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4th Field Survey Squadron

Operation NERVOSE 93

Operation Report

A control survey operation
conducted in the
Groote Eylandt and East Arnhem Land

July - August 1993

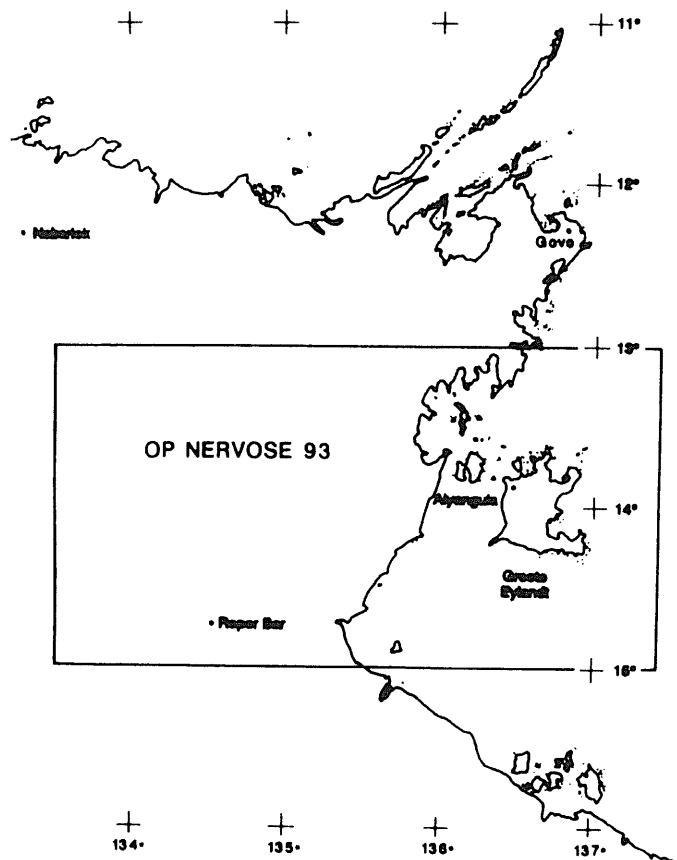


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Operation NERVOSE 93
Area of Operations



4th Field Survey Squadron



Operation NERVOSE 93

Operation Brief

An Army Field Survey Operation in the
Groote Eylandt - East Arnhem Land
Region of the Northern Territory.

July - August 1993



4th Field Survey Squadron

The 4th Field Survey Squadron is an Australian Army Unit responsible for all field survey operations undertaken by the Australian Defence Force as part of the defence mapping programme. Current priority areas in the programme include the Kimberley Region, the northern regions of the Northern Territory and Cape York. The Squadron uses sophisticated satellite surveying techniques to establish survey control points which form the basis of the mapping task. Other field tasks undertaken by the Squadron include aerial photography and verifying the accuracy and content of preliminary maps prior to their publication.

Vital to the success of these operations is the aviation, engineering, communications, transport, medical and catering support provided by other Army units and the Royal Australian Air Force. The understanding and co-operation of civilian organisations and individuals will also continue to be a key factor in the accomplishment of this essential Defence task.

4th Field Survey Squadron
Keawick Barracks
KESWICK SA 5035

Ph: (08) 293 9274
Fax: (08) 2939 361

Operation NERVOSE 93

Operation NERVOSE 93 will be conducted in the Groote Eylandt - East Arnhem Land region of the Northern Territory between 14 July and 7 August 1993 in the area shown overleaf. Five two-man GPS survey teams supported by Army helicopters will be used to establish survey control points for mapping purposes. The teams will be supported from a base camp which will be established on Groote Eylandt and a forward base at Roper Bar airstrip. Squadron personnel and stores will be transported by RAAF Hercules aircraft between Adelaide and Groote Eylandt.

A total of 62 survey control points will be established using GPS satellite surveying equipment. The information obtained will provide soldiers at the Army Survey Regiment in Bendigo, Victoria with the fundamental information required for the map making process.

Thank you for your assistance and please call me if you have any questions or concerns regarding Operation NERVOSE 93 or the Squadron.



Major Andrew McLeod
Officer Commanding

3 March 1993

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EXECUTIVE SUMMARY

1. Operation Nervose 93 was a GPS control survey operation conducted by 4 Fd Svy Sqn in the Groote Eylandt and east Arnhem land region of the Northern Territory during the period 21 Jul to 7 Aug 93. 4 Fd Svy Sqn's mission was to establish ground control for the 1:50 000 Defence mapping programme. Three LOH and a Nomad were in support of the operation.

2. It was originally intended for the operation to be conducted in much the same manner as Op Nervose 92. This involved LOH mounted reconnaissance teams deployed ahead of UH1H based GPS teams utilising the Texas Instruments TI4100 equipment. Although capable of achieving the technical aim in this manner, the operation was unavoidably large scale and required considerable resources. Furthermore, the TI4100 equipment is not able to operate during periods of Anti-Spoofing (AS) testing by the US Defence Department. This motivated 4 Fd Svy Sqn to evaluate the use of alternate GPS equipment, as recommended following OP Nervose 92.

3. Six weeks before the operation was to begin, following a user trial period, 4 Fd Svy Sqn purchased new low cost, commercially available Magellan GPS equipment which was smaller, lighter and easier to use. The plan for the operation was changed to suit the new equipment. Importantly, the new equipment negated the requirement for the UH1H as the Magellan based GPS teams are transportable in LOH. Operation plan modification included a reduction in manpower by 30 personnel, shortening the operation by seven days, and the relinquishment of 65 C130 hours and 150 UH1H hours. These savings are testimony to the power of DUP.

4. The new Magellan GPS equipment exceeded expectations; few problems were encountered, despite the relative user unfamiliarity. Both the reconnaissance and GPS parties were transportable by LOH, an aircraft ideally suited to Magellan GPS operations. All specific technical aims of the operation were achieved. This included the establishment of 26 new stations with the Magellan, 32 stations re-observed with the Magellan, the re-identification of four existing stations, and the observation of five stations with the TI4100 equipment. All aerial station target identification photography was successfully flown by the Nomad fitted with an RC10 aerial camera. However, 35mm photography for photographic interpretation guides, though successfully acquired in the field, was destroyed by civilian contractor during processing. This is to be ^{pursued} pursued by the Australian Government Solicitors Office.

5. As the AO is almost wholly Aboriginal land, considerable problems arose with obtaining access to the AO. HQ NORCOM is to be commended on their patience and perseverance to eventually coordinate the required unrestricted access, albeit only one week prior to the commencement.

6. Administratively, the operation ran very well. The Groote Eylandt Mining Company (GEMCO) have considerable facilities and infrastructure on Groote Eylandt which were utilised. Past problems with bill payment have been rectified.

7. Operation Nervose 93 was a most successful operation. Significantly, the operation saved considerable resources, and saw the introduction of new GPS equipment. All personnel are to be commended on their application and professionalism to achieve the aims of the operation.

OPERATION REPORT
OPERATION NERVOSE 93
JULY TO AUGUST 1993

- References:
- A. HQ ADF MPO 86-26470, Tasking Directive 1/1993 Survey Operations FY 93/94 Forecast Mapping And Charting Operations and Objectives, dated 21 Apr 93
 - B. LHQAUST OPORD 42/93 Op Nervose 93, dated 23 Jun 93
 - C. LHQ K92-00916 3759/93 Op Nervose 93(Control) Mounting Instruction, dated 27 Jun 93
 - D. 4 Fd Svy Sqn 851-93-1 Reconnaissance Report - Op Nervose 93, dated 4 May 93.
 - E. DSvy-A A91-31290 00537/93 Operation Nervose 93 - Technical Directive to OC 4 Fd Svy Sqn, dated 6 Jul 93
 - F. DSvy-A A91-31290 470/93 Approval to Use Finance Codes - Op Nervose 93, dated 17 Jun 93
 - G. 4 Fd Svy Sqn 851-93-1 Operation Nervose 94 - Concept of Operations dated 11 Sep 92
 - H. LHQAUST SIC KAA AVN 7521/93 dated 200415Z JUL 93

INTRODUCTION

1. Op NERVOSE 93 was a GPS control survey operation conducted by 4 Fd Svy Sqn in the Northern Territory during the period 21 Jul to 7 Aug 93. The Operation was conducted in response to References A, B and C.

MISSION

2. 4 Fd Svy Sqn's mission was to establish ground control suitable for future 1:50 000 mapping, in accordance with Reference E. The survey was to be based on Differential GPS positioning techniques, with additional Point Positioning GPS post processed by the US Defence Mapping Agency (DMA).
3. In addition to the control requirements, the following priority two and opportunity tasks were undertaken:
 - a. Priority Two Tasks.
 - (1) Update and/or produce photography interpretation guides (PIGs) in the AO as required in Reference E.

- (2) Reoccupy and co-ordinate an existing first order control point to assist in the verification of existing AGD/WGS 84 transformation parameters in the Arnhem Land area.
- b. Opportunity Task. Acquire VAP data as requested through LHQ.

AREA OF OPERATIONS

4. The AO, as depicted at Annex A, includes Groote Eylandt and Eastern Arnhem Land. The Arnhem land AO contains a variety of different terrain types from sandy beaches to savanna, and densely vegetated plains to saline coastal flat. Movement between survey stations was only possible by air.
5. The Groote Eylandt Mining Company (GEMCO), a subsidiary of BHP, operate within negotiated leases on Groote Eylandt Aboriginal Land. Alyangula is the town wholly owned and operated by GEMCO, located in the north west corner of Groote Eylandt. Alyangula has port facilities suitable for the ore ships which transport the manganese ore from the island. The air strip is located approximately 16 km south of Alyangula, adjacent to the town of Angurugu, connected by the all-weather, sealed Rowell Highway.
6. As the AO was largely Aboriginal Land, special considerations are required, in particular regarding access and public relations. Land clearances are of vital importance, and an essential pre-operation planning requirement.

CONDUCT OF OPERATIONS

Outline Technical Plan

7. The plan entailed establishing a fixed perimeter framework of independently observed GPS survey points within which all other survey points would be observed by GPS traversing. To achieve the technical aim of the operation, the survey points had to:
 - a. be visited and cleared if necessary for the required 15° elevation unobstructed view of the GPS satellites;
 - b. be permanently marked (if required);
 - c. have documentation completed;
 - d. be panelled to enable the identification of the site from the air, and on subsequent target identification aerial photography (so called "ident");
 - e. be occupied to collect sufficient GPS data to enable precise determination of station latitude, longitude and height; and
 - f. have their respective idents proven to ensure that it is adequate for later transfer to mapping photography.
8. The plan was to complete the stations on and around Groote Eylandt prior to heading west into the rest of the AO. Reconnaissance teams comprising two technicians were deployed to

locate and panel enough stations for several days GPS observations. Panelling requires the station to be targeted with distinct plastic panels. In accordance with Aboriginal land clearance requirements, no vegetation was cleared on survey stations. An alternate location was found for any stations which did require clearing in excess of minor vegetation or grass clearing. As many as six stations could be done by one reconnaissance party in one day. GPS parties also comprised two technicians. All differential observations with the new Magellan equipment had to be done simultaneously between GPS parties. As many as nine GPS observation sessions could be completed in one day, though on average only four or five sessions were completed daily. For point positioning with the TI4100, a party of one technician and a pilot were deployed independent of the other parties, with its own dedicated aircraft. This was generally done only when the movement of the remaining parties could be coordinated with the remaining aircraft. Each of the survey stations was photographed at 10 000 ft by an RC10 aerial camera mounted in a Nomad aircraft.

Sequence of Events

9. The operation was conducted according to the Sequence of Events as detailed at Annex B. Significant events are detailed below.

Reconnaissance

10. A reconnaissance of the AO was conducted during the period 16 to 21 Apr 93 by the OPSO 4 Fd Svy Sqn. The aims of the reconnaissance were to:

- a. ascertain the best main base location for the operation;
- b. examine the existing support infrastructure in the AO;
- c. liaise with all appropriate personnel to ensure the effective planning and conduct of the operation; and
- d. initiate liaison between 4 Fd Svy Sqn and the supporting AAAvn elements; in particular for AAAvn fuel positioning.

11. The reconnaissance successfully achieved all of its aims, and greatly facilitated the co-ordination of all of the administrative requirements of the Operation. In particular, it enabled HQ NORCOM and local aboriginal councils on Groote Eylandt to be familiarised with the exact nature of the tasks required during the operation.

Issue Of Orders And Instructions

12. The Operation Order and mounting instruction were issued on 23 Jun and 27 Jun 93 respectively. The late change in the technical plan for the operation prevented their release any earlier.

Pre-Operation Training

13. Pre-operation training was conducted during the period 6 to 13 Jul 93. As both were vital to the plan, emphasis was given to the operation of new Magellan GPS equipment and to RAVEN HF radios.

Insertion Of Force

14. On 21 Jul 93 one RAAF C130 inserted the main body into Groote Eylandt. The main base was established at the Angurugu airstrip. The supporting LOH Det from 161 Recce Sqn arrived approx 1800 hrs on the same day.

Aboriginal Liaison

15. Concerns regarding access to Aboriginal land made Aboriginal liaison a priority both before and during the operation. Every effort was made to ensure that the operation impinged upon the local Aboriginal population as little as possible. Details of the Land Clearances are detailed later in this report.

Commencement Of Tasks

16. On 22 Jul 93, the technical tasks commenced around Groote Eylandt. Once all technical equipment had been checked to ensure serviceability following insertion, reconnaissance tasks began on Groote Eylandt and a TI4100 GESAR point was established at the main base. Magellan GPS observations began on 23 Jul 93. On 29 Jul 93 the Nomad arrived at Groote Eylandt ready to commence photography tasks.

Extraction Of Force

17. On 5 Aug 93, the Nomad departed the AO after successfully completing all tasks. The Nomad overnigheted at RAAF Tindal prior to travelling to Broome to complete the air photo requirements from Op MIZMAZE 93. LOH support departed the AO on 6 Aug 93. The main base was dismantled on 6 Aug 93 in preparation for the extraction of the main body by RAAF C130 on 7 Aug 93.

OPERATION RESULTS

18. A comprehensive report on the technical aspects of the operation is at Annex C. Significant points are detailed below.

Significant Points

19. The initial plan for the operation was to utilise existing RASvy TI4100 GPS receivers in point positioning mode. However, unit awareness for the potential application of commercially available GPS equipment to save Army resources led to the acquisition of MAGELLAN GPS 500 PRO hand held GPS receivers. The equipment was purchased using DUP funds approximately six weeks prior to the operation. All plans for the conduct of the operation were changed accordingly.

20. The Magellan equipment performed very well with no problems. As a direct consequence of the new equipment, considerable Army resources were saved in the course of the operation:

- a. UH1H - 150 hours;
- b. C130 - 65 hours,
- c. Allowances - \$42 700,
- d. Time - 7 days, and
- e. Manpower - 936 mandays,

21. Furthermore, the use of the Magellan equipment avoided the effects of the US Defence Department Anti-Spoofing (AS) testing which interfered with Op NERVOSE 92 with the TI4100 equipment. Further information on the new Magellan equipment is detailed at Annex C.

Summary Of Results

22. Priority One Tasks. All priority one tasks were completed successfully.

23. Priority Two Tasks.

- a. Photo Interpretation Guides (PIGs). Photographs for PIGs were successfully taken during the operation. However, the civilian company who attempted to develop the film "accidentally" destroyed the PIG films. A claim for compensation to enable a second attempt of PIG photography is being prepared for action through the Australian Government Solicitors Office.
- b. U210 was re-observed to assist in the verification of existing AGD/WGS 84 transformation parameters in the Arnhem Land area.

So much for PIGs

24. Opportunity Task. Specific requirements for VAP data were not received in the AO until 4 Aug 93, the day prior to the planned departure of the Nomad from the AO. This made it impossible for all of the required photography to be obtained in the time frame left. In the course of the GPS traverse, a number of points were established for aero-triangulation internal checks.

ADMINISTRATION AND LOGISTICS

Operation Manning

25. The operation manning list is detailed at Annex D.

Groote Eylandt Mining Company (GEMCO) Support

26. All of the infrastructure on Groote Eylandt is the result of GEMCO's independent mining operation. Alyangula was established to support the 1000 GEMCO employees and their families. Accordingly, the island has the required infrastructure of their large scale operation, and impressive facilities for families, despite the relative isolation. Contractors provide most services

not capable of being provided by GEMCO. As a result, administration for the operation was based on exploiting the support offered by GEMCO during the operation reconnaissance. The relative simplicity of operation administration was largely attributable to the support by GEMCO.

Training

27. All of the planned GPS operators for the operation had only recently completed their Control Svy Course. As a consequence of this, the majority of the training was directed towards the use of the newly acquired Magellan equipment.

28. However, the operation did highlight some inadequacies of the Control Survey course, these being that:

- a. there was not enough generalist instruction on GPS theory and concepts,
- b. the course was too specific to the use of the TI4100 GPS unit, and
- c. there was not enough instruction in panel selection criteria, and other reconnaissance tasks.

29. Although the purchase of the Magellan was sudden, it is believed that the Control Survey course should have been less hardware specific and concentrated more on GPS and related concepts, with perhaps hands on use of a variety of commercially available GPS units.

AAAvn Support

30. The following AAAvn support was provided by 1 Avn Regt:

- a. LOH Kiowa. Three LOH were provided from 161 Recce Sqn, along with four pilots and two all-trades. A total of 136.1 hrs were flown during the operation. The new equipment meant that some flexibility would be needed and approval to exceed the initial 130 task hour LOH allocation was granted by telephone by LO 1 Avn Regt.
- b. Nomad. Following release from the UAV trials at Tindal, one Nomad was provided from 173 Survl Sqn with 55 tasks hours, of which 38.4 hours were used. The Nomad was primarily used as an air camera platform, but was also used for resupply to the forward bases. On completion of its operation tasks, the aircraft went on to complete the air photography tasks from Op Mizmaze 93.

31. Although, the forecast requirement was for two LOH on line, the AAAvn Det OC was prepared to task the third LOH while all aircraft were serviceable. While three LOH were flying, tasks were quickly achieved and the operation was proceeding ahead of schedule. However, when two aircraft went unserviceable (one due to a fuselage puncture, and the other due to an over-torque), the operation looked destined to have to be extended. However, the AAAvn Det OC co-ordinated the loan of the CO 1 Avn Regt LOH for the period 31 Jul to 4 Aug 93. This quickly made the operation time frame workable once more.

32. The Kiowa is perfectly suited to the GPS tasks undertaken on the operation. The aircraft is very flexible in its LZ requirements, can carry the required survey equipment for either reconnaissance or observations, as well as two survey technicians, and still have adequate

endurance to complete the task. The only restrictive facet of the employment of the Kiowa is its inability to carry all of the required equipment to complete a number of panelling and observations tasks in the same sortie. It is, however, accepted that the technical tasks undertaken by both the reconnaissance and GPS parties is achievable by one survey technician assisted by the pilot of the supporting LOH. In so doing, one LOH could carry the required equipment for the reconnaissance and GPS observations for several stations. This however, does not offer the same training value afforded by coupling an inexperienced technician with an experienced one. In future, it is accepted that this training value may be disregarded if there is seen to be more benefit in the more efficient employment of LOH task hours.

33. One dedicated LOH aircraft for each mobile GPS party should be considered highly desirable to all future GPS operations of this type. Although manageable, the lack of a dedicated aircraft for each mobile party wastes time, fuel and air hours.

34. Notification of the VAP data requirement arrived in the AO late. Had the extent of the requirement been known, appropriate Nomad hours would have been incorporated into the operation plan. Instead, there was not adequate nomad hours, and time, to complete all of the VAP acquisition tasks

35. AAAvn Liaison. Initial AAAvn liaison, as initiated with the operation reconnaissance, was based on the original operation plan and included 171 Op Spt Sqn. With the late change in the operation plan, liaison between 4 Fd Svy Sqn and 161 Recce Sqn could have been improved. Most notably, the late change removed the ability to confirm the fuel positioning plan with 161 Recce Sqn. Furthermore, copies of the AO maps sent to 1 Avn Regt for dispatch to the appropriate supporting AAAvn unit prior to the operation were not distributed to 161 Recce Sqn.

36. GL Support. The support provided by 68 GL Sect greatly assisted in the co-ordination of the C130 support to the operation.

RAAF Support

37. C130 Hercules. C130 aircraft from 36 Sqn were provided for both the insertion and extraction of the main body between Adelaide and Groote Eylandt. One LOH was also recovered from the AO to Sydney by C130 on 4 Aug 93.

Land Clearances

38. All land clearances for the operation were coordinated initially through HQ LCN, and then HQ NORCOM following the dis-establishment of HQ LCN. It was well understood from last year that many of the problems experienced in the past with obtaining land clearances for survey operations came as a result of a poor understanding of the nature of the required survey tasks in the field. Accordingly, to facilitate the acquisition of land clearances, detailed liaison between HQ LCN and 4 Fd Svy Sqn began early in the year. During the operation reconnaissance, HQ LCN was made familiar with the detailed plan of the operation, including technical tasks and requirements for LZs and survey point clearance.

39. The lead time for dealing with the Northern Land Council (NLC) is over six months (although this information was not passed to 4 Fd Svy Sqn). According to the NLC, in depth liaison between the NLC and LCN should have started in Aug 92 to enable the operation reconnaissance. The first that 4 Fd Svy Sqn heard of this was when access by OPSO

4 Fd Svy Sqn to Groote Eylandt in Mar 93 for the operation reconnaissance was denied. Continued efforts by HQ LCN enabled the recon to go ahead, albeit at the latest date possible in late Apr 93.

40. Following continual feedback from NORCOM, the process of land clearance acquisition was all going to plan, until correspondence was received direct from the NLC detailing the unlikelihood of approval to visit some areas of the AO. The letter was followed up by HQ NORCOM and was discredited, however it did highlight that at that point, the NLC had failed to action any requests for access to land under their control, despite their reports to the contrary. A cut off date of 2 Jul 93 was given to the NLC, after which, if clear access to the AO was not assured, the operation was to be cancelled. This cut-off date was extended when the likelihood of the operation going ahead was increased. NLC approval for the operation to go ahead was finally given on 14 Jul 93, subject to "face to face" talks between OC and OPSO 4 Fd Svy Sqn and NLC Nhulunbuy and the Laynapuy Homelands Association on arrival in the AO. This contact was made on 22 Jul 93, and on the return journey from Nhulunbuy, on advice from NLC and Laynapuy, Baniyala homeland was visited to clarify access to their land.

41. Another condition of the granting of land clearances by the NLC was the possible requirement for Aboriginal guides, if deemed necessary by the appropriate traditional owners in the AO. This was to be determined by the Det through consultation with each of the appropriate councils. The requirement for guides threatened to be a major restriction on the timely completion of the operation as they would have necessitated additional fuel, air hours and an extension for the operation. In anticipation of this requirement, blanket approval for civil passengers in LOH was requested through, and approved by LHQ as per Reference H.

42. On arrival on Groote Eylandt, the Anindilyakwa Land Council was visited to clarify access to all areas around Groote, without the requirement for guides. On 23 Jul 93, OC 4 Fd Svy Sqn returned to Baniyala to take an guide over some islands of cultural significance under their control. Fortunately, there was no further requirement for Aboriginal guides.

43. There were no problems with access to private land.

POL

44. POL Costings. POL required for the operation was forecast as in Reference G, which was submitted to LHQ as part of 4 Fd Svy Sqn FAPE FY 93/94. POL was costed accordingly as number of litres requested at a specific cost per litre, with no margin for the cost of fuel positioning. The isolated nature of the AO meant that fuel positioning to some areas cost more than the actual fuel itself. This uncosted expense promised to create some problems as 7 Log Coy attempted to comply with the fuel positioning requirements until Adelaide Log Bn agreed to meet all fuel costs. The high cost of fuel positioning in the AO must be taken into account in future operation POL costings.

45. Pre-Positioned Drummed Fuel. All pre-positioning of drummed fuel was done by 7 Log Coy. Despite the late changes to the overall plan of the operation, with obvious effects on the fuel requirement, and the aforementioned problems with the cost of fuel positioning, all fuel was positioned as required. 7 Log Coy are to be commended for their prompt and professional response to the changing logistic support requirements of this operation.

46. Bulk Aviation Fuel. Bulk AVTUR was obtained at Angurugu, and also at Nhulunbuy on the one occasion that it was visited. Excellent rapport between the refuellers and the Det led to call out fees being waived, and excellent service whenever required.

47. Drum Fuel Recovery. A total of 71 fuel drums were left at various locations throughout the AO. 7 Log Coy are coordinating the recovery of the drums.

Vehicle Support

48. Vehicle support to the operation consisted of:

- a. one RFSV on loan from NORFORCE Groote Eylandt Patrol,
- b. one hired commercial vehicle (Cabstar), and
- c. a chartered Coaster minibus as required.

49. The two main vehicles provided for admin movement between the main base and Alyangula, while the minibus was chartered as required to transport Det personnel for local leave. Given the small numbers of personnel involved in the operation, this arrangement proved most adequate.

Stores and Equipment

50. Technical Equipment. Problems with the GPS equipment relate to the severity of the AO. The dust, so unavoidable in the AO, represented a real problem with the GPS data logging PCs, despite the best efforts to keep the dust from getting into them. This resulted in a variety of problems ranging from keyboard keys sticking to floppy and hard disk failure. No other problems were experienced with any of the technical equipment. This is a problem which needs to be addressed prior to the next operation requiring the data logging PCs.

51. RAVEN HF Equipment. The new 4 Fd Svy Sqn RAVEN equipment initially performed well. However, cheap, poor quality connections in the RAVEN handsets lead to pressel switch failure, and resultant lack of communications. This proved to be a major inhibition to the essential communications between parties. The problem was overcome in the AO by soldering the connections to prevent their coming loose. RAVEN incident reports were submitted for this problem on RTU.

52. Accommodation Stores. All accommodation stores were drawn from 4 Fd Svy Sqn and Adelaide Log Bn Camp Earmark. No problems were experienced with any of these stores.

53. Other Stores. No problems were experienced with any of the other 4 Fd Svy Sqn stores.

Accommodation

54. The main base was established to the North of the refuellers compound at the Angurugu airstrip. Sleeping accommodation was in tentage. The operations room was in a spare ATCO style hut in the refuellers building adjacent to the tentage accommodation area.

Messing

55. All meals were provided by the unit cook who worked from a tentage kitchen established within the main base, and were of an exemplary standard. Rations for the forward bases were resupplied by Nomad. Fresh rations were purchased using the 4 Fd Svy Sqn Survey Party Ration Account (SPRA). A rate of \$14.00 per man per day was used to determine the SPRA amount. This amount proved adequate, despite the expensive nature of the food bought through an outlet with a monopoly; Nationwide. At the completion of the operation, the SPRA account was reconciled, and the unused remainder returned to the receiver of public monies. Additional freezer space and other associated support was also available from Nationwide.

Canteen

56. A "dry" unit canteen operated at the main base. Alcohol was not permitted at the main base due to its prohibition outside the Alyangula township area. Although a permit could have been obtained for consumption of alcohol, it was not deemed appropriate.

Medical

57. Medical facilities in Alyangula were utilised. Very few medical problems were encountered. However, one member was treated for an unknown viral infection, and another for a crushed finger.

Water

58. High quality town water was available in the base camp area.

Morale and Discipline

59. Morale remained high throughout the operation despite the hectic schedule of work being met. There were no incidents requiring disciplinary action.

Finance

60. Expenditure was as follows:
- a. Travel and Subsistence - \$12 553.50
 - b. Freight and Cartage - \$742.00
 - c. Petty Cash - \$429.15
 - d. SPRA - \$5654.30

Allowances

61. The following allowances were paid:
- a. Travelling Allowance.
 - (1) The incidental and meal elements of travelling allowance were paid in advance to all members travelling to and from the AO on C130.
 - (2) Full TA was paid in advance to all AAAvn elements for insertion and extraction.
 - (3) Full TA was paid to the Air Camera and Nomad personnel for the Op MIZMAZE supplementary photography phase.
 - b. District Allowance. District allowance was paid in retrospect at the appropriate rates, depending on member categorisation.
 - c. Field Allowance. Field allowance was paid in retrospect whilst not in receipt of travelling allowance.
 - d. Separation Allowance. After a 14 day qualifying period, separation allowance was paid in retrospect to Cat M members, whilst not in receipt of travelling allowance.
 - e. Flight Duties Allowance. Flight duties allowance was paid in retrospect to RASvy air camera operators.

Banking

62. Banking facilities in the AO consisted of:
- a. Commonwealth Bank agency (Post Office) - Alyangula, and
 - b. ANZ bank branch - Alyangula.

Mail

63. The mail arrangement for the operation was c/- Post Office Alyangula.

Remote Locality Leave

64. All participants accrued remote locality leave at a rate of 7/12 days per month in the AO.

Rest

65. Members accrued two days rest, which was taken at the completion of the operation on RTU.

Visits

66. The following personnel visited the operation:

- a. LTCOL BW Millen
CO 1 Avn Regt
31 Jul - 1 Aug 93
- b. LTCOL P.J. Neuhaus
SO1 Avn LHQ
27-28 Jul 93
- c. MAJ W.A. Fleming
SO2 Ops LHQ
27-28 Jul 93
- d. MAJ M. Holmes
SO2 Comms
27-28 Jul 93
- e. MAJ J.R. Rudd
SO1 Svy LHQ
27-28 Jul 93
- f. CAPT S. Cameron
SO PR DC-A
21-24 Jul 93
- g. SGT M.P. Varley RE
Ex Long Look - Army Svy Regt
2-7 Aug 93
- h. LCPL G. Fox
PR DC-A
21-24 Jul 93

Public Relations

67. Public Relations (PR) in the AO was largely initiated during the operation reconnaissance, which included the Operation Brief (included at page i), and an interview by OPSO 4 Fd Svy Sqn and the editor of the "Eylandt Echo". This resulted in several articles in the local "Eylandt Echo" community newspaper during the lead up to the operation.

68. The visiting PR staff from DC-A also co-ordinated a video report suitable for uptake by a TV news/current affairs program. This report was later shown on Imparja TV news (NT) and Channel Ten (Adelaide) News.

Amenities

69. DC-A provided a colour TV and VCR for use on the operation. The equipment was greatly appreciated by all members.

Contact Information

70. Details of all contacts made in the AO are at Annex G.

Account Payment

71. All accounts from the operation were promptly paid by the appropriate paying authority. This is directly attributable to the specific tasking of paying responsibilities in the Operation Order (Reference B) and the Mounting Instruction (Reference C).

COMMAND AND SIGNAL

Command

72. No problems were encountered with the command arrangements detailed at Reference B.

Communications

73. Rear Link. Rear link communications were by telephone and fax.

74. Radio Net. Communications between the GPS/Recon parties and the main base was by RAVEN HF Radio. Initial minor problems associated with the HF communications in the AO were quickly overcome. Aside from the previously detailed equipment failures, the HF communications proved most adequate.

75. SITREPs. Weekly SITREPs were sent by fax.

CONCLUSIONS

76. General. Op Nervose 93 was a very successful control survey operation, which, following the purchase of new GPS equipment, was achieved with considerable savings in resources to Army. These savings were only made possible because of the flexibility and power of DUP.

77. DUP. If the unnecessary restrictions on the use of DUP were removed, enormous savings of resources and increases in efficiency could be realised.

78. VAP Tasking. The acquisition of VAP data must be formally tasked if it is ever to be achieved. This will ensure adequate time and air hours are allocated to achieve the task.

79. New Magellan Equipment. The new Magellan equipment is lighter, easier to use, and can produce the required result in considerably less time than the previously used TI4100 equipment. In essence, this makes the operation quicker and far less demanding in resources. However, the problem of dust ingress in the data logging PCs needs to be addressed.

80. Reconnaissance. A reconnaissance of the AO is of vital importance in the effective co-ordination of such an operation.

81. Training. The present format of the Control Svy Course is inadequate given that the TI4100 equipment is now not the only GPS equipment in use in the corps, and lacks background on associated tasks such as reconnaissance and panelling. The course should be modified to be based on concepts rather than equipment.
82. Personnel Support. The professionalism and flexibility of all supporting personnel was a major contributor to the success of the operation. This is especially significant given the relative unfamiliarity of 4 Fd Svy Sqn personnel with the new equipment, and associated lack of certainty regarding the technical conduct of the operation. Similarly, the tolerance of the supporting AAAvn personnel with the changing overall technical plan for the operation was commendable.
83. AAAvn Support.
- a. LOH. The LOH is perfectly suited to all Magellan based GPS tasks. One LOH is highly desirable for each mobile survey party
 - b. Nomad. The Nomad is a very versatile aircraft to support operations as it is ideal for ident photography and also for resupply.
84. Land Clearances and Aboriginal Liaison. Land Clearances and Aboriginal Liaison remains a delicate matter. The removal of the requirement to clear LZs in the AO (as was required for Op Nervose 92) facilitated the acquisition of land clearances. In future, this will be enhanced by Aboriginal authorities having a better understanding of the nature of survey activities.
85. Fuel Costings. Costings for fuel based on FAPE submissions must consider the cost of positioning fuel in remote areas, rather than just the per litre cost of the fuel.
86. RAVEN HF Equipment. The RAVEN HF handsets contain poor quality components which detract from their reliability.
87. Survey Party Ration Allowance (SPRA). SPRA continues to be the most efficient method of rationing on survey operations.

RECOMMENDATIONS

Recommended Action By:

88. DUP. The restrictions on the use of DUP be reviewed. LHQ
89. GPS.
- a. Magellan GPS 5000 PRO receivers be used for acquisition of control for mapping. 4 Fd Svy Sqn
 - b. All aspects of GPS training be reviewed. DSvy-A
School of Mil Svy

- c. The Magellan data logging PCs need to be either environment proofed or replaced with an alternative which is not susceptible to dust in the AO. 4 Fd Svy Sqn
90. VAP Tasking. Tasking for the acquisition of VAP data should be formally tasked with good lead time. LHQ
91. Aviation. LOH continue to be used for GPS tasks.
92. Land Clearances. Land clearances for survey operations must be initiated at least six months in advance. 4 Fd Svy Sqn
93. Fuel Costings. The cost to position fuel in remote areas should be included in FAPE fuel costings. 4 Fd Svy Sqn
LHQ
94. RAVEN HF Equipment. The connections on the handsets of the RAVEN equipment should be replaced with ones which are more reliable. LHQ
95. Messing. The 4 Fd Svy Sqn SPRA account continue to operate and be calculated at a rate of \$14.00 per man per day. 4 Fd Svy Sqn
Adelaide Log Bn

18 November 1993



A.B. McLeod
Major
Officer Commanding

ANNEX B TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

OP NERVOSE 93
SEQUENCE OF EVENTS

Serial (a)	Date (b)	Event (c)
1.	16-21 Apr 93	Reconnaissance.
2.	23 Jun	Issue of Op Order.
3.	6-13 Jul	Pre-operation trg
4.	27 Jun	Issue of Mounting Instruction.
5.	21 Jul	Main base inserted into Groote LOH arrive Groote.
6.	22 Jul	Recce/Panelling commenced.
7.	23 Jul	GPS obs commence.
8.	26 Jul	2 x camera operators arrive Adelaide by vehicle.
9.	27 Jul	2 x camera operators depart Edinburgh for Richmond by C130 overnight Richmond.
10.	28 Jul	2 x camera operators arrive Tindal by C130. RC10 fitted in Nomad.
11.	29 Jul	Nomad departs Tindal for Groote. Air photography ops commence.
12.	4 Aug	Unserviceable LOH recovery.
13.	5 Aug	GPS obs/Air photo tasks complete. Nomad departs for Broome via Tindal to complete tasks for Op Mizmaze.
14.	6 Aug	LOH support released.
15.	7 Aug	Main base extracted to Adelaide.
16.	19 Aug	Nomad returns to Adelaide.

ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

TECHNICAL REPORT

Introduction

1. Operation NERVOSE 93 was a GPS control survey operation conducted by Det 4 Fd Svy Sqn in the Northern Territory during the period 21 Jul to 7 Aug 93.
2. The aim of the Operation was to establish ground control suitable for future 1:50 000 scale topographic mapping. The AO, as depicted at Annex A, includes Groote Eylandt and Eastern Arnhem Land in the following 1:250 000 areas:
 - a. SD 53-6 Mount Marumba,
 - b. SD 53-7 Blue Mud Bay,
 - c. SD 53-8 Port Langdon,
 - d. SD 53-10 Urapunga,
 - e. SD 53-11 Roper River, and
 - f. SD 53-12 Cape Beatrice.

Specific Tasks

3. Det 4 Fd Svy Sqn was tasked to carry out the following specific tasks:
 - a. Priority One Tasks.
 - (1) establish or re-coordinate horizontal control stations,
 - (2) connect horizontal control points to sea level where possible, and
 - (3) target and positively identify horizontal control stations on identification photography where required.
 - b. Priority Two Tasks.
 - (1) Update and/or produce photography interpretation guides (PIGs) in the AO as required in Reference E.
 - (2) Reoccupy and co-ordinate an existing first order control point to assist in the verification of existing AGD/WGS 84 transformation parameters in the Arnhem Land area.
 - c. Opportunity Task. Acquire VAP data as requested through LHQ.

Motivation to Purchase New Equipment

4. It was initially intended for the operation to be conducted in the same manner as Op NERVOSE 92; LOH based reconnaissance teams, followed by UH1H based GPS parties using TI400 GPS equipment. As was detailed in the Op NERVOSE 92 operation report, this method is very resource intensive, not only in LOH and UH1H, but also in the associated logistics required for an operation involving in excess of 60 personnel. Furthermore, problems were associated with vegetation clearing on Aboriginal land on Op NERVOSE 92. This largely restricts the employment of UH1H on Aboriginal land as LZs may not be prepared.

5. Six weeks prior to the planned operation deployment date, commercially available GPS equipment which offered a technical alternative to the then current plan were brought to the attention of 4 Fd Svy Sqn. Following an initial evaluation, it was noted that the equipment offered the potential to use considerably less resources during than was forecast. The equipment was later purchased on DUP. Further details on the new equipment are detailed later in this report. All non-essential resources were relinquished, and the logistic and administrative plan was reviewed and modified. The technical directive for the operation, Reference E, was reviewed in line with the newly purchased equipment.

New Magellan Equipment

6. The MAGELLAN GPS NAV 5000 PRO is a commercially available, off the shelf, hand held GPS receiver. Three such items were purchased by 4 Fd Svy Sqn using DUP funds complete with the "sub-metre" kit consisting of multipath resistant antennae, palm top data logging personal computers (PCs), and "sub-metre" post processing module software. In Carrier Phase Differential mode, as was used on Op NERVOSE 93, the resulting data may be post processed to sub-metre accuracy.

7. Advantages. The are several major advantages with the Magellan equipment:
- a. Simple to Use. Menu driven and intuitive functions.
 - b. Training. Because the equipment is simple to use, the requirement for a lengthy training course in its operation is negated.
 - c. Size and Weight. It is small, lightweight and powered by dry cell batteries.
 - d. Time. Less than 20 minutes of satellite observations are required, a significant reduction on the four hours required of the TI4100 in point positioning mode.
 - e. Ability to Operate in an Anti-Spoofing (AS) Environment. As the equipment does not use the GPS "P Code" which is subject to AS, operations are not at the mercy of AS.
 - f. Ability to Operate in a Selective Availability (SA) Environment. In differential mode, SA position error is removed.

Operational Results

8. Priority One Tasks. All Priority One tasks were successfully completed. A summary of the results is as follows:

a.	New stations with Magellan GPS observations and photo ident	26
b.	Existing stations with Magellan GPS observations and photo ident	32
c.	Existing stations, re-ident only	<u>4</u>
	<u>TOTAL</u>	<u>62</u>

9. The Reconnaissance, GPS Observations, GPS Computations, Provisional Co-ordinates and Aerial Photography reports are at Appendices 1, 2, 3, 4, and 5 to this Annex respectively.

10. Priority Two Tasks.

- a. Photo Interpretation Guides (PIGs). Photographs for PIGs were successfully taken during the operation. However, on return from the field, the civilian contractor tasked with developing the films accidentally destroyed all of the film. A claim is at present being prepared through the Australian Government Solicitors Office to pursue financial compensation for the incident. The desired outcome of the claim is the payment of sufficient funds to re-obtain PIGs of the AO.
- b. One existing first order control point, U210, was successfully re-observed to assist in the verification of existing AGD/WGS 84 transformation parameters in the Arnhem Land area.

11. Opportunity Task. Specific requirements for VAP data were not received in the AO until 4 Aug '93, the day prior to the planned departure of the Nomad from the AO. This made it impossible for all of the required photography to be obtained in the time frame. Furthermore, where only a few hours of photography were anticipated for this task, the required photography was such that a considerable number of Nomad hours would have been needed, which were simply not available.

Oct 93

G.C. ADDISON
CAPT
OPSO

Appendices:

1. Reconnaissance/Clearing Report
2. GPS Observations Report
3. GPS Computation Report
4. Provisional Coordinates
5. Aerial Photography Report

APPENDIX 1 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

RECONNAISSANCE / CLEARING REPORT

General

1. As the LOH could not fit the required stores for both GPS observations and reconnaissance for several stations, it was decided to deploy the different tasked parties separately. A practice was established of deploying reconnaissance teams before the GPS parties. The reconnaissance parties were made up of two survey personnel and a pilot in an LOH. It was found that the deployment of reconnaissance teams in advance of the GPS observation teams saved time. As a result, the GPS parties were able to land, set up and commence observing with minimal fuss. Reconnaissance party activities and GPS observations were carried out concurrently in the western sector of the AO where stations were up to 250 km from the main base. The parties were required to stay overnight at Delara and Ngukurr Airstrips where there were no facilities, as the distance from the main base made it uneconomical to return.

Tasks

2. The teams carried out the following tasks:
- a. locate existing or establish new survey stations,
 - b. fully mark six new survey stations,
 - c. lay plastic panel targets for aerial ident photography,
 - d. compile a reconnaissance report for each station, and
 - e. take Photo Interpretation Guide (PIG) photographs en route.

Operations

3. AAAvn Support. The LOH is well suited to reconnaissance tasks, as a result of its small LZ requirements. As UH1H aircraft were not in use on this operation (as they were on Op Nervose 92) to support the GPS tasks, there was no requirement to clear LZs for UH1H. This saved the reconnaissance teams considerable time.
4. Reconnaissance. This task was achieved ahead of the schedule originally planned. Some parties managed to complete five to six stations in a day, particularly when doing the islands close to main base. Those existing stations not located were either in areas that required clearing or the use of a tower. In these instances, the parties were instructed to select new station locations. The hand held GPS equipment was useful in the featureless terrain of the western sector for confirming that locations were within the appropriate aero-triangulation window. The station packages prepared by 4 Fd Svy Sqn were of a high standard and proved

to be useful. LOH hours were able to be saved when aerial photography of the potential station site was available in the station packages.

5. Clearing. Light clearing of some small bushes and grass was carried out in order to lay the plastic panels. With the careful selection of new survey stations in conjunction with the use of the LOH, it was not necessary to clear any tall vegetation. This complied fully with HQ NORCOM's directions for land clearances and permissible activities on Aboriginal land in the East Arnhem area of the Northern Territory.

6. Marking. Six stations were required to be fully marked and documented for station summary purposes which presented no problems for the party teams. All other selected stations were marked with Feno rods.

7. Panelling. This task went well except for three stations which were required to be repanelled. In these instances, the lack of contrast between the white panels and the surface being panelled made it difficult to identify the panels. This resulted from a lack of understanding of the requirements for different panel colours, which was inadequately covered in both the Control Survey Course at the School of Mil Svy. Most survey members on the Operation had very little knowledge on these subjects prior to pre-operational training.

8. PIG Photography. PIG photography was taken as tasked.

Conclusions

9. The following conclusions are made:

- a. The reconnaissance tasks were successfully achieved, contributing to the successful completion of the operation ahead of time,
- b. The deployment of the reconnaissance teams separately from the GPS teams was very worthwhile as it saved the GPS teams considerable time and effort,
- c. The LOH provides the best means for deployment of the reconnaissance teams,
- d. Vegetation clearing is minimised if there is no requirement to clear UH1H LZs,
- e. Topics such as reconnaissance, and panel selection and requirements are not being adequately addressed on the Control Survey Course, and
- f. Hand held GPS is an invaluable aid to reconnaissance teams.

Recommendations

10. The following recommendations are made:

- a. reconnaissance teams continue to operate in advance of the GPS observing teams,
- b. LOH continue to be used for deployment of reconnaissance teams,

- c. UH1H are not used to support the GPS tasks on future operations,
- d. reconnaissance and panelling be given greater emphasis on control survey courses, and
- e. hand-held GPS equipment continue to be used.

Sep 93

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APPENDIX 2 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

GPS OBSERVATIONS REPORT

General

1. GPS observations were carried out in the AO during the period 22 Jul to 5 Aug 93. Three 2-man parties were employed throughout the operation as either reconnaissance and marking or GPS parties by turn. Point positioning observations were carried out by one operator on an opportunity basis. Priority was given to differential observations since their short duration required careful coordination of the movements of all available rotary-wing support. When a one-man party deployed, his transport remained with him for the duration of the observation to fulfil the safety requirement for two personnel in a remote locality.
2. All stations were observed using the Magellan NAV 5000 PRO in carrier phase differential mode. Additionally, five stations were also observed using the Texas Instruments TI4100 Navigator with GESAR point positioning software. This was done to provide a framework within which the Magellan DGPS Observations could be made. The TI4100 stations along the southern edge of the AO provide a basis for a possible future extension of control into the adjoining aerotriangulation block. One station (U210) was observed to gain data for transformation parameters between AGD84 and WGS84.
3. A total of 58 stations were occupied for GPS observations, resulting in 151 successful differential measures over 114 baselines. Baselines ranged from 3 km up to 194 km. Six baselines were measured between GESAR stations, ranging from 28 km up to 186 km.

Technical Preparation

4. Planning. The investigation of new technology led to the trialing of the Magellan NAV 5000 PRO for sub-metre carrier phase observations. Subsequently, the Magellan was adopted as the main method of gaining control on Op NERVOSE 93. All facets of the Operation then required amendment. The GPS plan was completely redrafted. Logistic requirements were drastically reduced. Operators were dedicated to testing the Magellans to produce an operating procedure and operator's checklist. A suitable booking form was developed. Inconsistencies between instrument firmware and software upgrades were identified and overcome.
5. Pre-Operational Training. Pre-operation training was postponed twice due to the late change to the scenario and the time taken to overcome teething problems with the Magellan. Final timings were from 6 Jul 93 to 13 Jul 93, leaving three days for packing stores for the operation. Instruction was by officers, SNCOs and senior CPLs. It covered all tasks expected of a GPS party. With a view to the planned limited use for the TI4100 on Op NERVOSE 93, only one day was spent revising it since all party leaders had completed a GPS course only four months previously. Two and a half days were dedicated to the Magellan for differential observations. The different marking and recording requirements for permanent and "temporary" stations were emphasised. The new electronic barometers and psychrometers were introduced.

Operations

6. Transport. All movement to and from survey stations was by LOH. This was determined to be the only practical method of capitalising on the Magellan's speed of observation. Main base was at Angurugu Airfield on Groote Eylandt. The field parties overnighted at Delara Airstrip on 1-2 Aug 93. A small forward base was established at Ngukurr Airfield from 2-4 Aug 93.
7. Station Reconnaissance. Station reconnaissance was generally carried out prior to occupation with the GPS. In some remote areas, this was not economically feasible and the GPS party did the selection, ground marking and panelling. Points for occupation were selected within the geographic "windows" supplied by the Army Survey Regiment.
8. Station Clearing. Inside each station window, ease of access and minimal clearing were the main criteria for point selection. Clearing was a particularly sensitive issue since the AO was mostly Aboriginal Land. Each Magellan was provided with an adaptor for the Raven radio mast, which were available for GPS observations. "Bush" towers, comprising tripods with tent pole leg extensions, were also available. In the event, no towers were required.
9. Station Marking. Six new stations were fully ground marked and recovery details were observed. Each station consisted of:
 - a. a ground mark consisting of a RASvy plaque fixed to a Feno or deep penetration rod,
 - b. three reference marks each consisting of a Feno rod with collar, and
 - c. a 5 cm square galvanised iron witness post.

Distances and magnetic bearings were observed. The remaining 26 new stations were ground marked with a Feno rod only.

10. Magellan Network. The Magellan observations commenced with simultaneous observations with a base station on a suitable control point, and two field parties leap-frogging each other. This produces the tightest control network and obtains redundant radiations from the base station and ties between the radiated points. The base station first used was NER 93 12 which was also a GESAR point position station. It was used in 31 of the 57 sessions. NER 93 25 at Ngukurr forward base was used as a base station for four sessions.
11. Traversing with three parties was also used. Starting at a coordinated point, two parties leap-frogged the "leading" party after each successful session. This resulted in a traverse composed of a string of triangles with every second point fixed with four baselines and the intermediate points fixed with two baselines. Progress is faster with this method, providing the logistic demands for aircraft and refuelling can be met.
12. Two sessions were observed between only two stations
13. The speed of observation will be dramatically increased if independent radiations can be observed. In this scenario, the two roving parties observe sessions with the base station independently of each other. Analysis of the results is expected to indicate if an acceptable result is obtained with this method.

14. Differential Sessions. Differential sessions were observed simultaneously for a minimum of 20 minutes. This was done to ensure that the maximum amount of data that could be processed by the software was collected. Immediately after each session the Magellan "STATISTICS" function was run by at least one observer to assess the quality of the data collected. This was the major tool used for accepting or rejecting the session in the field. Unacceptable sessions were reobserved immediately. Only six baselines were rejected in the office, where the Carrier Phase Dilution of Precision (CPDOP) was unacceptably high.

15. Predictions were updated daily. This became critical as the operation progressed due to the increasing number of satellites that became unusable. An almanac collected during the day was downloaded. From it were deleted those satellites that were known to be or suspected of being unusable. The predictions were centred on the area covered by the expected sessions for the day. Where the stations were spread out over the day, predictions were prepared for more than one locale.

16. Point Positioning. The five TI4100 point position stations were observed by one man parties. The helicopter remained at the station during the observation as a safety measure, but it was also more efficient to do so. Predictions were prepared from Magellan data as required. Magellan data was used due to the difficulties SATPLAN and GEOMARK software have with more than 18 satellites. The user friendly Magellan software made the preparation of predictions simple and quick when used with a 486 computer which incorporates a maths coprocessor.

17. Transformation Parameters. U210 was observed using the TI4100 with GESAR point positioning software primarily to acquire data to evaluate existing AGD84 to WGS84 transformation parameters.

Equipment

18. TI4100. No problems were experienced with the TI4100s used on operation. Three TI4100s were taken in view of their recent history of breakdown, and the absence of RAEME GPS support on the operation. One TIPPC with printer was taken. All available spare leads, all CDUs (handsets), and four Memtecs were taken. Observers used the same TI4100 which was trouble free for the duration of the operation.

19. The difficulties encountered with the software not recognising all satellites and the ongoing and worsening problems of hardware repairs means the TI4100 has become a liability. Its replacement with a modern geodetic instrument capable of tracking all available satellites should be considered as a priority matter. Compatibility with other GPS instruments in use with RASvy should be a consideration. Modern software should be user friendly as well as time saving.

20. Magellan. The use of a 10m extension coaxial cable between the Multipath-resistant antenna and the antenna coupler led to some loss of signal strength in those signals that were already low (less than 9). This was not considered a problem since these weak signals did not usually produce good results anyway. A more serious problem is the antenna coupler. A weakness in the design and/or construction of the clip holding the coupler onto the antenna built into the Magellan resulted in two out of three clips breaking. One was repaired by gluing it together and the other was taped into position. The problem was exacerbated by frequent removal of the coupler to enable the Magellan to be used for navigation. Temporary repairs in the field prevented this problem impacting on the Operation. No other problems were encountered with the Magellan. The computers used to collect the Magellan data in the field suffered some problems with dust, notably sticking keys and a sticking floppy drive mechanism.

21. Generators. No problems were encountered with the Yamaha EF1000 generators used to power the TI4100.
22. Meteorological Equipment. The new electronic barometers and psychrometers were simple to use. Unlike the Baromec both new items have to be physically turned off when not in use. The claimed life for the 9 volt batteries was up to 80 hours, but operators found the batteries discharged within 24 hours when left on.
23. Towers. No towers were used, although three Raven radio masts and two "bush" towers were available.
24. Communications. The major problems with communications were the Raven radio handsets and the antenna setup. Six out of seven handsets were repaired in the field by RAEME attached to the operation as AAAvn support. Until the problem was identified, it caused serious problems for GPS observations. The Magellan relies on good communications for its simultaneous observations. Experimentation and the experience from Op MIZMAZE 93 led to a 21 metre "Longwire" antenna being adopted by all field parties. The same 21 metre Longwire was used for all frequencies. The Longwire comprised one half of the lightweight antenna kit marked at 21 metres. It was simple and quick to roll out in line with the base station. In order of preference, it could be laid out:
- a. directly away from the base station:
 - (1) sloped up over a convenient tree,
 - (2) horizontally over bushes,
 - (3) on the ground (salt pans require props to keep the wire out of contact with the surface), or
 - b. horizontally directly towards the base station.

The NCS at main base retained an "inverted V" antenna supported by a mast. The antenna was connected to a Raven Radio Base Station. Communications deteriorated rapidly after 1700 hours Central Standard Time.

Observing Problems

26. The main problem was keeping up with the satellites that were not useable. A number of satellites became "unuseable until further notice" in the latter part of the Operation. The Magellans had problems collecting 20 minutes of continuous data from some satellites that were supposedly useable. 4 Fd Svy Sqn forwarded NANUs (Notice Advisory to Navstar Users) by fax immediately upon receipt, but no prior warning of satellite outages were issued. Once a problem satellite was identified, it was deleted from the Magellan almanac, and predictions were prepared excluding it. During the last week, suitable satellite combinations were very sparse before 1100 hours. TI4100 observations were done after this time of day.
27. U930 was located in a shallow quarry or scrape with trees to the South and West. Two sessions were found to be unsuccessful after computations. Neither the reconnaissance and marking party nor either of the GPS parties recommended a tower be used. A result was obtained at the third attempt due to a fortunate satellite configuration.

28. A two hour delay on the last observing day was caused by several keys sticking on the T1850 computer. The computer was cleaned and reconfigured with judicious use of the backspace key. The final two sessions were then successfully observed.

29. The Bicom computer was operated by six "D" cells in series in a local pattern power pack connected to the external power port. This avoided replacing the internal power supply of five "AA" cells after each session. The AA cells had a short life because the hard drive is kept running throughout the session, logging the constant data stream from the Magellan. The D cell pack lasted several days, depending on usage. The Bicom constantly emitted a "low power" beep but this did not affect its performance. If the Bicoms are retained for future use, an improved power source should be obtained. Any new power source should be small enough to be co-located in the Magellan's protective carry-case to maintain the portability and convenience of the package.

Conclusion

30. The GPS observations ran very well. Apart from unsuccessful or unacceptable sessions, the only delays were:

- a. a very late start due to fog on one day,
- b. the problem with dust in the computer keyboard on the last day,
- c. the two revisits for observations on U930, and
- d. unserviceable LOHs.

31. The avoidance or minimisation of station clearing was probably the most significant external factor to assist in the speed of the operation. The amount of clearing required may significantly affect the planning and timing of a similar operation in a different AO.

32. The TI4100 performed adequately although its effectiveness is limited by its age and inability to be upgraded.

33. The Magellan equipment proved to be well worth the complications caused by its late introduction less than two months before the Operation. Its speed and ease of use enabled the Operation to be completed on schedule despite the problems with satellite and aircraft availability.

Recommendations

34. It is recommended that:

- a. protection from dust for computers used in the field be improved, including:
 - (1) plastic keyboard membranes be acquired for all keyboards to be used on operations;
 - (2) methods of temporarily sealing floppy disk apertures be investigated;
- b. a more robust antenna coupler for the Magellan be acquired;

- c. a more suitable system of logging data from the Magellan be acquired.

APPENDIX 3 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

GPS COMPUTATIONS REPORT

General

1. All data processing was carried out in main base at Angurugu Airstrip. The observing parties returned to base each day except while at the forward bases at Delara and Ngukurr airstrips. The Nomad ferried the data diskettes and observation logs from the forward base observing parties back to main base each evening. This enabled the baseline traverses to be computed nightly in time to amend the next day's operations if necessary.
2. Two types of computation were carried out:
 - a. Confirmation of the suitability of data collected with the TI4100 using GESAR point positioning software, and
 - b. Computation of provisional and redundant coordinates from data collected with the Magellan NAV 5000 PRO using Magellan differential sub-metre post-processing software.

Manning

3. Computations were carried out by the OC and one SNCO.

Responsibilities

4. The responsibilities of computations personnel were to:
 - a. collect GPS satellite Almanac (usually done by GPS party);
 - b. generate predictions for suitable observing periods;
 - c. supply predictions and booking forms;
 - d. receive and check data from the field parties;
 - e. receive and check records from the field parties;
 - f. for TI4100 data:
 - (1) allocate processing number;
 - (2) produce a copy data cassette for retention by the unit;
 - (3) translate data cassettes to binary and FIC(A) files;

- (4) amend FIC(A) files with PRTN;
 - (5) produce printouts of PRTN summary files for forwarding to the Army Svy Regt;
 - (6) assess the suitability of the data from the PRTN summary;
 - (7) produce a 3.5" HD diskette for each station, containing the binary file, the amended FIC(A) file and the PRTN summary file, for forwarding to the Army Svy Regt;
 - (8) produce a photocopy of the original booking form for retention by the unit and forward the original to the Army Svy Regt;
- g. for Magellan data:
- (1) duplicate data,
 - (2) allocate session numbers,
 - (3) prepare computation forms,
 - (4) run Magellan sub-metre post-processing software on each observed baseline,
 - (5) print out results onto computation forms,
 - (6) assess results,
 - (7) allocate baseline numbers,
 - (8) update database,
 - (9) annotate and photocopy the original booking form, and
 - (10) photocopy the computation forms for forwarding with the database printout to the Army Svy Regt (for NUGAN adjustment when the GESAR coordinates become available).

Equipment Used

5. The major computing items were used as follows:

a. Satellite predictions

- (1) TIPPC,
- (2) Toshiba T4400 laptop computer,
- (3) Epson 24 pin printer, and
- (4) IBM 4070 bubble-jet printer.

- b. GESAR Data Cassette Translation
 - (1) IBM XT PS2,
 - (2) Memtec tape reader, and
 - (3) TI4100 Navigator.
- c. GESAR Data Analysis Computations
 - (1) Toshiba T4400 laptop computer, and
 - (2) Epsom 24 pin printer.
- d. Magellan Differential Relative Computations
 - (1) Toshiba T4400 laptop computer, and
 - (2) Epsom 24 pin printer.
- e. Magellan Statistics Computations
 - (1) Toshiba T4400 laptop computer, and
 - (2) Toshiba T1850 laptop computer.
- f. Document Reproduction
 - (1) Sharp Z-30 photocopier.
- g. Other computers used
 - (1) Toshiba T3200 laptop computer.

Equipment Performance

6. The new Magellan sub-metre post processing software (used on a 486 computer) significantly reduced the time required for baseline computation. The T4400 computer (a 486DX33) took less than a minute to complete a baseline calculation compared to 67 minutes for a 386DX25 without a coprocessor and about four minutes for a 386 with a coprocessor. The T4400 rapidly completed the calculation and data base entry phases.

7. No problems were encountered with equipment used solely in the operations room. The T4400 and T1850 used in the field suffered problems with dust. Dust caused the sticking of keys and difficulty in inserting floppy diskettes. One data disk was rendered unserviceable by dust in the field. This caused a delay while the data was retrieved from the hard drive on which it was originally logged. A second diskette was found to be unserviceable after the operation. This data was retrieved from a backup tape. Attempts to reduce the ingress of dust met with little success. A more field compatible system of logging data from the Magellan should be acquired. At least one kit should retain the ability to process the Magellan stats program, preferably as a part of the data logging system.

8. For one GESAR data cassette (NER 93 12), the MFERD program terminated before all data was recovered from the tape. This occurs when the program cannot find data. The problem was overcome by manually winding the tape forward a small amount, restarting MFERD and writing the data to another file. Following a second break, the data had been collected in three files that were then concatenated. The resulting file was then further processed without problem. The data cassette was also copied to another cassette using the TI4100 copy utility. This copy cassette was then translated with MFERD without problems, and resulted in an additional 86 bytes of data. This was selected as the source of the data to be forwarded to the Army Svy Regt.

9. There were no problems with the TI4100s, the Memtecs or the TIPPC. Despite not breaking down during the operation, this equipment was cumbersome and slow to collect and process data. It is incompatible with modern technology in the forms of data collection and processing.

Satellite Predictions

10. Due to the difficulties in using SATPLAN with 21 satellites in operation, and the rapid dating of SATVIZ, all predictions were done by Magellan software.

11. The Magellan also proved very useful in detecting non-operational satellites. NANUs provided no prior warning of satellite problems. The earliest notification was received next day by fax from the rear link.

12. The Magellan predictions provide the four best (lowest PDOP or CPDOP) satellite combinations based on the almanac collected. Satellites that were known to be non-functional or suspect were edited out of the almanac used to make the predictions.

13. Predictions and observations became very difficult in the last week of the operation as several satellites became "unusable until further notice" which severely limited the options available, especially before 1100 hours.

14. When there were no observations at base (NER 93 12), one of the party leaders decided which satellites to observe. He chose the satellites for each particular session, using the predictions and current information on the satellites gained from the Magellans. Radio communication allowed him to assess problems encountered by other observers. Advice from main base was always available.

Post Processing Results

15. Magellan Differential Relative. 58 stations were occupied for observations with the Magellan, of which:

- a. 26 were existing stations, including:
 - (1) All TI4100 GESAR stations,
 - (2) One TRANSIT station (U734) classified as DOP 2 used as the start point for WGS84 provisional coordinates,

- (3) 19 existing (mostly Aerodist) stations for upgrading.
- b. 32 were new stations, including:
 - (1) 6 "U" stations that were fully groundmarked for recovery, and
 - (2) 26 "NER 93" stations designated as "temporary" that were groundmarked with a Feno rod only.

16. Baseline Data. Provisional and redundant coordinates were calculated using the Magellan sub-metre carrier phase postprocessing software. A total of 151 acceptable baselines were computed.

17. The length of baseline measured varied between 3 km (for Baseline 34 between U048 and NER 93 10) and 194 km (for Baseline 10 between NER 93 12 and U516).

18. CPDOP (Carrier Phase Dilution Of Precision) is described in the User Guide as a "geometric figure of merit (error multiplier)". It is inversely proportional to the duration of the measure. Observations were a minimum of 20 minutes long. This was done to gain the maximum data that can be processed by the Carrier Phase Module of the Magellan software. The User Guide describes the geometric quality of the various CPDOPs as follows:

- a. < 21 - Excellent,
- b. 20-44 - Good,
- c. 45-74 - Fair,
- d. 75-99 - Poor, and
- e. > 99 - Unreliable.

Of the 151 baselines accepted, 126 (83.4%) were less than 21; 24 were below 45; and one was 48.7. Fifty percent of the accepted baselines were less than 14. Six baselines with CPDOPs of 49.9, 52.0, 55.1, 82.5, 92.4 and 92.4 were rejected.

20. The number of carrier measures per baseline varied between 1512 and 538. The baseline with 1512 measures also had the lowest CPDOP (8.6). Four baselines with less than 900 measures had the highest acceptable CPDOP (above 33). However, while CPDOP is affected by the number of measures, it is not necessarily tied to it. For example:

- a. baseline 89-1 has a CPDOP of 22.2 from 669 carrier measures; and
- b. baseline 54-1 has a CPDOP of 30.4 from 1253 carrier measures.

21. GESAR Point Positioning. Five stations were also observed with the TI4100. This was done to:

- a. provide the fixed framework within which all differential observations could be made,

- b. provide a comparison for the assessment of the Magellan results,
- c. provide a basis for a possible future extension of control into the block adjoining to the South, and
- d. provide data for transformation parameters at one first order station (U210).

22. The stations observed were:

- a. U210 Arrowsmith,
- b. U114 Mount Day,
- c. U510 Claypan,
- d. NER 93 12 at base, Angurugu Airstrip (new station), and
- e. NER 93 13 at the SE corner of Groote Eylandt (new station).

23. The differential baselines measured between GESAR stations were:

- a. Baseline 114 U848 to U210 28 km
- b. Baseline 1 NER 93 12 to NER 93 13 59 km
- c. Baseline 27 NER 93 12 to U210 80 km
- d. Baseline 28 NER 93 12 to U848 108 km
- e. Baseline 8 NER 93 12 to U510 154 km
- f. Baseline 30 NER 93 12 to U845 186 km

24. Post-Processing Package. A post-processing package for the GESAR observations was dispatched to the Army Svy Regt by safe hand. It contained:

- a. Original booking form (x5);
- b. Printouts of PRTN summary (x5); and
- c. 3.5" HD diskettes (x5) containing:
 - (1) Binary file,
 - (2) Amended FIC(A) file, and
 - (3) PRTN summary file.

25. Adjustment Package. An adjustment package of Magellan differential results was dispatched to the Army Svy Regt by safe hand. It contained:

- a. provisional coordinates list;

- b. printout of the database;
- c. 3.5" HD diskette of the above items
- d. diagram of the AO showing control points; and
- e. baseline diagrams.

Provisional Coordinates

26. Provisional Coordinates for all stations are given in Appendix 4 to Annex C.

APPENDIX 4 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

PROVISIONAL COORDINATES (WGS84)

Station Name	Plan Stn Name	Panel	Fixed Magell	T14100 PP	Latitude (S) (d.m.s)	Longitude (E) (d.m.s)	h _{sn} (m)	Source of Coordinates
NER 93 01	NEW 01	X	X	-	13 12 42.938	135 00 47.438	105.37	Traverse 8
NER 93 02	NEW 02	X	X	-	13 43 29.063	135 00 12.566	154.71	Traverse 8
NER 93 03	NEW 03	X	X	-	14 01 27.272	134 46 54.431	151.40	Traverse 8
NER 93 04	NEW 05	X	X	-	14 18 19.537	135 03 31.622	84.98	Traverse 10
NER 93 05	NEW 07	X	X	-	14 55 27.193	133 51 22.820	141.42	Traverse 10
NER 93 06	NEW 08	X	X	-	14 01 41.249	135 50 53.024	64.06	Traverse 9
NER 93 07	NEW 10	X	X	-	13 13 53.657	136 10 24.366	61.10	Traverse 4
NER 93 08	NEW 13	X	X	-	13 47 53.817	136 11 45.264	86.22	Traverse 2
NER 93 09	NEW 14	X	X	-	13 45 05.591	136 37 19.804	63.15	Traverse 2
NER 93 10	NEW 17	X	X	-	14 09 10.178	136 25 52.113	63.98	Traverse 1
NER 93 11	NEW 18	X	X	-	14 13 49.481	136 50 20.448	61.21	Traverse 1
NER 93 12	NEW 19	X	X	X	13 58 25.198	136 27 38.991	71.56	Radiation from U734
NER 93 13	U512	X	X	X	14 14 34.307	136 55 56.242	68.74	Traverse 1
NER 93 14	U047	X	X	-	13 50 15.741	136 29 36.648	62.13	Traverse 2
NER 93 15	U207	X	X	-	13 27 46.238	136 04 43.231	59.54	Traverse 4
NER 93 16	U707	X	X	-	13 14 24.338	135 50 59.130	56.37	Traverse 4
NER 93 17	U482	X	X	-	13 29 25.741	134 59 30.353	127.91	Traverse 8
NER 93 18	N/A	X	X	-	13 08 21.860	134 42 41.914	134.20	Traverse 8 - Aerotrig check point
NER 93 19	N/A	X	X	-	13 21 48.622	134 02 45.641	234.20	Traverse 8 - Aerotrig check point
NER 93 20	U522	X	X	-	14 00 13.864	134 15 46.361	137.06	Traverse 8
NER 93 21	U486	X	X	-	14 02 15.028	135 25 37.261	103.32	Traverse 9
NER 93 22	U508	X	X	-	14 29 08.990	135 01 15.923	84.31	Traverse 10
NER 93 23	N/A	X	X	-	13 12 47.155	135 36 24.298	105.66	Traverse 6 - Aerotrig check point
NER 93 25	N/A	X	X	-	14 43 28.160	134 44 49.529	67.19	Traverse 10 - Aerotrig check point
NER 93 32	U509	X	X	-	14 50 18.749	135 44 54.046	60.24	Traverse 9
NER 93 36	U524	X	X	-	13 29 19.613	133 27 59.150	444.43	Traverse 8
U043	U043	X	-	-	n/a	n/a	n/a	Ident only
U048	U048	X	X	-	14 10 42.735	136 26 07.996	61.34	Traverse 1
U114	U114	X	X	X	14 56 46.564	133 28 44.786	217.06	Traverse 10
U208	U208	X	-	-	n/a	n/a	n/a	Ident only
U210	U210	X	X	X	13 14 47.420	136 28 05.020	73.18	Radiation from NER 93 12
U484	U484	X	X	-	13 27 44.696	135 49 08.709	143.98	Traverse 4
U488	U488	X	X	-	13 20 35.873	135 58 32.038	58.13	Traverse 4
U489	U489	X	X	-	13 23 19.620	136 09 00.745	64.50	Traverse 4
U491	U491	X	X	-	13 26 14.390	136 14 49.986	62.62	Traverse 4
U493	U493	X	X	-	13 30 49.184	136 10 02.642	59.90	Traverse 4
U494	U494	X	X	-	13 34 44.894	136 14 08.295	73.41	Traverse 4
U497	U497	X	X	-	13 35 19.366	136 19 15.676	87.13	Traverse 4
U498	U498	X	X	-	13 37 18.405	136 24 59.221	64.08	Traverse 2
U499	U499	X	X	-	13 39 26.576	136 04 17.741	65.60	Traverse 4
U502	U502	X	X	-	13 42 48.220	136 23 58.642	73.14	Traverse 2

Station Name	Plan Stn Name	Panel	Fixed Magell	TI4100 PP	Latitude (S) (d.m.s)	Longitude (E) (d.m.s)	h_{sn} (m)	Source of Coordinates
U503	U503	X	X	-	13 48 55.690	136 06 20.902	62.97	Traverse 2
U505	U505	X	X	-	13 48 39.127	136 21 14.077	63.94	Traverse 2
U506	U506	X	X	-	13 42 28.706	136 17 33.277	65.63	Traverse 2
U507	U507	X	-	-	n/a	n/a	n/a	Ident only
U510	U510	X	X	X	14 59 26.563	135 29 01.328	57.08	Traverse 9
U511	U511	X	X	-	14 13 10.182	136 41 06.222	100.56	Traverse 1
U516	U516	X	X	-	14 59 37.139	135 00 03.453	97.91	Traverse 10
U517	U517	X	-	-	n/a	n/a	n/a	Ident only
U518	U518	X	X	-	14 58 10.319	134 14 31.666	85.68	Traverse 10
U525	U525	-	X	X	13 00 18.789	133 29 57.401	379.25	PA GPS (1992) - Fixed
U526	U526	X	X	-	13 01 07.897	134 16 32.115	315.40	Traverse 8
U712	U712	X	X	-	14 58 41.057	134 40 10.010	91.19	Traverse 10
U734	U734	X	X	-	13 50 48.124	136 52 39.257	72.65	NGDB
U845	U845	-	X	X	12 58 11.040	135 04 40.580	102.16	PA GPS (1992) - Fixed
U848	U848	-	X	X	12 59 49.078	136 30 07.876	58.45	PA GPS (1992) - Fixed
U926	NEW 04	X	X	-	13 58 35.497	135 02 16.304	131.34	Traverse 8
U927	NEW 06	X	X	-	14 53 52.535	133 33 42.645	137.63	Traverse 10
U928	NEW 09	X	X	-	15 01 33.134	135 24 36.874	56.15	Traverse 9
U929	NEW 11	X	X	-	13 42 19.289	136 10 58.045	76.73	Traverse 4
U930	NEW 15	X	X	-	13 51 41.693	136 46 43.589	75.42	Traverse 2
U931	NEW 16	X	X	-	14 12 50.279	136 19 49.738	60.37	Traverse 1

LEGEND

Station Name	The name of the station adopted for Op NERVOSE 93.
Plan Stn Name	The name of the station as it appears on the plan supplied by Army Svy Regt.
Panel	Ident panels laid and absolute imagery acquired.
Fixed Magell	The station was observed with the Magellan NAV 5000 PRO using the Sub-metre system.
TI4100 PP	The station was observed with the the TI4100 using GESAR Point Positioning software.
Latitude (S) (d.m.s)	The latitude of the station in degrees, minutes and seconds (WGS84).
Longitude (E) (d.m.s)	The longitude of the station in degrees, minutes and seconds (WGS84).
h_{sn} (m)	The ellipsoidal height of the station mark (WGS84).
Source of Coordinates	<p>a. Provisional coordinates were computed on Op NERVOSE 93 from a number of separate traverses using U734 as the origin (whose AGD84 coordinates from NGDB were transformed to WGS84).</p> <p>b. "PA GPS 1992 - Fixed" are Absolute Point Position, Class A, GPS stations observed in 1992 using GESAR Point Positioning software. They are to be used as fixed points for the Magellan Traverses.</p>
n/a	Not applicable.
Ident only	This station required only a new photo ident. No observations were made.
Aerotrig check point	Temporary Magellan station panelled as a check point for aerotriangulation.

APPENDIX 5 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 19 NOV 93

AERIAL PHOTOGRAPHY REPORT

General

1. Identification photography of 58 control stations was acquired during the period 31 Jul to 5 Aug 93. Photography was acquired using a WILD RC10 Camera, Serial No. 1465 with a SWA lens, Serial No. 2006 with calibrated focal length of 88.013mm. The camera was mounted in a military Nomad aircraft, A18-315.

Tasking

2. The following tasks were undertaken:
- a. Identification Photography. A total of 58 stations were photographed during the operation. Three exposures were taken of each station at an altitude of 10,000 feet. Attachment 1 to this appendix summarises all ident photography flown. Idents were proved from the negative developed in situ, with bromides being produced and annotated at the Army Survey Regiment as per TI305 after the completion of the operation.
 - b. Vital Asset Protection (VAP) Photography. A request from 1 Topo Svy Sqn for VAP photography of various towns, airstrips, wharves and other vital assets could not be fully realised due to the request being received at the completion of the allocated flying hours in the AO. Oblique and vertical photography was flown of the township of Alyangula and also of the airstrip and Angurugu. Some of the ident photography that covered other airstrips could be used for VAP if required.

Personnel

3. The following personnel were involved:
- a. 317246 SSGT J.M. Phillips, Army Svy Regt, Air Camera Operator;
 - b. 554198 LCPL G.D. Craggs, Army Svy Regt, Air Camera Operator;
 - c. 329037 LT D. Kemp, 173 Survl Sqn, Pilot;
 - d. 557248 LT K. Yeats, 173 Survl Sqn, Pilot; and

- e. 65155 CFN M. Lillehagen, 173 Survl Sqn, All Trades.

Processing

4. Film processing was performed in the photographic laboratory at the Alyangula High School, located in the township of Alyangula, approximately 17km from the mainbase at the airstrip. The room was ideal for the task required, although the air conditioning was not working properly. B5 Morse Tanks were used for film processing, with no bromides being required to be produced in the AO.

Problems Encountered

5. The following problems were encountered:

- a. Kodak 2405 Film. All 2405 film developed in the B5 Tanks had a high base fog. Kodak 2402 film developed under the same conditions and with the same time/temperature tables produced very acceptable results, which concluded that the problem was caused by either of the following:

- (1) The film was over developed, due to excess time in developer or incorrect developer temperature.
- (2) The time/temperature charts used for calculating development time are not compatible for 2402 and 2405 film under the same conditions, i.e. a different chart is required for each film.
- (3) The 2405 film used, which had an expiry date of Sep 93, had been degraded due to temperature and condition changes through its life. Kodak 2405 film is susceptible to this type of degradation.

It was considered that the most probable cause of the problem was the quality of the film. Unfortunately this cause was not considered whilst in the AO and hence the film continued to be used, with the cause being thought to be caused by the time/temperature charts. It must be emphasised that the results produced were still of an acceptable quality for point transfer.

- b. Fixer. Liquid Kodak Rapid Fixer is designated dangerous cargo (DC) and hence was forwarded by land and sea transportation before the main party insertion. On arrival at the AO it was found that the fixer had not arrived. After acquiring more fixer by local purchase in Darwin and borrowing some from RAAF Darwin Photographic Centre it was found that the original consignment had been unloaded in Darwin and not forwarded to the AO. No undue delays were caused by this inconvenience.

- c. WILD RC10 Serial Number 1465. The camera was fitted in the Nomad at Tindal before deploying to the AO. The following problems were encountered with the camera:
- (1) The NF2 sight mount and control panel mount were both difficult to install due to incompatible nuts and bolts being supplied. This problem is not as relevant when the camera is installed in Adelaide, but dedicated nuts and bolts should be found that can be easily fitted, that also secure the mounts more stably.
 - (2) The control for the exposure setting was found to be very delicate. Although it is the camera operator's responsibility to constantly check all exposure settings, it was found to be a nuisance when the camera was the cause of intermittent changes.
 - (3) The spiral controlling the overlap behaved inconsistently with constant attention being required. This problem occurred even when wind was negligible. The circuit board controlling the overlap was replaced, but the problem still remained indicating that the problem was more likely to be found in the control panel. This problem is not as critical for identification photography as single exposures are taken, but when series photography is required the overlap control is vital.
 - (4) The fuse controlling the longitudinal tip constantly blew. Manual levelling in this direction overcame the problem easily. It was found that Nomad aircraft have an attitude problem, i.e. at an altitude of 10,000 ft the level of the aircraft is approximately one degree nose-up. This amount was considered to be optimistic, with the camera needing to be manually brought up to its maximum extent. This may have caused the problem with the fuse and also the servo motor controlling the tip.
 - (5) The first main mission flown, 4FDA424, was overdeveloped caused by the developer not being at ideal temperature. The problem was amplified by the additional problem with Kodak 2405 Double X film. Chemical temperatures were maintained at their optimum by ice bottles after this first occurrence. Idents that were severely damaged by the over development were reflowed.
 - (6) VAP requests invariably desire photography at varying altitudes. This requires the aircraft to manoeuvre from the ident photography altitude of 10,000 ft to possibly 3,000 ft. Unless dedicated flying hours are given for VAP then it is unlikely sufficient flying time will be available to complete VAP requests at altitudes over than those used for ident photography, i.e. 10,000 ft.

Conclusions

6. All 58 idents were positively proved in the AO, with bromides being produced at the Army Survey Regiment at the completion of the operation.
7. The availability of a proper darkroom facility greatly increased the ease of performing the tasks required.
8. The on job training of junior air camera operators with experienced personnel on Australian identification and supplementary photography tasks proved beneficial. Members given experience on relatively easy tasks such as this are then more confident to tackle future mapping photography missions.

Recommendations

9. The following recommendations are made:
 - a. WILD RC10 Serial No. 1465 be serviced to rectify problems mentioned.
 - b. Kodak 2405 Double X film not to be used on future ident/supplementary operations, with 2402 Plus X Aerographic to be used in its place.
 - c. Future ident/supplementary photography operations continue to employ a second air camera operator for on job training purposes, at least until a suitable quota of air camera operators at the corporal rank are competent.
 - d. Requests for VAP photography be forwarded well in advance of deployment to AO. A Technical Instruction be written detailing VAP procedures, particularly in the area of oblique photography requests.

Sep 93

J.M. PHILLIPS
SSGT
Air Camera Operator

Attachment:

1. Ident Photography Summary

ATTACHMENT 1 TO
APPENDIX 5 TO
ANNEX C TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

IDENTIFICATION PHOTOGRAPHY SUMMARY

Serial	Station No.	Date	Time (Zulu)	Film No.	Frame No.	Altitude Feet	Panel Configuration
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	NER 93 01	1 AUG 93	0547	4FDA425	0026	10,000	- -
2	NER 93 02	1 AUG 93	0603	4FDA425	0032	10,000	- -
3	NER 93 03	4 AUG 93	0342	4FDA426	0014	10,000	- -
4	NER 93 04	4 AUG 93	0358	4FDA426	0017	10,000	- -
5	NER 93 05	4 AUG 93	0444	4FDA426	0032	10,000	- -
6	NER 93 06	1 AUG 93	0355	4FDA425	0002	10,000	- -
7	NER 93 07	31 JUL 93	0520	4FDA424	0101	10,000	- -
8	NER 93 08	31 JUL 93	0137	4FDA424	0045	10,000	- -
9	NER 93 09	31 JUL 93	0233	4FDA424	0074	10,000	- -
10	NER 93 10	31 JUL 93	0428	4FDA424	0086	10,000	- -
11	NER 93 11	31 JUL 93	0408	4FDA424	0080	10,000	- -
12	NER 93 12	31 JUL 93	0453	4FDA424	0095	10,000	- -
13	NER 93 13	31 JUL 93	0402	4FDA424	0077	10,000	- -
14	NER 93 14	31 JUL 93	0149	4FDA424	0054	10,000	- -

Serial	Station No.	Date	Time (Zulu)	Film No.	Frame No.	Altitude Feet	Panel
							Configuration
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
15	NER 93 15	31 JUL 93	0559	4FDA424	0116	10,000	- -
16	NER 93 16	31 JUL 93	0540	4FDA424	0110	10,000	- -
17	NER 93 17	1 AUG 93	0557	4FDA425	0029	10,000	- -
18	NER 93 18	1 AUG 93	0540	4FDA425	0023	10,000	- -
19	NER 93 19	1 AUG 93	0516	4FDA425	0017	10,000	- -
20	NER 93 20	1 AUG 93	0453	4FDA425	0014	10,000	- -
21	NER 93 21	1 AUG 93	0419	4FDA425	0007	10,000	- -
22	NER 93 22	4 AUG 93	0406	4FDA426	0020	10,000	- -
23	NER 93 25	4 AUG 93	0412	4FDA426	0023	10,000	- -
24	NER 93 32	4 AUG 93	0704	4FDA426	0050	10,000	- -
25	NER 93 36	4 AUG 93	0210	4FDA426	0011	10,000	- -
26	U 043	31 JUL 93	0227	4FDA424	0071	10,000	- -
27	U 048	31 JUL 93	0433	4FDA424	0089	10,000	- -
28	U 114	4 AUG 93	0455	4FDA426	0038	10,000	- -
29	U 208	31 JUL 93	0527	4FDA424	0104	10,000	- -
30	U 210	31 JUL 93	0513	4FDA424	0098	10,000	- -
31	U 484	31 JUL 93	0552	4FDA424	0113	10,000	- -
32	U 488	31 JUL 93	0532	4FDA424	0107	10,000	- -
33	U 489	31 JUL 93	0604	4FDA424	0119	10,000	- -

Serial	Station No.	Date	Time (Zulu)	Film No.	Frame No.	Altitude Feet	Panel Configuration
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
34	U 491	31 JUL 93	0610	4FDA424	0122	10,000	- -
35	U 493	5 AUG 93	0049	4FDA427	0044	10,000	- -
36	U 494	5 AUG 93	0046	4FDA427	0041	10,000	- -
37	U 497	5 AUG 93	0044	4FDA427	0038	10,000	- -
38	U 498	5 AUG 93	0040	4FDA427	0035	10,000	- -
39	U 499	5 AUG 93	0054	4FDA427	0047	10,000	- -
40	U 502	5 AUG 93	0038	4FDA427	0032	10,000	- -
41	U 503	31 JUL 93	0135	4FDA424	0042	10,000	- -
42	U 505	5 AUG 93	0035	4FDA427	0029	10,000	- -
43	U 506	5 AUG 93	0105	4FDA427	0053	10,000	/ \
44	U 507	5 AUG 93	0000	4FDA427	0015	10,000	/ \
45	U 510	4 AUG 93	0645	4FDA426	0044	10,000	- -
46	U 511	31 JUL 93	0418	4FDA424	0083	10,000	- -
47	U 516	4 AUG 93	0633	4FDA426	0041	10,000	- -
48	U 517	5 AUG 93	0005	4FDA427	0018	10,000	/ \
49	U 518	4 AUG 93	0434	4FDA426	0029	10,000	- -
50	U 526	1 AUG 93	0529	4FDA425	0020	10,000	- -
51	U 712	4 AUG 93	0421	4FDA426	0026	10,000	- -
52	U 734	5 AUG 93	0018	4FDA427	0023	10,000	- -

ANNEX D TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

OPERATION MANNING

4 Fd Svy Sqn

OC	226259	MAJ	A.B.	McLeod
OPSO	555409	CAPT	G.C.	Addison
Det Admin Offr	455349	LT	J.T.	Bath
Tech WO	313339	WO1	G.E.	Timmins
Computing/Resup	1202719	SGT	M.D.	Evans
GPS	455113	CPL	S.G.	Adrain
GPS	183333	CPL	B.C.	Parkin
GPS	323320	CPL	G.T.	Weatherell
GPS	555964	CPL	S.	Wegener
GPS	329308	LCPL	M.C.	Oake
Cook	3168177	LCPL	N.A.	Smith
GPS	5101262	SPR	M.V.	McInerney
GPS	3804809	SPR	M.A.	Zehntner

Army Svy Regt

Observer	F328934	LT	T.C.	Bucknall
Air Cam Op	317246	SSGT	J.M.	Phillips
Ex Long Look	24569412	SGT	M.P.	Varley, RE
Air Cam Op	3168177	LCPL	G.D.	Craggs
GPS	555427	SPR	S.A.	Fitzsimmons

161 Recce Sqn

Det Comd	238010	CAPT		Lynch
Pilot	240576	LT		Bezzina
Pilot	3805089	LT		Everett
Pilot	2306875	LT		Gibbons
All trades	227102	CPL		Jenkins
All trades	323971	CFN		Miller

173 Survl Sqn

Pilot	557248	LT	K	Yeates
Pilot	329037	LT	D	Kemp
All trades	65155	CFN	M.B	Lillehagen

ANNEX E TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

AAAVN SUPPORT
OPERATION NERVOSE 1993

Introduction

1. AAAvn support to Operation Nervose 93 was provided by 161 Recce Sqn and 173 Survl Sqn from 1 Avn Regt. Three LOH from 161 Recce Sqn arrived in location on 21 Jul 93. The Nomad, fitted with the RC-10 camera, arrived in location on 29 Jul 93. The area of operations extended from Groote Eylandt and surrounding islands in the east to a point 20Nm east of Mataranka Springs in the west.
2. The flying hours allocated to the task initially were as follows:
 - a. Travel - 150 hrs
 - b. Task - 130 hrs
3. As it turned out, more task hours were required to complete the task. The final tally was as follows:
 - a. Travel - 100.2 hrs
 - b. Task - 136.1 hrs

Pre-Operation Administration

4. Direct liaison between both Aviation sub-units and 4 Fd Svy was adequate to ensure deployment of the assets into the AO and the subsequent commencement of tasking. In future operations, it would be valuable for the aviation supporting unit to have more input into aspects such as fuel dumping and advice could also be provided when seeking to determine the duration of the task.

LOH Operations

5. The LOH began tasking on 22 Jul 93. During the operation, the acft were used to conduct control point reconnaissance and marking. Once this was complete, observation parties carrying Magellan GPS kits were deployed to establish control points and provide the necessary data so that the aerial mapping photography could be accurately interpreted.

6. Specifically, the aircraft were used for the following tasks:
- a. control point reconnaissance,
 - b. control point marking,
 - c. land clearance reconnaissance by indigenous guides,
 - d. deployment of observation parties, and
 - e. liaison with local units.

Nomad Operations

7. The aerial identification photography required for all of the established control points was not particularly time consuming. The only thing that restricted Nomad operations was the fact that at one point all the established points had been photographed and it was necessary to wait until the rest were done before continuing. For the nights when observation parties were deployed forward to the mainland with the LOH, the Nomad was used extensively for resupply and relocation.

Crew Endurance

8. Four LOH pilots attended this task. This allowed for one day off in four. The flying rate required was not excessive. Aircrew were required though to assist in panelling sites and made themselves useful wherever possible. The days were long and generally quite arduous. AFO endurance limitations were never really an issue but the day off was required. In future, for long deployments, care should be exercised as travel hours used in transit can be restrictive with respect to endurance during the early stages of a task.

9. Two Nomad pilots attended the task and organised to work one day off in two. Endurance for them was not a problem.

Maintenance

10. Maintenance support for this task consisted of two all-trades. This was sufficient for the task and provided enough signatures to complete all routine servicings encountered. Although it was not viable on this operation, I strongly support the provision of an FRT for deployments of this size where possible in the future.

Recovery

11. Unfortunately, one of the LOH had to be recovered by C-130 from Groote Eylandt. This was well co-ordinated and aircraft loading was smooth and rapid. The C-130 landed at 041030IK and the aircraft to be recovered was loaded and tied down by 041115IK. All this was a credit to all involved.

Fuel

12. The provision of fuel for the operation was well organised. 4 Fd Svy Sqn co-ordinated the pre-positioning of drum stock in appropriate locations to allow operations to some of the more distant control points. Two galco pumps were taken from Holsworthy for the task. This is a minimum requirement for this type of operation.

Maps

13. Maps of the AO were provided with all the necessary control points marked on them. These were useful but far too large to be user friendly in the cockpit. The practice of marking the points on a 1:250 000 map should be continued but the maps should not be joined as they were on this op. Alternatively, the points could be marked on a 1:500 000 map instead. Also, it would be advantageous to have at least one copy of the map prior to the operation to enable any pre-operation planning to be conducted.

Aircraft Cargo Capacity

14. The limited cargo capacity of the LOH was a restriction on this operation. The requirement to deploy two man panelling parties and panelling equipment effectively reduced the endurance of the aircraft to 1.8 hrs. This did not present any major problems but in future liaison between units, specific weights and loads should be discussed in detail as aircraft range and endurance could vary significantly from published planning figures.

15. Although it was primarily required for aerial photography, the Nomad was used extensively as a cargo aircraft. Performance and payload was limited due to the fitment of the RC-10 camera.

Camp Administration

16. As always, the base camp facilities were well organised and managed. Additionally, as is now customary for operations with 4 Fd Svy Sqn, the food was excellent.

Conclusion

17. The operation provided the aircrew generally with many learning opportunities. All gained a good understanding of the need for survey control operations and the impact these operations have on the eventual production of maps. It also provided an exposure to modern navigational equipment such as GPS. A lot was learned about GPS theory and applications and the impact of GPS on modern survey operations. Also some of the shortcomings of GPS were illuminated.

Recommendations

18. The following is recommended:

- a. Copies of marked maps be forwarded, direct to the supporting unit prior to the task, and be of a useable size, and

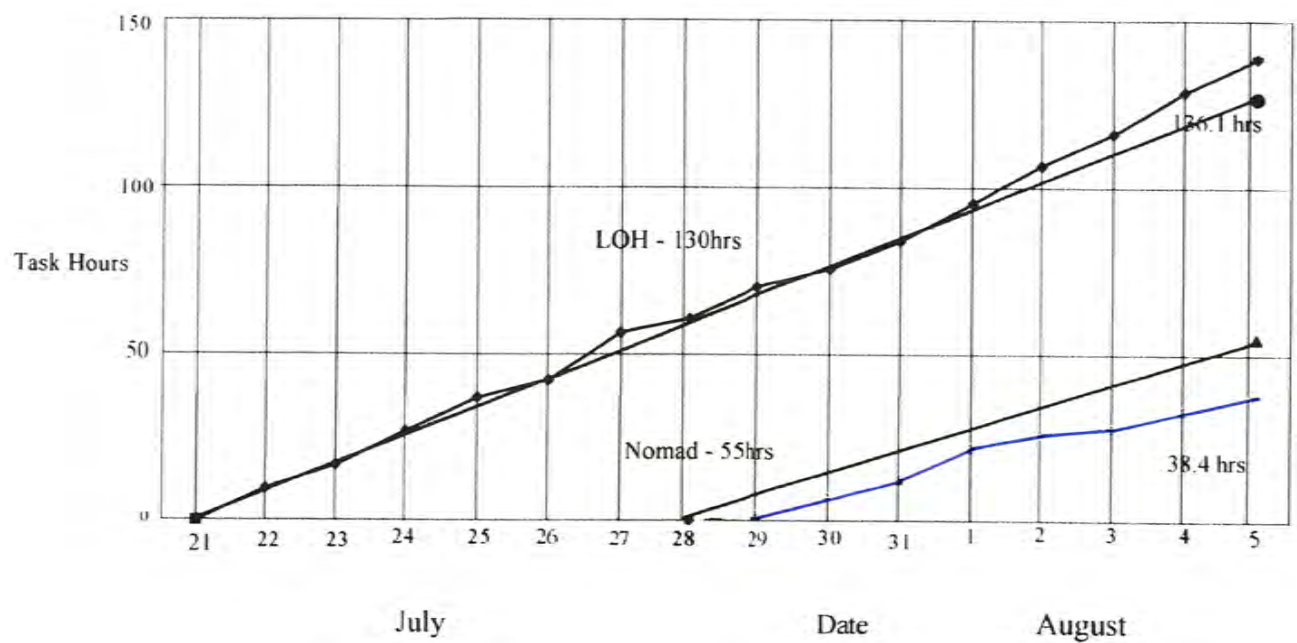
- b. LOH should be used for this type of task in the future; as they are ideally suited to the work required.

10 Aug 93

D.A. LYNCH
CAPT
DET COMD

Op Nervose 93

Aircraft Usage Graph



ANNEX F TO
OP NERVOSE 93
OPERATION REPORT
DATED 19 NOV 93

ANNEX G TO
OP NERVOSE 93
OPERATION REPORT
DATED 18 NOV 93

CONTACT INFORMATION IN THE AO

Army

SO2 Ops
HQ NORCOM
(089) 801 385
Responsibility: Aboriginal Liaison, Land Clearances

SO3 Ops
HQ NORCOM
(089) 801 385
Responsibility: Operations

OPSO
7 Log Coy
(089) 801 604
Responsibility: General logistic support

SUPO
7 Log Coy
(089) 801 621
Responsibility: Supply and positioning of POL

OPSO
HQ NORFORCE
DARWIN
(089) 801 350
Responsibility: Coordination of NORFORCE assistance

OC Arnhem Sqn
NORFORCE
NHULUNBUY
(089) 871 007
Responsibility: NORFORCE assistance in the AO

Groote Eylandt Patrol
NORFORCE
(089) 876 486
Responsibility: Support on Groote Eylandt

Aboriginal Liaison

John Paterson
NLC DARWIN NT
(089) 205 100
Responsibility: First point of contact on Aboriginal matters in the Northern Territory. Generally deals direct with SO2 Ops HQ NORCOM

Colin Thilp
NLC KATHERINE NT
(089) 722 894
Responsibility: First point of contact on Aboriginal matters in the central Northern Territory

Wally Wunungmurra/ Wayne Barbour
NLC NHULUNBUY NT
(089) 872 602
Responsibility: First point of contact on Aboriginal matters in north-east Arnhem region

Don Billet
Anindilyakwa Council
ANGURUGU (GROOTE EYLANDT) NT
(089) 876 638
Responsibility: Aboriginal interests on Groote Eylandt and neighbouring Islands

Ronnie Lindsay
Gun Gun Resource Centre
BULMAN NT
(089) 754 747
Responsibility: Aboriginal matters in Bulman area

Timmy Mangura
Town Clerk
NUMBULWAR NT
(089) 754 675
Responsibility: Aboriginal matters in Numbulwar/ Walker River area

John Joshua
NGUKURR NT
(089) 754 656
Responsibility: Aboriginal matters in Ngukurr area

Terry Marawili
Baniyala Homeland
VIA NHULUNBUY
(089) 879 174
Responsibility: Access to Baniyala areas

Groote Eylandt Mining Company (GEMCO)

Wrai Eivers
Alyangula Town Administrator
(089) 874 248
Responsibility: Administration of GEMCO facilities

Warren Paull
Senior Public Affairs Officer
(089) 874 488
Responsibility: Co-ordination of all non GEMCO activities, first point of contact at GEMCO

Graeme Johnson / George Crompton
Airport Officers
(089) 874 412
Responsibility: Refuelling facilities at Angurugu Airport

Mike Hemsley
Supply Officer
(089) 874 465
Responsibility: Supply and Logistics for GEMCO

Mario Nigg
Catering Manager
Nationwide Food Services
(089) 876 200
Responsibility: Catering and messing for GEMCO. Rations purchased through Nationwide are 40 -60% cheaper than elsewhere on Groote.

Civilian on Grootte Eylandt

Sen Sgt Owen Claridge
OIC Alyangula Police Station
ALYANGULA NT
(089) 876 122

Tim Robertson
ALYANGULA NT
(089) 876 418
Responsibility: Bus hire/charter on Grootte Eylandt

Kate Hale
Editor "Eylandt Echo" Newspaper
(089) 876 031
Responsibility: Public Relations