Appendix 4

Missile Combat Crew Selection and Training

Selection for Crew Duty

Officers entering the Air Force, much like the enlisted force, were placed in a career field based on the needs of the Air Force although a choice could be made from the current list of Air Force needs based on the career description. The Minuteman crew member career area was listed as Nuclear and Missile Operations Officer. The Air Forces requires potential ICBM crew members to be 18 to 39 years old, have completed a Bachelor's or Master's degree in a technical or science area and meet the physical qualifications. The physical qualification would be verified by passing a flight physical, much more stringent than that required for simple entry into the Air Force. The career candidate must have completed the Air Force Officers Training School or be an Air Force Academy or Reserved Officer Training Corps graduate. The candidate could not be color blind as there were lots of colored lights, buttons and video screen warnings where prompt recognition was required.[1]

Candidates were required to undergo a security clearance background investigation and qualify for a Top Secret clearance. In addition, personal histories would be examined to determine stability and general good citizenship (honesty, reliability, etc.) in order to be certified in the Personnel Reliability Program (PRP).   All personnel controlling or working directly with nuclear weapons must maintain certification under this program. Stress at home, a relative's death, bad debts and even prescription medications that could impair alertness can result in temporary or permanent decertification. Finally, candidates must successfully complete specific ICBM crew member training.[2]

Crew Member Training

Crew training consists of orientation and initial skills training at Vandenberg AFB, California, conducted by Air Force Training Command. Vandenberg training duration ranged over 2-3 months in the last five decades. This was followed by more intensive instruction at the assigned Minuteman base to perfect crew coordination on critical tasks, get orientation on local policies and procedures and generally learn how the real Air Force worked. Vandenberg graduates spent roughly another 1-2 months at their base assignment before they performed operational combat crew duty.

Vandenberg training consisted of classroom training on the Minuteman weapon system and Emergency War Order functions and processes. High proficiency was required in both areas for graduation. Classroom training was put to use in Missile Procedures Trainer (MPT) Launch Control Center (LCC) simulator rides. The simulators allowed trainees to perform and perfect tasks they will utilize in a real Minuteman nuclear control situation. All actions and responses mimicked those in the actual weapon system while in a safe environment. Trainees experienced

25-30 MPT rides. A ride was a session simulating tasks performed with the real weapon system and ranged from observing and reporting a fault at a missile site, to launching a squadron of missiles. There was also a very cursory orientation of the layout of the launch facility (LF) and maintenance team processes and coordination actions. Midway through the 2-3-month Vandenberg training, trainees would receive notification of where they would be assignment after graduation.

Operational Base Training

Unit training was in some respects a duplicate of the skills taught at Vandenberg although with the addition of a greater demand on handling problems, mastering Emergency War Order (EWO) procedures, coordinating with a variety of organizations associated with crew duties both while in the LCC and during support base duties. Instruction covered orientation about operations group personnel and functions. MPT rides where continued to hone crew skills until they met the certification standard, culminating in a certification ride where all required skills and knowledge were tested. This was a very exacting demonstration of performance and could result in additional training to help the trainee meet the standard. As part of certification the graduate gave a face-to-face briefing to the operations commander who certified their fitness to perform missile alert and EWO duties.

During the training process the trainee's medical record was reviewed and a personal interview conducted in preparation for PRP certification. As part of the PRP program, personnel were briefed on their responsibilities to report situations where their performance reliability might become compromised and to also monitor others in the program to detect any errant actions or situations that should be reported. Temporary decertification can occur and it does not constitute a black mark for the individual. Life presented situations that can impair concentration on critical tasks which could cause the person to make a critical error. When these conditions were resolved, the person could be recertified for PRP duties.

Once in the PRP program, the individual's and family member medical record were prominently stamped to alert medical personnel to their critical duty status. Any temporary medical condition and especially medical treatment of the crew member or his family that might impair duty concentration resulted in temporary PRP disqualification. If a medication lists "Do not operate drive or machinery while taking," it was appropriate to remove the person from PRP duties until the medication ends and the person is evaluated for return to duties. Decertification and recertification was a formal process by the person's certifying commander and was heavily monitored for prompt actions and record preparation/filing. PRP controls were considered to be critical to nuclear safety and were grounds for failure of inspections and potential dismissal of commanders if program performance was found to be deficient. Commanders did lose their job over infractions in this area.

Crew Duty

With training complete and certifications in place, the newly minted missile combat crew operator was assigned to a missile combat crew commander (MCCC) as a deputy missile combat crew commander (DMCCC.)   Typically, they performed crew duties as a team to develop coordination in their actions which helped ensure safety and successful task completion including missile launch. However, crew members did serve with other people during their period of crew duty due to illness, conflicting requests for time-off (leave), crew member reassignments and just life in general. The crew duty schedules were built around projected conflicts; however, crew members were expected to schedule around their crew duty dates as much as possible. Some examples: routine doctor and dentist appointments would be made for scheduled off-days. The medical staff cooperated in this process to limit crew duty conflicts.

A Day in the Life of a Minuteman Missile Combat Crew

Crew Dispatch-Pre-Departure

Prior to crews going to the missile field to perform crew duty they all attended an early-morning Pre-Departure briefing. During this meeting they were briefed on the current world situation with specifics relating to the missile force. Major ongoing maintenance efforts were presented along with their potential impact on crew/missile operations. They also received current information on weather and road conditions for their eminent travel by vehicle to their duty LCC.

After the Pre-Departure briefing, crews proceeded to pick-up any materials that must be transported to their LCC as well as some items needed for non-LCC functions. The crew, usually the DMCCC, also inspected and signed for an Air Force vehicle for transportation to their duty location. This vehicle was also used by the crew they would relieve for travel back to the support base. Basic vehicle functions were checked to ensure proper operation during the trips. Also, at northern bases during the winter, a survival kit was loaded along with tire chains and snow shovels. Upon departure from the support base, they notified the Trip Control section of their departure, destination and approximate arrival time. This was done as a safety measure. Trip Control logged their departure and expected destination arrival time and would alert security police and other personnel in the field to search for an overdue crew if they did not arrive and check-in within their arrival window. This was a critical function during inclement weather. Crews could also provide transportation for the Launch Control Facility/Missile Alert Facility (LCF/MAF) Facility Manager (FM) and chef if their trips coincided. Crew vehicles had VHF radios to contact either the base or a nearby LCF if needed.

Crews loaded their vehicle with personal technical data and any personal items they needed while at the LCC. These could include, meals, snacks, books, exercise equipment, non-uniform clothes almost anything with the exclusion of electronics. Non-approved electrically powered items could interfere with LCC equipment and weren't allowed into the LCC.

The crew's drive to the LCF/MAF was typically uneventful, but winter weather was a risk from early October through late April at the northern bases. Each vehicle was equipped with a special missile facility map that designated what roads were approved for use. Approval was primarily based on most direct route of travel to the destination and surface condition, but also weight restrictions for the larger maintenance vehicles. The crew would take the approved route which would also serve to define the search area if their vehicle was disabled due to mechanical failure, accident or snow. Snow stranding was not uncommon during winter storms.

All personnel traveling in the missile field were instructed to stay with the vehicle in the event of a disabled or stuck vehicle. The vehicle was much easier for search teams to locate. If a vehicle missed their arrival window with Trip Control, security police from a local LCF/MAF as well as any maintenance teams in the area would be sent to search for the late vehicle.

Arriving at the LCF/MAF the driver stopped at the vehicle entrance gate and the passenger stepped out of the vehicle to use a phone line at the gate. The phone connected to the Flight Security Controller (FSC) at his/her desk in an office with a view of the gate. Information on the trip number and vehicle occupants would be passed to the FSC who checked their trip information against data that was passed to them from the support base. If their trip was confirmed as authentic, the gate was unlocked and the vehicle driven into the LCF/MAF compound and parked next to the main building. The crew would exit and present their identification to the FSC who again verified that the details matched their trip information.

The crew would check with the Facility Manager (FM), a middle-ranked enlisted airman, for an undated on any problems at the facility. There were usually a few. This information would be used during the crew's inspection of the Launch Control Support Building (LCSB) as part of their arrival inspection. They might also visit the chef and arrange for meals to be sent down to them during their time in the LCC. The only meals prepared fresh were breakfast and salads. Everything else was a re-heated Afoil pack@ that was essentially a military frozen dinner. There were a variety of meals to choose from.

There have been a large variety of duty periods over the history of Minuteman. In the early days when both crewmembers were required to be awake while in the LCC, two crews would be at the LCF/MAF with one in the LCC and one above ground resting, eating, watching TV or getting some exercise. Although it varied, this duty was usually a three-day tour with each crew pulling 12-hour shifts. On the fourth day two new crews would arrive to take their places. This arrangement could be disrupted by weather. As a safety measure, during severe weather, the base could prohibit military vehicle travel except for emergencies. At bases like Whiteman in Missouri, travel could be halted for a few inches of snow due to it being a short duration event and it was better to just stop rather than endanger people and equipment during seldom experienced, risky driving conditions. At bases in the northern tier travel only halted for blizzards. Most travel was stopped when the wind chill temperature reached minus 80 degrees. All travel except emergencies stopped when the wind chill temperature reached minus 100 degrees. Travel was also restricted due to low road visibility. Minot was famous for having ground white-outs due to blowing snow. Twenty feet above the ground the sky could be clear while in a vehicle you could not see across an intersection. There were remarkably few vehicle accidents given the conditions, the young age of drivers and winter driving experience.

When any topside business had been completed, the crew returned to the FSC office to descend to the LCC. The FSC would contact the crew on duty and request entry. To verify the FSC's identity (and that he was not under duress) an authentication code was used. Once verified, the LCC crew would electrically unlock the door to the elevator room and cross to the elevator. The elevator was a freight elevator design as it was used at times for very large/heavy equipment that must pass between the levels for repairs. The elevator did use an accordion type metal gate rather than the freight elevator large solid doors that would open vertically. The trip from topside to the LCC/power center level was about a minute.

The bottom of the elevator shaft varied depending on location. At Malmstrom and Ellsworth, where the power center was topside, it was possible to walk through a short tunnel to the LCC blast door and use a phone intercom to contact the LCC crew and request entry. At the other Minuteman wings (Minot, F.E. Warren, Grand Forks, Malmstrom Squad 20 and Whiteman) the arriving crew encountered a large tunnel junction blast door. This door could be opened from either side using a rotary hand crank to withdraw the locking pins and a small hand wheel to release the door latch. When unlatched the door could slowly be swung open, slowly because it had a lot of mass and the operator needed to stop it before it slammed into an adjacent concrete wall. The crew would step through and close/secure the door. The door was never left open except during maintenance tasks when equipment/people were constantly transiting the area.

Past the tunnel junction blast door, the crew turned left to enter the LCSB and performed their arrival inspection. This was extensive and checked the condition of all equipment required to operate the LCC. During this inspection they would verify the FM's status report they had received and note any new problems to be reported. Ending their inspection, they backtracked and crossed to the LCC blast door, stopping to use a telephone intercom to request LCC entry.

At the LCC blast door the arriving crew stood behind a yellow safety line as the LCC door locking pins were hydraulically withdrawn using a hand pump on the inside of the door and the latch released using a ratcheting handle. The opening operator would always announce Astand clear@ while swinging the door open as an additional warning to those outside the door. Once the arriving crew was inside the LCC blast door was closed and secured by swinging the latch in place and screwing it tight then extending the locking pins with the hydraulic hand pump.

Crew Changeover

Changeover was the transfer of LCC operating responsibility from one crew to another. It included a review of the LCC and LFs status, including maintenance actions in progress or anticipated. Status of all missiles controlled by the LCC (nominally ten, but it can be as many at thirty) was constantly monitored by the crew. Missile alert status was quickly verified from either the commander's console display or, after REACT, either of the visual display units. Any existing or new security alarms would be reviewed. Current and projected security response efforts would be identified (local security team, camper security team, maintenance). Any missile faults were reviewed to include troubleshooting actions and maintenance status as applicable. Also, Missile in Calibration requirements were identified along with start and projected finish times.

Sites with current maintenance in progress were identified and status, as reported by the maintenance team, relayed. If possible, this also includes an anticipated completion time and if the site would be returned to Strategic Alert or remain off-alert awaiting additional maintenance. All LCC and power center status was reviewed. This includes all communication systems. Pertinent message traffic was reviewed to update the arriving crew of the latest information or directives.

Seals on coded components were examined to detect any tampering. The seals, a special product of the 3M company, were virtually counterfeit proof. A special viewing tool confirmed authenticity of the seals. Seals were placed on the MCCC's Launch Control Panel (LCP) and DMCCC Cooperative Launch Panel; the Launch Switch, and the Enable Panel and switch. The seals would be broken if the panels were removed or the switch activated. Any discrepancies with documents or seals were immediately recorded and resolved. All classified materials were inventoried and, for critical items, signed for. This included materials stored in a file cabinet type safe, EWO binders at the operator positions and finally launch keys and message authentication documents kept in the small red security box in the middle of the LCC. After verification of the red box contents, the arriving crews would use their two combination locks to secure the documents ensuring that only the on-duty crew had access. The two locks also prevent access by only one crew member.

With completion of all changeover actions, the departing crew was relieved of duty, departed the LCC, took the elevator to the topside and processed out through the FSC office. Any personal items were retrieved, loaded into the vehicle and the relieved crew (crews if operating on 12-hour shifts) departed for the support base.

The return trip was a reverse of the outbound including depart/arrival notifications. An additional step was vehicle refueling at the base fuel station where a vehicle unique credit card was used to Apay@ for the fuel. The vehicle was returned to the operations area and keys returned into a vehicle control person. Any vehicle problems were noted and would be referred to the base vehicle maintenance section. There was an attempt to control accumulated mileage on the vehicles if the base had large differences in LCC travel distances. LCCs could be as close as less than a mile (Whiteman) to more than 100 miles (Whiteman, Malmstrom). The objective was to avoid some vehicles accumulating significantly more mileage than others as this directly defined maintenance intervals and ultimately vehicle life.

The returning crew(s) may also need to check-in documents returning from the LCC and sign transfer documents. They would also check for possible scheduling changes and verify their next duty date.

Daily Verification Checks

To verify system operation there were a number of daily actions performed by the crew. There were also some tasks performed at varying intervals. Daily actions include Sensitive Command Network Test (SCNT), Enable Test, Target Verification and Inhibit Test.

The SCNT was commanded from the DMCCC's console (pre-REACT) or from either operator position (REACT). The SCNT was addressed to a single launcher at a time. The launcher responded by performing a test of the Safety Control Switch (SCS), if manually allowed by a maintenance action at the launcher, some message processing functions in the Programmer Group electronics rack and initiating root function checks of the Outer Zone (OZ) and Inner Zone (IZ) security systems. The results of these tests were reported using the standard launcher fault detection and reporting circuits and status was sent via encrypted message to all monitoring LCCs.

The status results included Launch In Progress (LIP), primary power failure, radio mode, radio data present (RADAT), warhead alarm, LF secure data unit (SDU) alarm/fault, Strategic Alert and no launch simulated conditions. OZ and IZ status was actual, although induced by test stimuli. Pre-REACT all of this status was verified by displays or printouts. With REACT all the expected responses were filtered and only exceptions were displayed to the operators. If the launcher equipment was functioning properly, all test status would reset in the next status message (nominally 40 seconds) and actual status would be displayed to the operators. The SCNT was not effective for launchers in an LF Down (LFDN) condition reflecting a loss of status communications capability.

Enable test verified Enable message decoding and most of the function of the Command Signals Decoder - Missile (CSD(M)) inside each missile by stepping the device to just before armed position. The CSD(M) was stepped using a test code instead of the actual code to ensure it could not arm. Initial Enable Tests after maintenance ensured that the CSD(M) has been operationally coded by initially using the operational test coded for the first attempt and the maintenance code for the second and all subsequent tests. The maintenance code was inverted in alternate tests to exercise the CSD(M) coding posts in both positions (0 and 1). If the Enable Test was successful status was reported in the next status message. Test failures would result from the CSD(M) arming due to it containing an operational test or maintenance code. It would also fail due to the mechanism not reaching the proper position when stepped. An Enable Test failure would result in guidance shutdown and effectively prevent launch. The Enable Test was individually addressed to each missile. Status from the test was nominally received in 40 seconds.

Target Verification was performed by sending a Target Verification Interrogation (TVI) to an individual launcher or all launchers in a flight. It was initiated from the commander's console (pre-REACT) or from either operator position (REACT). Daily verifications were normally performed with an all-call address (every LF will respond). The TVI caused the guidance computer to respond with a Target Verification Reply (TVR) in the next status message reply. The TVR contained the current guidance target number, target launch delay (in seconds, zero to

9hrs, 50min, 50sec) and Execution Option number (1-2400). The results were manually verified pre-REACT or automatically in the REACT configured LCCs with a summary report to the operators if the data was available. There were a number of conditions where the TVI/TVR process would be suppressed and are too numerous/involved to list here.

Inhibit Test was commanded daily to all launchers to verify the capability to prevent launch. The actual inhibit code was used during the test to positively ensure functionality. Use of this code and a daily verification were nuclear surety requirements. When the Enable Command was received by the guidance computer, it verified the message match stored values. If the comparison was successful, the next status message will have unique Inhibit Test status. This status was verified manually by the crew pre-REACT and automatically verified as expected status and a summary message displayed to the operators. Exceptions would be displayed separately. There were many conditions in which an Inhibit would not be processed, the most prominent being the guidance set was inoperative. In such cases the ground system electronics would not send the Inhibit codes to the guidance set.

Monthly and Other Interval Performance Verification

Some tests were performed at longer intervals to confirm proper operation or improve performance. Missile Tests were performed monthly (or after certain maintenance) while guidance calibrations had a varying schedule depending upon the type of action required and how long the guidance set had been in continuous operation.

Missile Test

Missile Test, as the name applies, checked missile function performance. The command was individually addressed to each launcher. Using ground power (onboard power was used only during flight) the hydraulic unit in Stage I was energized to move the four Stage I nozzles to prescribed positions. Success was monitored through position feedback loops. For Minuteman IA and IB this type of test was repeated for stages II and III. With the advent of Minuteman II, different thrust control mechanisms were employed on various stages. For these configurations, nozzles did not move and thrust was vectored by injected high pressure gases through the nozzle to bend missile motor thrust and control direction of flight. To test these configurations only the control circuitry was exercised and monitored without activating the high-pressure gas sources. As an accommodation to make more memory available for essential pre-flight, launch and flight only computer functions, the Missile Test was separated into two parts and offloaded until needed during the Command Data Buffer (CDB) modification. The crew would send the required computer program code to the missile when needed then command start of the test segments. Missile Test was restored to permanent guidance memory residency when more guidance computer memory was added during the Guidance Upgrade Program (GUP). Missile Test results were reported to the crew by status message once the test was complete. Missile Test testing would not be permitted for some missile faults or launcher conditions and are too numerous to describe.

Guidance Calibrations

Missile guidance calibrations were periodically performed to verify operation and improve accuracy of the instruments in the guidance set. Initial calibrations began shortly after guidance startup was complete (Strategic Alert status). All calibration software code was offloaded by the CDB modification and reloaded into temporary memory similar to that described for Missile Test above and restored with GUP.

Phi Calibration

Minuteman III Phi Calibration was initially performed soon after the guidance set achieved Strategic Alert. Phi Calibration maneuvered the inertial guidance instrument stable platform through a series of positions, paused to accumulate instrument data, then compared the data to factory data preloaded into the guidance computer. The overall purpose was to verify the platform could be accurately positioned and that instruments were performing with initial accuracy. Phi could be re-initiated to acquire additional guidance fault troubleshooting or, in some cases to correct a fault. There was no schedule for periodic re-performance of Phi calibration. Phi calibration could be terminated within 15-20 minutes for launch depending upon where it was in the process.

Inertial Measurement Unit (IMU) Calibration

IMU calibration consisted of two segments. During the first segment the stable platform was maneuvered to four positions to check level detector switches calibration. The second sequence used a similar process to check initial accelerometer calibration using a gravity vertical value unique to each launcher location. Total time for Segment 1 was typically 2.5 hours, but could extend to five hours if certain sub-processes required repeating. Time for Segment 2 was 2-4 hours. Successful completion would exit into guidance Strategic Alert with status reported to the LCC crew.

Perturbation Self-Alignment Technique (PSAT) Calibration

With Minuteman III, PSAT calibration could only be entered from Strategic Alert and was commanded by the LCC crew. PSAT entry could be delayed for about 1.3 hours for certain conditions. PSAT provided a fine calibration of instruments by precisely offsetting instrument orientation and monitoring their sensing sensitivity. The results were used to verify proper operation and to tweak measurement precision. The calibration process required almost 6 hours with successful completion resulting in entry and reporting of Strategic Alert.

Communication System Checks

The LCC had many communication systems that required daily operational checks and periodic encryption code changes. These systems ranged from a simple voice circuit to high-speed satellite links and were being constantly upgraded in the LCC. These are discussed below.

Emergency War Order (EWO)Actions

EWO actions were generally all associated with launching missiles, either the lead-up to that event or launch itself. The sensitivity of the subject limits what can be described. EWO messages advised the crew of certain conditions which resulted in crew actions. EWO messages were preformatted and, if by voice, were copied onto message templates for each message type. If a text copy was received it was in the same format as the voice message template. Each part of the message must be complete and of a nature valid for that message type. Missing or garbled components could be corrected by requesting a repeat with another source including other receiving LCCs. Verification of message authenticity was by checking portions of the message with predetermined corroborating documents consisting of pre-defined coded components that must match. The source for authenticating the message varied depending upon the message types with messages having more impact requiring more stringently controlled authentication sources. Launch, the most serious, required the use of one-time codes which were protected from anyone viewing the values until they were needed for authentication. Damage to these code containers resulted in their immediate invalidation and a replacement source being designated for use.

Crews practiced EWO procedures from message receipt and authentication to taking the actions required by the message. This practice was repetitive and frequent so prompt, accurate responses were assured by every crew member. General and specific EWO knowledge was tested at least monthly. Failure of any test would require the crew member to receive additional training and testing. Crew EWO action standards demanded that actions be automatic and without any margin for error.

DEFCON Actions

EWO messages were also used to change Defense Readiness Conditions ((DEFCONs). The DEFCON readiness levels were established in November of 1959 and were jointly used by the U.S. and Canada. DEFCONs could be designated for individual military commands or as all-encompassing as world-wide.

The Minuteman force, due to their mandate for immediate response, was only slightly affected by higher DEFCON levels. To ensure the maximum number of missiles were readily to launch, routine missile training, servicing, and evaluation actions could be delayed in higher DEFCON conditions. Maintenance actions to bring a missile to launch readiness could be increased to a higher tempo. Off-duty maintenance and operations personnel could be required to be available immediately by a phone-contact recall. This was typically referred to as Six Ring Alert. Specific actions to be taken at higher DEFCON levels were classified.[3]

READINESS CONDITION	DESCRIPTION	READINESS
DEFCON 1Cwhite	Nuclear war is imminent	Maximum readiness
DEFCON 2Cred	Next step to nuclear war	Armed Forces ready to deploy and engage in less than 6 hours
DEFCON 3Cyellow	Increase in force readiness above that required for normal readiness	Air Force ready to mobilize in 15 minutes
DEFCON 4Cgreen	Increased intelligence watch and strengthened security measures	Above normal readiness
DEFCON 5Cblue	Lowest state of readiness	Normal readiness

EWO Communication Systems

EWO messages could be valid by any mode of receipt. There was an old maxim in the EWO community that if the site cook delivers an Emergency Action Message (EAM) along with your lunch and it authenticates and was valid (complete and proper format), you act on it. In the real world EAMs would arrive over an approved primary EWO communications system that includes voice and digital forms.

In the beginning of the Minuteman program there was the Primary Alerting System (PAS) which was a voice-only system operating over dedicated, leased telephone lines to all SAC command points and alert facilities. PAS predated Minuteman, but was extended to Minuteman LCCs due to their direct nuclear system control. The circuit was monitored every three seconds with an automated line check. Faults were immediately displayed at SAC Headquarters. In addition, periodic voice checks of the system verified audio quality. The PAS was a one-way voice circuit and was accessed via a unique red telephone handset at the SAC Senior Controller's console in the SAC underground command post. Connection to all subscribers was initiated by a single Alert button on the PAS console. Subscribers receipt of the message was indicated by their depressing an acknowledge button on PAS speaker box. This action was immediately displayed on the Senior Controller's PAS console.

In 1965, the SAC Automated Command and Control System (SACCS), also designated as the 465L system, was delivered to SAC. It was a network of computer and communication systems for command and control of SAC combat aircraft, refueling tankers and ballistic missiles. International Telephone and Telegraph (ITT) was the prime contractor with American Telephone and Telegraph (AT&T) providing the communication circuits. Besides the SAC HQ central hub, redundant hubs were located at March AFB, Barksdale AFB, the Cheyenne Mountain Complex and Air Force Command Posts to ensure system survivability due to equipment failure or attack. During 1986-1988 the system was upgraded to the SAC Digital Information Network (SACDIN). The SACDIN upgrade gave LCCs send and receive capabilities replacing the mostly receive only capability. The system was renamed the Strategic Automated Command and Control System (SACCS) with the deactivation of SAC in 1993.[4],[5] SAC and Minuteman received the AN/FRC-117 Survivable Low Frequency Communication System (SLFCS) in 1971. SLFCS was a dedicated EAM and force direction receive only system using both very low (14kHz) and low (60kHz) frequencies. The major benefits of SLFCS were low degradation from nuclear blasts and a very blast hard antenna. It provided a survivable (trans- and post-attack detonation) communication system for SAC, the Joint Chiefs of Staff and North American Air Defense Command with an interconnect to the Navy low frequency systems.[6]

The Intercontinental Ballistic Missile (ICBM) Super High Frequency Satellite Terminal (ISST) was fielded as an interim system in 1990. ISST used the Single Channel Transponder (SCT) package on the Defense Satellite Communication System (DSCS). The DSCS SCT system was not planned to be capable of support to strategic communications beyond 2003. It was replaced with an integrated ICBM LCC EHF/VLF/LF System (ILES) communications suite that provided the LCCs with the ability to receive EAMs and send back force report messages (via EHF) over the MILSTAR network. The ILES system provided secure, survivable, and reliable communication between the National Command Authority (NCA) and the LCCs. The modified EHF terminal replaced ISST and AFSATCOM report back capabilities. It also replaced the SLFCS. Future plans include an Advanced EHF (AEHF) capability concurrent with deployment of the AEHF satellite network into geosynchronous orbits.

REACT, jointly managed by SMC-Det 10 and Electronics Systems Command (ESC), was a class V modification to Minuteman LCCs to improve EWO supportability. The $650 million program upgraded LCCs with state-of-the-art electronic systems. REACT would speed up missile retargeting, taking only a few minutes to perform tasks that the previous CDB System required thirty or forty minutes to perform. REACT consisted of two major components, the weapon system control (WSC) and the higher authority communications/rapid message processing element (HAC/RMPE). HAC/RMPE integrated all higher authority communications (primarily EWO) and automatically passed Minuteman essential data to the WSC for processing and use in the Minuteman targeting and launch control functions.

HAC/RMPE integrated SACCS, AFSATCOM, SLFCS) and ISST communications and enhanced processing of EAMs to meet AFSPACECOM and USSTRATCOM's warfighting needs. It provided enhanced message piecing and correction across the systems and automatically presented the information to the LCC crew.[7]

Alternate Crew Duty

There are alternate crew duties based on the type of launch center where duty is performed. There are three types of LCCs in a Minuteman squadron. Each squadron has one LCC that is a Squadron Command Post (SCP). One of the SCPs is also an Alternate Command Post (ACP) which serves as an alternate to the Wing Command Post (WCP) located on the support base. All other (four) LCCs in a squadron are designated primary LCCs (PLCCs). Standard crew duties are performed in PLCCs. Extra coordination duties are performed in the other launch control center types

SCPs collect critical information from PLCCs in the squadron (launch coordination/launch success and squadron-wide problems) and report them to the WCP or ACP with direct reporting to the Airborne Launch Control System aircraft via radio as a last resort (EWO reports primarily). These reporting channels are used frequently to confirm functionality. There are three reporting networks; Emergency War Order One (EWO1), Emergency War Order Two (EWO2) and Hardened Voice Circuit (HVC). The communication networks use dedicated telephone lines external to the missile complex and hardened circuits within the missile complex including the inter-squadron link for the ACP. EWO1 links the WCP to ACP/SCPs over soft telephone lines. EWO2 links ACP and SCPs only, however, PLCCs are used as non-subscriber relay points along the hardened intersite cable system. Senior crew members are assigned to ACP/SCPs to employ their crew experience and weapon system knowledge

Alternate crew duty is also performed in the Airborne Launch Control Center (ALCC) aircraft operated from Offutt AFB. Their control of missiles is restricted until allowed by the ground LCC crews or by each launch facility (LF) via default when LCC communications are lost. ALCC duties are limited to missile launch, inhibit and periodic tests of the UHF communication systems aboard the aircraft and at LFs. ALCC crews receive no status from the LFs. Launch coordination with LCCs is performed via radio.

Crew Idle Time

Most crewmembers would spend some time working on a Master’s Degree in one of the many subjects offered at the support base. Reading, for degree or recreation, was popular as there were few other options. Over the years there have been several attempts to provide entertainment.

Radio was the first. The early LCCs had an HF transmitter and receiver. With the receiver it was possible to listen to shortwave stations from various countries depending on the time of day with night time over the U.S. and Europe being the best. Early in the program AM radio was provided to allow the crew to listen to local (plus national clear channel stations at night) stations. It was basically a car radio in a steel box with a speaker. It was attached to the overhead cable tray to the left of the DMCCC’s position (roughly mid-LCC). An antenna cable connected to topside. With the AM radio it was possible to pick up news, weather, sports and of course the local farm report broadcasts.

Television arrived in the LCC in the mid-70s via a small Sony Trinitron color set. It was located above and to the left of the commander’s console (back wall of the LCC) and was attached to the overhead cable tray. It was enclosed in a box that provided electromagnetic shielding. The box had a door on the front with a window for viewing the screen. However, the window had a fine metal mesh embedded which slightly degraded the picture. There was no remote control so the door had to be unlatched and swung upwards to adjust volume or change channels. The TV antenna was coupled to the antenna that serviced the topside television, but the long coax line to reach the LCC caused noticeable signal attention and reception quality. Channel selection was limited. During the mid-70s the city of Minot, North Dakota, had only two stations so only two networks. The stations also would broadcast local events/programs. In the summer one Minot station would broadcast Little League baseball games captured with a camera of such poor quality that a runner appeared as a smear on the screen. Early Saturday evenings, Chmielewski Fun Time provided a musical show that seemed to have an overage of accordions and consisted mostly of polka music.

Then came the satellite TV miracle. Satellite TV was installed at all the LCF/MAFs complete with an 8-foot diameter dish that had to be pointed at different satellites to get all the channels. The channel box was topside and fed the TV in the dayroom with the signal split to provide the same channel to the LCC. That caused a problem. Since the LCC crew were the ranking members at the site, they could, and some did, dictate the channel/program being watched. This caused some friction, especially when competing sports events were being broadcast. The change to small fixed position, satellite dishes and a wide array of channels on that satellite helped the program selection process. Two receivers fed by the small dish allowed the crew to watch their preference and the topside team to watch theirs, presumably decided by a vote of those in attendance.

The LCC TV has been upgraded over the years, but size was limited to the opening in the REACT console. Overall console size was restricted to what would eventually fit in the Small ICBM, mobile system (sometimes referred to as Midgetman) although that system was cancelled in the early 90s. A DSL (usually very slow) internet connection was added to the LCC in the early 2000s along with authorization of notebook computers in the LCC. Topside use was never restricted.

Endnotes

1. Unless otherwise noted this information is from Mitch Cannon, CMSgt., USAF (ret.), personal communication, April 2019.

2. https://www.airforce.com/careers/detail/nuclear-and-missile-operations-office

3. https://en.wikipedia.org/wiki/DEFCON

4. https://en.wikipedia.org/wiki/Strategic_Automated_Command_and_Control_System

5. https://en.wikipedia.org/wiki/ITT_465L_Strategic_Air_Command_Control_System

6. https://en.wikipedia.org/wiki/Survivable_Low_Frequency_Communications_System

7. https://fas.org/nuke/guide/usa/c3i/react.htm