



LAVI PROJECT

In 1983, I was assigned to the Israeli Lavi Fighter Project which was located in the trailers east of the 503 building. Milt Parker was the Program Manager and Skip Stohlgren was the Project Engineer. Milt and Skip had been involved in the program since the proposal stage and were instrumental in attaining a contract from Israeli Aircraft Industries (IAI).

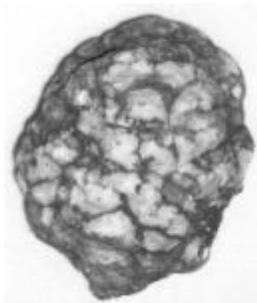
After the usual interview by Milt, he told me he wanted some Public Relation (PR) items. So I had to arrange for the art work and creation of 50 Israeli blue and white caps with a blue and white LAVI aircraft on the front face.. He wished to hand these caps out to important Israeli personnel and to select Garrett people. I accomplished this task even though I did not like this type of operation! Reason? A few people would be made happy, but there would be many of my fellow workers made very unhappy and I would be in their "Dog House!" Further, I could never

understand how Milt had funds for such an operation while exceeding his budget and not being called on the carpet for over expenditures.

The trailer was not the most pleasant work environment. It shook , rattled and rolled with the wind and as people walked around. The environmental controls were not very good either.

The offices were arranged around the perimeter, the center contained desks and tables for our crew. Since the Lavi Project was the only occupant, we became a close group with all of our supporting people on the premises.

My family and I had been members of the AiResearch Rock Hound Club for many years.



We participated in many field trips, meetings and other activities of the club. On one of the field trips, I found several geodes which were called “Brain Rocks” for that is how they appeared. One was about the size of a small grapefruit. Hoping that it may have a crystalline interior, I asked Rolly Klaprott to cut it into halves, which he did using the Club’s equipment. Sadly, it was solid quartz but still pretty and the halves served me well as paper weights while reviewing print vellums. I mention this only to tell of the following.

Our cleaning crew consisted of one portly lady who spent most of the day in the trailer. She had the bad habit of going to sleep every afternoon, after her lunch, in front of my office. She snored so loud that the windows rattled! I would wake her and it would be quiet for a short period and start once again. Very distracting for the Lavi crew!

For some reason, she took a liking for me and started visiting every day. She expressed interest in my Brain Rock paper weights and claimed to be a Rock Hound. Fortunately, she did not last very long for it appears she had sticky fingers. Along with my missing Brain Rock paper weights, there were several other reports of missing items from project desks, so she was escorted out! My afternoons became much quieter!

I became responsible for the detail design and met with Guy Wagner to establish the design requirements. Guy assigned John Robertson as the Design Engineer. By this time John

was well trained in the computer assisted design program. It was interesting to watch him operate the “Mouse” and see items jump on the screen.

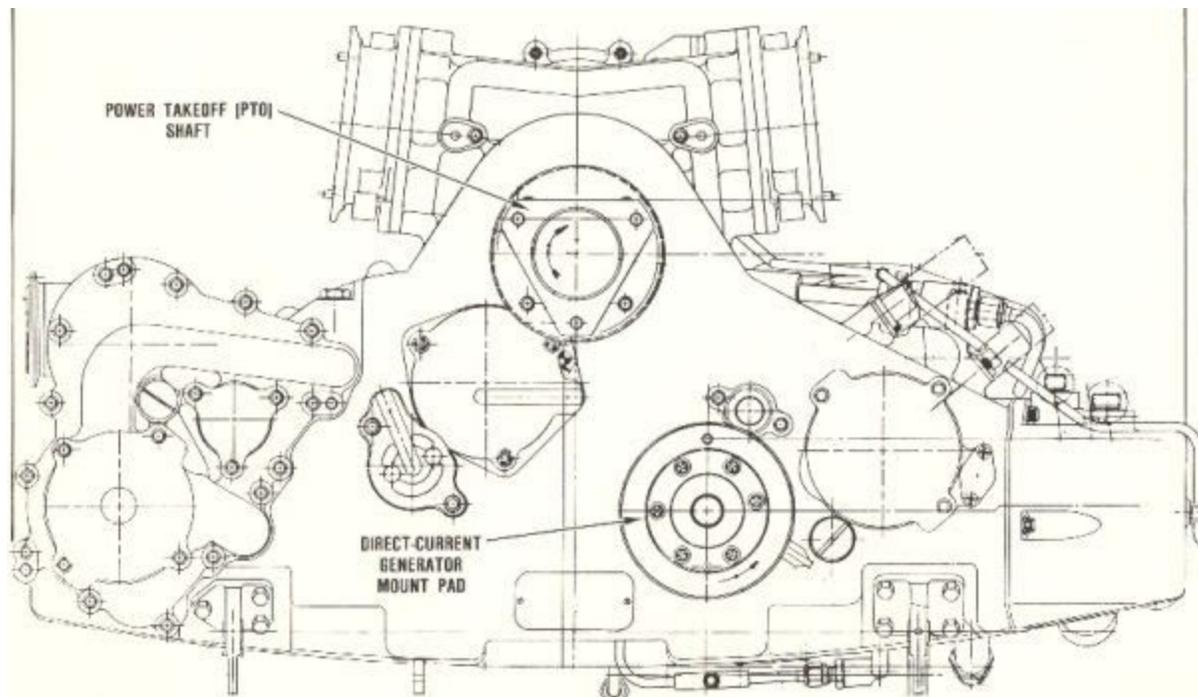
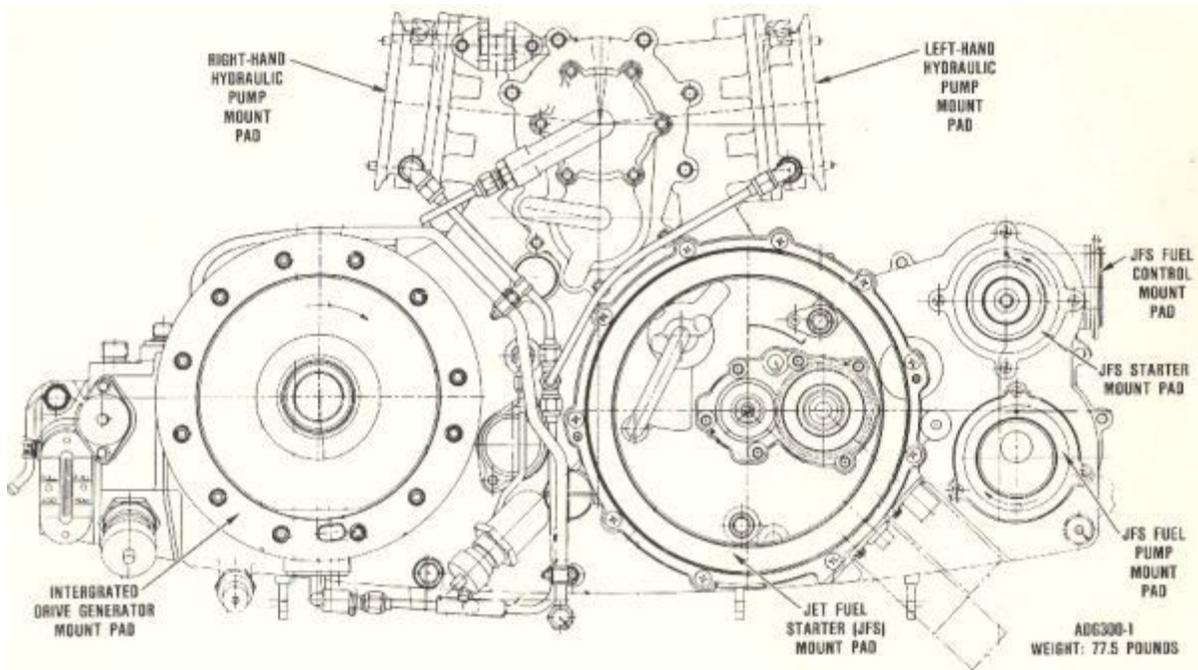
The LAVI secondary power system was designated as Model SPS300-1. The system was to be composed of four major components, a Jet Fuel Starter (JFS), an Accessory Drive Gearbox (ADG), a Power Take-Off Shaft (PTO) and an Electronic Control Unit (ECU). All components of the Model SPS300-1 except the ECU are airframe mounted on a bulkhead in a compartment just forward and below the main engine.

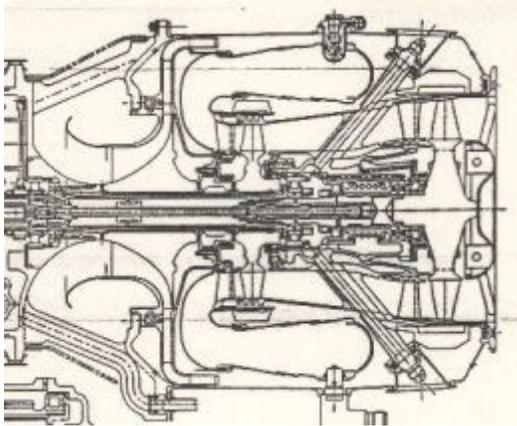
The ECU is contained in a single enclosure, mounted remotely from the JFS to provide an environment compatible with electronic equipment. The ECU provides the system operational logic, including JFS fuel/speed control.

The PTO shaft passes through the bulkhead and connects the ADG to the main engine. The shaft transmits JFS power to the main engine for starting, and also from the main engine to the ADG, during mission mode operation. The PTO shaft is a flexible diaphragm shaft manufactured by the Bendix Fluid Power Division.

The JFS is utilized for main engine starting, both on the ground and in flight. The JFS, a two-spool design, is a modification of the JFS used on the U.S. Air Force F-15 aircraft. The gas generator spool consists of a single-stage centrifugal compressor, a reverse-flow annular combustor and a single-stage axial turbine. The power turbine spool consists of a single-stage axial turbine. The power turbine provides shaft power via the ADG to the aircraft main engine for engine motoring and starting.

The ADG is a new design for the LAVI installation. The main housing is a single-piece magnesium casting. The housing is match-machined with three different covers to form a four piece housing assembly. Mounting provisions are provided for the JFS and JFS start motor, fuel control and fuel pump, as well as the customer furnished Integrated Drive Generator (IDG), two hydraulic pumps and a dc generator.





The major modification in the JFS was the arrangement of the axial containment feature in the turbine exhaust. The space in Lavi was not long enough to utilize the F-15 JFS part. I instructed John to utilize a V-band clamp flange with five tangential rods that would be in tension when impacted during a power turbine failure. All parts, including the inner body, had to be within the V-band flange envelope. This design brought objections from our stress people, but I told them that it would go into test. If failure occurred during containment testing, it would be redesigned.

Redesigned Axial
Feature

Containment

John produced, Drawing 3610930 LAVI SYSTEM LAYOUT JFS190-10/ADG300-1, a detailed cross-sectional drawing displaying all of the mechanical features of the system. The following page presents a copy of this drawing,

gearbox castings. I found that magnesium casting foundries were very limited in number and in capabilities. We finally settled on a foundry in the Los Angeles area near Watts, you can't imagine the graffiti!. The owner of the company told me he had repainted the building many times. Finally he just gave up!

The foundry plant manager and chief metallurgist of the casting facility was a tall, impressive man from Punjab, India. I lost his business card long ago and can not recall his name. I do remember it was very long and included almost every letter, some more than once, in the English alphabet. So due to the difficult pronunciation, we just called him "Singh" (pronounced Sing). He was of the Sikhism religion and therefore did not cut his hair or shave. In the Sikh tradition, he wore a very colorful turban in which he tucked his beard and hair. Every time he visited our facility, he had matching bright colored clothes and a turban that would attract much attention.

Unknown to me at this time, there were problems between Milt and the IAI managers. This situation resulted in Phil Garner replacing Milt as our Program Manager. There was an immediate improvement in attitude and work environment.

January 21, 1984 Phil and I made our first trip to Israel. Skip, Steve La Croix (controls), Brunett (Quality Control) and his wife completed our crew. Skip and Steve had visited the Lavi project once before and were helpful in the travel problems.. The travel was totally with TWA (Thousands Wait in Anguish or Terror While Aloft).

All kidding aside, TWA provided us with good service, especially with the Boeing 747. The trip to Tel Aviv was long and tiresome. Upon arrival in New York, you entered international travel which meant passports and customs. Therefore movement was restricted, from New York, to Paris and on to Tel Aviv, until you cleared customs. Security? In Paris and Tel Aviv armed police and soldiers were visible everywhere. The custom people in Tel Aviv spoke excellent English and were very thorough in finding out why one was visiting Israel. As soon as custom was cleared, it was necessary to exchange dollars for shekels. Israel was going through a very serious inflation period. When I left the money exchange with a hand full of 10,000 Shekel notes, I did not know if I should feel wealthy or feel sorry for the Israelis. We were cautioned to avoid the money traders that were active on the streets. Some were actually officers who entrapped those who would exchange dollars for shekels.

The shortest time for one of these trips was 24 hours. Therefore, the company attempted to make the trip as easy and as comfortable as possible, we flew in business class. Our schedule was arranged so we had Saturday and Sunday free to overcome "jet lag." We had first class

accommodations, at the Tel Aviv Hilton, on the top floor for security reasons. A lounge was available on this floor which gave us a place to relax in a very casual way.



The free weekends permitted seeing some of Israel. This time we boarded a tour bus for a sightseeing trip with the prime objective to visit Masada. We departed Tel Aviv early with a driver and a very knowledgeable narrator. They were Jewish men and very proud of what their people had accomplished in establishing Israel. A common trait I found in all Israelis I met. As we proceeded southeast toward the Jordan border, the narrator pointed out the limestone along the way which was the building material utilized in many of the ancient buildings that we would see. We traveled past the walled city of Jerusalem (visit to this city was not a part of our tour) and soon turned north to Jericho. We visited an active archaeological dig and were told that they were searching for the Walls of Jericho. The only thing in sight was a large hole and no activity due to the weekend. The valley along the Jordan River had large areas under cultivation and the Israel developed drip irrigation system farming methods were proudly pointed out. There were large citrus groves and we were told that Israel had become the fruit and vegetable garden of Europe.

The tour continued on the road that headed south along the west bank of the Dead Sea. The cave where the Dead Sea Scrolls were found was pointed out and the ancient trails where shepherds still guided their herds up and down the mountain side. We finally reached Masada.

Masada was built by King Herod prior to the birth of Christ. It was his royal citadel, in 40 B.C. he fled from Jerusalem to Masada with his family in a moment of danger. Later he fortified and furnished the citadel as a refuge fearing “a peril from Jewish people” and more seriously from “Cleopatra of Egypt”. During the Jewish Revolt against the Roman Empire it became the Zealots (rebels) last outpost. Masada was a site of the most dramatic and symbolic act in Jewish history, where the rebels chose mass suicide rather than submit to Roman capture.



The Masada Rock - view from the west

From the Parking Lot

Masada is located at the top of an isolated rock on the edge of the Judean Desert and the Dead Sea valley. The flat top of the rock has a rhomboid shape, elongated from north to south. Its height is 440 feet above the Dead Sea (50 meters above sea level); it is isolated from its surroundings by deep gorges on all sides. This position forms a natural fortification, and the place is natural to build a fortress. The access in ancient times was by a steep “Snake Path” from the east (from the Dead Sea), “the White Rock” from the west, and two approaches from north and south, all rather difficult to climb. Today there is an easy 10-minute ascent from the west, and the cable-car from the east. The “Snake Path” is still open for tourists wishing to use this ancient trail.

Masada has become a symbol of courage for the present day Jewish people. The “Right of Passage” for new members of the Israeli armed forces is a march up the “Snake Path” and bivouac on top of Masada. We utilized the cable-car!

We were surrounded by archaeological wonders that had remained unknown until 1838. Modern excavation and limited restoration was not started until 1963, which ultimately revealed evidence of King Herod’s fortress and living quarters. There were drainage systems that filled cisterns with water, an extensive water system, remains of storerooms, a large bath house, living quarters, a synagogue and the royal palace. As we journeyed through 2000 years of time, we saw the spectacular planning, engineering and workmanship lying in the broken stone and pottery.



Food Storage Room



Living Quarters with Mosaic



Synagogue

One of many restored
Fireplaces added by
Zealots



Steam Bath House- A double floor rested on these pillars providing the fire and creation of steam



Water Storage- One of 12 larger cisterns for water collection

It was here that the Zealots resisted the siege of the Roman Tenth Legion. Just prior to our visit, a very timely presentation of a television program gave an excellent account of this event. As I looked down from the top of Masada, I could see the remains of the stone wall with its eight large camps surrounding the base of the fortress. The remains of the earthen assault ramp, built by slaves, from which a battering ram was used to break the walls of Masada, was still visible (the replica battering ram used in the movie was visible in the valley below). After a siege of almost a year, the Romans entered the silent fortress and found mass suicide (only two women and five children survived by hiding in a cave).



Above--one of eight stone Roman Encampment sites and a section of the stone wall which completely surrounded the mountain. Still visible after almost 2000 years. They are as they were found, i.e., they are not rebuilt or restored. The right photograph shows the badly eroded remains of the original ramp, built by slaves, that was used to locate a battering ram for destruction of the fortress wall. The dark object at the bottom is the battering ram prop used in the television movie.

As we departed from Masada we stopped at the Dead Sea to observe people in the water. Due to the density of the water, it appeared as if they were lying on top of the sea. There was also an area where one could have a very black mud bath which was claimed to cure everything! I think Steve La Croix was the only member of our crew who took advantage of this service.

The return trip gave us the opportunity to learn the meaning of "baksheesh." Somewhere along the way, at a stop, we were besieged by a group of desert children, probably Beduoin, chanting this term. Our guide explained that they were begging for money. The men of our tour crew were not relieved at the Jerusalem station, so we had a rather worn out and cross crew on our return to Tel Aviv. We were pleased to settle into the lounge and have a couple of cool ones after a long and eventful day.

We were at the entry of the IAI plant early Monday morning. Security was very obvious so we drove up to the guard office. Concrete inverted T shaped barriers were arranged to require a serpentine route with a stop midway where several soldiers checked us out. It was

uncomfortable with UZI barrels hanging in the windows as they talked to us and checked our papers. It was common to see many armed people everywhere we went.

Once we were cleared and escorted into the Engineering Offices, we met Shraga Bar Nissan, Phil's counterpart at IAI, and approximately sixteen other IAI personnel. The first order of business was a tour of the IAI facility. I was impressed by the modern equipment and the arrangement of the factory area. We broke for lunch at the cafeteria, very similar to an Army Mess Hall and smelled just as I remembered. The entire group sat at a long table and the meal was quite an experience, for there was much passing around food and drinks, far more than I normally ate for lunch, but the IAI employees considered this meal as a part of their pay and they did eat! I was sitting by their Quality Control Engineer and had an interesting conversation with him. He had immigrated from one of the central European countries and could speak seven languages, but he was fluent in Yiddish and not Hebrew! I asked him how he had been able to learn all of these and he said that his country had been invaded by so many others that he had to learn the invaders language or he would not fare very well.

During our talk he cautioned me about the security in the facility and told me to never leave any package or briefcase unattended. He said shortly after he started working, he left his office and prior to leaving the parking lot he realized that he had left something back at the office. When he entered the office, he set his briefcase down by the door. When he came out the briefcase was not there! It had been picked up, taken to an area where it was destroyed by an explosive charge. His papers were scattered all over an empty field! That evening I passed this information on to all of our party.

The tour ended at the office of the head man of IAI where we received a good briefing on the status of the LAVI program and more refreshments. The Israelis believe in food and drink! The long day ended with an exit via the same procedure as our day started. Security, guns and concrete barriers to leave the airport.

The next day, after we cleared security procedures it was my show. I presented the design features and answered any questions concerning the engineering aspects of the JFS190-10 and the ADG300-1. The design review was in the same conference room where we started the previous day's activities. A long table with participants sitting on both sides and I displayed material and talked from one end of the table. The discussion of the design details proceeded very well. The only problem was when the Israeli people had anything they wanted to discuss, they would talk in Hebrew until they had settled things and then come back to us in English. This resulted in long periods of no action on my part.

As a part of my presentation, I displayed various hardware and passed it around for inspection. The Israeli engineers had expressed concern about failures which could result in

the engine driving the power turbine to destructive overspeed. One of the parts was a “mechanical fuse,” as I called it. I had borrowed it from Starter Project Engineer Kal Sorenson. Those present were informed that this mechanism had been a successful protective feature in our starters for many years.

The three-piece assembly is composed of two splined couplings which incorporate three jaws, parallel to the shaft center line, with inclined planes radiating from the jaws (the arrangement is similar to the Bendix clutch used on automobile starters). The third element is a, small centrally located, coaxial shaft that permits assembly under a slight torsional load. When subjected to reverse torque, the protective feature will separate axially and disconnect the power turbine wheel from the main engine. To reassemble the “mechanical fuse” requires removal of the JFS.

The unit, being passed around, was fully assembled. As it arrived at the IAI Chief Engineer, I watched as he put it out of sight and soon thereafter he placed the three parts on the table. He had applied reverse torque to the assembly by hand! This required strength plus some tolerance to pain, for the splines had fairly sharp edges.

Since this was my first trip to Israel, I must tell of some observations. I was quite surprised at the crowds out in the evenings and nights. People were walking and having a good time. We mingled with the crowds and never had any trouble.

We had dinner in several interesting restaurants. One was directly across from our hotel, I think the name was Poon Dang, you can imagine what we called this place. It was a small grungy place, fish nets hanging from the ceiling and a dumb waiter, in which, the food was brought from the basement. I often wondered what really happened down there! But the owner was a jovial man who often set at with us and enjoyed shooting the “bull.” Regardless of appearance, he served the best fillet of sole I have ever had. Since we were right on the shore of the Mediterranean, sea food was always fresh and prepared well.

Another restaurant, which was quite a walk along the shoreline from the hotel, was where I had my first experience with Israeli service of “after dinner coffee.” We had finished an excellent dinner with our IAI guest and we were having dessert and coffee. It was dark in the area and I proceeded to uncover my coffee cup and take a sip. My exclamation of “This the weakest coffee I have ever had!” brought much laughter. That’s when I learned that coffee was served with a package on top of a cup of hot water and you had to make your own brew! The cover, I had removed, was the makings!

After eight days of successful meetings, we started the trip back to Phoenix. You think security in the States is strict, the Israelis even in those days were very thorough. We were

advised to be at the airport two hours minimum prior to boarding the aircraft. While in line waiting to check in, I observed a family who were either Arab or Beduoin. Beside the man, there were two children and his wife who was in a dark full covering dress. They and their luggage were removed into a closed door room. After approximately an hour they were released into the boarding area. My investigation required only about 15/20 minutes of the usual questions and opening of both my checked luggage and briefcase, which were inspected thoroughly.

Once again, it was flying with TWA in a Boeing 747 with the stop in Paris. Since there was no leaving the International area, we settled into a lounge and one of the rounds was on me. I gave the Frenchman waiter a twenty and he made change in francs! I had quite an argument trying to convince him that I had no use for French money where I was going. I lost and arrived home with an addition to my "Short Snorter." A WWII ritual involving a collection of paper money from foreign countries visited. Being caught without yours, cost you a round of drinks.

Traveling across the Atlantic via the Great Circle route you see Iceland and Greenland and enter the North American airspace in Canada. It is interesting to see all of the area from above 30,000 feet. But I did have a problem, my seat was on the left side and just aft of the bulkhead between Business Class and First Class. The Service Room for the First Class passengers was right in front of my seat. Every time one of the stewards/stewardesses prepared something for their guest and stepped back from that area they stepped on my foot! The head Steward apologized, but I could not move, for the aircraft was full. The stepping on my foot happened quite often and sleep was almost impossible. As I deplaned in New York, the Steward gave me a bottle of wine with an additional apology. When we arrived in Phoenix, I gave the wine to Skip. It had been a long and successful trip. We were glad to be home!

During his briefing, of the interested parties, the following work day, Skip said "It was Abraham, Isaac and Gammill!" which received much laughter. But I appreciated the comment, for it proved that we had a good meeting. It was the result of good team effort, in which we made many friends and established a good relationship with the IAI personnel.

The project reached a point where more personnel was required, so Roger Payne, Rick Dorsey, Steve Woodard, Jim Sullivan (Fluid Controls) and Audie Scott (Electronic Controls) joined the group. Roger and Steve initiated the assembly and test planning, Rick became the coordinator with Bendix for the design and testing of the PTO shaft, Jim was responsible for all control components and Audie had the difficult task of the coordinating the ECU with AiResearch Electronic Systems Division in Tucson.

The project was assigned two student engineers during the summer vacation. I received a good looking blonde girl who was an ASU sophomore. The only short time job I could assign her was weight calculations as drawings were released.

The company may have thought this was a good idea, but a good looking female results in many young studs wanting to help her! Instead of gaining another hand, I had too many people doing the same job (mostly shooting the bull around her desk)!

At the end of summer, the students returned to school. Personnel required a performance review and it fell my duty to answer specific items about this young lady. Before I filled out the review, I consulted with Don Birmingham and Jackson Milligan, Designer and Checker, for whom she had been doing the weight calculations. They indicated she had not done a good job, in fact, Jackson said that he had to redo many of her calculations due to errors. One review question was "Would you hire this person?" which I answered "No." Some time afterwards, an upset Skip came into my office and asked "What the hell did you say?" It became his task to explain my "politically incorrect," but honest answer. As a result, I learned that her father was a Garrett employee and that he was very upset about my review. They asked and I told the truth. Done!

I left, with everything in good hands, for a three week vacation. When I returned I found that John Robertson had violated one of my design requirements concerning wet sump gear boxes. I always required that the sump be maintained as calm as possible by returning relief or discharged oil from all control components to the inlet of the oil pump. This reduces the amount of fluid movement within the sump, reduces foaming and improves adverse attitude performance. The gear box drawings had been released to the foundry. When I called Singh, he informed me he had finished the two development casting and was preparing to deliver. We had no alternative but to continue and make changes later. So our development test ADG units would not be of the Qualification Test configuration.

In the meanwhile, Rick Dorsey had prepared the test procedures for bench testing the PTO shaft. Testing was to be conducted at the Bendix facility in Red Bank, NJ. The IAI specification required that PTO shaft display no critical resonance within the range of 0 to 150 percent of PTO operational speed. The test required mounting features that represented the ADG and engine interfaces with the PTO shaft. These laboratory (boiler plate) adaptations were designed and fabricated to be used in the Bendix test facility. Rick was off with the hardware to assist and monitor the testing.

Audie Scott was very involved with Tucson to accomplish the completion of the design and delivery of our development Electronic Control Units.

On September 9, Phil Garner, Steve LaCroix and I arrived in Israel after a relatively easy trip with TWA. My only problem, after clearing Tel Aviv customs and money exchange, was I could not find my luggage (one of those old hard case Samsonite cases). There was an identical case still in the area, but it was not mine! Naturally, as soon as there is a problem, no one speaks English! I was holding up Phil and Steve and becoming more frustrated and mad as time passed. Finally an obvious desert family came in carrying my case! With an apology, which I could not understand, he returned my case. My suitcase was most likely headed out into the desert, to a Beduoin tent, with my camera and a box of my fine cigars, two irreplaceable items!

On our first off day, we joined a tourist group for a guided tour to the Sea of Galilee. We departed Tel Aviv in a large tour bus heading north. At Haifa, we turned southeast and reached our first stop in Nazareth. Naturally, the stop was at a large tourist trap store. Not being interested in the items for sale, I just stood outside at the corner of the building and observed what the local people were doing. When I heard a noise that caused me to turn, I observed a woman, on the second floor, throw the families waste out of a window into a vacant lot. The lot was covered with a mass of garbage and sewage. Apparently, Nazareth was not participating in the plumbing modernization that was happening in Israel. This may have been political, for it appeared that Nazareth was primarily an Arab town.

Our next stop was Tiberias on the west coast of the Sea of Galilee. We boarded a boat and sailed north to Capernaum, an ancient city that lay in ruins.



On the Sea of Galilee



Ancient City of Capernaum



Phil among the Columns



Phil and Steve on the Jordan River

We spent most of the morning exploring the site and returned to Tiberias in time for lunch at a local restaurant. Most of the travelers had Simon Peter fish from the Sea of Galilee. The fish had many fins and lots of bones! Afterwards we boarded the bus and traveled to the south end of the sea and visited the Jordan River.

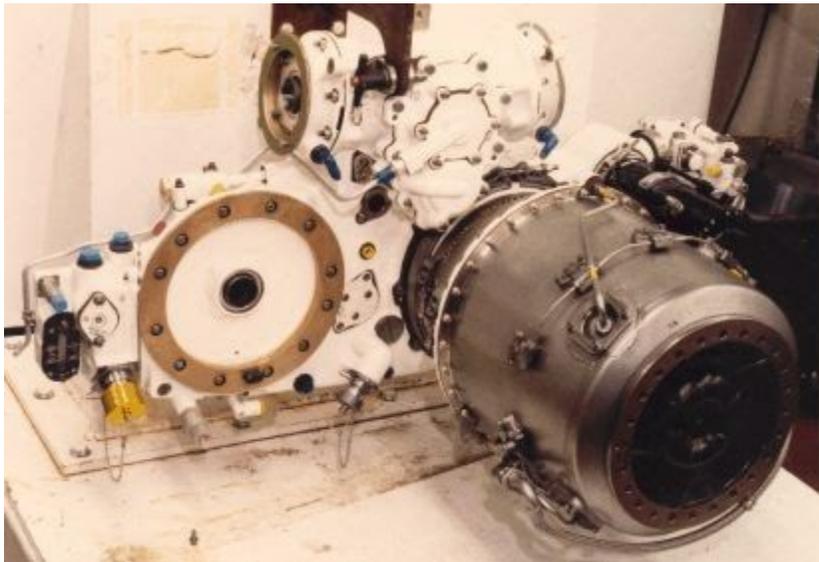
The return route was through the small town Afula. Along this route the tour guide pointed out where it is thought that Jesus delivered The Sermon on the Mount. We reached the coast at Hadera and proceeded south to Tel Aviv. It was a long day full of history and interesting places. Sunday we just had a restful day.

For the next nine days there were meetings reviewing the status of the program. Phil had many separate meetings with IAI managers and Steve and I covered the progress of the design, fabrication of the development hardware, test planning and the status of the overall program. It was a successful series of meetings.

The return trip home was uneventful, but there was a very comical event as we were waiting to recover our luggage in New York. A small man, who appeared to be an Irishman, was very talkative and had obviously partaken of too much of the first class liquid refreshments! As the luggage carousel delivered the bags, he grabbed a very large one and was immediately pulled down and away he went holding on, talking and sliding along the floor. He never gave up as he disappeared around the far curve. Everyone laughed and cleared the way for this happy and tenacious man. I assume a Red Cap came to his rescue somewhere in the back of the carousel.

IAI engineering expressed an item of concern during the meetings. What would the system response be if there were a disconnection of the power turbine due to either a separation of the mechanical fuse or a sheared shaft. The analysis of six cases, that involved both engine starting and accessory drive modes, predicted that the released power turbine could attain a speed of 98000 rpm in the worst case. A report was submitted to IAI for review and comment. I do not recall the date, but sometime during this period, Skip Stohlgren departed the Lavi Program and became the Project Engineer on one of the GTCP36 Programs.

As the year came to an end, the fabrication of the development units was completed. One of the test units is shown in the following photograph.

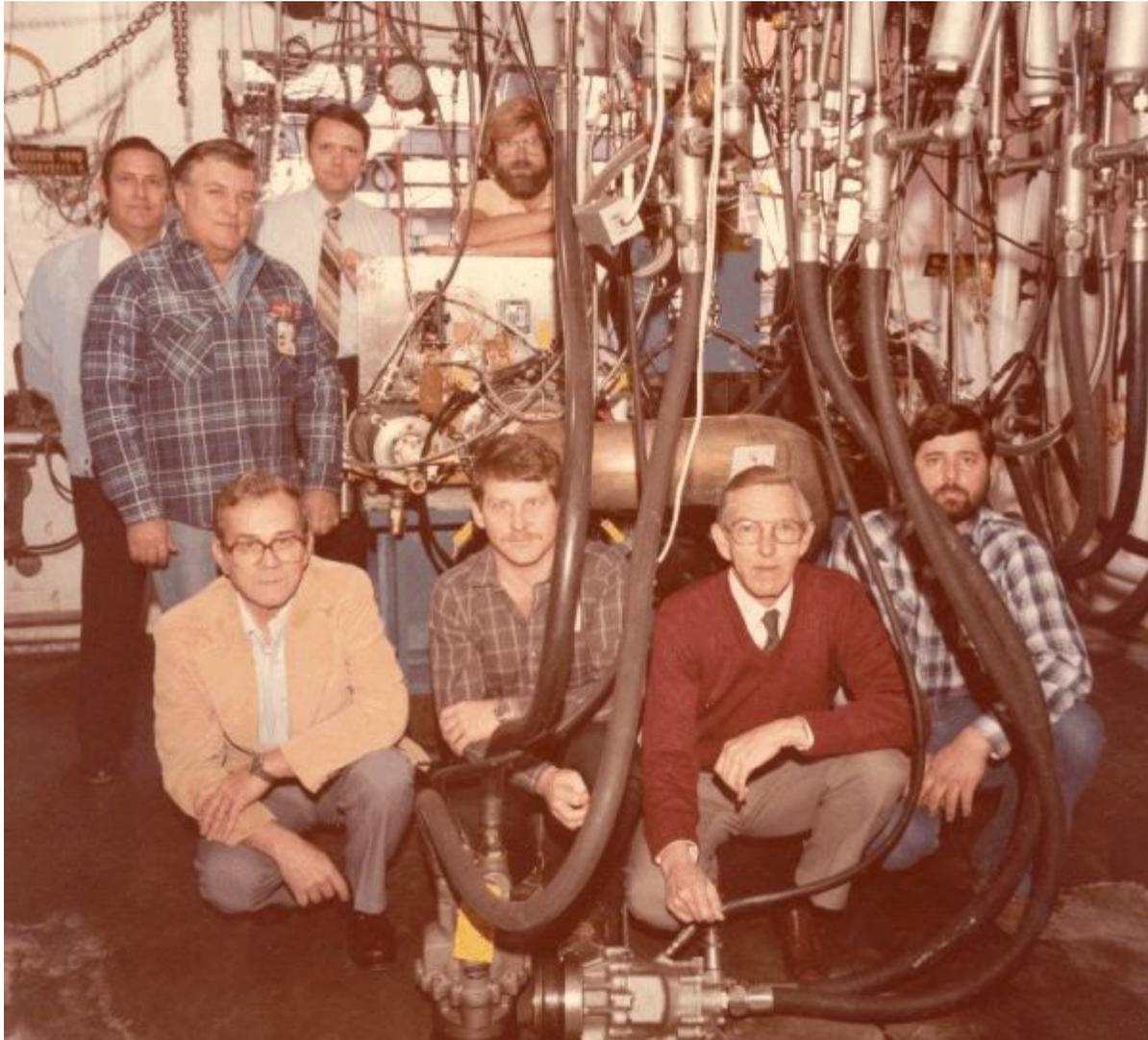


With the increased workload, Carl Pugliese, Wayne Schmidt and John Volkman joined the crew. The first development test system in the test cell is shown in the following photograph.

During the development test program, we often had IAI engineering visitors as observers. On one occasion, I spent a Saturday with two of these visitors (one was my little tank mechanic buddy, the other an Egyptian that I never carried for). At noon, we went to Bob's Big Apple.

Even though they were probably of a faith that precluded eating pork, they both ordered ham sandwiches and followed with pork sandwiches. As I have said before these guys could really eat and this time, away from home, violated their code!

Phil Garner and I received a nice surprise. Doug Jones issued the following letter about our performance on the Lavi Project.



LAVI SYSTEM IN LABORATORY TEST CELL

Standing L-R: Marty Bleigh, Ez Baumer, -----and Steve Woodard

Kneeling L-R: Guy Wagner, Rick Dorsey, John Robertson and Chuck Kocmich

GARRETT TURBINE ENGINE COMPANY
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA
OFFICE MEMO

DATE: August 27, 1985

TO: Bob Choulet/John Boppert
J.P. Frignac
Bob Von Flue

FROM: Doug Jones

SUBJECT: LAVI SPS, MEETING 8/26/85

Shraga Bar Nissan, IAI Deputy Manager for LAVI, indicated to me that Phil Garner and Ed Gammill have turned this program around and restored this effort to Garrett standards; and he is very pleased to report this to his management.

Phil, Ed, and other contributors to this further evidence of a 180 degree change in our customer's attitude are to be congratulated.

Great job!
JH

Doug Jones
Doug Jones

DJ:jn

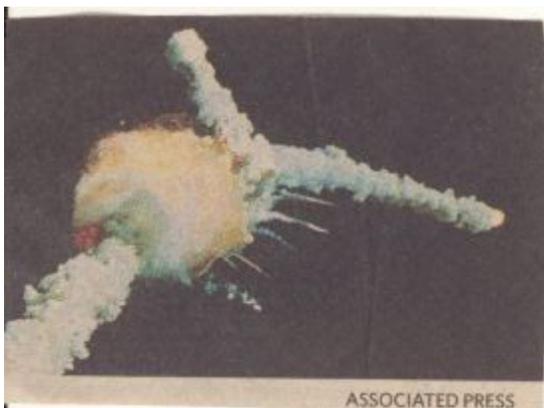
1985 was a good year for John Boppert, for in August he became the Senior Vice President of Engineering, J.P. Frignac replaced John as the VP of Engineering and Bob Von Flue became the Chief Engineer. Another good thing, in December we finally moved out of the trailers into the Barnes Building (later became the 1301 Building) The west side of the building was solid large clear glass windows. The afternoon sun became vicious from both the glare and heat. Our offices were on the second floor which waved up and down from people's movement. It was very distracting. I predicted that the floor will fail one day due to low cycle fatigue!

As the new year opened, we were on the way to Tel Aviv for another status meeting. This was a miserable trip! We checked into the New York TWA International travel area and were aboard Lockheed L1011 (first and only, thank GOD, time) we were told that it could not take off due to an APU (Canadian Pratt Whitney PT6 version) problem. Because we had cleared customs, boarded the aircraft and were in a secure area, we could not leave the area. We were stuck for over eight hours, until another L1011 was brought in from Los Angeles! It was a boring, tiresome wait without comfortable facilities because everything closed down for the night! It required 36 hours for this trip. No sight seeing trip this time, for Saturday was shot and we slept late!

A friend of Phil's had told him of a new restaurant that was like an American hamburger joint. Good sandwiches and French fries! We walked to the address that Phil had and arrived about eleven to find they were not open. As we stood outside, deciding where to go, the door opened. We were invited in and assured that we could have lunch with them. This required some time, so we ordered salads. As we started on the salads, Phil noticed what we in the states would call an inch worm making its way out of the lettuce and started measuring the distance around his salad bowl! Everything went downhill from there, the hamburgers were not very good and the potatoes turned out to be boiled. We spent the rest of the afternoon exploring Tel Aviv.

Monday morning, the first order of business was a tour to see some of the aircraft hardware. While we were in a hanger, the IAI engineer that was conducting the tour proudly displayed a right wing panel. He explained that it was manufactured by Grumman as a vendor for IAI and it was a carbon-fiber composite structure. As I walked up to the wing, I started to touch it. This action brought forth the loudest and most understandable "STOP" even though it was in every language except English. There was a test in process to determine the center of gravity (CG) and the wing was resting on three very sensitive scales. The technicians were waiting for the instruments to stabilize. I do not know if the area was sensitive to earth tremors or to wind gust from an open hanger door, but I found out that human hands were not to touch! The tour revealed that the construction of the aircraft was progressing very well.

At our first meeting, I reported the results of the PTO shaft critical speed test. The test, which was conducted by Bendix, at their Red Bank facility utilizing Garrett furnished fixtures representing the main engine and ADG interfaces, revealed the first critical occurred at a PTO speed below the IAI specification requirement. I informed IAI that it was impossible to meet the IAI specification without changes that involved both the Pratt and Whitney engine and the ADG. After much discussion and negotiations IAI agreed to change the specification requirement to 125 percent shaft speed. As a part of negotiations, Phil agreed to add testing to the qualification program to demonstrate the system response to a power turbine disconnect under representative failure conditions during main engine starting and ground check out modes.



On January 28, as we returned to the hotel, all of the people were expressing their deep sorrow about the Challenger accident. It wasn't until we settled into the lounge and watched the television report that it really hit home. We departed Tel Aviv January 30 for an uneventful but sad return home.

Development testing was progressing well and the first Flight Test Systems were delivered to IAI. Qualification Tests were initiated and Bob Noriega and Miguel Gomez joined the crew.

One day, during a power failure in the Barnes Building, all of the people were either looking at a vacant screen on their computer or shooting the bull. Fred Maynard came into my office and asked "Do you know how to calculate the square root of a number?" After I said I did, Fred told me that the guys out on the floor did not believe it could be done and he did not remember the method. So, I asked Fred to give me a number, which he did (a six digit number with a few numbers on the right side of the decimal point). I showed him the method, which he proceeded to impress his fellow engineers with the dead computers. I wondered, if this wonderful tool, the computer with its vast store of knowledge and capabilities had caused the loss of some basic math skills.. I also wondered if the old reliable, don't require electricity, slide rule had become a forgotten tool. I still used the slide rule, for I did not have the computer skills of our younger engineers. Didn't even have a computer in my office! Apparently the company would not fund training and equipment for old hands!

Phil, Steve and I made another trip to Tel Aviv. We spent only four days, June 22-26, reviewing program status. We also were able to see the aircraft and our equipment operation. The aircraft program is on schedule and first flight will occur in the fall. It was a successful and uneventful trip.

As summer approached, my office became more unbearable and my complaints, to Jerry McCoy, became often and annoying. Audie Scott heard my bitching and presented me with a temperature sensor! He assembled this excellent tool with parts the instrument lab was throwing away. It consisted of a thermocouple, a set of electronic parts and a LED display screen in a small metal box. With the instrument on my desk, plugged it into wall power, 86 degrees or greater was consistently displayed! Even though we were able to attain Jerry's attention, all we received was sympathy and the installation of tinted film on the west windows. This did nothing, except to give a pretty green view! I still have Audie's temperature sensor and it continues to provide good service.

As the Qualification Tests proceeded, I received additional good news. The separation of the power turbine from the engine load during engine start mode confirmed my calculations of a

maximum turbine speed slightly less than 98000 rpm. I also won another one, concerning the axial containment of the power turbine tri-hub burst. The five tangential spoke arrangement, that held the inner body in the turbine exhaust, passed the test with flying colors. The Lavi Project guys utilized the surviving part to make a necklace with chain and LAVI logo.



It was presented to me. I had to wear it for a short period. It became a badge of honor which hung on my cubical wall! I still have it hanging in my home, proof that you must try a questionable design sometimes and hope it works.

Sometime during this period Skip Stohlgren left the company to join Faye McDonald and Carl Reed, at American Gear, as the Chief Engineer. Skip was instrumental in securing the LAVI program and had been in charge of initiating all project activity from the beginning. I do not know what the problem was with the IAI people, but I bet it was a Parker problem and Skip was just caught in it!

All of the test programs were going well, Phil and I were off to Tel Aviv for the first LAVI flight! The first flight was longer than I thought it would be. In fact, I had a painful neck from looking up so long during all of the flying. There was much Hebrew chatter from the speaker system. I could not understand a thing, but it was obvious that the first flight was progressing very successfully, for there were smiles, laughter and much back slapping. All of our equipment performed without a problem. After the post flight partying and review, we headed home. A short, four day, successful meeting.

As 1986 came to a close, the LAVI program and aircraft was the primary story in the Christmas issue of Engineering News. A description of the features of the secondary power system and its successful aircraft flight tests was reported in detail.

February 28 through March 4 Phil and I made a quick trip to Tel Aviv for another program review. It was a rather uneventful trip.

Things became exciting in April though, for an incentive retirement package was offered to obtain a reduction in manpower (layoff in those days). I had just turned 65 and in my analysis of the situation, I decided to accept! I told Phil of my plans, within an hour he came by and told me that he was going also. So the process was started.

While this was going on, Bill Spragins dropped by my office and insisted that I go to the Pneumatics Facility for Cox's retirement party. I resisted, for I was very busy, but had to give up when Bill indicated it would be ill mannered for me not to attend this old friend's retirement party. We stood around in the lobby for sometime and finally we were escorted up to Nick Hughes' office. I had not seen Nick in a long time which required some small talk before we went to the retirement party. These son-of-a-guns fooled the hell out of me, for in walked many of my old CSDS friends! As you can see, they presented me a retirement trophy/clock utilizing a CSDS cone clutch. The cone clutch was a most troublesome component for me and Perry Sebring in the early days of the CSDS100 program.



Front Row: Norm Marley, Palmer Wood, Ed Gammill, Bill Spragins and Nick Hughes

Back Row: Ron Bacon, Don Ender, Maury Davis, Perry Sebring, Bob Rencenberger and Phil Garner

The clock is powered by a D cell battery and sits in my den. The battery has been changed once since that day 20 years ago!

During the last days, I turned over my duties and files to the crew. Bob Von Flue dropped by to bid me “good retirement” and told me he was going to beat me out. Phil and I had a joint retirement party in the Barnes Building cafeteria. There was a signing of the cartoon created by Karen Brunett, the retirement book, photos, speeches, hand shaking, best wishes and finally coffee and cake.



CAKE!



Bill presents “Cap’n Eddie”



Phil receives a troublesome trophy from Howard Daudet

Since there were so many (see following for just those in Power Systems Engineering) who elected to retire, the company threw a big party at the Gateway Hotel. So we left the LAVI Project in good hands

 KEITH BENN	 EARL BURCHER	 JIM BUSTRIN	 MAURY DAVIS
 SAM RUSSELL	JOIN THESE GTEC RETIRES FROM POWER SYSTEMS ENGINEERING		 ED GAMMILL
 HANK PREJS	FOR HORS D'OEUVRES NO-HOST BAR		 PHIL GARNER
 RON PICCO	AT THE GATEWAY HOTEL		 BILL GUARINO
	TUESDAY, MAY 26 5:00-7:00 P.M.		
 GENE STUMPP	 TERRY SHELBOURNE		

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I wish to thank William W. Spragins (Bill) for editing and correcting my writing . My thanks to Rick Dorsey, Roger Payne, Steve Woodard and John Zimmerer for data and prompting my failing memory. I hope to be forgiven for any mistakes or omissions due to that failing.