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# Chinese Technology Gains Four

## AIAA tour group surprised and impressed by advances being made for applications to spacecraft, launchers

Washington—Detailed analysis of Chinese space technology made by an American Institute of Aeronautics and Astronautics U. S. industry team, which recently toured Chinese facilities, indicates extensive and “surprising” high-technology progress is being made across many space program fronts.

The AIAA group discovered that China is planning a complex near-term meteorological satellite program and also learned additional details of previously known Chinese space programs, involving:

- Planned launch of a geosynchronous orbit communications spacecraft in 1981 (AW&ST Sept. 4, 1978, p. 78).

- Liquid oxygen upper stage capability (AW&ST Oct. 22, 1979, p. 25; Sept. 4, 1978, p. 78).

- Earth resources program (AW&ST Jan. 1, 1979, p. 14).

Chinese officials declined to discuss any detailed manned space program plans with the space-applications-oriented AIAA group, although the Chinese said in early January they have a small group of astronauts under training and recently had recovered a dog from space. AVIATION WEEK & SPACE TECHNOLOGY reported earlier (May 28, 1979, p. 26) that China was in the earliest stages of developing a manned flight capability and had recov-

ered dogs and mice from suborbital space missions. The U. S. and Soviet Union both progressed to manned flights relatively soon after flying successful missions with animals.

The Chinese told an earlier National Aeronautics and Space Administration team that manned flight development is secondary to space applications goals (AW&ST June 25, 1979, p. 77), and the AIAA team found extensive and “impressive” technology developments in the applications area.

The 19-member AIAA team included 16 top U.S. industry space applications engineers. The group was told that civil Chinese space program launches planned through 1985 will involve:

- 1980—Two experimental satellites testing such technology as solar cells and actuators are scheduled. A similar mission in 1979 failed (AW&ST Sept. 3, 1979, p. 15).

- 1981—Experimental communications spacecraft is planned for launch into geosynchronous orbit on a three-stage version of the Chinese FB-1 (CSL-2) booster using liquid hydrogen and oxygen as third-stage propellants.

- 1982—A 650-kg. (1,433-lb.) weather spacecraft is to be placed in a 900-km. (560-mi.) sun-synchronous polar orbit.

- 1984—U. S. space shuttle launch of two geosynchronous orbit television broadcast spacecraft is scheduled. These spacecraft are to be procured from U. S. industry (AW&ST Mar. 26, 1979, p. 53).

- 1985—Chinese geosynchronous orbit meteorological spacecraft will be launched to complement the polar orbit weather spacecraft capability.

The AIAA group toured 15 Chinese aerospace facilities in 17 days, a schedule that allowed substantially more detailed briefings than were provided the NASA team that toured many of the same facilities earlier last year.

Highlights of the AIAA trip included briefing at the Shanghai Institute of Technical Physics, where 350 technicians were said to be engaged in infrared sensor development; the satellite control facility at Xi' An (Sian), an area with a heavy military flavor characterized as China's Sunnyvale, Calif., and the Central Meteorological Bureau in Beijing (Peking), where an impressive computer capability was observed.

### Weather Spacecraft

China's polar-orbit, sun-synchronous weather spacecraft will carry a two-channel radiometer for high-resolution visible and infrared images. Engineering of the radiometer was characterized by AIAA as “good,” but weight and power consumption were noted as the main drawbacks of the Chinese design.

The instrument on the Chinese spacecraft weighs 30 kg. (66 lb.) compared to 9.1 kg. (20 lb.) for a similar sensor on the U. S. Improved Tiros operational spacecraft (ITOS) series. China's overall spacecraft weight is about double the U.S. ITOS weight. The AIAA group was shown a mockup of the spacecraft at the Huayin Machinery Plant in Shanghai. The three-axis-stabilized vehicle was designed as a 1.4-meter (4.6-ft.) cube.

The Central Meteorological Bureau coordinates and establishes the requirements for both civil and military weather monitoring systems, and the AIAA group said the Chinese are receiving data there from the U. S. Tiros N and NOAA 6 spacecraft and the Japanese geostationary meteorology spacecraft. AIAA was told that all 29 Chinese provinces are equipped with automatic picture transmission ground stations for reception of 4-km-resolution VHF pictures continuously transmitted from Tiros N and NOAA 6. More complex ground stations in Beijing and Shanghai can receive higher-resolution images in S-band transmissions from the two U. S. spacecraft.

The Central Meteorological Bureau had the greatest computer capability of any facility visited on the trip. Chinese-built

## NATO Presses Disarmament Talks

Brussels—North Atlantic Treaty Organization is letting stand its offer to initiate disarmament talks with the Soviet Union to reduce the Soviet buildup in medium-range weapons despite a recent formal rejection by the Russians.

The decision to maintain its willingness to undertake negotiations for a reduction in medium nuclear systems was made recently after NATO representatives were told the Soviets had rejected the proposal put forward in December, when NATO foreign and defense ministers also approved a theater modernization program (AW&ST Dec. 17, 1979, p. 14).

The NATO call for disarmament talks was rejected by the Soviets on the grounds that the theater modernization program had eliminated any prospects for reduction of nuclear forces in Europe.

Led by the U. S. and West Germany, NATO had proposed the medium-range-weapons disarmament talks as a follow-on to the Strategic Arms Limitation Talks (SALT) 2 agreement. In letting stand their offer to initiate talks for reduction in medium-range weapons in Europe, NATO officials said they were hopeful that the Soviet Union would agree eventually to discuss the proposal.

Meanwhile, NATO officials are puzzled over the present location of the Soviet 6th Guards Armored Div., which was withdrawn from East Germany in December as part of a much-publicized unilateral troop cut in Europe by Soviet forces.

Top NATO military officials are unable to determine whether the division remained in East Germany, was transferred to Czechoslovakia or was withdrawn into the Soviet Union, where it could have participated as a back-up force in the Afghanistan invasion.

The 6th Guards Div. was withdrawn after Soviet President Leonid Brezhnev announced a cut of 20,000 men and a reduction of 1,000 tanks from Soviet forces stationed in East Germany. The troop cut was described by Brezhnev as a demonstration of Soviet goodwill.

DJS-8 and DJS-9 computers, a Japanese Hitachi 170 and two other Japanese computers stood out in the AIAA group's impressions of the facility.

In the opinion of team member Abraham Schnapf, manager of satellite programs for RCA Astro Electronics, which built the ITOS series, the Chinese are "well on their way" toward launch of the polar-orbiting system placing them as only the third nation in the world behind the U.S. and Soviet Union to have this important civil/military capability.

### Picture-Taking Barred

Like the NASA group that preceded them, the industry team members were permitted to carry cameras throughout China but prohibited from taking pictures of any significant Chinese space hardware. Unlike the earlier NASA team, the AIAA group did not travel to China's Gobi Desert launch site, but James J. Harford, AIAA executive secretary and general manager, said that had the group desired a launch site visit, it probably would have been granted.

The group opted instead to devote the majority of its time to Chinese space applications technology. It was taken to the Shanghai booster assembly plant that builds at least the space launch version of the CSS-X-4, China's 6,800-mi.-range intercontinental ballistic missile. A flight-ready CSS-X-4, designated by the U.S. as the CSL-2 and the Chinese as the FB-1 in its space launch configuration, was displayed to the group, and the AIAA team learned additional details about the vehicle:

■ **Performance**—The two-stage vehicle can deliver 2 metric tons of payload to a 200-km., 69-deg., inclined orbit.

■ **Propulsion**—The vehicle is powered by four first-stage engines, each with 70 metric tons of thrust, and one 70-metric-ton thrust second-stage engine. The second stage also has four verniers with a total of 4,500 kg. additional thrust. Propellants are nitrogen tetroxide and unsymmetrical dimethylhydrazine. There are few if any redundant features in the propulsion system.

■ **Guidance**—The vehicle uses an inertial guidance system, a conclusion reached by U.S. team members only after detailed questioning of the Chinese, who were not eager to discuss this aspect of the vehicle. The finding, in effect, means China's largest ICBMs are inertially guided.

■ **Design quality**—Workmanship and design philosophy in the launcher impressed the U.S. team members. The launcher has heat-treated copper/aluminum propellant tanks, and chemical milling and automatic welding are used in the vehicle's fabrication. Conservative weld

Ft. Worth—Bell Helicopter Textron and Pratt & Whitney of Canada are negotiating coproduction agreements with the People's Republic of China covering civil versions of the 212 and 412 helicopter and its PT6 engines.

Each company has signed a memorandum of understanding with the China Aero Technology Import-Export Corp. and teams from both companies are scheduled to go to China at the end of this month to discuss the definitive agreements. U.S. and Canadian governments will have to approve the agreement but this is expected to be done this year. The Bell program covers assembly and production of 50 helicopters at the People's Republic Aircraft Factory at Harbin.

The coproduction negotiations result from the initial sale of eight Model 212s to China last year (AW&ST Feb. 26, 1979, p. 21). Negotiations include training of engineering, management and other technicians from the Harbin factory at Bell's Ft. Worth facilities, furnishing some 212/412 production tooling and providing specialized Bell personnel to help the Chinese in establishing an assembly and production operation at Harbin.

Under a four-year program, Bell would furnish the Chinese with 20 disassembled Model 212s and assist in coproduction at Harbin of 30 Model 412s. The program would give China the capability for producing the entire helicopter, and under the agreement the Chinese would also supply Bell with some components, not to exceed 30% of the value of the contract.

allowances are probably used, because no repair welds were noted by the team.

"Design and fabrication of the vehicle structure including propellant tanks is right up to date with U.S. approaches on Titan and Saturn stages and on the space shuttle external tank," Ralph Nansen of Boeing Aerospace told AIAA in his formal report. "Design of the engines, propellant delivery system and thrust structure was a simple and probably could be used in an excellent example of design-to-cost approach."

The only flexible joints on the vehicle were noted at the hinge line of the first-stage-engine gimbal interface.

The AIAA group, like the NASA team, was shown only one vehicle on a rail transporter in a room capable of holding many more boosters. The AIAA team was given clean room coats and shoes to wear in the facility and also observed two other first-stage engine clusters on display.

Although fabrication of the vehicles takes place at the facility, the AIAA group neither saw nor heard any evidence of extensive manufacturing during its visit to the plant. Use of the oxygen/hydrogen third stage was discussed with the AIAA group although they did not visit the Beijing facility where NASA officials earlier observed a small oxygen/hydrogen three-engine cluster under development. The Chinese will call their three stage booster the Long March 3. Its development "could make them competitive with most space transportation systems in the world," according to Nansen.

Communications satellite technology development was particularly impressive to the U.S. group, which, to its surprise, found advanced designs for and hardware of traveling wave tubes, solid-state amplifiers, wave guide filters and microwave integrated circuits. Burton I. Edelson, vice president of the Communications Satellite Corp. and leader of the AIAA delegation, believes technology will not limit China in developing a satellite communications capability.

"We conclude the Chinese are serious about their stated goal of obtaining an independent capability in communications satellites in the next decade and are making good technological progress toward it. Their own frequently cited description of their technology as primitive is excessively modest. Advanced but simple is more apt," Edelson reported to the AIAA.

"What they do lack and want and expect to get from the U.S. is integration know-how; how to put it all together. They don't have experience and skills in systems engineering and program management," he added. "They don't seem to know much about designing to conflicting goals such as performance, weight, power and cost. They need information about reliability modeling and quality assurance tech-

### Satellite Groups

Tokyo—Three international groups are being formed or reformed to bid on a series of Japanese satellites expected to cost more than \$2.6 billion over the next 15 years.

Nihon Electric has signed an agreement with RCA; Mitsubishi with Ford and Messerschmitt-Boelkow-Blohm, and Toshiba with General Electric. The Japanese companies have gone to outside firms for expertise in three-axis control and stabilization. Previous Japanese satellites were spin stabilized.

First satellite they will compete for will be MOS-1, a 1,600-lb. maritime observation payload scheduled to be launched in 1984 by the National Space Development Agency using an N-2 vehicle. A prime contractor is expected to be chosen this year.

## Republican Calls for 10% Defense Boost

Washington—Restoring U. S. military and intelligence capability will require several years of spending increases 10% above inflation, a Republican defense expert said here last week. President Carter is proposing a 5.6% increase for next year and roughly 4% for each of several years thereafter.

John Lehman, former deputy director of the U. S. Arms Control and Disarmament Agency, presented his list of U. S. military and intelligence deficiencies to the GOP Temporary Platform Committee Jan. 15 on Capitol Hill.

The canceled Rockwell B-1 bomber has no replacement, MX missile deployment is delayed, master sergeants and majors cannot qualify for home mortgages, poorly trained fighter pilots are causing accidents faster than the Defense Dept. is buying new aircraft and only one of three Army Ready Reserve billets is filled, he said.

The testimony of Lehman and several others came on the first stop of a 10-city tour of the country planned by the platform panel, headed by Sen. John Tower (R.-Tex.).

Fred Ikle, former director of the arms control agency, said the Soviets are increasing their rate of arms buildup by 4% a year and they were spending twice as much as the U. S. some time ago.

Ikle said President Carter's change of heart about ultimate goals of the Soviets after the Afghanistan invasion "did not go deep enough." Ikle illustrated Soviet intentions by saying: "Aden [the capital of South Yemen] is now as well controlled by Soviet advance teams, as was Kabul before Christmas Day."

Richard Allen, former Nixon aide, said the U. S. must build up its foreign intelligence gathering capability. "Adequate safeguards exist to insure that past abuses [by U. S. intelligence agencies] will not recur," he said.

niques, scheduling and project control."

C-band developments are being emphasized by the Chinese, but they are also designing across the board for satellite communications, including technology for satellite earth stations and transmission systems, with their focus on the 1981 experimental communications satellite to be placed in geosynchronous orbit by the Long March 3 booster.

### Satellite Antenna

The AIAA group was shown a complete 6/4-GHz. satellite antenna subsystem with a graphite fiber reinforced polymer feed horn and a rotating joint with what AIAA characterized as a combination of good materials technology and mechanical and radio frequency engineering. Plans for a complete Chinese tracking and telecommunications control organization for communications spacecraft were discussed by the Chinese. They also are developing a demand/assignment multiple-access, with distributed control, capability as part of the communications satellite work. The Chinese intend to procure K-band satellite hardware from the U. S.

One of the three Chinese spacecraft retrieved from orbit carried a traveling wave tube, and members of the industry team believe this is the first traveling wave tube that has performed in space to be returned for analysis. The reentry program was not discussed with the AIAA group. It involves work on a Chinese film return reconnaissance satellite capability and the future Chinese manned space program.

Work on a Chinese remote sensing spacecraft was the least advanced technology displayed to the industry team, but even here the U. S. group was surprised with what it found.

An earth resources spacecraft is not in the plan through 1985, but the Chinese now have and will continue to buy U. S. Landsat spacecraft data, later receiving Advanced Landsat D imagery with their own ground station (AW&ST Jan. 1, 1979, p. 14).

"By far the most advanced [earth resources] technology we found was at the Shanghai Institute of Technical Physics, where 350 research and technical people work on infrared technology, developing such instruments as cone horizon scanners, jitter scanners, visible and infrared line scanners, charge-coupled devices for sun-angle indicators and multispectral scanners," Sheldon Haas, general manager of the General Electric Space Div., told AIAA.

Although the AIAA group did not discuss military space programs, such an intensive infrared development program by the Chinese would have substantial military application, for such as a ballistic

### Midair Collision

London—In-flight thrust vectoring has been labeled as a contributing cause of the midair collision of two British Royal Air Force Harrier strike fighters over Britain last September (AW&ST Oct. 1, 1979, p. 23).

Accident investigation determined that the two aircraft were engaged in a mock dogfight when the lead aircraft used thrust vectoring to abruptly slow down.

The second aircraft overran the first and the wings of the two aircraft collided. Three persons on the ground were killed when one aircraft crashed into the village of Wisbech, England. Both pilots ejected safely.

missile early warning satellite the Chinese are expected to launch into geosynchronous orbit with the Long March 3 (AW&ST Nov. 19, 1979, p. 13).

AIAA members were especially surprised to learn about charge-coupled devices being developed in China, an indication of an extensive high-technology effort.

The Chinese discussed possible eventual development of a 10-meter (33-ft.) resolution earth resources data transmission spacecraft as a result of user community desires within China, but the strongest indications are that China's primary initial resolution capability will be more like 79 meters (259 ft.) from a spacecraft altitude of 700 km. (435 mi.).

### Extensive Questions

Remote sensing technology is one area where the Chinese asked the U. S. group extensive questions on technology. Use of charge-coupled devices and microwave systems on remote sensing spacecraft was brought up by the Chinese. The U. S. group believes the Chinese do not yet have a complete understanding of user requirements and orbital characteristic tradeoffs, but are rapidly gaining knowledge in this area by studying U. S. literature.

The Chinese, in addition to working on Landsat-type multispectral scanners, also are working on "push-broom" multispectral linear arrays requiring no moving parts.

"Overall, while technology in China is moving ahead on many fronts—detectors, linear arrays, digital signal processors, optics, bearings, plastics, receivers, transmitters and multiplexers—the essence of the component system reliability and long-life design guidelines has so far escaped them," Haas reported to AIAA. "While it may not be a fair comparison, it appears to us that the Chinese are not at the same point in total remote sensing technology that Hughes was when it undertook the multispectral scanner development in 1968, especially since many of the technologies are distributed in various cities and remote locations."

Military aspects of the Chinese space program were most evident during the group's visit to the Chinese satellite control facility at Xi' An. The facility was located against a large mountain at least 1 hr. travel from the city. The compound was fenced and patrolled by armed guards. It was a modern computer-equipped facility that struck Harford as comparable to the U. S. Air Force satellite control facility in Sunnyvale, Calif. There, as in other locations, the AIAA group received an impression of the severe Chinese concern over the Soviet threat. The Xi' An facility also illustrates the stark contrasts the AIAA group found in China. "You come away from a fairly modern facility, with good looking computers, then run into a water buffalo dragging a wooden plow," Harford said.