Note

For reasons of "National Security," page 26, 27, 38, 39, 40, and 41 remain classified.
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the detonation of its own weapons was extremely remote. Since the fragment damage radius is much greater than the lethal radius, the probability of fragment damage during weapon delivery was much higher than the probability of catastrophic loss. Since there were no reported cases of bomb fragment damage to F-111s, the probability of losing aircraft to the same hazard was actually quite small.

(C) The loss of radar returns (E scope blanking) on the TFR and attack radar scope was caused primarily by external attenuation of the radar signal due to weather factors. During periods of scope blanking, TF climb/dive commands to the aircraft were derived solely from the low altitude radar altimeter (LARA) inputs and no forward terrain clearance was provided for flight in rugged terrain. The phenomenon of E scope blanking due to rain was not fully recognized prior to the CONSTANT GUARD V deployment and may well have contributed to several of the losses. The loss of forward video returns was similar to that caused by radar shadowing when approaching and ascending a mountain; furthermore, rain showers of the type which caused scope blanking were generally found in the vicinity of mountain peaks. Hence, an aircrew could have misinterpreted the event and continued terrain following rather than climbing immediately to MEA. The aircraft flight path would then have been controlled by the LARA and at least two crash factors could have resulted. First, since the LARA looked downward rather than forward, the aircraft could have impacted on a steep slope. In this case, there would have been no mechanical or system failure, but only an aircrew error in failing to recognize or take precautions.
following E scope blanking due to rain. Second, a dive command caused by a failure of the LARA or TFR computer could have put the aircraft in a trajectory which would have been fatal unless the aircrew detected the failure and responded within a few seconds of its occurrence. Even the fly-up safety feature (which would cause a two-G fly-up if the aircraft descended below 68 percent of the preset altitude AGL [set clearance plane]), might not have prevented a crash if the terrain were very rugged and terrain clearance was being measured by the downward-looking LARA. Either of these hypotheses associated with E scope blanking due to rain could have been applied to the loss of Ranger 23 on the first night of CONSTANT GUARD V operations. The crash of Whaler 57, presumably in weather and mountainous terrain, may also have been a result of these phenomena.

(C) In the F-111's history, there were 37 reported incidents of low altitude penetration below the set clearance plane (SCP) when operating on LARA override over water or dry lake beds. In 20 of these incidents, penetration of the SCP was accompanied by failure of the 68 percent fly-up safety feature. The cause of these failures was not known. It was noteworthy that both Burger 54 and presumably Snug 40 crashed during low altitude egress over the Gulf of Tonkin. Both of these aircraft had histories of LARA discrepancy writeups which were definitely on the high side of the distribution for the fleet of F-111 aircraft assigned to the 474th TFW at Takhli. However, a relationship between this fact and the tragedies was not firmly established.
(C) The time available to the aircrew to detect and react to a LARA/TFR system failure could have been only a few seconds when flying at 500 feet or less. A particularly hazardous situation would have resulted if a failure producing a dive without the 68 percent fly-up protection occurred during an automatic letdown. Figure 4 indicates the reaction time as a function of altitude during such a dive from 500 feet AGL. Of importance is the fact that during the CONSTANT GUARD V missions, egressing crews tended to fly low because they felt there was more safety at low levels. In view of the identified enemy threat, this was true; however, from the viewpoint of systems failure, the opposite might have been true.

(S) In December, as a direct result of the CONSTANT SWEEP team findings regarding TFR/LARA failures, the Chief of Staff advised all F-111 units of the low-level hazard and suggested egress altitudes of 500 feet AGL or higher to lessen the possibility of losses to TFR/LARA system failures. Moreover, he suggested immediate climb to MEA if it appeared possible that the E scope would blank due to weather.

(S) Enemy air defense was always a possible cause of the losses; however, only in the case of Coach 33 did Hanoi make an F-111 shootdown claim prior to a loss announcement by the U.S. Command. Coach 33's target was in a heavily defended area, and enemy defensive reactions had been intense on the preceding night. However, through the month of November, F-111 aircrews reported no AAA or small-arms damage, and damage from approximately 22 SAM firings was sustained only once. Another hypothesis (mentioned in 28 percent of the aircrew responses to a questionnaire used by the investigating team) was that distraction and disorientation
FIGURE 4

REACTION TIME REMAINING IF SYSTEM FAILURE OCCURS DURING LETDOWN

PLANNED TFR LETDOWN FROM 500' TO 200' AGL
DIVE COMMAND WITHOUT 68% FLY UP
NET +4g RECOVERY PULL UP
RESULTS FROM GENERAL DYNAMICS FLIGHT SIMULATOR
480 KTAS

(THIS PAGE IS UNCLASSIFIED)
while performing evasive or weapon delivery maneuvers (stabilized climb) caused the aircrew of Coach 33 to fly into the ground. The location of the crash site relative to the planned run-in track to the target indicated that the aircraft may have crashed prior to weapon delivery.

B. (S)(U) Losses

(S) Examination of the loss data revealed several possible causes in each instance. Ranger 23 disappeared while on a strike mission against the Yen Son Military Storage Facility located southeast of Yen Bai in Route Package V. The flight plan for Ranger 23 included a lengthy portion of TFR flight over extremely rugged karst* areas. This terrain included abrupt variations up to 4,000 feet in passing from mountain peaks to valley floors. There were several 9,000-foot peaks in the vicinity of the flight path which towered over the typical 5,000 to 6,000-foot peaks in the region. Approximately 4 NM short of the target on the inbound track was a hill rising about 200 feet above the surrounding terrain. The target was adjacent to the Red River and lay in a relatively flat region, but beginning about 2 to 3 NM beyond the target along the extended inbound track the terrain rose in a series of 300- to 400-foot hills.

(S) Enroute weather for Ranger 23 was reported as scattered clouds at 4,000 feet with a second layer of scattered clouds at 12,000 feet; visibility was seven miles. Other F-111 aircraft encountered numerous heavy thunderstorms in the area.

* A limestone region characterized by abrupt ridges, irregular (sometimes towering) rock formations, depressions, caverns, and underground streams.
(S) The last radio contact with Ranger 23 was at 2141, and the last radar contact occurred at 2145 as the aircraft approached the Laotian border. At that time the pilot was deviating from his programmed track to avoid thunderstorms. His last reported altitude was 15,000 feet. U.S. ground-based radar coverage at 15,000 feet extended approximately 70 NM beyond the last reflected position. Taking the flight deviation into account, the estimated descent point would have been just north of Barthelemy Pass.

(S) On 29 September, after Ranger 23's loss had been officially announced, Radio Hanoi reported a shootdown of an F-111 in Yen Bai Province. No elaborate narrative or photography was produced to substantiate this claim. Moreover, all F-111 missions on the night of 28 September were fragged against targets in Yen Bai Province.

(S) Coach 33 disappeared on 16 October while on a strike against the Uai Loi Railroad Bridge located about 6.1 NM east-southeast of Vinh Yen on the Northwest rail line. The flight was planned for 15,500 feet to the descent point where a 1,000-foot MEA was to have been flown until approaching Thud Ridge,* then a descent to 500-foot TFR was planned, followed by bomb release and egress.

(S) The MEA portions of the flight ranged over 6,000 to 9,000-foot peaks inbound and 4,000-foot peaks outboard. The TFR portions were over terrain with variations of 1,000 feet. The final leg into the target paralleled Thud Ridge to the west. The terrain dropped about 600 feet during this run in. Directly on the planned track and about 7.4 NM from the target

*A mountain range in RP VI in NVN.
Figure 5

Targets of Lost F-111As

- Railroad
- Road
- Trail

Base 54714B-60

Figure 5
was a hill rising some 360 feet above its surroundings. Terrain beyond the target was the relatively flat Red River Plain.

(S) Weather enroute and for the target area was reported to include isolated thundershowers and rain showers. Target area weather was reported to be 1,000 to 1,500 feet broken with 10 NM visibility under the ceiling. Thunderstorms and lightning were observed by F-111 crews in the area.

(S) Coach 33's flight plan took it into the heart of the SAM envelope for Route Packages V and VI A, and it came within range of at least five photo-confirmed, occupied SAM sites. An estimated 12 SAM battalions operated in the Route Packages V and VI A area between Yen Bai and Hanoi. There were at least ten 57mm and two 85mm guns located along the route to the target area portion of Coach 33's track.* Numerous light AAA guns (12.7mm and 14.5mm) and automatic weapons were also scattered along the track. In addition, photographs taken in July west of Phu Yen (near Coach 33's track) showed two mobile gun systems capable of tracking and firing at an aircraft flying at 500 feet.

(U) The last known location of Coach 33 was in Laos about 50 NM from the North Vietnamese border, five minutes before its descent scheduled for 2339. At that point, U.S. radar lost contact. At 0007, while in the vicinity of Coach 33's fragged target, Coach 27 heard some seemingly-normal conversation between Coach 33 and another agency.

(U) North Vietnamese press releases reported an F-111 was shot down by AAA fire in Vinh Phuc Province, northwest of Hanoi and along Coach 33's projected track. However, should a TFR failure have occurred and the aircraft been forced to a higher altitude, the potential for a threat existed.

*(S) During low level flight these guns presented no threat to the F-111. However, should a TFR failure have occurred and the aircraft been forced to a higher altitude, the potential for a threat existed.
flight path into the target area. On 18 October, two photographs purporting to show the wreckage of an F-111 shot down in Vinh Phuc Province were released by Hanoi. On 19 and 20 October Radio Hanoi broadcast details of crew identification papers and claimed Coach 33 to be the 4,000th U.S. plane shot down. Subsequently, the U.S. investigating team also received Japanese news film showing the crash site. Analysis of the film confirmed that the wreckage shown was from an F-111.

(S) Whaler 57 disappeared on 7 November 1972 while on a mission against the Luat Son Highway Ferry and Ford Complex located on Route 101B about 6.5NM southeast of Bat Lake in Route Package I.

(S) An altitude of 15,500 feet was planned for ingress to a descent point. A 70 NM MEA track was to be flown from descent point to within approximately 10 NM of the target. At this time the crew was to have used TFR at 500 feet to the target, returning at 1,000 feet TFR from target to a scheduled climbout point. They were to have returned to base at 24,500 feet.

(U) The terrain from the descent point to 10 miles from the target was irregular with mountains and karst formations along the track. The MEA for this leg was 3,455 feet. Ten miles from the target, where flight planning called for TFR at 500 feet, terrain features were karst formation for the first two-thirds of the leg, with the last third being level. About 3 NM enroute to the target was a series of 600-foot hills. Beyond the target the terrain was tidal plain with few significant features. The return flight plan took the aircraft over similar terrain.

(S) Weather conditions reported along Whaler 57's planned flight path consisted of scattered clouds between 2,500 and 10,000 feet in the
western section of Southern Laos, with broken cloudy conditions between 2,500 and 10,000 feet along the Laotian-North Vietnamese border. Visibility throughout Southern Laos was 7 NM. Over the target area, the weather deteriorated, with visibility below 5 NM in rain. Cloud cover was reported one to two thousand feet and broken, variable overcast with a second broken cloud layer at 10,000 feet. Thunderstorms were reported in the target area. Three other F-111s were scheduled into lower Route Package I, but aborted due to severe weather conditions.

(S) Enroute to the target, Whaler 57 could have encountered isolated AAA units. At approximately 35 NM from the target, its track took it over a heavy AAA concentration estimated to have had one 85mm, five 57mm, and twenty-two 23mm AAA guns.

(S) Whaler 57 took off from Takhli at 0219, 7 November. At 0250, he checked in with ABCCC, but no position report was given at that time. Two unexplained incidents involving Mode 3 IFF squawks* were noted. The first squawk intercepted by U.S. radar was at 0257 and would have placed Whaler 57 approximately 45 NM south of track. The second intercept, at 0408, one hour and two minutes after the last radio contact, was a Mode 3 MAYDAY squawk. Investigations of these IFF squawk incidents were not conclusive in tying these transmission to Whaler 57.

(U) The initial North Vietnamese report of an F-111 shootdown was made the day after the U.S. announced the loss of Whaler 57. Significantly,

*An encoded signal transmitted from an aircraft which, when received at a ground station, provides identification and location of the aircraft on a radar screen.
this was the first Hanoi report to credit a Western news agency as the source of the report.

(5) The fourth F-111 to be lost, Burger 54, disappeared on 20 November 1972 while on a strike mission against the Co Giang Transshipment Point located on Route 101 about 8.5 NM southwest of Quang Khe in Route Package I.

(5) The planned flight profile included a descent from 15,500 feet to a tactical MEA prior to reaching the North Vietnamese border. A 1,000-foot AGL TFR flight from the initial point to 10 NM short of the target was to be followed by a 300-foot AGL run in to the target and a 200-foot altitude egress out over the Gulf of Tonkin. The return to Takhli was to be accomplished at high altitude south of the Demilitarized Zone. According to the flight plan, Burger 54 was to have crossed terrain containing some 4,500-foot peaks located just prior to the karst region with 2,000-foot peaks.

(5) Enroute to the target, there was a cloud deck from 2,000 to 8,000 feet with no rain or thunderstorms reported along the flight route. Over the target, visibility was reduced to between two and four nautical miles with both thundershowers and rainshowers prevalent. A 1,000-foot cloud deck was topped with a 20,000-foot overcast.

(U) At 0239, Burger 54 reached the low-level entry point. From there he descended from 15,500 feet to 3,000 feet at the initial point. The initial point was reached at 0245, the time of the last radar and radio contact with Burger 54. According to 7AF, at this last contact there were no indications of any problems.
(S) Although there was no evidence of enemy air defense reaction, another F-111, Burger 52, reported signals from three enemy height-finder radars one hour prior to Burger 54's time on target. The enemy did not announce any shoot-down which could have possibly been Burger 54.

(U) A fairly good indication of Burger 54's fate was revealed several days later when pieces of wreckage of the aircraft were found on the coast approximately 14 miles north of DaNang (all parts found floating were honeycomb). Prevailing currents flowing along the coast at about one-half to one knot suggested that the wreckage could have traveled between 120 and 240 NM during the period following the loss. Although it was not possible to determine the exact location of impact, the crash site could have been within the area of the planned egress. Analysis of the debris indicated post-impact fire, 72° wing set at impact, and that the crew module probably had not separated at the time of impact.

(S) Snug 40 disappeared on 18 December while on a night TFR strike mission against the Hanoi International Radcom Transmitter, located 5.3 NM west-southwest of Hanoi. The flight profile called for an altitude of 19,500 feet followed by a TFR letdown over a region of 3,000-foot peaks. Shortly after letdown, the track descended to 500 feet into the target area in the Red River Plain, which was generally void of elevation features. The TFR flight at 500 feet continued past the target and was 130 NM long overall, the last 20 NM of which were over the Gulf of Tonkin.

(S) The weather enroute to and at the target area was reported to be 4,000 to 6,000 feet, scattered to broken clouds. No rain or thunderstorms
were reported, and visibility was six to ten miles with 91 percent moon illumination.

(S) At 2030, U.S. radar at Udorn had its last contact with Snug 40. By 2037, the aircraft was to begin its descent from 19,500 feet. An MEA profile was to continue to the initial point where TFR at 500 feet AGL was to begin. At 2054, one minute after scheduled time over target, Snug 40 transmitted an off-target call. Another call from Snug 40 was received at 2100 on UHF but there was no radar contact. Further attempts at radio contact were unsuccessful. There was no indication of any problem. The loss of Snug 40 and the earlier loss of Burger 54 were similar in that both had an egress plan of TFR over water.

(S) The final F-111 to be lost, Jackel 33, disappeared on 22 December 1972 while on a strike mission against the Hanoi Port Facility located near highway Route 117A and water Route 27E, 1.6 NM southeast of the center of Hanoi.

(S) Unlike the previous F-111 losses during the three-month period, the crew of Jackel 33 was able to eject from their aircraft and have since returned to the U.S. According to the weapons system officer, AAA was always behind them and no problem. However, Jackel 33 did encounter small arms fire, one round of which ruptured the aircraft's hydraulic system forcing the pilot to shut down his right engine and ultimately eject due to loss of flight controls.

C. (S)(U) Conclusion

(S) It was not possible to establish with certainty the specific cause for any but the last of the F-111 combat losses, although there
was sufficient evidence to indicate a probable cause for each. It was concluded that no one cause was responsible for all six losses. Two of the aircraft (Ranger 23 and Whaler 57) apparently crashed in the mountains while attempting to penetrate an area of rain storms that degraded the aircraft's radar and disoriented the aircrews. One of the aircraft (Coach 33) crashed in the vicinity of the target, having been shot down or having flown into the ground during a maneuver to evade enemy defenses. The other two aircraft (Burger 54 and Snug 40) most likely crashed in the Gulf of Tonkin due to a limitation or failure of the LARA system. As noted, Jackel 33 was shot down.

(S) The most useful results of the CONSTANT SWEEP investigation were the findings that led to corrective actions to overcome problems related to aircrew training, tactics, weaponry, and LARA/TFR system failures.

(S) It should be noted that the F-111 combat loss rate was remarkably similar to that of the Navy A-6 and the F-105F (in limited COMMANDO NAIL sorties) when performing night, terrain following missions. Since four of the six F-111 losses probably occurred during ingress or egress from the target, it was logical to conclude that improved procedures and increased LARA/TFR reliability would reduce the loss rate. Bank limitations in the F-111A TFR system were highlighted by the TAC OT&E* project (TAC PROJECT 72A-182U). A Combat ROC for improved TFR capability was submitted through PACAF and validated by the Air Staff. Incorporation of the capability will allow positive corrections to aircraft track in the final portions of an attack and during defensive maneuvering.

*OT&E—operational test and evaluation.
CHAPTER V
EVALUATION OF EFFECTIVENESS

A. (S)(U) Summary of Operations

(S) The first F-111 strikes were scheduled on 28 September 1972, the same day the aircraft arrived in SEA. The targets were carefully selected to avoid high threat areas and yet still provide an estimate of the system's combat capability. The unexplained loss of one of the aircraft on the first mission brought a halt to combat operations and led to an intense investigation of aircraft systems and employment tactics. The next five days were devoted to further training and orientation flights for the pilots and to the revision of penetration and enroute altitude criteria.

(S) Beginning 4 October 1972 the F-111s were again fragged for combat operations, but the target selection was even more cautious than before. Training and orientation flights, both day and night, continued through 12 October. By that time sufficient confidence had been gained in the aircraft and tactics to permit the scheduling of 24 sorties into RPs V and VI A on the night of 13 October. Three of the 24 sorties were sent against targets in the high-threat areas. Two days later, nine of the sorties were against high-threat targets. A second F-111 was lost on 16 October, leading to a further reappraisal of tactics. Also, to permit monitoring of F-111 missions, each crew was to provide position reports on HF radio at each turn point along the flight route so long as the aircraft was beyond radar control.

(S) Through 22 October, a total of 317 sorties had been fragged into RPs V and VI A. Of these, 280 were actually flown and 215 expended
against their targets. On 23 October bombing was halted north of the 20th Parallel in NVN, and efforts were intensified to identify targets elsewhere in SEA. Initially, these targets were concentrated primarily in RP I, but crews were provided alternate targets in the STEEL TIGER and BARREL ROLL areas of Laos by ABCCC-directed releases using tactical air navigation (TACAN) bearing/Distance Measuring Equipment (DME) position.

(S) To increase bombing effectiveness against targets of such low radar-reflectivity* as truck parks and interdiction points, low-threat targets were selected to permit the F-111 to fly at higher altitudes (15,000 to 18,000 feet) and carry a full load of 24 MK-82 bombs.

(S) Beginning 29 October 1972, six sorties per day were fragged into the BARREL ROLL area. The adaptation of the F-111 to an offset bombing role, in conjunction with the AN/PPN-18 Forward Air Control Transponder, precipitated a sharp increase in the number of sorties being fragged into Laos. By the end of November the average number had reached 33 per day, and continued at that rate through the ceasefire in Laos. During this period, 90 percent of the strikes in Laos used the beacon offset system.

(S) Strikes continued in RP I throughout November and December, but it was not until the advent of LINEBACKER II and the attendant resumption of bombing north of the 20th Parallel that the opportunity was again provided to test the system and its employment concept in the high-threat

*(S) The basic F-111A has a capability for setting only one offset aim point in the weapons delivery system. This immediately showed up as a limitation in their operations against targets of poor radar reflectivity. Multiple offset aim point capability allows cross referencing to ensure proper target acquisition and lineup. The rapid recognition of this shortcoming led to the accelerated incorporation of an already approved multiple offset aim point (MOAP) capability in the SEA F-111A aircraft.
areas. During that operation a total of 154 F-111 sorties, all at night, were flown against a variety of NVN targets, including airfields, SAM sites, radio communications facilities, and LOCs.

(S) Following the termination of LINEBACKER II operations on 29 December, F-111 sorties were again directed against targets in RP I and Laos, including sorties that were fragged to serve as PATHFINDER for A-7/F-4 strikes in Laos.

B. (S)(U) Operational Factors

(S) The initial employment concept for the F-111 called for low-level penetrations and provided ordnance delivery tactics for both low-drag and high-drag weapons. The fragmentation patterns of the 2,000 pound MK-84 low-drag bomb dictated higher delivery altitudes. The tactic devised was a 10 degree stabilized climb to approximately 1,400 feet, initiated 15 to 20 seconds prior to ordnance release. Following the loss of two aircraft, TFR minimums were raised from 200 to 500 feet, and weapon delivery was restricted to the 500 pound MK-82 high-drag (SNAKE-EYE) bombs in the level mode. TFR flight at 200 feet was still permitted to avoid defenses when SAM and AAA tracking was indicated on the RHAW equipment. Later, when it was discovered that SAM acquisition and guidance radar was effectively tracking aircraft at 500-foot altitudes, penetrations at 200 feet were again authorized.

(S) Initial target selections were made from a 7AF high-value target list based on CINCPAC strike priorities. Of the 189 targets chosen, 144 were considered suitable for F-111 operations. In evaluating the target
selection list, 7AF suggested that bridges be assigned a lower priority, and recommended the addition of 56 area targets. The targets from the revised list were photographed and SENTINEL LOCK coordinates produced. The unit developed target folders, selected aim points, and prepared hand drawn radar predictions based on optimum attack headings.

(S) During the course of F-111 operations before the bombing halt of 23 October, continuing target selections were made on the basis of their value as reflected in the CINCPAC list of priorities. However, the more lucrative targets were generally excluded from consideration because they were located in restricted areas. Bridges, which at one time had been very high on the priority list, had to be excluded from consideration because the use of MK-82s against bridges had proven ineffective. In RPs V and VI A, railroad sidings, spurs, and other LOC now became priority targets. There were other considerations, such as the necessity to avoid collateral damage and civilian casualties, which further limited the number of radar-significant targets available for strike.

(S) A continuing problem throughout F-111 operations was the inadequacy of the charts used in making radar predictions. It was found that they were somewhat inaccurate in portraying terrain features, and the hand drawn predictions upon which target crosshair placement was originally predicated did not always coincide with the radar scope presentation. Greater emphasis was placed on collecting, analyzing, and cataloging radar scope photography to reduce the reliance on predictions.
Performance of the ES-85 Mobile Film Processing Facility was commendable; average production was 50 radar predictions and 3,000 feet of 35mm radar scope film per day.

Relatively inexperienced weapons system officers (WSOs) had difficulty adjusting to the extremely brief spans of time available for them to look at their radar aim points. Many crews had only a matter of seconds to acquire their targets or aim points while at TFR altitudes. This, in addition to the problems normally associated with initial combat sorties, resulted in instances of incorrect crosshair placement or bombing in less than optimum modes. Yet, because of the TDY nature of the deployment, a new group of inexperienced crews was scheduled to enter training in early 1973.

C. (S)(U) Destruction, Harassment, Presence

It was recognized that the F-111 concept of employment, i.e., single-ship penetration at a low level, was not likely to produce spectacular results in terms of physical damage alone with conventional weapons. Its value was based on a combination of three factors: destruction, harassment, and presence. The F-111 provided the Air Force with the capability to strike the enemy, day and night and in poor weather. Although the number of F-111 strike sorties was modest (13 sorties per day), the unique capability of the F-111 to penetrate enemy defenses and strike targets around-the-clock added a formidable psychological/harassment effect to the purely military damage resulting from the strikes. The F-111 had the capability to appear suddenly, and virtually without warning. This ever-present threat was, in itself, of significant importance.
In attacking airfields, for instance, a single aircraft could not normally be expected to shut down flight operations for any significant length of time, but the F-111 strikes during the nighttime hours contributed an immeasurable psychological effect by harassing defenses and overnight repair efforts. Even though the F-111 sorties generally caused only light damage to airfields, it is interesting to note that the only reported period of non-operational status at Yen Bai was the result of a successful F-111 attack.

The F-111 represented only an infinitesimal portion of the total strike resources committed against storage facilities in NVN, yet they were able to record significant damage. Again, however, the major contribution was in keeping pressure on the enemy in areas where significant damage had already been done and striking SAM sites prior to B-52 attacks.

D. (S)(U) Logistics and Maintenance

The 474th TFW maintenance organization, which shared maintenance facilities with the 366th TFW until the latter unit redeployed at the end of October, was fully operational within a very short time of its arrival at Takhli. Routine maintenance was accomplished on schedule, with virtually no delayed maintenance backlog.

Following the loss of Ranger 23, the F-111s were not allowed to fly in the high threat areas of RPs V and VI A unless all systems aboard, primary and redundant, were fully operational. This caused an abrupt rise in the number of aborts and in the NORS* rate. If a system deficiency was discovered prior to takeoff, the aircraft would not be permitted to fly; if the problem arose after takeoff, the crew was

*NORS--not operationally ready, supply.
required to abort the mission. To ensure the availability of backup aircraft to replace the aborts whenever practical, the 474th TFW maintained an average of four combat configured spares.

(S) Aircraft antennas, modulators, and LARA indicators were the principal items of concern. At one time, 13 aircraft were NORS due to the LARA indicators. Of 53 aborts between 28 September and 22 October 1972, 39 were due to failure of some mode of the terrain following radar, attack radar, or inertial navigation systems. The first two systems, which together accounted for 32 of the 39 aborts, were identified as major shortfall items. The LARA indicators were in critically short supply. They were depot reparable items, and it was only through the closest possible monitoring of each asset in the system that the serious shortage was prevented from adversely affecting combat operations.

(S) Between 23 October and 17 December the abort rate was insignificant because no strikes were being flown into the high-threat areas north of the 20th Parallel, where strikes could only be conducted if all systems were fully operational. On 18 December, the first day of LINEBACKER II operations, an F-111 again was forced to abort because of a malfunction in the TFR system, but that was the only abort resulting from such a malfunction for the remainder of combat operations over North Vietnam.*

(S) The NORS rate at Takhli was approximately 11 percent, compared to an average of 4 to 5 percent at Nellis when the F-111 was undergoing testing and evaluation. Although the avionics equipment accounted for the majority of the NORS items, it was also discovered that such items *(C) Crew experience levels may have been a factor in compensating for some equipment malfunctions, with the net result being the very low abort rate noted.
as struts and brakes were not as durable as had been expected and were contributing to the NORS problem.

(S) The cannibalization rate, which had reached 33.2 percent by December, was significantly higher than had been the case at Nellis for twice the number of aircraft. This was due, in part, to the inadequate supply of spare parts available at Takhli upon arrival of the 474th TFW. The high point in December reflects the all-out effort involved in LINEBACKER II. Despite the relatively high NORS and cannibalization rates, combat operations were not adversely affected.

E. (S)(U) Ability to Perform in Intended Role

(S) The F-111 did not really have an opportunity to prove the full range of its combat capabilities. The initial concept of operations became suspect on the very first mission on 28 September 1972 with the unexplained loss of Ranger 23. There followed an extensive period of crew training and orientation, and reevaluation of the mission concepts and aircraft capabilities.* From 28 September 1972 through the end of LINEBACKER II operations, it was employed against NVN targets on a total of only 33 days, and only 22 days against RPs V and VI A targets. Of 434 total sorties flown in the upper route packages, 369 expended their ordnance on target.

(S) Because of the cautious initial employment of the F-111, the concept of committing it only against high-priority, radar-significant targets received no practical application until the LINEBACKER II campaign. From the beginning, target suitability in terms of radar reflectivity was less important than the selection of low-threat targets. Also contributing

*Nevertheless, very few changes were made.
to this trend was the scarcity of radar-significant targets authorized for strike.

(S) The scarcity of radar-significant targets was but one of the problems faced by targeteers. The desire to avoid stereotyping the missions required that approach routes and run-in headings be varied as much as possible. The nature of the terrain in NVN and the relatively confined space into which the targets were packed made it difficult to meet this requirement. Of even more serious concern was the lack of a reliable combat CEP for the F-111. The initial employment against low-threat targets did not provide an adequate basis for assessment. Further, the very nature of the tactics employed—night, low-level, high-speed, radar delivery—precluded accurate damage assessment by the crew. Neither was post-strike photography very helpful: of 203 strikes flown through 22 October, post strike photography was limited to 85 by cloud cover. Of the 85, only 23 could be correlated with F-111 strikes. Using this as a basis, a CEP of 656 feet was obtained, but the limited sample size made the results suspect. The target selection process had to take this lack of reliable CEP into consideration, and choose run-in headings which would minimize the possibility of collateral damage to non-military areas.

(S) Between 23 October and 18 December the F-111 did not operate in its designed role. Its activities were largely limited to bombing from medium altitudes, and there was little opportunity to take advantage of its unique design characteristics. Nonetheless, its subsequent performance during the LINEBACKER II operations demonstrated that it was
capable of doing what it was designed to do. It proved to be an effective tactical aircraft in the multiple-threat environment of NVN. During the early stages of LINEBACKER II it was targeted against airfields in an attempt to minimize the MIG threat. It was observed that there were far fewer MIG reactions than during previous LINEBACKER operations.* During the latter stages of LINEBACKER II, the F-111 force worked in concert with B-52s, striking SAM sites in advance of B-52 operations to reduce the SAM threat. Subsequently, the F-111 performed with great effectiveness in Laos using the beacon bombing technique. In these varied roles, the F-111 demonstrated its ability to penetrate the enemy defenses at low altitude and conduct strikes against targets in heavily defended areas.**

*(S) While this decrease of MIG reactions might be attributable in part to the F-111 strikes, the timing of LINEBACKER II operations (most of which were conducted at night) was also a significant factor in the reduced level of MIG reactions.

**(S) All F-111 operations in SEA, particularly LINEBACKER II, pointed up a deficiency in an effective high speed, low altitude deliverable, area coverage munitions. A Combat ROC was submitted through PACAF and validated by Air Staff to produce and certify such a munition. This development will greatly enhance the F-111 strike capability at TFR altitudes against such targets as airfields, SAM sites, etc.
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FOOTNOTES


2. Ibid.

3. Ibid.

4. Ibid.

(U) Ltr, Hq 474 TFW/DOW to Hq PACAF/DOAD, 11 Sep 73, subject: CHECO Report Review.

5. (S) Report, Hq PACAF/DOA, CONSTANT GUARD V and VI, Mar 73, pp. 1, 4. Hereafter cited as CONSTANT GUARD.

6. (S) Briefing by Brigadier General Bellamy, Assistant Director of Air Ops, 7AF, to 7AF CC and CINCPACAF; Summary of F-111 Operations in SEA, 25 Oct 72. Hereafter cited as Gen Bellamy Briefing.

7. Ibid.

8. Ibid.


12. Ibid., pp. II-9, II-10.


14. Ibid., pp. V-5, V-8


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18. (S) Technical Guide; 474 TFW Radar Strike Division, Tactical Fighter


21. Ibid.


23. Ibid.

(S) Ltr, Hq PACAF/IN to Hq PACAF/DOAD, 15 Jun 73, subject: Project
    CHECO Report, "The F-111 in SEA, Sep 72-Jan 73." (Hereinafter cited as Hq
    PACAF/IN ltr.)


27. Ibid., pp. II-12, II-13.


29. Ibid., pp. II-13, II-14.


32. Ibid., p. 4.

33. Ibid., p. 16.


36. Ibid.


38. Ibid.

39. Ibid.

40. Ibid.

41. Ibid.

42. Ibid.


43. Ibid.


(S) Message: 010515Z Oct 72, 7AF to PACAF, subject: Initial F-111 Operations in Southeast Asia.

46. (S) Brochure, Hq TAC (D0O), subject: Tactical Air Command SEA Tactics Review Brochure, Jan 73, Vol. I, pp. 29-30. Hereafter cited as TAC SEA TRB.


Op. Cit., TAC SEA TRB.


50. (S) Report, Hq PACAF, subject: Summary Air Operations Southeast Asia, Nov 72, pp. 4-5 through 4-11. Hereafter cited as SEA Air Ops, with appropriate date.
51. Ibid., pp. 1-2 through 1-A-2, 4-5 through 4-11.


53. (S) Message 020310Z Dec 72, 7AF to CSAF, PACAF, subject: F-111/AN/PPN-18 Beacon Employment.


54. (S) Staff Summary, PACAF (DOAE), subject: F-111 Beacon Delivery Technique Concept and Results, 17 Nov 72.

Op. Cit., TAC SEA TRB, pp. 60-61


56. (S) Analysis, PACAF (DOAE), subject: LINEBACKER II Air Operations, 31 Jan 73.

57. (S) Review, PACAF, subject: Pacific Air Forces Air Intelligence Review (PACAIR 3-73), 30 Jan 73, p. 17.

(S) Summary, PACAF (INT), subject: Lessons Learned Summary: Airfields, undated (circa Jan 73).

(S) Summary, PACAF (INT), subject: LINEBACKER II Operations, 19-29 December 72, undated (circa Jan 73).

58. (S) Summary, PACAF (INT), subject: Lessons Learned Summary: SAM Sites, undated (circa Jan 73).

(S) Message, 100850Z Jan 73, 7/13th AF to TAC, subject: Report 2-73, LINEBACKER II F-111 Operations.

59. (S) Summary, PACAF (INT), subject: Lessons Learned Summary: Storage Facilities, undated (circa Jan 73).

(S) Summary, PACAF (INT), subject: Lessons Learned Summary: Railroad, undated (circa Jan 73).

60. (S) Summary, PACAF (INT), subject: Lessons Learned Summary: Radio Communications Facilities (U), undated (circa Jan 73).

(S) Summary, PACAF (INT), subject: Lessons Learned Summary: Bridges, undated (circa Jan 73).

(S) Summary, PACAF (INT), subject: Lessons Learned Summary: Power Facilities, undated (circa Jan 73).
   (S) Message 090755Z Jan 73, 7AF to 7/13AF/DO, subject: F-111/A-7
   Pathfinder Mission Results. Hereinafter cited as F-111/A-7 msg.
65. Ibid.
66. Ibid.
   (S) 191525Z Dec 72, CONSTANT GUARD V to TAC, subject: TAC Project
   72A-182U CONSTANT GUARD V OT&E.
68. Ibid., p. 12.
69. (S) Briefing; Hq USAF to PACAF Staff, subject: CONSTANT SWEEP, 30
   Jan 73.
70. (S) Report, 474 TFW, subject: Report of Investigation Involving
   the Disappearance of F-111A 67-078, 28 Sept 72.
71. Ibid.
73. Ibid., p. 14.
74. Ibid.
75. Ibid.
77. (S) 222241Z Dec 72, CSAF to 474 TFW, subject: F-111 Operations.

(S) Interview, topic: Comments of JACKEL 33 WSO, with Capt M. Wehrell, Staff Officer, PACAF INT, by Capt R. Burnham at Hq PACAF, 1 May 73.

(S) Ltr, Hq PACAF/DOQ to Hq PACAF/DOAD, 15 Jun 73, subject: Project CHECO Report, "The F-111 in Southeast Asia, Sep 1972-Jan 73." (Hereinafter cited as Hq PACAF/DOQ ltr.)
86. (S) Message 211210Z Oct 72, 7AF to CINCPACAF (DOA), subject: CONSTANT GUARD V and VI Report for Period 1-15 October 1972. Hereafter cited as CONSTANT GUARD Report with appropriate time period and date/time group.
87. Ibid.

90. Ibid.

91. (S) Report, E.O.T., Colonel Frank J. Malkiewicz, Director of Intelligence, 7/13AF, 26 Jun 72-10 Apr 73, 10 Apr 73.


96. Ibid.
99. Ibid.
100. (U) Message 110245Z Jan 73, 474 TFW to TAC.
102. (S) Staff Summary Sheet, subject: Orientation Training for F-111 Replacement Crews, 7AF (DO), 3 Jan 73.
105. Ibid.
108. Ibid.
112. (S) Interview, F-111 Abort/HORS Statistics, MSgt U. McFadden, Hq PACAF (LGMM), by Capt Jack C. Bethea, at Hq PACAF, 17 May 73.
117. Ibid.
118. Ibid.
119. Ibid.


GLOSSARY

AAA
Anti-aircraft Artillery

ABCCC
Airborne Battlefield Command and Control Center

ACIC
Aeronautical Chart and Information Center

ADVON
Advanced Echelon

AF
Air Force

AFB
Air Force Base

AGE
Aerospace Ground Equipment

AGL
Above Ground Level

AOB
Air Order of Battle

ATTG
Automated Tactical Target Graphics

BDA
Bomb Damage Assessment

CEP
Circular Error Probable

Combat ROC
Required Operational Capabilities statement

CONUS
Continental United States

DMAAC
Defense Mapping Agency Aerospace Center

DME
Distance Measuring Equipment

ECM
Electronic Counter-Measure(s)

ETA
Estimated Time of Arrival

FAC
Forward Air Controller

FAG
Forward Air Guide

GCI
Ground-Controlled Intercept

GOT
Gulf of Tonkin

HF
High Frequency

IFR
Instrument Flight Rules

KTAS
Knots True Air Speed

LARA
Low Altitude Radar Altimeter

LOC
Lines of Communication

LORAN
Long Range Airborne Navigation

MAC
Military Airlift Command

MEA
Minimum Enroute Altitude

MOAP
Multiple Offset Aim Point

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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>NM</td>
<td>Nautical Miles</td>
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<tr>
<td>NVN</td>
<td>North Vietnam(ese)</td>
</tr>
<tr>
<td>NORS</td>
<td>Not Operationally Ready, Supply</td>
</tr>
<tr>
<td>OAP</td>
<td>Offset Aim Point</td>
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<tr>
<td>OT&amp;E</td>
<td>Operational Test and Evaluation</td>
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<tr>
<td>PACAF</td>
<td>Pacific Air Force(s)</td>
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<tr>
<td>PAD</td>
<td>Programmed Action Directive</td>
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<tr>
<td>PME</td>
<td>Precision Measuring Equipment</td>
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<td>Precision Measuring Equipment Laboratory</td>
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<td>Route Package</td>
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<td>RTAFB</td>
<td>Royal Thai Air Force Base</td>
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<tr>
<td>RTG</td>
<td>Reconnaissance Tactical Group</td>
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<tr>
<td>SAM</td>
<td>Surface-to-Air Missile</td>
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<tr>
<td>SAR</td>
<td>Search and Rescue</td>
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<td>SCP</td>
<td>Set Clearance Plane</td>
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<td>Tactical Air Control Center</td>
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<td>Time Compliance Technical Order</td>
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<td>Terrain Following</td>
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<tr>
<td>TFCU</td>
<td>Transportable Field Calibration Unit</td>
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<td>TOT</td>
<td>Time Over Target</td>
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<tr>
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