THE AIR FORCE COMMAND AND CONTROL SYSTEM

1950 - 1966

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by

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August 1967

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FOREWORD

The Air Force Command and Control System, 1950-1966 summarizes the efforts at major headquarters-level to automate and integrate operational data processing and transmission.

The Headquarters USAF command post established communications with its counterparts in the field during the early 1950's. This so-called "manual command and control system" quickly evolved into a vitally important national emergency warning center. However, it never achieved what battle staffs considered their equally important mission -- to provide commanders the data that they required to decide the most effective employment of air forces during fast-breaking crises. This study seeks to trace the causes for delays in acting on the problem and developments that promised to solve it.

Other recent historical studies in this series include: The Air Force and the Worldwide Military Command and Control System, 1961-1965; Command and Control for North American Air Defense Command, 1959-1963; and USAF Strategic Command and Control Systems, 1958-1963.

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I. EVOLUTION OF THE REQUIREMENT

(U) The history of the Air Force command and control system began the day war broke out in Korea in June 1950, at which time Headquarters USAF established an emergency command post on the fourth floor of the Pentagon. For the next six months this facility served primarily as the central processing point for Far East radio messages which arrived in the Headquarters after normal working hours. Since air defense was solely a USAF mission at this time, the Headquarters also set out to establish communications which could facilitate early warning should Moscow respond to the free world's determined stand in Korea with a sneak bomber attack on America. Lt. Gen. Ennis C. Whitehead, the air defense commander, ordered his meager, understaffed forces on 24-hour alert in late June 1950. Two weeks later the Air Force installed direct phone lines from the Pentagon post to General Whitehead's headquarters and to the Roslyn, N. Y., defense sector which controlled the few radar stations then operating on the East Coast. This was the start of the USAF air raid warning system. It became a rudimentary national system in August 1950 when, on request of President Harry S. Truman's military aide, the Air Force ran a direct phone line from the command post to the White House. [1]

(U) A small staff under command of a colonel operated the post during regular working hours, referring any unusual reports or requests to the personal attention of the Director of Operations. General officers from the Air Staff commanded the post on an extra-duty basis after regular hours. Gen. Hoyt S. Vandenberg, USAF Chief of Staff, affirmed the gravity and importance of their responsibility by authorizing them to act in his name, if necessary, on situations that required immediate action. [2]

(U) In the fall of 1950 the Director of Operations, to whom the post has always been assigned, obtained funds for the design and construction of permanent facilities

in the Pentagon basement, and operations from there began the following February. The central area, called the Chief of Staff war room, seated about 50 persons and quickly became a popular and busy place. Surrounded by double walls containing an electronic alarm system and entered through a steel door which opened into a guarded anteroom, it was used for presentations and discussions of highly classified data. Recessed map panels were mounted on tracks; 16mm and 35mm display projectors operated from a small booth at the back of the room; and spotlights and dimmers dispersed or concentrated lighting. It pioneered the use of fluorescent paint and "black light" to make displays easily readable from any point in the room.* Finally, it contained its own emergency power plant. In short, the Air Force command post was a well-equipped, impressive installation for its time. The Air Staff used it daily throughout the war for operations and intelligence briefings and planning sessions. Prestigious staff groups, such as the Air Force Council, adopted it for their regular and emergency meetings. Special top gatherings, including commanders' conferences, used it as did officials from other defense department agencies.+

(U) War room operations improved steadily and satisfactorily throughout the Korean War years. As the command post staff grew in size and experience it afforded the field commands increasingly precise and comprehensive guidance on compiling and submitting force status information. And the statistical and operations staffs of the field commands did a good job of furnishing the information despite overburdened, drastically inadequate communications. As a result, the war room staff, through displays and briefings, was able to provide General Vandenberg and his deputies a

*(U) Installed by the Thomas Cook Advertising Co. in 1952 and later employed in field command posts, this equipment bathed operations in the eerie light that impressed visitors as being highly suited to the potentially grim business conducted there.

+(U) On one memorable instance of this sort in 1952 Prime Minister Winston Churchill accompanied Secretary of Defense Robert A. Lovett to the post for a briefing on Air Force preparedness.

reasonably current and succinct picture at all times of the strength, deployment, and combat readiness of air forces around the world.

(U) In early 1952 the command post sought to expand its mission by arranging for the gradually-building Air Defense Command (ADC) to send in via teletype combat exercise data. Then, employing the same techniques used in air defense posts, it recorded this information in grease pencil on a large, vertical, plexiglass map of North America set up in the war room. After witnessing the first tests of the operation, one officer exuberantly concluded that the Pentagon post, in addition to its air raid warning and force display capabilities, now could provide "an up-to-date graphic picture of our air defense effort in the event of an attack." Nothing could have been further from the truth. The information plotted was several hours old, at best. It also suffered considerable distortion during its long journey up the chain of command. Subsequent exercises brought many refinements in this data passing and plotting information but the end results remained much the same.[4]

([redacted]3) The final important development during the Korean War years was the establishment of the requirement for alternate command posts. On the assumption that the Pentagon would be among the first targets on any enemy's strike list, General Vandenberg in 1950 selected Langley Air Force Base (AFB), Va., home of the Tactical Air Command (TAC), as his primary alternate headquarters. Later, he designated Air University (AU) at Maxwell AFB, Ala., as a second alternate. If the Pentagon were bombed out, command of the Air Force would switch to Langley for as long as it survived, and then to Maxwell. However, personnel and fund shortages prevented the Air Force from manning or equipping these alternate posts to any satisfactory degree. Too, the Joint Chiefs of Staff (JCS) began a project early in the war which, in effect, discouraged any long-range planning on this score. This was the construction of an underground facility near Ft. Ritchie, Md., that was to serve as a wartime operation center. As initially conceived and implemented, the JCS plan called for the Battle

Staffs of the service headquarters to evacuate the Pentagon as soon as an attack was confirmed, journey to the mountain center, and assume strategic control over America's fighting forces from within its protective walls. Precisely how they would get there and what means they would employ to maintain contact with the forces during the conflict remained problems for future solution.

Automating the Air Defense and Strategic Air Systems

(U) After the Korean armistice all USAF activity except air defense and strategic air underwent immediate and drastic reduction. In accordance with the Eisenhower administration's policy of "massive retaliation," the Strategic Air Command (SAC) became America's first line of defense against Russia's rapidly growing and now nuclear-armed long range bomber force. ADC's primary job was to develop early warning to a point where it provided SAC and the nation maximum time to respond to attack before the bombers reached their targets. Consequently, President Eisenhower in early 1954, on recommendation of the National Security Council (NSC), approved construction of a distant early warning (DEW) line of radar stations across North America south of the Arctic circle. Soon after, Canada agreed to build a second line of radars along its 55th parallel to close possible gaps in DEW coverage and provide more precise headings on enemy penetrations. When completed these lines would give the nation as much as a two-hour warning of manned bomber attack. The ADC headquarters operation center in Colorado Springs, Colo., would assess the meaning of DEW sightings and, on suspicion or confirmation of attack, simultaneously alert the SAC control center in Omaha, Neb., and the Air Force command post. While Colorado Springs and Omaha alerted their forces, the Pentagon post would pass the warning to the President, Secretary of Defense, and JCS. From this point, air defense weapons could move against the attackers whenever ADC positively identified them as enemy forces intent on committing hostile action. The SAC bombers would fly to launching points and there await attack orders

which only the President could release. In accordance with this policy, the National Security Council in 1955 officially designated the command post as the nation's air defense warning center.[5] This did more than merely confirm what the post had been doing all along. It stimulated a greater sense of urgency among non-defense agencies in Washington toward their emergency action preparations. This in turn eased the way for JCS and the Air Staff to improve and test communications between the command post and all agencies and military commands that had important defense responsibilities.

(U) DEW and Canadian line data were to feed into the outer ring of the air defenses, then proceed up the ADC chain of command to the Colorado Springs post. The cheapest way to insure rapid transmission of this data would have been to expand and strengthen phone, teletype, and radio communications already in use within ADC. However, Headquarters USAF pointed out, since the nation had invested so much already in its efforts to guard against nuclear attack, it ought to improve overall ADC data handling facilities. The program proposed dated back to 1950 when air defense planners had set out to develop an electronic computer around which they could build an automatic air defense data passing and display system for both warning and weapon control. They first tried to adapt a British-made computer to the job, and it appeared sufficiently promising by 1952 for ADC to reorganize its major defense zones in anticipation of installing the equipment at sites of highest traffic density. This plan faltered when a problem arose in transmitting data between computers. The University of Michigan's Willow Run Research Center tackled the problem and emerged with a workable solution. Meanwhile, however, the Lincoln Laboratory of the Massachusetts Institute of Technology had developed a system based around a totally new computer. In April 1953, the Air Force decided to cancel the Willow Run project in favor of Lincoln's proposal. Redesignated the ADC Semi-Automatic Ground Environment (SAGE) and assigned research and development project number 416L, the program, as now offered,

called for a large-scale installation of computers in specially constructed facilities dispersed over the northern and coastal areas of the United States. The administration and Congress approved the idea and intent of the program but trimmed it to far fewer centers on highly-exposed but government-owned locations. In 1955 the National Security Council accorded this reduced version of 416L top funding priority and directed the Air Force to bring it into operation as soon as possible. *

(U) Thus the Air Force, more of necessity than prescience, became the first of America's military services to accept computers as the answer to large-scale combat data handling problems. From a strictly operational viewpoint, SAGE later came to be regarded as a dubious investment. The cutback of the original program left the final system dangerously exposed even to bomber attack. By the time it started to come into operation in the late 1950's, the new threat of intercontinental ballistic missiles had robbed it of all post-attack value. However, it should be noted that SAGE had served as a major sponsor and testing ground for the fledgling American computer industry and, as such, played a pioneering and seminal role in the rapid advance of the computer sciences which took place in the years following its implementation. Also, SAGE proved the validity of the Air Force's original idea that computers deployed over a wide area could exchange large amounts of military data rapidly and effectively. Finally, it enabled the Air Force to acquire a unique competence in the design, development, and operation of computer systems. From an experimental and development point of view, therefore, SAGE produced results which might not have accrued as quickly from a lesser effort, and all elements of the defense department in later years profited from this knowledge and experience.

* For further background on the genesis and development of SAGE, see Thomas A. Sturm, Command and Control for North American Air Defense, 1959-1963 (AFCHO, Jan 1965), and Richard F. McMullen The Birth of SAGE, 1951-1958 (Hq ADC).

(U) Meanwhile, Headquarters USAF approved contracts with the Radio Corporation of America and International Business Machines (IBM) companies to study possibilities of doing for SAC what SAGE hoped to do for ADC. This led to the installation of an experimental IBM computer operation in the SAC headquarters operation center in 1957 and, ultimately, to the 465L system.*

Priority on General War Preparations

[redacted] Although the office of the Secretary of Defense (OSD) imposed no restrictions on overall USAF command and control planning in the immediate post-Korean period, the policy of massive retaliation more or less dictated how this would proceed. That is to say, most of the equipment and construction funds went to projects supporting general war preparations. In the eyes of the Air Staff, one of the more important of the many casualties which stemmed from this policy was the Air Force command post. Early in the war, as noted earlier, it acquired a reputation as a modern, efficient operation. By the time the war ended, however, ADC and SAC posts had matched it and soon after, with their greater priority for funds and personnel, forged ahead in both accommodations and effectiveness. The chief of the Air Force command post in late 1954, Col. Joseph G. Russell, first voiced what remained the Air Staff's basic grievance on this point during the next several years. The war room, he noted, had "deteriorated into a show place tending to stagnate around long-range presentations" and he thought that the whole operation ought to be staffed and equipped so that it could, if the occasion arose, "depict the current operational situation of the major combat commands during actual hostilities."[6] However, this view ran contrary to national thinking and Colonel Russell's superiors, though they supported him in principle, were not in a position to justify the proposal or submit a request for funds to OSD. They did authorize

* For background and description, see Carl Berger, USAF Strategic Command and Control Systems, 1958-1963 (AFCHO, Nov 1964), and Strategic Command, Control Communications, 1959-1964 (Hq SAC, Oct 1965).

staff planning and as much actual improvement as might be accomplished from funds on hand. What was needed, of course, was a project of the nature and scale of 416L, but this was unthinkable at the time.

(S [redacted] As a consquence, the USAF officials responsible for the Headquarters command and control "system" through the mid-1950's concentrated on improving and expanding attack warning communications and preparing for the emergency evacuation of the Battle Staff to the Ft. Ritchie site. Although the Army finished basic construction at this "Alternate Joint Communication Center" in 1953, the Air Staff was not called on to submit construction and non-operation type equipment requirements for its portion of the site until the spring of 1955. In June of that year the Air Staff participated in an initial, very limited emergency redeployment exercise which involved the movement of defense department and civil defense officials from Washington to the new center. Later that year, the facility was sufficiently equipped for Headquarters USAF to designate it as the "advanced" primary redeployment post and to relieve TAC (Langley AFB) of that responsibility.

(S [redacted] In July of the next year, the Air Staff participated in Operations Alert-1956, the first government-wide exercise held to acquaint agencies with the types of "operational-continuity" problems they could expect under massive nuclear attack. A USAF helicopter airlift underwent evaluation in this exercise and proved sufficiently successful for the JCS to accept it as the primary mode of transport for top officials. These and subsequent exercises in following years undoubtedly afforded all concerned invaluable experience. However, there was an inexplicable failure or reluctance to man the post with permanent staffs so it might remain in constant readiness and gear its development philosophy and facilities to ADC and SAC command and control objectives.[7]

[redacted] Meanwhile, the Air Staff's communication expansion program pursued an anomalous course in an effort to satisfy ambiguous national command and control objectives and, at the same time, provide the command post the "current operational" picture,

as Colonel Russell had called it, of overall USAF resources. Perhaps the best example of this state of things occurred in September 1955 when a modern switchboard with 100 long distance lines and room for more, if necessary, was installed in the command post. The Directorate of Operations noted this was far more than needed under "the present approved concept of operation" that direction "of a future war" would come from the Ft. Ritchie site. However, since the switchboard backup equipment was being provided and maintained by the telephone company at no cost to the Air Force until a line was activated, the post had at its disposal a long line capacity which required very little expenditure of resources.[8]

Changing Definition of National Requirements

(U) The first demand on the command post by higher authority for something more than warning came in December 1956 when the Joint Chiefs made it responsible for dispatching emergency JCS decisions via a special after-duty-hour telephone system.* This, in effect, established the post as the crisis alert link between the JCS and joint commanders around the world. The new assignment required the post to augment communications in such a way that the Joint Chiefs could go directly to the joint commanders, by-passing executive agents. It also enabled the command post to initiate actions that eventually resulted in more adequate staffing.[9]

(C) The significance of the Joint Chiefs' decision to establish essentially the same relationship with the joint commanders as the Air Force command post had been seeking with its field commands was that it marked the beginning of the end of the dangerous rigidity in communications. While nuclear attack would remain the primary

* (U) Until 1956 the Air Force was prevented by law from installing phones at government expense in private residences. At that time, after several years of trying, the Air Force managed to get it changed sufficiently to put phones in the homes of the Joint Chiefs and top Headquarters USAF, ADC, SAC, and European Command officers. Eventually, the Air Force was authorized to install them wherever they were needed.

threat, it became increasingly accepted that joint commanders would frequently encounter nonnuclear crises which would require immediate, secure, and constant communication directly with the Joint Chiefs. This meant, in turn, that the Ft. Ritchie site alone could not afford the central, decision-making facilities required to satisfy this broadened concept of national command and control requirements -- not unless the Joint Chiefs and other military leaders were prepared to deploy there every time a crisis occurred.

(U) In direct consequence of these new considerations, the defense department initiated studies and actions which contributed to the decision made during the 1958 reorganization to open a direct operational channel between the President and Secretary of Defense through the Joint Chiefs to the joint commands. In this regard, Soviet space and intercontinental ballistic missile advancements in 1957-1958 had shocked the Congress and the administration into reappraisals that lifted the lid off military spending. From this point the Air Staff, for the first time since the Korean War, was free financially as well as conceptually to take steps to improve its command post and overall USAF command and control equipment and techniques.

Concept for an Air Force System

Confirmation of the validity as well as the wisdom of the new philosophy of national command and control was not long in coming. Communist-inspired demonstrations against Vice President Richard M. Nixon in Caracas in April 1958 prompted President Eisenhower to dispatch four companies of American troops to the Caribbean area to help the Venezuelan government protect the Nixon party if necessary. The Air Force command post installed communications from the Joint Chiefs' conference room to all service operation centers in the Pentagon and, since only the Air Force had direct land-line contact with military bases in the Caribbean, it generally functioned as the JCS communication central throughout the affair. The Venezuelan episode was

followed by the Lebanon-Taiwan crises of July-September 1958 which uncovered serious defects in America's nonnuclear war preparedness and worldwide communication reliability and security.[10]

Up to this time command post personnel staffed and operated what came to be called the "Joint War Room Annex" for the JCS. After the 1958 emergencies, the Joint Chiefs assumed operational control of the annex. Finally, in August 1959, the JCS established its own Joint War Room (JWR) and, during the next year, acquired the trained staff to operate it. In December 1960, although continuing to provide JWR communications, the Air Force command post formally relinquished its joint and national duties to the JWR and became in fact, as well as name, a strictly USAF agency.[11]

While the Joint Chiefs proceeded in this fashion to lay the foundation for what eventually emerged as a national command and control system, Headquarters USAF unilaterally introduced a three-part project for expanding and modernizing its command post operations to make it the center of an initial Air Force-wide system. The first phase of the project, introduced in late 1957 and subsequently given the code name "Quick Fix," originally called for just a "general renovation of the war room which /had/ assumed an . . . out-of-date and run-down appearance over the years." However, this soon expanded into a full-scale modernization of the facility and its communication and projection equipment. Except for the central emergency telephone console, which stayed in place while construction went on around it, all operations moved to temporary quarters in the Pentagon in late 1959. The communication section reopened in its new quarters the following spring but the war room and staff conference portions of the post were not completed until the fall of 1960. Meanwhile, all sections received additional manning and, on 1 October 1960, assigned "emergency action teams" replaced the general officers who had commanded the post during non-duty hours on a roster basis.[12]

These improvements corrected or ameliorated problems of the type that arose within the command post during the Lebanon-Taiwan crises. That is, the post would

no longer have to suspend its alert operations during formal briefings in the war room. It was better staffed to move large volumes of messages and, at the same time, maintain message files and security accounting. It had modern equipment and the graphic arts support required to keep presentations current. Finally, it was sufficiently staffed "to maintain smooth continuity on an around-the-clock basis."[13] However, these improvements were only a beginning. The two remaining parts of the project called for an automated data handling capability and eventually tieing the command post's operations into the automated systems coming into being in the air defense area and planned for the strategic air forces.

The first formal steps in this direction came after the subject was briefed to an Air Force commanders' conference in July 1958. Soon after, the Air Staff opened an investigation into the problems of passing data between the different makes of computers employed in the 416L and 465L systems.* About the same time it asked both USAF and Joint Staff offices to suggest types of automated operations that might suit the decision-making needs of the Air Force command post and still be "compatible" with the field systems.[14]

By late 1958 some 11 separate proposals from as many different offices had been received. The most promising came from the Air Battle Analysis Division of the Directorate of Plans. Its officers, helped by technical advice from the computer industry, had been working to design what they called a Global Battle Evaluation System (GLOBE) that could accept data from automated systems in the field, store it in a computer, then display on request whatever facts they needed to evaluate total USAF capability to cope with situations anticipated in war plans. In early 1959 command post and planning officers completed and submitted a feasibility study recommending that the "Quick Fix" command post improvement program and the global evaluation project be joined.[15]

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* See Chapter IV.

[redacted]

II. ESTABLISHING THE HEADQUARTERS SYSTEM

(U) Final decision on the so-called QUICK GLOBE command post automation proposal dragged on for many weeks while top USAF officials sought to make certain it would satisfy Joint Staff as well as Air Force needs. Headquarters USAF finally approved the proposal on 17 June 1959 and directed the Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC)* to proceed with a formal, high priority development. AFSC's Electronic Systems Division (ESD) designated it the 473L program, established a system program office (SPO) to guide development, and authenticated the engineering contract work statement prepared by Air Staff and Rome Air Development Center officers.[1]

(U) Meanwhile, a 473L system source selection board met for the first time in early June 1959, appointed a working group to screen possible contractors, and in early July sent copies of the work statement to 21 firms. Nine responded, and on 24 July their representatives met with project officers in the Pentagon to submit bids. Subsequently, an evaluation group of about 60 members from AFSC, AFLC, and the Air Staff met from 17-29 August at the Rome Air Development Center, considered the bids, and recommended that IBM be chosen as the major contractor. The Secretary of the Air Force concurred in October.[2]

([redacted]) In the following months, 473L project officers prepared a careful justification for letting the initial study contract. They emphasized USAF intentions to keep costs down by providing IBM as much "blue suit" assistance as possible. In April 1960 Gen. Thomas D. White, USAF Chief of Staff, endorsed issuance of the contract and OSD approved and funded it soon after.[3] Following completion of contract negotiations with IBM in July, USAF officers met with contractor representatives to prepare

* At this time these organizations were still the Air Research and Development and Air Materiel Commands, respectively. They were redesignated on 1 April 1961.

initial estimates of system and equipment design costs and testing requirements. They also discussed the extent of technical and supervisory support IBM would furnish the Air Force until the latter was able to take over maintaining, operating, and further developing the system.[4] The fruits of their labors appeared on 2 December in an official "specific operational requirement" document (Headquarters USAF SOR 185).[5] As stipulated in this basic statement, the system would improve the receipt, processing, and storing of information that USAF officials needed to control operational resources and enable them and higher authority to make "virtually instantaneous decisions." It would also be sufficiently developed within the USAF emergency deployment post at Ft. Ritchie to insure continuity of operations in case the Pentagon were destroyed.[6]

Special Development Features

[redacted] In January 1961 IBM personnel with the aid of SPO and Air Staff officers began preparing the 473L implementation plan. Completed in late February and approved by the Weapons Board on 22 March, the plan called for 473L to proceed in a manner quite differently from that pursued in the 416L and 465L systems. Unlike these, 473L would acquire an almost immediate capability with currently available computer equipment. Later, through "incremental growth," it would gradually expand to a final configuration based on new, specially developed equipment with no break in operational continuity. Equally distinctive, all phases of 473L's development were to take place in the command post -- the "user's environment" -- and not in a test facility many miles away like the others. This would enable command post, Battle Staff, and Air Staff personnel to actually use the system while it was being built. Hopefully, this in turn would provide system designers valuable "feedback" which they could apply to the development of each following phase.[7]

[redacted] Specifically, the system was to progress in three equipment or "hardware" phases and five programming or "software" expansion steps. The first or Operational

Training Capability (OTC) phase would begin in January 1962 using "off-the-shelf" equipment and take a year to complete. IBM would also complete three of the five programming steps during this time. At their completion, the command post would have a limited automated capability, serve as a "test-bed" for additional system development, and provide a training ground for command post and Air Staff analysts, programmers, and operators. [8]

The second phase of development was to begin in January 1963 and give the command post an Initial Operational Capability (IOC) with the permanent equipment. Concurrently, a model I programming phase would be completed and then placed in use with the permanent equipment during the next year. By January 1964 all of the new equipment would be installed and operating and the final or model II programming phase could begin. This Complete Operational Capability (COC) phase would be finished by the beginning of 1965 at which time the command post would assume full operation and support of the system. * [9]

Extending the Completion Dates

The Air Force sent the implementation plan to OSD just as the newly installed Kennedy administration began an extensive overhaul of national military command and control projects and planning. + Under the circumstances, 473L received a very favorable reception. On 25 May 1961 Secretary of Defense Robert S. McNamara approved the plan to the extent of releasing funds for initiating the temporary system. At the same time, he directed that the overall schedule be stretched out a year to ease funding pressures and place greater emphasis on the incremental growth and blue suit features of the plan. In forwarding these instructions to the Air Staff, Dr. Joseph V.

* (U) For ease of expression, the OTC phase is subsequently referred to as the first or temporary phase (or temporary operational system), IOC as the second phase or first step of the permanent or development system, and COC as the final phase.

+ See Chapter IV.

Charyk, Under Secretary of the Air Force, noted that emphasis now would "definitely" be placed on personnel training and providing feedback in the first phase. The second phase would "provide minimum equipment to perform all the functions expected of the final system but at reduced volume and reliability." The final phase would then add the balance of equipment and programming.[10]

Headquarters USAF announced the new schedule on 1 September 1961 and instructed AFSC to begin preparing a 473L system program package. The new time schedule called for the first phase to begin in October 1961 and continue through November 1963. The second would begin in July 1963 and thus provide a five-month overlap to prevent loss of operational capability during the changeover from temporary to permanent equipment. The final phase would start in January 1965 and be completed by the beginning of 1966.* [11]

After receiving the Air Force's request for funds to begin development of permanent equipment in accordance with the above timetable, Secretary McNamara asked the Joint Chiefs to review the program for a last time from the point of view of need. Assured that it would indeed contribute "in a major way" to both Air Force and overall national military strategic requirements, he approved the plan on 20 November 1961 and, early the next month, released funds for initiating equipment development.[12]

The Capabilities Concept

The process of translating the December 1960 473L requirement statement into lucid, logical programming guidance was completed in major outline during 1961. The first product of this awesomely complex job, called the "complete operational concept," enunciated the broad purpose of the system. Briefly summarized, it

* (U) Soon after, the beginning date of the final phase was moved up to March 1965 to coincide with the scheduled completion of final programming testing.

prescribed that 473L would be plans-oriented and serve the command post and Battle Staff round-the-clock during both normal and emergency conditions. In normal times it would provide sufficient current information on emergency plans and combat resources to enable the Battle Staff, through exercises and routine manipulation of the data base, to continually assess and thus promptly identify any potential or actual weaknesses in Air Force preparedness. In emergencies it would enable the Battle Staff to advise the Chief of Staff on the most effective application of air power in support of JCS objectives, answer specific JCS questions, and carry out the Chief of Staff's unilateral obligations to his field commanders.[13]

[redacted] Through the arcane techniques of "model analysis," system designers next converted the general ideas expressed above into specific functional concepts. From this, they concluded that 473L should perform the following six major tasks: (1) monitor the worldwide situation, (2) monitor Air Force resources, (3) evaluate plans, (4) generate and modify plans, (5) alert forces and execute emergency orders, and (6) monitor air operations. To perform its "situation monitoring" task, 473L had to remain constantly alert to the following type of specific incidents that might necessitate Air Force response: civil uprisings (revolutions, coups), natural disasters (earthquakes, floods), military aggressiveness (weapon buildups, border encroachments), and war threats (guerrilla attacks, missile flauntings). In "resource monitoring," it had to assess the status of resources critical to Air Force operations.* "Plan evaluation" required the system to assess the ability of an emergency plan to cover a situation and appraise the effect its implementation might have on resources committed to the support of other key plans. "Plan generation and modification" involved the manipulating of the data base and the writing or rewriting of plans to assign, distribute, and schedule resources to cope with unplanned for or only partially planned for

* (U) Resources included the following: forces, materiel, medical units, personnel, communication and electronic equipment, and airfields.

emergencies. Finally, "operations monitoring" required 473L to stand watch over air operations from beginning to end during which time the Battle Staff would employ it to (1) judge whether operations were proceeding as planned, (2) assess the extent and significance of any deviation from the plan, and (3) notify the Chief of Staff immediately when the plan no longer appeared adequate for the situation.[14]

[redacted] Since the above "tasks" were abstractions and not amenable to direct translation into automated form, designers recast them in terms of "capabilities." A capability was defined as a collection of interrelated programs that could provide system operators with answers to prescribed sets of questions when the operators requested them. After lengthy and intensive study, which included examining questions that had occurred most frequently in Air Staff emergency planning and during actual emergency situations, designers established four basic categories of capabilities.[15]

[redacted] One category, frequently referred to as the "executive" program and described by one officer as the "heart of the computer operation," enabled operators to "monitor" the system -- that is, to maintain the data base, exercise the system, and record system activities.[16] The very important "query language" capability, which gave operators a flexible means for retrieving, manipulating, and formating data, was included in this category.[17]

[redacted] A second category of capabilities enabled operators to generate, modify, and evaluate plans. A third contained computational capabilities that employed prestored factors and coefficients to answer such specific questions as what routes to fly, how aircraft would perform over the routes, what refueling procedures were best, and what deployment schedules were necessary. A final category supported the monitoring tasks. In addition to keeping constant check on the status of resources, plans, and operations, it monitored resource changes, reassessed the applicability of plans within the constantly changing worldwide picture, and assessed the impact such

incidents as late flight arrivals, aborts, and plan deviations would have on current operations.[18]

(U) In actual application, capabilities would work as follows. In a situation where an insurrection in a pro-Western country threatened to result in a "hostile" government, the "plan data retrieval" capability would search the files for emergency plans appropriate to it. Employing the "query language" or "overlay" capabilities, operators would enter "descriptors" (type of operation, location of crisis, etc.) indicating the required action to be taken and 473L would produce a "readout" of titles and other identification of those plans that qualified. From this readout, textual abstracts of plans that qualified would be retrieved and reviewed for applicability. After a plan was selected, the "overall plan evaluation" capability would compare the resources committed to the support of the plan against the requirements of the situation and the needs of other emergency plans. If the Battle Staff felt that the resources were inadequate or that their commitment seriously affected Air Force readiness in other critical areas, it would call for Air Staff assistance. These offices, in turn, employing the force, plan, materiel, personnel, and communication and electronic "modification/evaluation" capabilities would suggest ways for reallocating resources to meet all conceivable contingencies. Thus plans would be brought to readiness and, through the "resource status data retrieval" capability, kept in readiness throughout the developing crisis. In no appropriate plan existed, the Battle Staff would be able to construct one using the applicable capabilities from within the various system categories.[19]

(U) Actual program production began at the point the Air Staff approved the operational specification for a capability. IBM programmers then completed program design, coding, and debugging." When all the programs essential to the capability were integrated in the computer, they underwent a first or integration test in which IBM demonstrated to the SPO that the capability performed as the operational specification

prescribed. They then underwent a second or verification test in which IBM demonstrated to the command post staff that it performed according to the specification. When all discrepancies that cropped up in the tests were corrected and satisfactorily retested, the Air Force formally accepted the capability and assumed responsibility for its maintenance and further development.[20]

Selection of Permanent Equipment

[redacted] Employing the funds released in December 1961, the Air Staff completed arrangements during the next few months for 473L permanent equipment development and delivery. By June 1962 it had engaged the Librascope Group of General Precision, Inc., to build three central data processors. Two of these L-3055 computers were scheduled for installation in the Pentagon command post and the other at Ft. Ritchie.* Later that year the International Telephone and Telegraph Co. (IT&T) was awarded a contract to manufacture integrated consoles for "user" communication with the computers. Eventually the headquarters considered ordering 13 of the consoles for installation in the two posts and in "remoted" Air Staff positions on other floors of the Pentagon. The last major provision of this original hardware planning called for the development and purchase of eight, computer-driven multi-color large panel displays. These would facilitate presentations to large audiences during exercises or emergency situations.[21]

* (U) AFSC designated 473L permanent equipment as the AN/FYQ-11 system. For ease of expression, it will be referred to as the L-3055 permanent or development equipment.

III. BUILDING THE HEADQUARTERS SYSTEM

(U) Implementation of the first or temporary phase of 473L began on schedule during the week of 13 November 1961 when IBM installed a leased IBM 1401 computer in the command post. The same month the Air Force arranged for the Thompson-Ramo-Wooldridge Company to rehabilitate two computer communication consoles for temporary use in the system.[1] These, with a display interface buffer, served as the major devices through which operators performed special manipulations of the data base.* By mid 1962 the computer and consoles and other interim equipment were operational, and the first of the three program "packages" scheduled for development during the temporary phase had been loaded into the computer.+[2]

Loading the Temporary Capabilities

([redacted]) IBM now set out with this off-the-shelf gear to build an initial software system which could serve as a small model of the total system design.[3] As one officer later summarized this first stage of the project, IBM started with a few capabilities built around a simple retrieval system that drew forth

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* (U) The display interface buffer served as the communication link between the two consoles and the computer. It possessed its own core storage, primarily used as buffering (i. e., intermediary storage between elements with different access time or format), and the logic for controlling the operation and transmission of information. Each console possessed a seven-inch square cathode ray tube display that could carry characters in any or all of 36 horizontal and 20 vertical positions for a total of 720 readable positions. The system also included a console inquiry station (typing 80 characters per line at 7. 5 lines per minute under computer control) and a high speed printer (132 characters per line at 600 lines per minute). A final major item of equipment was the card read-punch for entering routine data into the computer.

+ (U) IBM's Federal Systems Division served as prime contractor for system analysis, electronic data processing, and system integration. Dunlap and Associates, Inc., and Technical Operations, Inc., were the principal subcontractors for system analysis and programming.

simple status information. Once this was operating, IBM "developed and added more dynamic capabilities," including support capabilities such as logistics and war reserve materiel.[4]

(U) Final testing of the first package began in July 1962, was adjudged operational by the end of the year, and included data in the following categories: force status, aircraft and missile characteristics, airfield facilities, defense condition (DEFCON) actions, plan digests, flight following, airlift capability estimator (ACE-A), emergency action message file, and great circle distance calculations. Most of these items were in the computer when the Cuban crisis occurred in the fall of 1962 and command post outputs, employing the data, proved helpful to Joint Staff, Department of Defense, and State Department as well as Air Staff officers engaged in acquiring and deploying forces to meet that emergency.[5]

(U) In keeping with the "incremental growth" concept, work on the two follow-on software packages of the temporary system began while the first was being loaded into the computer. IBM programmed the second package by the end of 1962, integrated it into the system in following months, and completed it in April 1963. This provided the following capabilities: plan selection, static plan interaction, force readiness and force availability, exercise monitoring, H-Hour updating and deploying monitoring, and airlift capability estimator -- Package B (ACE-B).[6]

(U) IBM began analysis of the third and last package of the temporary system in late 1962 and completed the study early the next year. In preparation for the increased capability, IBM added a second random access disk file to the computer, doubling its storage from 20 to 40 million characters. Later in the year, IBM also added improved tape drives. Meanwhile, IBM installed another 1401 computer system in its nearby Federal Systems Division offices to help with debugging and checkout of the software package. This freed the command post computer for more

operational use. In September 1963 the Air Force accepted final contractor documents for the temporary phase and IBM began final testing.[7]

Expanding Air Staff Proficiency

[redacted] Original 473L planning called for the eventual assignment of about 150 additional military personnel to the command post to operate and maintain the computer complex.[8] The post's Systems Division, originally established as a small section in early 1960, assumed primary responsibility for acquiring and expanding this in-house proficiency.

(U) The first 473L authorization for manpower increase came in October 1961 after Secretary McNamara released initial funds for permanent equipment. Authorizations and actual assignments proceeded slowly from this point until the latter half of 1963 when enough analysts and programmers were on hand for the Systems Division to feel it had finally achieved the "first step toward implementation of the concept of incremental system development." Additional personnel were on hand by June 1964 for the division to conclude that it was now able to participate fully with IBM in all aspects of 473L development.[9]

[redacted] As it grew and gained in proficiency, the division concentrated on establishing firm personnel goals and policies. One important question concerned the extent of the command post's responsibilities once IBM completed its contract and handed the system over to the Air Force. A carefully designed advantage of 473L was its ability to expand and adjust to meet changing USAF needs in future years. However, since the capabilities planned for the final development phase would not satisfy all existing requirements, a question arose over who would perform these future analysis and programming tasks.[10] The division concluded that, for reasons of both cost and operational necessity, the Air Staff had to plan to take them over without further contractor help. On the basis of its early work with the system, the Systems Division also

confirmed its previous conviction that blue suit analysts and programmers had to be functional experts before they could truly aspire to become expert automated command and control specialists. Where officers assigned to these duties had a solid understanding of the function involved (operations, personnel, logistics, etc.), they soon emerged confident and valuable members of the development team. Others with perhaps greater computer skill at the start but less functional experience found their tasks more difficult.[11]

(U) In this connection, the Systems Division became a prime mover for creating attractive career fields in the new area. In mid-1964 the Air Force established special prefixes in the appropriate specialty code for system analysts and program designers. The Air Training Command (ATC) then proposed a workshop for representatives from all USAF agencies that employed or planned to employ these specialties to achieve a clearer definition of the skills and establish better training programs. As finally worked out, the workshop met at Headquarters USAF the following spring, discussed requirements in all automation career fields, both officer and airmen, and thus laid an important cornerstone for improving and expanding training in this area.[12]

(U) In contrast with the 416L and 465L systems, which were operations -rather than plans- oriented, the Headquarters USAF system demanded broad participation from the Air Staff. That is, as one officer expressed it, 473L "could not function remotely from the staff officer."[13] Consequently, after the command post acquired an initial cadre of computer specialists, it promptly instituted a number of measures, including a broad program of instruction, to increase use of the system throughout the Air Staff.

(C) Basically, the command post sought to develop two broad categories of skills within the Air Staff -- operators and users. "Operators" included officers and airmen trained in data base and console operations and assigned to either the command post staff or Battle Staff. Some were mission oriented -- concerned with final results

and displays and outputs. Others were technically oriented -- proficient in data entry and system maintenance. "Users" functioned at the policy or mission support levels. They included senior officers on, or qualified for, the Battle Staff who used computer data to solve or recommend action on operational problems. Among mission support users were command post and Air Staff officers who understood and could call for (or actually retrieve, if they were also qualified as operators) plan annex and other data from the system. In addition, users (1) helped decide general system policy, (2) validated and prepared inputs, and (3) approved outputs and applied them to tasks.[14]

(U) One of the earliest moves to insure coordination and joint participation of users and operators in capabilities production occurred in July 1963 with the creation of a Headquarters USAF 473L "users group." Composed of officers from across the Air Staff, the group reviewed current and projected automation needs proposed by users or IBM and, generally, served as a sort of board of directors for these matters.[15]

(U) Logistic and personnel expertise gradually came to be centered in special readiness centers established outside the command post. The first such unit, the Logistics Readiness Center (LRC), went into operation on 17 October 1962 to serve as a round-the-clock focal point for USAF logistic actions during the Cuban crisis.[16] The Personnel Readiness Center (PRC), which came into being five days later, performed the same duties for manpower needs.[17] Both proved so valuable that they were retained after the crisis primarily to develop into data information centers for their respective Air Staff chiefs. To afford direct access to the 473L personnel and logistic files, which they helped to design, steps were taken to provide them remoted consoles. So equipped, the centers directly query the files despite the fact that they were physically located in other Pentagon areas.

(U) Analysts and programmers assigned to the command post attended IBM 1401 courses where they acquired preliminary instruction and proficiency in the development of capabilities within their assigned functional areas. In turn, during the latter

half of 1963 they instituted an in-house training course consisting initially of 14 one-hour lectures and demonstrations of temporary system operations. While no potential Air Staff users were denied entrance, the course was specifically designed to acquaint officers of the Battle Staff and the two readiness centers with the capabilities and limitations of the system. It became the primary users training course; about 130 officers completed it in 1963 and more than 400 in 1964. In August of 1964 the command post broadened this instruction by offering Battle Staff officers daily in-house exercise training with the temporary system. By this time, too, the post had instituted, and a sizeable group of officers and airmen completed, a general course in computer console operation and special ones in query language and data control.[18]

(U) A final broad area of 473L general instruction sought to educate officers not directly involved in development or operation in its methods, current abilities, and future goals. In 1964 the Systems Division instituted a briefing and demonstration program which achieved widespread popularity. During the latter half of that year, for example, the division gave 73 briefings to high-ranking military and government officials, chiefs of foreign armed services, business executives, military cadets, and reserve officer association officials. IBM had contributed greatly to this effort by setting up in 1963 a 473L "executive seminar" for general and top field grade officers at Poughkeepsie, N. Y. Finally, the Navy-managed Department of Defense Computer Institute (DODCI) in Washington also allocated generous time to the 473L system in its computer orientation courses for top defense department officials.* [19]

* (U) The Air Staff nonconcurred in the proposal to create DODCI when it first was made in 1963, feeling that the Air Force could handle instruction in-house. However, onece higher authority directed its establishment the Air Force provided the bulk of the know-how and support to get it started. By 1966, one command post officer noted, the Air Force considered the institute "the best formal thing we have seen so far...." DODCI provided a one-week course for general officers, a two-week course for middle management personnel, and a six-week course for operators. The courses included both lectures and actual computer operation.

Delay and Revision of the Development System

(U) All had not gone smoothly, however, in the development of the permanent system. Original 473L schedules began to slip during the latter half of 1962 when the SPO informed the Air Staff that unforeseen technical problems had delayed performance and reliability testing of the L-3055 computers. As a result, IBM adjusted its delivery schedule from mid-1963 to the spring of 1964 then to the fall of that year.[20]

(U) Also, in 1963, planned funding for 473L was reduced as a result of a general reappraisal of L-system costs designed to free funds vitally needed elsewhere. The Support Systems Panel of the Air Staff Board issued the initial recommendation to this effect in August. The Program Review Committee concurred in October after deciding that the reduction would not impair the basic 473L purpose.[21]

(S-[redacted]) The reappraisal confirmed the original requirement for three L-3055 computers -- two in the Pentagon post and one at Ft. Ritchie -- but felt that some of the other major equipments could be eliminated. The biggest reduction applied to the large, computer-driven displays. The reviewers decided that the developers had not produced a suitable one to date, only one of the eight originally scheduled ought to be procured, and this for experimental purposes only. While some loss of system performance might result, this step seemed prudent since their worth had not yet been clearly demonstrated. A second major reduction involved four of 13 planned consoles. Since they were to have been remoted to Air Staff offices in upper floors of the Pentagon, their reduction saved the cost of installing secure cabling as well. Of the nine remaining consoles, five were for the command post, two for Ft. Ritchie, and one, each, for the LRC and PRC. To save remoting costs on the LRC and PRC consoles, the Air Force decided to remodel the command post area and locate the readiness centers adjacent to it.* [22] Gen. Curtis E. LeMay, USAF Chief of Staff, approved

* (U) The reduction also deleted a closed circuit TV project.

these proposals on 13 November 1963, in effect reducing hardware costs from $12 to $7.4 million.[23]

In-House Expansion of the Operational System

(U) The delay in production and delivery of the permanent computers meant that the temporary system had to remain in operation much longer than originally planned. It also meant that the limits of the IBM 1401 computer would be reached before the L-3055 became operational. To resolve this problem the developers in October 1963 elected to replace the 1401 with a higher speed, greater capacity machine that would enable them to expand operation of the temporary system beyond its original specification. The only equipment that fit this bill was the IBM 1410 since it could operate a mixture of 1401 and 1410 instructions.[24]

(U) Accordingly, in February 1964 command post and IBM technicians installed a leased 1410 with one disk and, after retrieval tests were run on both machines to verify the efficacy of the change, phased out the 1401. The changeover was completed in April.[25]

(U) To take full advantage of the new computer, the Systems Division launched Project OUR (OTC Update and Revision) which, essentially, entailed a rewriting or recoding of 1401 "executive" programs into 1410 language.[26]

[redacted] Meanwhile, command post and Air Staff analysts and programmers proceeded with the unanticipated job of expanding the temporary software system in-house to compensate as much as possible for the delayed delivery of the L-3055 computers. By late 1963 they had completed, or were completing, development of a transport airlift estimator capability (TREST), a highly classified program for use in the national military command center, and a program for retrieving selected logistic data. Also, since no personnel data was originally planned for the temporary system but, obviously, was an essential item if the system now were to satisfy Air Staff needs

for an indeterminate period, they instituted action to include personnel annexes of selected war plans to be retrieved by the temporary system's "plan data retrieval" capability. They also undertook the development of a tape-oriented, structured file to permit retrieval of personnel authorizations by selected critical specialty code number, base of assignment, and geographical area. Eventually, console operators were able to "access" this personnel data (in support of plan feasibility and interaction checks) through the use of yet another capability developed in-house known as QUEST.*[27]

(U) Other major in-house developments introduced in late 1963 or 1964 included establishment of a plans abstract section in the command post and the initiation of a special air activities capability for Southeast Asia. The new section, formed in January 1964, had the primary duty of abstracting current operations plans and loading them into the temporary data base. By the end of that year, it had abstracted 178 plans and, of these, placed 145 on the disk file and the rest on punch cards available for loading.

(U) Work on the special air activities capability for Southeast Asia began in June 1964 after the 473L users group had approved the requirement. After command post analysts visited Headquarters, Pacific Air Forces to determine the type of information that should be developed, they prepared and published the operational capability description. By the end of the year, the Special Air Warfare Division, scheduled to be the primary user of the capability, made final determination of the specific data to be reported. The preliminary operational specification was then drawn up with a forecasted "capability completion date" of mid-1965.[28] This initial effort to improve Southeast Asia combat reporting was the beginning of what soon became the biggest in-house software expansion task in the command post.

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* (U) QUEST was a flexible retrieval capability that could search tape files containing fixed format records. It became the primary means of retrieving (1) personnel annexes of plans, (2) personnel planning factors, (3) statistics on assigned military and U.S. civilian personnel by operating locations, state and country, and (4) statistics on the same by unit and location.

IV. ESTABLISHING THE AIR FORCE SYSTEM

(U) From the time it initiated 473L until the fall of 1962 the Air Force assumed that its three automated systems -- 416L, 465L, and 473L -- would eventually link up, at least to the extent where they would be able to exchange data needed by top-level USAF and national decision makers.* Actual investigation of the technological problems involved began in mid-1959 when the Support Systems Panel of the Weapons Board assigned a working group to explore the possibility of "integrating all electronic data processing weapon and support systems involved in command and control." On the basis of the group's preliminary effort, the Air Staff issued a draft document to the field commands for comment which validated the requirement for "an integrated Air Force resource management capability" and authorized the Air Force Systems Command to "insure the technical compatability of systems."[1]

In February 1960 the Weapons Board asked the Directorate of Plans to prepare "a brief statement of concept for the development, employment and integration of all Air Force L-systems into a command and control evaluation system." As that office viewed the problem, USAF decision-making had to keep pace with the growing threat, and automated command and control processes offered the only means for accomplishing it. The systems being built for air defense and strategic warfare were steps in the right direction, but "the full potential of automated data processing in the execution of aerospace functions [could] be realized only when these systems [were] combined with and became a part of an overall Air Force System." To achieve this, existing or planned equipment had to be retained and employed to the utmost, priorities currently

* (U) A fourth automated program, 425L, had come into existence by this time. It sought to correct 416L's inability to provide an automated facility for the top echelon of the air defenses in Colorado Springs. However, the many uncertainties connected with the project at this time complicated rather than helped to clarify overall planning.

existing for them had to be honored, and all new facilities constructed had to be sufficiently flexible to "provide. . . extension and augmentation, vertically or laterally, in order that the Joint Chiefs of Staff [could] make maxium use of this system in the performance of its functions." [2]

The Weapons Board after reviewing this development concept decided it was "too broad, general, and vague" to form a basis for action. The board approved the statement, however, with the understanding that more detailed guidance would be provided at an early date. Accordingly, General LeMay authorized its issuance as an Air Force Objectives Series paper on 30 March 1960. The following month, the Directorate of Operational Requirements, in compliance with the Weapons Board instruction, prepared a more detailed, but still tentative, blueprint for USAF command and control development for 1960-1970. [3]

Impact of the Worldwide Plan

(U) During the course of the above activity the major reorganization of the defense department authorized by Congress in 1958 had begun to take shape. It led to the strengthening of the offices of the JCS and the Secretary of Defense, which shortly turned their attention to a study of military command and control requirements from a national perspective. By the time Secretary McNamara took office in 1961, all were agreed that current systems fell dangerously short of meeting the needs of the nation's top leaders. From this point until the fall of 1962 OSD gave priority to working out a plan for correcting the situation. The Air Force suspended efforts to develop its own long-range plan for an integrated system pending further guidance. This came in October 1962 with the issuance of Department of Defense Directive S-5100. 30.

This directive provided the long-overdue concept for a worldwide military command and control system. Under it the Joint Chiefs received authority and the promise of sufficient funds to (1) create and operate an automated national command

and control center in the Pentagon and establish emergency alternates, (2) strengthen the command and control facilities and authority of unified commanders, and (3) integrate all of the nation's command and control resources into a single, survivable, and flexible system that could be used by the National Command Authorities (the President, Secretary of Defense, and Joint Chiefs).* [4]

[redacted] The new guidance, as Maj. Gen. John K. Hester, Assistant Vice Chief of Staff, explained in June 1963, designated 473L as the "Air Force service headquarters subsystem" of the national system. Henceforth, USAF major command "subsystems" would be configured to support the 473L mission of "providing information on Air Force resources to the national system." Also, as a Directorate of Operations concept statement issued later in the year noted, all USAF systems in the future would support the Chief of Staff and his commanders in the management of the Air Force's resources under both normal and emergency conditions. [5]

(U) One of the significant effects of the worldwide plan was that the Air Force could no longer proceed to integrate the three automated USAF systems. While the Air Force would continue to develop and support 416L and 465L, they now belonged entirely to the unified commanders and would link with the national military command center, not the USAF command post. On the other hand, while the worldwide plan did not authorize the Air Force to build an integrated system, it was obvious that 473L could not operate in a vacuum. Something would have to take the place of the support that the Air Force had expected the 416L and 465L systems to provide the command post. The problem was to determine what this might be and would OSD, faced with the vast expense of building the newly approved national facilities, sanction it.

* For detailed accounts of these developments and Air Force participation and contributions, see: Arthur K. Marmor, USAF Command and Control Problems, 1958-1961 (AFCHO, Jan 1963), and Thomas A. Sturm, The Air Force and the Worldwide Military Command and Control System, 1961-1965 (AFCHO, Aug 1966).

Automating Major Command Headquarters Systems

(U) The answer emerged from an effort introduced in late 1962 to "export" 473L equipment and programs to TAC and Military Airlift Command (MAC)* headquarters command posts. Encouraged by the worldwide planning during 1962 to automate their posts, both headquarters proposed systems similar to the temporary 473L system. OSD approved and, by the close of 1963, both had leased and were operating IBM 1401 systems employing capabilities furnished by the USAF command post.[6]

([redacted]) In both commands the shortage of knowledgeable and trained personnel was a major problem. However, through in-house training at Headquarters USAF and at the commands, the shortages eventually eased. Adapting 473L capabilities to specific command needs posed another problem. Three months after installation of the TAC system in April 1963, it became apparent that modifications and extensions to 473L programs were necessary to align the system more closely with the command's unique and more detailed requirements. Eventually, practically all of the original 473L capabilities were slightly or totally modified to make them useful to the TAC staff.[7] At MAC, where the system was installed in December 1963, the USAF command post worked with project officers to adapt the 473L data base to meet that command's requirements.[8]

([redacted]) The TAC and MAC installations went sufficiently well from the outset to convince Air Staff planners that this was the cheapest and quickest way to automate major command headquarters posts. As Lt. Gen. David A. Burchinal, Deputy Chief of Staff, Plans and Operations, explained in late 1963 to Gen. John P. McConnell, then Deputy Commander-in-Chief, U.S. European Command, who was investigating means for automating that command's operations, the application of 473L equipment, programs,

* (U) Known as the Military Air Transport Service (MATS) until 1 January 1966.

and knowledge to TAC and MAC requirements had enabled both commands to obtain an automated operation at least two years earlier than otherwise possible.[9]

Approval of the Standard Air Force System

(U) In October 1964 the Air Force command post formed a small working group to pick up the effort begun in early 1960 (and postponed during the planning for the worldwide system) to draw up detailed guidance for Air Force command and control development. Applying the guidelines furnished in the worldwide plan and the experience gained from the TAC and MAC installations, the group recommended that the Air Force build a standard command and control system that could employ capabilities and documentation currently being prepared for the final phase of 473L development. All commands would have a hand in formulating the standard system to insure that it met their individual needs.

(U) Pending completion and funding of plans for this operation, the group proposed that the Air Force immediately begin to build an interim system consisting initially of four automated major command headquarters' posts linked to the USAF command post. TAC and MAC would replace their 1401 computer systems with 1410's, and the United States Air Forces in Europe (USAFE) and ADC would automate their posts for the first time employing 1410's. All would use revised 473L programs and documentation to build an initial system. The interim operation, the group noted, would satisfy immediate, overall operational needs and provide experience from which the commands could describe and determine their future requirements.[10]

(U) In early 1965, three Air Staff directorates (Operations, Data Automation, and Command Control and Communications), with the help of command representatives, jointly developed an initial "standard" system concept. Headquarters USAF submitted this concept to OSD to support a funding request for the lease and installing of 1410 equipment in the four field headquarters posts. In his approval of 17 May, Mr. Paul

R. Ignatius, Assistant Secretary of Defense for Installations and Logistics, authorized sole-source acquisition of IBM 1410 systems to establish an initial automated data processing, storage, retrieval, and display capability at ADC and USAFE headquarters and to expand the TAC and MAC systems to a point where they could accommodate "all the integral segments of the operational training capability portion of the 473L system." He also authorized replacing interim equipment with improved, competitively selected equipment within three years.[11]

(U) This authorization enabled the Air Force, for the first time, to visualize how its separate headquarters' operations might be formed into a significant and cohesive capability in the worldwide military command and control system environment.[12] It also ended isolated development of systems, identified areas for hardware and software standardization, and provided an immediate capability and an experience base from which to build.[13]

V. DECISION ON THE HEADQUARTERS SYSTEM

As mentioned earlier, the Air Force command post timetable for acquiring the permanent system using the L-3055 computer began to slip in late 1962 when Librascope ran into technical problems and had to postpone delivery. However, even if the L-3055's had been delivered on time (the first one was to have been installed by July 1963), the command post would have been hard pressed for a place to put them. In December 1961 OSD had approved a USAF fiscal year 1963 construction request which included $490,000 for adding a large room to the command post to house the new equipment. Although Congress authorized construction, it did not allocate funds in the 1963 appropriations. In December 1962 Deputy Secretary of Defense Roswell L. Gilpatric, pointing out the urgency for beginning the project, won the support of Congressman Harry R. Shepphard, chairman of the House appropriations subcommittee, and funds were subsequently provided. Accordingly, the Air Force began construction in the spring of 1963 and completed the facility in December. The final cost came to $431,000.

(U) Meanwhile, in mid-1963 IBM began indoctrinating a small number of Systems Division analysts and programmers on the characteristics and potentialities of the permanent system. In early 1964, the division established an in-house L-3055 computer course for newly-assigned officers. In June of that year Librascope, under ATC contract, began to train command post L-3055 operators and programmers and support communication specialists. By this time, too, some Systems Division programmers had begun to work directly under IBM supervision on all aspects of L-3055 software development. This helped to cut time and costs and provided the officers with experience they could not have acquired elsewhere.[2]

(U) Work on L-3055 software documentation began with the model I capability plan which IBM published in final form in November 1963. Completion of the plan

came after several months of study during which the users group, Systems Division, and other concerned Air Staff offices reviewed IBM working papers, suggested changes, and finally concurred on a final version. By mid-1964, operational specifications for model I executive control capabilities had undergone similar scrutiny, been documented, and IBM had begun the programming task. Meanwhile, IBM and the Air Staff had agreed on the final version of the model II capability plan which the firm then published in May 1964.[3]

(U) Under terms of the two plans, model I software for the most part would seek to add a greater flexibility to capabilities of the temporary 473L system. For example, the temporary "deployment monitoring" capability, which enable the command post to keep track of tactical and transport aircraft movements, was able to accept only positive reports of events as inputs. The lengthy processing time involved often resulted in such output delay that the command post, during exercises in which it participated, frequently had to revert to manual reporting to keep current. Model I programs were designed to add "positive reporting by exception" to this and other capabilities. Basically, this meant that the system would recognize from data being fed continuously into it whether all was going according to plan. If so, it merely updated its memory, as necessary. When there were variances or exceptions, it so notified the user.[4]

[redacted] The model II plan would add even greater flexibility -- that is, extend or modify model I capabilities to enable the Battle Staff to deal with a broader spectrum of emergency situations.* It would also provide the command post L-3055's and the one at Ft. Ritchie the ability to interchange data. Finally, it would insert personnel, medical, and communication capabilities for the first time.+5

*(U) The following model I capabilities were to be extended in model II: shortage detection; ACE-Transport (aircraft performance); plan abstracts; and materiel plan modification and evaluation.

+(U) As noted earlier, the Air Staff found it necessary to depart from this original personnel software development schedule.

(U) Beginning in 1964, Air Staff offices devoted an ever-increasing amount of time to L-3055 software development. For example, the automation task group of the office of the Deputy Chief of Staff, Systems and Logistics, helped redesign and improve logistic reports to fit 473L needs. Users previously had to rely on three separate reports of varied frequency and format to get a complete picture of the status of war readiness materiel. Also steps were taken to increase the temporary 473L data base, which contained 100 items of war consumables arranged into six groups: munitions, POL, chaff, tanks, pylons, and miscellaneous (lox, racks, etc.). Completion of model I software would expand this to 134 items and insert two new groups: "missiles maintenance production/compression (AMREP)" and "new aircraft/missiles production." Model II would further expand the war consumables data base to about 200 items, identify some 1,200 "absolutely essential" combat mission items and insert narrative summaries of housekeeping capability.[6]

Acquiring the Permanent Equipment

(U) In May 1964 Librascope started testing the first of the L-3055 computers at the factory but had to stop to correct component weaknesses and design deficiencies. Testing resumed in mid-June. In August a Librascope installation team came to the command post and, on 15 September, completed the electrical ducting and other preparations for installing the equipment. The first computer system arrived two days later and installation and checkout began the 19th.* The SPO formally accepted it for the Air Force on 14 October.[7]

* (U) The system consisted of the central processing unit (computer), core memories (Librascope and Indiana General), three magnetic tape units, card punch unit, high speed printer, and a test model of the operator console. The mass memory unit stayed with Librascope for further checkout until 23 September when it was rushed to the command post by Air National Guard C-97 aircraft.

(U) The second L-3055 arrived soon after and all system components were on hand and installed in November. However, noise and timing problems in the magnetic tape units required Librascope to perform additional engineering and delayed Air Force acceptance until late March 1965.[8]

([redacted]) The third computer system remained at the factory pending completion of the Ft. Ritchie installation. Bids for this work were advertised in August 1964, and when the low bid exceeded approval authority the Air Force was forced to submit a request for the extra money. However, OSD rejected the increase and directed the Air Force to restudy the requirement and submit an alternative location.[9] The Air Staff considered the Air University, which had been designated a secondary emergency post, but Maj. Gen. Reginald J. Clizbe, Director of Operations, and his command post staff held to the view that Ft. Ritchie was the only appropriate place for it. Consequently, in April the Air Force submitted a reclama for the Ft. Ritchie site but OSD, in June, reaffirmed its earlier position. Pending an Air Staff decision on where the third system might be emplaced, it stayed at the factory and was used for development of diagnostic programs and updating memory disks.[10]

(U) In addition to the above problems, the first integrated consoles that were procured were "test models" which failed to perform according to specifications. By late 1963 so many problems had arisen with this equipment that AFSC began to consider default action against IT&T, the contractor. When, in February 1964, the contractor requested several waivers to the procurement specification which officials felt would degrade display quality to an unacceptable point, top Air Force procurement officers met with the president of IT&T to review the matter. As a result of this and subsequent discussions, the Air Force and contractor agreed on new specifications. After this, the latter was able to satisfactorily fulfill the contract. IT&T delivered the first console by July 1965, and five others were installed by the end of the year. The seventh and last arrived in March 1966.[11]

(U) The last major hardware item outstanding was the large panel display. The operational requirement for it was defined in early 1964 and, after the Air Force published the final specification in July, prospective bidders were briefed and proposals were submitted. The contract was awarded to IT&T in May 1965. The contractor was to deliver a panel in the summer of 1966 which would display information in both black and white and color.[12]

Loading the Permanent Capabilities

(U) Following the installation of the L-3055 computers, command post activity began to shift from development to actual operation and maintenance of the permanent data base. To provide additional training to the USAF personnel who wound have to accept, test, and operate the initial permanent capabilities, IBM established an eight-week course at Ft. Myer, Va., in July 1965 that combined classroom study with practice retrievals on the L-3055. However, for reasons discussed below, the computers became so tied up that officers in the first group to take the course in 1965 received very little actual practice.* A second group which attended during the first quarter of 1966 was more successful, its members emerging as a knowledgeable core of operators. Also, the Air Training Command in 1965, at the request of the command post instituted a complementary course in L-3055 programming for Air Staff users.+[13]

(U) Unfortunately, serious delays in achieving an operational system soon developed. In December 1964, IBM estimated that it would be able to complete development, loading, and testing model I capabilities by late February 1965. Early in 1965 IBM slipped this date to late May. By mid-year it had further postponed the date to 15

* (U) First called the "test cadre" course, it became known as the Model I Capability Indoctrination Course in 1966.

+ (U) This 12-week course started at Bolling AFB but shifted to Ft. Myer in 1966.

August. Finally, despite the fact that the contractor began working multiple shifts, seven days a week, in the fall of 1965, the date continued to slip into the spring of 1966.[14] A Joint Air Force-IBM investigation of this continued slippage concluded that it stemmed primarily from a combination of "poor management, overoptimistic estimates of capability test dates... and some bad luck." Crowded conditions in the command post plus some data control operator errors also contributed to the difficulties.* [15]

(U) Much of the "bad luck" stemmed from the unreliability of tape drive equipment and a delay in delivery of expanded disks. The basic problem with the moderately priced, medium-quality tape drives (essential to program coding and debugging) was that they were about five years behind the state-of-the-art. Their unsatisfactory performance prevented the programmers from writing data on tape or reading taped data with acceptable accuracy. Technicians attempted several "desperation fixes" on the devices without success during early 1965. Finally, in August, the SPO returned the tape heads to the manufacturer for remilling. When this proved of little value, the items which had been causing the most trouble (amplifiers, erase heads, tape pinch rollers, etc.) were replaced. These modifications, completed by mid-1966, resulted in some improvement in performance and reliability but the equipment still fell far short of what was needed.[16]

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* (U) Command post exercises in the latter half of 1963 afforded a good example of the snowball effect delay in software development at any one point, whatever its cause, had on overall production. IBM was not able to complete the "transport airlift capability estimator (ACE-C)" for the final package of the temporary system. Consequently, duringthe exercises the command post employed both the IBM-produced ACE-B capability and an in-house developed transport capability (TREST) to respond to Air Staff and Joint Staff inquiries for airlift resource information. Designers gained much feedback from these experiences which they applied to specifications for the model I version of the capability then in production. However, feedback would have been far greater had the extended and more sophisticated ACE-C version been employed. This, in turn, meant that the model I capability would not afford model II designers as adequate a springboard as originally planned. In short, inadequacies contained in the ACE-B version carried into the model I version and, again, into the final or model II version where, eventually, bluesuit suit programmers would have to correct them in-house after termination of the IBM contract.

(U) The disk problem dated back to 1963 when IBM first reported that the original equipment, designed to store 20 million characters, would be inadequate. To correct the matter, Librascope engineers sought and achieved a breakthrough in this aspect of computer technology. They succeeded in quadrupling original disk storage by a new and imaginative design which wedded an expanded capacity disk to an auxiliary or "slave" disk. Contracts for the new equipment were let in 1964 for mid-1965 delivery and IBM programmers geared production around this date. However, Librascope was unable to meet the equipment delivery schedule. Then, when the first expanded disk finally arrived in November 1965, it failed to function properly. Factory engineers arrived promptly to fix it but still could not make the disk available to the programmers before mid-January 1966. Soon after, the second disk was delivered and quickly put into use.[17]

(U) Initial testing of completed model I capabilities actually began in the latter half of 1965. Three capabilities successfully completed integration testing by the end of the year ("resource characteristics data retrieval" on 14 October, "query language" on 2 November, and "operational monitor/integrated console" on 8 December). Except for the "aircraft capability estimator/TAC (ACE-TAC)" * the rest of the model I capabilities were integrated by the spring of 1966 ("plan data retrieval" on 4 January, "data control" on 24 March, "forces plan modification/evaluation" on 5 April, and "deployment monitoring" on 13 May). Testing conducted 20-21 May 1966 demonstrated

* (U) The deficiencies which showed up in the ACE-TAC capability were such that IBM proposed in March 1966 that all programming be discontinued on the existing design, a new operational specification incorporating changes in logic and methodology be prepared, and the entire capability be reprogrammed. The Mitre Corp investigated the proposal at the request of the Air Force and adjudged it to be the most realistic, economical approach to achieving the capability. Accordingly, the SPO directed IBM to begin the project while the Systems Division helped IBM review and revise the operational specification, which was published in April 1966. The new delivery date was set for mid-1967.

that the five consoles then operating could work simultaneously with the model I data base and that all programs were compatible with one another and the equipment. The tests also uncovered areas that required further development in model II versions.[18]

(U) Initial or integration testing of model II capabilities began in 1966 with "query language overlay" being completed on 15 March, "communications-electronics" on 14 April, "planned data retrieval" on 26 April,"resource characteristics data retrieval" on 12 May, "exercise and evaluation" on 1 June, and "personnel status and evaluation" on 11 June.[19]

Cancellation of the Development System

[redacted] When IBM and the system project office realized in late 1965 that the 1966 completion date could not be met, they set a new date of 1 February 1967 and negotiated a new contract for funding the extended programming and testing.* In April 1966 the SPO informed Headquarters USAF that the date had to be set up again, this time to November 1967, and asked for additional funds to cover the extension.[20] At this point, the Air Staff, on recommendation of the Directorate of Production and Programming, set up an ad hoc committee to study possible alternatives for continuing the L-3055 program. After about a month's deliberations, the committee concluded that the L-3055 system would cost $6.3 million to complete by 1 November 1967. For about the same amount ($6.2 million), an additional 1410 could be installed and a complete operational capability achieved on this system. In other words, the L-3055 development system could be discarded and the current, temporary operation expanded into a permanent one. However, the committee pointed out, the expanded 1410 operation would never be able to "give us the same capability that could be obtained in continuing the L-3055 system."[21]

(U) Thus the decision facing the Air Staff was whether to continue with the L-3055 or abandon it completely in favor of expanding the 1410 operation. The Air Staff Board's Command Control and Communications Panel first considered the proposal

* (U) The new contract was for $2.954 million which brought the total cost of system acquisition to $44.2 million.

and recommended to the board that the L-3055 program be discontinued and the additional 1410 installed. However, the board disagreed, recommending to the Air Force Council that the L-3055 program continue along its present course.* [22]

(U) Meanwhile, an additional consideration arose. In late June 1966 President Lyndon B. Johnson instructed all government agencies, in the interest of lowering costs and increasing efficiency, to make full and wise use of computers. To help ensure this, he instructed the Director of the Bureau of the Budget to report to him semiannually on progress made on the subject throughout the federal government. On 29 July Secretary McNamara dissiminated the directive throughout the defense department, informing all agencies that in the future they would "select and acquire new or replacement computers only after systems had been redesigned to make full use of the improved capabilities of later model hardware, and then only where there [were] proven cost benefits." In the future, he said, agencies would not purchase equipment until full-scale or bench-mark tests had clearly demonstrated that the complete package, software and hardware, met system specifications.[23]

[redacted] For the Air Force Council, this guidance lent added weight to the argument for expanding the 1410 system. While the L-3055 system could be completed in less time and for about the same cost, it would not be compatible with the 1410 installations approved for the major command headquarters. Also, its equipment reliability problems might not be resolved by the time software development ended. All things considered, therefore, the council concluded an expanded 1410 system offered most promise and the L-3055 system ought to be discontinued.[24]

On 9 August 1966 Dr. Alexander H. Flax, Assistant Secretary of the Air Force for Research and Development, summarized the difficult situation the Air Force had

* (U) During the above discussions, concerned staff agencies reviewed all L-3055 programs not yet completed and revalidated all of them with the exception of materiel. The Director of Operations subsequently reported that the latter also was valid since its programs were essential to plans evaluation.

found itself in with the L-3055 system and why, in his opinion, the Air Force Council conclusion was the right one. The L-3055 equipment, he reported to the Chief of Staff, was "a vestige of the era in which the Air Force undertook to develop and procure special purpose computers to meet [specification requirements] which stretched the state of the art." The fallacy of the approach was that "even if the required capability is achieved (usually after schedule slippage and cost increase) the lack of a broad hardware and software industry support base makes operation and maintenance.... difficult and costly, if indeed it is at all possible." * [25]

(S) General McConnell, on the basis of the council and Flax recommendations, thereupon advised the Air Staff on 22 August 1966 that "study in depth has led to the conclusion that the elements of risk, cost, and delay can be reduced by substituting the 1410 for the L-3055." +After stipulating that a $6.3 million ceiling be placed on 1410 expansion, he directed the Air Staff as follows: Systems and Logistics to terminate L-3055 software development and provide for expanding the 1410 system, Plans and Operations to take over responsibility for developing the 1410 system, and the Comptroller to complete formal disposal action of the L-3055 system's equipment. [26]

Changeover to the 1410 System

(S) On 27 September 1966 Mr. Leonard Marks, Jr., Assistant Secretary of the Air Force for Financial Management, submitted to OSD the USAF request for

* (U) One Systems Division officer offered the following personal, unofficial view of the matter: "The period of time required to develop studies, prepare detailed specifications, and begin actual development normally extends beyond the average tours of duty of the functional staff officers and even beyond the tenure of the... staffs of the contractors and other technical supporting agencies. With the rotation of personnel, new ideas and influences are introduced in the direction of systems development. Hence, continuity in developmental management and direction is periodically jeopardized. Further, the original concept is in constant danger of gradual erosion from many other causes, including: budget cuts, technical problems, policy changes, and ... changes in military missions and requirements." The 473L development effort, he felt, was "subjected to all of [these] erosion processes."

+ (U) SOR 185, 2 December 1960 (revised 9 March 1963) was rescinded and the 473L program discontinued following this decision.

acquisition of an additional 1410 system. Mr. Ignatius on Secretary McNamara's staff approved on 10 October. OSD and the Air Force agreed that sole-source acquisition was necessary because the use of any other computer would require the expenditure of an additional $250,000 to rewrite executive control programs. They also agreed that leasing was the wiser course because the purchase cost could not be amortized before the interim computers were replaced by permanent ones.[27]

(U) Meanwhile, Air Force and IBM personnel met to define the expanded 1410 system's hardware and software configuration and to plan for installing the second 1410 system. A first step was to determine if any of the L-3055 software could be salvaged for the 1410 operation. Both IBM and the Systems Division agreed that "little or nothing could be retained due to the inherent differences of the two systems." They also tentatively agreed on which software capabilities could be developed in-house and which ought to be done on contract. As for the latter, IBM was the logical choice since any other company would have to spend four to six months simply catching up with IBM's current understanding of the requirement. On 11 October, AFSC authorized sole-source selection of IBM to assist with 1410 expansion and, though the final contract was not yet awarded by the close of 1966, IBM went to work immediately on its portions of the project.* [28]

(U) On 29 August 1966, the system project office completed plans to remove L-3055 equipment, although the question of where to send it still was unanswered. After seeking in vain for an Air Force research agency that might profitably use the hardware and software, the Air Staff finally directed their storage at Tinker AFB, Okla. Librascope personnel began dismantling the equipment on 19 November and finished the job on 1 December.+ [29]

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* (U) IBM's task included providing engineering technical support for installing new operations control consoles (OCC's) programmed for the expanded 1410 system (see Chapter VI, p 51) and to develop the following software: 1410/OCC interface; OCC graphics; Quest 2 overlay; force status improvement; war readiness materiel revision; munitions monitoring capability; personnel requirements estimator; and communications-electronics status.

+ The Air Force eventually donated the equipment to Brigham Young University, Utah.

(U) By 15 December, the original target date, modification of facilities for the second 1410 system was completed and the system installed. Checkout began at once and the Systems Division formally accepted it on 22 December.[30]

Continuing Expansion of the 1410 System

(U) By the time the Air Force cancelled the L-3055 system, the command post had completed the bulk of the OUR project initiated after the 1410 replaced the 1401 computer. After testing in October 1965, the command post declared operational that phase of the project known as OUR executive control. In April 1966, after two months of intensive weekend testing, it installed the final portion of OUR query language and file maintenance programs and removed the 1401 versions. One immediate advantage accruing from the project was that OUR programs ran faster enabling users to accomplish more on the computer in less time.[31]

(U) The command post also expanded and otherwise improved currently operating capabilities during 1965 and 1966. Most of these in-house revisions corrected shortcomings in original programming that showed up during tests, practice retrievals, and exercises. The Systems Division also continued to add new capabilities to the operational system. One of these, called the daylight-darkness capability, calculated first and last light -- sunrise and sunset -- for any point in the world at any altitude and at any time. Another, the aircraft parking capability, enabled the Air Staff to estimate quickly the ability of USAF bases around the world to handle traffic in the midst of rapidly changing emergency situations. The command post integrated and tested both of these capabilities by the end of 1965. Others of a similar nature in production in 1966 included one for conventional weapon employment and another for operational airfield selection.[32]

(U) However, by 1966 the command post had postponed or slowed down previously scheduled 1410 software development projects in order to assist in establishing more effective data reporting between Washington and U.S. forces in Southeast Asia (SEA). A Systems Division officer noted that the increasing U.S. involvement in Vietnam in 1965 "necessitated lengthy and continuous collective efforts on the part of . . . the Joint Staff, Services, CINCPAC,* and his service components" to establish a reporting system to produce the needed raw data. At first it appeared that creating a system that could satisfy everyone's needs would take a long time. However, the work was completed in record time and the Air Staff embarked on a maximum effort to provide a computer capability for appropriate Air Force personnel to review and analyze the detailed air operations reports flowing in from SEA.[33]

(U) The first common automated report for Southeast Asia, called the combat and reconnaissance air activity report (COACT), was published by the Joint Staff in June 1965, but subsequent operating experience proved it to be "seriously deficient" and, as a consequence, the Joint Staff completely revised it on 1 October. Meanwhile the Systems Division developed a 1410 air combat activities report capability (CARA) to process the report. Declared operational on 7 October 1965 and subsequently proved to be very flexible and simple to use, it afforded users 10 output summaries modified by combinations of 9 different qualifiers. CARA took over 4 man-months of analysis and nearly 13 man-months of programming to complete.[34]

(U) During 1966 the Joint Staff continued to refine the basic report and the command post followed suit. For example, the Systems Division developed a modification to CARA in the summer of 1966 which allowed greater flexibility through the use of guery language. Up to this time, the division had been forced to turn away many Air Staff requests for CARA special products because they either could not be satisfied

* Commander-in-Chief, Pacific.

by standard outputs or required manual search through too many files. However, the revised capability enabled operators to retrieve any desired combination of the 67 COACT items (up to a limit of 132 characters per line) that it dealt with.[35]

(U) By the end of 1966 the command post had begun or was preparing to begin many other projects for exacting as full use as possible of its 1410 system in support of SEA operations. At the request of the logistics readiness center, for example, the division developed a capability for helping to maintain the current status and projected requirements for selected munitions items in Southeast Asia. It used average sortie rates and munitions load factors of past operations to predict future requirements. The Systems Division programmed the initial capability and the logistics readiness center assumed responsibility for keeping it current.* [36]

* As noted earlier, the Air Staff decided in 1963 to collocate the readiness centers with the command post. Action on the project began in June 1964 when the Assistant Vice Chief of Staff assigned it a top priority. Work orders for construction were submitted in September and the next month offices adjoining the command post moved to other areas in the Pentagon basement to make space for them. Originally, it was hoped the centers could be completed and occupied by the end of 1964. However, the setback in L-3055 delivery removed any sense of urgency and other USAF Pentagon construction projects of equal priority took precedence. Actual construction finally began in 1965. Work on the PRC began in April and the facility was finished and occupied in June. LRC construction began in June but was held up because IBM and other L-3055 development personnel had to use the area. As of the close of 1966, the LRC was scheduled to begin the move into its new quarters in the spring of 1967.

VI. BUILDING THE AIR FORCE SYSTEM

(U) Action to establish an integrated Air Force command and control system (AFICCS) began on 1 June 1965 when Headquarters USAF notified the four command headquarters (TAC, MAC, USAFE, and ADC) of their selection as charter members. On 19 July the chiefs of the field operations met with Air Force command post and other Air Staff officers in the Pentagon primarily to develop equipment packages. Their discussion, ranging over a broad area, proved so beneficial that all agreed periodic meetings should be incorporated as a prime feature of the expansion effort.* The command representatives then returned home to select or expand their computer facilities, order equipment, and requisition personnel and supplies. The Air Staff turned its attention to preparing guidance.[1]

(U) To accomplish the latter, General Clizbe, Director of Operations, formed a working group in August comprised of officers from Air Staff offices with command and control responsibilities and chaired by Lt. Col. Joseph C. Carley of the command post's Systems Division. By early September 1965 this group completed a draft copy of a project directive, circulated it among the field commands for review and comment, and on 13 October published it as Air Force Letter 55-3.[2]

(U) After specifying overall objectives and Air Staff and field command responsibilities, the directive set forth general design criteria for the interim system.+

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* (U) Subsequent meetings convened in the Pentagon in January 1966 and the following October. In addition, all except USAFE representatives attended a RAND Corporation "Air Force Command and Control Users' Symposium" in December 1965 where they were joined by top civilian and military experts from agencies engaged in Air Force command and control development. The lucid minutes of this meeting, published by RAND in April 1966, provide a particularly instructive summary for expert and layman alike of all aspects of the subject.

+ Under terms of this directive, the Director of Operations became responsible for implementing the system and the Director of Command Control and Communications for primary policy guidance. The following Air Staff directorates became responsible for providing inputs to the system and supporting major air commands within their specialties: Data Automation, Production and Programming, Aerospace Programs, Personnel Planning, Development, Civil Engineering, Manpower and Organization, Supply and Services, Plans, and the Assistant for Logistics Planning.

It stipulated that they would be limited to the IBM 1410 system plus whatever additional allied equipment Headquarters USAF might approve to enable commands to meet unique requirements. Software would consist of 473L capabilities plus those developed by TAC and MAC. To prevent programming duplication and ensure the broadest possible common use of programming, Headquarters USAF would review and coordinate all proposals for modifying or adding to 473L capabilities except for the executive control programs. Commands would not change the latter without prior approval of the USAF Director of Operations.[3]

The Implementation Plan

(U) In January 1966 the working group issued a "coordinated implementation plan" describing the equipment each AFICCS member would employ and the initial computer programs the Air Force command post would load into the field headquarters' systems. During the interim period, the plan noted, all members would "explore every possibility for automatic transfer of operational data between ⌈their⌋ respective commands." Through such "persistent effort. . . . an experience platform ⌈would emerge⌋ from which the follow-on standard system ⌈could then⌋ be designed and launched." Praised by the field headquarters for its comprehensive and direct coverage, this implementation plan played a major role in getting the AFICCS project off to a quick and highly promising start.[4]

(U) The working group called for the four field headquarters systems to employ the same 1410 equipment used in the Pentagon post -- computer (central processing unit), file unit, tape units, input-output console, card read-punch, and high-speed printer. Initially, TAC and MAC headquarters were scheduled to retain their computer communication consoles (CCC's) while USAFE, ADC, and Air Force headquarters were to get new Bunker-Ramo Operations Control Consoles (OCC's) developed

originally to meet a SAC requirement. By the end of 1966, the original purchase order was amended to equip all AFICCS members with the new consoles.* [5]

(U) Programs to be loaded into the field systems consisted of three basic 473L elements: the OUR package, 17 operational capabilities, and the data base necessary for support of the capabilities.+ After these had been processed and placed on tape, Systems Division program integration teams would take them to the major command headquarters posts and load them. All systems had to load the OUR package since the 1410 could not properly "access" the 1401 operational capabilities without them. However, commands were free to specify what parts of the capabilities and the supporting data base they wanted to load. [6]

Installing the Interim System

(U) The TAC and MAC posts began conversion from 1401 to 1410 operations in the latter half of 1965 after the Systems Division had provided their personnel as much training as possible so they could carry out their loading duties with full understanding of the purpose of each action. IBM and the division also provided the initial documentation (operational specifications, program coding specifications, operator guides, etc.) which the commands needed to revise, update, and operate capabilities after the integration teams departed. [7]

(U) TAC headquarters became the first to begin operation with the 1410/OUR system, completing the conversion in November 1965. MAC headquarters finished the changeover in January 1966. That same month, the Headquarters ADC command post began automated operation for the first time. USAFE achieved operational status the following March. In ADC and USAFE, where no systems previously had existed,

* (U) The new consoles cost $123,000 each plus $31,000 for the "hardware box" for the tape control unit. The CCC used by the Pentagon command post had cost $25,000 plus $50,000 for the display interface buffer.

+ (U) The OUR "package" consisted of control programs, input-output service routines, utility routines, disk access and allocation, structured file generation and maintenance, query language, system assembly program, and connective control. The latter allowed operation of the 1401 programs with 1410 control programs.

the integration teams delivered duplicate copies of 473L software and then assisted the commands to exclude whatever they wished from the operational capabilities before they were loaded.[8]

(S [redacted]) Meanwhile, PACAF headquarters prepared to become the sixth member of the integrated system. It had used computers for command and control since 1959, starting with an IBM 650 and changing to a General Electric (GE) 225 in late 1962. During these years, however, the computer installation was oriented toward supporting general war readiness. By the fall of 1963 the increasing American commitment in Southeast Asia began to saturate PACAF operations staffs with more data than they could manually extrapolate within the time available to them. Consequently, with the aid of officers dispatched from the Air Force command post and the directorates of Data Automation and Command Control and Communications, PACAF headquarters undertook to expand the GE 225 operation (in Hawaii and Japan) to handle tactical weapon data. Headquarters USAF approved in November 1964, and PACAF implemented the expansion plan in early 1965. However, this still did not satisfy PACAF's continually growing requirements, and in July 1965 the Secretary of the Air Force approved the Air Staff's recommendation for further expansion to include, if feasible, the employment of 473L capabilities. When this proved to be impractical, PACAF and the Air Staff requested total replacement of the GE 225 with the IBM 1410 system.[9]

(U) OSD approved the conversion in March 1966 and the following month a USAF team, consisting of officers from the Systems Division, AFSC, and the Air Force Communications Service, went to Hawaii to help prepare a new PACAF-wide communication plan. In June 1966 an implementation team from Washington loaded the OUR programs into the Headquarters PACAF 1410 computer.[10]

Direction of Future Expansion

Thus by the close of 1966 the Air Force Integrated Command and Control System included the central Pentagon command post and five field installations. Maj. Gen. Woodrow P. Swancutt, General Clizbe's successor as Director of Operations, in evaluating the six-member, integrated system, concluded that it formed "a sound base, collectively and individually, for growth" and that the Air Force had already begun to capitalize on the opportunities for economy it afforded.[11] The broad task ahead, Secretary of the Air Force Harold Brown informed Mr. McNamara, was "to develop standardized command and control computer programs and to insure definitive guidance for the development and acquisition of...follow-on systems."[12]

(U) During an October 1966 AFICCS conference, Col. Charles J. Beck, USAF command post director, summarized the "associated responsibilities" that members bore for future expansion. He said that Headquarters USAF would "develop, establish, and publish operating procedures, perform system evaluation, and take remedial action on command-identified deficiencies and problems." For their part, the commands would "establish control standards at their level, implement procedures, and effect mutual support and coordination with other system operators."[13] Col. George P. Birdsong, Jr., Systems Division chief, summarized immediately pressing tasks, which included (1) improving existing capabilities, with priority on Southeast Asia and other data used daily by the Air Staff, (2) identifying and transferring infrequently used data from disk to tape, (3) expanding control programs to insure full use of the new OCC consoles when they were delivered, (4) expanding hardware, and (5) reorganizing and clarifying procedures and functions. Concerning the latter, the division began preparing a 55-series manual to define AFICCS operational management responsibilities and provide specific direction on such matters as "system change proposals, documentation maintenance, exchange and storage, evaluation activity, contractor support, personnel control, and system incident reporting."

It had also begun writing AFICCS documentation standards, testing and training guides, a staff users manual, and technical (programmer) guides.[14]

(U) Broad planning for the transition to a final, standard system by the end of the decade also got under way at the close of 1966. OSD had already approved the goal and the overall program was considered in consonance with McNamara's June 1966 dictum on equipment purchase. Because of its advanced configuration, the AFICCS promised to point the way in the future development of other military command and control systems. During the year, for example, the Air Force command post decided to adopt the "Jovial J-3" programming language* as standard for all USAF command and control systems. It expected that the step would help ATC to standardize this aspect of training, simplify personnel and program transfers between systems using different computers, and minimize software loss in changing to new equipment. If the standard programming language concept proved feasible for the Air Force, it would undoubtedly be adopted throughout the defense department.[15]

* Developed by Systems Development Corporation.

NOTES

This study, even more than most, is indebted to the Headquarters USAF semi-annual staff histories for information which, had it not been for them, would have been discarded long ago or hopelessly dispersed among the general records. These, as well as all printed publications cited, are filed in AFCHO. Unless otherwise noted, all other sources are located in the Record Branch, Directorate of Plans, or the Correspondence Control Branch, Office of the Secretary of the Air Force.

Chapter I

1. Hist (S), Dir/Ops, Jul-Dec 50, pp 5-7; Hist (TS), Dir/Plans, Jul-Dec 50, pp 6-8.

2. Ibid., Dir/Plans.

3. Hist (S), Dir/Ops, Jan-Jun 51, pp 4-5, 28; Jul-Dec 51, p 7; Jan-Jun 52, p 6; Jul-Dec 52, pp 7-9.

4. Ibid., Jan-Jun 52, p 7.

5. Ibid., Jul-Dec 55, p 16, cites NSC 5513/1, subj: Attack Warning Procedures for Civilians.

6. Ibid., Jul-Dec 54, p 43.

7. Ibid., Jan-Jun 55,p33; Jul-Dec 56, p 11.

8. Ibid., Jul-Dec 55, pp 17-18.

9. Ibid., Jul-Dec 56, pp 9, 11, 15, 20.

10. Ibid., Jan-Jun 58, pp 16-17; USAF Hist Div Ln Ofc studies: Wilhelmine Burch & Robert D. Little, Air Operations in the Lebanon Crisis of 1958 (S), Oct 62, and Jacob Van Staaveren, Air Operations in the Taiwan Crisis of 1958 (S), Nov 62.

11. Hist (TS), Dir/Plans, Jul-Dec 59, p 171; Jan-Jun 60, p 155.

12. Hist (S), Dir/Ops, Jul-Dec 57, p 64; Jul-Dec 58, pp 215-217; Jul-Dec 59, p 228; Jul-Dec 60, pp 127-128.

13. Ibid., Jul-Dec 58.

14. Hist (TS), Dir/Plans, Jul-Dec 58, p 109; Jan-Jun 59, p 78.

15. Ibid.

Chapter II

1. Hist (S), Dir/Ops, Jan-Jun 59, pp 185-191, cites Hq USAF Chief of Staff Decision, 26 Jun 59, subj: Hq USAF Operations Control Center.

2. Hist (TS), Dir/Plans, Jul-Dec 59, p 83.

3. Ibid., Jan-Jun 60, p 83; Hist (S), Dir/Opl Rqmts, Jan-Jun 60, p 48.

4. Hist (S), Dir/Ops, Jan-Jun 60, p 59; Hq USAF Current Status Rprt (S), Mar 64,p 7-51.

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GLOSSARY

ACE	Airlift Capability Estimator
Acq	Acquisition
ADC	Air Defense Command
ADPE	Automatic Data Processing Equipment
AF	Air Force
AFB	Air Force Base
AFICCS	Air Force Integrated Command and Control System
AFL	Air Force Letter
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFSC	Air Force Systems Command
Appn	Appropriation (s)
Asst	Assistant
ATC	Air Training Command
Atch	Attachment
Auto	Automation
Bd	Board
Br	Branch
C	Confidential
CARA	Combat Activities Report (Air)
CCC	Computer Communication Console

Chmn	Chairman
CINC	Commander-in-Chief
CINCPAC	Commander-in-Chief, Pacific
Cmte	Committee
Co	Company
COACT	Combat Activities Report
COC	Complete Operational Capability
Comd	Command
Comdr	Commander
Compt	Comptroller
Con	Control
Const	Construction
Corp	Corporation
CP	Command Post
CSAF	Chief of Staff Air Force
DAF	Department of the Air Force
DAP	Data Automation Proposal
DCS	Deputy Chief of Staff
DDR&E	Director Defense Research and Engineering
DEFCON	Defense Condition
Dep	Deputy
DEW	Distant Early Warning (Line)
Dev	Development
Dir	Director, Directorate, or Directive (OSD)
Div	Division
DOD	Department of Defense
DODCI	Department of Defense Computer Institute

EDPS	Electronic Data Processing System
Educ	Education
Encl	Enclosure
ESD	Electronic Systems Division
Fed	Federal
Fin	Financial
GLOBE	Global Battle Evaluation System
Gp	Group
Hist	History
Hon	Honorable
Hq	Headquarters
IBM	International Business Machines Co
Inc	Incorporated
Instl	Installation
Instruc	Instruction
IOC	Initial Operational Capability
IT&T	International Telephone and Telegraph Co
JCS	Joint Chiefs of Staff
JCSM	Joint Chiefs of Staff Memo
JWR	Joint War Room

Ln	Liaison
Log	Logistic (s)
LRC	Logistics Readiness Center
Ltr	Letter
MAC	Military Airlift Command
Maj	Major
Mgt	Management
Mil	Military
NSC	National Security Council
OCC	Operations Control Console
Ofc	Office
Opl	Operational
Ops	Operations
OSD	Office of the Secretary of Defense
OTC	Operational Training Capability
OUR	OTC Update and Revision
PACAF	Pacific Air Force
Pers	Personnel
Plng	Planning
PRC	Personnel Readiness Center
Prod	Production
Prog	Programming
Pub	Publication

R&D	Research and Development
RCA	Radio Corporation of America
Rprt	Report
Rqmts	Requirements
S	Secret
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SAGE	Semi-Automatic Ground Environment (System)
SEA	Southeast Asia
SECDEF	Secretary of Defense
SOR	Specific Operational Requirement
SPO	System Program Office
Stdn	Standardization
Stf	Staff
Subj	Subject
Sys	System (s)
TAC	Tactical Air Command
Telecomm	Telecommunications
Tng	Training
TS	Top Secret
U	Unclassified
USAF	United States Air Force
USAFE	United States Air Force Europe

USEUCOM	United States European Command
VCSAF	Vice Chief of Staff Air Force

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