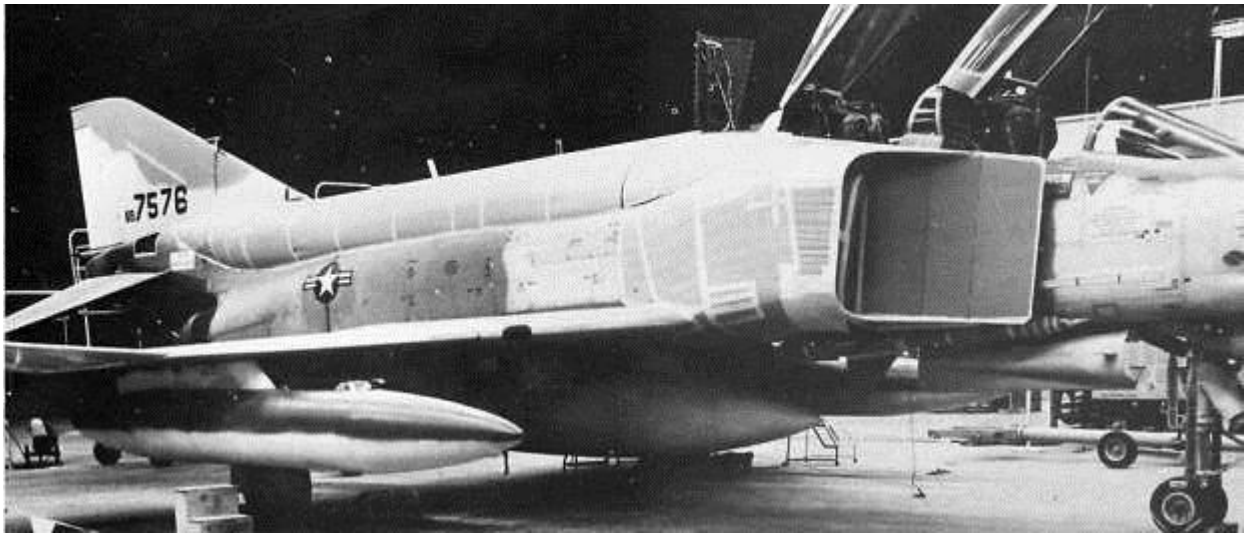
Redeveloping the F-4 Phantom II into a Mach 3+ Fighter/Spy Plane



The F-4X mockup. (public domain)

Few aircraft in history have flown to the same level of distinction as McDonnell Douglas' F-4 Phantom II. It was the jet that ushered in a new age of fighter aviation, proving itself on the front lines in a number of different conflicts with a variety of air forces around the world. As with any aircraft, regardless of its military or civilian purposes, early Phantoms came with their share of failings and faults. Further development led to the F-4E variant of the ugly fighter-bomber, widely regarded as the best all-around iteration of the Phantom. The Rhino, as US Air Force aircrew liked to call it, came with a capable AN/APQ-120 radar, two very powerful (and improved) General Electric J79 engines that could push it to Mach 2.2, and an internal M61 Vulcan cannon which previous Phantoms lacked (and sorely needed). The US began shopping around the Rhino in the late 1960s and '70s, and interest was quickly generated among prospective buyers. Eleven countries, other than the United States, wound up operating the Rhino, with Israel being one of the bunch, having bought a set of F-4E and RF-4E (recon) Phantoms for the IAF beginning in 1969.

An Israeli pilot, Shimshon Rozen, climbing into a McDonnell Douglas F-4E Phantom II during the Yom Kippur War. (Public Domain)

Known as the Sledgehammer in Israel, the IAF fighter jocks who flew it found the F-4E to be just as fast and versatile as they needed it. With a bit of training and tactics development, they could dish out a world of hurt and then some to the Soviet export fighters flown by Arab nations including Egypt and Jordan. The RF-4E Raven afforded Israeli Defense Forces commanders a much-needed (though very limited) aerial reconnaissance capability that they otherwise lacked. The IAF didn't possess high-flying SR-71 Blackbird or U-2 Dragon Lady spy planes, nor were satellites with photographic capabilities available to them at the time. Their requests to buy Martin RB-57F Canberra, outfitted with the revolutionary General Dynamics HIAC-1 camera system, were constantly rebuffed by the US State Department, with the reason being that selling Israel such technology would have likely thrown off a supposedly carefully-crafted strategic balance in the Middle East.

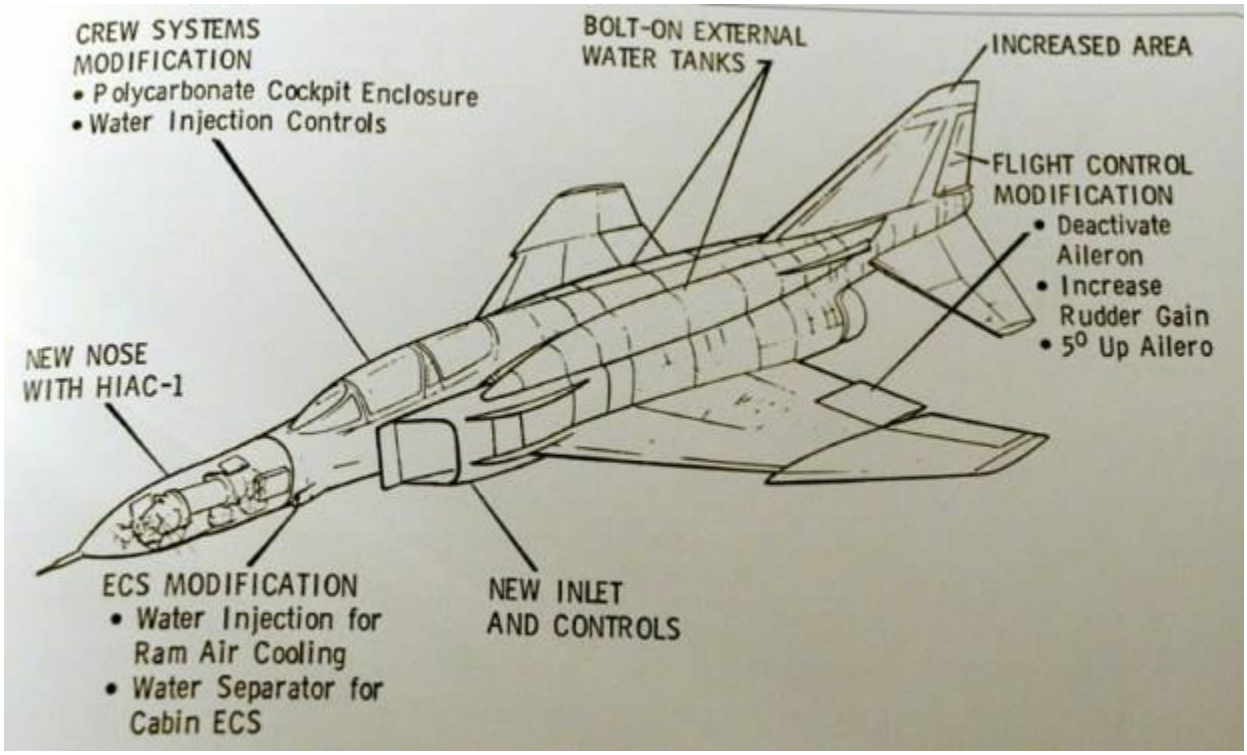
Around the time of Israel taking delivery of the Rhinos from the United States, the surface-to-air threat that they constantly faced worsened in the late 1960s/early 1970s, thanks to Egypt's more-than-cordial relationship with the Soviet Union. To assist the Egyptian military with bringing their anti-air crews up to proficiency standards, the USSR poured technical and military advisors into the country like vodka into shot glasses. Thus, towards the end of the 1967-1970 War of Attrition, the Egyptian military was able to set up an advanced network of SAM (surface-to-air missile) sites; terrible news for IAF pilots. Any pilot that stayed too long within the SAM station's radar ranges found themselves on the run just seconds later after being alerted to a missile launch in their general direction. Israeli fighters were getting blown out of the sky and by mid-1970, close to the war's end, five Israeli F-4E Sledgehammers were lost while two were written off due to being damaged beyond repair, all thanks to the Soviet-supplied SAMs. Staggering and extremely unacceptable numbers for an air force of Israel's size (at the time).

After active aerial combat ended, Israel still needed a way to monitor the Sinai region and Egypt for further SAM emplacement buildup, and the RF-4E was their only available option. The Raven wouldn't be able to function as the high-value resource to Israeli commanders that it once (briefly) was, however. Its cameras needed the aircraft to move into contested airspace for them to capture images with acceptable detail and resolution. And since it was basically just a very under-gunned version of the Sledgehammer, this meant that the RF-4E, like its armed counterpart, it would still be highly susceptible to SAMs. Israel needed an aircraft (and reconnaissance system) capable of LOROP (LOng Range Oblique Photography). This would allow them to spy on foreign military activity from the relatively safe confines of Israeli airspace. Interestingly enough, at the same time, a bigger, badder and faster problem began taking off from Egyptian air force bases in March of 1971.

The Soviet Union posted a bunch of MiG-25R Foxbat-B recon birds to Egypt, outfitted with a suite of cameras for intelligence gathering. While it wouldn't be actively engaging Israeli fighters (not that it realistically could, given its relative lack of armament), it would still be able to relay data on IDF troop positions to Egyptian intelligence officers, who would in turn be able to disseminate such vital information to aerial and

ground elements, keeping them updated on Israeli maneuvering. This was far from any ideal situation for the IAF, especially since they now needed to be able to chase the MiG-25Rs out of and away from Israeli airspace. The F-4, though a very fast jet, couldn't really catch up to the speedy Foxbat which could normally hit Mach 2.83 with the aid of its powerful Tumansky R-15 afterburning turbojets. And if it were absolutely necessary, Foxbat pilots could push their jets to Mach 3.2, though at the cost of irreparably mangling their engines.

The solution to Israel's speed issues came in the form of a proposal from General Dynamics to convert/modify existing F-4Es to a different engineering standard. The overall aerodynamics of the jet would largely remain the same, save for the inclusion of two large conformal tanks on both sides of the fuselage just above the engines, carrying around 2500 gallons of water (9600 liters for our friends who use the metric system). Now, you're thinking- wait a second… did I just read that right? What the heck are they going to do with 5000 gallons of water on a fighter jet?



The RF-4X's main modifications from its F-4E standard. (public domain)

Water injection. The boffins at General Dynamics figured that the secret to lifting the Phantom's speed was pre-compressor cooling (PCC for short), where water would be injected into the air rushing through the engine inlets on its way to the combustion cores, reducing the temperature of the air passing in. By cooling down the air, the mass and density would theoretically be increased, giving the F-4 a major improvement on its thrust output, especially at higher altitudes. The corporate suits at General Electric, the company that designed and built the Phantom's J79 engines, weren't thrilled with this

suggestion but nevertheless assisted nominally with the research into the concept. This wasn't anything especially new- General Dynamics had previously attempted something similar with the Convair F-106 Delta Dart, though the work that was put into modifying the F-106 never amounted to anything substantial. Testing done at the Arnold Engineering Development Center, operated by the USAF, found that with pre-compressor cooling, engines could be run with the afterburner engaged for incredible periods of time (e.g. they managed to keep a J75 going with the afterburner lit for 40 hours). PCC had also been used by McDonnell Douglas when the F-4 was first built, just to help break and set a few speed records with the then-new jet, though the system installed in the early F-4 was very basic and barebones, compared to what General Dynamics wanted to do with the F-4X. The new PCC setup for the F-4X would "mist" the water into the engine, thus preventing moisture buildup inside the engine. To make the most of PCC, the air intake inlets were redesigned with larger scoops and a redefined shape, improving the airflow moving into the compressor chambers. To help manage the airflow as efficiently as possible, controllable intake ramps were installed as well as vortex generators for both of the J79s installed. What was the final result of all of this? An F-4 Phantom II that could fly at more than three times the speed of sound for sustained dashes, and would be able to cruise at above Mach 2.4 during missions. The fastest fighter jet ever made (that we know of).

The US Air Force quickly gave up on the concept, floated to them first by General Dynamics before Israel got wind of it; likely due to the coming of the high-performance McDonnell Douglas F-15A. While Air Force brass were unwilling to demonstrate any semblance of interest in such an idea because of the impending air superiority fighter acquisition, the State Department had a different worry in mind. At that point in history, the SR-71, flown solely by the United States, gave the US an unparalleled and untouchable intelligence-gathering capability. Allowing foreign customers, even ones with closely-held allegiances to the US, the ability to posses and operate an aircraft with such strengths as the F-4X would be a less than optimal situation. Soviet human intelligence (HUMINT) agents would potentially garner information on the jet, or heaven forbid, actually take an F-4X for analysis, giving the USSR the opportunity to build and field a counter-aircraft that could take out the SR-71 and severely hinder the USAF/CIA's intel program. The government immediately banned the export of the jet. Working quickly, General Dynamics removed the F-4X's weapon systems and hardpoints, disarming the jet and circumventing the ban. Instead of flying as a fighter, the aircraft would be equipped with the previously-mentioned HIAC-1 LOROP camera in the nose. Dubbed the RF-4X, it wasn't the fighter that Israel wanted, but it still fit their reconnaissance purposes well.

After securing permission to shop the RF-4X to Israel in 1974, the, the Israeli Air Force loaned General Dynamics an F-4E (serial no. 69-7576) to work with as a mockup, and later, an RF-4X prototype/testbed. Physical work commenced on the RF-4X in November, soon after the aircraft's delivery, and carried on into the next year. Cardboard and papier-mache was used to simulate the new intake/inlet architecture, as well as the large PCC blister tanks on the sides of the fuselage. The nose of the Rhino was also taken apart and modified to house the HIAC-1. The IAF hounded General Dynamics to build

the PCC system as soon as possible, since their need was urgent. However, engineers discovered that they needed far more time than what Israel had to offer. After the USAF withdrew interest from the RF-4X, the program was cut. There was no way Israel could fund such a project on its own. The fastest Phantom in history was dead, having never flown or even proceeded past the mockup stage.

Phantom phanatics, I hope you had a box of tissues handy while reading the above.

The F-4X mockup. (Public domain)

Credit: http://tacairnet.com