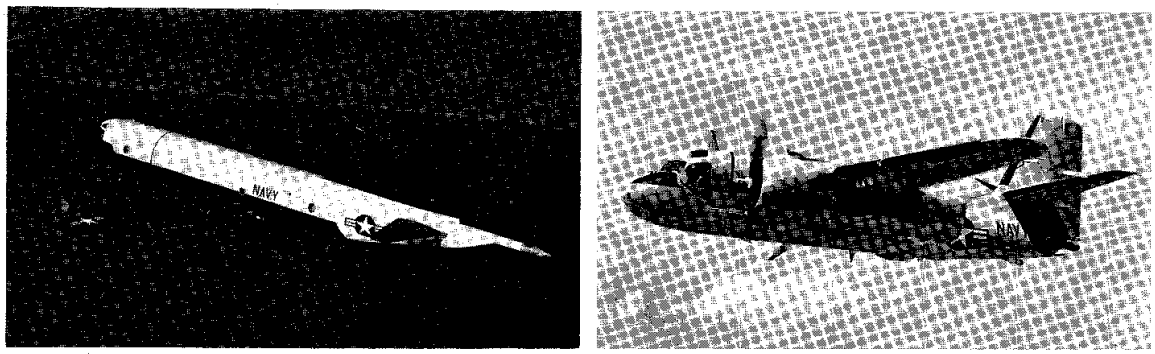
Introduction

This document is mostly an electronic scan of a McGraw Hill reprint from a July 8, 1963 "Aviation Week & Space Technology" article. The article title was "Navy Planning Integrated ASW Avionics System." The reprint was found in an old file box by former UNIVAC employee, William Curt Nelson, as the VIP Club's Legacy Committee was pursuing information about the CP-823/U computer. We've supplemented the article with a few photos provided by Curt and explanatory text by the editor.

AVIONICS



PROJECT A-NEW, RECENTLY LAUNCHED Navy program, seeks to integrate variety of anti-submarine warfare sensors on carrier- and land-based ASW aircraft into more effective system for coping with high-speed nuclear submarines. Previously, Navy first bought suitable aircraft, such as the P-3A (left) and S-2D (right), then stuffed them full of avionic black boxes.

Navy Adopts New ASW Avionics Approach

By Philip J. Klass

Washington—Fundamentally different approach to the design of airborne anti-submarine warfare weapons, expected to improve significantly Navy's ability to cope with high-speed nuclear submarines, has been adopted by the Bureau of Naval Weapons.

Instead of buying a long-endurance patrol plane and equipping it with miscellaneous avionic black boxes and sensors, Navy has set out first to design an integrated airborne avionics system specifically suited to the ASW task. Only after the system's design parameters have been established will a new ASW aircraft be procured, according to present plans.

Project A-New

The program, launched earlier this year, is known as Project A-New, not an acronym. Current funding is about $4 million with an estimated $8 million projected for Fiscal 1964.

The program's implications are far more important than these modest figures would indicate since the A-New concepts will shape future large-scale procurements of airborne ASW avionics equipment.

Project A-New is primarily a systems engineering program, intended to integrate existing ASW sensors and subsystems and improved models already under development to achieve greater effectiveness and ease the workload of aircraft crews. But the system integration effort involves some new hardware, including a central airborne digital computer and new tactical situation displays.

First experimental version of the A-New system, referred to as XN-1, is being assembled at the Naval Air Development Center, Johnsville, Pa., for initial evaluation using an ASW simulator. Later this fall the system will be shifted to a Lockheed YP-3A, a converted turboprop Electra, for flight tests which are slated to begin early next year. The XN-1 hardware is intended to serve as a flying testbed and not to reflect the ultimate size or weight of the system.

By late 1964, it is expected that an engineering prototype (XN-2) of the integrated ASW avionics system will have been procured for simulator and flight evaluation. Meanwhile, preliminary performance specifications will have been prepared and sent out to airframe manufacturers for use in preparing future proposals for new Navy ASW land- and carrier-based aircraft competitions.

Bureau of Naval Weapons is managing the A-New program, with technical direction assigned to the Naval Air Development Center (NADC), according to Lt. Cdr. Guy Buck, advanced systems project officer in BuWeps ASW Detection and Classification Div. Principal contractors in the program include Dunlap & Associates, General Dynamics/Electronics, Grumman Aircraft, Lockheed-California, Loral Electronics and the Univac Div. of Sperry Rand Corp.

The ASW problem of target detection and classification (threat or non-threat) is one of the most difficult and complex in the spectrum of modern warfare, particularly with the advent of deep diving, high-speed nuclear submarines which don't have to surface very often.

It requires surveillance of vast volumes of a medium which is not homogeneous as seen by submarine detection sensors and which is filled with many non-threat objects.

Because there is no single type of sensor which has the range and effectiveness in water that radar has against airborne and spaceborne targets, a variety of sensors must be used, each operating on a different principle. These range from radar to sonar, from magnetic anomaly detectors (MAD) to infrared sensors and ferret receivers.

Sensor Variety

Some of the sensors are fixed in their location, while others such as sonobuoys drift.

Still others on board ASW aircraft, surface ships and submarines are in continuous motion over or in waters which have few convenient landmarks. For maximum effectiveness it is necessary that each ASW vehicle not only correlate the data obtained from its own variety of sensors but that it also attempt to correlate this data with sightings made by other ASW vehicles in the area.

With the present state of the ASW sensor art, the most pressing problem is one of data correlation, a task which is relatively easy for a digital computer but which now heavily taxes the airborne ASW crew, particularly when it has been on station for many hours, Buck said.

Frequently there may be conflicting data from different airborne sensors, making it difficult for the crew to determine its best next move, according to Donald F. Smith, technical director for A-New at NADC's Anti-Submarine Warfare Laboratory. Today the ASW crew must manually calculate the optimum positions in which to drop sonobuoys and the number that must be used to achieve the desired range, a factor which depends upon temperature levels in the ocean. The crew also

must select radio transmitting frequencies for each sonobuoy which will avoid interference. And it must do this quickly before the submarine is able to escape into the ocean's depths.

Submarine skippers are trained to employ unpredictable and unconventional tactics to avoid any pattern of behavior which will make their detection and destruction easier. But the long memory of a digital computer may be able to spot even faint patterns of behavior that might be overlooked by an ASW crew which has been on duty for many hours.

In the A-New integrated system, the airborne digital computer will perform many functions. It will continuously compute the aircraft's latitude and longitude, calculate optimum deployment configurations for sonobuoys, keep tab on their location with respect to the moving aircraft and determine estimated target position from data supplied by all aircraft sensors.

It is expected that the computer will use statistical techniques to derive several possible courses of action, displaying these and the computed probability of success, for final selection by the aircraft commander.

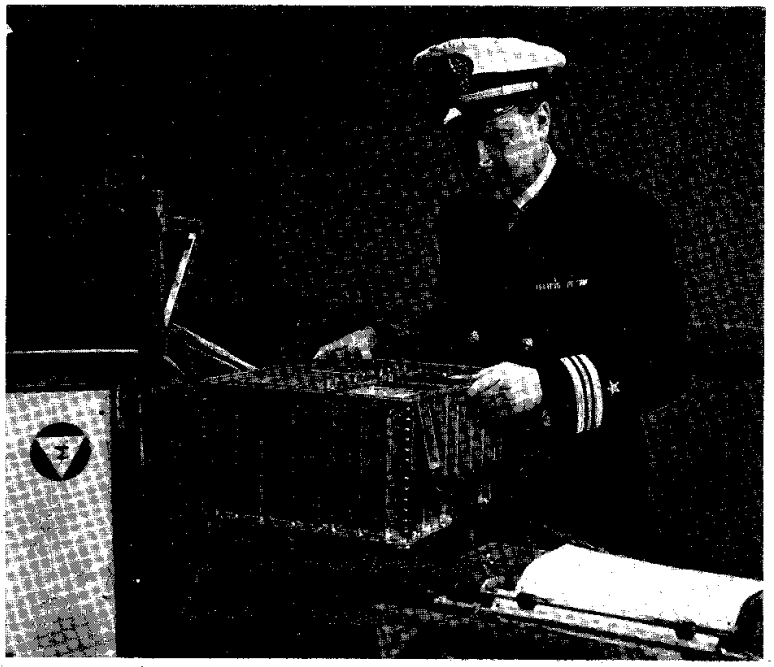
Because the computer acts a a central clearing house for all sensor data as well as keeping track of the aircraft movement, it should greatly simplify the problem of briefing the crew of a new aircraft coming on station. At present this must be done by voice radio and is necessarily sketchy, which can result in needless duplication of areas already patrolled. By means of a two-way data link, Navy expects to be able to automatically transfer the complete history of the departing aircraft's operations to the oncoming ASW aircraft's digital computer.

Data Transferral

Similarly, information on potential ASW targets available at shore or shipboard combat information centers can be quickly transmitted to the airborne digital computer, via data link. Radio Corp. of America currently is under contract to adapt Navy's standard AN/ASW-21 data link system, originally designed for airborne intercept use, to the ASW information transfer requirements.

Because of the key role planned for the airborne digital computer, Sperry Rand's Univac Div. is playing a major role in the A-New program. It is responsible for modifying an existing computer, originally developed by Univac under Air Force sponsorship for missile guidance, to suit the ASW mission.

Univac also is developing the complex programs, "software," needed for this new ASW mission. Modification of the original computer design includes addition of increased memory capacity and instruction repertory.



UNIVAC DIGITAL COMPUTER will play key role in Project A-New integrated ASW avionics system which Naval Air Development Center is assembling for installation on YP-3A. Flight evaluation of the experimental system is scheduled to begin early next year.

The machine is a stored-program type rather than a wired-program computer which Navy currently is using on its Grumman E-2A (W2F) and A-6A (A2F). The choice of a stored program machine will not only provide greater flexibility for evaluating different tactics and procedures during the early flight test phase, but also will make it easier to adapt an operational system to new ASW sensors or tactics, according to M. R. Clement, Jr., Univac's A-New program manager.

The digital computer also will be used to generate tactical situation displays in the aircraft, combining information now displayed on a multitude of devices. The aircraft commander and ASW system operators will be able to select and display only the information needed at any moment. There will be an alpha-numeric display which will enable the crew to interrogate the computer for stored information and read the response on the face of a Charactron cathode ray tube. General Dynamics/Electronic has developed a short-neck Charactron for this use and is responsible for design of the tactical situation display equipment for A-New.

Dunlap & Associates is responsible for human engineering aspects of the system design, including what usually is called the man-machine interface involving communications between computer and human operators.

Grumman and Lockheed are under contract to develop system configuration requirements with the former considering carrier-based vehicles and the latter working on land-based aircraft. Loral Electronics is developing the black-boxes and controls required to provide an interface between existing sensors, the digital computer and displays.

Increased Commonality

At present there is considerable difference between the ASW avionic systems used in carrier- and land-based aircraft. NADC officials express the hope that increased commonality will come out of the A-New program and that ultimately the two types of airborne systems will differ primarily only in the number of crew stations required.

System integration and display techniques being considered for A-New have been undergoing simulated ASW wargame evaluations at NADC for several months.

These are conducted using a modified version of an analog simulator originally built by ACF Electronics for training P-2H (P2V-7) ASW crews.

This will be replaced with a more versatile digital simulator next summer. It will be able to simulate a larger variety of sensors and will be designed to reproduce the high speed and maneuverability of nuclear submarines expected to be operating during the next decade. The new machine will enable Navy scientists to "fly" a complete ASW mission in a 500 x 500 mi. area

of ocean.

Because of the difficulty of conducting well-instrumented airborne ASW tests in the ocean and the problem of obtaining the use of late-model nuclear submarines for extended periods of time, the new ASW simulator is expected to play a vital role in quantitatively assessing new techniques. Choice of the contractor to build the new simulator is expected to be announced soon.

The A-New program is an outgrowth of problems that have plagued newly procured ASW aircraft in the past. Only partial integration of the multiple sensors has been obtained and this usually at the expense of a costly retrofit program, according to Cdr. E. O. Skidmore, superintendent Systems Div. of NADC's ASW Laboratory. Too frequently in the past, the over-all effectiveness of the aircraft and its airborne avionics equipment did not undergo meaningful tests under actual operating conditions until dozens of aircraft had been produced and dozens more were in production, Skidmore said.

Two years ago, in an effort to correct this situation, Navy awarded contracts to four teams of avionics companies to study the feasibility of using a central digital computer for ASW data processing. The teams were headed by North American's Autonetics Div., Hughes Aircraft Co., Librascope Div. of General Precision and Loral Electronics. Under the study, the companies were to consider not only existing ASW sensors but new types under development. The study reports indicated that the concept had much to offer in improving the effectiveness of airborne ASW operations.

Last December, after Navy approval for A-New had been granted, the present team of contractors was selected and the program was officially launched. Recognizing that system integration is both a state of affairs and a state of mind, Navy A-New project managers lay great stress on bringing Navy and industry team members together at frequent intervals for mutual progress reports and to work out interface problems.

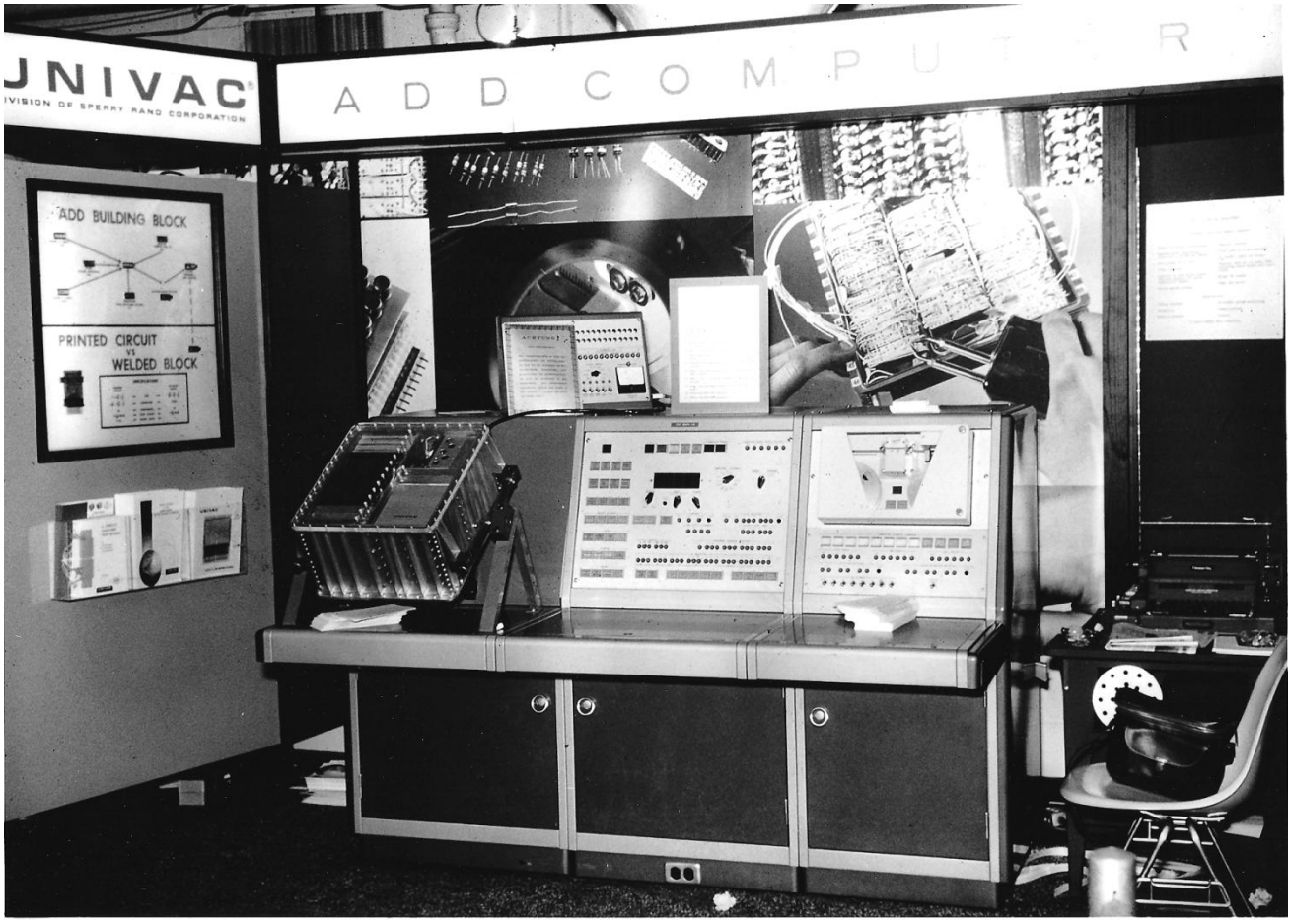
To familiarize industry with the objectives of the A-New program and Navy's anticipated future requirements for airborne ASW avionics, NADC gives a classified briefing every Wednesday morning at Johnsville. Program personnel also are available on Wednesday to answer questions on the project.

End of scanned Aviation Week pages.

Supplemental Information

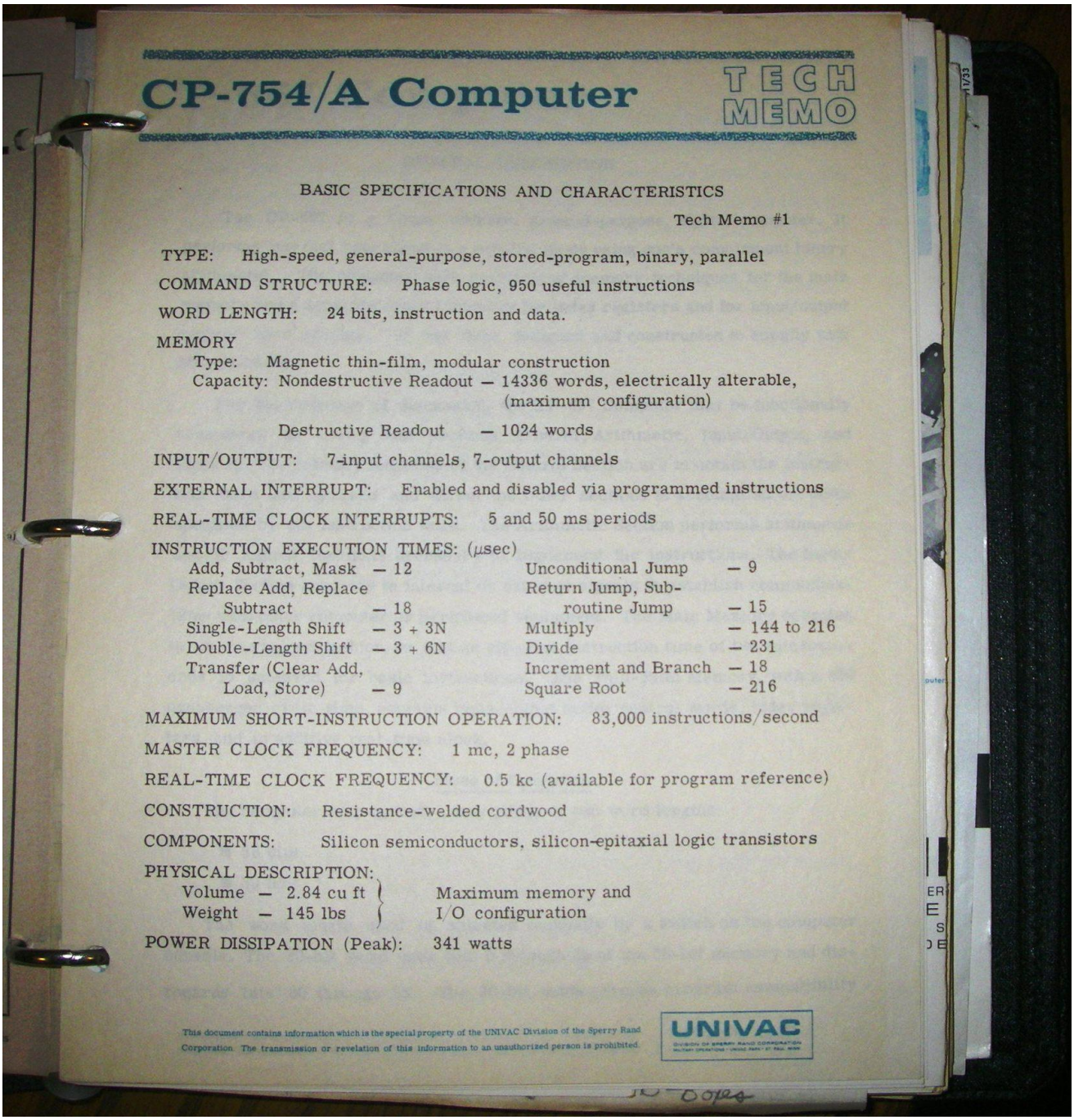
The planned Lockheed YP-3 aircraft installation is shown in an artist's rendition, an 8"x10" black & white photo from Mr. Nelson. The original artwork source is unknown.

The Aviation Week article states: "Sperry Rand's Univac Div. is playing a major role in the A-New program. It is responsible for modifying an existing computer, originally developed by Univac under Air Force sponsorship for missile guidance, to suit the ASW mission." The UNIVAC computer had the company type designation ADD 1000, shown in this photo from Mr. Nelson's files.



Page 2 of the Aviation Week article also shows a Navy officer with his hands on the ADD computer. Curt Nelson provided us with another photo and identified the officer as Lt. Cdr. Swenson.

Univac assigned company type number 1020 to the modified computer then processed the paperwork to receive government nomenclature CP-754/A for this ASW Mod I computer. The technical description 'snapshot' is on the next page. Snapshot provided to the Legacy Committee by Todd J. Thomas. Mr. Thomas had recently acquired the CP-823/U computer (Univac type 1830) which became the ANEW Mod 3 computer. Information about that acquisition is available in the VIP Club document, http://vipclubmn.org/Documents/CP823CommLog.pdf.



CP-754/A Computer

TECH MEMO

BASIC SPECIFICATIONS AND CHARACTERISTICS

Tech Memo #1

TYPE: High-speed, general-purpose, stored-program, binary, parallel

COMMAND STRUCTURE: Phase logic, 950 useful instructions

WORD LENGTH: 24 bits, instruction and data.

MEMORY
Type: Magnetic thin-film, modular construction
Capacity: Nondestructive Readout — 14336 words, electrically alterable, (maximum configuration)
Destructive Readout — 1024 words

INPUT/OUTPUT: 7-input channels, 7-output channels

EXTERNAL INTERRUPT: Enabled and disabled via programmed instructions

REAL-TIME CLOCK INTERRUPTS: 5 and 50 ms periods

INSTRUCTION EXECUTION TIMES: (μsec)

Add, Subtract, Mask	— 12	Unconditional Jump	— 9
Replace Add, Replace Subtract	— 18	Return Jump, Subroutine Jump	— 15
Single-Length Shift	— 3 + 3N	Multiply	— 144 to 216
Double-Length Shift	— 3 + 6N	Divide	— 231
Transfer (Clear Add, Load, Store)	— 9	Increment and Branch	— 18
		Square Root	— 216

MAXIMUM SHORT-INSTRUCTION OPERATION: 83,000 instructions/second

MASTER CLOCK FREQUENCY: 1 mc, 2 phase

REAL-TIME CLOCK FREQUENCY: 0.5 kc (available for program reference)

CONSTRUCTION: Resistance-welded cordwood

COMPONENTS: Silicon semiconductors, silicon-epitaxial logic transistors

PHYSICAL DESCRIPTION:
Volume — 2.84 cu ft
Weight — 145 lbs
} Maximum memory and I/O configuration

POWER DISSIPATION (Peak): 341 watts

UNIVAC

Next Legacy Committee 'Paper'

The Aviation Week article also states: "Univac also is developing the complex programs, "software," needed for this new ASW mission." Mr. Nelson has provided a 1963 paper written by Bob Blixt which describes this software. That paper has been scanned and will be compiled as next month's web site 'Article for the Month.'