

INDEPENDENT POSITION PAPER:

**THREE REASONS WHY THE ATF SHOULD NOT BE APPROVED
FOR ENGINEERING AND MANUFACTURING DEVELOPMENT**

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The views expressed in this paper are those of the author.
They do not represent an approved position of ASD/PA&E
or the Office of the Secretary of Defense.

[Author's Note: In 1991, the F-22 was known as the ATF or Advanced Tactical Fighter. When this paper was written the AF planned to buy over 648 as part of its plan to retain a force structure of 26 tactical fighter wings. Since that time, the force structure has been reduced to 20 wings and the number of F-22s has been reduced to 341 F-22s, so the basic problems outlined below remain uncorrected. FCS, 10-2-99.]

[Note: the Figures 1-9 are appended to the end of this report]

I believe there are at least three reasons why the ATF should not be approved for Engineering and Manufacturing Development (EMD) at this time. These reasons and my recommendations can be summarized as follows:

I.

Even if the approved program unfolds flawlessly between now and the year FY 2012, that is, EMD proceeds without problems, production rates build up on schedule, and Congress appropriates sufficient budgets to buy out the entire production run (see Figure 1), a decision to go forward with the ATF carries with it profound force structure consequences. If we intend to maintain a force structure of 26 TFWs and 180 air defense interceptors, we must buy about 1200 additional fighter/attack aircraft during the same period we are buying the ATF (see Figure 2), *and* we must permit the average age of the force structure to increase substantially above its current high level of 11 years (see Figure 3). On the other hand, if we do not buy the additional airplanes, and we continue the current policy of retiring airplanes after 22 years, force size will decline precipitously and force mix will become so unbalanced in favor of air superiority fighters that the mission of tactical fighter aviation will have to be redefined (see Figures 4 & 5).

There is no approved plan to resolve the long-term force structure problem. Moreover, current planning documents contain serious contradictions. While the Air Force acknowledged the need to buy a multi-role fighter at the Conventional Systems Committee (CSC), and the draft Defense Program Projection (DPP) contains a production funding wedge between 1999 and 2003, there is no funding for this program in the FY 1992/1993 budget, and the DPP claims the RDT&E program is underfunded by 42% in the four outyears of the FYDP. Also, there are no plans to modernize the force structure by remanufacturing existing airplanes, and there has been no explicit decision to increase the average age the force above its current level.

We need to define where we want go and how we are going to get there, before we increase our nation's commitment to the ATF. Accordingly, a decision to proceed with the further development of the ATF should be deferred until the force-structure issues have been analyzed, options have been evaluated, precise force-structure goals have been defined, and a comprehensive modernization strategy is approved and integrated into the FYDP and the DPP.

II.

The ATF program might not unfold flawlessly. Should this happen, the problem described above will get much worse. There are at least three potential problem areas:

Technical Risk: With the possible exception of the F-14, the ATF is the most technologically ambitious leap forward in the history of fighter aviation. Yet the YF-22 is a prototype in only the most limited definition of the term. To date, the airframe, engine, and avionics have been developed along three quasi-independent paths. While the YF-22 demonstrated the aerodynamics and persistence of the supersonic-cruise concept, it does not incorporate stealth features, including the required composite materials, the engine is not yet rated for full power, and although brassboard avionics have flown inside a capacious Boeing 757, they have not yet been designed to be integrated into the YF-22's much smaller airframe. The inevitable tradeoffs needed to bring together these disparate efforts in a single integrated design magnify the risk of unexpected weight growth, cost growth, and performance degradation. Moreover, since the wing is optimized for supersonic flight, the problem of unexpected weight growth is especially dangerous in the case of the ATF. Should weight growth reduce supersonic persistence to the point where the ATF must rely on subsonic maneuvering performance in combat, the result could be an aerodynamically inferior fighter.

Bias in Cost Estimates: Procurement costs might also be higher than predicted because of systemic biases in our estimation techniques. At this stage of development, without a comprehensive engineering design, industrial engineers have no way of reliably estimating what the ATF will eventually cost to produce. Nevertheless, there is reason to believe that the estimates presented to the CSC were too optimistic. Those numbers were based on a "learning curve" that predicted continuous decreases in unit costs as production increases (see Figure 6). Learning curves, however, have a long history of underestimating actual costs. For example, while considerably higher, the ATF's cost predictions are almost identical in form to those made for the F-14, F-15, and F-18 *after* EMD was completed but before production started up. But in the latter three examples, the advantage of having comprehensive engineering drawings, detailed materials specifications, and estimates for "touch labor" did not prevent their actual costs from significantly exceeding their predicted costs (see Figures 7-9). No such "advantage" exists for the ATF. The greater uncertainty inherent in the ATF's *Pre-EMD* learning curve suggests that higher costs are probable, if not inevitable. The impact of this uncertainty--in terms of increased budget requirements, reduced production rates, or the need to find compensating offsets in other programs--has not been explored.

Circumstantial Management Uncertainty: The ATF is being built under a complicated contractor-teaming concept. To proceed smoothly, a large number of hi-tech engineering tasks, performed at widely separated locations, under conditions of very different corporate cultures, must come together harmoniously in terms of time, form, fit, and function. This prodigious

effort clearly requires a savvy, experienced, management team. While I do not question the selection of the team members, their track records raise the possibility of administrative dissonance that may disrupt the precise choreography of these diverse activities. To wit: the integrating contractor, Lockheed, has not designed and mass produced a fighter since the mid-1950s (i.e., the F-104). Lockheed's plant in Georgia has a history of cost overruns and quality control problems when producing comparatively simple, large subsonic transports. Our only experience with contractor teaming in a complex tactical aircraft, the A-12, just collapsed in failure, and while liability has not been determined, the management practices at General Dynamics were clearly part of the A-12's cost/weight debacle.

Taken together, these technical, economic, and circumstantial uncertainties are flashing red lights suggesting there is a substantial risk that the ATF's development program will not unfold flawlessly. We can reduce this risk by reducing concurrency--that is, by partitioning the program into a Phase II Advanced Development Program aimed at producing a truly combat-capable prototype with full-powered engines and fully-integrated stealth and avionics capabilities, while deferring manufacturing development until a competitive fly-off against current generation fighters confirms the advantages of proceeding with manufacturing development and production.

III.

There is reason to believe that the ATF can proceed at the slower, more prudent pace described above without excessive military risk.

It is important to remember that the ATF was conceived at the height of the Cold War. Its System Operational Requirement (1 Mar 91) is clearly premised on the belief that the Soviet Union is the threat to be countered and that the intensity of cold-war competition would continue unabated. But that stable world no longer exists, and while the long-term consequences of Communism's collapse can not be known, it is now clear that our primary adversary, the USSR, must focus inward for many years. The Secretary of Defense and the Chairman of the JCS have stated repeatedly (e.g., in Congressional testimony and in the JCS Net Assessment) that our new planning assumptions assume the threat of a conventional war with the Soviet Union is greatly diminished, and the threats of major regional contingencies are now the most appropriate scenarios for sizing and shaping conventional forces over the FYDP's planning horizon. While the ATF's continued development might be justified as a prudent hedge against the revival of the Soviet threat in the long term, the overwhelming superiority that our pilots and aircraft demonstrated in air combat against current generation Soviet fighters during the war with Iraq makes it difficult to imagine what major regional contingency could justify the high-risk, concurrent development program being now contemplated.

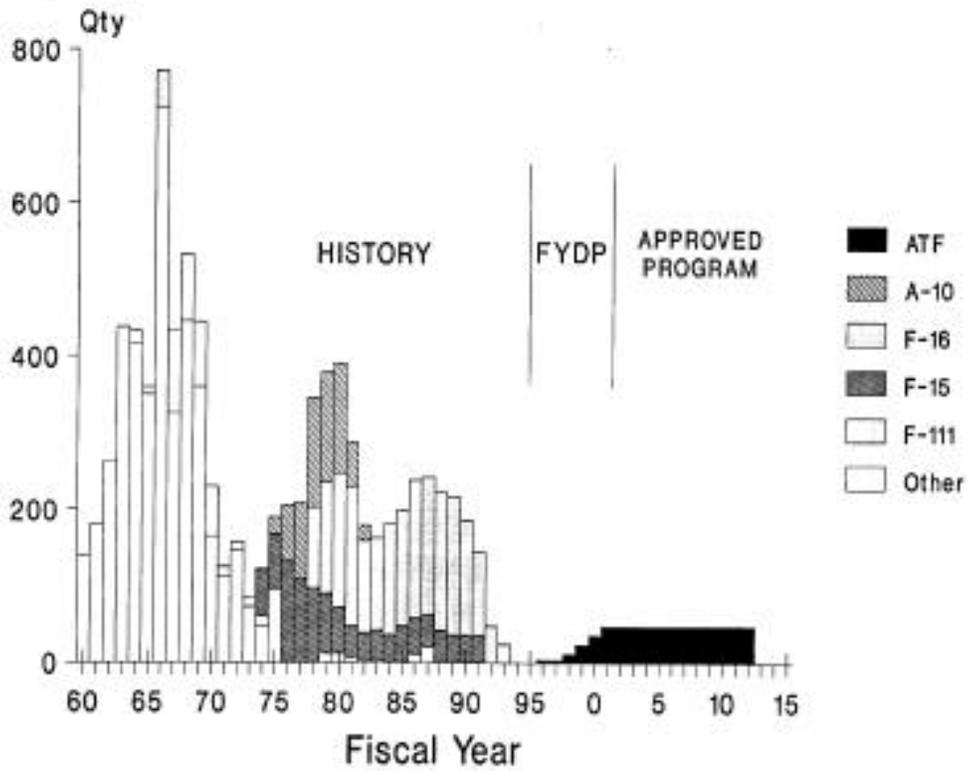
In summary, the profound but unexamined force structure consequences embodied in a commitment to the ATF, the technical and economic uncertainties of the ATF, and the uncertain but certainly diminished character of the air-to-air threat facing our pilots combine to suggest that

the ATF should not be approved for EMD. The Air Force needs to formulate a comprehensive, fiscally-pragmatic plan for modernizing the entire fighter force. If the ATF becomes part of this plan, it should be restructured into a less-concurrent, lower-risk, fly-before-you-buy program. The Air Force should defer manufacturing development until the uncertainties are reduced by a competitive flyoff between a combat-capable prototype and current generation fighters.

Finally, when considering the ATF's future, senior management should also ponder its political risk: a decision to approve the concurrent engineering and manufacturing development program will lock in and magnify the powerful constituent forces aiming to commit our country to this course of action for the next 30 to 40 years. Such a decision will greatly diminish our future freedom of action during a period of increasing financial uncertainty. Should the ATF be deemed undesirable at some time in the future, it will not be reversed before billions of dollars of the public treasure have been futilely expended. Our experience with the A-12 is a flashing red warning light in this regard. The lesser commitment of a fly-before-you-buy program would reduce political risk and increase management's ability to adapt to unforeseen changes in future years.

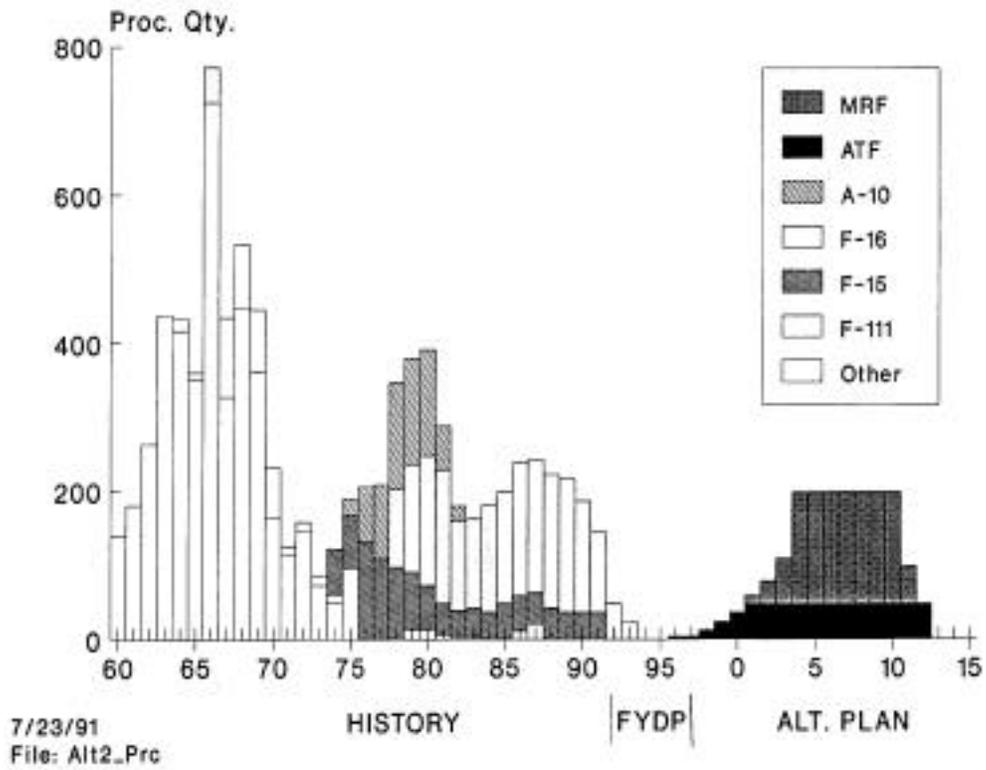
Figure 1

**AF Fighter/Attack Procurement
Plans vs. History**

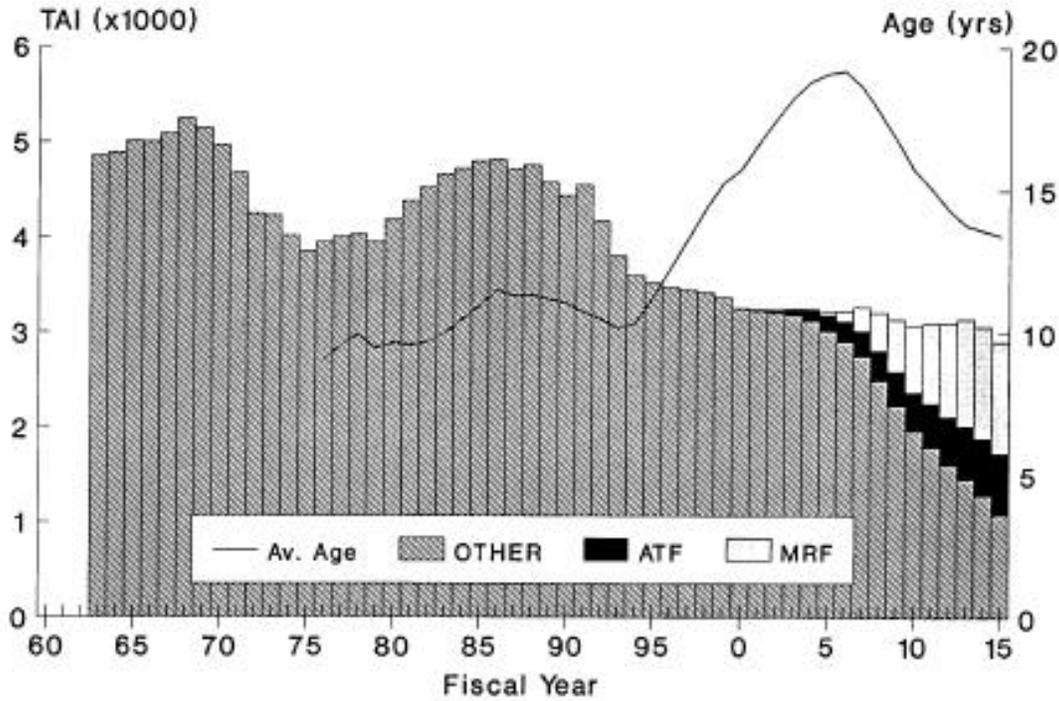


Date: 7/23/91

ALTERNATIVE PROCUREMENT PLAN Buy 1200 MRF'S In Addition to 656 ATF's



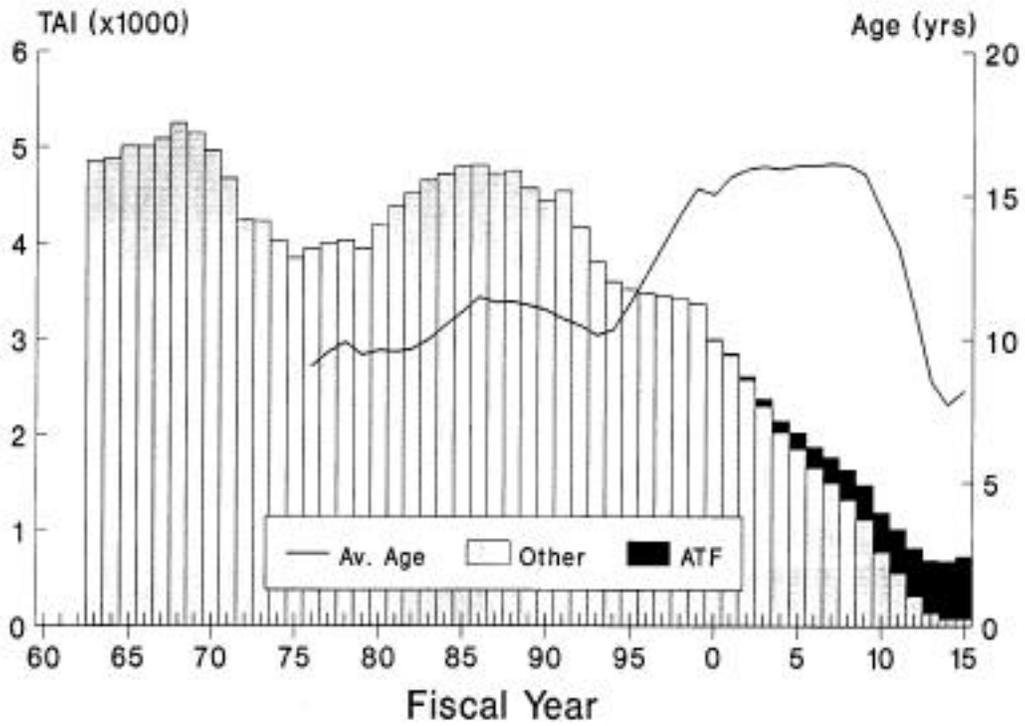
**Buy 1200 MRF's In Addition To ATF's
Retire All A/C After 28 Years**



7/23/91
File: MRF-28A1

Figure 4

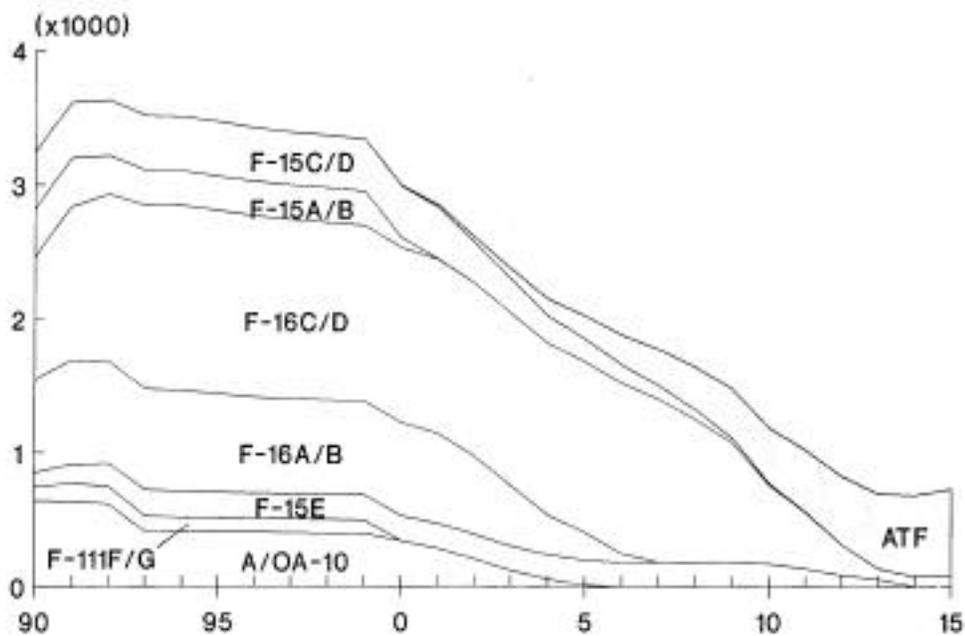
**Buy 656 ATF's
Retire A/C After 22 Years**



7/23/91
FY 2000-15 Attrition Rate = 0.5%/yr
Ret#_22A

Figure 5

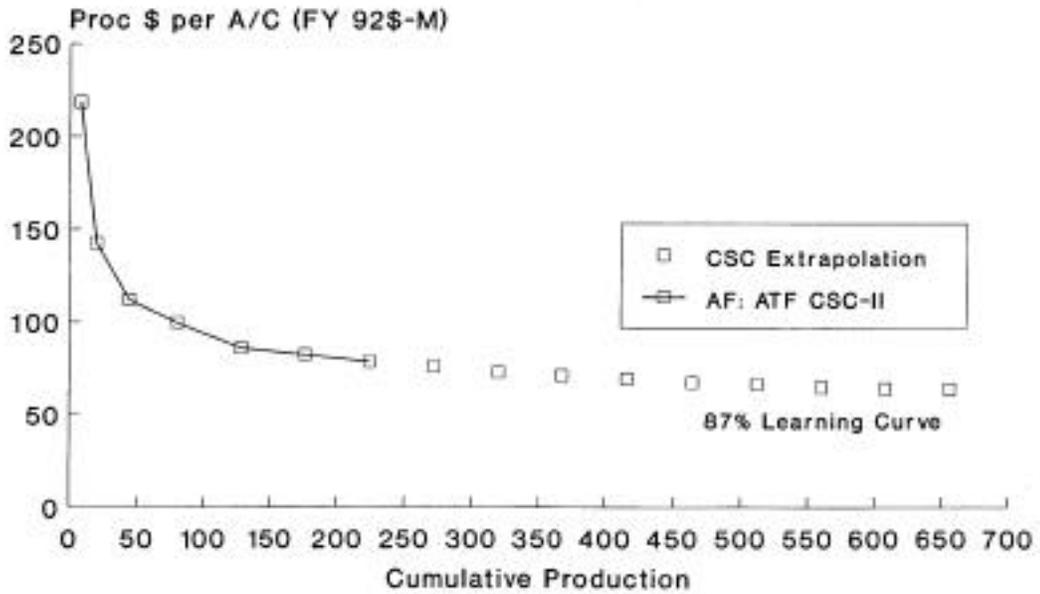
**FORCE MIX (ALTERNATIVE 1: OPTION 1)
Buy 656 ATF's, Retire A/C After 22 Years**



6/14/91
Does not include A-7s and F-4s
File: Mix_1A

Figure 6

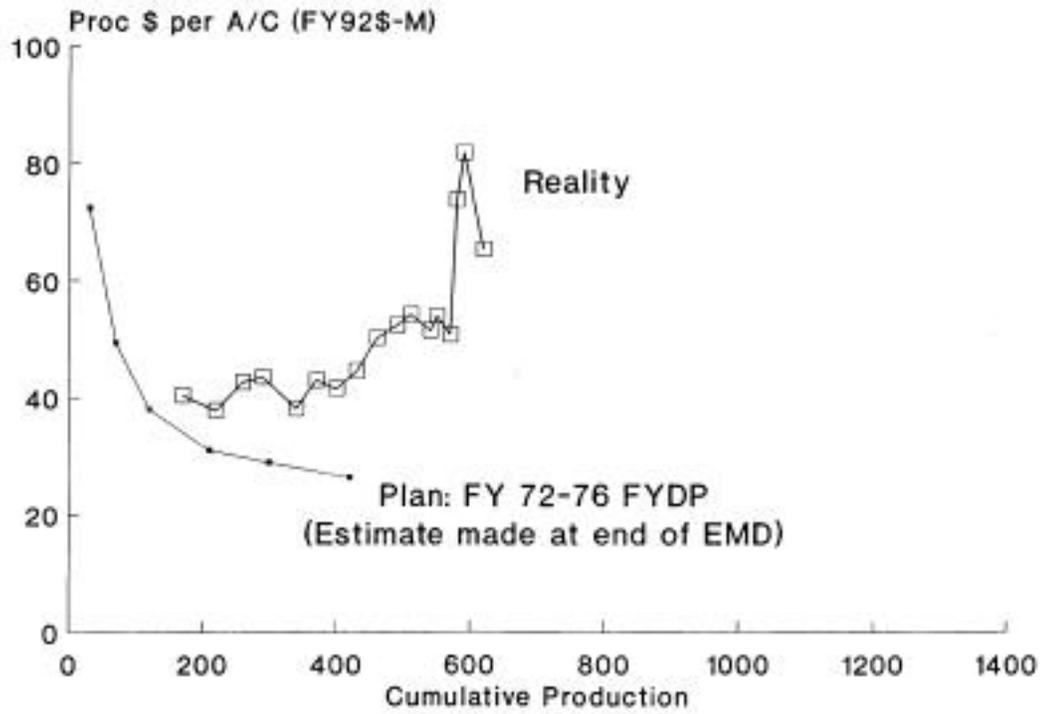
ATF Procurement Cost Prediction
Base Case: Pre-EMD Estimate
87% Learning Curve After 80th Unit



7/12/91
Source: AF - Extrapolated to 656 A/C
File: ATF\$_CSC

Figure 7

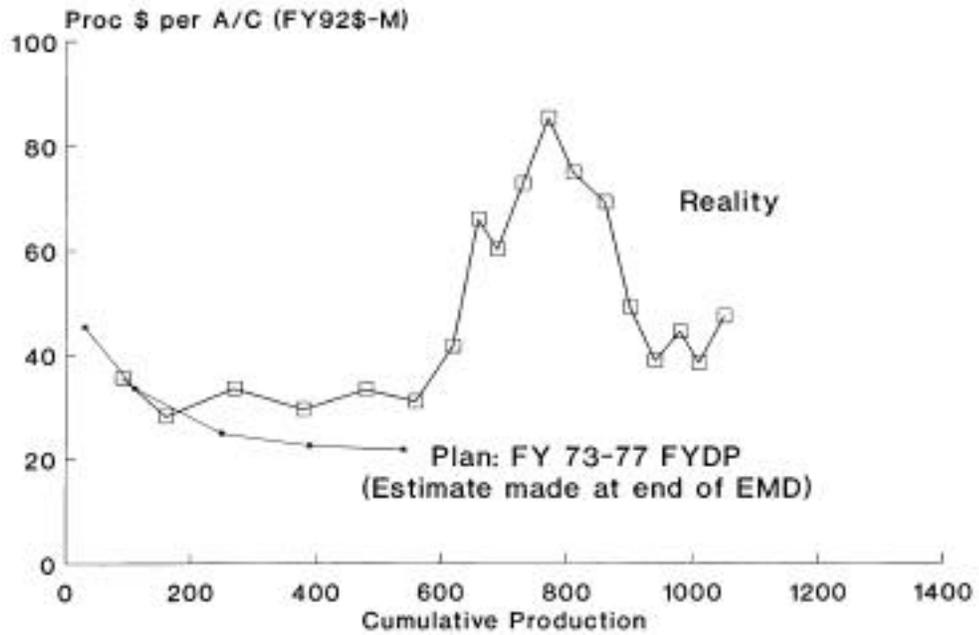
F-14: EARLY PLANS vs. REALITY



7/16/91: File Lrn_F-14
Note: FY 91 is last year of hist. data

Figure 8

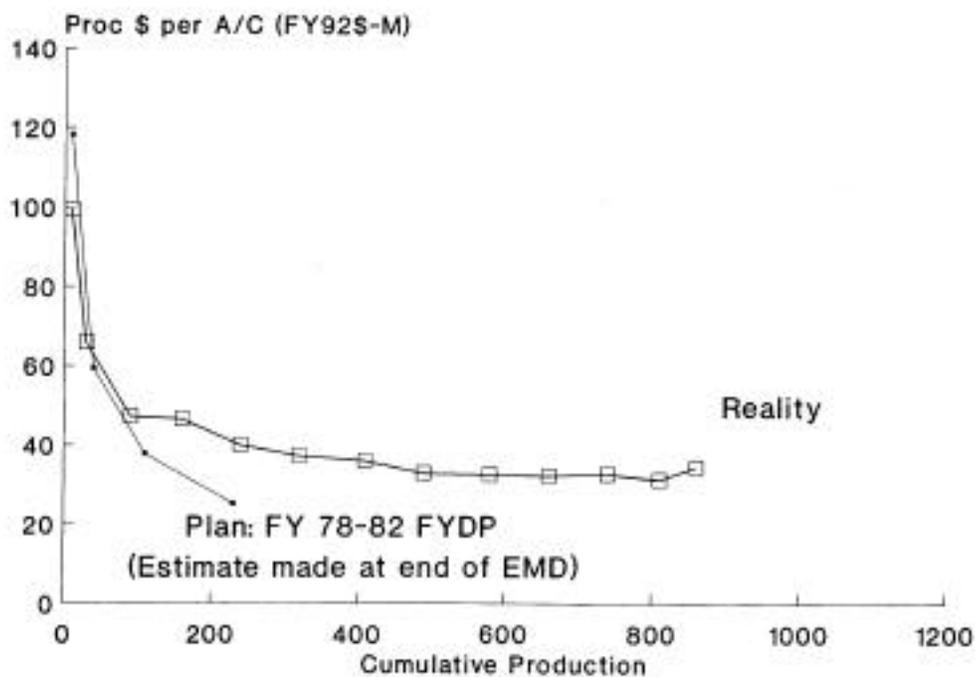
F-15: EARLY PLANS vs. REALITY



7/16/91: File Lrn..F-15
Note: FY 91 is last year of hist. data

Figure 9

F-18: EARLY PLANS vs. REALITY



7/16/91: File Lrn_F-18
Note: FY 91 is last year of hist. data