



# FOUNDATION REPORT:

ADVANCES IN COMMERCIAL AND GENERAL SPACE DEVELOPMENTS

## INSURANCE AND RISK MANAGEMENT ON THE SHUTTLE

### How Can The Risks Be Managed?

by Arthur M. Dula

Clearly, a large number of potential risks are associated with industry's use of Space Shuttle. Despite NASA's enviable safety record it would be foolish to assume that no accidents will occur during routine Shuttle operations. Fortunately these risks can be controlled by following a few simple rules.

Successful risk management for the Shuttle must allow industry to evaluate the nature and extent of the risk it is assuming. This risk must be perceived as low enough to encourage industry to participate on the Shuttle. Finally, all possible means should be employed to avoid long and complex litigation.

### Past and Present NASA Policy

Past reimbursable launches have been performed by NASA using expendable vehicles such as the McDonnell-Douglas Delta. If an expendable vehicle goes off course or otherwise malfunctions, the range safety officer can transmit a coded radio signal that will destroy it. This destruct capability minimizes third party liability for expendable launches, but is not practical for use with a manned Shuttle.

As late as 1975 NASA was satisfied with very general contract language to the effect that all parties would give each other "all assistance practicable" in the defense of third party claims for injury, death or damage to property associated with launching expendable vehicles. This level of protection was quite adequate when NASA could make and enforce safety rules, perform detailed safety inspections, and blow everything up without liability if anything went wrong.

NASA is evolving a new set of insurance standards that will apply to all future launches. Current contracts still include the 1975 general language, but, by early 1977 NASA also required that the user purchase a large (i.e. \$100,000,000) policy of third party liability insurance. The user had to agree to purchase this policy of insurance, payable to NASA, as a condition precedent to NASA's providing launch services on a Delta. This level of private insurance is neither available to nor affordable by many of the private industries that would otherwise use the Shuttle.

If a \$100,000,000 policy of third party liability insurance is required by NASA for flight on a proven and safe expendable vehicle, how much more insurance

will be required for flights on the Shuttle? The answer is obvious: less insurance must be required to fly on the Shuttle, otherwise many industries will not fly.

### The Future—Some Possibilities

Shuttle liability may best be met by a combination of private insurance and government indemnification of developing space industry.

The Price-Anderson Act was enacted in 1957 to protect the emerging nuclear industry and the public by assuring availability of funds for payment of claims in the unlikely event of a catastrophic nuclear accident. The funds are provided by a combination of private insurance and government indemnity. The Act requires that private industry must obtain \$60,000,000 of third party liability insurance. The government then grants industry an indemnification of up to \$500,000,000. In 1975 the Act was renewed and Congress extended a portion of the indemnity coverage to claims arising outside the United States' territorial limits.

A similar program for space industrialization on the Shuttle would allow industry to face a known and acceptable risk while protecting third parties and meeting U.S. treaty commitments for international liability. This mechanism for risk management would allow industry to assume more liability as its experience on the Shuttle increases and risks become better defined. Finally, quick administrative settlement could lessen the possibility of drawn out lawsuits arising from Shuttle accidents.

In addition to paying for all or part of the third party liability coverage required by NASA, business users of the Shuttle will insure their investments against casualty loss. If private insurance firms are reluctant to offer insurance at reasonable rates in an area where they have so little experience, the government might be justified in underwriting special policies of insurance for Shuttle users.

NASA and all parties flying on the Shuttle should mutually contract to bear their own risks as joint venturers on each mission. No fault should be the rule on the Shuttle. NASA would inspect all payloads and certify their safety. Such inspection should be enough for insurance companies to insure a space payload since NASA has both great technical expertise and an enviable record of safety.

Personnel on the Shuttle might be insured by the Travelers Insurance Company, which has already ventured into the field by insuring the astronauts. Standard aviation life and injury insurance may also cover such personnel. If commercial carriers are unwilling to make such insurance available, the government should underwrite special space life insurance, analogous to that purchased by military personnel on active duty, and make it available through NASA for

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the duration of the mission.

Such a program of private no fault insurance combined with governmental underwriting of special life and property insurance when and if necessary, would allow industry to accurately access the interparty risks involved in Shuttle operations. It would also minimize the government's cost while enhancing the Shuttle's attractiveness as a research and manufacturing tool. Like government indemnification for third party liability, this public underwriting could be phased out as private insurance companies move into the market after gaining experience and confidence in the safety of Shuttle operations.

**Centralization of Claims—Procedure**

It is within the authority of Congress to require that all claims dealing with a given government instrumentality, such as the Shuttle, must be brought before one court. Congress can also require that administrative remedies be exhausted prior to bringing suit. Centralization of both interparty and third party claims can be accomplished by providing for special jurisdiction and venue in the Court of Appeals for the District of Columbia. This would place Shuttle-related claims before a court having skill and experience in the resolution of complex administrative matters. Concurrently a claims commission should be established within NASA to administratively settle all claims arising out of Shuttle operations. Exhaustion of this avenue of relief before permitting appeal to the federal courts could tend to discourage long and costly litigation. This claims commission should not be a passive body, but should include agents able to seek out injured parties and attempt to settle with them. The commission would then be subrogated to the rights it had extinguished in the third parties.

**Conclusions**

In order to allow industry to evaluate and economically tolerate the level of liability inherent in initial space industrialization. NASA's Administrator should recommend to Congress through the President, as provided by 42 U.S.C. §2476(b), that:

- legislation be enacted to establish a program of no fault joint private insurance—public indemnification of third party and international liability arising out of National Space Transportation System related activity;
  - legislation be enacted to establish a federally underwritten program of special space life and property insurance to provide no fault excess property and life insurance for users of the National Space Transportation System until such time as the private insurance industry makes such coverage commercially available;
  - legislation be enacted to establish special exclusive jurisdiction and venue in the U.S. Court of Appeals for the District of Columbia for claims arising out of National Space Transportation System-related activity. Such jurisdiction should require exhaustion of administrative remedies as a prerequisite to any action.
- B. The Administrator of the National Aeronautics and Space Administration should:
- establish an administrative tribunal to settle claims arising out of National Space Transportation System activity;

- commission agents with the authority to quickly settle claims of third parties.

Finally, the aerospace industry should internally fund studies to determine how much industry can afford to pay for insurance in an initial program of space industrialization.

Without some near-term remedy, the business of space industry may never get off the ground.

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## **NEW EXPERIMENTS SELECTED FOR 1980 OPERATIONAL SHUTTLE FLIGHT**

Sixteen new experiments in space technology have been selected for NASA's Long Duration Exposure Facility (LDEF) mission, currently scheduled as the payload for the first operational flight of the Space Shuttle in 1980.

These experiments join seven other technology experiments selected earlier this year.

LDEF, managed by NASA's Langley Research Center, Hampton, Va., is a reusable, unmanned, free-flying structure on which many different technical and scientific experiments can be mounted in special trays.

LDEF provides an easy and economical way to conduct primarily passive experiments in Earth orbit.

The 16 new experiments were chosen from 190 candidates submitted to NASA in answer to an announcement of opportunity distributed in June 1976. Candidates came from industry, government institutions, universities, individual researchers and eight foreign countries.

Investigators for the experiments selected to date represent six universities, six private companies or research institutes and five NASA research centers. Seven of the experiments are from France, two from England and one from Canada.

With selection of these new experiments, 80 per cent of LDEF's experiment trays are now filled with research projects. The remaining 20 per cent of experiment space will contain micrometeoroid detection panels, designed to measure the number and variety of tiny meteoroid particles in Earth orbit.

Experiments were selected for their research and development value, their compatibility with LDEF and other experiments and the cost of the effort.

Some experiments could not be accommodated because of NASA budget limitations. However, these experimenters have been offered the opportunity to have their experiments flown aboard LDEF if their experiments are provided at no cost to NASA.

Technical areas represented by the experiments include materials, thermal control coatings, detectors, power, micrometeoroids, electronics, lubrication, optics and space debris detection.

After launch inside the Shuttle Orbiter's cargo bay from NASA's Kennedy Space Center in Florida, LDEF will be placed in a circular Earth orbit of at least 330 kilometers (270 miles) with an inclination to the equator of 28.5 degrees.

LDEF will remain in orbit from six to 12 months while its experiments are exposed to the environment of space. At the end of its mission, it will be retrieved by the Orbiter and returned to Earth. Experiments will be returned to their investigators for data analysis.

The Shuttle is scheduled to begin a series of six operational test flights in 1979. Once these are completed, operational flights will begin. LDEF is currently planned as the payload for the first operational flight in 1980.

Among selected experiments are:

- **Influence of Extended Exposure in Space on Mechanical Properties of High-Toughness Graphite-Epoxy Composite Material.**

These composites are promising candidates to replace aluminum alloys for structural use in space vehicles. Before they can be used with confidence for extended space flights, however, the behavior of

their mechanical properties must be determined, when exposed to space for long periods.

- **Atomic Oxygen Stimulated Outgassing.**

The effect of oxygen impingement on thermal control surfaces in near-Earth orbit will be investigated with regard to the production of optically damaging outgassing products. The bi-directional reflectance of selected coating will be measured before and after space exposure. Data will help determine if atomic oxygen impingement was a major factor in unexplained Skylab contamination by providing an understanding of the effect of atomic oxygen on thermal control surfaces.

- **Space Testing of Holographic Data Storage Crystals.**

The effect of long space exposure on electro-optic crystals, for use in ultra high capacity data storage and retrieval systems, will be tested. Information will help in the development of high-bit-capacity recorder and memory systems.

- **Space Plasma-High Voltage Drainage.**

This experiment is a determination of long-term current drainage properties of thin dielectric film subjected to high-level electric stress in the presence of the ambient plasma in space and solar radiation. Observed behavior of these films will establish allowable long-term electric stress levels for such films, as applied to solar array and spacecraft thermal control coating materials.

- **Passive Exposure of Earth Radiation Budget Experiment Components.**

Earth Radiation Budget (ERB) experiments require accuracies in solar and Earth flux radiation measurements in fractional percentages. To assure that these high-accuracy devices are measuring real variations and are not responding to changes induced by the space environment, the devices should be radiometrically tested, after exposure, to the best approximation of the orbital environment. Because the ERB experiment has been operational on Nimbus 6 since July 1975 and will be operational on Nimbus G and because in-flight calibration is difficult for solar and Earth-flux channels, this experiment will include exposure, retrieval and resubmittal for radiometric calibration of ERB channel components. Corrections may later be applied to ERB results, and information will also be obtained to help select components for future solar and ERB experiments.

- **Advanced Solar Array Technology.**

The experiment will test and qualify for space flight advanced solar array components, and test conductive epoxy bonding techniques, filterless cover glasses and high-efficiency solar cells, to increase the efficiency and cost effectiveness of satellite solar arrays.

- **Space Evaluation of Advanced Solar Array.**

This experiment will determine the effects of space on mechanical, electrical and optical properties of candidate lightweight solar array materials such as those needed for a space station, a satellite power station and solar electric propulsion solar arrays. Data obtained on the combined effects of ultraviolet, penetrating radiation and vacuum on these material properties will allow spacecraft manufacturers to design solar arrays with more predictable lifetimes.

- **Solar Array Materials and Assembly Techniques Evaluation.**

This experiment will allow accurate determination and prediction of the performance characteristics of space solar array candidate materials and assembly techniques when exposed to space. The materials and techniques are essential for high-power, ultra-light-weight solar arrays for future solar-powered planetary missions, space power station applications and low-power arrays for lunar and planetary missions. Data will reveal those materials and techniques that are compatible with space, and accurate predictions of their performance can be projected for future space missions.

- **Evaluation of Long-Duration Exposure to Natural Space Environment on Space Shuttle Payload Bay Door Graphite-Epoxy Mechanical Properties.**

These two experiments will establish and evaluate the effects of long space exposure on the mechanical properties of graphite-polyimide as applied laminates of payload bay door graphite-epoxy. There are no specific data on the effects of the near-Earth orbital environment on graphite-polyimide materials systems. Flight data will enhance confidence to apply this relatively high-temperature, advanced composite matrix system for present and future applications. Allowables for graphite-epoxy have been established, based on pseudo environments. This experiment will confirm the validity of previous tests or identify correction factors for application to future structures.

- **Study of Factors Determining Radiation Sensitivity of Quartz Crystal Oscillators.**

Radiation-induced frequency drifts and acoustic absorption in quartz crystals oscillators must be minimized to avoid undesirable variations in high-precision clocks in satellites and missiles. The experiment will obtain information on predicting and improving the

radiation sensitivity of these oscillators. The effects of exposure to an orbital radiation environment will be compared with results from a transmission electron microscope.

- **Multiple Foil Microabrasion Package.**

This a passive evaluation of the near-Earth pico-particle environment by penetration of micron thickness multiple foil arrays. Definition of the micron penetration spectrum will provide technological environmental definition and design guides for long-term, near-Earth missions. In addition, the mechanics and efficiency of meteor "bumbers" will be evaluated from multiple foils.

- **Exposure to Space Radiation of High-Performance Infrared Multilayer Filters.**

This experiment will expose to space radiation infrared multilayer interference filters of novel design, construction and manufacture, which are useful in sensing atmospheric temperature and composition. Optical behavior of these filters under radiation is not known and is critical to their performance.

- **French Cooperative Passive Payload.**

This payload is comprised of a single LDEF tray containing five electronics and two materials experiments. These experiments will include space exposure of the following components: optical thin metal filters and evaporated cathodes for extreme ultraviolet photometry; coated optical components, rules and holographic gratings; thermal control coatings and materials; optical solar reflectors; and optical fibers and thin film optical circuits. The payload also includes a dust and debris impact analysis experiment.

- **Orbital Lubrication Experiment.**

The experiment will evaluate the cumulative effects of space on lubricant oils. Eight fluid lubricants with current or high potential use in space mechanisms will be analyzed to obtain preflight data, impregnated into porous discs and ball bearings, subjected to space exposure during the LDEF flight, and analyzed after the flight to determine space induced changes. Measurements of mass loss due to outgassing in vacuum and surface creep will also be obtained and observations of the amount, distribution and effects of recondensed outgassed lubricant on typical surfaces of critical hardware will be evaluated. Lubricant performance in ball bearing assemblies will be investigated. The experiment relies on the stable characteristics of the lubricants. Small changes caused by space exposure are important to such physical behavior as friction and surface wetting. Radiation effects are virtually unknown. Results from this experiment will provide useful data for the selection of lubricants and mechanical design requirements for future oil lubricated space mechanisms.

- **Effects of Long-Duration Exposure on Active Optical Systems Components.**

The effects of space exposure will be measured on the performance of lasers, radiation detectors and other optical components, to identify any degradation and to establish guides for component selection.

- **Space Debris Experiment.**

Future spacecraft, because of their sizes and space lifetimes, will be damaged by meteoroids. This experiment will expose passive targets of several different configurations to meteoroid impacts and, after recovery, establish if impact damages are the same as predicted from lower velocity impact tests performed in laboratories.

- **Fiber Optic Experiment.**

Tremendous volumes of data from applications satellites are expected by the year 2000. Fiber optic transmission lines will be required for future satellites because of their large band widths, lack of electro-magnetic interference problems, low weight and cost and safety. The experiment will determine long-term degradation of fiber optic data transmission equipment and test designs for mounting techniques, terminal coupling and sheaths.

- **Advanced Photovoltaics.**

This experiment is to provide the space testing needed for the acceptance of the new low cost solar cells and solar arrays being developed and to improve the correlation of space and ground test results. The experiment will investigate the effect of space exposure on new solar cell and array materials, evaluate their performances, measure long-time variations in spectral content of sunlight and calibrate solar cells for space use.

- **Thermal Control Surfaces (Both Active and Passive).**

These two experiments will determine the effects of space exposure on new coatings being developed for spacecraft thermal control. The passive experiment will use samples of paints, other coatings and second-surface mirrors, some exposed in a tray to all environments of the mission, and some exposed in the control canister only to specific environments.

Spectral reflectance of the samples will be measured before and after the mission. The active samples will be mounted on an indexing wheel with a reflectometer that will periodically record reflectance values in space.

First in a series of editorials about the relationship of government and industry.

## Actions Speak Louder . . .

Most individuals who have thought about space exploration and exploitation have always assumed that such activity would occur first under the sponsorship of nation states, and second with the cooperation of the international community. Some writers have gone so far as to conclude that international cooperation in space could be an outlet for the aggressiveness that they feel leads to war. The official policy of the Federal government is aimed towards continuing international cooperation. Projects are on-going with the European Space Agency involving the SpaceLab system, and with other governments around the world. Most prominently discussed is our preoccupation with involving the Soviet Union in joint space ventures. This is a rigidly enforced posture on the part of our government, and criticism of the concept is not taken favorably in the space law community, the astronautics profession, or in Washington.

Nonetheless, it is time for criticism. In the beginning of the post-detente era we cannot afford the luxury of naivete, nor over-reaction. Just what should our position be vis-a-vis the Soviet posture in matters of space use? Since the beginning of the Space Age, the inflexible posture of the Kremlin has not wavered. The Soviets are completely opposed to the private exploitation of space. If anyone seriously and objectively questions this blunt statement, they should take the time to read TASS dispatches printed elsewhere on this page concerning the development of the world's first private launch vehicle, the OTRAG project. The project has been subjected to official Soviet propaganda blasts for some months, ostensibly for its "colonial" appearance and "imperialist" inroads into the heart of Africa, but actually for the boldness of OTRAG's Lutz Kayser. He has challenged both the Soviet's implacable opposition to private enterprises in space, as well as the entrenched government monopolies like NASA and ESA. The true capitalist is a threat to both totalitarian regimes and government agencies. The latter reason is why no spirited defense of OTRAG can be heard in the corridors of NASA or the State Department.

When the first drafts of the Outer Space Treaty of the United Nations was under debate early in the 1960's, the Soviets demanded that all activities in space be carried out by states exclusively. At that time, only a few farsighted persons realized that there was economic value in space exploitation (indeed, use of the term exploitation at that time in the same sentence with space would have been considered a typographical error).

The debate finally produced a consensus among the parties, leading to the infamous Section Five: "Activities of non-governmental entities in outer space shall require authorization and continuing supervision by the State concerned." In a spirit of conciliation on the part of the United States, which has incidentally characterized the SALT negotiations as well, human beings' birthright to the universe was sold for a few words and promises. Promises like the demilitarization of space, which have been flagrantly violated time and again by the Soviets, through the development of their Fractional Orbital Bombardment System to the most recent case of their satellite killer weapons.

Fifteen years later we are still blindly following the path of international cooperation. The Draft Lunar Treaty under consideration would have a stifling effect on private use of the moon for profit. But few if any voices can be heard crying out for rational response to the blatant Soviet challenge to individual liberty. If you wonder what individual liberty has to do with material resources and industry, let me say only that without economic freedom there can be no human freedom.

Several years ago, I found myself seated next to a Soviet cosmonaut aboard a flight to Washington, D.C. When we began to chat, I learned that he had flown as flight engineer on both Soyuz 10 and 16, and was seeing the U.S. as part of the Apollo/Soyuz Test Flight. We had a very pleasant conversation, and were enjoying each other's tales, when he inquired as to my profession. I explained that I was part of an organization studying launch systems and commercial payloads for space exploitation, and began to show him some of the detailed sketches which our company illustrators had prepared. After a long time, during which he guardedly asked questions about the projects, I got the impression that he was puzzled by some of my statements. (Only later did I realize that it must have seemed wildly unlikely that a person with detailed astronautics background could coincidentally be seated in a first-class seat on an airplane leaving the hinterlands of the U.S., i.e., Minneapolis, next to a Soviet space expert. He must have thought that I had been put there to pump him for information. Additionally, it was obvious that one of the academicians on board was not an academician at all . . . I leave you to guess). At

any rate, after my long explanation of some very advanced space industrialization concepts, he inquired as to what agency was sponsoring my work. I explained that no one but my organization was responsible for the work which had just been explained to him. He couldn't believe me. Private adventures in space were forbidden.

I assured him that private ventures would occur, and offered him an invitation to visit the first private space station sometime in the 1980's, if he could get his government's approval.

As I was leaving the plane, however, I had to wonder. Given the seemingly irresistible force of will of the Soviet Empire and the vacillation of the U.S., will I, or anyone else, be able to get my government's approval?

—Gary C. Hudson

## MORE ON OTRAG AND CRUISE MISSILE CHARGES

Back issues of the Foundation Report (September, October, December, January) have followed the OTRAG story, and the criticism the first successful test flight has received. A Foundation staffer has visited the OTRAG offices in Germany, studied the vehicle plans, and spoken with an OTRAG consultant in the United States. Films of the first flight and development of the launch site have been viewed. In no cases was there any indication that there was any truth to the claims in these articles. Weapons systems experts have pointed out the problems involved in the operation of a test range of the type that would be necessary to develop a sophisticated missile system for military use. The OTRAG range, from all indications, just does not meet the requirements which would be necessary. A further problem to be considered is the need to export cruise missile technology from the United States to Germany. Since the U.S. cruise missiles have just begun testing, and are three years away from development, it seems highly unlikely that such systems including the highly secret TERCOM guidance platform and electronics, would be shipped into Central Africa where they would be threatened by Soviet espionage forces.

### SERIOUS CONCERN REPORTED ABOUT ROCKET TESTS IN ZAIRE

Moscow TASS International Service in Russian 9 Dec 77

Moscow, 9 Dec—TASS commentator Vladimir Petrov writes:

The tests being carried out in Zaire by the West German OTRAG firm on new rockets capable of carrying nuclear warheads are evoking serious concern in African countries. The rocket range set up in Zaire by OTRAG, writes NOTICIAS DA BEIRA, is the source of a nuclear threat to African countries. The Mozambique paper's misgivings are completely grounded. Wishing to advertise their product, (Lutz Kaizer), chairman of the OTRAG board, has stated frankly that the missiles being tested in Zaire "can carry any load and, of course, a nuclear warhead." (Kaizer's) cynical admissions—and he has made such statements more than once—naturally alarm the African countries, which point out that the missiles being developed by OTRAG could at any time fall into the hands of the South African racials.

The activities of OTRAG take on a particularly sinister tinge in light of Pretoria's efforts to create its own nuclear weapon. NOTICIAS DA BEIRA draws attention, among other things, to recent reports that a number of countries, including the racials of the Republic of South Africa, are showing special interest in the Zaire testing ground. The Pretoria regime, the paper says, is on the verge of producing its own nuclear weapon and is now planning to step up its missile potential. These plans, and the increasingly distinct prospect of the Republic of South Africa racials acquiring nuclear and missile weapons, are arousing legitimate alarm not only in Africa but throughout the world. The peace-loving public justly regards OTRAG's activities in Zaire as a serious threat to peace and security in Africa. The creation of a nuclear testing ground in Zaire and the testing there of missiles gives further proof of the urgency for Africa of the idea of turning that continent into a nuclear-free zone.

### ROUNDUP OF REPORTS ON WEST GERMAN ROCKET TESTING IN ZAIRE

Moscow TASS in English 12 Dec 77

The public, the press and leaders of independent African countries voice serious concern over the fact that the West German firm OTRAG has built a rocket testing range in the center of the African Continent.

Paris, December 12 TASS—The establishment of a rocket testing range in the territory of Zaire cannot be justified by any security reasons. Zaire is threatened by no country, including its neighbors Angola, Zambia or the Congo. Didier Ratsiraka, the president of the Democratic Republic of Madagascar said in an interview with the magazine AFRIQUE-ASIE. Standing behind this step are certain foreign powers. A military place d'armes in the heart of the continent is to be used, according to their plans, as an instrument of pressure on the neighboring African states.

MAPUTO, 12 Dec TASS—The Mozambique newspaper NOTICIAS DA BEIRA describes the rocket-testing range in Zaire as a serious threat to free Africa. The sinister activities of the OTRAG firm which has behind it imperialist and militarist circles of the West has aroused the indignation of the peoples of the world. They demand removal of this bridgehead of aggression

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## **MORE ON OTRAG**

which threatens the security of the people throughout the world. The African public is particularly alarmed by the fact that the South African racist regime shows great interest in this testing range. NOTICIAS DA BEIRA says. Pretoria is now on the threshold of developing its own nuclear weapons and is planning to create, in cooperation with OTRAG, its own rocket potential. The newspaper quotes one of the leaders of the OTRAG firm, L. Keiser, who said that the rockets tested by (words indistinct) nuclear warheads.

### **ARTICLE LINKS U.S. TO ZAIRE MISSILE RANGE**

**Moscow TASS in English 14 Dec 77**

**Washington, 14 Dec TASS**—West Germany is secretly testing cruise missiles and intermediate range ballistic missiles in Zaire's Shaba Province with the knowledge and approval of the United States. This is reported by well informed American observer Tad Szulc, quoting highly reliable sources. There is evidence, he noted in his article, that the United States supplied West Germany with the necessary technology for this project. This fact is kept strictly classified in Washington, but officials of the U.S. administration have privately confirmed that the CIA and its West German equivalent, BND, have played a decisive role in sponsoring this programme by selecting for it personnel, which underwent training in the USA, and coordinating the whole operation in Washington, Bonn and Kinshasa. It was under pressure of the USA and West Germany that an agreement was concluded in 1976, according to which Zaire agreed to grant a huge territory for the implementation of the West German missile programme in exchange for annual 50-million dollar payments and insignificant arms supplies.

Nominally, says the article by Szulc, the testing of West German missiles is done by the "OTRAG" private company with a headquarters near Frankfurt allegedly specializing in the manufacture of equipment for meteorological exploration. But actually, the article stresses, the company receives up to 300 million dollars from West Germany's defense budget, and behind the whole of this programme is the military-industrial complex of West Germany. The recipient of the missiles tested in Zaire is the Bonn Government.

West Germany, says the article, has already long wanted to have its own cruise missiles and in the long run decided to start their production. The fact that the USA cooperates in this field with West Germany, Tad Szulc writes, has been actually reaffirmed by Defense Secretary H. Brown, who told a meeting of defense ministers of the NATO member countries that the USA had not committed itself to deny technology for the production of cruise missiles to its European allies. The production and testing by West Germany of cruise missiles and intermediate range ballistic missiles, the article notes, is a "direct and crying violation" of international legal documents imposing "clear-cut restrictions on West Germany's rearmament."

## **LANDSAT 1 EARTH RESOURCES SATELLITE IS RETIRED**

Landsat 1, the world's first spacecraft designed to monitor and discover the Earth's natural resources was retired by NASA Jan. 16, 1978, after operating five and a half years in outer space. The multispectral scanner, a camera-like device carried by Landsat 1, has revolutionized the technology of observing the Earth from space.

Designed with a life expectancy of only one year, Landsat 1 was launched in 1972. The spacecraft "more than achieved its goals, in fact, beyond any stretch of the imagination," said Ron Browning, Landsat Project Manager at NASA's Goddard Space Flight Center in Greenbelt, Md.

Browning said problems with the pitch wheel, the device which automatically keeps the satellite and its instruments pointed toward the Earth, have worsened during the past two years and that time-command problems have also developed. Both tape recorders on the satellite have long been inoperative, the first stopping in August, 1972 and the second in July 1974.

Since the latter date the satellite has been transmitting its images of Earth directly to ground stations around the globe as they came within the satellite's range. Problems with the pitch wheel brought these operations to a halt.

Landsat 2, launched in 1975, is still in orbit and will be joined by a third Landsat in March of this year. The instruments on this third Landsat will be improved versions of those carried by the first two.

Landsat 1's more than 300,000 pictures of different parts of the world demonstrated the potential of remote sensing from Earth resources spacecraft in the fields of geology, oceanography, agriculture, forestry, hydrology, urban planning, crop prediction and many other resources disciplines.

Such data are important to the United States and the rest of the world as well. Global analysis of food and mineral resources alone are important to economic planners worldwide. These data can be updated rapidly and frequently as the Landsat spacecraft covers each point on the globe every 18 days returning 80-meter (240-foot) resolution pictures of Earth in 185 kilometer (115 miles) by 185 km segments, in four spectral bands, as it passes 915 km (570 mi.) overhead.

Data received from the Landsat satellites are received by three U.S. ground stations as well as one each in Canada, Brazil and Italy. The information is sold to users for nominal fees. Two more stations are under construction in Iran and Japan and others are planned by Argentina and India.

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## **MARSHALL FORMS COMMERCIAL PAYLOADS GROUP**

In December of 1977, the Marshall Space Flight Center in Huntsville, Alabama, formed a special project team to stimulate commercial ventures in space. The group, which is just in the formative stages, has as a mandate the task of developing liaisons with industries which could be expected to undertake materials processing in the space environment.

This task team will serve as a focus for commercial involvement with NASA, and plans on being very receptive to commercial views. It will serve as a voice for industry within the NASA establishment, according to the task team leader, Richard Brown.

Facilitation of small industry participation is also one of the group's goals. By establishing an inventory of NASA-owned hardware, smaller research and development labs and institutions would find it easier to participate in the space processing opportunities. These firms could be expected to lease NASA facilities, perhaps orbital furnaces or processing equipment, rather than be forced to develop their own equipment for Shuttle flights. Through these means many more firms could participate in early space processing experiments and pilot plant production.

Team members concede that one major problem, besides high launch and integration costs, is the unwillingness of most industries to commit funds now for projects which cannot be flown until 1984 or later. Ways to overcome this reluctance will be investigated, according to Brown.

# news notes...

**SOVIET NUCLEAR POWERED SATELLITE FALLS...** Major popular press coverage has been given to the failure of a USSR electronic ferret spacecraft, and to its entry over Yellowknife, Northwest Territories, Canada. The satellite contained about 100 pounds of U-235 nuclear fuel in a highly enriched form used for powering its on-board systems. A spokesman for the Institute for Space Research in Bochum, West Germany, said the large amount of fission fuel aboard indicated the satellite was a "killer" type. He said that only killer spacecraft armed with high-power lasers for space-to-space combat would require the enormous fuel load that the Cosmos 954 carried. An alternative explanation is that the spacecraft was a radar-carrying observation type which the Soviets have flown previously to spy on the whereabouts of U.S. ships at sea. Such a satellite would consume many kilowatts of power, necessitating the use of a nuclear-brayton cycle generator. While solar cells could provide the power, they would be vulnerable to damage from attack by future U.S. killer satellites. A nuclear power system aboard a small satellite is far less likely to be damaged in such a way, and will operate in the shadow of the earth as well.

**SMALL MANNED VEHICLE UPDATE...** Santa Rosa, California... A spokesman for Western Aviation Enterprises in Santa Rosa indicated in an interview with the Foundation REPORT that the proposed suborbital vehicle project is well underway. The vehicle, which can carry one person to an altitude of 50-70 miles, will be recovered at sea off the Californian coast. The location of the launch site has not been announced at this time. At 4000 pounds total liftoff weight, the complete vehicle is lighter than the Mercury capsule which was flown in the early days of the U.S. space program. The booster/spacecraft combination, designed by Robert Truax, is recovered as one reusable piece, completely intact, without any separation of the rocket from the capsule. The first flight will cost one million dollars, but subsequent flights will be about ten thousand dollars each. Overall length is 25 feet, with about a three-foot diameter. Four surplus Atlas D vernier rocket motors of about 1000 pounds thrust each provide liftoff power.

**EARTHPORT AND PRIVATE INDUSTRY...** Santa Barbara... A new brochure on private enterprise and Earthport has been released by the Sabre Foundation. Titled "A Launch Pad for Industry into Space", it was written for the Earthport project by Foundation. Copies are available from the Sabre Foundation, Earthport Project, 221 West Carrillo Street, Santa Barbara, California 93101.

**SPACE MANUFACTURING FACILITIES, PART TWO...** The Proceedings of the May 1977 Princeton/AIAA Conference on Space Manufacturing Facilities has been published as a hard-cover book by the AIAA. With 34 presentations on the problems of transport, industrial operations, human factors, and social system interactions, it is the most recent work available on the space settlements idea. Copies are available from the AIAA, 1290 Avenue of the Americas, New York, NY 10019. Be sure to specify the book as SMF, Number Two. Price is \$17.50. California residents should add 6% sales tax.

## JOP NAMED FOR GALILEO

The 1982 Jupiter Orbiter Probe has been named for Galileo, the 16th Century astronomer who was the first to observe the planet through a telescope, and was the discoverer of its four primary moons.

The probe will be launched aboard the Space Shuttle, and will conduct the most detailed investigation yet of Jupiter and its environs.



The Report is published monthly, and has a subscription price of \$20 per year (\$15 per year for students, \$25 per year for institutional and library subscriptions and \$25 per year for overseas airmail). Back issues are available at \$2 each from September, 1977. Xerographic copies may be substituted as stocks are depleted. Address all correspondence to Foundation, 85 East Geranium Avenue, St. Paul, MN 55117 or call (612) 489-4466. Editorial Direction: Gary C. Hudson; Special Assistance: Resident Fellows E. Anne Roebke and T.A. Brosz; Staff Artist: David Egge. The Foundation Report accepts VISA/BankAmericard and Master Charge. Please give us your full credit card number, expiration date, and the four digit Interbank number (Master Charge only). Your signature is also required on mail orders. Phone orders accepted at (612) 489-4466. No collect calls please.

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