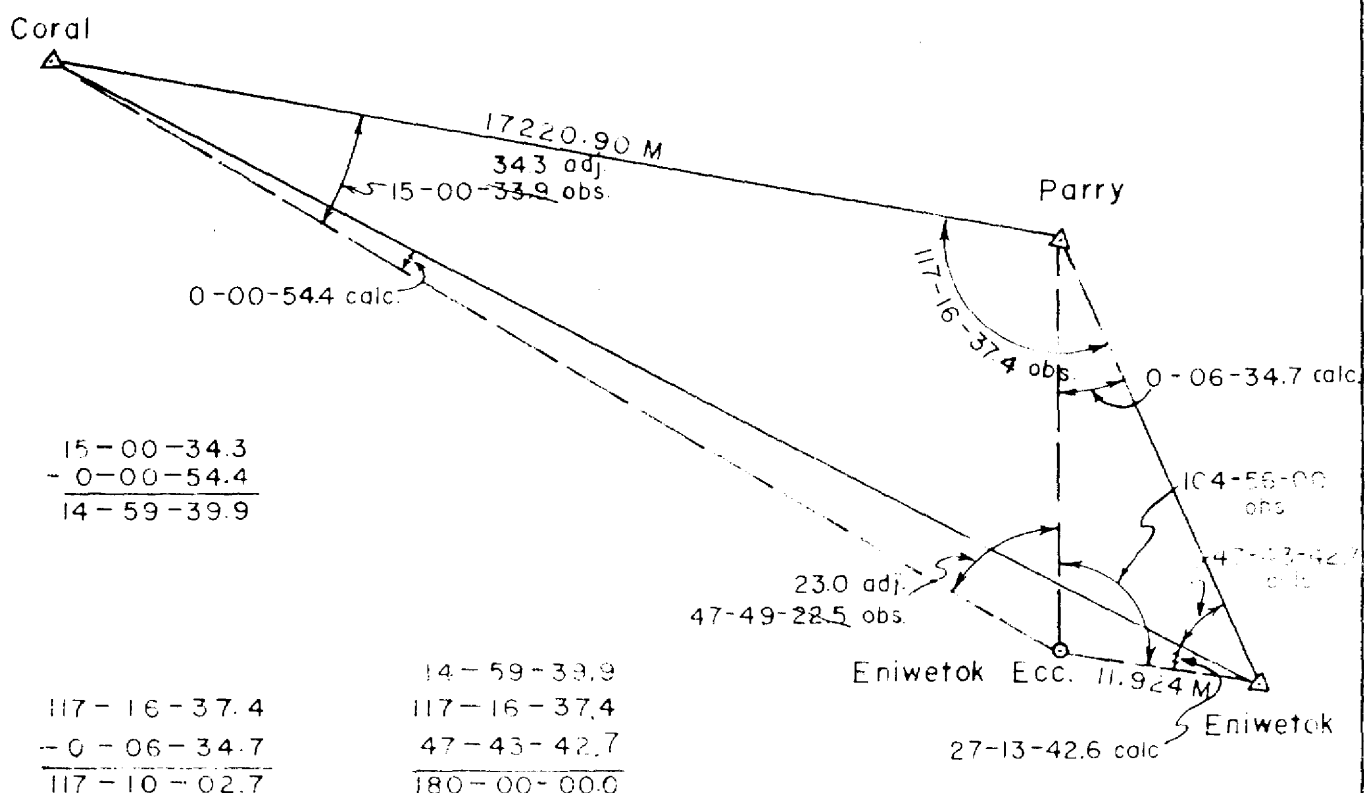
Eccentric Station — ENIWETOK

Log. d = 1.07642
colog Sin 1" = 5.31443
6.39085

d = 39.12 Ft. = 11.924 M.

	a ° '	Log. Sin a	Log s Meters	Log($\frac{\text{Sin a}}{\text{s}}$)	Log. red. in seconds	Reduction = C
Parry	255-04	9.98508	3.77967	6.20541	2.59626	394.7"
Coral	207-15	9.66075	4.31566	5.34509	1.73594	54.4"



15-00-34.3
- 0-00-54.4
14-59-39.9

117-16-37.4
- 0-06-34.7
117-10-02.7

14-59-39.9
117-16-37.4
47-43-42.7
180-00-00.0

HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION Aniyaanii COMPUTED BY L.S.H. DATE 12-14-49

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Parry	Coral				
	INITIAL 0°-00'.	101°-54'				
1	0.00"	27.0				
2	0.00"	29.5				
3	0.00"	24.1				
4	0.00"	26.1				
5	0.00"	29.3				
6	0.00"	23.4				
7	0.00"					
8	0.00"					
SUM		159.4				
MEAN		26.6				
CORR. FOR ECC.						
DIRECTION		26.6				

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION AOMAN COMPUTED BY L.S.H. DATE NOV. 16, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Bokon	Engebi	North Base		
	INITIAL 0°-00'	86°-53'	94°-05'	311°-56'		
1	0.00"	45.4	59.6	58.2		
2	0.00"	47.8	59.8	56.6		
3	0.00"	41.3	56.2	54.5		
4	0.00"	42.0	00.0	57.7		
5	0.00"	48.4	59.2	58.6		
6	0.00"	39.5	56.1	53.1		
7	0.00"					
8	0.00"					
SUM		264.4	350.9	338.7		
MEAN		44.1	58.5	56.4		
CORR. FOR ECC.						
DIRECTION		44.1	58.5	56.4		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION AOMAN COMPUTED BY L.S.H. DATE NOV 29, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Photo				
	INITIAL 0°-00'	21°-49'				
1	0.00"	02.1				
2	0.00"	02.2				
3	0.00"	03.2				
4	0.00"	02.6				
5	0.00"	05.4				
6	0.00"	01.4				
7	0.00"					
8	0.00"					
SUM		16.9				
MEAN		02.8				
CORR FOR ECC.						
DIRECTION		02.8				

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION Boga COMPUTED BY L.S.H. DATE Nov. 18, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Teiteir	Engebi			
	INITIAL 0°-00'	293°-21'	311°-03'			
1	0.00"	25.0	59.0			
2	0.00"	25.9	57.1			
3	0.00"	24.0	54.7			
4	0.00"	23.2	54.5			
5	0.00"	26.2	58.9			
6	0.00"	23.8	53.7			
7	0.00"					
8	0.00"					
SUM		148.1	337.9			
MEAN		24.7	56.3			
CORR. FOR ECC.						
DIRECTION		24.7	56.3			

HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION BOGA COMPUTED BY L.S.H. DATE Oct. 31, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST Wild T-2

POSITION	STATIONS OBSERVED	
	Engebi	Photo
	INITIAL 0-00	55°-44'
1	0.00"	09.3
2	0.00"	10.6
3	0.00"	04.7
4	0.00"	07.2
5	0.00"	11.5
6	0.00	02.7
7	0.00"	
8	0.00"	
SUM		46.0
MEAN		07.7
CORR. FOR ECC.		
DIRECTION		07.7

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION BOKON COMPUTED BY L.S.H. DATE Nov. 22, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Aoman	Coral				
	INITIAL 0°-00'	62°-59'				
1	0.00"	26.2				
2	0.00"	25.3				
3	0.00"	25.7				
4	0.00"	23.1				
5	0.00"	23.9				
6	0.00"	24.1				
7	0.00"					
8	0.00"					
SUM		148.3				
MEAN		24.7				
CORR. FOR ECC.						
DIRECTION		24.7				

HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION CORAL COMPUTED BY L.S.H. DATE Oct. 26, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	North Base	Photo				
	INITIAL 0°-00'	210°-39'				
1	0.00"	28.5				
2	0.00"	28.5				
3	0.00"	26.6				
4	0.00"	27.1				
5	0.00"	28.6				
6	0.00"	26.0				
7	0.00"					
8	0.00"					
SUM		165.3				
MEAN		27.5				
CORR. FOR ECC.						
DIRECTION		27.5				

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION CORAL COMPUTED BY L.S.H. DATE Nov. 21, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED						
	North Base	Boga	Teiteir	Engebi	Bokon	Aoman	Piiraai
	INITIAL 0°-00'	234°-40'	253°-58'	268°-07'	279°-24'	309°-31'	326°-49'
1	0.00"	30.5	13.4	10.4	19.3	12.4	31.0
2	0.00"	33.5	11.5	07.4	23.5	09.1	27.5
3	0.00"	33.4	10.5	06.7	16.3	08.6	28.4
4	0.00"	34.6	15.8	11.0	18.7	10.0	28.6
5	0.00"	35.0	14.2	10.1	21.8	11.2	29.8
6	0.00"	33.2	11.3	06.9	16.9	09.4	30.3
7	0.00"						
8	0.00"						
SUM		200.2	76.7	52.5	116.5	60.7	175.6
MEAN		33.4	12.8	08.7	19.4	10.1	29.3
CORR. FOR ECC.							
DIRECTION		33.4	12.8	08.7	19.4	10.1	29.3

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION CORAL COMPUTED BY L.S.H. DATE Dec. 5, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED				
	North Base	Runit	Sond	Pinnacle	Parry
	INITIAL 0°-00'	15°-48'	34°-01'	34°-35'	69°-02'
1	0.00"	15.0	31.2	09.7	45.1
2	0.00"	14.3	34.6	07.6	48.8
3	0.00"	16.9	32.5	07.1	47.0
4	0.00"	13.5	30.9	07.8	46.9
5	0.00"	13.1	34.6	07.3	46.3
6	0.00"	14.8	31.4	04.0	43.7
7	0.00"				
8	0.00"				
SUM		87.6	195.2	43.5	277.8
MEAN		14.6	32.5	07.2	46.3
CORR. FOR ECC.					
DIRECTION		14.6	32.5	07.2	46.3

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION CORAL COMPUTED BY L.S.H. DATE Dec. 14, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Parry	Aniyaanii				
	INITIAL 0°-00'	336°-51'				
1	0.00"	00.4				
2	0.00"	00.0				
3	0.00"	02.0				
4	0.00"	00.7				
5	0.00"	00.9				
6	0.00"	00.9				
7	0.00"					
8	0.00"					
SUM		04.9				
MEAN		00.8				
CORR. FOR ECC.						
DIRECTION		00.8				

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION CORAL COMPUTED BY L.S.H. DATE Dec 22, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Parry	Eniwetok				
	INITIAL 0°-00'	15°-00'				
1	0.00"	34.5				
2	0.00"	34.6				
3	0.00"	34.5				
4	0.00"	32.6				
5	0.00"	34.6				
6	0.00"	32.7				
7	0.00"					
8	0.00"					
SUM		203.5				
MEAN		33.9				
CORR. FOR ECC.		- 54.0"				
DIRECTION		14°-59'-39.9"				

HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION ENGEBI COMPUTED BY L.S.H. DATE Nov. 17, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Teiteir	Aoman	North Base		
	INITIAL 0°-00'	120°-21'	315°-30'	332°-33'		
1	0.00"	31.8	03.4	44.3		
2	0.00"	32.6	01.0	48.3		
3	0.00"	28.6	00.7	44.0		
4	0.00"	30.0	00.0	43.8		
5	0.00"	30.8	02.8	48.4		
6	0.00"	28.0	00.2	43.2		
7	0.00"					
8	0.00"					
SUM		181.8	08.1	272.0		
MEAN		30.3	01.4 ~~01.35~~	45.3		
CORR. FOR ECC.						
DIRECTION		30.3	01.4	45.3		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION ENGEBI COMPUTED BY L.S.H DATE NOV. 28, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Photo	Boga			
	INITIAL 0°-00'	17°-01'	97°-37'			
1	0.00"	01.6	24.0			
2	0.00"	01.2	21.6			
3	0.00"	03.9	21.2			
4	0.00"	02.7	24.7			
5	0.00"	05.0	22.1			
6	0.00"	00.8	18.2			
7	0.00"					
8	0.00"					
SUM		15.2	131.8			
MEAN		02.5	22.0			
CORR. FOR ECC.						
DIRECTION		02.5	22.0			

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION ENIWETOK COMPUTED BY L.S.H. DATE Dec. 19, 1949

OBSERVER F.P.C CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Parry				
	INITIAL 0°-00'	47°-49'				
1	0.00"	20.2				
2	0.00"	20.3				
3	0.00"	24.6				
4	0.00"	20.4				
5	0.00"	22.2				
6	0.00"	27.0				
7	0.00"					
8	0.00"					
SUM		134.7				
MEAN		22.5				
CORR. FOR ECC.		- 5'-40.3"				
DIRECTION		47°-43'-42.2"				

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION ISLET COMPUTED BY L.S.H. DATE Dec. 11, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Pinnacle	Runit				
	INITIAL 0°-00'	48°-33'				
1	0.00"	59.5				
2	0.00"	01.9				
3	0.00"	55.5				
4	0.00"	59.0				
5	0.00"	01.5				
6	0.00"	56.2				
7	0.00"					
8	0.00"					
SUM		353.6				
MEAN		58.9				
CORR. FOR ECC.						
DIRECTION		58.9				

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HOLMES & NARVER ENGINEERS JOB Nº. 640

ABSTRACT OF DIRECTIONS

STATION NORTH BASE COMPUTED BY L.S.H. DATE Dec. 3, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Engebi	Runit	Pinnacle		
	INITIAL 0°-00'	60°-40'	247°-45'	320°-23'		
1	0.00"	55.2	20.8	47.2		
2	0.00"	48.5	16.0	42.8		
3	0.00"	52.3	17.6	38.8		
4	0.00"	51.9	17.6	42.4		
5	0.00"	51.4	15.8	47.6		
6	0.00"	49.9	15.1	38.9		
7	0.00"					
8	0.00"					
SUM		309.2	102.9	257.7		
MEAN		51.5	17.2 ~~17.15~~	43.0 ~~42.95~~		
CORR. FOR ECC.						
DIRECTION		51.5	17.2	43.0		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION North Base COMPUTED BY L.S.H. DATE Oct. 28, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Aomon	Sand	Parry		
	INITIAL 0°-00'	81°-28'	252°-54'	274°-44'		
1	0.00"	08.8	51.0	03.5		
2	0.00"	04.8	50.2	59.2		
3	0.00"	04.6	46.7	58.3		
4	0.00"	05.6	49.2	00.3		
5	0.00"	04.4	50.7	00.3		
6	0.00"	04.5	47.1	56.4		
7	0.00"					
8	0.00"					
SUM		32.7	294.9	358.0		
MEAN		05.5 ~~05.45~~	49.1	59.7		
CORR. FOR ECC.						
DIRECTION		05.5	49.1	59.7		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION NORTH BASE COMPUTED BY L.S.H. DATE Nov. 30, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Piiraai				
	INITIAL 0°-00'	79°-53'				
1	0.00"	47.2				
2	0.00"	49.8				
3	0.00"	46.1				
4	0.00"	49.0				
5	0.00"	50.2				
6	0.00"	48.5				
7	0.00"					
8	0.00"					
SUM		290.8				
MEAN		48.5				
CORR. FOR ECC.						
DIRECTION		48.5				

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION PARRY COMPUTED BY L.S.H. DATE Dec. 13, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED				
	Coral	North Base	Sand	Aniyaanii	Eniwetok
	INITIAL 0°-00'	25°-42	39°-44'	54°-56'	242°-43'
1	0.00"	16.0 ~~18.6~~	35.7	36.0	23.0
2	0.00"	14.0	35.8	32.1	24.3
3	0.00"	15.2	34.7	37.1	25.3
4	0.00"	10.6	33.9	35.5	18.9
5	0.00"	10.7	35.6	31.5	19.2
6	0.00"	14.8	35.9	34.0	24.9
7	0.00"				
8	0.00"				
SUM		81.3 ~~83.9~~	211.6	206.2	135.6
MEAN		13.5 ~~14.0~~	35.3	34.4	22.6
CORR. FOR ECC.					
DIRECTION		13.5	35.3	34.4	

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION PINNACLE COMPUTED BY L.S.H. DATE Dec. 2, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	North Base	Runit	Islet		
	INITIAL 0°-00'	105°-48'	139°-57'	173°-14'		
1	0.00"	36.6	12.8	13.7		
2	0.00"	39.7	10.3	18.1		
3	0.00"	37.8	11.1	12.1		
4	0.00"	35.5	13.1	16.1		
5	0.00"	37.4	08.6	18.2		
6	0.00"	36.6	06.5	11.5		
7	0.00"					
8	0.00"					
SUM		223.6	62.4	89.7		
MEAN		37.3	10.4	14.95		
CORR. FOR ECC.						
DIRECTION		37.3	10.4	14.9		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION PIIRAAI COMPUTED BY L.S.H. DATE Nov. 20, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	North Base	Coral				
	INITIAL 0°-00'	66°-55'				
1	0.00"	44.5				
2	0.00"	39.1				
3	0.00"	39.9				
4	0.00"	41.9				
5	0.00"	37.8				
6	0.00"	38.8				
7	0.00"					
8	0.00"					
SUM		242.0				
MEAN		40.3				
CORR. FOR ECC.						
DIRECTION		40.3				

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HOLMES & NARVER ENGINEERS JOB Nº.640

ABSTRACT OF DIRECTIONS

STATION RUNIT COMPUTED BY L.S.H. DATE Dec. 4, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	North Base	Islet	Pinnacle	Coral		
	INITIAL 0°-00'	188°-38'	286°-46'	308°-02'		
1	0.00"	03.6	03.6	57.3		
2	0.00"	02.3	59.5	00.3		
3	0.00"	59.8	54.2	53.9		
4	0.00"	01.8	59.3	54.1		
5	0.00"	03.0	57.6	59.5		
6	0.00"	00.9	57.0	52.3		
7	0.00"					
8	0.00"					
SUM		371.4	351.2	337.4		
MEAN		01.9	58.5	56.2		
CORR. FOR ECC.						
DIRECTION		01.9	58.5	56.2		

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION SAND COMPUTED BY L.S.H. DATE Dec. 6, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Parry	Coral	North Base			
	INITIAL 0°-00'	105°-14'	144°-07'			
1	0.00"	13.1	30.6			
2	0.00"	16.9	25.2			
3	0.00"	08.7	25.0			
4	0.00"	12.5	30.7			
5	0.00"	16.3	26.6			
6	0.00"	11.4	25.9			
7	0.00"					
8	0.00"					
SUM		78.9	164.0			
MEAN		13.15	27.3			
CORR. FOR ECC.						
DIRECTION		13.1	27.3			

60

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF DIRECTIONS

STATION TEITEIR COMPUTED BY L.S.H. DATE Nov. 27, 1949

OBSERVER F.P.C. CHECKED BY W.E.H. INST. Wild T-2

POSITION	STATIONS OBSERVED					
	Coral	Boga	Engebi			
	INITIAL 0°-00'	94°-03	314°-30'			
1	0.00"	48.0	31.3			
2	0.00"	50.3	26.9			
3	0.00"	47.5	31.1			
4	0.00"	46.0	24.6 ~~23.2~~			
5	0.00"	44.4 ~~50.5~~	29.3			
6	0.00"	48.9	27.3			
7	0.00"					
8	0.00"					
SUM		285.1	170.5			
MEAN		47.5	28.4			
CORR. FOR ECC.						
DIRECTION		47.5	28.4			

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TRIANGLE COMPUTATIONS

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HOLMES & NARVER ENGINEERS JOB Nº. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 7, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3					2591.9749	3.4136308
1 Pinnacle	34-08-33.1	-0.1	33.0	-0.0	33.0	0.2508413
2 North Base	72-38-25.8	-0.1	25.7	-0.0	25.7	9.9797538
3 Runit	73-13-01.5	-0.2	01.3	-0.0	01.3	9.9810958
	00.4	0.4		0.0		
1-3						3.6442259
1-2						3.6455679
2-3						3.6455679
1 Coral	34-35-07.2	-0.5	06.7	-0.0	06.7	0.2459339
2 North Base	39-36-17.0	-0.5	16.5	-0.0	16.5	9.8044704
3 Pinnacle	105-48-37.3	-0.4	36.9	-0.1	36.8	9.9832515
	01.5	-1.4		-0.1		
1-3						3.6959722
1-2						3.8747533
2-3						3.4136308
1 Coral	15-48-14.6	-0.4	14.2	-0.0	14.2	0.5648783
2 North Base	112-14-42.8	-0.4	42.4	-0.0	42.4	9.9664106
3 Runit	51-57-03.8	-0.4	03.4	-0.0	03.4	9.8962414
	01.2	-1.2		0.0		
1-3						3.9449197
1-2						3.8747505
2-3						3.9449197
1 Pinnacle	139-57-10.4	-0.3	10.1	-0.0	10.1	0.1915065
2 Coral	18-46-52.6	-0.2	52.4	-0.0	52.4	9.5077958
3 Runit	21-15-57.7	-0.2	57.5	-0.0	57.5	9.5595450
	0.7	-0.7		0.0		
1-3						3.6442220
1-2						3.6959712

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 7, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3						3.8747533
1 Aoman	48-03-03.6	+ 0.3	03.9	- 0.0	03.9	0.1285782
2 North Base	81-28-05.5	+ 0.4	05.9	- 0.1	05.8	9.9951673
3 Coral	50-28-49.9 / 59.0	+ 0.4 / + 1.1	50.3	- 0.0 / - 0.1	50.3	9.8872850
1-3						3.9984988
1-2						3.8906165
2-3						3.9984988
1 Engebi	44-29-58.6	+ 0.6	59.2	- 0.1	59.1	0.1543401
2 Aoman	94-05-58.5	+ 0.6	59.1	- 0.1	59.0	9.9988873
3 Coral	41-24-01.4 / 58.5	+ 0.5 / + 1.7	01.9	- 0.0 / - 0.2	01.9	9.8204108
1-3						4.1517262
1-2						3.9732497
2-3						3.8747533
1 Engebi	27-26-14.7	+ 0.9	15.6	- 0.1	15.5	0.3365036
2 North Base	60-40-51.5	+ 0.9	52.4	- 0.1	52.3	9.9404709
3 Coral	91-52-51.3 / 57.5	+ 1.0 / + 2.8	52.3	- 0.1 / - 0.3	52.2	9.9997659
1-3						4.1517278
1-2						4.2110228
2-3						4.2110228
1 Aoman	142-09-02.1	+ 0.1	02.2	- 0.1	02.1	0.2121229
2 North Base	20-47-14.0	± 0.0	14.0	- 0.0	14.0	9.5501041
3 Engebi	17-03-43.9 / 00.0	± 0.0 / + 0.1	43.9	- 0.0 / - 0.1	43.9	9.4674744
1-3						3.9732498
1-2						3.8906201

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 7, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3						4.1517262
1 Boga	48-56-03.7	- 0.2	03.5	- 0.1	03.4	0.1226537
2 Engebi	97-37-22.0	- 0.2	21.8	- 0.2	21.6	9.9961452
3 Coral	33-26-35.3	- 0.2	35.1	- 0.1	35.0	9.7412367
	01.0	- 0.6		- 0.4		
1-3						4.2705251
1-2						4.0156166
2-3						4.1517262
1 Teiteir	45-29-31.6	+ 0.7	32.3	- 0.0	32.3	0.1468152
2 Engebi	120-21-30.3	+ 0.9	31.2	- 0.1	31.1	9.9359497
3 Coral	14-08-55.9	+ 0.8	56.7	- 0.1	56.6	9.3881817
	57.8	+ 2.4		- 0.2		
1-3						4.2344911
1-2						3.6867231
2-3						4.2344911
1 Boga	66-38-35.3	- 0.6	34.7	- 0.1	34.6	0.0371327
2 Teiteir	94-03-47.5	- 0.7	46.8	- 0.1	46.7	9.9989072
3 Coral	19-17-39.4	- 0.6	38.8	- 0.1	38.7	9.5190623
	02.2	- 1.9		- 0.3		
1-3						4.2705310
1-2						3.7906861
2-3						4.0156166
1 Teiteir	139-33-19.1	+ 0.4	19.5	0.0	19.5	0.1879479
2 Engebi	22-44-08.3	+ 0.3	08.6	0.0	08.6	9.5871283
3 Boga	17-42-31.6	+ 0.3	31.9	0.0	31.9	9.4831312
	59.0	+ 1.0		0.0		
1-3						3.7906928
1-2						3.6866957

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HOLMES & NARVER ENGINEERS JOB Nº. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 8, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3						3.8747533
1 Sand	38-53-14.2	+ 0.8	15.0	- 0.0	15.0	0.2021834
2 Coral	34-01-32.5	+ 0.8	33.3	- 0.0	33.3	9.7478528
3 North Base	107-05-10.9 / 57.6	+ 0.9 / + 2.5	11.8	- 0.1 / - 0.1	11.7	9.9803951
1-3						3.8247895
1-2						4.0573318
2-3						4.0573318
1 Parry	39-44-35.3	- 0.6	34.7	- 0.1	34.6	0.1942652
2 Coral	35-01-13.8	- 0.6	13.2	- 0.1	13.1	9.7588110
3 Sand	105-14-13.1 / 02.2	- 0.7 / - 1.9	12.4	- 0.1 / - 0.3	12.3	9.9844590
1-3						4.0104080
1-2						4.2360560
2-3						3.8747533
1 Parry	25-42-13.5	+ 0.1	13.6	- 0.1	13.5	0.3627925
2 Coral	69-02-46.3	+ 0.1	46.4	- 0.1	46.3	9.9702860
3 North Base	85-15-00.3 / 00.1	+ 0.0 / + 0.2	00.3	- 0.1 / - 0.3	00.2	9.9985058
1-3						4.2078318
1-2						4.2360516
2-3						4.2078318
1 Sand	144-07-27.3	+ 0.2	27.5	- 0.1	27.4	0.2320808
2 Parry	14-02-21.8	+ 0.1	21.9	- 0.0	21.9	9.3848717
3 North Base	21-50-10.6 / 59.7	+ 0.1 / + 0.4	10.7	- 0.0 / - 0.1	10.7	9.5704917
1-3						3.8247843
1-2						4.0104043

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HOLMES & NARVER ENGINEERS JOB Nº. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 10, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM	
2-3						3.9984988	
1 Bokon	62-59-24.7	+ 0.2	24.9	- 0.0	24.9	0.0501568	
2 Aoman	86-53-44.1	+ 0.3	44.4	- 0.1	44.3	9.9993622	
3 Coral	30-06-50.7	+ 0.1	50.8	- 0.0	50.8	9.7004647	Bokon
	59.5	+ 0.6		- 0.1			
1-3						4.0480178	
1-2						3.7491203	
2-3						3.8747533	
1 Piiraqi	66-55-40.3	+ 0.2	40.5	- 0.0	40.5	0.0362062	
2 North Base	79-53-48.5	+ 0.3	48.8	- 0.1	48.7	9.9932129	
3 Coral	33-10-30.7	+ 0.1	30.8	- 0.0	30.8	9.7381472	Piiraqi
	59.5	+ 0.6		- 0.1			
1-3						3.9041724	
1-2						3.6491067	
2-3						3.6442259	
1 Islet	48-33-58.9	0.0	58.9	0.0	58.9	0.1250993	
2 Pinnacle	33-17-04.5	0.0	04.5	0.0	04.5	9.7394124	
3 Runit	98-08-56.6	0.0	56.6	0.0	56.6	9.9955925	Islet
	00.0	0.0		0.0			
1-3						3.5087376	
1-2						3.7649177	
2-3						4.2360559	
1 Aniyaanii	101-54-26.6	- 0.0	26.6	- 0.1	26.5	0.0094470	
2 Parry	54-56-34.4	- 0.0	34.4	- 0.1	34.3	9.9130610	
3 Coral	23-08-59.2	- 0.0	59.2	- 0.0	59.2	9.5945430	Aniyaanii
	00.2	- 0.0		- 0.2			
1-3						4.1585639	
1-2						3.8400459	

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE March 11, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3				0.1		4.2360560
1 Eniwetok	47-43-42.2	+ 0.6	42.8	~~1.0~~	42.7	0.1307881
2 Coral	14-59-39.5	+ ~~0.5~~ 0.4	~~40.0~~ 39.4	- 0.0	39.9	9.4128382
3 Parry	117-16-37.4	+ 0.1	37.5	~~2.1~~	37.4	9.9488044
	59.1	+ 1.2		- 2.0		
1-3						3.7796823
1-2						4.3156485
2-3						
1						
2						
3						
1-3						
1-2						
2-3						
1						
2						
3						
1-3						
1-2						
2-3						
1						
2						
3						
1-3						
1-2						

Eniwetok

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HOLMES & NARVER ENGINEERS JOB Nº 640

COMPUTATION OF TRIANGLES

COMPUTED BY L.S.H. CHECKED BY L.M.P DATE March 11, 1950

STATION	OBSERVED ANGLE	CORR-N	SPHERICL ANGLE	SPHERICL EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3						3.9732498
1 Photo	46-12-03.1	- 0.9	02.2	- 0.1	02.1	0.1416029
2 Engebi	61-31-01.2	+ 0.1	01.3	- 0.1	01.2	9.9439685
3 Aoman	72-16-55.7 / 00.0	+ 1.1 / + 0.3	56.8	- 0.1 / - 0.3	56.7	9.9788961
1-3						4.0588211
1-2						4.0937487
2-3						4.0156166
1 Photo	43-39-32.7	+ 1.1	33.8	- 0.1	33.7	0.1609184
2 Boga	55-44-07.7	- 0.9	06.8	- 0.1	06.7	9.9172136
3 Engebi	80-36-19.6 / 00.0	+ 0.1 / + 0.3	19.7	- 0.1 / - 0.3	19.6	9.9941357
1-3						4.0937486
1-2						4.1706707
2-3						
1						
2						
3						
1-3						
1-2						
2-3						
1						
2						
3						
1-3						
1-2						

Photo

Photo

TRIANGLE SIDE CHECKS

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		a	b
Quad. A	Coral-North Base	0.0000028	0.0000298
	Coral-Pinnacle	0.0000010	0.0000298
	Pinnacle - Runit	0.0000039	0.0000298
		a	b
Quad. B	Aoman - Engebi	0.0000001	0.0000242
	Aoman - North Base	0.0000036	0.0000274
	Engebi - Coral	0.0000014	0.0000162
		a	b
Quad. C	Boga - Coral	0.0000060	0.0000162
	Boga - Teiteir	0.0000067	0.0000240
	Teiteir - Engebi	0.0000274	0.0000334
		a	b
Quad. D	Sand - North Base	0.0000052	0.0000337
	Sand - Parry	0.0000037	0.0000210
	Parry - Coral	0.0000044	0.0000175

a = Actual difference in logarithms of length of a side.

b = Allowable maximum - four times the tabular difference corresponding to one second in the logarithm of the Sine of the smallest angle entering into the computation of that side.

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GEOGRAPHIC POSITION COMPUTATIONS

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Runit	to 3 Coral	90	50	32.7	α	3	to 2			
3d ∠		&	+51	57	03.4	3d ∠		&	−		
α	2 Runit	to 1 North Base	142	47	36.1	α	3	to 1			
Δα				−	10.4	Δα					
			180	00	00.0				180	00	00.0
α'	1 North Base	to 2 Runit	322	47	25.7	α'	1	to 3			

FIRST ANGLE OF TRIANGLE

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	32	16.080	2 Runit	λ	162	22	01.621	φ				3	λ			
Δφ		+1	07.187		Δλ		−	51.728	Δφ					Δλ			
φ'	11	33	23.267	1 North Base	λ'	162	21	09.893	φ'				1	λ'			

	Logarithms	Values in seconds	
s	3.4136308		
Cos α	9.9011639		
B	8.5125002		
h	1.8272949	1st term	−67.1885
s^2	6.82726		
$\sin^2 \alpha$	9.56307		
C	0.71656		
	7.10689	2d term	+ .0013
h^2	3.6546		
D	1.9845		
	5.6391	3d term	+ .0000
		−Δφ	−67.1872

	°	'	"
$\frac{1}{2}(\phi+\phi')$	11	−32	−49.675

	Logarithms	Values in seconds
s	3.4136308	
Sin α	9.7815338	
A'	8.5096678	
Sec φ'	0.0088946	
Δλ	1.7137270	−51.728
$\sin\frac{1}{2}(\phi+\phi')$	9.3014076	
−Δα	1.0151043	+10.355

	Logarithms	Values in seconds	
s			
Cos α			
B			
h		1st term	"
s^2			
$\sin^2 \alpha$			
C			
		2d term	+
h^2			
D			
		3d term	+
		−Δφ	

	°	'	"
$\frac{1}{2}(\phi+\phi')$			

	Logarithms	Values in seconds
s		
Sin α		
A'		
Sec φ'		
Δλ		"
$\sin\frac{1}{2}(\phi+\phi')$		
−Δα		

74

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HOLMES & NARVER ENGINEERS JOB Nº 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"			°	'	"
α	2 North Base to 3 Runit	322	47	25.7	α	3 Runit to 2 North Base	142	47	36.1
$\Delta^d\angle$	8	+ 72	38	25.7	$3^d\angle$	8	− 73	13	01.3
α	North Base to 1 Pinnacle	35	25	51.4	α	3 Runit to 1 Pinnacle	69	34	34.8
$\Delta\alpha$			−	16.9	$\Delta\alpha$			−	27.3
		180	00	00.0			180	00	00.0
α'	1 Pinnacle to 2 North Base	215	25	34.5	α'	1 Pinnacle to 3 Runit	249	34	07.5

FIRST ANGLE OF TRIANGLE 34 − 08 − 33.0

		°	'	"			°	'	"
ϕ	11 33 23.267 2 North Base	λ	162	21	09.893	ϕ	11 32 16.080 3 Runit	λ	162	22	01.621
$\Delta\phi$	− 1 57.257	$\Delta\lambda$		− 1	24.586	$\Delta\phi$	− 0 50.070	$\Delta\lambda$		− 2	16.314
ϕ'	11 31 26.010 1 Pinnacle	λ'	162	19	45.307	ϕ'	11 31 26.010 Pinnacle	λ'	162	19	45.307

	Logarithms	Values in seconds	
s	3.6455679		
Cos α	9.9110599		
b	8.5124992		
h	2.0691270	1st term	+117.2538
s^2	7.29114		
$\sin^2\alpha$	9.52644		
C	0.71736		
	7.53494	2d term	+ .0034
h^2	4.1382		
D	1.9847		
	6.1229	3d term	+ .0001
		$-\Delta\phi$	+117.2573

		Logarithms	Values in seconds
$\frac{1}{2}(\phi+\phi')$	11 − 32 − 29.638		
s		3.6455679	
Sin α		9.7632192	
A'		8.5096676	
Sec ϕ'		0.0088442	
$\Delta\lambda$		1.9272989	− 84.586
$\sin\frac{1}{2}(\phi-\phi')$		9.3005820	
$-\Delta\alpha$		1.2278809	+16.900

		Logarithms	Values in seconds
s		3.6442259	
Cos α		9.5427746	
b		8.5124998	
h		1.6995003	1st term +50.0611
s^2		7.28845	
$\sin^2\alpha$		9.94361	
C		0.71664	
		7.94860	2d term + .0089
h^2		3.3990	
D		1.9845	
		5.3835	3d term + .0000
			$-\Delta\phi$ +50.0700

		°	'	"
$\frac{1}{2}(\phi+\phi)$	11 − 31 − 51.045			
		Logarithms	Values in seconds	
s		3.6442259		
Sin α		9.9718035		
A'		8.5096678		
Sec ϕ		0.0088442		
$\Delta\lambda$		2.1345414	−136.314	
$\sin\frac{1}{2}(\phi-\phi)$		9.3008029		
$-\Delta\alpha$		1.4353443	+ 27.258	

SV

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HOLMES & NARVER ENGINEERS JOB. № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"			°	'	"
α	2 North Base to 3 Pinnacle	35	25	51.4	α	3 Pinnacle to 2 North Base	215	25	34.5
2d ∠	8	+ 39	36	16.5	3d ∠	8	−105	49	36.9
α	2 North Base to 1 Coral	75	02	07.9	α	3 Pinnacle to 1 Coral	109	36	57.6
Δα			−	47.8	Δα			—	30.8
		180	00	00.0			180	00	00.0
α'	1 Coral to 2 North Base	255	01	20.1	α'	1 Coral to 3 Pinnacle	289	36	26.8

FIRST ANGLE OF TRIANGLE 34 − 35 − 06.7

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	33	23.267	2 North Base	λ	162	21	09.893	φ	11	31	26.010	3 Pinnacle	λ	162	19	45.307
Δφ		− 1	03.013		Δλ		− 3	58.949	Δφ		+	54.244		Δλ		− 2	34.363
φ'	11	32	20.254	1 Coral	λ'	162	17	10.944	φ'	11	32	20.254	1 Coral	λ'	162	17	10.944

	Logarithms	Values in seconds	
s	3.8747533		
Cos α	9.4119899		
B	8.5124996		
h	1.7992428	1st term	+62.9858
s²	7.74951		
Sin² α	9.97003		
C	0.71736		
	8.43690	2d term	+ .0273
h²	3.5985		
D	1.9851		
	5.5836	3d term	+ .0000
		−Δφ	+63.0126

	°	'	"
½(φ + φ')	11 − 32 − 51.760		
	Logarithms	Values in seconds	
s	3.8747533		
Sin α	9.9850158		
A'	8.5096676		
Sec φ'	0.0088685		
Δλ	2.3783052		−238.949
Sin ½(φ+φ')	9.3014290		
−Δα	1.6797342		+ 47.834

	Logarithms	Values in seconds	
s	3.6959722		
Cos α	9.5259702		
B	8.5125006		
h	1.7344430	1st term	−54.2555
s²	7.39194		
Sin² α	9.94807		
C	0.71610		
	8.05611	2d term	+ .0114
h²	3.4689		
D	1.9839		
	5.4528	3d term	+ .0000
		−Δφ	−54.2441

	°	'	"
½(φ + φ')	11 − 31 − 23.132		
	Logarithms	Values in seconds	
s	3.6959722		
Sin α	9.9740342		
A'	8.5096679		
Sec φ'	0.0088685		
Δλ	2.1885428		−154.363
Sin ½(φ+φ')	9.3005148		
−Δα	1.4890576		+ 30.765

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"
α	2 North Base to 3 Coral	75	02	07.9
2d ∠	B	+ 81	28	05.9
α	2 North Base to 1 Aoman	156	30	13.8
Δ α			−	20.6
		180	00	00.0
α'	1 Aoman to 2 North Base	336	29	53.8

		°	'	"
α	3 Coral to 2 North Base	255	01	20.1
3d ∠	B	− 50	28	50.3
α	3 Coral to 1 Aoman	204	32	29.8
Δ α			+	27.4
		180	00	00.0
α'	1 Aoman to 3 Coral	24	32	57.2

FIRST ANGLE OF TRIANGLE 48 −03 −03.9

		°	'	"
φ	11	33	23.267	2 North Base
Δ φ		+ 3	52.015	
φ'	11	37	15.282	1 Aoman

		°	'	"
λ	162	21	09.893	2 North Base
Δ λ		− 1	42.309	
λ'	162	19	27.584	1 Aoman

	Logarithms	Values in seconds		
s	3.8906165			
Cos α	9.9624104			
B	8.5124992			
h	2.3655261	1st term	−232.0204	
s²	7.78123			
Sin² α	9.20127			
C	0.71736			
	7.69986	2d term	+ .0050	
n²	4.7311			
D	1.9851			
	6.7162	3d term	+ .0005	
		−Δ φ	−232.0149	

	°	'	"
½(φ+φ')	11	−35	−19.275

	Logarithms	Values in seconds	
s	3.8906165		
Sin α	9.6006329		
A'	8.5096676		
Sec φ'	0.0089948		
Δ λ	2.0099118	−102.3085	
Sin ½(φ+φ')	9.3029465		
−Δ α	1.3128583	+ 20.552	

		°	'	"
φ	11	32	20.254	3 Coral
Δ φ		+ 4	55.028	
φ'	11	37	15.282	1 Aoman

		°	'	"
λ	162	17	10.944	3 Coral
Δ λ		+ 2	16.641	
λ'	162	19	27.585	1 Aoman

	Logarithms	Values in seconds		
s	3.9984988			
Cos α	9.9588790			
B	8.5124997			
h	2.4698775	1st term	−295.0377	
s²	7.99700			
Sin² α	9.23684			
C	0.71669			
	7.95053	2d term	+ .0089	
n²	4.9398			
D	1.9845			
	6.9243	3d term	+ .0008	
		−Δ φ	−295.0280	

	°	'	"	4
½(φ+φ')	11	−34	−47.768	

	Logarithms	Values in seconds	
s	3.9984988		
Sin α	9.6184184		
A'	8.5096678		
Sec φ'	0.0089948		
Δ λ	2.1355798	+136.6409	
Sin ½(φ−φ')	9.3026229		
−Δ α	1.4382027	− 27.429	

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Aoman	to 3 Coral	24	32	57.2	α	3 Coral	to 2 Aoman	204	32	29.8
2d ∠		&	+ 94	05	59.1	3d ∠		&	− 41	24	01.9
α	2 Aoman	to 1 Engebi	118	38	56.3	α	3 Coral	to 1 Engebi	163	08	27.9
Δα				−	55.0	Δα				−	27.3
			180	00	00.0				180	00	00.0
α'	1 Engebi	to 2 Aoman	298	38	01.3	α'	1 Engebi	to 3 Coral	343	08	00.~~6~~5

FIRST ANGLE OF TRIANGLE 44 − 29 − 59.2

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	37	15.282	2 Aoman	λ	162	19	27.584	φ	11	32	20.254	3 Coral	λ	162	17	10.944
Δφ		+ 2	26.682		Δλ		− 4	32.432	Δφ		+ 7	21.710		Δλ		− 2	15.792
φ'	11	39	41.964	1 Engebi	λ'	162	14	55.152	φ'	11	39	41.964	1 Engebi	λ'	162	14	55.152

	Logarithms	Values in seconds	
s	3.9732497		
Cos α	9.6807361		
B	8.5124972		
h	2.1664830	1st term	−146.7179
s^2	7.94650		
$\sin^2\alpha$	9.88657		
C	0.71984		
	8.55291	2d term	+ .0357
h^2	4.3330		
D	1.9875		
	6.3205	3d term	+ .0002
		−Δφ	−146.6820

	°	'	"
$\frac{1}{2}(\phi+\phi')$	11	− 38	− 28.623

	Logarithms	Values in seconds
s	3.9732497	
Sin α	9.9432835	
A'	8.5096669	
Sec φ'	0.0090584	
Δλ	2.4352585	−272.4322
$\sin\frac{1}{2}(\phi+\phi')$	9.3048860	
−Δα	1.7401445	+ 54.972

	Logarithms	Values in seconds	
s	4.1517262		
Cos α	9.9809219		
B	8.5124997		
h	2.6451478	1st term	−441.7207
s^2	8.30345		
$\sin^2\alpha$	8.92484		
C	0.71669		
	7.94498	2d term	+ .0088
h^2	5.2903		
D	1.9845		
	7.2748	3d term	+ .0019
		−Δφ	−441.7100

	°	'	"
$\frac{1}{2}(\phi+\phi')$	11	− 36	− 01.109

	Logarithms	Values in seconds
s	4.1517262	
Sin α	9.4624220	
A'	8.5096678	
Sec φ'	0.0090584	
Δλ	2.1328744	−135.7921
$\sin\frac{1}{2}(\phi+\phi')$	9.3033758	
−Δα	1.4362502	+ 27.306

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
∠	2 Engebi	to 3 Coral	343	08	00.5	α	3 Coral	to 2 Engebi	163	08	27.9
2nd ∠		B	+ 97	37	21.8	3rd ∠		B	- 33	26	35.1
α	2 Engebi	to 1 Boga	80	45	22.3	α	3 Coral	to 1 Boga	129	41	52.8
Δα				- 1	08.2	Δα				- 1	35.2
			180	00	00.0				180	00	00.0
α'	1 Boga	to 2 Engebi	260	44	14.1	α'	1 Boga	to 3 Coral	309	40	17.6

FIRST ANGLE OF TRIANGLE 48-56-03.5

	°	'	"			°	'	"			°	'	"
φ	11	39	41.964 2 Engebi	λ	162	14	55.152	φ	11	32	20.254 3 Coral	λ	162	17	10.944
Δφ		- 54.250		Δλ		- 5	37.786	Δφ		+ 6	27.461	Δλ		- 7	53.579
φ'	11	38	47.71⅘ 1 Boga	λ'	162	09	17.366	φ'	11	38	47.715 1 Boga	λ'	162	09	17.365

	Logarithms	Values in seconds					Logarithms	Values in seconds			Logarithms	Values in seconds
s	4.0156166		½(φ+φ')	11 - 39 - 14.840		s	4.2705251		½(φ+φ')	11 - 35 - 33.984		
Cos α	9.2058438			Logarithms	Values in seconds	Cos α	9.8053248				Logarithms	Values in seconds
B	8.5124960		s	4.0156166		B	8.5124997		s	4.2705251		
h	1.7339564	1st term +54.1948	Sin α	9.9943231		h	2.5883496	1st term -387.5695	Sin α'	9.8861645		
s²	8.03123		A'	8.5096665		s²	8.54105		A'	8.5096678		
Sin² α	9.98865		Sec φ'	0.0090348		Sin² α	9.77233		Sec φ'	0.0090348		
C	0.72139		Δλ	2.52864 10	-337.7855	C	0.71669		Δλ	2.6753922	-473.5786	
	8.74127	2d term + .0551	Sin ½(φ+φ')	9.3053581			9.03007	2d term + .1072	Sin ½(φ+φ')	9.3030975		
h²	3.4679		-Δα	1.8339991	+ 68.233	h²	5.1767		-Δα	1.9784897	+ 95.168	
D	1.9888					D	1.9845					
	5.4567	3d term + .0000					7.1612	3d term + .0016				
		-Δφ +54.2499						-Δφ -387.4607				

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

	2 Engebi	to 3 Coral	343	08	00.5	α	3 Coral	to 2 Engebi	163	08	27.9
2nd $\angle$		8	+120	21	31.2	3rd $\angle$		8	- 14	08	56.7
α	2 Engebi	to 1 Teiteir	103	29	31.7	α	3 Coral	to 1 Teiteir	148	59	31.2
$\Delta\alpha$				-	31.6	$\Delta\alpha$				-	58.7
			180	00	00.0				180	00	00.0
α'	1 Teiteir	to 2 Engebi	283	29	00.1	α'	1 Teiteir	to 3 Coral	328	58	32.5/4

FIRST ANGLE OF TRIANGLE 45-29-32.3

ϕ	11 39 41.964	2 Engebi	λ	162	14	55.152	ϕ	11	32	20.254	3 Coral	λ	162	17	10.944
$\Delta\phi$	+ 36.899		$\Delta\lambda$		- 2	36.066	$\Delta\phi$		+ 7	58.609		$\Delta\lambda$		- 4	51.859
ϕ'	11 40 18.863	1 Teiteir	λ'	162	12	19.086	ϕ'	11	40	18.863	1 Teiteir	λ'	162	12	19.085/6

	Logarithms	Values in seconds					Logarithms	Values in seconds			Logarithms	Values in seconds
s	3.6867231		$\frac{1}{2}(\phi+\phi')$	11-40-00.414		s	4.2344911		$\frac{1}{2}(\phi+\phi')$	11-36-19.564		
Cos α	9.3679370			Logarithms	Values in seconds	Cos α	9.9330291				Logarithms	Values in seconds
B	8.5124960		s	3.6867231		B	8.5124997				s 4.2344911	
h	1.5671561	1st term -36.9110	Sin α	9.9878430		h	2.6800199	1st term -478.6520			Sin α 9.7119402	
s^2	7.37345		A'	8.5096665		s^2	8.46898				A' 8.5096678	
$\sin^2\alpha$	9.97569		Sec ϕ'	0.0090744		$\sin^2\alpha$	9.42388				Sec ϕ' 0.0090744	
C	0.72139		$\Delta\lambda$	2.1933070	-156.0655	C	0.71669				$\Delta\lambda$ 2.4651735	-291.8592
	8.07053	2d term + .0118	$\sin\frac{1}{2}(\phi-\phi')$	9.3058231			8.60955	2d term + .0407			$\sin\frac{1}{2}(\phi-\phi')$ 9.3035650	
h^2	3.1343		$-\Delta\alpha$	1.4991301	+31.559	h^2	5.3600				$-\Delta\alpha$ 1.7687385	+ 58.714
D	1.9888					D	1.9845					
	5.1231	3d term + .0000					7.3445	3d term + .0022				
		$-\Delta\phi$ -36.8992						$-\Delta\phi$ -478.6091				

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"
α	2 Coral to 3 North Base		255	01	20.1
∠d ∠	B		+ 34	01	33.3
α	2 Coral to 1 Sand		289	02	53.4
Δ α				+ 1	11.1
			180	00	00.0
α'	1 Sand to 2 Coral		109	04	04.5

			°	'	"
α	3 North Base to 2 Coral		75	02	07.9
3d ∠	B		-107	05	11.8
α	3 North Base to 1 Sand		327	56	56.1
Δ α				+	23.4
			180	00	00.0
α'	1 Sand to 3 North Base		147	57	19.5

FIRST ANGLE OF TRIANGLE 38-53-15.0

	°	'	"		°	'	"
φ	11	32	20.254 2 Coral	λ	162	17	10.944
Δ φ		-2	01.269	Δ λ		+ 5	55.926
φ'	11	30	18.985 1 Sand	λ'	162	23	06.870

	°	'	"		°	'	"
φ	11	33	23.267 3 North Base	λ	162	21	09.893
Δ φ		-3	04.282	Δ λ		+ 1	56.977
φ'	11	30	18.985 1 Sand	λ'	162	23	06.870

	Logarithms	Values in seconds	
s	4.0573318		
Cos α	9.5137013		
B	8.5124997		
h	2.0835328	1st term	+121.2084
s²	8.11466		
Sin² α	9.95109		
	0.71669		
	8.78244	2d term	+ .0606
h²	4.1671		
D	1.9845		
	6.1516	3d term	+ .0001
		-Δ φ	+121.2691

	°	'	"	Logarithms	Values in seconds	
½(φ+φ')	11	-31	-19.620			
s				4.0573318		
Sin α				9.9755442		
A'				8.5096677		
Sec φ'				0.0088155		
Δ λ				2.5513592	+355.9256	
Sin ½(φ+φ')				9.3004785		
-Δ α				1.8518377	-71.095	

	Logarithms	Values in seconds	
s	3.8247895		
Cos α	9.9281783		
B	8.5124992		
h	2.2654670	1st term	+184.2753
s²	7.64958		
Sin² α	9.44966		
C	0.71733		
	7.81657	2d term	+ .0066
h²	4.5309		
D	1.9851		
	6.5160	3d term	+ .0003
		-Δ φ	+184.2822

	°	'	"	Logarithms	Values in seconds	
½(φ+φ')	11	-31	-51.126			
s				3.8247895		
Sin α				9.7248287		
A'				8.5096676		
Sec φ'				0.0088155		
Δ λ				2.0681013	+116.9772	
Sin ½(φ+φ')				9.3008037		
-Δ α				1.3689050	-23.383	

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"
α	2 Coral	to 3 Sand	289	02	53.4
2d ∠		8	+ 35	01	13.2
α	2 Coral	to 1 Parry	324	04	06.6
Δ α				+ 1	06.3
			180	00	00.0
α'	1 Parry	to 2 Coral	144	05	13.0

			°	'	"
α	3 Sand	to 2 Coral	109	04	04.5
3d ∠		8	-105	14	12.4
α	3 Sand	to 1 Parry	3	49	52.1
Δ α				-	04.5
			180	00	00.0
α'	1 Parry	to 3 Sand	183	49	47.6

FIRST ANGLE OF TRIANGLE 39-44-34.6

	°	'	"			°	'	"
φ	11	32	20.254	2 Coral	λ	162	17	10.944
Δ φ		-7	33.882		Δ λ		-5	33.350
φ'	11	24	46.372	1 Parry	λ'	162	22	44.294

	°	'	"			°	'	"
φ	11	30	18.985	3 Sand	λ	162	23	06.870
Δ φ		-5	32.613		Δ λ		-	22.575
φ'	11	24	46.372	1 Parry	λ'	162	22	44.295

	Logarithms	Values in seconds	
s	4.2360560		
Cos α	9.9083344		
B	8.5124997		
h	2.6568901	1st term	+453.8267
s²	8.47211		
Sin² α	9.53701		
C	0.71669		
	8.72581	2d term	+ .0532
h²	5.3138		
D	1.9845		
	7.2983	3d term	+ .0020
		-Δ φ	+453.8819

	°	'	"	Logarithms	Values in seconds
½(φ+φ')	11	-28	-33.313		
s				4.2360560	
Sin α				9.7685032	
A'				8.5096677	
Sec φ'				0.0086735	
Δ λ				2.5229009	-333.3503
Sin ½(φ+φ')				9.2987573	
-Δ α				1.8216582	- 66.322

	Logarithms	Values in seconds	
s	4.0104080		
Cos α	9.9990284		
B	8.5125007		
h	2.5219371	1st term	+332.6114
s²	8.02082		
Sin² α	7.64976		
C	0.71538		
	6.38596	2d term	+ .0002
h²	5.0439		
D	1.9832		
	7.0271	3d term	+ .0011
		-Δ φ	+332.6127

	°	'	"	Logarithms	Values in seconds
½(φ+φ)	11	-27	-32.678		
s				4.0104080	
Sin α				8.8248816	
A'				8.5096681	
Sec φ'				0.0086735	
Δ λ				1.3536312	-22.5752
Sin ½(φ+φ')				9.2981279	
-Δ α				0.6517591	+ 4.485

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"			°	'	"
∠	2 Parry to 3 Coral	144	05	13.0	α	3 Coral to 2 Parry	324	04	06.6
2nd ∠	8	+ 54	56	34.4	3rd ∠	8	- 23	08	59.2
α	2 Parry to 1 Aniyaanii	199	01	47.4	α	3 Coral to 1 Aniyaanii	300	55	07.4
Δα			+	14.8	Δα			+ 1	21.3
		180	00	00.0			180	00	00.0
α'	1 Aniyaanii to 2 Parry	19	02	02.2	α'	1 Aniyaanii to 3 Coral	120	56	28.78

FIRST ANGLE OF TRIANGLE 101-54-26.6

	°	'	"			°	'	"		°	'	"		°	'	"
φ	11	24	46.372	2 Parry	λ	162	22	44.294	φ	11	32	20.254	3 Coral	λ	162	17	10.944
Δφ	+ 3	32.880			Δλ		+ 1	14.435	Δφ		-4	01.002		Δλ		+ 6	47.785
φ'	11	28	19.252	1 Aniyaanii	λ'	162	23	58.729	φ'	11	28	19.252	1 Aniyaanii	λ'	162	23	58.729

	Logarithms	Values in seconds		
s	3.8400459			
Cos α	9.9755921			
B	8.5125035			
h	2.3281415	1st term	-212.8832	
s²	7.68009			
Sin² α	9.02655			
C	0.71179			
	7.41843	2d term	+ .0026	
n²	4.6563			
D	1.9800			
	6.6363	3d term	+ .0004	
		-Δφ	-212.8802	

	°	'	"	Logarithms	Values in seconds
½(φ+φ')	11	-26	-32.812		
s				3.8400459	
Sin α				9.5132981	
A'				8.5096690	
Sec φ'				0.0087642	
Δλ				1.8717772	+74.4350
Sin ½(φ+φ')				9.2975056	
-Δα				1.1692828	-14.767

	Logarithms	Values in seconds		
s	4.1585639			
Cos α	9.7108123			
B	8.5124997			
h	2.3818759	1st term	+240.9217	
s²	8.31713			
Sin² α	9.86687			
C	0.71669			
	8.90069	2d term	+ .0796	
n²	4.7638			
D	1.9845			
	6.7483	3d term	+ .0006	
		-Δφ	+241.0019	

	°	'	"	Logarithms	Values in seconds
½(φ+φ')	11	-30	-19.753		
s				4.1585639	
Sin α				9.9334352	
A'				8.5096677	
Sec φ'				0.0087642	
Δλ				2.6104310	+407.7849
Sin ½(φ+φ')				9.2998596	
-Δα				1.9102907	-81.338

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POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"
α	2 Coral	to 3 Parry	324	04	06.6
2nd $\angle$	"	8	+ 14	59	40.0
α	2 Coral	to 1 Eniwetok	339	03	46.6
$\Delta\alpha$				+	48.4
			180	00	00.0
α'	1 Eniwetok	to 2 Coral	159	04	35.0

			°	'	"
α	3 Parry	to 2 Coral	144	05	13.0
3rd $\angle$	"	8	-117	16	37.5
α	3 Parry	to 1 Eniwetok	26	48	35.5
$\Delta\alpha$				-	17.7
			180	00	00.0
α'	1 Eniwetok	to 3 Parry	206	48	17.8

FIRST ANGLE OF TRIANGLE 47-43-42.8

	°	'	"			°	'	"
ϕ	11	32	20.254	2 Coral	λ	162	17	10.944
$\Delta\phi$		-10	28.789		$\Delta\lambda$		+ 4	03.781
ϕ'	11	21	51.465	1 Eniwetok	λ'	162	21	14.725

	°	'	"			°	'	"
ϕ	11	24	46.372	3 Parry	λ	162	22	44.294
$\Delta\phi$		- 2	54.907		$\Delta\lambda$		- 1	29.569
ϕ'	11	21	51.465	1 Eniwetok	λ'	162	21	14.725

	Logarithms	Values in seconds
s	4.3156485	
cos α	9.9703346	
B	8.5124997	
n	2.7984828	1st term +628.7570
s^2	8.63130	
$\sin^2\alpha$	9.10617	
C	0.71669	
	8.45416	2d term + .0286
n^2	5.5970	
D	1.9845	
	7.5815	3d term + .0038
		$-\Delta\phi$ +628.7894

	°	'	"
$\frac{1}{2}(\phi+\phi')$	11	27	05.860

	Logarithms	Values in seconds
s	4.3156485	
Sin α	9.5530842	
A'	8.5096677	
Sec ϕ'	0.0085993	
$\Delta\lambda$	2.3869997	+243.7810
$\sin\frac{1}{2}(\phi+\phi')$	9.2978492	
$-\Delta\alpha$	1.6848489	- 48.400

	Logarithms	Values in seconds
s	3.7796823	
Cos α	9.9506122	
B	8.5123035	
h	2.2427980	1st term +174.9033
s^2	7.55936	
$\sin^2\alpha$	9.30844	
C	0.71179	
	7.57959	2d term + .0038
h^2	4.4856	
D	1.9800	
ϵ	6.4656	3d term + .0003
		$-\Delta\phi$ +174.9074

	°	'	"
$\frac{1}{2}(\phi+\phi')$	11	23	18.919

	Logarithms	Values in seconds
s	3.7796823	
Sin α	9.6542065	
A'	8.5096690	
Sec ϕ'	0.0085993	
$\Delta\lambda$	1.9521571	-89.5689
$\sin\frac{1}{2}(\phi+\phi')$	9.2954837	
$-\Delta\alpha$	1.2476408	+17.686

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Pinnacle	to 3 Runit	249	34	07.5	α	3 Runit	to 2 Pinnacle	69	34	34.8
2d ∠		&	+ 33	17	04.5	3d ∠		&	− 98	08	56.6
α	2 Pinnacle	to 1 Islet	282	51	12.0	α	3 Runit	to 1 Islet	331	25	38.2
Δα				+	37.4	Δα				+	10.2
			180	00	00.0				180	00	00.0
α'	1 Islet	to 2 Pinnacle	102	51	49.4	α'	1 Islet	to 3 Runit	151	25	48.~~4~~ 3

FIRST ANGLE OF TRIANGLE 48 − 33 − 58.9

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	31	26.010	2 Pinnacle	λ	162	19	45.307	φ	11	32	16.080	3 Runit	λ	162	22	01.621
Δφ		−	42.154		Δλ		+ 3	07.237	Δφ		− 1	32.224		Δλ		+	50.922
φ'	11	30	43.856	1 Islet	λ'	162	22	52.~~6~~5 44	φ'	11	30	43.856	1 Islet	λ'	162	22	52.54~~3~~ 4

	Logarithms	Values in seconds	
s	3.7649177		
Cos α	9.3472444		
B	8.5125002		
h	1.6246623	1st term	+42.1369
s^2	7.52984		
$\sin^2\alpha$	9.97796		
C	0.71610		
	8.22390	2d term	+ .0167
h^2	3.2493		
D	1.9840		
	5.2233	3d term	+ .0000
		−Δφ	+42.1536

	°	'	"
½(φ+φ')	11 − 31 − 04.933		
	Logarithms	Values in seconds	
s	3.7649177		
Sin α	9.9889791		
A'	8.5096679		
Sec φ'	0.0088261		
Δλ	2.2723908	+187.2366	
Sin ½(φ+φ')	9.3003268		
−Δα	1.5727176	−37.387	

	Logarithms	Values in seconds	
s	3.5087376		
Cos α	9.9435987		
B	8.5124998		
h	1.9648361	1st term	+92.2224
s^2	7.01748		
$\sin^2\alpha$	9.35935		
C	0.71664		
	7.09347	2d term	+ .0012
h^2	3.9397		
D	1.9845		
	5.9242	3d term	+ .0000
		−Δφ	−92.2236

	°	'	"
½(φ+φ')	11 − 31 − 29.968		
	Logarithms	Values in seconds	
s	3.5087376		
Sin α	9.6796766		
A'	8.5096677		
Sec φ'	0.0088261		
Δλ	1.7069080	+50.9223	
Sin ½(φ+φ')	9.3005854		
−Δα	1.0074934	−10.174	

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HOLMES & NARVER ENGINEERS JOB Nº 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"			°	'	"
α	2 North Base to 3 Coral	75	02	07.9	α	3 Coral to 2 North Base	255	01	20.1
2d $\angle$	8	+ 79	53	48.8	3d $\angle$	8	- 33	10	30.8
α	2 North Base to 1 Piiraai	154	55	56.7	α	3 Coral to 1 Piiraai	221	50	49.3
$\Delta\alpha$			-	12.5	$\Delta\alpha$			+	35.4
		180	00	00.0			180	00	00.0
α'	1 Piiraai to 2 North Base	334	55	44.2	α'	1 Piiraai to 3 Coral	41	51	24.7

FIRST ANGLE OF TRIANGLE 66-55-40.5

	°	'	"			°	'	"			°	'	"			°	'	"
ϕ	11	33	23.267	2 North Base	λ	162	21	09.893	ϕ	11	32	20.254	3 Coral	λ	162	17	10.944	
$\Delta\phi$	+ 2	11.412			$\Delta\lambda$		- 1	02.341	$\Delta\phi$	+ 3	14.426			$\Delta\lambda$		+ 2	56.608	
ϕ'	11	35	34.679	1 Piiraai	λ'	162	20	07.552	ϕ'	11	35	34.680 79	1 Piiraai	λ'	162	20	07.552	

	Logarithms	Values in seconds			
s	3.6491067				
Cos α	9.9570365				
b	8.5124996				
n	2.1186428	1st term	-131.4143		
n^2	7.29821				
$\sin^2\alpha$	9.25409				
C	0.71736				
	726966	2d term	+ .0019		
n^4	4.2373				
D	1.9851				
	6.2224	3d term	+ .0000		
		$-\Delta\phi$	-131.4124		

	°	'	"	Logarithms	Values in seconds
$\frac{1}{2}(\phi+\phi')$	11	-34	-28.973		
s				3.6491067	
Sin α				9.6270451	
A'				8.5098676	
Sec ϕ'				0.0089513	
$\Delta\lambda$				1.7947707	-62.341
$\sin\frac{1}{2}(\phi+\phi')$				9.3024296	
$-\Delta\alpha$				1.0972003	+12.508

	Logarithms	Values in seconds		
s	3.9041724			
Cos α	9.8721147			
B	8.5124997			
h	2.2887868	1st term	-194.4405	
s^2	7.80834			
$\sin^2\alpha$	9.64844			
C	0.71669			
	8.17347	2d term	+ .0149	
h^2	4.5776			
D	1.9845			
	6.5621	3d term	+ .0000	
		$-\Delta\phi$	-194.4256	

	°	'	"	Logarithms	Values in seconds
$\frac{1}{2}(\phi+\phi')$	11	-33	-57.467		
s				3.9041724	
Sin α				9.8242197	
A'				8.5096677	
Sec ϕ'				0.0089513	
$\Delta\lambda$				2.2470111	+176.6083
$\sin\frac{1}{2}(\phi+\phi')$				9.3021056	
$-\Delta\alpha$				1.5491168	-35.409

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Aoman	to 3 Coral	24	32	57.2	α	3 Coral	to 2 Aoman	204	32	29.8
2d ∠		&	+ 86	53	44.4	3d ∠		&	− 30	06	50.8
α	2 Aoman	to 1 Bokon	111	26	41.6	α	3 Coral	to 1 Bokon	174	25	39.0
Δα				−	34.7	Δα				−	07.2
			180	00	00.0				180	00	00.0
α'	1 Bokon	to 2 Aoman	291	26	06.9	α'	1 Bokon	to 3 Coral	354	25	31.8

FIRST ANGLE OF TRIANGLE 62 − 59 − 24.9

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	37	15.282	2 Aoman	λ	162	19	27.584	φ	11	32	20.254	3 Coral	λ	162	17	10.944
Δφ		+ 1	06.764		Δλ		− 2	52.446	Δφ		+ 6	01.791		Δλ			− 35.806
φ'	11	38	22.046	1 Bokon	λ'	162	16	35.138	φ'	11	38	22.045	1 Bokon	λ'	162	16	35.138

	Logarithms	Values in seconds	
s	3.7491203		
Cos α	9.5630135		
B	8.5124992		
h	1.8246330	1st term	−66.7779"
s^2	7.49824		
$\sin^2 \alpha$	9.93768		
C	0.71736		
	8.15328	2d term	+ .0142
h^2	3.6493		
D	1.9851		
	5.6344	3d term	+ .0000
		−Δφ	−66.7637

	°	'	"
½(φ+φ')	11 − 37 − 48.664		
	Logarithms	Values in seconds	
s	3.7491203		
Sin α	9.9688423		
A'	8.5096676		
Sec φ'	0.0090237		
Δλ	2.2366539	−172.4463"	
Sin ½(φ+φ')	9.3044775		
−Δα	1.5411314	+34.764	

	Logarithms	Values in seconds	
s	4.0480178		
Cos α	9.9979427		
B	8.5124997		
h	2.5584602	1st term	−361.7930"
s^2	8.09604		
$\sin^2 \alpha$	7.97449		
C	0.71669		
	6.78722	2d term	+ .0006
h^2	5.1169		
D	1.9845		
	7.1014	3d term	+ .0013
		−Δφ	−361.7911

	°	'	"
½(φ+φ')	11 − 35 − 21.150		
	Logarithms	Values in seconds	
s	4.0480178		
Sin α	8.9872425		
A'	8.5096677		
Sec φ'	0.0090237		
Δλ	1.5539517	−35.8057"	
Sin ½(φ+φ')	9.3029656		
−Δα	0.8569173	+ 7.193	

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Boga	to 3 Engebi	260	44	14.1	α	3 Engebi	to 2 Boga	80	45	22.3
2d ∠		&	+ 55	44	06.8	3d ∠		&	− 80	36	19.7
α	2 Boga	to 1 Photo	316	28	20.9	α	3 Engebi	to 1 Photo	0	09	02.6
Δα				+ 1	07.7	Δα				−	00.2
			180	00	00.0				180	00	00.0
α'	1 Photo	to 2 Boga	136	29	28.6	α'	1 Photo	to 3 Engebi	180	09	02.4

FIRST ANGLE OF TRIANGLE

	°	'	"			°	'	"		°	'	"			°	'	"
φ	11	38	47.715	2 Boga	λ	162	09	17.366	φ	11	39	41.964	3 Engebi	λ	162	14	55.152
Δφ		− 5	49.623		Δλ		+ 5	36.708	Δφ		− 6	43.873		Δλ		−	01.078
φ'	11	32	58.092	1 Photo	λ'	162	14	54.074	φ'	11	32	58.091	1 Photo	λ'	162	14	54.074

	Logarithms	Values in seconds	
s	4.1706707		
Cos α	9.8603641		
B	8.5124964		
h	2.5435312	1st term	+349.5674"
s²	8.34134		
Sin² α	9.67606		
C	0.72082		
	8.73822	2d term	+ .0547
h²	5.0871		
D	1.9884		
	7.0755	3d term	+ .0012
		− Δφ	+349.6233

	°	'	"
½(φ+φ')	11 − 35 − 52.903		
	Logarithms	Values in seconds	
s	4.1706707		
Sin α	9.8380320		
A'	8.5096666		
Sec φ'	0.0088838		
Δλ	2.5272531	+336.7078"	
Sin ½(φ+φ')	9.3032916		
−Δα	1.8305447	− 67.693	

	Logarithms	Values in seconds	
s	4.0937486		
Cos α	9.9999985		
B	8.5124960		
h	2.6062431	1st term	+403.8712"
s²	8.18750		
Sin² α	4.84011		
C	0.72139		
	3.74900	2d term	+ .0000
h²	5.2125		
D	1.9888		
	7.2013	3d term	+ .0016
		− Δφ	+403.8728

	°	'	"
½(φ+φ')	11 − 36 − 20.028		
	Logarithms	Values in seconds	
s	4.0937486		
Sin α	7.4200540		
A'	8.5096665		
Sec φ'	0.0088838		
Δλ	0.0323529	−1.0784"	
Sin ½(φ+φ')	9.3035698		
−Δα	9.3359227	+0.217	

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Engebi	to 3 Aoman	298	38	01.3	α	3 Aoman	to 2 Engebi	118	38	56.3
2d ∠		&	+ 61	31	01.3	3d ∠		&	− 72	16	56.8
α	2 Engebi	to 1 Photo	0	09	02.6	α	3 Aoman	to 1 Photo	46	21	59.5
Δα					− 0.2	Δα					− 54.9
			180	00	00.0				180	00	00.0
α'	1 Photo	to 2 Engebi	180	09	02.4	α'	1 Photo	to 3 Aoman	226	21	04.6

FIRST ANGLE OF TRIANGLE

	°	'	"			°	'	"			°	'	"			°	'	"
φ	11	39	41.964	2 Engebi	λ	162	14	55.152	φ	11	37	15.282	3 Aoman	λ	162	19	27.584
Δφ		− 6	43.873		Δλ		−	01.077	Δφ		− 4	17.191		Δλ		− 4	33.509
φ'	11	32	58.091	1 Photo	λ'	162	14	54.075	φ'	11	32	58.091	1 Photo	λ'	162	14	54.075

	Logarithms	Values in seconds	
	4.0937487		
Cos α	9.9999985		
B	8.5124960		
h	2.6062432	1st term	+403.8715
s²	8.18750		
Sin² α	4.84011		
C	0.72139		
	3.74900	2d term	+ .0000
n²	5.2125		
D	1.9888		
	7.2013	3d term	+ .0016
		−Δφ	+403.8731

	°	'	"
½(φ + φ')	11 − 36 − 20.028		
	Logarithms	Values in seconds	
s	4.0937487		
Sin α	7.4200540		
A'	8.5096665		
Sec φ'	0.0088838		
Δλ	0.0323580	−1.0774	
Sin ½(φ+φ')	9.3035698		
−Δα	9.3359278	+0.217	

	Logarithms	Values in seconds	
s	4.0588211		
Cos α	9.8388758		
B	8.5124972		
h	2.4101941	1st term	+257.1545
s²	8.11764		
Sin² α	9.71920		
C	0.71984		
	8.55668	2d term	+ .0360
n²	4.8204		
D	1.9875		
	6.8079	3d term	+ .0006
		−Δφ	+257.1911

	°	'	"
½(φ + φ')	11 − 35 − 06.686		
	Logarithms	Values in seconds	
s	4.0588211		
Sin α	9.8595999		
A'	8.5096669		
Sec φ'	0.0088838		
Δλ	2.4369717	−273.5087	
Sin ½(φ+φ')	9.3028172		
−Δα	1.7397889	+ 54.927	

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BASE LINE COMPUTATIONS

405721 (92)

HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF RUNIT ISLAND BASE LINE

COMPUTED BY L.S.H. CHECKED BY L.M.R DATE Feb. 28, 1950

SECTION	DATE	DIR OF MEAS	TAPE NO	TAPE SUPPORT	UNCORRECTED LENGTH: TAPE LNGTH	UNCORRECTED LENGTH: METERS	TEMP.	CORRECTIONS: TEMP	CORRECTIONS: TAPE AND CATENARY	CORRECTIONS: SLOPE UP OR BACK	CORRECTIONS: INCLINATION	CORRECTIONS: SEA LEVEL	REDUCED LENGTH	ACCEPTED LENGTH	(V)	(V-)
							°C	METERS	METERS	METERS	METERS	METERS	METERS	METERS	MM	MM.
△ North Base																
Stake No. 2	2-24-50	F	6464	2		18.5349	38.0	+0.0001		18.5350	-0.0004		18.5346			
" " 3		F		2	½	25	34.0	+0.0002		-0.0579	-0.0000		24.9423			
" " 4		F		3	1	50	32.0	+0.0002			-0.0006		49.9996			
" " 5		F		3	1	50	32.0	+0.0002			-0.0040		49.9962			
" " 6		F		3	1	50	32.0	+0.0002			-0.0003		49.9999			
" " 7A		F		3	1	50	32.0	+0.0002		-0.0432	-0.0022		49.9548			
													243.4274	243.4274		
Stake No 7A																
" " 6	2-24-50	B		3	1	50	30.0	+0.0002			-0.0022		49.9980			
" " 5		B		3	1	50	32.5	+0.0002			-0.0003		49.9999			
" " 4		B		3	1	50	34.0	+0.0003			-0.0040		49.9963			
" " 3		B		3	1	50	34.0	+0.0003		-0.0434	-0.0006		49.9563			
" " 2		B		2	½	25	34.0	+0.0002		-0.0579	-0.0000		24.9423			
△ North Base		B		2		18.5349	38.0	+0.0001			-0.0004		18.5346			
													243.4274			

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF RUNIT ISLAND BASE LINE

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE Feb. 24, 1950

SECTION	DATE	DIR. OF MEAS	TAPE NO	TAPE SUPPORT	UNCORRECTED LENGTH		TEMP.	CORRECTIONS					REDUCED LENGTH	ADOPTED LENGTH	(V)	(VV)
					TAPE LNGTH	METERS		TEMP.	TAPE AND CATENARY	SET-UP SET-BACK	INCLINATION	SEA LEVEL				
							°C	METERS	METERS	METERS	METERS	METERS	METERS	METERS	MM.	MM.
Stake No. 7A																
" " 8	2-24-50	F	6621	3	1	50	34.5	+0.0003		-0.0734	-0.0000		49.9269			
" " 9		F		3	1	50	35.5	+0.0003			-0.0020		49.9983			
" " 10		F		3	1	50	35.0	+0.0003		+0.0526	-0.0000		50.0529			
" " 11		F		3	1	50	36.5	+0.0003			-0.0000		50.0003			
" " 12		F		3	1	50	36.0	+0.0003		-0.0627	-0.0001		49.9375			
" " 13		F		3	1	50	36.5	+0.0003			-0.0002		50.0001			
" " 14		F		3	1	50	33.5	+0.0003			-0.0005		49.9998			
" " 15		F		3	1	50	36.0	+0.0003			-0.0001		50.0002			
" " 16		F		3	1	50	34.5	+0.0003			-0.0000		50.0003			
" " 17		F		3	1	50	34.5	+0.0003			-0.0000		50.0003			
" " 18		F		3	1	50	33.0	+0.0003			-0.0014		49.9989			
" " 19		F		3	1	50	36.5	+0.0003			-0.0001		50.0002			
" " 20		F		3	1	50	37.5	+0.0003		-0.0356	-0.0001		49.9646			
													649.8803	649.8766		
Stake No. 20																
" " 19	2-25-50	B	6619	3	1	50	34.0	+0.0003		-0.0683	-0.0001		49.9319			
" " 18		B		3	1	50	34.0	+0.0003		+0.0411	-0.0001		50.0413			
" " 17		B		3	1	50	33.0	+0.0003			-0.0014		49.9989			
" " 16		B		3	1	50	33.0	+0.0003			-0.0000		50.0003			
" " 15		B		3	1	50	31.0	+0.0002			-0.0000		50.0002			
" " 14		B		3	1	50	32.0	+0.0002			-0.0001		50.0001			
" " 13		B		3	1	50	32.0	+0.0002			-0.0005		49.9997			
" " 12		B		3	1	50	33.0	+0.0003			-0.0002		50.0001			
" " 11		B		3	1	50	34.0	+0.0003		-0.0759	-0.0001		49.9243			
" " 10		B		3	1	50	34.0	+0.0003			-0.0000		50.0003			
" " 9		B		3	1	50	32.0	+0.0002			-0.0000		50.0002			
" " 8		B		3	1	50	32.0	+0.0002			-0.0020		49.9982			
" " 7A		B		3	1	50	33.0	+0.0003		-0.0229	-0.0000		49.9774			
													649.8729			

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10572/

HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF RUNIT ISLAND BASE LINE

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE Feb. 28, 1950

SECTION	DATE	DIR. OF MEAS.	TAPE NO	TAPE SUPPORT	UNCORRECTED LENGTH: TAPE LNGTH	UNCORRECTED LENGTH: METERS	TEMP. °C	COR: TEMP METERS	COR: TAPE AND CATENARY METERS	SET-UP SET-BACK METERS	INCLINATION METERS	SEA LEVEL METERS	REDUCED LENGTH METERS	ADOPTED LENGTH METERS	(V) MM.	(V·L) MM.
Stake No. 20																
" " 21	2-24-50	F	6619	3	1	50	38.0	+0.0004			-0.0030		49.9974			
" " 22		F		3	1	50	38.0	+0.0004			-0.0002		50.0002			
" " 23		F		3	1	50	38.0	+0.0004			-0.0005		49.9999			
" " 24		F		3	1	50	36.0	+0.0003			-0.0001		50.0002			
" " 25		F		3	1	50	35.0	+0.0003			-0.0010		49.9993			
" " 26		F		3	1	50	33.0	+0.0003			-0.0001		50.0002			
" " 27		F		3	1	50	32.0	+0.0002			-0.0000		50.0002			
" " 28		F		3	1	50	30.0	+0.0002			-0.0000		50.0002			
" " 29		F		3	1	50	30.5	+0.0002			-0.0023		49.9979			
" " 30		F		3	1	50	30.5	+0.0002			-0.0005		49.9997			
" " 31		F		3	1	50	31.0	+0.0002			-0.0004		49.9998			
" " 32		F		3	1	50	31.0	+0.0002			-0.0014		49.9988			
" " 33		F		3	1	50	32.0	+0.0002			-0.0001		50.0001			
" " 34B		F		3	1	50	30.0	+0.0002		No ±	-0.0000		50.0002			
													699.9951	699.9988		
Stake No. 34B																
" " 33	2-25-50	B	6621	3	1	50	29.0	+0.0002			-0.0000		50.0002			
" " 32		B		3	1	50	28.5	+0.0002			-0.0001		50.0001			
" " 31		B		3	1	50	29.0	+0.0002			-0.0014		49.9988			
" " 30		B		3	1	50	29.0	+0.0002			-0.0004		49.9998			
" " 29		B		3	1	50	29.5	+0.0002			-0.0005		49.9997			
" " 28		B		3	1	50	30.0	+0.0002			-0.0023		49.9979			
" " 27		B		3	1	50	30.0	+0.0002			-0.0000		50.0002			
" " 26		B		3	1	50	28.0	+0.0002			-0.0000		50.0002			
" " 25		B		3	1	50	29.0	+0.0002			-0.0001		50.0001			
" " 24		B		3	1	50	29.0	+0.0002			-0.0010		49.9992			
" " 23		B		3	1	50	30.0	+0.0002			-0.0001		50.0001			
" " 22		B		3	1	50	30.0	+0.0002			-0.0005		49.9997			
" " 21		B		3	1	50	31.0	+0.0002			-0.0002		50.0000			
" " 20		B		3	1	50	30.0	+0.0002		+0.0094	-0.0030		50.0066			
													700.0026			

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF RUNIT ISLAND BASE LINE

COMPUTED BY L.S.H. CHECKED BY L.M.P. DATE Feb. 28, 1950

SECTION	DATE	DIR. OF MEAS.	TAPE NO.	TAPE SUPPORT	UNCORRECTED LENGTH: TAPE LENGTH	UNCORRECTED LENGTH: METERS	TEMP.	COR—: TEMP.	COR—: TAPE AND CATENARY	—RECTIONS: SET-UP SET—BACK	—RECTIONS: INCLINATION	—RECTIONS: SEA LEVEL	REDUCED LENGTH	ADOPTED LENGTH	(v)	(v²)
							°C	METERS	METERS	METERS	METERS	METERS	METERS	METERS	MM.	MM.
Stake No. 34B																
" " 35	2-25-50	F	6464	3	1	50	37.0	+0.0003			-0.0006		49.9997			
" " 36		F		3	1	50	39.0	+0.0004			-0.0022		49.9982			
" " 37		F		3	1	50	38.0	+0.0004			-0.0001		50.0003			
" " 38		F		3	1	50	37.0	+0.0003			-0.0001		50.0002			
" " 39		F		3	1	50	38.0	+0.0004		-0.0409	-0.0002		49.9593			
" " 40		F		3	1	50	37.0	+0.0003			-0.0000		50.0003			
" " 41		F		3	1	50	39.0	+0.0004			-0.0027		49.9977			
" " 42		F		3	1	50	38.0	+0.0004		+0.0353	-0.0024		50.0333			
" " 43C		F		3	1	50	39.0	+0.0004		-0.0062	-0.0008		49.9934			
													449.9824	449.9832		
Stake No. 43C																
" " 42	2-25-50	B	6621	3	1	50	39.0	+0.0004			-0.0008		49.9996			
" " 41		B		3	1	50	38.0	+0.0004			-0.0024		49.9980			
" " 40		B		3	1	50	38.0	+0.0004			-0.0027		49.9977			
" " 39		B		3	1	50	38.0	+0.0004			-0.0000		50.0004			
" " 38		B		3	1	50	37.0	+0.0003			-0.0002		50.0001			
" " 37		B		3	1	50	38.0	+0.0004			-0.0001		50.0003			
" " 36		B		3	1	50	39.0	+0.0004		-0.0165	-0.0001		49.9838			
" " 35		B		3	1	50	39.0	+0.0004			-0.0022		49.9982			
" " 34B		B		3	1	50	38.0	+0.0004		+0.0061	-0.0006		50.0059			
													449.9840			

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HOLMES & NARVER ENGINEERS JOB No. 640

COMPUTATION OF RUNIT ISLAND BASE LINE

COMPUTED BY L.S.H. CHECKED BY L.M.F. DATE Feb. 28, 1950

SECTION	DATE	DIR OF MEAS	TAPE NO	TAPE SUPPORT	UNCORRECTED LENGTH TAPE LNGTH	UNCORRECTED LENGTH METERS	TEMP.	CORRECTIONS TEMP.	CORRECTIONS TAPE AND CATENARY	CORRECTIONS SET-UP SET-BACK	CORRECTIONS INCLINATION	CORRECTIONS SEA LEVEL	REDUCED LENGTH	ADOPTED LENGTH	(V)	(V v)
							"C"	METERS	METERS	METERS	METERS	METERS	METERS	METERS	MM.	MM.
Stake No. 43C																
" " 44	2-25-50	F	6619	3	1	50	34.0	+0.0003		-0.0226	-0.0002		49.9775			
" " 45		F		3	1	50	34.0	+0.0003			-0.0000		50.0003			
" " 46		F		3	1	50	31.0	+0.0002		+0.0203	-0.0004		50.0201			
" " 47		F		3	1	50	36.0	+0.0003			-0.0044		49.9959			
" " 48		F		3	1	50	38.0	+0.0004			-0.0011		49.9993			
" " 49		F		3	1	50	41.0	+0.0004			-0.0061		49.9943			
" " 50		F		3	1	50	37.0	+0.0003		-0.0422	-0.0031		49.9550			
" " 51		F		3	1	50	40.0	+0.0004			-0.0033		49.9971			
" " 52		F		3	1	50	40.0	+0.0004			-0.0000		50.0004			
" " 53		F		3	1	50	34.0	+0.0003			-0.0055		49.9948			
" " 54		F		3	1	50	28.0	+0.0002			-0.0139		49.9863			
" " 55		F		2	1/2	25	29.0	+0.0002		-0.0089	-0.0000		24.9913			
Δ Runit		F		2						+6.0652	-0.0006		6.0646			
													580.9769	580.9796		
Δ Runit																
Stake No 55	2-26-50	B	6621	2						+6.0652	-0.0006		6.0646			
" " 54		B		2	1/2	25	31.0	+0.0002		-0.0086	-0.0000		24.9916			
" " 53		B		3	1	50	30.0	+0.0002			-0.0139		49.9863			
" " 52		B		3	1	50	30.0	+0.0002			-0.0055		49.9947			
" " 51		B		3	1	50	32.0	+0.0002			-0.0000		50.0002			
" " 50		B		3	1	50	32.0	+0.0002		-0.0251	-0.0033		49.9718			
" " 49		B		3	1	50	32.0	+0.0002			-0.0031		49.9971			
" " 48		B		3	1	50	32.0	+0.0002			-0.0061		49.9941			
" " 47		B		3	1	50	32.0	+0.0002			-0.0011		49.9991			
" " 46		B		3	1	50	32.0	+0.0002			-0.0044		49.9958			
" " 45		B		3	1	50	32.0	+0.0003			-0.0004		49.9999			
" " 44		B		3	1	50	32.0	+0.0002			-0.0000		50.0002			
" " 43C		B		3	1	50	32.0	+0.0002		-0.0130	-0.0002		49.9870			
													580.9824			

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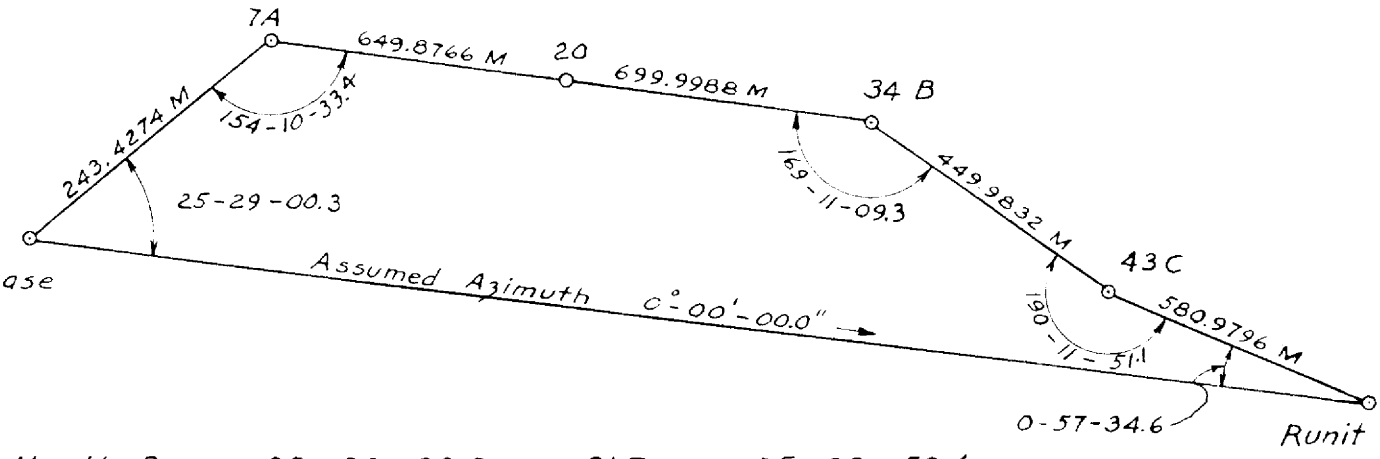

North Base	25-29-00.3	-01.7	25-28-58.6
7-A	154-10-33.4	-01.7	154-10-31.7
34-B	169-11-09.3	-01.8	169-11-07.5
43-C	190-11-51.1	-01.8	190-11-49.3
Runit	0-57-34.6	-01.7	0-57-32.9
	540°-00'-08.7"		540°-00'-00.0"

N.B.-Runit	0-00-00.0			2.0200827 = +104.7328
	+334-31-01.4	Log Sin	25-28-58.6	9.6337132
N.B.-7A	334-31-01.4	Log	243.4274	2.3863695
	+25-49-28.3	Log Cos	25-28-58.6	9.9555494
7A-34B	0-20-29.7			2.3419193 = +219.7452
	+10-48-52.5			
34B-43C	11-09-22.2			0.9056651 = -8.0476
	-10-11-49.3	Log Sin	0-20-29.7	7.7753714
43C-Runit	0-57-32.9	Log	1349.8754	3.1302937
		Log Cos	0-20-29.7	9.9999923
				3.1302860 = +1349.8516
+104.7328				
-8.0476				1.9398410 = -87.0645
-87.0645		Log Sin	11-09-22.2	9.2866447
-9.7252		Log	449.9832	2.6531963
Σ = 0.1045		Log Cos	11-09-22.2	9.9917148
				2.6449111 = +441.4800
219.7452				
1349.8516				0.9878995 = -9.7252
441.4800		Log Sin	0-57-32.9	8.2237386
580.8981		Log	580.9796	2.7641609
Σ = 2591.9749 = Log 3.4136308		Log Cos	0-57-32.9	9.9999391
				2.7641000 = +580.8981

Length of North Base-Runit base line 2591.9749 M 9?

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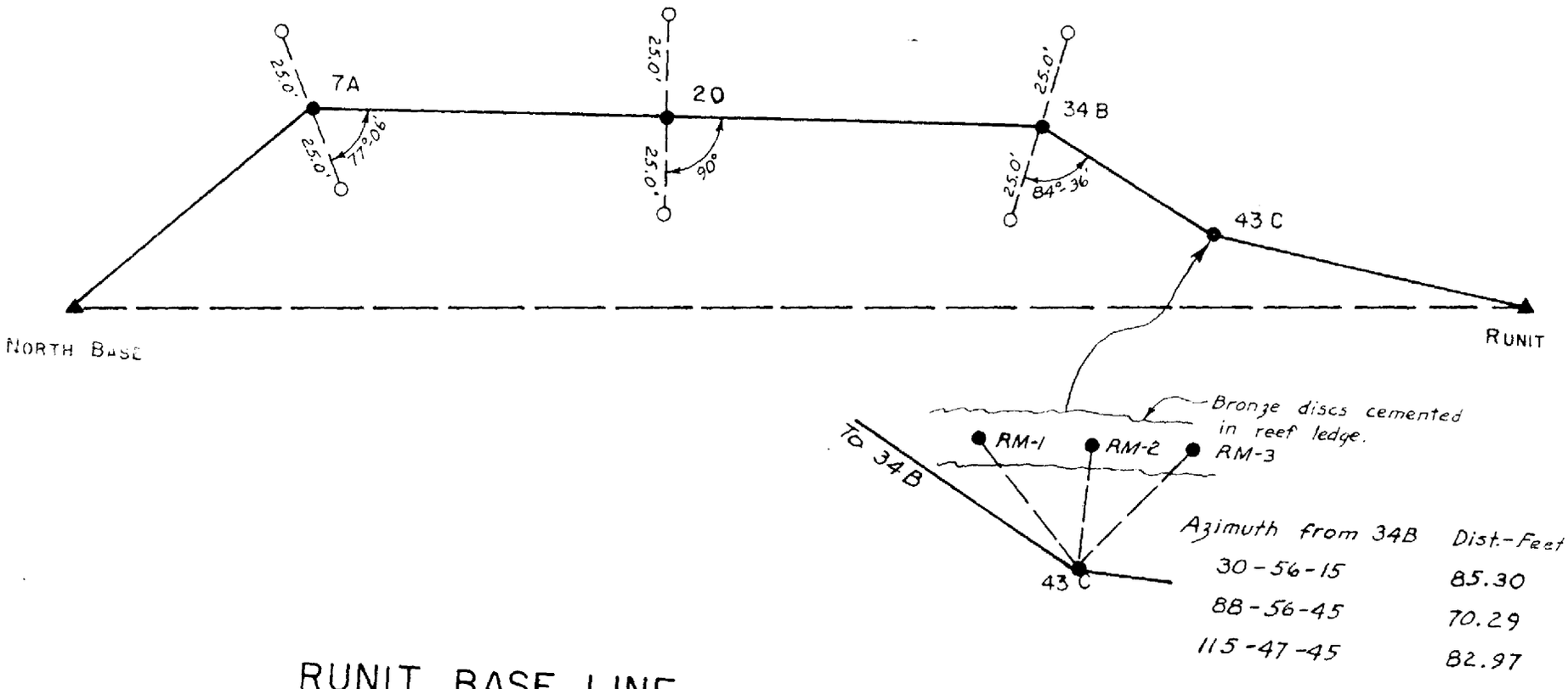

RUNIT BASE LINE

Reference Markers

● = Bronze discs in concrete blocks flush with surface.

○ = Bronze discs in concrete blocks 24" below surface.

For North Base and Runit reference marks see descriptions of triangulation stations.

HOLMES & NARVER ENGINEERS JOB No. 640

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PROBABLE ERROR COMPUTATION

SECTION	MEASURED DISTANCE	Discrepancy between 2 Measurements of Section			Probable Error	
		$20\sqrt{\text{dist. in Km.}}$	Allowable Maximum	Actual Difference	$0.6475\sqrt{\frac{\Sigma V^2}{n(n-1)}}$	1 Section
			m	m		m
North Base – 7A	F 243.4274					
	B 243.4274	$20\sqrt{.2434274}$	0.0098	0.0000	0.6745 x 0.000	0.0001
	0.0000					
7A – 20	F 649.8803					
	B 649.8729	$20\sqrt{.6498766}$	0.0161	0.0074	0.6745 x 0.0037	0.0025
	0.0074					
20 – 34 B	F 699.9951					
	B 700.0026	$20\sqrt{.6999988}$	0.0167	0.0075	0.6745 x 0.00375	0.0025
	0.0075					
34B – 43C	F 449.9824					
	B 449.9840	$20\sqrt{.4499832}$	0.0134	0.0016	0.6745 x 0.0008	0.0005
	0.0016					
43C – Runit	F 580.9769					
	B 580.9824	$20\sqrt{.5809796}$	0.0152	0.0055	0.6745 x 0.00275	0.0019
	0.0055					

0.0001^2
0.0025^2
0.0025^2
0.0005^2
0.0019^2

$\Sigma = 0.00001637 \quad \sqrt{\ } = 0.00405$ M

F 2624.2621
B 2624.2693
0.0072 M

Actual difference 0.0072 = 1:364481
Probable error 0.00405 = 1:647967

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HOLMES & NARVER ENGINEERS JOB No. 640

ABSTRACT OF WYE LEVELS AND COMPUTATION OF INCLINATION CORRECTIONS.

POINT	DISTANCE	REAR SIGHT OR FORE	INCLINATION CORRECTION	ELEVATION	MEAN ELEVATION	REMARKS
	METERS	~~+ or -~~ FEET	MM	METERS	METERS	
North Base						
2	18.5349	+ 0.44	0.4			
3	25	- 0.19	0.0			
4	50	- 0.78	0.6			
5	50	+ 2.06	4.0			
6	50	- 0.54	0.3			
7A	50	+ 1.54	2.2			
			Σ=7.5			
7A						
8	50	- 0.14	0.0			
9	50	+ 1.48	2.0			
10	50	+ 0.06	0.0			
11	50	+ 0.19	0.0			
12	50	+ 0.07	0.1			
13	50	- 0.48	0.2			
14	50	+ 0.75	0.5			
15	50	+ 0.32	0.1			
16	50	- 0.10	0.0			
17	50	+ 0.24	0.0			
18	50	- 1.20	1.4			
19	50	- 0.33	0.1			
20	50	- 0.34	0.1			
			Σ=4.5			

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ABSTRACT OF WYE LEVELS AND COMPUTATION OF INCLINATION CORRECTIONS.

POINT	DISTANCE	MEAN DIFF OF ELEV.	INCLINATION CORRECTION	ELEVATION	MEAN ELEVATION	REMARKS
	METERS	~~METERS~~ FEET	M/M	METERS	METERS	
20						
21	50	+ 1.81	3.0			
22	50	- 0.43	0.2			
23	50	+ 0.75	0.5			
24	50	- 0.31	0.1			
25	50	+ 1.05	1.0			
26	50	+ 0.40	0.1			
27	50	+ 0.12	0.0			
28	50	+ 0.02	0.0			
29	50	- 1.56	2.3			
30	50	- 0.75	0.5			
31	50	+ 0.66	0.4			
32	50	- 1.20	1.4			
33	50	+ 0.34	0.1			
34 B	50	- 0.17	0.0			
			Σ = 9.6			
34B						
35	50	+ 0.80	0.6			
36	50	- 1.53	2.2			
37	50	- 0.35	0.1			
38	50	- 0.32	0.1			
39	50	- 0.49	0.2			
40	50	+ 0.21	0.0			
41	50	- 1.72	2.7			
42	50	- 1.59	2.4			
43C	50	- 0.95	0.8			
			Σ = 9.1			

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ABSTRACT OF WYE LEVELS AND COMPUTATION OF INCLINATION CORRECTIONS.

POINT	DISTANCE	MEAN OF WYE LEVELS	INCLINATION CORRECTION	ELEVATION	MEAN ELEVATION	REMARKS
	METERS	~~FEET~~	MM	METERS	METERS	
43C						
44	50	+ 0.43	0.2			
45	50	- 0.03	0.0			
46	50	+ 0.67	0.4			
47	50	+ 2.15	4.4			
48	50	+ 1.08	1.1			
49	50	- 2.56	6.1			
50	50	- 1.84	3.1			
51	50	- 1.88	3.3			
52	50	+ 0.01	0.0			
53	50	- 2.44	5.5			
54	50	+ 3.87	13.9			
55	50	+ 0.07	0.0			
Runit	6.0652	- 0.27	0.6			
			Σ=38.6			

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6619

K+E

K E U F F E L & E S S E R C O.

Adams and Third Streets. Hoboken, N. J.

Telephone HOboken 3-1100 . Teletype HOB 1414

Date February 1st, 1950

REPORT ON

K. & E. TAPE NO. 7698CM - 50 Meters Nickel Steel Tape
LOVAR (Trademark)

Serial No. 6619

The above identified tape has been compared with our standard (which corresponds to the U. S. Standards at the National Bureau of Standards at Washington, D. C.) as was found to have the following length at 20° Centigrade (68° F.) under the conditions stated below:-

Supported on a horizontal flat surface:-

Tension	Interval	Length
11 Kg.	0-50 M.	50.000 M.

Supported at the 0, 25 and 50 M. points:-

Tension	Interval	Length
15 Kg.	0-50 M.	50.000 M.

The coefficient of expansion of the tape is assumed to be 0.000 000 4 per degree Centigrade (0.000 000 22 per degree Fahrenheit).

KEUFFEL & ESSER CO.

By /s/ A. W. Keuffel
Vice President

awk-fp

6621

K+E

KEUFFEL & ESSER CO.
Adams and Third Streets, Hoboken, N.J.
Telephone HOboken 3-1180, Teletype HOB 1414

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Pacific Southwest Region

Date: February 1st, 1950

REPORT ON

K. & E. TAPE NO. 7698CM - 50 Meters Nickel Steel Tape
LOVAR (Trademark)

Serial No. 6621

The above identified tape has been compared with our standard (which corresponds to the U. S. Standar at the National Bureau of Standards at Washington, D. C.) and was found to have the following length at 20° Centigrade (68° F.) under the conditions stated below:-

Supported on a horizontal flat surface:-

Tension	Interval	Length
11-1/4 Kg.	0-50 M.	50.000 M.

Supported at the 0, 25 and 50 M. points:-

Tension	Interval	Length
15 Kg.	0-50 M.	50.000 M.

The coefficient of expansion of the tape is assumed to be 0.000 000 4 per degree Centigrade (0.000 000 22 per degree Fahrenheit).

KEUFFEL & ESSER CO.

By /s/ A. W. Keuffel
Vice President

awk-fp

104

6464

K+E

K E U F F E L & E S S E R CO
Adams and Third Streets, Hoboken, N. J.
Telephone HOboken 3-1100 - Teletype HOB 1414

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Pacific Southwest Region

Date Sept. 16, 1949

REPORT ON

K. & E. TAPE NO. 7698CM - 50 Meters Nickel Steel Tape
LOVAR (Trademark)

Serial No. 6464

The above identified tape has been compared with our standard (which corresponds to the U. S. Standard at the National Bureau of Standards at Washington, D. C.) and was found to have the following length at 20° Centigrade (68° F.) under the conditions stated below:-

Supported on a horizontal flat surface:-

Tension	Interval	Length
11-1/2 Kg.	0-50 M.	50.000 M.

Supported at the 0, 25 and 50 M points:-

Tension	Interval	Length
15 Kg.	0-50 M.	50.000 M

The coefficient of expansion of the tape is assumed to be 0.000 000 4 per degree Centigrade (0.000 000 22 per degree Fahrenheit).

KEUFFEL & ESSER CO.

By /s/ A. W. Keuffel
Vice President

awk-fp

6465
6466

1 February 1950

LSH:

Pls forgive me for the lateness of this dispatch (HN409 received 29 Jan).
PENDING RECEIPT OF NEW SURVEY TAPES FOLLOWING INFO MAY BE OF VALUE CMA TAPES SIX FOUR SIX FIVE HAVING FIFTEEN AND ONE QUARTER KILO PULL HAS CORRECTED VALUE OF FOUR NINE POINT NINE NINE NINE SIX ONE METERS AT ONE FIVE KILO TENSION CMA TAPE SIX FOUR SIX SIX HAVING FIFTEEN AND ONE HALF KILO PULL HAS CORRECTED VALUE OF FOUR NINE PNT NINE NINE NINE TWO THREE METERS AT ONE FIVE KILO TENSION.

#6465 = 49.99961 Meters at 15 Kilos

#6466 = 49.99923 " " " "

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION AOMAN LOCATION Aoman Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Coral	-	-	0-00-00.0	
R.M. No. 1	22.860	75.00	188-08-10.0	
R.M. No. 2	22.860	75.00	278-08-10.0	

ELEV. OF MARK ABOVE MLW 10.0'

HEIGHT OF TELESCOPE ABOVE MARK 40.5'

HEIGHT OF LIGHT ABOVE MARK 40.5'

DETAILED DESCRIPTION:

This station is located on Aoman Island approximately 200 feet west of the west end of the Aoman-Biijiri causeway and 90 feet from the high water mark on the lagoon side. It is Traverse Station Aoman of the Joint Task Force Seven Survey and is a standard USC&GS triangulation disk set in a concrete block flush with the surface.

Reference marks are standard Holmes & Narver bronze disks in concrete blocks set flush with the surface.

This station was disturbed. See Recovery Note of June 7, 1951.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION BOGA LOCATION Bogallua Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Coral	-	-	0-00-00.0	
R.M. No. 1	59.015	193.62	94-53-50.0	
R.M. No. 2	36.576	120.00	154-54-00.0	

ELEV. OF MARK ABOVE MLW 7.1'

HEIGHT OF TELESCOPE ABOVE MARK 40.5'

HEIGHT OF LIGHT ABOVE MARK 40.5'

DETAILED DESCRIPTION

This station is located on Bogallua Island at the extreme east end of the island approximately 20 feet from the high water mark.

The mark is a standard Holmes & Narver bronze disk set in a concrete block flush with the surface.

The reference marks are standard Holmes & Narver bronze disks se t in concrete blocks flush with the surface and are intersection points on the Bogallua topo traverse.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION BOKON LOCATION Bokonaarappu Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Aomon	-	-	0-00-00.0	
R.M. No. 1	15.240	50.00	207-24-12.2	
R.M. No. 2	15.240	50.00	279-24-12.2	

ELEV. OF MARK ABOVE MLW 10.4'

HEIGHT OF TELESCOPE ABOVE MARK 15.5'

HEIGHT OF LIGHT ABOVE MARK 15.5'

DETAILED DESCRIPTION:

This station is located on Bokonaarappu Island approximately 660 feet from the west end of the island and 56 feet from the high water mark on the lagoon side.

The station mark is a standard Holmes & Narver bronze disk set in a concrete block flush with the surface.

The reference marks are standard Holmes & Narver bronze disks set in concrete blocks flush with the surface.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION ISLET LOCATION South of Runit Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
None				

ELEV. OF MARK ABOVE MLW 8.0'

HEIGHT OF TELESCOPE ABOVE MARK 11.5'

HEIGHT OF LIGHT ABOVE MARK 11.5'

DETAILED DESCRIPTION:

This station is located on the first sand island south of Runit at approximately the center of the island.

The disk is a standard Holmes & Narver bronze disk set in a concrete block flush with surface.

Due to the limited area of the island no reference marks were set.

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HOLMES & NARVER ENGINEERS JOB № 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION NORTH BASE LOCATION Runit Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Coral	-	-	0-00-00.0	
R.M. No. 3	45.686	149.89	101-59-20.0	
R.M. No. 1	31.992	104.96	267-33-20.0	
R.M. No. 2	25.233	82.785	340-35-50.0	

ELEV. OF MARK ABOVE MLW 8.9'

HEIGHT OF TELESCOPE ABOVE MARK 40.5'

HEIGHT OF LIGHT ABOVE MARK 40.5'

DETAILED DESCRIPTION:

This station is located at the north end of Runit Island approximately 200 feet from the end of the island and 65 feet from the high water mark on the lagoon.

The marker is a standard USC&GS triangulation station disk in a concrete block. This marker has been disturbed and is not in the location recorded in the Report of the Engineer, Joint Task Force Seven.

Reference marks are standard Holmes & Narver bronze disks cemented into the surface of the reef ledge at tide range.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION PARRY LOCATION Parry Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Coral	-	-	0-00-00.0	
R.M. No. 1	15.246	50.02	46-34-25.4	
R.M. No. 2	15.224	49.95	181-37-20.4	

ELEV. OF MARK ABOVE MLW 10.0'

HEIGHT OF TELESCOPE ABOVE MARK 24.5'

HEIGHT OF LIGHT ABOVE MARK 24.5'

DETAILED DESCRIPTION:

This station is located on Parry Island approximately 450 feet from the north end of the island. The mark is set at the intersection of the diagonals of the opposite legs of a four leg steel communication tower.

A twenty-four foot wood instrument tripod and a platform at the required height on the tower was constructed for observation.

The station is marked with a standard Holmes & Narver bronze disk in a concrete block flush with the surface.

The reference monuments are standard Holmes & Narver bronze disks in concrete blocks flush with the surface.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION PIIRAAI LOCATION Piiraai Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
N. Base	-	-	0-00-00.0	
R.M. No. 2	22.860	75.00	0-31-55.0	
R.M. No. 1	22.860	75.00	270-31-55.0	

ELEV. OF MARK ABOVE MLW 8.8'

HEIGHT OF TELESCOPE ABOVE MARK 15.5'

HEIGHT OF LIGHT ABOVE MARK 15.5'

DETAILED DESCRIPTION:

This station is located on Piiraai Island approximately 350 feet from the south end of the island and 75 feet from the high water mark on the lagoon side.

The station marker is a standard Holmes & Narver bronze disk set in a concrete block flush with the surface.

The reference marks are standard Holmes & Narver bronze disks set in concrete blocks flush with the surface.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION PINNACLE LOCATION Eniwetok Lagoon
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
None				

ELEV. OF MARK ABOVE M.W. 8.0'

HEIGHT OF TELESCOPE ABOVE MARK 5.0'

HEIGHT OF LIGHT ABOVE MARK 5.0'

DETAILED DESCRIPTION:

This station is a prefabricated steel tripod which was set in place on a coral reef approximately 2.7 statute miles west of the south end of Runit Island. The station was occupied at low water and under favorable weather conditions.

This is not a permanent station and will be removed as it is considered a navigation hazard.

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HOLMES & NARVER ENGINEERS JOB No. 640

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION TEITEIR LOCATION Teiteiripucchi Island
Eniwetok Atoll
Marshall Islands

CHIEF OF PARTY LSH

DATE 1949-50

DISTANCES AND DIRECTIONS TO REFERENCE MARKS				
OBJECT	DISTANCE		DIRECTION	AZIMUTH
	METERS	FEET		
Coral	-	-	0-00-00.0	
R.M. No. 1	15.240	50.00	125-23-00.0	
R.M. No. 2	15.240	50.00	215-23-00.0	

ELEV. OF MARK ABOVE MLW 8.6'

HEIGHT OF TELESCOPE ABOVE MARK 40.5'

HEIGHT OF LIGHT ABOVE MARK 40.5'

DETAILED DESCRIPTION:

This station is located on Teiteiripucchi Island approximately 800 feet from the west end of the island and 120 feet from the high water mark on the lagoon side.

The mark is a standard Holmes & Narver bronze disk set in a concrete block flush with the surface.

Reference marks are standard Holmes & Narver bronze disks in concrete blocks flush with the surface.

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MARKED BY

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HOLMES & NARVER ENGINEERS JOB No 640

RECOVERY NOTE TRIANGULATION STATION

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Name of Station CORAL Location Eniwetok Lagoon
Eniwetok Atoll
Established by J.T.F.-7 Year 1947-48 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station was recovered and found to be in good condition.

The station is located atop a circular concrete cell that is fifteen feet in diameter, about 2 miles east-southeast of the Reef Photo Tower, about 5 miles west of Runit Island and 0.15 mile west of buoy No. 15. The disk is a standard USC&GS station disk set in the center of the structure about 11 feet above M.L.W. stamped CORAL, and is surrounded by a sheet metal wall that projects 3 feet above the deck of the structure.

A 14 foot wooden tower was used for observations at this station.

RECOVERY NOTE TRIANGULATION STATION

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Name of Station **ELGIN (Engebi)** Location **Engebi Island**
Eniwetok Atoll
Established by **J.T.F.-7** Year **1947-48** **Marshall Islands**

Recovered by **LSH** Year **1949-50**

Detailed description as to fitness of original description:

This station was recovered and found to be in good condition.

The station is located on Engebi Island approximately 900 feet north of south end of island, 500 feet west of seaward side and 300 feet east of the lagoon, 130 feet south of a concrete building. The disk is a standard USC&GS station disk set in a 12 X 12 inch concrete block flush with surface and is stamped ELGIN.

This station has been re-named "ENGEBI" and is also bench mark No. 1 for this island.

RM No. 1 was set at a distance of 50.00 feet 15.240 M from the station at an azimuth of 105°-11'-10".

RM No. 2 was set at a distance of 50.00 feet 15.240 M from the station at an azimuth of 195°-11'-10".

These reference marks are standard Holmes & Narver bronze disks set in concrete blocks flush with the surface.

A 40 foot steel tower was used for observations at this point.

HOLMES & NARVER ENGINEERS JOB Nº 640

RECOVERY NOTE TRIANGULATION STATION

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Name of Station GRAFLEX Location Aoman Island
Eniwetok Atoll
Established by J.T.F.-7 Year 1947-48 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station has been destroyed.

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HOLMES & NARVER ENGINEERS JOB No. 640

RECOVERY NOTE TRIANGULATION STATION

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Pacific Southwest Region

Name of Station **KODAK (Aniyaanii)** Location **Aniyaanii Island**
Eniwetok Atoll
Established by **J.T.F.-7** Year **1947-48** **Marshall Islands**

Recovered by **LSH** Year **1949-50**

Detailed description as to fitness of original description:

This station has been recovered and found to be in good condition. The station has been renamed Aniyaanii and is located about 600 feet south of the north edge of vegetation in a small clearing on the lagoon side of Aniyaanii Island, 80 feet south of the north edge of the clearing, 125 feet east of the high water mark on the lagoon beach and 755 feet north of the northwest leg of a 75 foot steel tower. The marker is a standard USC&GS station disc set in a concrete block flush with the surface and stamped KODAK.

Reference mark No. 1 is set at a distance of 57.398 feet 17.495 M from the station at an azimuth of 214°-55'42.6".

Reference mark No. 2 is set at a distance of 110.819 feet 33.778 M from the station at an azimuth of 326°-01'-28.6".

These reference marks are standard USC&GS reference discs set in a concrete block flush with the surface.

Note: This station has been reset. See Restoration Note Triangulation Station of June 7, 1951.

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HOLMES & NARVER ENGINEERS JOB No 640

RECOVERY NOTE TRIANGULATION STATION

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Name of Station NORTH BASE Location Runit Island
Eniwetok Atoll
Established by USN Year 1944 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station was recovered and the results of the present survey determine that the marker has been disturbed.

The marker was used in its existing position and a new description and location of reference marks are included under description of triangulation stations.

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HOLMES & NARVER ENGINEERS JOB No. 640

RECOVERY NOTE TRIANGULATION STATION

Name of Station PHOTO (Reef Photo Tower) Location Eniwetok Lagoon
Eniwetok Atoll
Established by J.T.F.-7 Year 1947-48 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station recovered and found to be in good condition.

The station is a 4 leg 75 foot steel tower constructed atop 4 steel piles encased in concrete at tide range, located on a coral reef approximately 7 statute miles south of Engebi Island, 7 miles west of the north end of Runit Island and 2 miles west-northwest of station Coral.

The marker is a nail set in the wood deck at the intersection of the diagonals of the opposite legs of the tower. This wood deck is approximately 10 feet above M.L.W.

The light was mounted on a wood tripod 4.5 feet above the deck.

This station was not occupied due to excessive vibration.

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RECOVERY NOTE TRIANGULATION STATION

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Name of Station PRIVILEGE (Eniwetok) Location Eniwetok Island
Eniwetok Atoll
Marshall Islands

Established by USN Year 1944

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station was recovered and found to be in good condition. The station has been renamed ENIWETOK and is also BM No. 1 for this island.

The station is located on the north end of Eniwetok Island, 225 feet from the north end of the island, 70 feet west of the high water line on the seaward side and 90 feet east of the high water mark on the lagoon side. It is 30 feet north of a large Quonset building and is under a steel tripod which is Beacon B.

The marker is a standard USN triangulation disk set in an 8 X 8 inch concrete block flush with the surface.

Reference mark No. 1 is set at a distance of 39.12 feet 11.924 M from the station and an azimuth of 62°-46'-17.4".

Reference mark number 2 is set at a distance of 39.12 feet 11.924 M from the station and an azimuth of 332°-46'-17.4".

These reference marks are standard Holmes & Narver bronze disks set in concrete blocks flush with the surface.

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HOLMES & NARVER ENGINEERS JOB No. 640

RECOVERY NOTE TRIANGULATION STATION

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Name of Station RUNIT Location Runit Island
Eniwetok Atoll
Established by J.T.F.-7 Year 1947-48 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station was recovered and found to be in good condition.

The station is located approximately 900 feet north of the end of the sand spit at the south end of the island, 120 feet west of the high water mark on the seaward side of the island and 70 feet east of the high water mark on the lagoon side. The disk is a standard USC&GS station disk set in a 12 X 12 inch concrete block flush with the surface and is stamped RUNIT.

Reference mark No. 1 is 41.075 feet north-northwest of the station.

Reference mark No. 2 is 48.062 feet east of the station.

These reference marks are standard USC&GS reference disks set flush with the surface.

The station mark is approximately 9 feet above M.L.W. and a 20 foot wooden tower was used for observations.

HOLMES & NARVER ENGINEERS JOB No 640

RECOVERY NOTE TRIANGULATION STATION

Name of Station SAND Location So. of Runit Island
Eniwetok Atoll
Established by USN Year 1944 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station was recovered and found to be in good condition.

The station is located on the third sand island south of Runit Island, about 450 feet south of the north end of the island and 68 feet east of the high water mark on the lagoon side. The disc is a standard USN triangulation disc set in an 8 X 8 inch concrete block flush with the surface.

A 14 foot wooden tower was used for observations at this station.

As this is a remote location with limited land area no reference marks were set.

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RECOVERY NOTE TRIANGULATION STATION

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Name of Station STEEL Location Parry Island
Eniwetok Atoll
Established by USN Year 1944 Marshall Islands

Recovered by LSH Year 1949-50

Detailed description as to fitness of original description:

This station located on the north end of Parry Island has been destroyed.

Station PARRY of the present survey is in the approximate location of this station.

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Vertical Control

As no records are available of vertical control established here by previous surveys a temporary datum is being established on each of the project islands as surveys are made. This datum may be described as follows.

"A datum approximating mean low wate r springs was arrived at by applying corrections from the U.S. Coast and Geodetic publication "Tide Tables of the Pacific Ocean" to a series of tidal observations. This is a temporary datum but should be significant to less than a foot".

The procedure is to erect a tide staff at a suitable location at each island and take periodical observations as surveys are made at these islands. After applying corrections a mean of these corrected observations is accepted as the temporary datum. This datum is transferred to a permanent monument in the vicinity which becomes the point of origin of all vertical control on the particular island.

At a later date when personnel are available at these locations a longer series of observations will be taken and corrections applied to the datum. It is not anticipated that any temporary datum now in use will be refined by more than a few tenths of a foot.

When datums are established at all project islands a further check can be made by taking simultaneous observations at all tide staffs to check the relation between the individual datums. Due to little knowledge of currents in the lagoon it is doubtful if any refinement of the individual datums can be made by this method.

A list of the bench marks follows:

Aaraanbiru -- To be established at later date. △ Lucy Elev. 8.44

Aomon -- Triangulation station Aomon = Elev. 8.61

Biijiri -- Traverse station Biijiri - Elev. 7.67

Bogallua -- Triangulation station Boga - Elev. 7.14

Bokonaarappu -- Triangulation station Bokon - Elev. 10.40

Engebi -- Triangulation station Engebi (Elgin) - Elev. 10.08

Eniwetok -- Triangulation station Eniwetok - Elev. 10.34

Kirinian -- To be established at later date.

Muzinbaarikku -- To be established at later date.

Parry -- Triangulation station Parry - Elev. 9.80

Piiraai -- Triangulation station Piiraai - Elev. 8.80

Rojoa -- To be established at later date. Existing elevations are referenced to Traverse station Biijiri.

Runit -- Traverse station Runit - Elev. 12.95

Teiteiripucchi -- Triangulation station Teiteir - Elev. 8.60

The monuments at all points listed are bronze disks set in concrete blocks flush with the surface and these locations will be shown in topographical maps of the islands involved.

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EXPANSION OF HORIZONTAL CONTROL SURVEY

ENIWETOK ATOLL

MARSHALL ISLANDS

1951

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The primary horizontal control network furnished the basic controls from which the relations of test structures were determined. The scheme was expanded to include the photo stations at sites M, N, P and Q; C, E and V Zero points, and the islands of Bogon and Rigili. The islands of Muzin and Aaraanbiru were located from controls established in the local Zero areas.

General Features

The specifications and criteria for second order triangulation were followed in expanding the scheme. While the strength of figure was weak in some cases, additional observations were taken which offset the weakness.

All observations were made at night, and standard procedure was attempted throughout. Weather conditions and interference from construction and scientific work in the tower areas affected the survey, but the results are considered consistent with requirements.

A quadrilateral was developed including station Bokon, thereby increasing the strength of this station over the single triangle by which it was previously located. The adjusted values vary slightly from those recorded from the previous survey.

Station Islet was also strengthened by inclusion in a quadrilateral with no change in the values previously recorded.

The location of station Rigili is to third order accuracy, which conforms with instructions regarding location of this station.

Field Computations

Computations of the expanded scheme were made at the jobsite. While adjustments to balance out observing errors were not made, the results were within scientific requirements.

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Photo Tower Triangulation Report

A report was issued on May 18, 1951, including the relation of the photo tower to the Zero points. The values are listed as computed from the control network and also from check computations based on observations made at the structure sites. This report is included.

Adjusted Data

Adjusting of the expanded scheme has been completed, and the adjusted values are included in this report. The value of the length of each line is independent of the route followed in the computation.

All observations, including the check observations at the structure sites, were evaluated and used in the adjustments. While this data varies from the values given in the photo tower triangulation report, the differences are small and assure that the values given in this report are within requirements.

In the interests of economy, these computations are not included in this report. The sketches included record the adjusted values determining the inter-relation of the various stations.

The computations and field notes will be a part of the permanent survey records at the jobsite.

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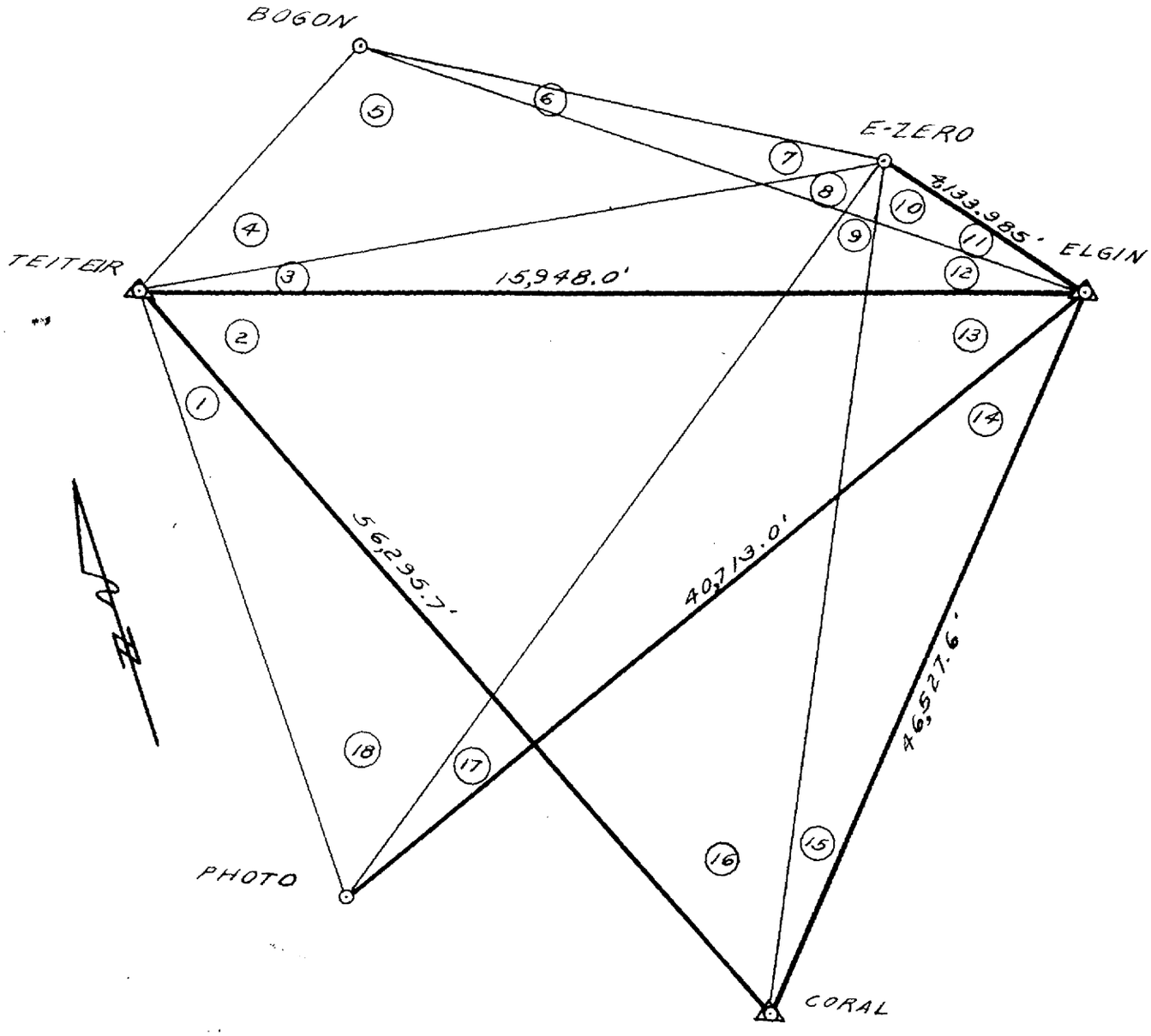

NOT TO SCALE

PRIMARY TRIANGULATION

SECONDARY TRIANGULATION

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ADJUSTED ANGLES

(1)	11°-53'-57.0"	(10)	27°-00'-18.6"
(2)	45°-29'-32.3"	(11)	21°-05'-09.8"
(3)	9°-34'-12.5"	(12)	9°-14'-16.6"
(4)	15°-27'-04.3"	(13)	103°-20'-29.0"
(5)	145°-44'-26.6"	(14)	17°-01'-02.1"
(6)	10°-22'-23.1"	(15)	2°-18'-43.9"
(7)	8°-26'-06.0"	(16)	11°-50'-12.7"
(8)	97°-41'-52.4"	(17)	3°-55'-35.9"
(9)	15°-24'-10.1"	(18)	15°-20'-25.8"

ADJUSTED DISTANCES

E-ZERO - BOGON	8,260.1'
E-ZERO - TEITEIR	12,554.4'
E-ZERO - PHOTO	43,669.8'
E-ZERO - CORAL	50,172.9'
ELGIN - BOGON	11,982.3'
TEITEIR - BOGON	4,548.0'
TEITEIR - PHOTO	47,027.0'

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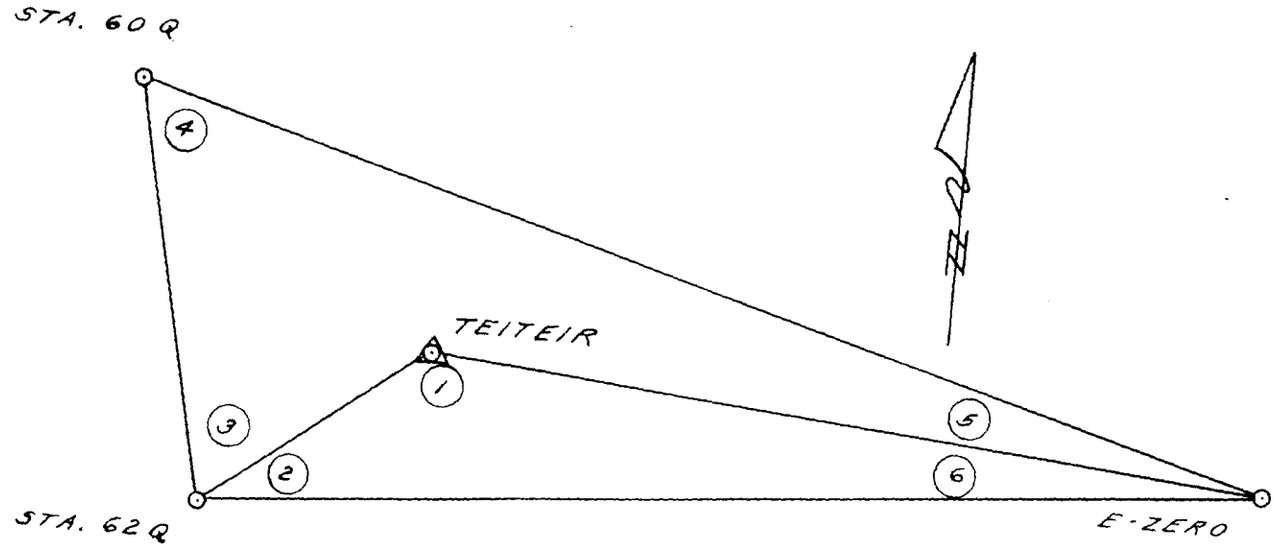

NOT TO SCALE

ADJUSTED ANGLES

1	177° - 08' - 02.5"
2	2° - 49' - 17.6"
3	101° - 54' - 50.0"
4	70° - 18' - 23.5"
5	4° - 54' - 49.0"
6	0° - 02' - 39.9"

ADJUSTED DISTANCES

TEITEIR	- E-ZERO	12,554.4'
TEITEIR	- 62 Q	191.62'
60 Q	- 62 Q	1,170.0'
E-ZERO	- 60 Q	13,092.3'
E-ZERO	- 62 Q	12,745.8'

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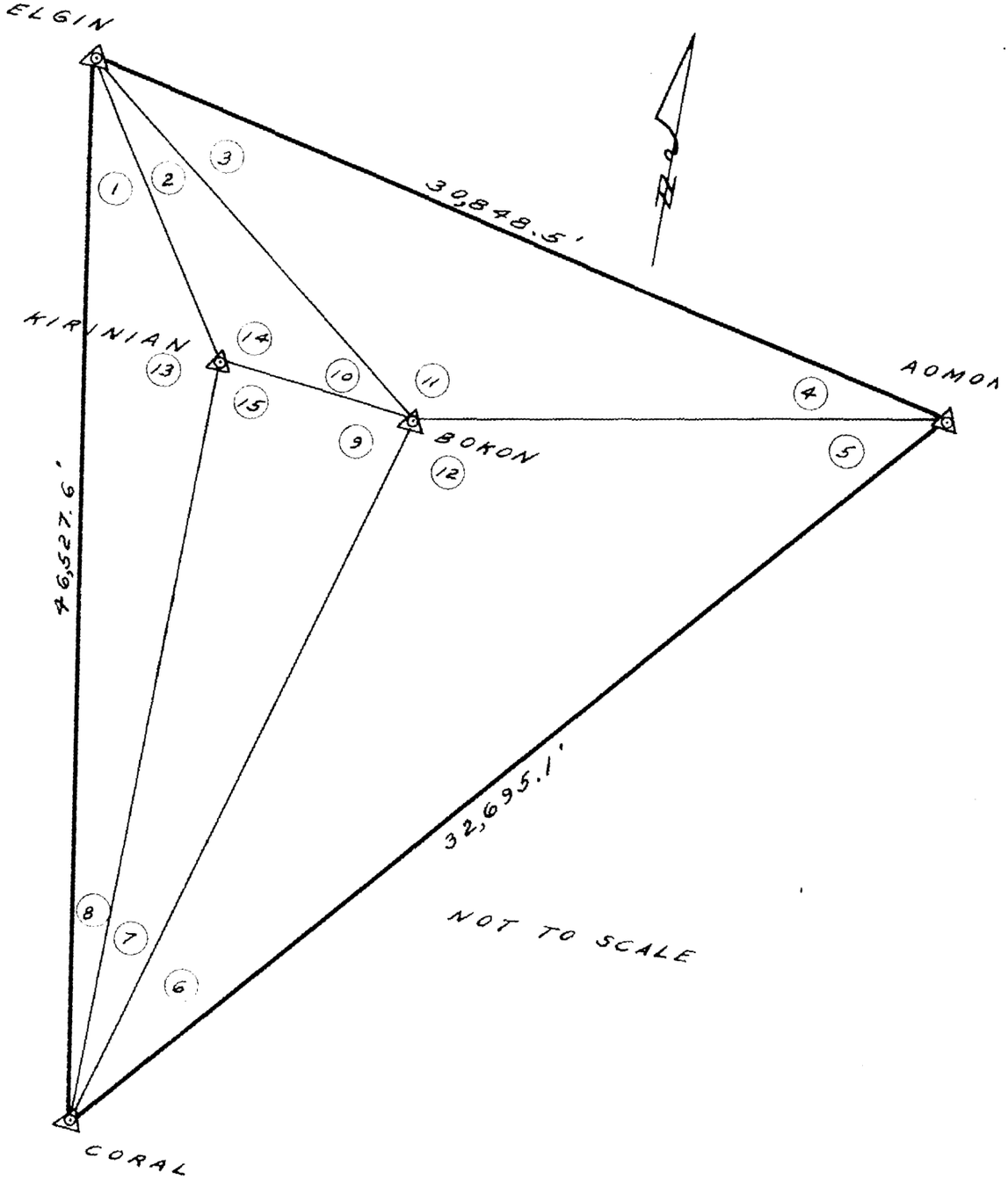

PRIMARY TRIANGULATION
SECONDARY TRIANGULATION

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ADJUSTED ANGLES

(1)	24°-14'-40.9"
(2)	9°-51'-23.2"
(3)	10°-23'-55.0"
(4)	7°-12'-14.1"
(5)	86°-53'-44.9"
(6)	30°-06'-49.9"
(7)	7°-44'-26.1"
(8)	3°-32'-45.9"
(9)	125°-39'-52.8"
(10)	8°-56'-51.1"
(11)	162°-23'-50.9"
(12)	62°-59'-25.2"
(13)	152°-12'-33.2"
(14)	161°-11'-45.7"
(15)	46°-35'-41.1"

ADJUSTED DISTANCES

BOKON - ELGIN	12,791.9'
BOKON - AOMON	18,412.0'
BOKON - CORAL	36,643.9'
BOKON - KIRINIAN	6,793.4'
KIRINIAN - CORAL	40,978.1'
KIRINIAN - ELGIN	6,172.3'

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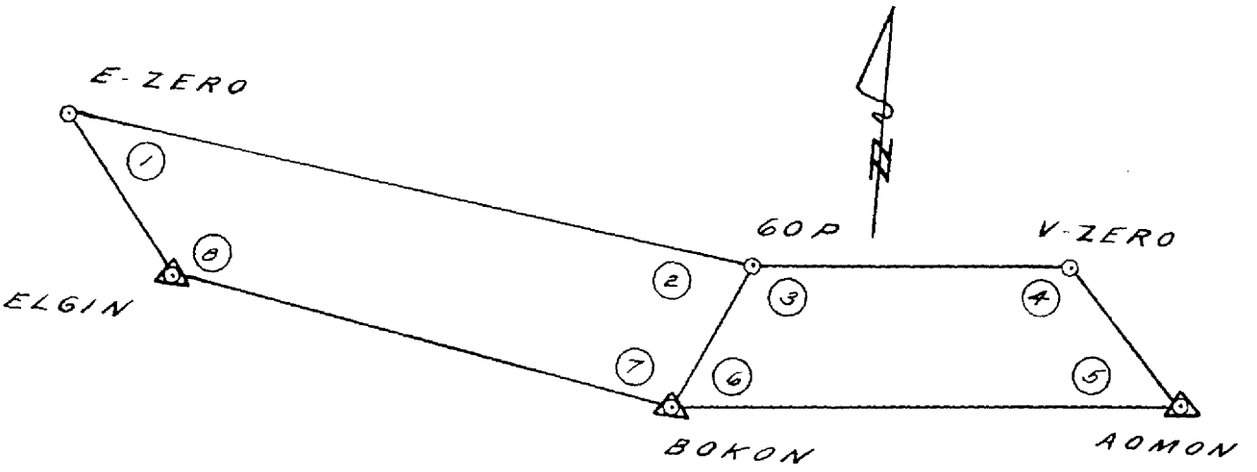

ADJUSTED ANGLES

(1)	4°-07'-18.6"
(2)	84°-41'-40.0"
(3)	116°-36'-55.9"
(4)	164°-25'-04.3"
(5)	12°-32'-11.9"
(6)	66°-25'-47.9"
(7)	95°-58'-03.0"
(8)	175°-12'-58.4"

ADJUSTED DISTANCES

60P - E-ZERO	16,928.2'
60P - V-ZERO	14,330.1'
60P - BOKON	150.0'
ELGIN - E-ZERO	4,133.985'
ELGIN - BOKON	12,791.9'
AOMON - BOKON	18,412.0'
AOMON - V-ZERO	4,140.9'

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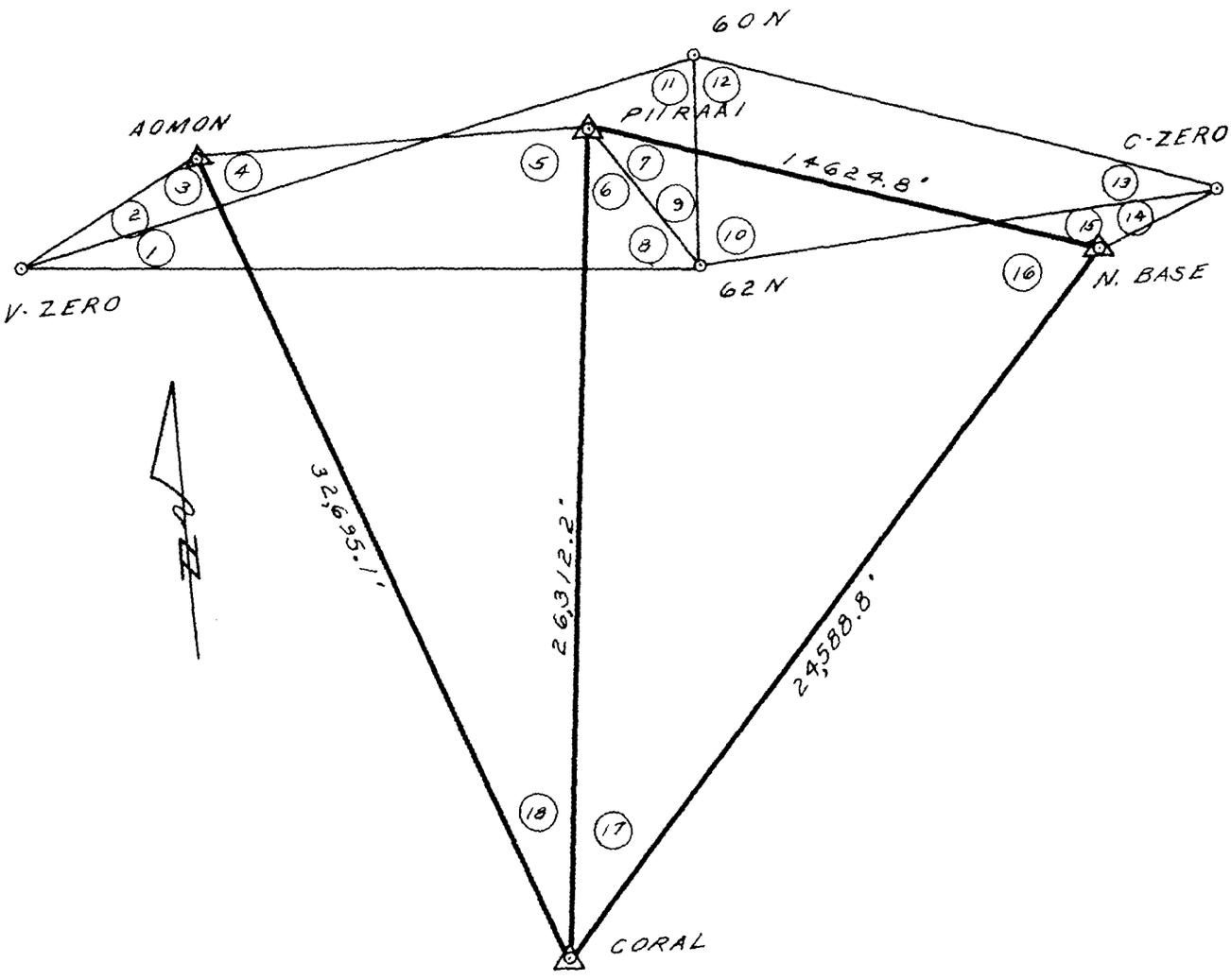

NOT TO SCALE

PRIMARY TRIANGULATION
SECONDARY TRIANGULATION

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ADJUSTED ANGLES

(1)	4°-05'-06.5"	(10)	106°-30'-24.2"
(2)	21°-28'-00.5"	(11)	98°-55'-43.2"
(3)	99°-25'-56.8"	(12)	69°-42'-03.2"
(4)	45°-56'-26.9"	(13)	3°-47'-32.6"
(5)	116°-45'-13.6"	(14)	45°-41'-26.3"
(6)	38°-43'-21.4"	(15)	132°-24'-33.0"
(7)	28°-12'-19.1"	(16)	79°-53'-48.7"
(8)	33°-35'-54.3"	(17)	33°-10'-30.8"
(9)	43°-23'-16.0"	(18)	17°-18'-19.5"

ADJUSTED DISTANCES

V-ZERO	-	AOMON	4,140.9'
V-ZERO	-	60N	14,393.4'
V-ZERO	-	62N	14,593.9'
C-ZERO	-	60N	15,255.6'
C-ZERO	-	62N	14,923.1'
PIIRAAI	-	62N	123.28'
PIIRAAI	-	AOMON	10,891.6'
60N	-	62N	1,052.4'
N. BASE	-	C-ZERO	591.27'

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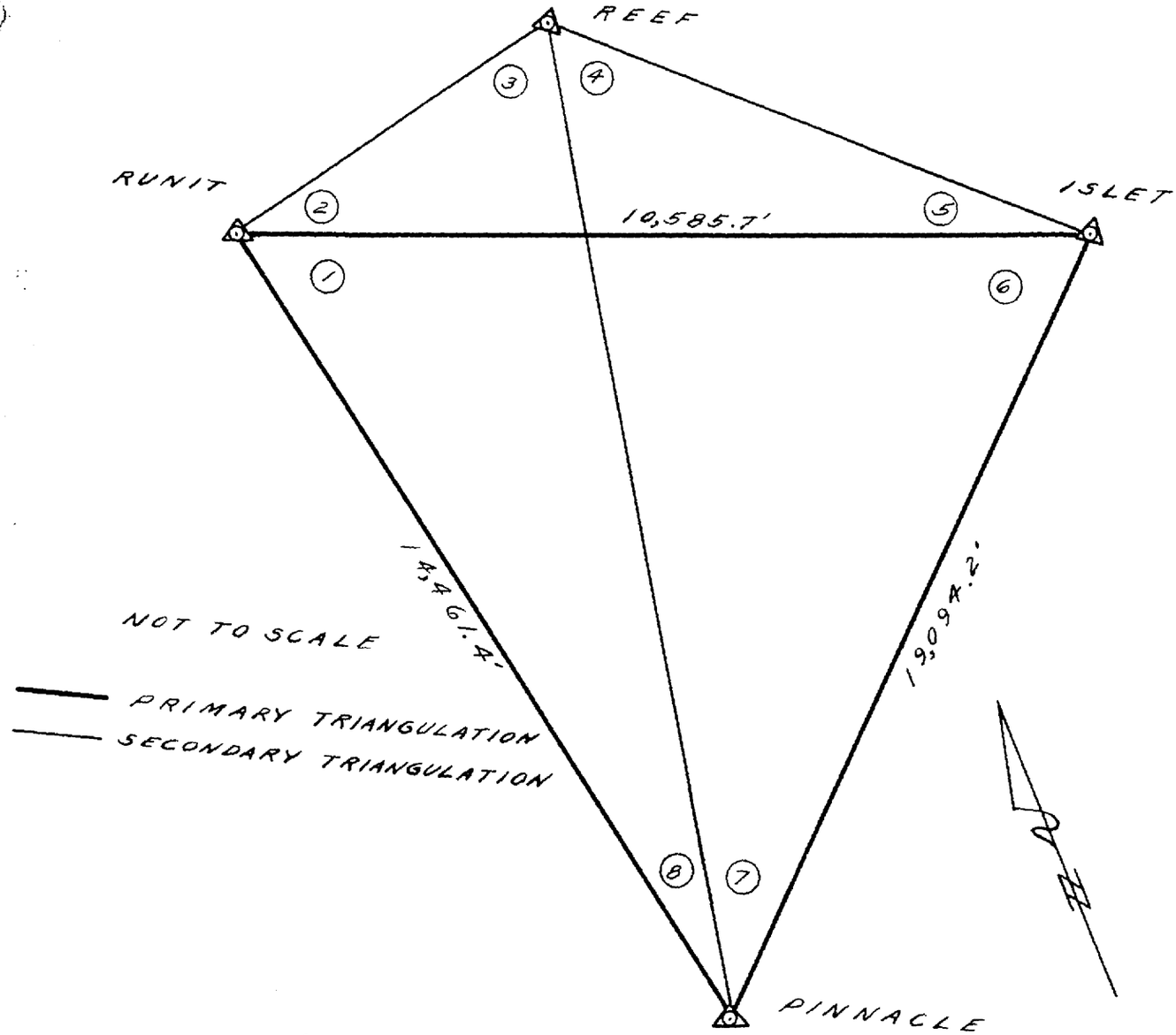

ADJUSTED ANGLES

(1)	98°-08'-56.6"
(2)	7°-10'-07.2"
(3)	60°-36'-29.4"
(4)	107°-50'-47.8"
(5)	4°-22'-35.6"
(6)	48°-33'-58.9"
(7)	19°-12'-37.7"
(8)	14°-04'-26.8"

ADJUSTED DISTANCES

REEF - RUNIT	4,036.2'
REEF - ISLET	6,600.3'
REEF - PINNACLE	16,008.2'

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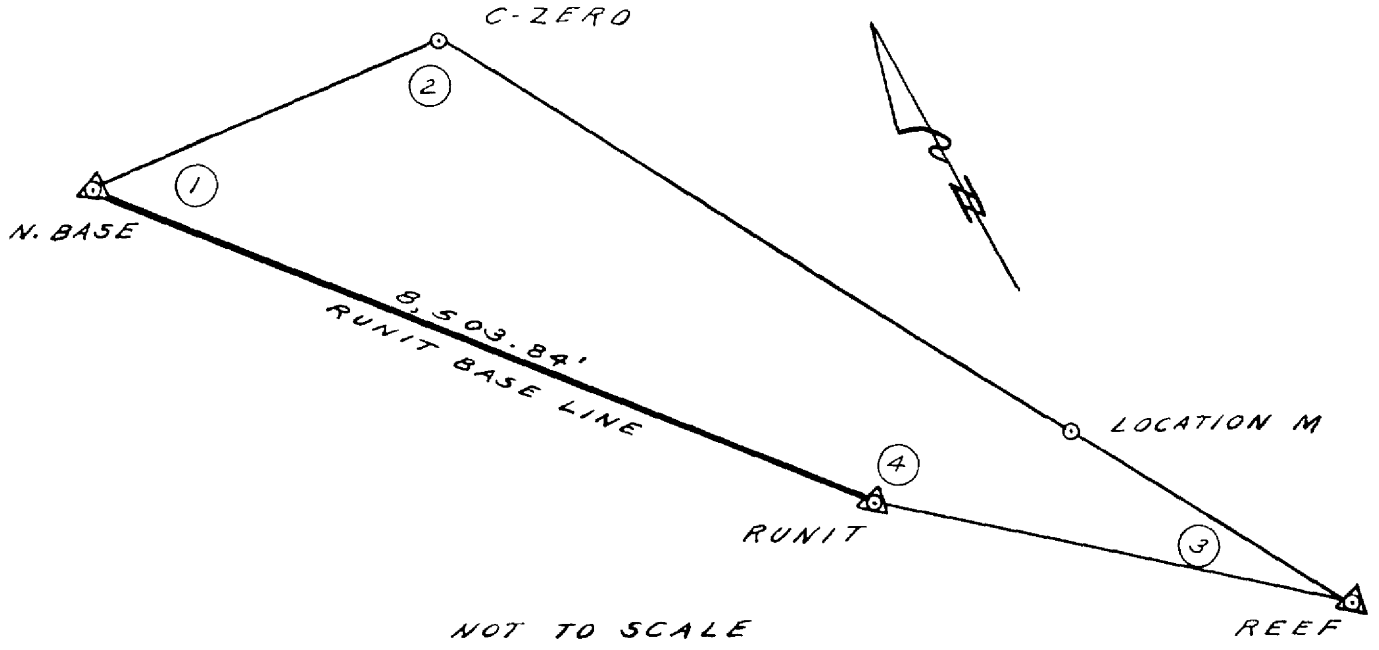

NOT TO SCALE

PRIMARY TRIANGULATION

SECONDARY TRIANGULATION

ADJUSTED ANGLES

(1)	35°-26'-55.9"
(2)	142°-25'-55.4"
(3)	0°-39'-13.8"
(4)	181°-27'-54.9"

ADJUSTED DISTANCES

N. BASE - C-ZERO	591.27'
C-ZERO - LOC. M	12,000.0'
LOC. M - REEF	65.27'
REEF - RUNIT	4,036.2'

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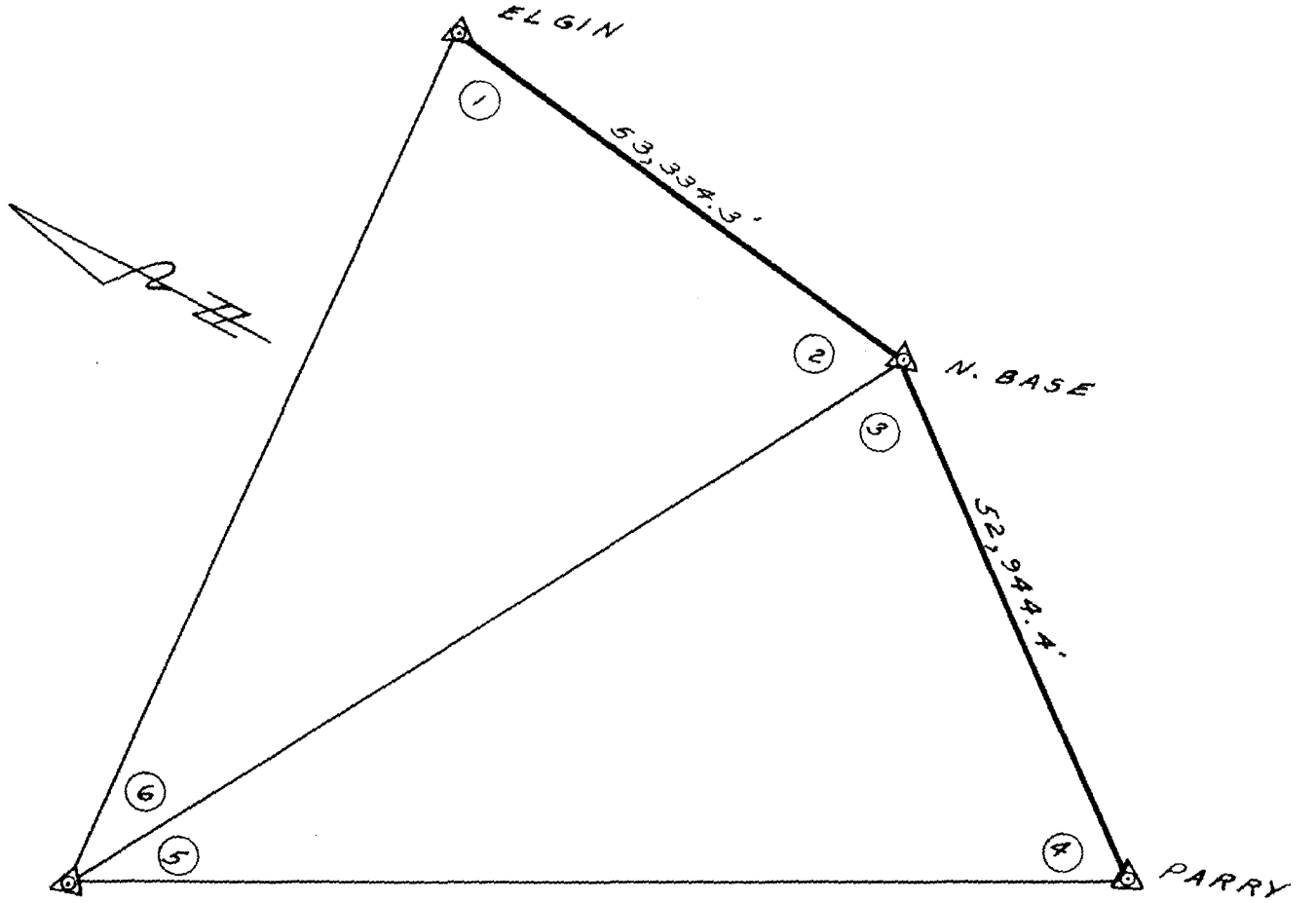

NOT TO SCALE

PRIMARY TRIANGULATION
SECONDARY TRIANGULATION (3RD ORDER)

ADJUSTED ANGLES

(1)	81°-04'-39.2"	(4)	69°-53'-17.5"
(2)	66°-20'-35.1"	(5)	30°-32'-11.1"
(3)	79°-34'-31.4"	(6)	32°-34'-45.7"

ADJUSTED DISTANCES

RIGILI - ELGIN	90,724.7'
RIGILI - N. BASE	97,849.7'
RIGILI - PARRY	102,483.7'

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CHECK COMPUTATION OF THE JOINT TASK FORCE SEVEN SURVEY TO DETERMINE THE AZIMUTH OF THE BASE LINE NORTH BASE-RUNIT OF THAT SURVEY,

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HOLMES & NARVER ENGINEERS JOB № 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"
α	2	to 3			
2d ∠		&	+		
α	2 North Base	to 1 Sand	327	56	52.40
Δα				+00	23.38
			180	00	00.0
α'	1 Sand	to 2 North Base	147	57	15.78

FIRST ANGLE OF TRIANGLE

	°	'	"			°	'	"
φ	11	33	23.265	2 North Base	λ	162	21	09.890
Δφ		− 3	04.284		Δλ		+ 1	56.983
φ'	11	30	18.981	1 Sand	λ'	162	23	06.873

	Logarithms	Values in seconds	
s	3.8247980		
Cos α	9.9281739		
b	8.5124992		
h	2.2654711	1st term	+184.2770"
s²	7.6495960		
Sin² α	9.4496824		
C	0.71736		
	7.8166384	2d term	+ 0.0066
h²	4.5309422		
D	1.9851		
	6.5160422	3d term	+ 0.0003
		−Δφ	+184.2839

	°	'	"
½(φ+φ')	11	− 31	− 51.123

	Logarithms	Values in seconds
s	3.8247980	
Sin α	9.7248412	
A'	8.5096676	
Sec φ'	0.0088155	
Δλ	2.0681223	+116.9829"
Sin ½(φ+φ')	9.3008037	
−Δα	1.3689260	−23.3834

NOTE: Position of North Base U.S.N. 1944 and azimuth of North Base U.S.N. to Sand U.S.N. has been held fixed in these computations.

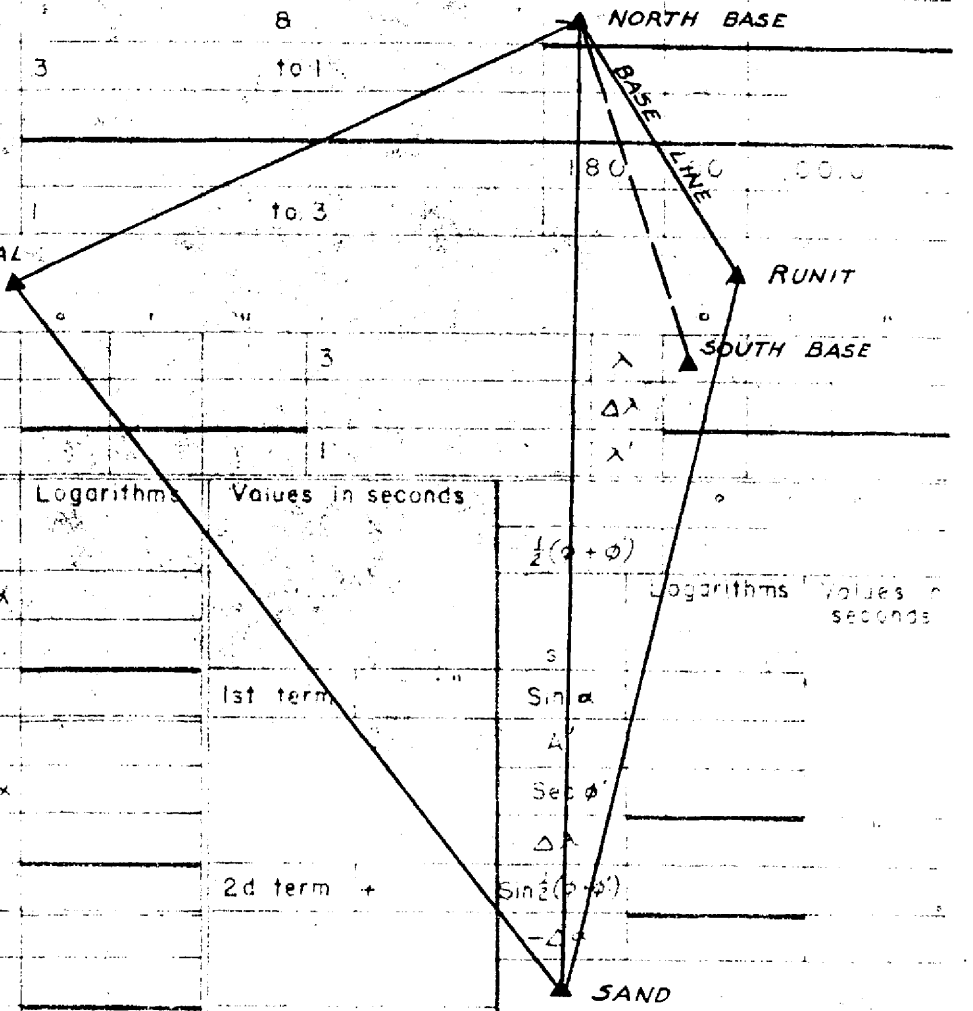
			°	'	"
α	3	to 2			
3d ∠		&			
α	3	to 1			
Δα					
			180	00	00.0
α'	1	to 3			

	°	'	"			°	'	"
φ				3	λ			
Δφ					Δλ			
φ'				1	λ'			

	Logarithms	Values in seconds	
s			
Cos α			
B			
h		1st term	
s²			
Sin² α			
C			
		2d term	+
h²			
D			
		3d term	+
		−Δφ	

	°	'	"
½(φ+φ')			

	Logarithms	Values in seconds
s		
Sin α		
A'		
Sec φ'		
Δλ		
Sin ½(φ+φ')		
−Δα		



Check computation of Task Force Seven Survey

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HOLMES & NARVER ENGINEERS JOB Nº 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

		°	'	"			°	'	"
α	2 North Base to 3 Sand	327	56	52.40	α	3 Sand to 2 North Base	147	57	15.78
$2^d\angle$	&	+107	05	20.48	$3^d\angle$	&	-38	53	11.73
α	2 North Base to 1 Coral	75	02	12.88	α	3 Sand to 1 Coral	109	04	04.05
$\Delta\alpha$			-00	47.84	$\Delta\alpha$			-01	11.10
		180	00	00.0			180	00	00.0
α'	1 Coral to 2 North Base	255	01	25.04	α'	1 Coral to 3 Sand	289	02	52.95

FIRST ANGLE OF TRIANGLE

	°	'	"		°	'	"		°	'	"		°	'	"
ϕ	11	33	23.265 2 North Base	λ	162	21	09.890	ϕ	11	30	18.981 3 Sand	λ	162	23	06.873
$\Delta\phi$		-1	03.010	$\Delta\lambda$		-3	58.959	$\Delta\phi$		+2	01.274	$\Delta\lambda$		-5	55.942
ϕ'	11	32	20.255 1 Coral	λ'	162	17	10.931	ϕ'	11	32	20.255 1 Coral	λ'	162	17	10.931

	Logarithms	Values in seconds					Logarithms	Values in seconds				
s	3.8747701			$\frac{1}{2}(\phi+\phi')$	11 -32-51.760		s	4.0573516		$\frac{1}{2}(\phi+\phi')$	11 -31-19.618	
Cos α	9.4119507				Logarithms	Values in seconds	Cos α	9.5141314			Logarithms	Values in seconds
B	8.5124992			s	3.8747701		B	8.5125007		s	4.0573516	
h	1.7992200	1st term	+62.9825	Sin α	9.9850186		h	2.0839837	1st term -121.3342	Sin α	9.9754928	
s^2	7.7495402			A'	8.5096676		s^2	8.1147032		A'	8.5096677	
$\sin^2\alpha$	9.9700372			Sec ϕ'	0.0088675		$\sin^2\alpha$	9.9509856		Sec ϕ'	0.0088675	
C	0.7173600			$\Delta\lambda$	2.3783238	-238.9592	C	0.7153800		$\Delta\lambda$	2.5513796	-355.9444
	8.4369374	2d term	+ 0.0274	$\sin\frac{1}{2}(\phi+\phi')$	9.3014290			8.7810688	2d term + 0.0604	$\sin\frac{1}{2}(\phi+\phi')$	9.3004785	
h^2	3.5984400			$-\Delta\alpha$	1.6797528	+47.836	h^2	4.1679674		$-\Delta\alpha$	1.8518581	+ 71.098
D	1.9850000						D	1.9833000				
	5.5834400	3d term	+ 0.0000					6.1512674	3d term + 0.0001			
		$-\Delta\phi$	+63.0099						$-\Delta\phi$ -121.2737			

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Check computation of Task Force Seven Survey

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HOLMES & NARVER ENGINEERS JOB Nº 640

POSITION COMPUTATION SECOND ORDER TRIANGULATION

			°	'	"				°	'	"
α	2 Coral	to 3 North Base	255	01	25.04	α	3 North Base	to 2 Coral	75	02	12.88
$\angle$		&	+ 15	48	09.52	$3^{d}\angle$		&	-112	14	55.77
α	2 Coral	to 1 Runit	270	49	34.56	α	3 North Base	to 1 Runit	322	47	17.11
$\Delta\alpha$				+ 0	58.14	$\Delta\alpha$				+ 0	10.36
			180	00	00.0				180	00	00.0
α'	1 Runit	to 2 Coral	90	50	32.70	α'	1 Runit	to 3 North Base	142	47	27.4 (6)

FIRST ANGLE OF TRIANGLE

	°	'	"			°	'	"			°	'	"
ϕ	11	32	20.255	2 Coral	λ	162	17	10.931	ϕ	11	33	23.265	3 North Base	λ	162	21	09.890
$\Delta\phi$		-0	04.175		$\Delta\lambda$		+ 4	50.690	$\Delta\phi$		-1	07.185		$\Delta\lambda$		+ 0	51.731
ϕ'	11	32	16.080	1 Runit	λ'	162	22	01.621	ϕ'	11	32	16.080	1 Runit	λ'	162	22	01.621

	Logarithms	Values in seconds	
	3.9449421		
Sec α	8.1589826		
b	8.5124997		
	0.6164244	1st term	+4.1345
e^2	7.88988		
$\sin^2\alpha$	9.99991		
	0.71669		
	8.60648	2d term	+ 0.0404
ρ''	1.23285		
f	1.98450		
	3.21735	3d term	+ 0.0000
		$-\Delta\phi$	+4.1749

$\frac{1}{2}(\phi+\phi')$ 11 - 32 - 18.17

	Logarithms	Values in seconds
s	3.9449421	
Sin α	9.9999548	
A'	8.5096677	
Sec ϕ'	0.0088657	
$\Delta\lambda$	2.4634303	+290.6900
$\sin\frac{1}{2}(\phi+\phi')$	9.3010828	
$-\Delta\alpha$	1.7645131	-58.145

	Logarithms	Values in seconds	
s	3.4136298		
Sec α	9.9011336		
b	8.5124992		
h	1.8272626	1st term	+67.1835
e^2	6.82726		
$\sin^2\alpha$	9.56317		
C	0.71800		
	7.10843	2d term	+ 0.0013
ρ''	3.65453		
L	1.98510		
	5.63963	3d term	+ 0.0000
		$-\Delta\phi$	+67.1848

$\frac{1}{2}(\phi+\phi')$ 11 - 32 - 49.67

	Logarithms	Values in seconds
s	3.4136298	
Sin α	9.7815864	
A'	8.5096676	
Sec ϕ'	0.0088660	
$\Delta\lambda$	1.7137498	+51.7309
$\sin\frac{1}{2}(\phi+\phi')$	9.3014075	
$-\Delta\alpha$	1.0151573	-10.355

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Check computation of Task Force Seven Survey

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[illegible] SINISGALLI TO