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SUMMARY FINAL REPORT
FOR
CONTRACT NO. N00014-84-C-0180

SAIC-86/1958



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report summarizes the work completed for Contract No. N00014-84-C-0180. The reports delivered and specific work performed have been addressed for each CDRL item.		

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A003 - Tasks 1 through 5

The following are reports that were delivered under these tasks:

"Bottom Loss Upgrade (BLUG) Extensions to Strategic Shallow Water Areas: Korea Strait" by W.F. Monet and R.R. Greene, SAIC-85/1825, September 1985 (UNCLASSIFIED).

"Final Report for Contract N00014-84-C-0180, Task 3, BLUG Upgrades and Test and Evaluation" by R.R. Greene, SAIC-85/1829, October 1985 (UNCLASSIFIED).

"Final Report for Contract N00014-84-C-0180, Task 5, BLUG Maintenance and Distribution" by R.R. Greene, SAIC-85/1596, October 1985 (UNCLASSIFIED).

"Consolidated BLUG Classes" by C.W. Spofford and W.W. Renner, SAIC-85/1591, February 1985 (UNCLASSIFIED).

BLUG interfaces with APP were of two forms:

Task 1 - Spofford interacted frequently with NUSC to ensure the successful delivery of BLUG for the APP (SIMAS) upgrade for USNS CURTS.

Task 4 - Spofford developed algorithms for incorporating system corrections to DI and RD due to rough bottom scattering. These were delivered to NUSC and incorporated in APP (SIMAS).

In general SAIC maintained close liaison with several Navy activities in assisting in upgrades to BLUG and the successful transition of BLUG maintenance and distribution to NAVOCEANO.

A004 - Tasks 6 through 8

The following are reports that were delivered under these tasks:

"Technical Description for the Ship Helicopter Acoustic Range Prediction System (SHARPS III) - Appendix (U)" by H.J. Venne, SAIC-84/1372, October 1984 (CONFIDENTIAL).

"Interim Report for Contract N00014-84-C-0180, Task 6" by W.W. Renner, SAIC-85/1064, February 1985 (UNCLASSIFIED).

"Interim Report for Contract N00014-84-C-0180, Task 8" by W.W. Renner, SAIC-85/1045, February 1985 (UNCLASSIFIED).

A005 - Task 9

D. White developed a computer code to convert BLUG parameters into an equivalent bottom with constant density which could be used with PE. E. Holmes installed software into SAIC's PE model and tested it. This model was used in a "Bake-Off" at NORDA.

A006 - Tasks 10, 14 and 15 (Tasks 11, 12, and 13 were reserved areas but never funded)

The following are reports that were delivered under these tasks:

"Final Report for Contract N00014-84-C-0180, Task 10" by W.W. Renner, SAIC-85/1593, February 1985 (UNCLASSIFIED).

"Ambient Noise Directionality Estimation System (ANDES) User's Guide (VAX 11/78X Installations)" by W.W. Renner, SAIC-85/1933, October 1985 (UNCLASSIFIED) (also referenced in A007).

"A Review of Data Bases and Models Used in SPARS" by J.S. Hanna, SAIC-85/1116, July 1985 (UNCLASSIFIED).

A007 - Tasks 16, 18 and 26 (Tasks 17, 19, and 20 were never funded)

The following are reports that were delivered under these tasks:

"Letter Summary Final Report on The Arctic Sub-Ice Exercise Analysis" by J.H. Wilson, 24 June 1985 (UNCLASSIFIED).

"Ambient Noise Directionality Estimation System (ANDES) User's Guide (VAX 11/78X Installations)" by W.W. Renner, SAIC-85/1933, October 1985 (UNCLASSIFIED) (also referenced in A006).

A008 - Tasks 21 through 25

The following are reports that were delivered under these tasks:

"1600 Briefing Material (U)" by J.S. Hanna, W.F. Monet and P.V. Rost, 8 May 1984 (SECRET).

"Sub-Bottom Influence on Propagation at a Bottomed Receiver at Low Grazing Angles (U)" by J.S. Hanna and P.V. Rost, SAI-84/1129, May 1984 (CONFIDENTIAL).

"1600 Geology and Geophysics (U)" by W.F. Monet,
SAIC-84/1349, 1 August 1984 (SECRET).

Under Task 25, the following was completed:

D. White reviewed the updated cycle 19 version of the FACT model implemented at NORDA and a letter was sent to Mr. Barry Scaife of ODSI indicating that in D. White's opinion this cycle was ready for an official release (with a minor correction as mentioned in the letter). This represented the final implementation of recommended computer code changes in the technical review of FACT 10. An additional review was made of changes to the computer code and a minor change was recommended for the next update in a letter to Dr. D. King (NORDA), Bay St. Louis, MS) as a result of this review. The task included work on the documentation of FACT 10. This documentation was published in two NORDA TN's and thus an SAIC report was not part of the contract. Work in this area consisted of documentation of some of the subprograms of the computer code, including the purpose of the subprogram, the method used to implement the solution, the I/O in the subprogram (including calling arguments and common blocks), the subprograms called by it and the higher level subprograms which called it. In addition D. White also wrote part of the physics documentation for the new modules in the upgraded FACT program. This documentation was transferred to the NORDA VAX via phone as part of the deliverables in the contract. A preliminary set of documentation (draft) of some subprograms was sent to:

Mr. Bruce Northridge
Naval Ocean R&D Activity
NSTL Station, Code 270
Bay St. Louis, MS 39529.

A review of the draft report (NORDA TN) was completed for the software documentation and a letter was sent to Dr. King with comments.

A009 - Task 27

The following are reports that were delivered under this task:

"SAI Interim Scattering Model/Ice (SISM/ICE)" by R.R. Greene, SAI-84/1100, April 1984 (UNCLASSIFIED).

"Ice Statistics and Acoustic Scattering in the Arctic Basin" by R.R. Greene, SAI-84/1132, October 1984 (UNCLASSIFIED) (also referenced in A010).

"Final Report for Contract N00014-84-C-0180, Subtask 27.1" by R.R. Greene, SAIC-85/1047, March 1985 (UNCLASSIFIED).

"Acoustic Scattering Kernels from Arctic Sea Ice" by D.M. Rubenstein, SAIC-86/1077, October 1986 (UNCLASSIFIED).

"FRAM IV Ambient Noise: (100 Hz - 500 Hz) Data Analysis" by R.E. Keenan and L.A. Gainey, SAIC-85/1901 November 1985 (UNCLASSIFIED).

Under Task 27.3, the following was completed:

Ruth Keenan participated in the RANGEX exercise planning as part of NORDA's team and contributed to the ambient noise section of the Arctic overview compiled by PSI. Ms. Keenan acted as a liaison between the NUSC/Newport RANGEX group and the NORDA team and participated in the meetings held on 20 October 1983 and 6 December 1983. R. Keenan

worked closely with Ed Gough at PSI sifting through data and writing a significant part of the ambient noise section in "Arctic Ocean Environmental and Acoustics Overview" [PSI Report No. PSI-TR-S-303-006, E. Gough (ed.)]. On 22-23 February 1984, Ms. Keenan presented a paper on ambient noise mechanisms at the NORDA Arctic Modeling meeting.

Also under this task, and in conjunction with PSI, SAIC carried out an analysis of environmental conditions, technology, and logistics for the NORDA Arctic Acoustics research review. The Arctic and adjacent seas were divided into fifteen sub regions:

- A. Central Arctic Basin
 - 1. Eurasian Basin
 - 2. Amerasian Basin

- B. Continental Shelf Seas
 - 1. Barents Sea
 - 2. Kara Sea
 - 3. Laptev Sea
 - 4. East Siberian Sea
 - 5. Chukchi Sea
 - 6. Beaufort Sea
 - 7. Canadian Archipelago

- C. Peripheral Seas
 - 1. Baffin Bay
 - 2. Greenland Sea
 - 3. Bering Sea
 - 4. Sea of Okhotsk
 - 5. Labrador Sea
 - 6. Sea of Japan

Each region was treated separately. Available literature on environmental factors, technology, and logistics pertinent to conducting acoustical research was reviewed and summarized for each region. The following environmental factors that affected arctic operations were considered:

- Weather
- Sea Ice Conditions
- Bathymetry
- Waves
- Currents
- Tides.

The various modes of logistic support were studied next. This included:

- Aircraft (fixed-wing and helicopter)
- Ships (icebreakers and transports)
- Submarines
- Track Vehicles.

Logistic bases and staging modes were also examined in addition to the human factors.

A010 - Task 28

The following are reports that were delivered under this task:

"Interim Report for Contract N00014-84-C-0180, Subtask 28.1" by R.R. Greene, SAIC-85/1597, March 1985 (UNCLASSIFIED).

"Ice Statistics and Acoustic Scattering in the Arctic Basin" by R.R. Greene, SAIC-84/1132, October 1984 (UNCLASSIFIED) (also referenced in A009).

"An Assessment of Remotely Operated Vehicles to Support the AEAS Program in the Arctic" by W. Denner, SAIC-86/1844, 15 September 1986 (UNCLASSIFIED).

The following was completed under Tasks 28.1 through 28.3:

An assessment has been made of the support potential of remotely operated vehicle technology scientific acoustic research in arctic regions (Tasks 28.1, 28.2, 28.3). Since it is necessary to acquire information to environmentally characterize an area (28.1) in order to select a site (28.2) and to plan an exercise (28.3), these three tasks have, in part, been simultaneously addressed because of their close inter-relationships. The study report establishes the state-of-the-art in this technology and documents the assessment described above.

Task 28.1 - A world-wide inventory of 267 remotely operated vehicles has been compiled that includes the country of origin, its manufacturer, and the physical characteristics of each. The vehicles were evaluated for their capabilities to acquire both qualitative and quantitative boundary conditions in arctic regions. Environmental data acquisition instrumentation compatible with ROV platforms was identified for C-T-D, sound velocity, sediment type and thickness, volume scattering, under-ice roughness, and other parameters required for modeling.

Task 28.2 - The capabilities and utility of remotely operated vehicle technology to site selection was assessed. The technology was evaluated and compared to traditional site selection options. The attributes of this technology were evaluated on the basis of compatibility with (1) logistics

support, (2) portability, (3) unique capabilities to acquire environmental information in real-time and delay-time modes under the ice canopy in three dimensions, (4) spectrum of data types, (5) vehicle payload, and (6) support platform options both on the ice and in the marginal ice zone. Utilization of the ROVs was assessed for instrumentation array installation, monitoring, and retrieval. The unique ROV capability of three-dimensional mobility under the ice canopy offers expanded opportunities for selection of new experiment geometries and test durations.

Task 28.3 - Remotely operated vehicle technology was evaluated to determine its potential contribution to acoustic exercise planning. Scenarios for a spectrum of new test geometries involving both real-time and time-delay measurements can be created through the applicable ROV technology. Application of the three-dimensional mobility and payload capacity of ROVs can markedly influence the planning of measurements of the oceanographic, bathymetry, bottom type, sediment thickness, ice, acoustic propagation, noise conditions, and other parameters associated with acoustic experiments. Recommendations and guidelines for the execution and analysis of data acquired through the use of ROV technology was evaluated.