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PROJECT
AZORIAN

~~SECRET~~ ~~NOFORN~~

Despite widespread media publicity in 1975, almost all aspects of the Hughes Glomar Explorer *project are still classified, and it is important that they remain so. The widespread publicity has contained much fact and extensive error. It remains important* [redacted] *to protect sources and methods which may have future application.*

In the course of continuing litigation related to the project—principally concerning California State tax liability, Freedom of Information Act matters, and a patent infringement claim—several facts about the Glomar Explorer *project have been acknowledged in court by the U.S. Government. These include the fact of CIA sponsorship of the project for "intelligence collection purposes;" the participation of Hughes Tool Company, the Summa Corporation, and Global Marine, Inc.; and the actions of senior CIA officials in 1975 to attempt to persuade members of the media not to broadcast or publish reports concerning the project. Beyond these few details, however, it is still firm U.S. Government policy that nothing further about the project is to be said or acknowledged. This prohibition was recently reaffirmed by the President's Advisor for National Security Affairs, the Secretaries of State and Defense, and the DCI. It applies particularly to the specific purpose of the AZORIAN mission; the degree of success; operational details; participation of other contractors, government organizations, and individuals; classified technology; and project funding matters.*

The following article is being published because it now is possible to discuss most of the foregoing matters and other classified project details at the SECRET NOFORN level rather than in the TOP SECRET compartmentation which previously applied to all aspects of the AZORIAN project. Nevertheless, there has been no relaxation of the necessity to keep most of the details of the AZORIAN project classified for the foreseeable future.

PROJECT AZORIAN:

THE STORY OF THE *HUGHES GLOMAR EXPLORER*

[redacted]

In March 1968 a Soviet submarine of the G-II class was lost with all hands, 16,500 feet below the surface of the Pacific Ocean.

On 8 August 1974, [redacted] that submarine was brought to the surface in [redacted] a recovery system designed and developed specifically for that mission.

The story of the more than six years intervening is the story of Project AZORIAN, that is, the story of the *Hughes Glomar Explorer*.*

AZORIAN ranks in the forefront of imaginative and bold operations undertaken in the long history of intelligence collection. It combined immense size and scope, advanced technological development, complex systems engineering and testing, unusually severe cover and security requirements, a demanding mission scenario in an unforgiving marine environment, the potential for a serious confrontation with the Soviet Union, a difficult and technically unusual exploitation phase, and high cost.

The project became widely known to the media in early 1975. At a time when the Central Intelligence Agency was under investigation by two committees of Congress and many members of the press, the CIA was credited in some newspaper editorials

* The full name of the ship is the *MV Hughes Glomar Explorer*, as shown in Figure 5. Global Marine, Inc., operates a number of ships with the word *Glomar* in their names.

with pursuing its tradecraft in a most imaginative manner and doing what intelligence organizations are supposed to do—collect intelligence. Other articles were critical of the project, its cost, and method of operation.

Many senior U.S. Government officials, including three Directors of Central Intelligence, two Secretaries of Defense, two Secretaries of State, and two Presidents, were personally knowledgeable of the program and recognized it as an innovative undertaking of great magnitude and complexity. Key members of four Congressional committees were also kept informed of project progress and reviewed budget requests for the project.

Because the AZORIAN Project was of such huge dimensions in cost, risk, and intelligence value, it sometimes caused difficult problems for the officials who had to make the major decisions affecting it. Some of the questions did not lend themselves to clear-cut unequivocal answers: the intelligence value of the target after six years on the ocean floor, for example, or the political or physical response of the Russians if they should learn of the recovery effort. Because of these difficult questions, there could not be and was not unanimity of opinion among senior officials in CIA, Defense, State, the White House, and other agencies collectively responsible for AZORIAN and the decision on whether or not to proceed. Differences of opinion were expressed and debated in appropriate forums, both before the project was initiated and during its lifetime. These differences are expressed candidly in this article in several places.

In March 1975, columnist Jack Anderson disclosed the existence of the Hughes *Glomar Explorer* (HGE) project on national television and radio. The original press leak had occurred in the *Los Angeles Times* in February 1975. The *Times* story was unspecific, and wrong in important facts, but it gradually developed into a widespread security problem for the program before the Anderson disclosure.

The original leak resulted from an improbable series of events following a break-in and robbery in June 1974 at Summa Corporation headquarters in Los Angeles. It was thought that among the stolen documents there might be a memorandum from a senior Hughes official to Howard Hughes describing a proposed CIA attempt to recover a sunken Soviet submarine and requesting Hughes' approval for Hughes Company participation. Thus it became necessary to brief several persons involved in the investigation in order to protect the document from disclosure if it were recovered. While the source of the leak was never identified, the circumstances became known to reporters who were covering the story and were disclosed in the *Los Angeles Times* story. Extraordinary efforts by DCI Colby and others were able to contain the spread of the story for a time, but it eventually became widely known in press circles, and Anderson decided to break it.

[redacted]

This article describes how the *Glomar* project—code-named AZORIAN, not "JENNIFER" as stated in the press—came about, how it was managed and conducted, and to what extent it met its goal. Subsequent articles will describe how the [redacted] cover aspects of the AZORIAN/MATADOR program, and other related issues.

Project Origin

The diesel-powered Soviet G-II-class ballistic missile submarine pendant 722 ([redacted] sailed from Petropavlovsk on about 1 March 1968 to take a patrol station

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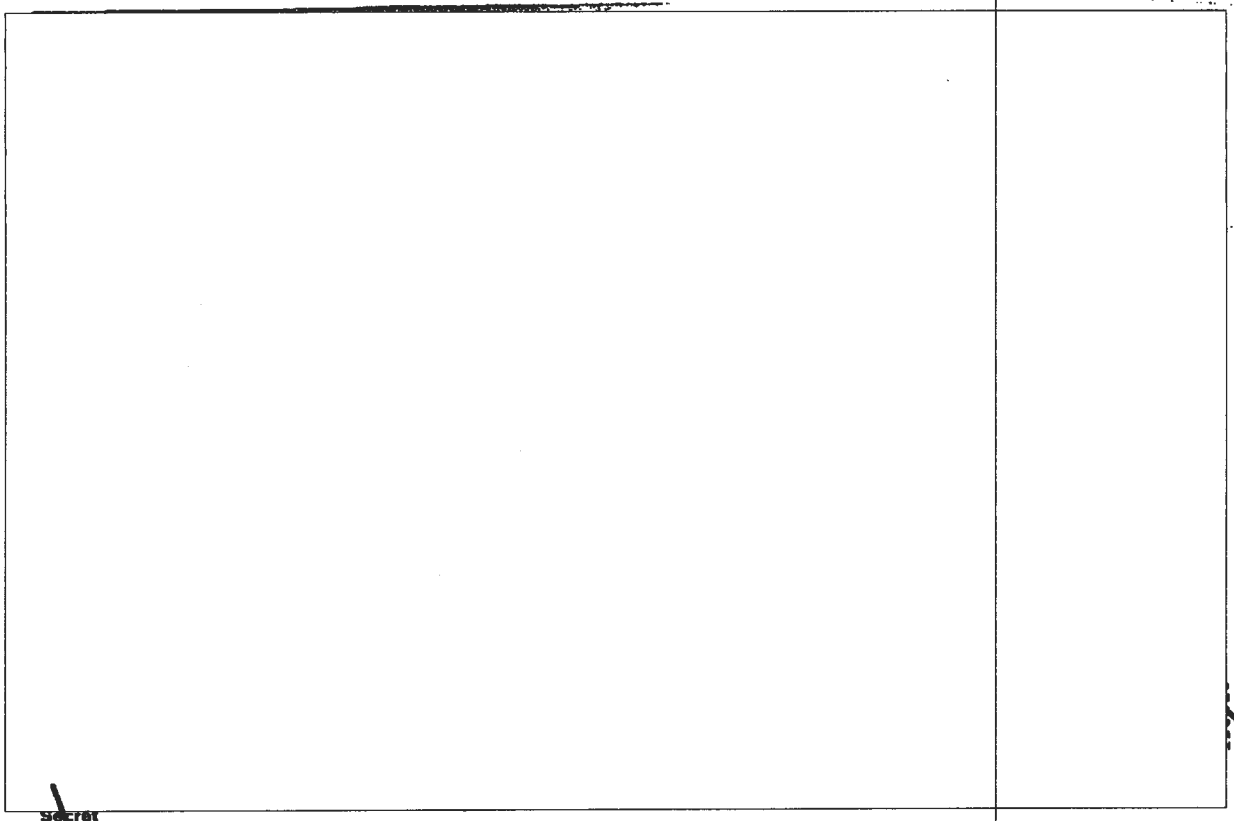


northeast of Hawaii, off the west coast of the United States, where it would be available for nuclear attack on U.S. targets in event of war. The submarine suffered an accident—cause unknown—and sank 1,560 miles northwest of Hawaii. With the 722 out of contact and overdue, the Soviets undertook a massive two-month search effort covering a broad area from Petropavlovsk to the patrol area northeast of Hawaii. The Soviet search was fruitless.

enior officials in the Department of Defense and CIA recognized that if it were feasible to devise a plan to recover important components of the submarine, extremely valuable information on Soviet strategic capabilities would be obtained.

Organizing for Recovery

Discussions regarding the feasibility of recovering components of the G-722 took place between technical representatives of CIA and the Department of Defense during the latter months of 1968 and in early 1969. These talks resulted in a letter to the Director of Central Intelligence, Richard Helms, from the Deputy Secretary of Defense, David Packard, on 1 April 1969. Packard, referring to the sunken submarine, asked for a study of what could be done in the next few years to recover significant components. He asked CIA to take the lead and designated Dr. John Foster, Director of Defense Research and Engineering (DD/R&E) as the point for coordination. Mr. Helms designated Carl Duckett, Deputy Director for Science and Technology (DD/S&T) as the CIA focal point.

During early July 1969 CIA representatives, including John Parangosky and worked to develop a plan for a program to recover the submarine. This plan was coordinated and approved by mid-July 1969

On 17 July 1969, Helms advised Packard that considerable work had been accomplished to undertake submarine recovery; that Duckett had met with and work was in progress to develop a charter for it, that an Agency task force was studying the retrieval problems associated with the sunken G-II submarine,

On 8 August 1969, outlined to a high-level Executive Committee (consisting of Packard as Chairman; Helms; and the Science Advisor to the President, Dr. Lee DuBridge) the proposed organization for the submarine recovery effort, including structure, management, assets, personnel assignments, and intelligence objectives.

ExCom approved the establishment of the new organization and the allocation of resources and personnel, and agreed that the President should be advised of its establishment. This was done in a memorandum from Dr. Kissinger to President Nixon, which the President approved. Ernest "Zeke" Zellmer, a senior CIA official from the DDS&T, who was a Naval Academy graduate and a submarine officer during World War II, Deputy Director,

[redacted] agreement describing the organization's detailed responsibilities, management structure, and working relationships was signed by Packard and Helms on 19 August 1969. Among other features, it specified that the staffing of the new organization should reflect the best talent available from the CIA, [redacted] security policy and procedures were in accordance with the basic [redacted] agreement, which placed security management responsibility for the new security system, code-named JENNIFER, with the Director of Security, CIA, acting for the DCI. The Director of Security, in turn, delegated everyday security responsibility to the Chief of the [redacted] at CIA and directed him to establish compartmentation procedures to insulate JENNIFER data from data relating to other programs.

From the beginning, extraordinary security was imposed and clearances severely limited to those with an absolute need-to-know. It was clear at all stages of the AZORIAN Project that it had to be leak-proof to enable the mission to be conducted without diplomatic or physical interference from the Soviets. Therefore, air-tight security and effective cover were of the utmost importance, and project continuation depended upon them completely.

The original CIA task force for Project AZORIAN, established on 1 July 1969 in the [redacted] became the program headquarters complement, carried in Agency records as the Special Projects Staff, DDS&T. John Parangosky, who had previously held key assignments in the Agency IDEALIST (U-2) and OXCART (A-12) aircraft reconnaissance programs, was named to head this staff [redacted] a senior CIA officer and Naval Academy graduate, was appointed as his Deputy.

Development of Engineering Concept

Parangosky initially assembled a small task force of engineers and technicians, who were closeted each day in a large room dubbed the "think tank," to develop an engineering concept to recover the Soviet submarine [redacted]

Because of the great difficulty and complexity of the recovery problem, the task force called on three security-cleared contractors for early help: [redacted] for structures and mechanisms; [redacted] for naval architecture; and [redacted] for sensors. Principal criteria for the recovery concept were technical and operational feasibility, timeliness of implementation (get the system into the field as soon as possible for an early recovery mission), and reasonableness of costs. The group quickly immersed itself in the problem, fully aware of the challenge of a uniquely difficult task. No country in the world had ever succeeded in raising an object of this size and weight from such a depth.

1. *Early Concepts*

Three basic categories of lift concepts were considered for use in the early studies: total "brute force" or direct lift; trade ballast/buoyancy; and at-depth generation of buoyancy. Each is reviewed below:

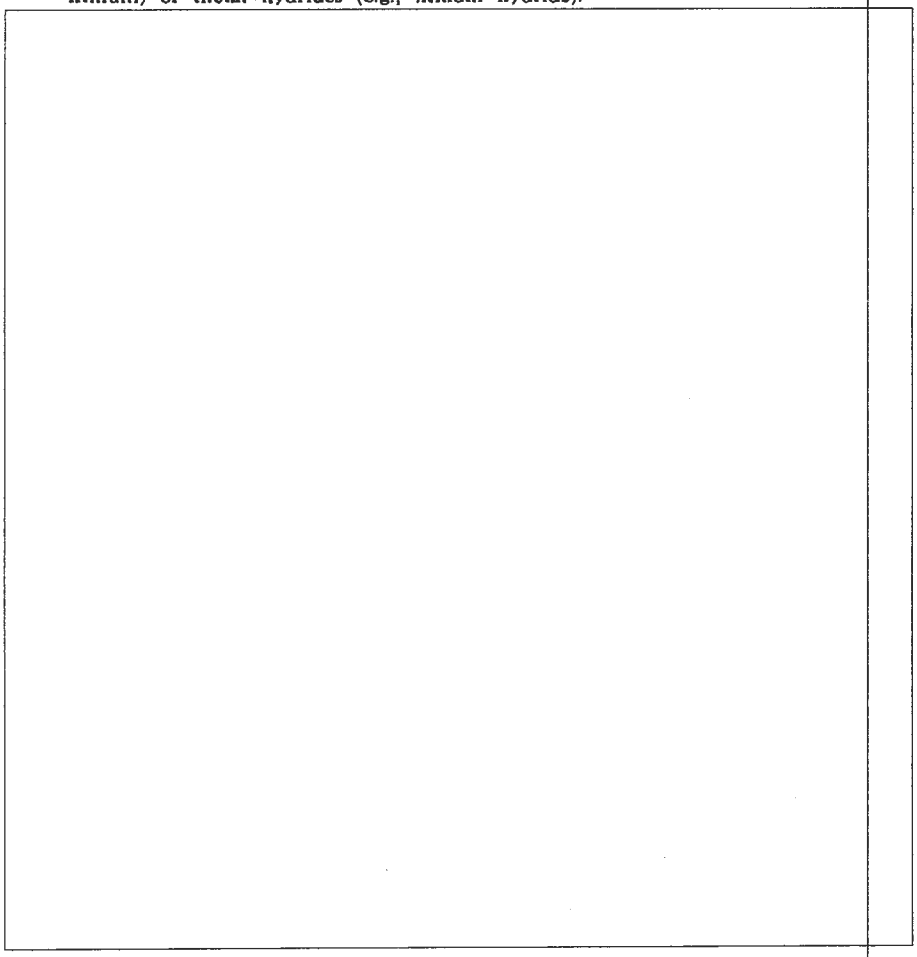
a. *Total "Brute Force" (Direct) Lift*, referrred to as the Rosenberg Winch, involved massive floating winches with wire ropes of the necessary strength to manage

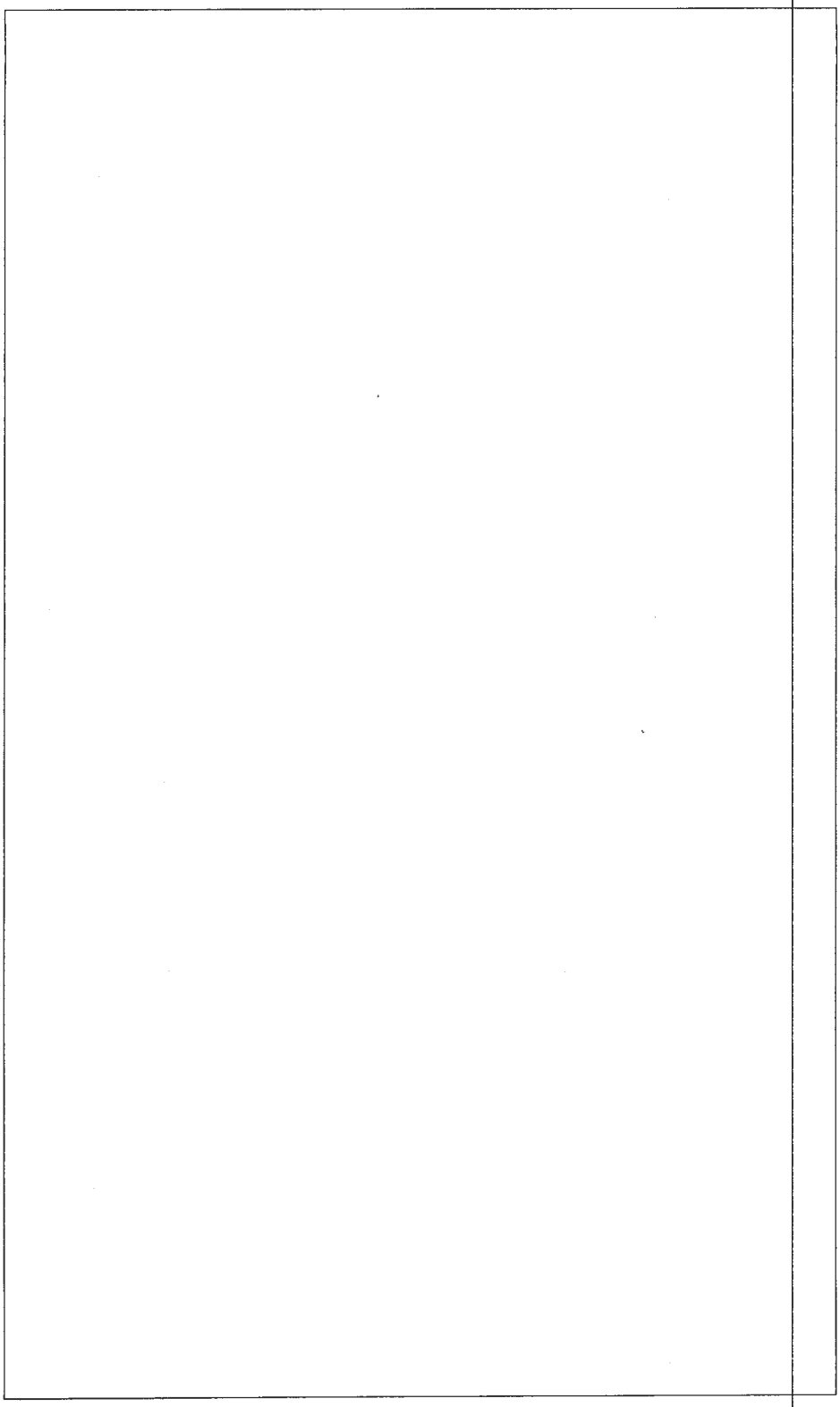
the total weight of the target object (believed, at that time, to be about 2,000 to 2,200 long tons).

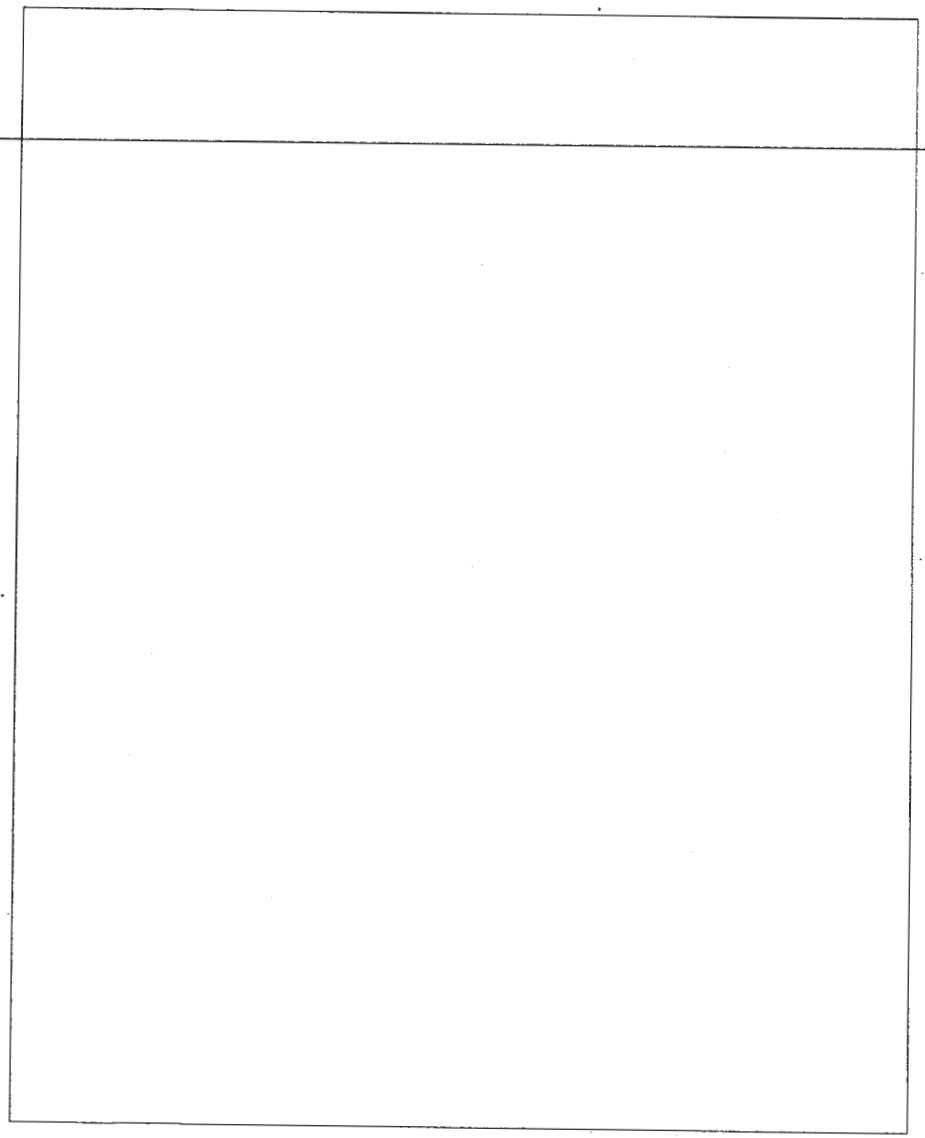
Use of a "drill string" (i.e., a "string" of connecting pipe) was discarded by the task force in the early discussions because it was difficult to envisage how the massive pipe required could be successfully deployed. It was believed at that time that the weight of the pipe alone could not be supported from the surface and still allow enough strength and lifting capacity for the submarine hull section.

b. In the *Trade Ballast/Buoyancy* concept, buoyant material would be carried to the bottom using excess ballast. On the bottom the ballast would be dropped, generating sufficient positive buoyancy to extricate the target from the bottom and help lift it to the surface.

c. *At-Depth Generation of Buoyancy* envisaged the generation of gas at depth to create buoyancy to lift the target. Methods reviewed were electrolysis of sea water, cryogenic gases (hydrogen, nitrogen), catalytic decomposition of hydrazine, and chemical generation of hydrogen through the reaction of active metals (e.g., sodium, lithium) or metal hydrides (e.g., lithium hydride).







[redacted]

4. *Engineering Concept Selected*

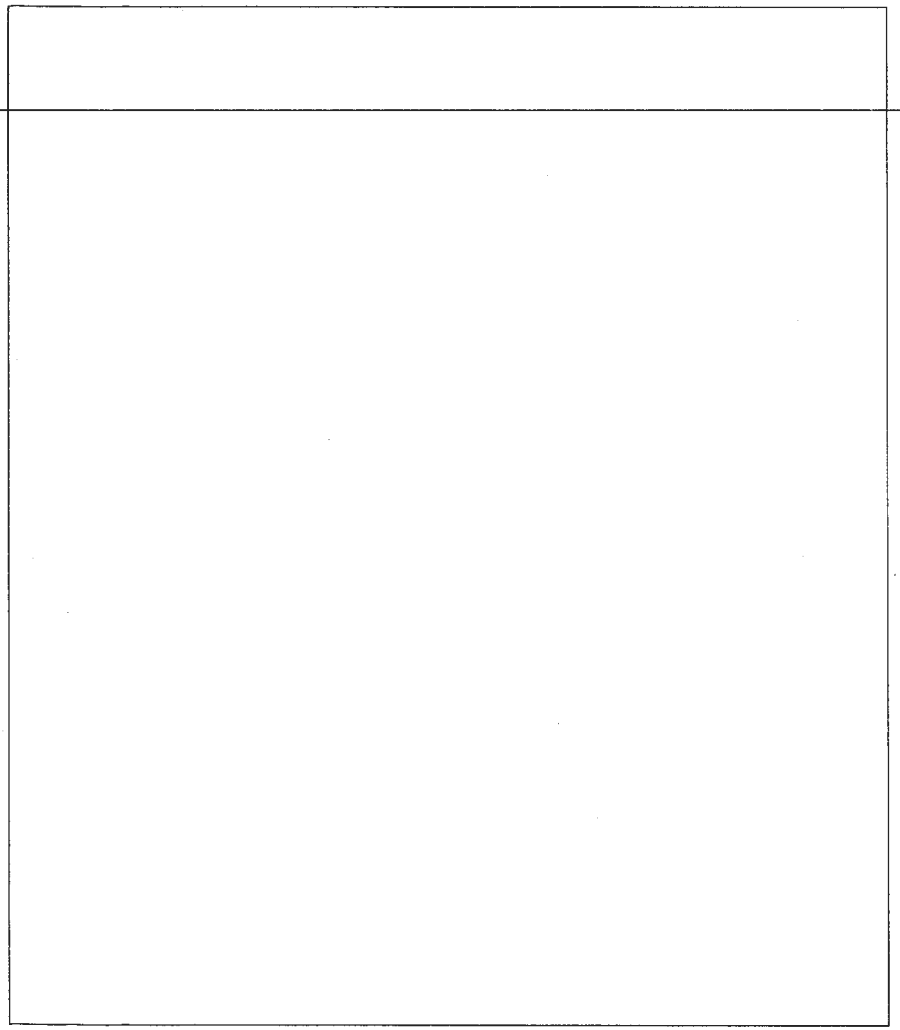
By late July 1970, the heavy-lift concept was clearly the favored system to develop for the recovery mission. From that time on, it was given full attention by all appropriate parties, [redacted] gave the formal authorization to concentrate studies on the heavy-lift method on 11 September 1970 during a briefing at the Pentagon.

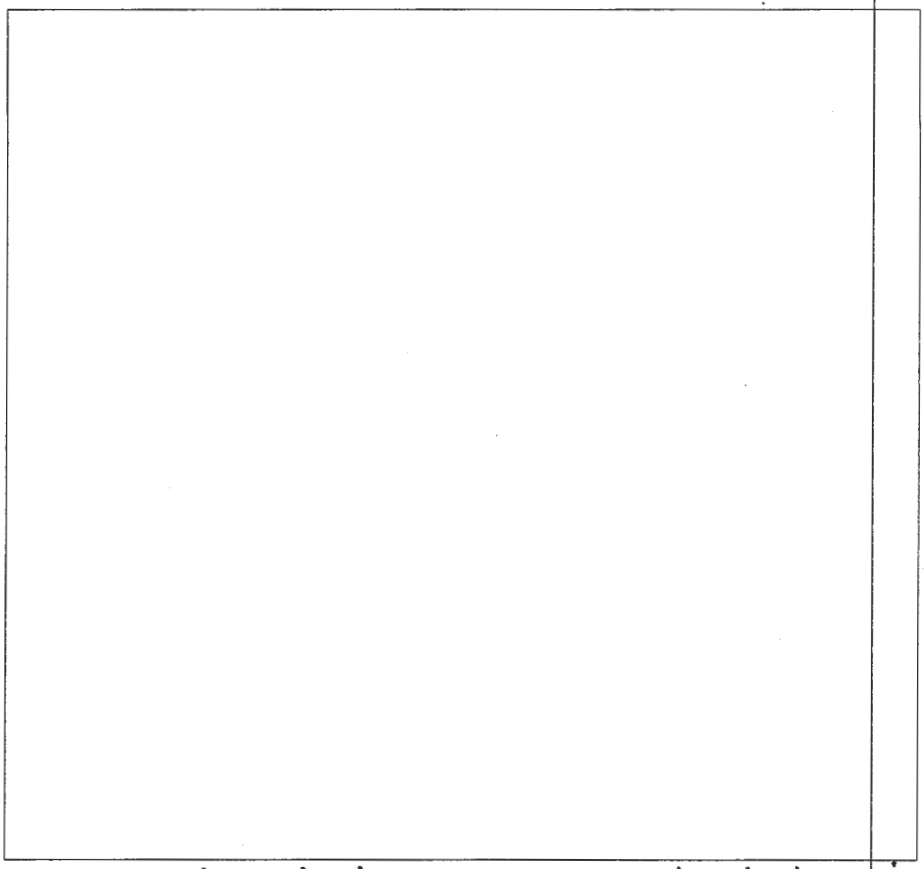
As the engineering concept was being formalized, a deep-ocean mining cover story was beginning to take form to explain all the project activities, particularly those planned for at-sea operations.

Executive Committee Approval

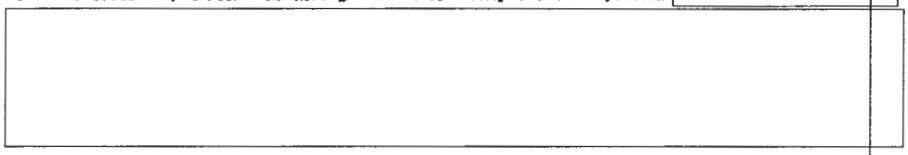
At the 30 October 1970 Executive Committee meeting, [redacted] addressed the matter of conceptual development for target recovery. He described the dead-lift (or brute force) concept which would be designed to lift the estimated 1,750-ton target object from the 16,500-foot depth by means of heavy-lifting equipment mounted on a large (565' by 106') surface ship. [redacted]

[redacted]





As mentioned previously, a deep-sea mining venture was to be used as the cover story for this operation. To support this theory, a mining device would be constructed, which could be handled by the surface ship and mated into its center well. A submersible dry dock was also planned to complete the system.



As with all engineering concepts, technical risk areas were involved, and Frosch identified the major ones. They were characterized as being within the state-of-the-art but requiring a major beef-up to handle the weights and pressures involved. The control system was also considered a risk area, but its feasibility had already been demonstrated by another Global Marine ship, the *Glomar Challenger*, which drilled a hole in the sea floor, withdrew the drill bit, and then placed a new bit into the same drill hole in deep water earlier in 1970. Further pointed out that an extensive simulation program would be conducted to define the dynamic characteristics and stresses of the system. Initial analyses had not uncovered any unexpected or insurmountable problems.

All in all, at that time estimated the probability of success at about 10 percent, a not very assuring number. (This estimate continued to rise, however, as

design, development, and testing proceeded. Just prior to the mission, [redacted] believed the probability of success to be about 90 percent.) Helms stated that the *ad hoc* committee of the U.S. Intelligence Board (USIB) had completed a detailed review of the value of the AZORIAN target on which they had placed the highest priority, and he concurred in their assessment. [redacted]

[redacted] Dr. Edward David, the President's Science Advisor, asked what assurance there was that the desired material [redacted] he also questioned whether it would be in an exploitable condition when recovered. [redacted]

[redacted] pointed out that there were two basic questions to be answered: should the organization proceed all-out with AZORIAN? If so, where would funding be obtained? Packard answered that not all data on fund availability were known, but that [redacted] nevertheless should go ahead with the AZORIAN project.

Some concluding remarks were made by others at the meeting. Dr. John Foster, Director of Defense Research & Engineering, observed that there appeared to be an underestimation by those present of the value of the target and of the impact AZORIAN would have [redacted] Helms commented that he was more confident in regard to this project than to some others because of the thorough work that had been done up to that point.

Packard summed up the proceedings of this meeting and said the consensus was to proceed with AZORIAN. He felt that planning should be done on a [redacted] level but said it would be necessary to identify possible sources of funding.

[redacted]

Recovery Systems Modification

[redacted] reported back to ExCom on 24 March 1971 on technical and design progress of AZORIAN. Total cost now was projected to [redacted] with the

principal cost increases attributable to two factors: (1) extended operations to permit more adequate systems testing, and (2) cover enhancement and recomputation of general and administrative expenses. Increases in hardware costs were relatively small.

The Crucial 4 August ExCom Meeting

The next ExCom meeting, on 4 August 1971, proved to be crucial to the life of the project.

Packard opened by stating he considered it necessary to terminate AZORIAN because of the risks involved, escalating costs, and the general budget situation. Nevertheless, he asked [redacted] to brief ExCom on program status.

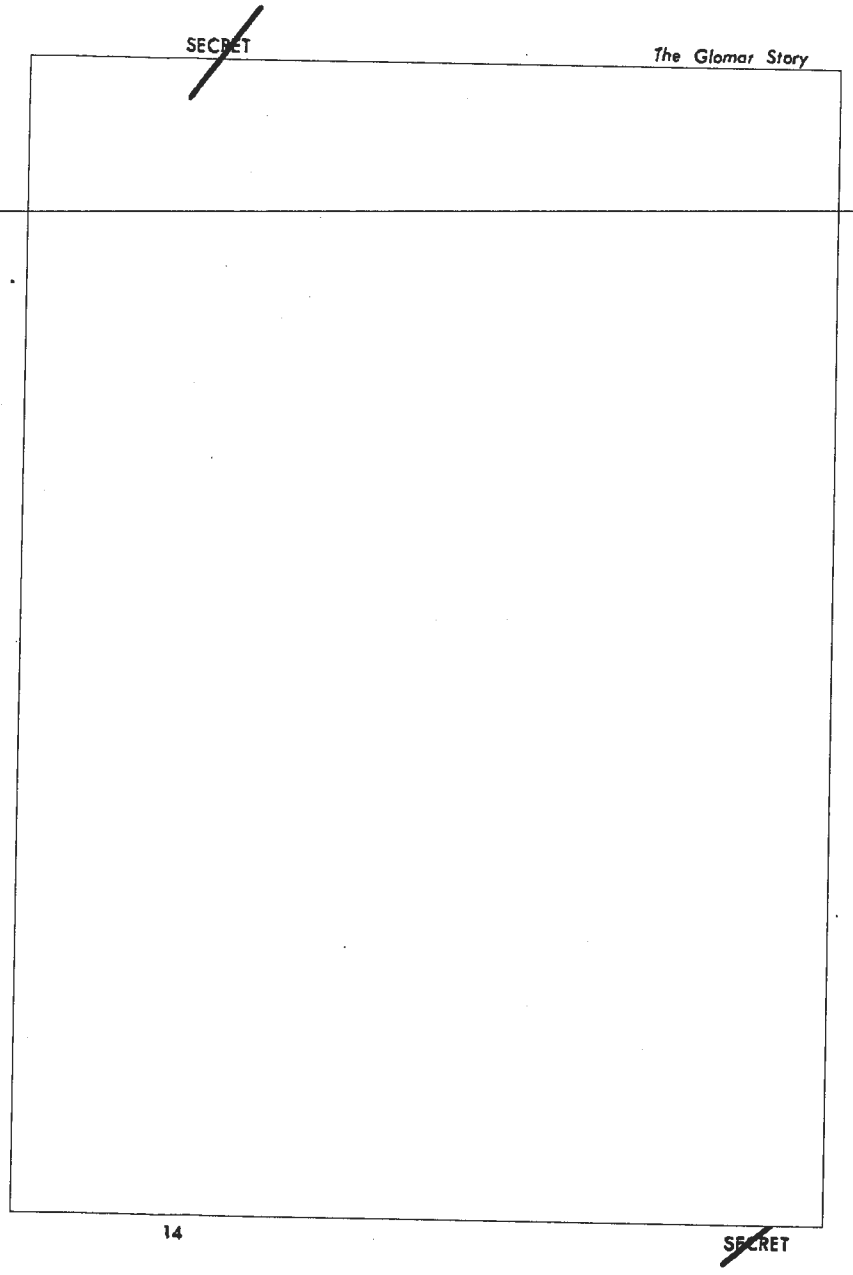
[redacted]

The "other increases" included, for example, modifications of the well area for safety reasons; design and manufacture of a small mining machine for cover purposes; and other contractor cost increases.

There was an extended ExCom discussion of the cost growth problem along with the strained budget status, the anticipated very high intelligence value of the target, and the operational risks. Packard concluded that the project should be continued for a few months, but that [redacted] should consider alternatives in case it were subsequently terminated. This guidance was later expanded to direct a thorough cost review while permitting procurement of long-lead items. However, the keel of the surface ship should not be laid until further approval.

Budgetary Shoals

The 4 August 1971 ExCom meeting was but the first of a number of recurring occasions on which AZORIAN nearly foundered over cost increases and operational risks. Some of the original recovery concepts such as buoyancy lift had been price-tagged as low as [redacted] the chosen concept was first costed at [redacted] in 1970. In less than a year it had jumped more than 50 percent to some [redacted]



[redacted] and another year brought the figure to [redacted] Each time, however, consideration of the intelligence potential carried the day.

Design and Development of AZORIAN System

By the November 1971 ExCom meeting, substantial strides had been made in design and engineering development of major ship systems, such as the heavy-lift and heave-compensation systems. All details of the pipe-string design also had been completed, and a pipe-string specimen had been fabricated to develop confidence in pipe section fabrication. Design of the large test fixture which would prooftest each 30-foot section of the pipe was nearly complete.

[redacted]

By the early fall of 1971 Sun Shipbuilding and Drydock Co., Chester, Pa., which had been selected to build the surface ship, was proceeding with fabrication of the docking well gate guides and the temporary bottom structure for the docking well, and preparing to lay the keel. [redacted]

[redacted]

On 4 October, Packard authorized [redacted] to proceed with AZORIAN but directed that every effort be made to contain costs within the then-refined total program cost of [redacted]

In April 1972 [redacted] reported to ExCom that the keel for the surface ship had been laid by Sun Shipbuilders on 16 November 1971 and that the schedule now called for a launch by 5 October 1972 and delivery to the program by 20 April 1973. Further, all long-lead equipment was under procurement and on schedule.

The construction barge was launched in San Diego in January 1972, and reached Redwood City early in May. [redacted]

[redacted]

equipment—control center, sensors, and control, power, and data-transmission subsystems—had been completed during FY 1971.

By April 1972, 55 pieces of the pipe string had been poured [redacted] —and final delivery of all 590 pieces at dockside was scheduled for 7 June 1973.

All data-processing functional requirements were defined and documented during December 1971, and the configuration of [redacted] and associated peripheral equipment was put in final form in January 1972.

Managerial Views of Program in 1972

At the ExCom meeting on 28 July 1972, [redacted] pointed out that AZORIAN had been developed as a one-of-a-kind system intended for a specific job and that because of this uniqueness and the need to accomplish the mission at the earliest possible time, work on the system was proceeding concurrent with design and production. The consequence had been that the amassing of a considerable body of knowledge enhanced the chances of success, but it had also necessitated some costly changes along the way. [redacted] said he expected delivery of the ship in the spring of 1973, and operational deployment in the summer of 1974. He pointed out that recent major changes had driven the total system cost to more than [redacted] These changes included ship hull strengthening, modification of propulsion shafting, increased electrical capacity, the incorporation of a sewage system to meet new ecological standards, and an improved pipe-string handling process. In addition, a second and more expensive subcontractor had been brought into pipe-string production to meet the tight delivery schedule. [redacted] said construction of the whole AZORIAN system was expected to be largely completed by the end of FY 1973.

Early Political Feasibility Evaluation by 40 Committee

At this 28 July 1972 ExCom meeting, it was agreed that the 40 Committee should be asked for an early evaluation of the political feasibility of conducting the mission in mid-1974, in the light of increasing concern that by that time the developing political climate might prohibit mission approval. On 14 August 1972 Kenneth Rush, who had succeeded David Packard as Deputy Secretary of Defense and thereby as chairman of ExCom, forwarded two documents to the 40 Committee, one an intelligence reevaluation of the submarine target object by the *ad hoc* Committee of USIB, the other a summary of the program's technical, operational, cover, and security factors. He reported to the 40 Committee in his covering memorandum that AZORIAN was proceeding on schedul[redacted] It would reach an accrued cost of [redacted] by 31 August 1972, and was expected to cost [redacted] for completion. In the light of the developing political climate and uncertain budget problems, he said, ExCom was requesting a preliminary political assessment.

On 15 August 1972, Rush forwarded to Helms and David copies of three memoranda relative to the AZORIAN assessment which he had received from the Chief of Naval Operations, Admiral Elmo R. Zumwalt, Jr.; the Assistant Secretary of Defense (Intelligence), Dr. Hall; and DIA Director Vice Admiral de Poix. All three to varying degrees judged that the value of the anticipated intelligence gain from the mission was less than that estimated by the *ad hoc* Committee, pointed to the escalating costs and political risks of AZORIAN, and generally felt that the program should be terminated. Zumwalt, while not recommending immediate termination,

stated his strong reservations about continuing AZORIAN and recommended that the cost-benefits be studied further with relation to the total DoD intelligence program.

[redacted] forwarded a detailed report to Hall which discussed in detail expected [redacted] benefits potentially derivable from recovery of the G-722 target object. It was clear that [redacted] was still favorable as far as expected mission intelligence value was concerned.

In any event, all these papers and the assessment of the *ad hoc* Committee of USIB which reaffirmed the expected important intelligence gains including those in [redacted] areas were forwarded to 40 Committee by Deputy Secretary Rush on 21 August 1972 along with CIA comments which took issue with Zumwalt's and Hall's memoranda.

At this crucial juncture Admiral Moorer, Chairman of the Joint Chiefs of Staff, sent a memo to the 40 Committee on 28 August stating that he could not support the proposed AZORIAN mission, primarily because of decreased intelligence value of the target with the passage of time since the G-722 sank in March 1968, the escalating costs which he believed would continue, and the possibility of strong reaction from the Soviets if they suspected the nature of the activity. [redacted]

Helms countered on 14 September with a memo to Chairman, 40 Committee, which argued for a continuation of AZORIAN. While agreeing that the differing judgments around the community concerning the intelligence value of items and systems believed to be aboard the G-722 were understandable in such a difficult program, Helms urged a decision to proceed based on the documentation prepared by the joint program organization and the USIB *ad hoc* Committee assessment, which he considered an accurate national evaluation of intelligence potential. He further believed the technical risks were acceptable in view of the expected intelligence value, and that a political judgment as to whether to conduct the mission could be made satisfactorily only at mission time. He also believed the risk of further significant cost increase was low, and that in any case the costs recoverable if the program were terminated would be small.

Then, on 18 September 1972, Rush weighed in with his judgment. Because of current and continuing political relationships and negotiations with the Soviet Union, he believed it undesirable to execute AZORIAN as then planned. He predicted the Soviets would react strongly with physical force if they learned of the nature of the mission beforehand, and even if they discovered its nature only at a later date, U.S.-Soviet relationships and negotiations would be seriously damaged. He also believed there was a high risk of technical failure, and estimated the chances of technical success at 20 to 30 percent based on the existing program schedule and budget. Rush did not take issue with Helms' evaluation of the intelligence benefits but believed that, overall, the program should be terminated in view of high political and technical risks. He shared Helms' concern about the effects of termination on contractor relationships, because the major contractors had publicly committed themselves to a large ocean mining endeavor. Helms felt that a termination now would appear capricious to contractors and jeopardize future cooperative efforts with the intelligence community when contractor support would be needed.

The AZORIAN Review Panel

Rush made the next major move by establishing a panel under Hall to review and refine AZORIAN cost data, to examine projected savings if the program were

cancelled, and, alternatively, to look at technical risk areas that he believed might lead to greater costs; he invited Helms to provide a panel member. The AZORIAN Review Panel consisted of representatives of the DCI, Office of the Science Advisor to the President, [redacted] Defense Contract Audit Agency, and the Office of the Assistant Secretary of Defense (Comptroller), and was convened by Helms and Rush.

The panel reported back to Rush on 11 December 1972. By way of background, the report stated that the program had been organized around four major developmental tasks: surface ship [redacted] pipe string, and data-processing systems, and that program management had been highly effective with the result that all key phases of the program were on schedule. The key phases included developments on the boundary of the state-of-the-art, such as some of the largest forgings ever made, entirely new pipe metallurgy, and a lifting apparatus that could not be fully tested prior to the actual mission operation. The new and dramatic individual developments led to some legitimate concern about the future technological risks. The panel could not in the time available examine the program's technical uncertainties, but stated that such a bold engineering undertaking must be considered a high-risk venture. The panel concluded:

1. The saving to the government if AZORIAN were terminated, would range between [redacted] depending upon the effectiveness of the cover operation and availability of a competitive market.

2. Should the program be continued, the estimated cost growth could range from [redacted] assuming that the mission was accomplished on the planned date.

3. Current schedule and program office planning should allow the mission to be performed on the target date.

4. There was no way to test the full system in advance of the actual lift operation, and engineering unknowns at the time provided the greatest uncertainty in the program.

In a separate report on 21 November 1972, [redacted] and member of the AZORIAN Review Panel, concluded as a result of his overview of the project that the technical prognosis was good, project management was excellent, and schedule and cost aspects had been tracking reasonably well. He noted that the project was then entering a critical testing phase wherein difficulties had to be expected despite anticipatory efforts that had been exerted to date. He believed that further cost growth would probably develop during the testing phase, but that substantial offsets could be generated as well.

Regarding costs [redacted] noted that total project cost had grown by 66 percent to [redacted] estimated in October 1970 based on contractor proposals, and by six percent from the [redacted] at which the contracts were calculated in December 1971. Considering the highly developmental nature of the undertaking, he regarded this as a creditable performance. AZORIAN, he said, was clearly a bold engineering undertaking which staggered the imagination. It reflected a massive degree of concurrency in design, development, and production, and—being without precedent in its totality—must be considered a high-risk venture. Each element of the total system, however, had highly professional scientific and engineering attention, and thorough testing routines were planned short of the final operation.

The 40 Committee Decision to Proceed

The 28 July 1972 ExCom decision to seek a 40 Committee review culminated on 11 December 1972. After the most intensive, detailed, and broad-based examination to date of all facets of the program, the final decision, made by the President, was to continue the AZORIAN project, with 40 Committee exercising appropriate policy supervision. In his memo on that date to 40 Committee principals, Dr. Kissinger said the President was impressed by the project's creative and innovative approach to a complicated task and that he praised the cooperation among elements of the intelligence community to serve a national objective.

[redacted]

So, almost four years after the initial discussions between Agency and DoD representatives about the feasibility of recovering the G-722 [redacted] a very crucial milestone had been passed, the most important in a long series of high-level program reviews which, at times, had threatened the continued existence of the AZORIAN program. Now, with the Presidential green light, the program office redoubled its efforts to keep all work and planning on schedule to maximize the chances of success in 1974.

Construction and Delivery of HGE

In April 1971, Robert F. Bauer, chairman of the board of Global Marine, Inc., had issued a press release announcing that GMI would build a 600-foot mining ship for the Hughes Tool Company (HTC). The following month, the GMI Quarterly Financial Report to the stockholders mentioned that a preliminary agreement had been reached with Sun Shipbuilding Company for construction of the ship. On 4 November 1972, the *Hughes Glomar Explorer* was launched with the usual champagne christening ceremony and speeches by Bauer and by Paul Reeve, general manager of the Ocean Mining Division of the HTC. At the same time, a press release was made available to the news media providing general information about the *Hughes Glomar Explorer* and some of the principal contractors.

Between 25 November and 23 December 1972, the ship's well-gate guides were installed. The next few months at Sun Shipyard were somewhat hectic as the HGE was readied for builders' trials, scheduled for mid-April 1973 to verify to Global Marine the satisfactory basic operation of the ship and its operating equipment and machinery. Additionally, certain tests were scheduled to obtain certification by the U.S. Coast Guard and the American Bureau of Shipping. Sea trials were conducted under normal operating and weather conditions, in open sea and deep water, and, where applicable, in the presence of Global Marine, Sun Shipbuilding, the U.S. Coast Guard, the American Bureau of Shipping, and various vendors or subcontractors.

Trials and tests were divided into three categories: general items including trim and ballast, dual pilot houses, lifeboat drill, and vibration; standard ship tests which involved main propulsion, speed trials, turning radius, astern and emergency steering, stabilizing system, calibration of propulsion and thruster motors; and unconventional ship tests such as checking docking legs, gimbal bearings, and the dynamic positioning system.

Summary of Trials and Trial Data—Builder's Trials

The HGE (see Figure 5), left Sun Shipyard, Chester, Pa., on 12 April, down the Delaware River and through Delaware Bay into the Atlantic Ocean where all tests were conducted in an area approximately 75 nautical miles southeast of Delaware Bay. There were 203 people on board, either participating in or observing the trials. Sun Shipyard had four key operating personnel, four who were supervising, and also a large number of engineers, electricians, pipe fitters, and operating crew; Global Marine had 58 representatives with an engineering group; and the Special Project Staff had several representatives under cover. The American Bureau of Shipping and the U.S. Coast Guard also had several representatives on board.

The ship and its equipment and machinery were operated by Sun Ship personnel only, and tests and trials were carried out under normal operating conditions, in good weather and calm seas. All scheduled tests were accomplished successfully in all areas. The ship's handling during the tests was reported as follows: "HGE overall seaworthiness, mobility, and response is excellent." A few major and a number of minor discrepancies were noted which Sun Ship and Global Marine were responsible for correcting before the ship was delivered.

Builder's trials were concluded late in the evening of 14 April with completion of thruster tests. The HGE then proceeded to Delaware Bay and retraced its route up the Delaware River, arriving at Sun Shipbuilding, Chester, Pa., on 15 April. Upon return to Sun Shipyard, the HGE underwent a major effort to correct deficiencies and ready it for delivery to Global Marine as operator for the U.S. Government, with completion of East Coast trials scheduled for early July 1973.

East Coast Trials, July–August 1973

Even though all marine systems were given their first sea test during builder's trials, it was the intent during East Coast trials to test most basic marine systems again and to record test data. Further, a great many systems had not been tested at sea during builder's trials and could not be adequately tested at the dock, such as heavy lift, docking legs, heave compensator, gimbal platform, and the pipe-handling system, and test personnel were to give maximum effort to these. Dockside work at Sun Shipbuilding was completed early in July, and the *Hughes Glomar Explorer* set out for East Coast trials (originally scheduled for 7 July) on 24 July 1973. Curtis Crooke of GMI was designated overall test director, and each test was assigned a principal reviewer from the Global Marine review team. As discrepancies were encountered and recorded, reviewers were responsible for signing off formal acceptance or rejection of each test. Discrepancies which could not be corrected immediately were recorded and scheduled for correction either during transit from the East to West Coast or during West Coast mobilization after the HGE's arrival at Long Beach.

Ship's activities were scheduled from departure from Sun Shipyard dock until it arrived at Hamilton, Bermuda, the first port of call, including some 47 different tests or activities which were conducted in six main areas.

As the HGE headed south down the Delaware River at low tide, it passed under two bridges and one power line. One bridge was the Delaware Memorial Bridge at Wilmington. To get the ship under the 225-foot-high span, the top 28 feet of the derrick had to be removed and stored on main deck. Once below the bridge, the *Sun 200*, a huge floating crane, picked up the 28-foot section and placed it back atop the 200-foot derrick where it was secured.

MV HUGHES GLOMAR EXPLORER

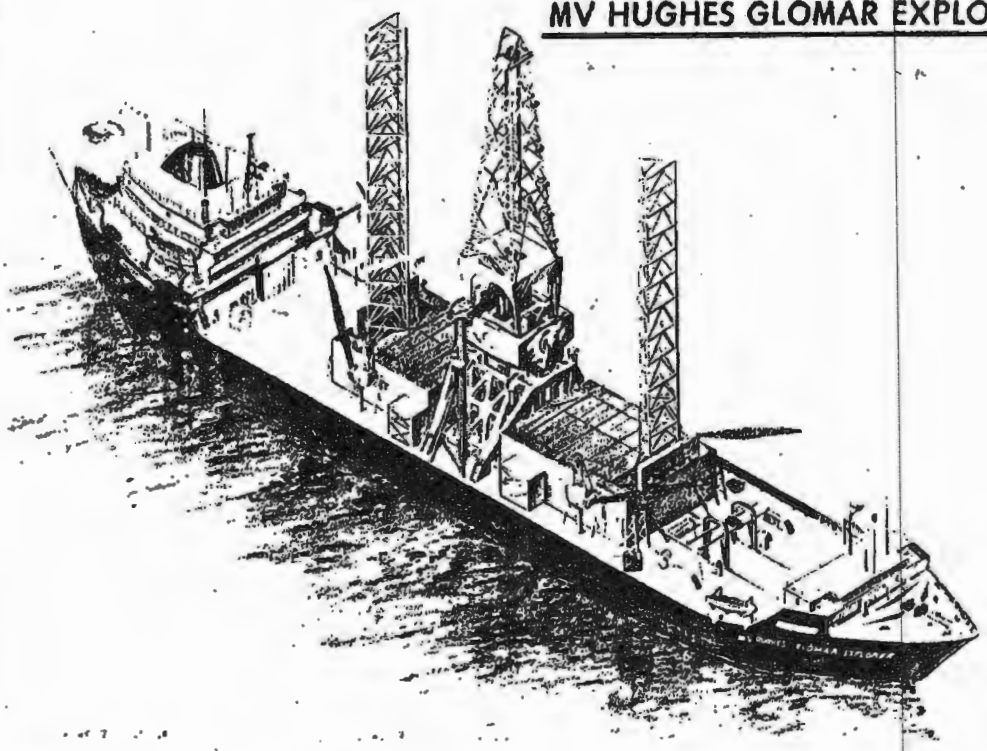


Figure 5. Schematic Drawing

After shallow-water tests off Delaware Bay, the ship proceeded to the deep-water test location 80 miles northwest of Bermuda, where the Automatic Station Keeping (ASK) system had its first test in deep water: about ten double sections (600 feet) of heavy pipe were run in the pipe-handling system; and the gimbal platform was put through its first fully operational test. At the conclusion of test activity the ship proceeded to Bermuda for crew change and final preparation and loading for the East-West transit to Long Beach, Calif., around South America via the Strait of Magellan.

Results of East Coast Trials

It was concluded that—except for a few deficiencies—basic ship's systems had performed very well, and the HGE was capable of performing its intended job. The hull was determined to be sound, with no apparent flaws or weaknesses. Major structural assemblies such as the well gates, A-frame, gimbal platform, derrick, and docking legs all appeared to be structurally sound with satisfactory alignment and fit, so that no major structural rework or change in concept of the basic ship's systems was required. For the most part, all mining equipment items operated as designed, although there were several serious deficiencies and many minor ones. Corrective work was scheduled to begin during the transit to Long Beach and early in West Coast mobilization for the mission. To illustrate the complexity and magnitude of readying the ship for West Coast testing, it was determined immediately after East Coast trials that 40 corrective tasks could be performed prior to departure from Bermuda; 136 tasks could be performed during transit to Long Beach; and 245 tasks would have to be performed as soon as possible during West Coast mobilization.

East–West Transit, 11 August–30 September 1973

After completion of East Coast trials, the *Hughes Glomar Explorer* remained at anchor off Bermuda 9 through 11 August 1973 while a crew change was accomplished and all preparations completed for the 12,700-mile voyage. This was planned to take just over 50 days at an average speed of advance of 10.5 knots. The long way around was necessary because the HGE's 116-foot beam was too wide to permit passage through the Panama Canal. A transit crew of 96 persons was decided upon, of whom 47 were regular ship's crew members and the remaining 49 were Global Marine engineers and technicians who used the time in transit to complete a number of fitting-out tasks.

Arrangements were made through the Global Marine agent in Valparaiso, Chile, to carry two Chilean pilots for the transit through the Strait of Magellan. They were to board the HGE in Possession Bay on the Atlantic side, provide the ship safe passage for the 320-mile journey through the Strait to the Pacific Ocean, and ride the ship to Valparaiso for disembarkation.

The replacement crew for the East-West transit was flown to Bermuda from Los Angeles on 10 August 1973. By midday on the 11th, engine modifications had been completed, stores and provisions loaded, and final preparations completed, so that the HGE was under way from the Bermuda anchorage at 1630. Because the ship was government property, there was a senior U.S. Government representative on board as commander—as differentiated from the ship's captain. The commander's responsibility was to ensure that the government's best interests were served even though the ship was in a "white"—i.e., commercial—configuration and the majority of the crew were not witting of the AZORIAN Program. U.S. Government representatives used aliases as they were under tight security cover for the voyage. The HGE's Captain and a few

others were briefed and aware of proper actions to take in event of a political incident en route to Long Beach.

Bermuda to Entrance, Magellan Strait, 11 August–5 September 1973

Weather was consistently excellent throughout this leg, although 50 to 60-knot winds and 15 to 20-foot seas were experienced for a brief period while passing through a storm front.

The HGE handled and rode well; a work routine was established, and good progress made on all transit tasks; morale was good, and the marine crew competent and well-organized. Morale was helped by a well-staffed galley (three cooks and two bakers) which produced superb food.

During the latter part of August, news reports from Chile verified that the Allende government was experiencing problems, with the possibility of widespread labor strikes. Although it was considered unlikely, project headquarters developed plans for the possibility that Chilean pilots might not be available for passage through the Strait of Magellan. Additionally, contingency plans were prepared in the event Chilean or Argentine ships showed intentions of interfering with the HGE. Alternative options were prepared for Director, Special Projects, in case passage through the Strait was denied or it was deemed politically inadvisable to go through. These options were: (1) standing off the coast of South America until things settled down, (2) going around Cape Horn into the Pacific, or (3) going east around South Africa, through the Indian Ocean, then through the Pacific. As events turned out, an alternative was not required.

Transit of Magellan Strait, 5–6 September 1973

The HGE arrived at the entrance to the Strait on 5 September, anchored in Possession Bay, and the two Chilean pilots were embarked at 1100 local time. The transit was made without incident, although during the last half of the passage the ship went through a cold front with accompanying 45 to 50-knot winds. This slowed progress somewhat, but the HGE cleared the Strait and entered the Pacific Ocean at approximately 1500 6 September.

Strait of Magellan to Valparaiso, Chile, 6–13 September 1973

Immediately after entering the Pacific Ocean, the HGE ran into extremely heavy weather which slowed its progress again and actually forced the ship to heave to for a short period in 60-knot winds and 25-foot seas. Throughout these conditions, however, the ship handled beautifully, rode well, and its performance was never of concern to the crew. The remainder of the leg into Valparaiso was uneventful, and the ship's crew used this time to complete for Global Marine a list of parts and supplies to be loaded at Valparaiso when the pilots were disembarked. During the few days preceding the 11 September military coup, the ship's commander monitored commercial radio broadcasts as the HGE approached Valparaiso, and he was aware of the increasing tension developing in Santiago and Valparaiso. Nevertheless, he and the HGE's captain, Louis Kingma, did not allow any concern over these events to show in their daily messages to headquarters.

The HGE anchored in the outer harbor of Valparaiso at 2100 local time on 12 September. Shortly after its arrival, a small Chilean naval launch came alongside, and a naval officer and seaman came aboard for discussions with Captain Kingma, at which time the ship was formally entered into the port and Kingma was apprised of the military coup in Chile. Because a curfew was in effect, no further personnel

movements to the ship could be accomplished that night, but the two Chilean pilots left the HGE with the Chilean naval personnel.

On 7 September, prior to these events, Global Marine's enterprising personnel representative had left Los Angeles for Santiago accompanied by one other Global employee. They brought some 28 boxes of materials and supplies for the HGE, as well as a bag of personal mail. Their principal task was to arrange for the transfer of the supplies and, more importantly, the entry into Chile and transfer to the HGE of seven technicians, all this having been programmed in early August. They arrived in Santiago on 8 September and with the assistance of other representatives, processed the supplies through customs and proceeded to Valparaiso. On Monday, 10 September, Global's representatives traveled to Santiago again to meet six arriving [redacted] personnel who, along with their tools, luggage, and supplies, were all processed and cleared by Customs. The entire party then returned to Valparaiso and settled in the Hotel O'Higgins to await the arrival of the HGE on 12 September.

At approximately 0600 on 11 September, the Americans were awakened by noise outside the hotel. It was evident the revolution had started, as there were soldiers, tanks, armored cars, and other military vehicles all over the city. The hotel was surrounded, communications cut off, and guests confined to the hotel for the next two or three days. As attested to in his trip report—which reads like a Hollywood script—Tom Williams, the GMI personnel representative, encountered much intrigue and suspense in getting the seven technicians, supplies, and parts loaded on the HGE in the midst of the revolution. Nevertheless, in spite of a curfew, lack of communications, and the general confusion, Williams did a magnificent job of getting to the right people in the new government so that at approximately noon on 13 September, all persons and supplies were allowed aboard the HGE, and the ship was cleared to leave Valparaiso. The HGE weighed anchor at about 1500 and sailed for Long Beach. The presence of a covert U.S. intelligence ship in a Chilean port during the military coup was a bizarre coincidence quite unrelated to the rumors that "the CIA had 200 agents in Chile for the sole purpose of ousting Allende." There were no unfavorable incidents involving the ship, crew members, or the Global Marine representative.

Valparaiso, Chile, to Long Beach, California, 13–30 September 1973

This leg of the voyage was completed without incident. The weather was excellent with the exception of two tropical storms that the ship easily avoided; work progressed well, and the HGE made a final report on transit task completions. Only 21 scheduled jobs were not completed due to lack of time. The heavy-lift team which boarded at Valparaiso made excellent progress, following a preplanned work schedule. The HGE arrived Long Beach at 1700 PST, 30 September, and tied up at Pier E without incident. As it was a Sunday evening, the ship's arrival did not attract undue attention; stores were loaded and the relief crew came on board early Monday to conclude the east–west transit phase of the AZORIAN program.

In its transit from the Atlantic to the Pacific, the HGE travelled 12,745 nm in 50 days, 7 hours and 30 minutes, for an average speed of 10.8 knots. A total of 20,643 barrels of fuel were consumed, which equates to 68 gallons per mile.

Mobilization for Mission, October 1973–January 1974

After the East–West transit and arrival at Long Beach on 30 September, the HGE began a period of mobilization for the mission that would end with further systems testing [redacted]

[redacted] This final "fitting out" period was originally allocated approximately 51 days. It was to take about twice that long. The primary purpose of in-port mobilization was to convert the ship from an overt to a covert configuration [redacted]

During this same time, operations personnel activated the mission team and began an intensive mission team training program which was accomplished aboard ship as vans and equipment were installed, checked out, and made available to users.

After considerable discussion and analysis of the number of crew members required for the mission, a total of 178 was decided upon, the maximum size limited by lifeboat capacity. Despite distractions such as the busy pierside maintenance activity, crew members, ship workers, and technicians turned to their specialized assignments with a high degree of technical competence, motivation, and morale. The mobilization period produced a cohesive team effort for the mission and presented the first opportunity to assemble a mission team in accordance with key functions and positions established earlier in the program. Key mission personnel were: Mission Director, Deputy Mission Director, Deputy for Recovery, Deputy for Handling, Deputy for Exploitation, Deputy for Operations; Director, Technical Staff, and Ship's Captain. Although the ship's captain normally is in command of a vessel, the Mission Director was the senior command authority on the *Glomar Explorer*, because of its unique mission and responsibility for the operation of the complete AZORIAN recovery system. At sea, he alone was responsible for implementation of contingency or emergency plans if required, while maintaining mission security and cover. As an indication of the thoroughness of pre-mission planning, when the HGE sailed on the recovery mission in June 1974, the shipboard mission team and organization were very similar to that originally set down on paper in 1971 and 1972.

Conversion of the HGE From "White" to "Black"

From July 1973, when the HGE left Sun Shipyard in Chester, Pa., through east coast trials and the transit from the east coast around South America to the west coast, the ship was in a completely "white" configuration. That is, there was no equipment or activity aboard which would indicate its intelligence nature or the projected recovery operation. Although the HGE had some unique features such as the massive "A" frame, the unusually large well area, and the towering derrick (236 feet above the waterline), all could be attributed to a prototype mining vessel which required these for the heretofore unexplored mission of deep-ocean mining.

During mobilization, the primary effort was to install equipment and facilities for the recovery mission and for exploitation of valuable intelligence items expected to be acquired. Twenty-four mission vans were loaded and installed aboard ship for these purposes. They had been prefabricated to a standard 8' x 8' x 20' size and delivered to contractors for outfitting with specialized mission gear. For example, 20 such vans were equipped [redacted] and then trucked to Long Beach for loading aboard ship under tight security.

[redacted]

[redacted]

All ship-to-shore communications were open and transmittted via commercial radio circuits using radio teletype or manual morse. Commercial messages were addressed to Global Marine, Inc., Los Angeles, and were normally handled by RCA radio station KPH in San Francisco. Weather observations were transmitted to Coast Guard stations for further relay to Fleet Numerical Weather Central [redacted]

[redacted]

Global Marine responded to the ship's requirements and questions as required by answering messages in a normal commercial manner via normal commercial radio circuits. These messages to the ship helped to maintain the appearance that Global Marine was controlling operations of the HGE. [redacted]

[redacted]

[redacted] two control vans served as the nerve center of operations. Other vans were installed in appropriate positions on the HGE for such purposes as:

Cleaning: fitted out for ultrasonic cleaning and the preservation of items recovered from the submarine.

Decontamination: separate rooms for decontaminating exploitation personnel and target materials containing nuclear contaminants.

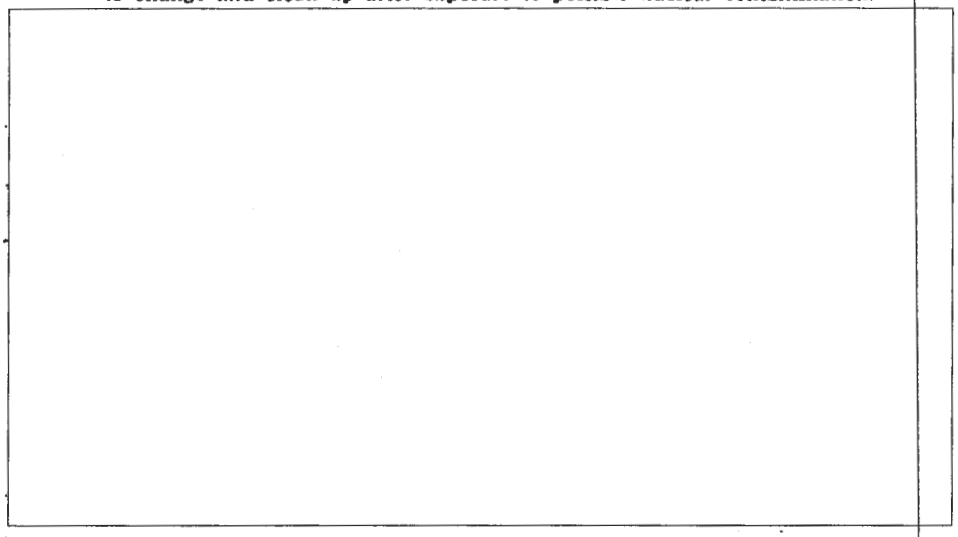
Paper processing: facility for processing and restoring the great volume of manuals, documents, and other papers expected from the target.

Drying: special facility for proper drying of documents and other items.

Darkroom: to process the large number of photographs taken to record intelligence material.

Waste handling: to safeguard and handle any nuclear-contaminated materials.

Dress out and change rooms: facilities for personnel working in the well to change and clean up after exposure to possible nuclear contamination.



Weather Facilities

The weather forecasting capability established aboard the HGE [redacted] meteorologists were assigned to provide onboard meteorological and oceanographic expertise which was imperative for the mission. The aft chart room, adjacent to the aft bridge and pilot house, housed the meteorology office, display center, and main weather equipment space. Shipboard capability for reception of weather data included all required advanced equipment.

Manning

As in-port mobilization continued, labor-management problems were developing between the Marine Engineers Benevolent Association (MEBA) and Global Marine. As a result, MEBA set up picket lines in an attempt to boycott the *Hughes Glomar Explorer* at Pier E. This unfortunate situation took a serious turn on 12 November when MEBA escalated its picket activity from a small group to mass picketing by about 100 persons including strong-arm types. The resulting tense situation continued for the next week to ten days. During this time, the ship's crew and shipboard workers were harassed, delivery trucks stopped, and special security measures had to be put into effect. The union problem, added to certain engineering problems, worked havoc with the mobilization schedule, and with the Christmas–New Year holiday approaching, departure for sea trials was set back until mid-January 1974.

One of the prerequisites for beginning sea trials was a valid pipe-handling system (PHS) demonstration at dockside. However, on 9 January there were still several engineering tasks to be accomplished before the heavy-lift pipe could be moved through the system. It was decided to move the ship from the dock to the Long Beach outer anchorage and conduct the PHS demonstration there, and then move out on sea trials. The main reasons were the sagging morale of the sea trials crew and the fear that the repeated delays would begin to affect mission crew performance adversely.

Rather than risk this, it was decided to give everyone a "shot-in-the-arm" with the move to the outer anchorage.

Because of the delays in getting ready for sea trials, time now was very precious. It was essential that all the tests be completed, the ship be readied for the mission, and depart in time to be on station at the target in early July. The mission could only be accomplished during the July to mid-September weather window. Only during this period could one expect moderately good weather to last long enough for the operation to be completed. For planning purposes, 14 to 21 days were expected to be required for the recovery sequence. If the HGE could not be ready to leave on its mission by mid- to late June, the recovery attempt would have to be delayed a full year.

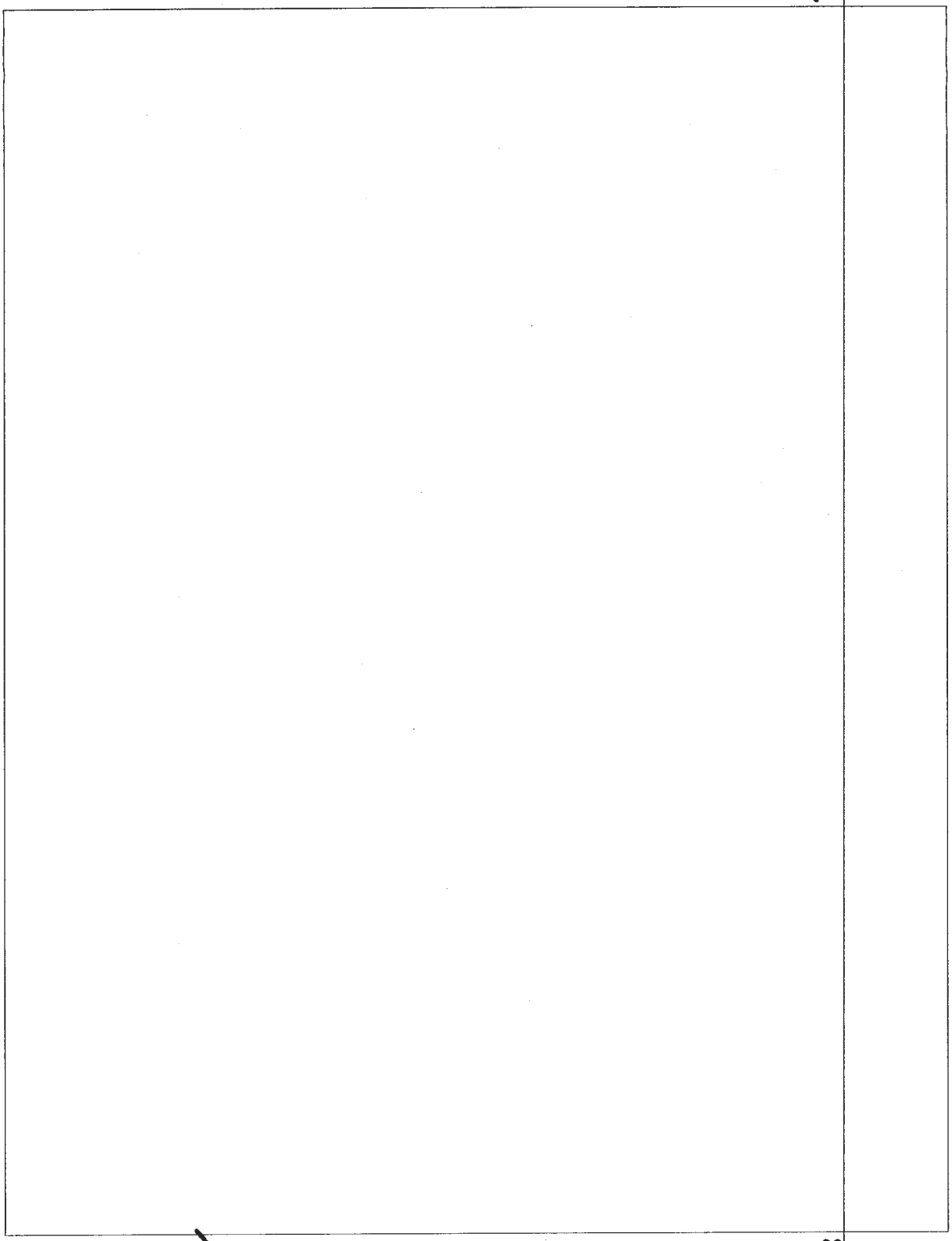
During the period the HGE was being mobilized at Pier E (and where it was berthed after the mission as well), Soviet merchant ships made routine port calls to Long Beach of two or three days' duration. In almost all cases the Soviet ships were docked at Berth 10, located some 400 yards across the channel off the HGE's starboard quarter. Even though the Soviet ships were close to the HGE and had the opportunity for close inspection, there has been no evidence that the Soviets gained prior knowledge of its true mission, a tribute to the security precautions and mining cover lived by the ship's crew during West Coast mobilization.

First West Coast Trials, 11 January–23 January 1974

West Coast trials began 11 January when the *Glomar Explorer* left Pier E at 1230 Pacific time. The MEBA union problem was still plaguing Global Marine, and two union picket boats were present, but neither tried to interfere with the ship. The site for trials was approximately 160 miles west-southwest of Long Beach, where water depth was expected to be about 12,500 feet. The primary purpose of the test was to verify readiness of the pipe-handling system (PHS) and heavy-lift system (HLS) as well as the readiness of operating personnel. The trials also would include checks of engine propulsion, navigation systems, and other ship's systems while under way to and from the test site. Upon completion of tests, the well gates would be closed and the ship would proceed on approximately 1 February to Isthmus Cove at Catalina where the HMB-1 would be anchored.

Trials Chronology

After the HGE moved to the outer harbor anchorage, the mining crew ran a practice double of pipe—60 feet—through the system two or three times; the well was flooded and the PHS and docking legs checked for reliability. After five days at the anchorage, during which a myriad of problems occurred in the PHS, it was concluded that the system had limited reliability in its configuration at that time. If time had not been so critical, the obvious course of action would have been to return to Pier E for needed modifications, but all believed the penalty in time would be unacceptable because the 1974 weather window would be missed. Even though it became clear that the PHS could not be qualified during the trials, it was considered that many priority tests could be completed.

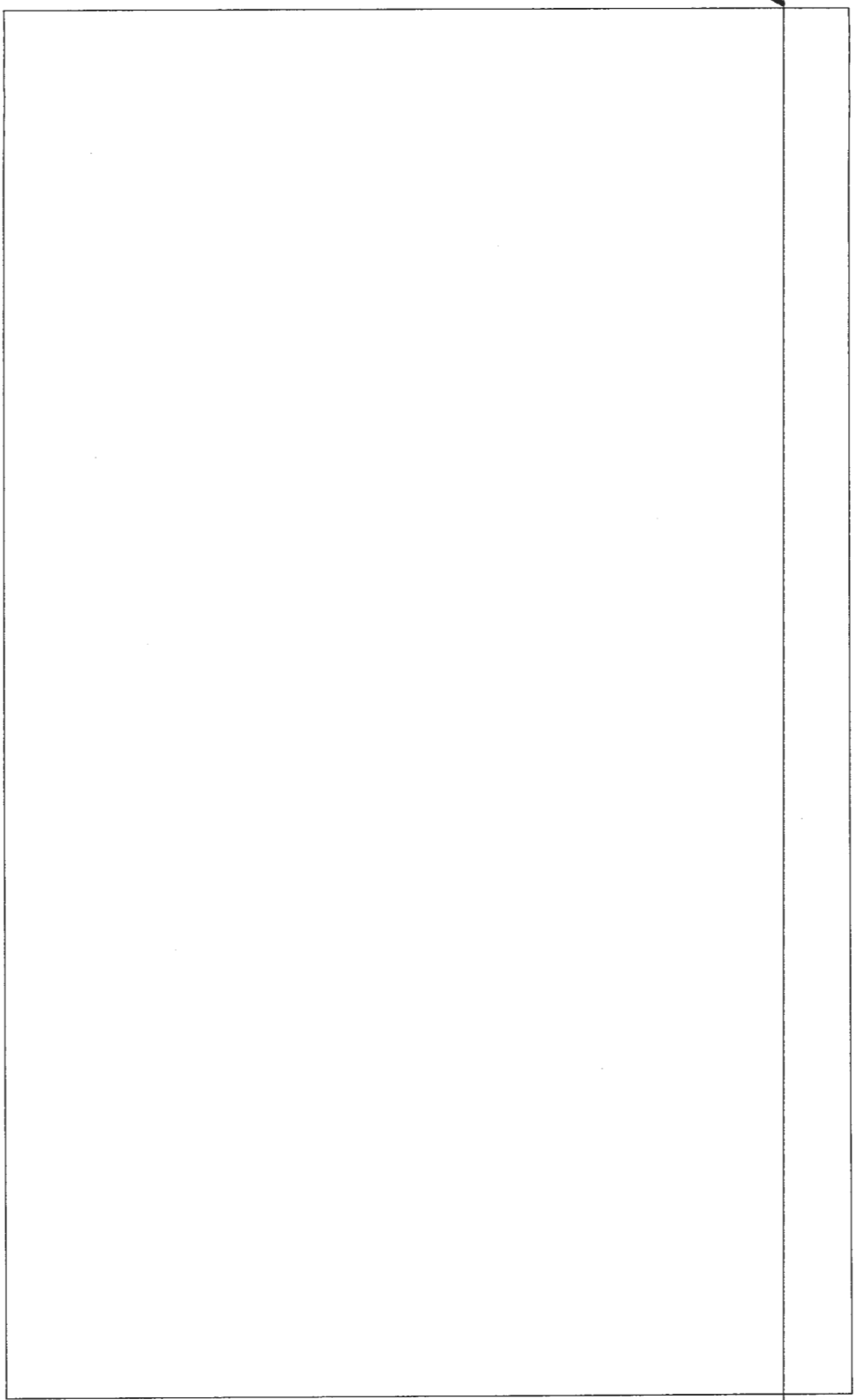


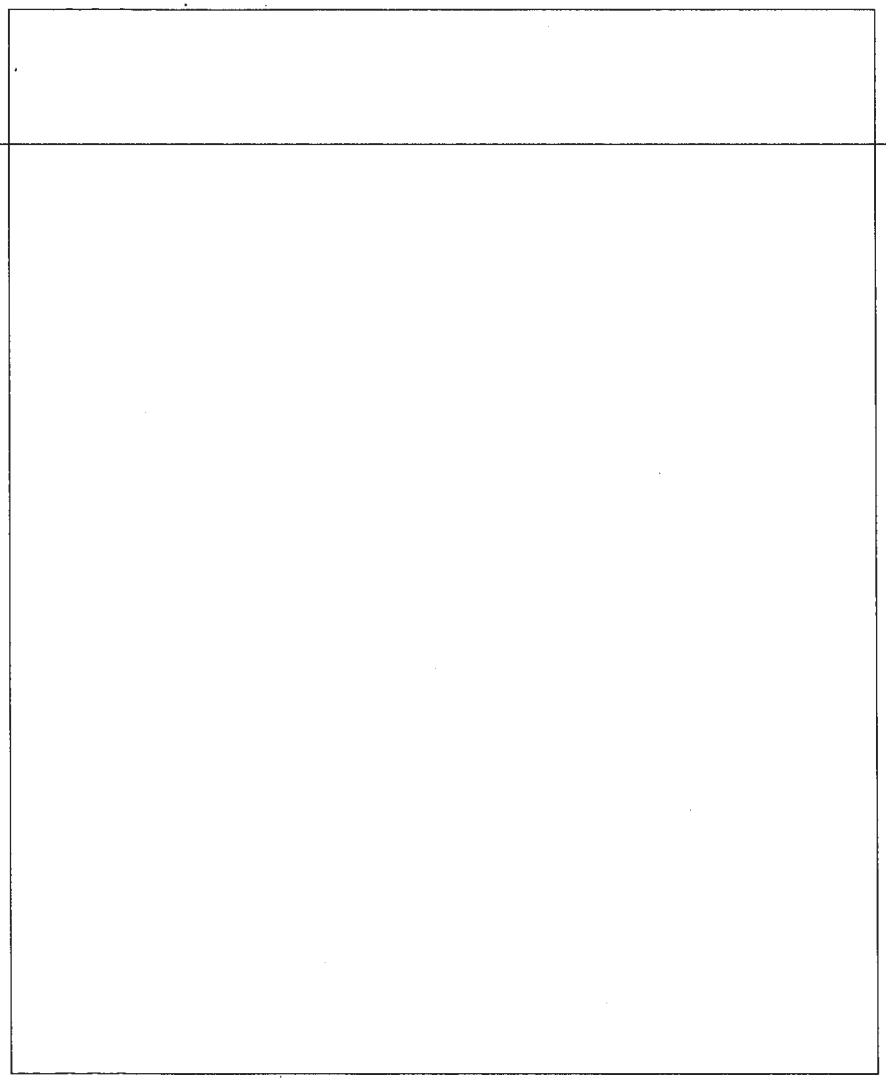
The ship arrived on site at approximately 2400 hours on 19 January and deployed long and short baseline transponders as well as the wave-rider buoy, the latter a device which measured, recorded, and continuously transmitted sea-state data to the ship for its use

On 21 and 22 January, the unfavorable sea state and winds on site delayed the tests, including the important initial step of flooding the well and opening the well gates. Weather improved temporarily on the 22nd sufficiently, however, so that was able to make a quick visit to the ship by helicopter for a first-hand review of test operations.

On 23 January, the well had been flooded and well-gate opening was in progress when the ship suffered damage in the aft gate-operating machinery. The casualty occurred during heavy surges of the sea in the well. An inspection revealed damage to the aft gate seal, distortion to aft gage drive gear teeth, and damage to the pedestal supporting the aft gear driveshaft. The after well gate had to be hauled to a closed position by rigging cables and using winches. Because of these problems, it was not possible to continue the sea trials. Headquarters was advised that the HGE would return to Long Beach anchorage for further inspection and repairs. The trip back was uneventful, and time was spent in communications between the ship and Global Marine to order parts and technical help for repairs. The HGE arrived at Long Beach harbor on 24 January.

Examination of the well-gate damage cause to conclude that although the sea state may have been within the upper limits of the stated specifications for opening the gates, it nevertheless stressed the system too greatly and caused the failure. After a thorough evaluation, engineers estimated 13 to 15 days would be needed to accomplish repairs. With this added to several other major component tasks, it was estimated the ship would be ready for sea again about 14 February to complete West Coast trials The repairs had to be accomplished under difficult conditions because there was not time to move the ship to a drydock large enough to handle her—even if one would have been immediately available. Thus inspection and some seal repairs had to be done by divers. One small but persistent seal leak was never corrected, and the seepage of a few gallons per hour was accepted. Thus the *Glomar Explorer* lived with a small puddle in the starboard wing well.





Interestingly, the press took note of the HMB-1 departure from Redwood City in an Associated Press article datelined Redwood City which appeared in the Long Beach *Independent Press Telegram*. Basically, the article enhanced program cover in that it discussed the barge's connection with the HGE and its role in the Hughes ocean mining venture.

After the safe arrival and mooring of both barges at Catalina, they went into a "sit and wait" mode because HGE sea trials were short-lived due to the well-gate casualty on 23 January.

Second West Coast Trials
15 February–2 March 1974

was selected to be the Mission Director for the operation. He was an excellent choice, as future events would verify. Not only did he provide the leadership required for this complex and dangerous mission, but his earlier role in preparing to handle the nuclear materials and contaminated items gave the mission crew confidence in an area of little-understood danger.

Excellent progress was made during the in-port work period after the well-gate casualty on 23 January, and it was possible this time to conduct tests immediately upon completion of repairs and modifications. These included flooding the well and opening the well gates to check the previously damaged gate drive system. Also, because the well gates were open, pipe was run through the entire system. All operations were performed satisfactorily to the degree that senior officials considered the ship ready to go back to sea to complete trials

GMI Vice President Curtis Crooke was on board for the new trials as the senior Global Marine official. This position conformed to what the ocean mining world would expect.

was necessary because completing trials was a Global Marine contractual responsibility to the U.S. Government

Performance Criteria and Agenda for West Coast Trials

In view of the poor performance and problems with the pipe-handling system during East Coast and West Coast trials, established specific performance criteria for the PHS and the heavy-lift system for the new trials. These included reliability demonstration by lowering and raising 60 to 70 doubles of pipe (3,600 to 4,200 feet), with the exact number based on available water depth near Catalina Island, but in the event that bad weather or time available precluded selection of a site to complete the 60 to 70 doubles requirement, the Mission Director was authorized to allow a moderate backoff from that specific range of pipe lengths. The basic criterion was a "reasonably reliable demonstration," with the sole judge of acceptability and suitability in meeting the test objective.

For the next ten days on test location, everything and everybody were devoted to solving test problems, and virtually all tests were successfully completed within the scheduled time frame. Of the problems surfaced, perhaps the most serious were malfunctions in the heavy-lift system sensors and controls, which were repaired. Most importantly, the pipe-handling system operated satisfactorily with only a few minor

delays. A total of 40 doubles of pipe were deployed and recovered (equivalent to 2,400 feet), with the only problem being untorquing of some joints. All agenda events for trials were satisfactorily completed by the evening of 25 February. With an excellent weather outlook projected for Catalina for the next few days, the HGE estimated arrival at Isthmus Cove at 0700 on 26 February.

[redacted]

From Isthmus Cove the *Glomar Explorer* proceeded to a point 65 nm miles southwest of Catalina Island to coordinates 32-44N; 119-14W. The technical purpose was to complete roll stabilization tests, but a more compelling reason for leaving California coastal waters was that commercial vessels in California waters on 1 March were subject to a special California inventory tax. Rather than face possible scrutiny over the tax, and possibly uncover true ownership of the ship by the U.S. Government, it was decided to be in international waters at that time. After completing tests in the vicinity, the HGE sent a message to that effect and then returned to Long Beach, where it arrived at Pier E at 1645 local time on 2 March. The HGE was scheduled to remain in port for a 25- to 30-day period completing rigging [redacted] together with other mobilization tasks still required.

[redacted]

Integrated Systems Tests (IST), 28 March–13 May 1974)

After [redacted] the ship's return to Pier E, Long Beach on 2 March, the next 25 days were devoted to final preparation of the complete AZORIAN recovery system for the Integrated Systems tests (IST) scheduled to begin 28 March.

Concurrently, work on ship's systems also was being accomplished at a feverish pace with particular attention to the pipe string, thread compound, gimbal platform, A-frame, yokes, hydraulic pumps and controls, and docking legs, all considered essential to pipe-handling and heavy-lift systems. Excellent progress was made in all areas. In many cases round-the-clock activity was required to complete tasks on schedule.

The time pressure of meeting the July–August weather window forced a drastic change in the IST. An intermediate water depth (about 2,600 feet) site was chosen off Catalina Island where the water was deep enough [redacted] and to exercise the pipe-handling system thoroughly. The HGE left Pier E on schedule at 0045 on 28 March and, after mooring at the initial test site eight miles east on the lee side of Catalina Island on 29 March, immediately began its test schedule.

A torquer casualty was followed by a series of bridle, heavy-lift, and pipe-handling problems which required in-port repairs [redacted] and the tines and davits. Valuable training was accomplished by the Control Center crew; personnel performance was outstanding and represented a shot-in-the-arm for crew morale. In view of the many setbacks and delays in the program thus far, it was indeed heartening to know that [redacted] system was operational and had demonstrated satisfactory reliability. The problems and delays encountered previously, however, now required major revisions of the remaining test schedule and scenario. If the recovery mission were to be accomplished in the summer of 1974, a major decision was required now as to the need for further testing versus declaring the system to be ready for recovery operations.

[redacted] in conjunction with senior CIA officials, decided that completion of system testing at the 2,400-foot depth location would satisfy the requirement for a satisfactory demonstration of system reliability and that planning would continue for a June departure on the recovery mission. This decision waived the need for a deep test to 12,000 feet. A major factor in this decision was confidence in [redacted] crew performance. Additionally, what had been an earlier recognition of two factors was coming into renewed and clearer focus. The first was that this unique recovery system was unparalleled in size and complexity and the first ever to operate at these depths and loads. The second was that the system design was based upon a one-time operation, not a series of repetitive test and development operations such as with a new airplane. Further tests would create additional confidence but would also place some wear and tear on the system. AZORIAN was the world's largest salvage operation, and its success, after a reasonable preliminary test demonstration, would depend to a large extent upon people and their ability to devise "work-arounds" for the many problems which would never go away completely no matter how many tests were conducted.* Risks were inherent and some would remain, no matter what.

[redacted]

* Further, no test (short of the mission itself) could ever duplicate the target with its unknowns of structural integrity, stability, and breakout characteristics.

As planned, elements of the underwater teams directed by the Deputy for Handling and Deputy for Exploitation were put aboard the HGE just before completion of the Integrated Systems tests to familiarize them with their work areas, equipment, and procedures in the at-sea atmosphere.

On 12 May 1974, the ship advised project headquarters that all scheduled tests were completed. The gates were closed, the well pumped down, and the HGE returned to Long Beach. It moored alongside Pier E in the early morning hours of 13 May where it was scheduled to remain for a 28- to 30-day refitting period in preparation for departure on the recovery mission in mid-June.

Final Approval in Washington

In Washington, meanwhile, USIB's *ad hoc* committee in April and May 1974 had made one more evaluation of the expected intelligence benefits of AZORIAN at the request of Dr. Kissinger to support the 40 committee's discussions regarding approval for the mission to begin in June. This study, approved by USIB in executive session on 7 May, was forwarded to Kissinger with a covering memorandum which stated:

> The United States Intelligence Board has reviewed and updated its intelligence assessment of Project AZORIAN. On the basis of this review, the Board concludes that there have been no significant developments since the last Board assessment which would detract from the unique intelligence value of this target.
>
> Successful recovery and exploitation [redacted] expected to be on board [redacted] . . Acquisition of the nuclear warheads and the SS-N-5 missile system, together with related documents, would provide a much-improved baseline for estimates of the current and future Soviet strategic threat. The Board also expects that recovered documents would provide important insights into Soviet command and control and certain aspects of their strategic attack doctrine.
>
> In its evaluation the Board assumed a successful mission. On this basis the Board continues to believe that recovery of the AZORIAN submarine would provide information which can be obtained from no other source, on subjects of great importance to the national defense.

With the planned mission departure date barely a fortnight away, the 40 Committee met to consider AZORIAN on 5 June, and Dr. Kissinger prepared a memorandum for the President covering the essential points of the discussion. President Nixon approved the mission on 7 June, with the proviso that actual recovery must not be undertaken before his return from an impending 27 June–3 July visit to the Soviet Union.

AZORIAN Mission Recovery, 20 June–16 August 1974

On 20 June 1974 the *Glomar Explorer* moved from its anchorage off Long Beach to a pre-arranged point outside the three-mile limit for the ceremony marking Summa's acceptance of the ship, and the next day representatives of Summa, [redacted] Global Marine, [redacted] arrived by helicopter for the ceremony. They were given a tour of the HGE and demonstrations in the control center using the [redacted] other features of the ship. The acceptance ceremony was duly recorded and photographed for cover purposes, after which the representatives returned to Long Beach by helicopter.

That same day, the HGE set its course for the recovery mission in the northwest Pacific. As the message that day from the HGE to project headquarters indicated, morale was high and preparations for departure had proceeded smoothly.

On 27 and 28 June, several ships passed the HGE on an easterly course but got no closer than 2½ miles. On 29 June, the HGE had covered a distance of 1,888 miles without incident and still had 1,120 miles to go; a container ship, *Oriental Charge*, passed the HGE that day on the port side at a distance of about two miles. On 30 June, various drills were held aboard ship. The Deputy for Exploitation conducted a drill for the control and flow of personnel in and out of the well in event of nuclear contamination; the Deputy for Recovery conducted target acquisition dry-runs using [redacted] and there was an emergency drill for destruction of classified documents and equipment.

Transit to the recovery site in the Pacific Ocean proceeded without incident, and on 4 July, Independence Day, the HGE arrived at the recovery site at 1301 local time. (President Nixon had left Moscow the preceding day.) Transponder deployment went relatively smoothly, but several unsatisfactory units had to be rejected before the ship eventually got its six-transponder grid deployed. These were necessary for precise location of the ship and automatic station-keeping at the recovery site.

On 5 July, a final and complete [redacted] was carried out. Two wave-rider buoys were also deployed, and the automatic station-keeping system was calibrated. On 8 July, the well gates were opened [redacted] was started immediately; [redacted]

On 10 July, heavy fog, which had been present, continued in the area. After conducting [redacted] a thorough workout of the pipe-handling system (30 doubles or 1,800 feet of pipe, up and down) [redacted] only 8 hours. [redacted] was delayed, however, because of concern for the weather. Typhoon "Gilda" was expected to affect the recovery site, and it was decided to sit out the expected high waves [redacted]

On 11 July, with waves about 7 feet, there was significant vertical surge of water in the well with peaks of about 8 feet, making [redacted] operations, including camera rigging, very difficult. [redacted]

The sky was leaden, yet the crew had spirits that were as bright as polished silver. Under way at last! Finally, we were really going to do it. The course was set West-Northwest—a direct line to the target. If we could only be there tomorrow—but an eight-knot rate of advance meant a 13-day voyage. We would not arrive until the Fourth of July. Surely that would void any evil spirits lurking in a 13-day voyage.

But thoughts of jinxes were in few people's minds. We could do anything. Let Headquarters give us a last-minute change of targets—with this crew and this beautiful ship, no task was too difficult. Mission impossible? Nonsense! "Impossible" was not in our vocabulary. Moments like this must contain the true meaning of team spirit, that extra ingredient that hardware will never possess. To experience it once is enough for a career.

[redacted]

The HGE encountered its worst effect from "Gilda" on 12 July when a series of long swells (15 to 16 seconds) came through the area about noon with a combined significant height of 9 to 10 feet. [redacted] and surge in the well went as high as 22 feet. The crisis [redacted] seemed to be over on the 13th of July, as the waves were down to 8 to 9 feet [redacted]

That same day, a British merchant ship, *Bel Hudson*, which earlier had requested medical assistance by radio for a stricken crew member, arrived on the scene. Headquarters contingency planning for AZORIAN had anticipated such an event, and a pre-mission decision had been made—based on humanitarian and cover reasons—that the HGE would respond to medical emergencies if possible. Nevertheless [redacted] had to ponder the situation carefully to consider whether this might be some sort of ploy based on an awareness of the mission, and make certain there would not be an unwitting disclosure of the HGE's activities. The HGE's surgeon, accompanied by a medical technician and security officer, and a British boatswain, made the precarious trip to the *Bel Hudson* to examine the patient. After diagnosing the patient and determining he had not had a heart attack (as the *Bel Hudson* had earlier described the ailment) the doctor brought the patient back to the HGE for X-rays and treatment. He relieved the patient's severe internal discomfort and returned him to the *Bel Hudson* in one of her lifeboats. Throughout the incident, careful security precautions were taken and mission activities not exposed. The captain of the *Bel Hudson* was very grateful to the HGE and to the doctor in particular, for his assistance and skillful diagnosis and treatment which quickly improved the seaman's condition. The incident ultimately worked to the advantage of the HGE as far as cover was concerned. As the *Bel Hudson* and the HGE were arranging the rendezvous position, the British ship asked, via the open radio circuit, what activity the HGE was engaged in. The HGE responded that it was engaged in deep-ocean mining testing using a prototype mining machine. It was hoped the Soviets were monitoring this exchange.

By 14 July, the weather had subsided enough for [redacted] o consider undocking, although higher seas were predicted for the 15th. On the evening of 14 July, unfortunately, cracks were discovered in both the forward port and after starboard docking leg guide structures and were considered a serious problem and difficult to repair. With the uncertain weather, there was concern whether the cracks could be repaired properly before further damage might result which could cause aborting the mission. The ship's heading was adjusted and canvas screens rigged to provide as much protection as possible for the critical welding repair job, which took the next 72 hours to complete. But the weather took a turn for the worse; tropical storm "Harriet" was causing high seas, and the Mission Team was reluctant to risk [redacted] For safety reasons, a decision was made [redacted] close the well gates, and be prepared to leave the recovery site if wave conditions became too extreme. The well gates were closed on 16 July amid 6-foot waves; no big problems were encountered, but closing the huge well gates was never a dull exercise on the HGE.

The weather hold continued on 17 July when the HGE was advised that a Soviet naval ship, the Missile Range Instrumentation Ship *Chazhma*, was under way on a course towards the recovery site and expected in the immediate vicinity of the HGE at 0400 hours on 18 July. *Chazhma*, 459 feet long, carried a helicopter and was based in Petropavlovsk. As a precaution, the Mission Director ordered that piles of canvas-covered crates be placed on the HGE's helicopter deck to preclude the possibility that the Soviet helicopter might land on the HGE for any reason. *Chazhma* had sailed

from Petropavlovsk about 15 June to support a SOYUZ/SALYUT space event, and during 10–13 July began her return to Petropavlovsk from near Johnston Island. During the early morning hours, the bridge was reporting fog conditions as patchy and visibility as less than five miles. Between 0600 and 0800, *Chazhma* closed its position with the HGE to approximately two miles. [redacted]

[redacted]

At 1430, *Chazhma* closed to within one mile of the HGE. At 1540 Soviet personnel on the boat deck began taking pictures with a binocular camera, and then the helicopter was launched and made many approaches to the HGE for approximately the next hour taking photographs from all angles. The Mission Director, with crates already stacked on the helicopter deck, sent a number of crew members to the bow of the HGE to preclude any attempt by the Soviet helicopter to hover and lower personnel onto the bow. At 1619, to the relief of the HGE, the helicopter landed back aboard *Chazhma*. Although [redacted] and his team found it difficult to assess Soviet intentions with the many close passes and detailed scrutiny given the HGE by the helicopter, the consensus was that it ranged from being a thorough photographic assignment to a downright aggressive and provocative act.

These actions by *Chazhma* caused a measure of concern that the Soviets had become knowledgeable from other sources of the true mission of the HGE. The HGE was vulnerable sitting alone in the vast Pacific Ocean, miles from any friendly supporting forces and very much aware of other unidentified contacts in the vicinity which its communications unit had picked up the preceding few days. Accordingly, [redacted] advised the officer in charge [redacted] to be prepared to order emergency destruction of sensitive material which could compromise the mission if the Soviets attempted to board the ship. The team designated to defend the control room long enough to destroy the materia[redacted] was alerted, but guns were not issued.

At 1630, *Chazhma* started blinking a light signal to the HGE which was difficult to read because of the lighting conditions. The Soviet ship then passed 500 yards astern the HGE and signaled it would communicate using the local code. The HGE responded with its own signal flag signifying "I am going to communicate with your station by means of international code signals." The HGE's communication unit then received an indication that another Soviet helicopter launch was impending. A few minutes later, *Chazhma* put up a flag hoist signifying "Understand your signal," then crossed the bow of the HGE at a distance of 1,000 yards. During all the surveillance the HGE was stationary in the water. At 1711 hours, *Chazhma* transmitted by radio in Russian requesting acknowledgement if its transmission was heard; the HGE did not answer. At approximately 1730, *Chazhma's* helicopter took off and again made many low passes over the *Glomar Explorer* taking pictures of the ship. About one-half hour later, the helicopter completed its work and landed back aboard *Chazhma*.

After several hours of HGE attempts to respond to communications from the Soviet ship, *Chazhma* transmitted at 1847 "WCHG (HGE) this is UMGT" and indicated it now was ready for the HGE's message. The HGE answered "We have no message. Understand you have a message for us." The Soviet ship replied "Stand by five minutes" and then shortly afterwards transmitted "We are on our way home and heard your fog horn. What are you doing here?" This statement appeared questionable because *Chazhma* was not in hearing range during the fog. In any case, the HGE answered "We are conducting ocean mining tests—deep-ocean mining tests." *Chazhma* asked "What kind of vessel are you?" to which the HGE replied "A

deep-ocean mining vessel." The Soviets then wanted to know what kind of equipment was aboard the HGE, to which the answer was "We have experimental deep-ocean mining equipment onboard." The Soviets asked "How much time will you be here?" and the HGE answered "We expect to finish testing in two to three weeks." The Soviet ship signed off with "I wish you all the best." *Chazhma* left the recovery area at about 2100 hours on 18 July and sailed off to Petropavlovsk.

The weather cleared sufficiently on 19 July for [redacted] to order the well flooded and the gates opened, after which [redacted] system checks began. On 20 July, [redacted] and all systems were brought up to operating condition. [redacted] was of particular concern due to a substantial (five-foot) heave of the HGE. [redacted]

On the morning of 22 July a 155-foot Soviet seagoing salvage tug, the SB-10, arrived and maintained a distance from the HGE of about 3 to 4 miles. Work continued, however, [redacted]

Meanwhile, the Soviet SB-10 conducted closer surveillance, passing within 200 feet and conducting runs up and down both sides of the *Glomar Explorer*. HGE personnel observed (over time) 43 crew members (including one woman) on the deck of the SB-10. They were dressed in fatigue-type outfits, swim trunks, shorts, and other such apparel. About a half-dozen Soviet sailors with cameras took photographs of the *Glomar Explorer*. By 2300 hours, the SB-10 had moved off to a distance of several miles.

The HGE continued lowering pipe on 24 July and, despite more problems, the [redacted] A Greek ship, *Pelleas*, passed within two miles of the HGE without incident. The SB-10 continued its close surveillance of the HGE, frequently at short distance.

The HGE kept headquarters informed of engineering problems it was encountering. For example, [redacted] reported on 25 July, [redacted] that malfunctions of the recovery system continued to make the situation difficult but not discouraging. He indicated that frequent shutdowns were experienced, mostly associated with the heavy-lift sensors and controls.

On 26 July, the Command-Control Van reported sonar contact with the ocean bottom. By this time, the series of equipment breakdowns which had occurred was beginning to wear on the nerves of the recovery team. A bright side to all these problems, however, was the confidence the crew began to have in the pipe, which seemed able to bounce back from nearly all kinds of abuses and remain unscarred. On this date, the Mission Director reported that 230 doubles, or 13,800 feet of pipe, had been deployed. Also, information had been regained [redacted] Meanwhile, the SB-10 continued surveillance.

On 28 July, [redacted] failed, [redacted] causing a display of noise, fire (sparks and smoke primarily) and spastic shaking of the derrick. These effects were startling, to say the least, but no

insurmountable damage was suffered. [redacted] reported that many among the crew were very nervous about the safety of the heavy-lift system and, as a precaution, unneeded personnel were kept away from the area around the A-frame.

While this situation was being corrected, high resolution sonars were used to pinpoint the target submarine. The SB-10 was back within radar range at approximately 5 miles, but heavy fog prevailed, limiting visibility to less than one mile.

[redacted]

Everyone on board was caught up in the anticipation of seeing the target object for the first time. The main source of action was the control center. All eyes were watching the display from the scanning sonars (our long-range detectors) for any sign of a return. The yellow dots marched across the cathode ray tube in unending regularity. Then, on one pass, an irregular hemispherical hump displaced the flat line on the screen. One, two, three, . . . and more times it was the same. It was the submarine hulk for sure. Word spread rapidly throughout the ship. We were on target.

Within hours we were close enough to the target for the TV cameras to pick up a clear picture of the remains of the submarine. All hands wanted to see the picture, and the Mission Director allowed the crew, in small groups, to file through the control center to see for themselves. The most common comment was [redacted]

The Mission Director and his deputies recognized that during actual recovery operations the ship's crew could not be allowed in the control center. The concentration and tension would be too great to risk any distractions. The crew had contributed greatly to the project's success and denying them a chance to observe the recovery operation weighed heavily on the Mission Director's mind. He directed that several TV monitors to display the video [redacted] *be placed around the ship for the crew's benefit. These were intently watched by sailors, cooks, divers, drill crew—all hands—during the crucial moments of the recovery.*

[redacted]

There was one last hiccup from the pipe-handling system that night. As a 15-ton pipe double was being placed in the cart, it slipped over the center joint stop used to restrain the pipe and became loose in the cart. The galley and port-deck sleeping areas near the transfer boom were evacuated until the pipe was back under control. Once again, fortunately, no personnel injury or damage to the system resulted from the accident. Meanwhile, the SB-10 maintained its usual surveillance activity of closing in toward the HGE and then drifting off a couple of miles. Generally, the visibility remained poor, less than two miles, and the HGE sounded its fog signal during these poor conditions. Pipe No. 268 was put into the upper yoke, but at this stage the pipe was moving very slowly [redacted] The Deputy for Recovery reported the following information to Headquarters:

> The heavy lift system is operating marginally; two additional heave compensator position transmitters failed; [redacted] the target was easily located . . . high resolution sonar and video are excellent; the salt water (seawater) hydraulic flow to test the hydraulic system was checked out [redacted] preparations are continuing [redacted] one heave compensator position transmitter was repaired; [redacted]

The SB-10 tug remained within close range during the night, and was illuminated with a searchlight from the HGE whenever it maneuvered uncomfortably close. This tactic was always successful in making the SB-10 move off. It continued its close-in surveillance of the HGE in the morning, circled the ship once, and was observed taking height and distance measurements of the HGE substructure using a sextant and an alidade.

[redacted]

On 31 July, Headquarters was informed that some [redacted] problems had been experienced [redacted] Also, the heave compensator position indicators were working well. [redacted] all systems were normal. Optics remained good until touchdown, when mud obscured visibility for about one-half hour. [redacted]

Lift-off

On 1 August, lifted from the bottom. By 2200 that night, recovery was under way During all this time, the SB-10 appeared to be running in circles, moving in at close distances to all points of the ship. In addition, unidentified radar contacts were reported within short range of the ship.

Pipe lifting went well on 2 August and the weather cooperated instructed his team to start preparing for entrance into Midway in accordance with the AZORIAN operations and cover Plans. Two hundred and seventy-four doubles or 16,440 feet of pipe had been deployed and were coming up.

In accordance with the cover plan, a message went out in the open commercial channel on 3 August to explain an entry into Midway. The *Glomar Explorer* duly reported that it believed the "nodule collector vehicle" might have collided with a hard silt-covered outcrop. It was this fictional "casualty," reported in the clear, which would have been used as an excuse for the HGE to request permission from U.S. Naval authorities to enter Midway for repairs to the vehicle. The scenario would follow that the damage to the "nodule collector" was more serious than at first diagnosed and a new part would be required from the U.S. mainland.

that same day pointing out that the operation was still plagued with serious heavy-lift system problems, even with the load on the pipe decreasing. At high pressures, the heavy-lift hydraulic pumps required much attention, and a great deal of trouble was experienced in keeping a sufficient number operable. Because of these conditions, it was necessary to bypass some fail-safe circuitry and depend instead on operating personnel. The operators and hydraulic mechanics were complimented for doing what the Mission Director judged an outstanding job, and he expressed pleasure that the ship had overcome some major hurdles while facing up to all the problems associated with recovery operations. All hands were very busy and concerned, knowing the many times they came close to

aborting the mission because of equipment problems. The mission team was not discouraged, however, and had every intention of accomplishing the objective of raising the submarine [redacted] on 3 August [redacted] The SB-10 continued close surveillance. During the preceding night, the tanker *Bangkok* (Thailand registry) had passed within five miles of the *Glomar Explorer*. A short series of flashing light exchanges passed between the *Bangkok* and the HGE, and there was also an exchange via radio. The *Bangkok* asked questions as to HGE operations, and HGE replied briefly that she was conducting experimental deep-ocean mining operations. The query from the *Bangkok* appeared to stem from curiosity and was judged social in nature.

[redacted]

the SB-10 presence near the recovery site was related to Soviet Pacific Fleet submarine operations and transit.

[redacted] the HGE team maintained its composure and adhered to the AZORIAN cover plan by sending a commercial message via station KPH in San Francisco advising that the "nodule collector vehicle" might be more damaged than originally thought. [redacted] On 6 August, the HGE received a message from Paul Reeve, Summa Ocean Mining Division General Manager, addressed to "the Senior Summa Representative" aboard the ship. This overt commercial message instructed that as soon as the Summa representative was in a position to assess the damage to the "nodule collector vehicle," he was to start reporting at least twice daily on progress towards effective repairs.

Meanwhile, the SB-10 continued to operate at close range [redacted] raised closer to the well of the HGE, On the afternoon of 5 August, the HGE executed a plan to lower the docking legs to 90 feet, tilt them in and out and then move them

slowly back to their previous position. This drill attempted to elicit any possible reaction the SB-10 might be planning to take [redacted] Although the SB-10 started to close its distance with the HGE when it saw the docking legs were being lowered, its maneuvers generally were no different from any previously conducted.

On 6 August, [redacted] the SB-10 again maneuvered completely around the HGE, closing to a distance of 75 yards. The *Glomar Explorer* gave a flashing light signal to warn the SB-10 to keep clear because it was "maneuvering with difficulty."

[redacted] the SB-10 was considered to have a limited shallow-water diver capability normally used to support submarine contingency situations and minor salvage roles. The capability indicated that both hard-hat and Scuba divers were trained to perform hull inspection and repairs under controlled conditions at depths of less than 30 feet. However, headquarters did not believe Soviet tug personnel would have the training or experience to accomplish the extremely dangerous task of underwater reconnaissance of the HGE. The divers could easily be observed, and the risk of injury or death in open ocean near an unknown objective would be so great as to be unacceptable. The Mission Director and his advisors had in any case devised a few simple ship maneuvers to counter possible Soviet divers without endangering [redacted]

AT 2135, the SB-10 approached the HGE within 75 yards on the starboard beam. The HGE sent a signal to the SB-10 to keep clear. The Soviet ship backed off, sounded three long blasts of her whistle and went around the stern of the HGE still at a distance

[redacted]

The lifting operation had become more comfortable. Pressure in the hydraulic power units was dropping and had fallen to almost a routine level. Each double of pipe removed meant about 15 tons less load on the system. No one was relaxing, but there was a sense arising that we were, indeed, going to make it. [redacted]

of about 75 yards. The SB-10 crew members were observed waving. The ship appeared to be headed for Petropavlovsk, and by 2238 hours was fading from the HGE's radar screen. Its departure marked the end of a close surveillance of the HGE which had lasted 13 days and 16 hours.

A touch of irony was that as the SB-10 broke off its last close-in surveillance, the recovered G-722 submarine [redacted] below the HGE. One can only conjecture the reaction and chagrin of Soviet authorities when they later realized that two Soviet Navy ships were on the scene and, in effect, witnessed the recovery operation against their lost submarine.

[redacted] 6 August reported problems that the recovery team were then encountering. For example, the heavy-lift system had a leaking seal on the upper yoke, and sticking isolation valves were making the system dangerous; three hydraulic pumps had blown manifolds, and difficulty was being experienced keeping them running at the proper pressure. Other problems occurred and were corrected as quickly as possible so that recovery could proceed. All this was transmitted virtually as a matter of routine in a status report on engineering matters rather than an emotional litany of calamities, as might have occurred in such a stressful situation.

[redacted]

No radioactive contamination had been detected as yet.

[redacted]

While the water was being pumped out and before shoring began, an inspection team checked [redacted] its target for nuclear contamination. Evidence of plutonium was found. Later as the inspection and exploitation continued, the contamination was found [redacted] apparently primarily from one or more of the nuclear torpedoes whose high explosive had detonated without creating a nuclear explosion—the war heads were "one point safe." Fortunately, the plutonium was in a hydroxide form and thus there was little danger of airborne particulate. [redacted]

The recovery phase of the AZORIAN mission was finished on 9 August. In an overt commercial message to "Summa headquarters" sent via Station KPH, San Francisco, the HGE advised it had completed "Event 36-A," a prearranged code for

the recovery phase. Previously, other major events had been coded sequentially to keep headquarters informed on mission progress. In accord with the AZORIAN cover plan, mention also was made that damage analysis of the "nodule collector vehicle" was still progressing.

Despite a certain amount of apprehension because of the past and potential future presence of Soviet ships at the recovery site and a desire to move away from the area as soon as possible, [redacted] decided that all residual actions, such as recovery of the wave rider buoys, should be completed. After all, the buoys cost about $25,000, and he also pointed out that their situation would not be improved appreciably by limping away from the site before completing all that had to be done. If the Soviet Navy were inclined to challenge the HGE, the ship could not outrun them. Thus, [redacted] carried out the HGE cover role as a commercial mining research ship according to plan.

The HGE sent an overt commercial message on 10 August, ostensibly to Summa, stating that every effort was being made to determine whether repair of the nodule collector vehicle could be made at sea. At that time, the ship was continuing its course toward a prearranged site in the direction of Midway where, under the cover plan, a decision would be made as to whether it was necessary to enter Midway [redacted]

On 11 August, the HGE sent another overt commercial message indicating it was changing its destination to a new site and that repairs to the "nodule collector vehicle" would take at least 30 days. [redacted]

The Soviet tug left. We were going to be able to do the telltale pumpdown operation without surveillance. Our cover story had held: the Soviets had been fooled. Now we could anticipate seeing our prize without being concerned about sharing it with the owner.

Everyone wanted to get the first glimpse of the target. [redacted]

[redacted] *Those of us waiting anxiously on deck received a reward of a different type. Bobbing up to the surface (luckily in the well) was a brimming full Jerry-can of torpedo juice. It had travelled over three miles to the bottom and back and been subjected to pressures of over 7000 pounds per square inch without spilling a drop.*

[redacted]

[redacted] *The Mission Director and his team viewed the scene from a balcony-like portion of the ladder which led down to the well gates. Radiation monitors had reported readings 5 times background even at this distance. We knew that we were in for a nasty time. Some of the earlier excitement of the mission was returning to the exploitation party. There was going to be* [redacted] *It was going to be difficult—the jumbled hulk was not going to reveal its secrets easily.*

[redacted]

necessary to go to Midway. A decision was made by headquarters that the ship would proceed instead to Lahaina Roads off the Island of Maui, Hawaiian Islands, where a crew change could be made. A special exploitation team to recover, process, and package the intelligence items [redacted] also would board in Hawaii.

The HGE sent a commercial message on 12 August for cover reasons stating that the "nodule collector vehicle" would be ready for inspection and commencement of repair work upon arrival at Site 130-1, which was Lahaina Roads. Arrangements were made [redacted] for an inspection team from Washington to examine [redacted] For cover purposes, Paul Reeve, General Manager, Summa Ocean Mining Division, would lead this team aboard ship. Meanwhile, a series of personal messages were sent from crew members not under cover to make arrangements for relatives and friends to meet them either in Honolulu or on the West Coast.

The HGE arrived and anchored at Lahaina Roads at 1430 local time, 16 August. The mission crew was relieved by the exploitation crew in the evening, and Paul Reeve and the engineering inspection group also boarded the HGE at that time. In Hawaii, the *Honolulu Advertiser* newspaper featured a front page article on the HGE and the Summa mining venture.

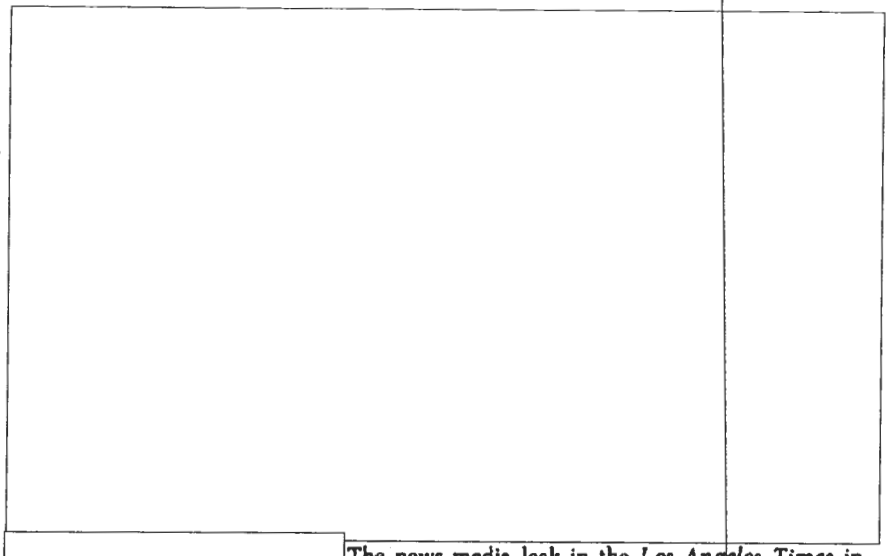
On the 17th of August, the Summa office at Honolulu maintained its cover image by sending a message via RCA, San Francisco to its home office advising that the crew change went smoothly.

The HGE was initially anchored approximately one mile south of the Lahaina Roads sea buoy, but that morning it shifted anchorage to a point eight miles south of Lahaina Roads buoy, approximately five miles off shore.

Looking back on the AZORIAN operation [redacted] remarked that he was extremely grateful for the advice and confidence he received from William Colby, Director of Central Intelligence, immediately prior to the HGE departure on the AZORIAN mission in June. Colby told [redacted] he was fully aware of what it meant to operate in the field and that the officer-in-charge at the scene of action is usually much more aware of a given situtation than someone back at headquarters. Therefore, Colby said, he wanted to assure the Mission Director that he was to use his own good judgment in critical situations as long as he was adhering to the basic guidelines of the directives and plans which governed the operation. In looking back to that challenging, demanding, and very difficult experience [redacted] recounted that he took this advice gratefully and literally.

Thus, the long saga of AZORIAN came to a conclusion as the HGE rested at anchor in the Hawaiian Islands, more than six years since the Soviet G-II-class submarine 722 sank in the Northwest Pacific Ocean. The efforts to locate the site of the sinking and to conceive, develop, build, and deploy the HGE system [redacted] stretched almost as long in time, beginning in mid-1968. And the success that was achieved depended, in the end, on the combined skills of a multitude of people in government and industry who together forged the capability that made it possible to proceed with such an incredible project.

As the operational phase of AZORIAN ended, the important task of exploiting the [redacted] intelligence information began. After preliminary examination aboard the HGE [redacted]



The news media leak in the *Los Angeles Times* in February 1975, however, culminating in Jack Anderson's decision to expose the project on national TV and radio in March 1975, As proof that the USSR had gotten the message—and no doubt intended as a message to us—the Soviets reacted immediately to the disclosure and assigned one of their ships to sit and monitor the site of their lost submarine, which had then become known to them.

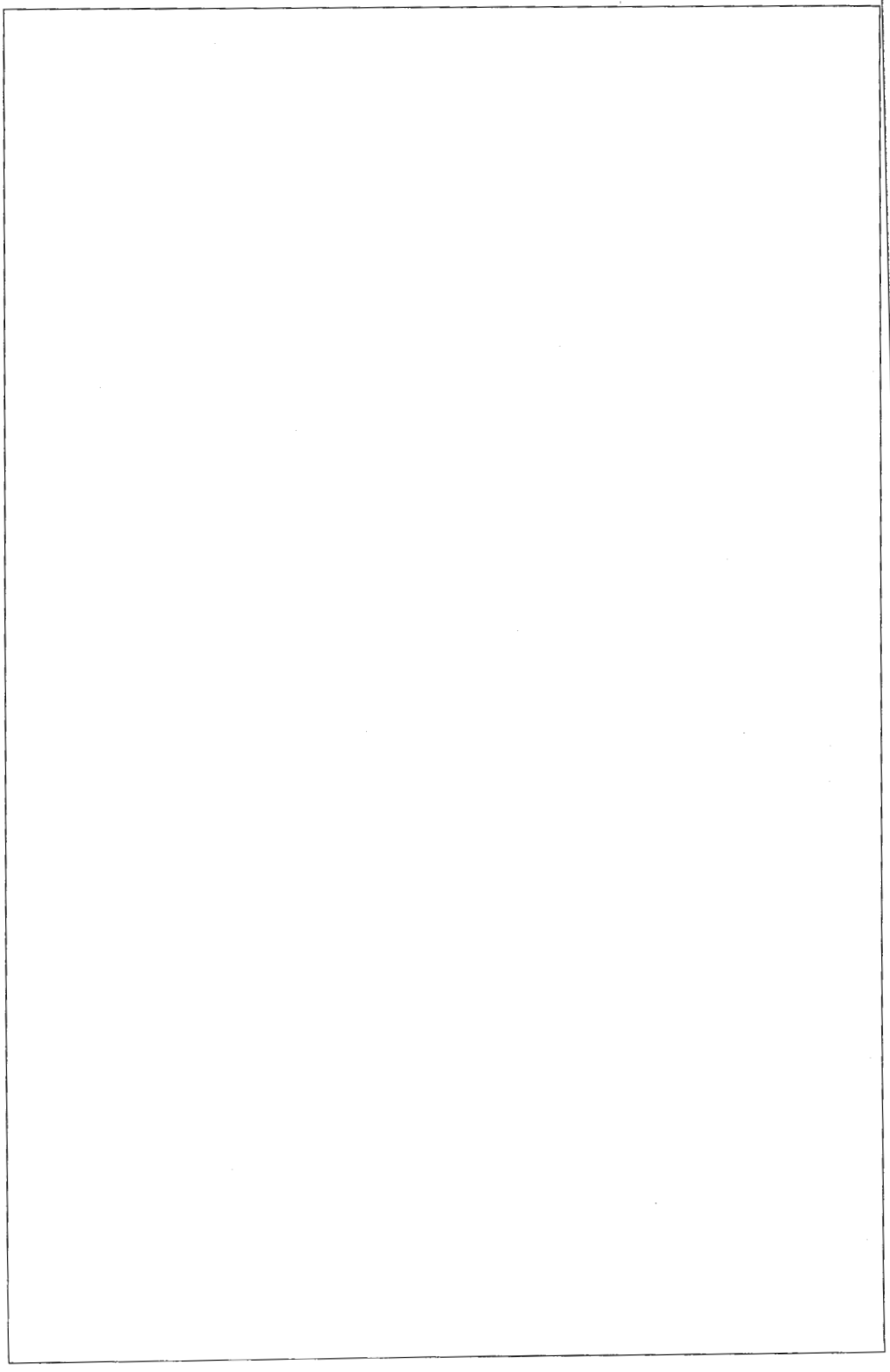
One of the most difficult exercises is to apply the cost-benefit principle to a specific intelligence operation. This is particularly true of Project AZORIAN. During its early stages of planning, Deputy Secretary of Defense David Packard and his fellow ExCom members and other senior officials were wrestling with projected costs of the program and evaluating the technical risks involved. Lifting a submarine weighing approximately 1,750 tons from a depth of 16,500 feet had never been attempted or accomplished anywhere before. Packard contended if they were to wait until all the risks were eliminated, the project would never get under way. The resulting decision to move ahead with the plan to recover the Soviet submarine was courageous, carefully considered, and intangibly beneficial: a government or organization too timid to undertake calculable risks in pursuit of a proper objective would not be true to itself or to the people it serves.

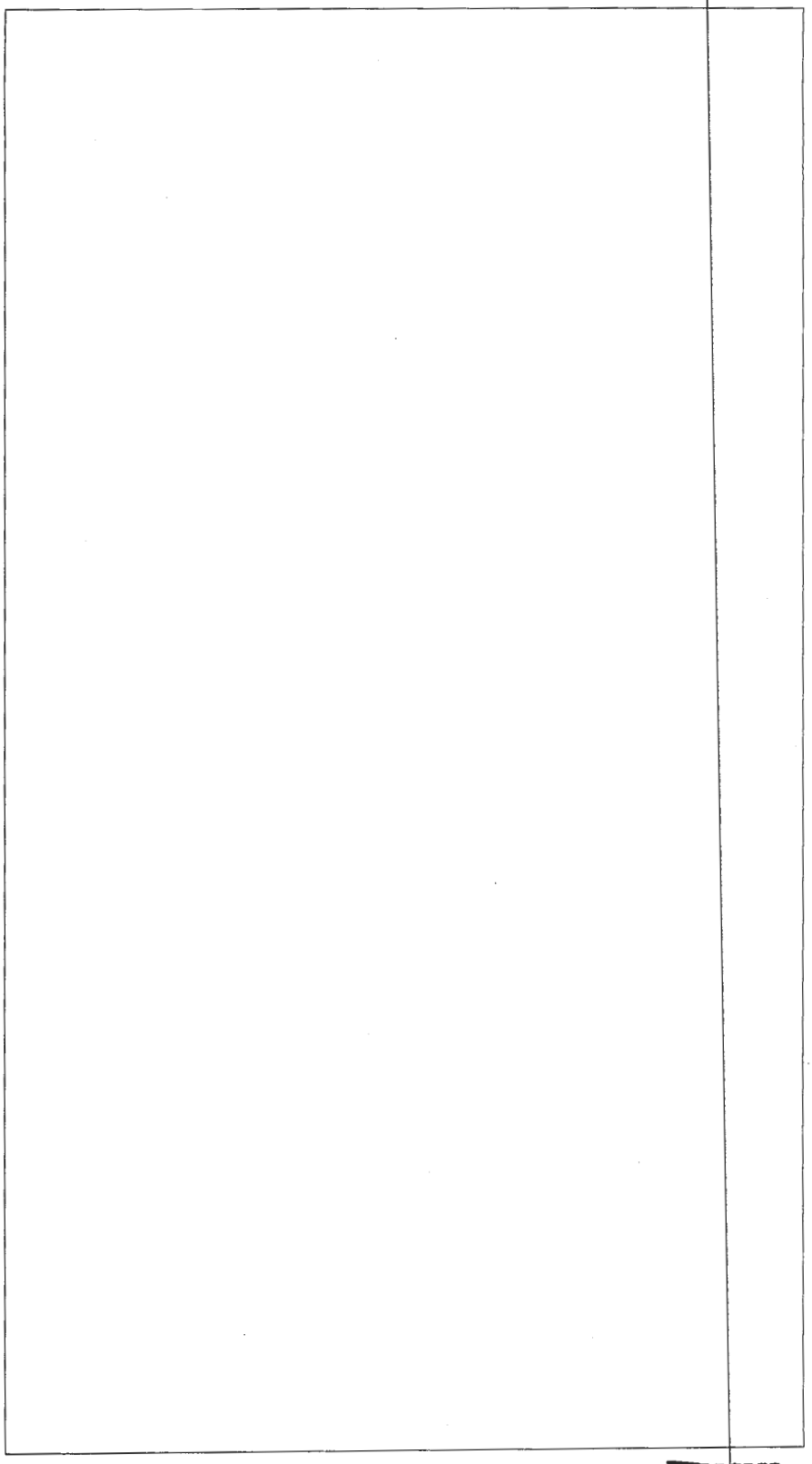
To attempt to evaluate Project AZORIAN in terms of cost benefits, one must consider not only the immediate intelligence gained but the broader aspects and achievements as well.

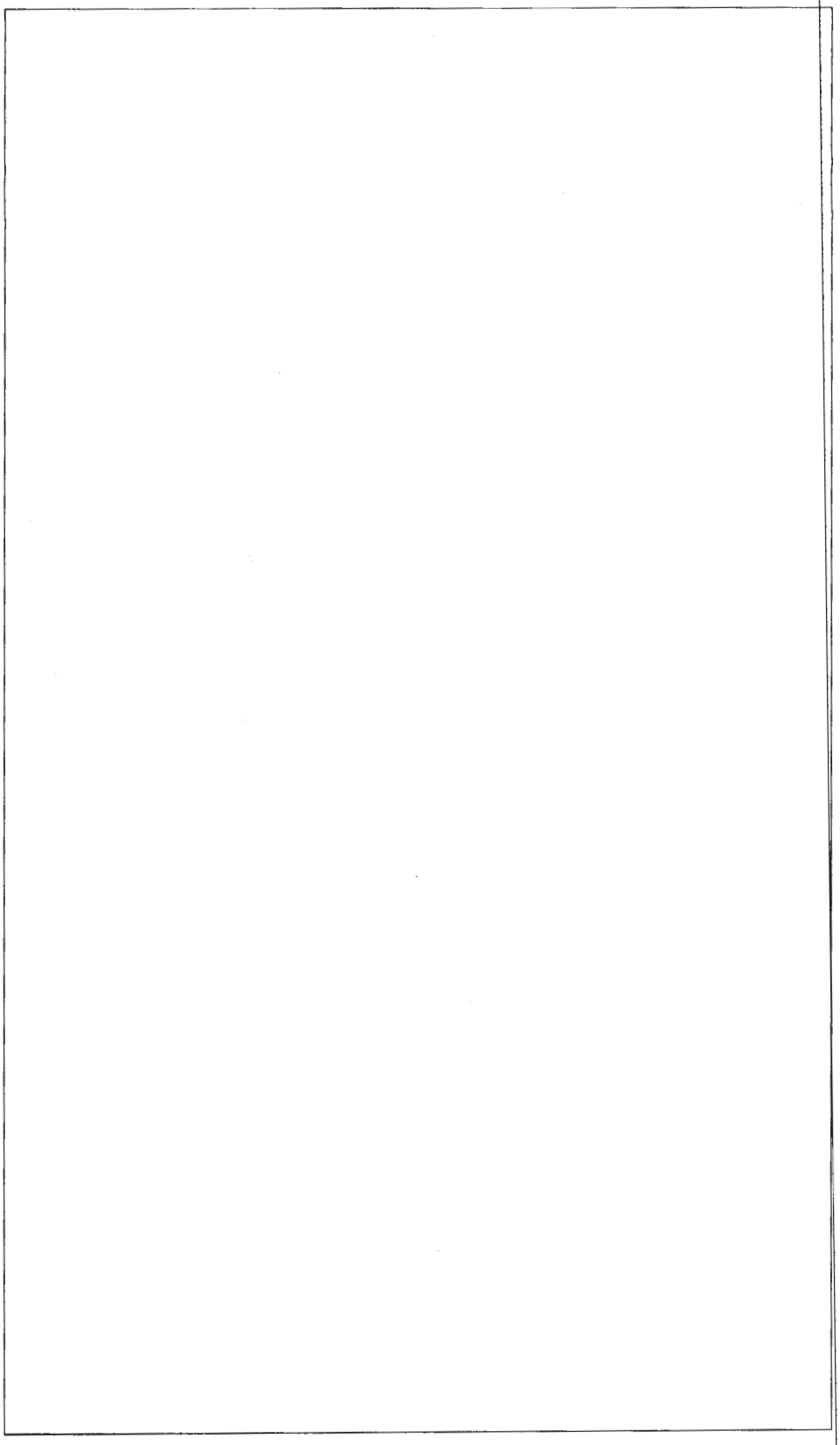
For example, the state-of-the-art in deep-ocean mining and heavy-lift technology was advanced in a major way. AZORIAN produced an advanced deep-ocean system with important future economic, political, and strategic potential for the United States. The need for such a capability is well-documented in the United Nations Law-of-the-Sea Negotiations. As this article is published, a private consortium of companies, including Lockheed, Global Marine, Standard Oil of Indiana, and Royal Dutch Shell, are readying the *Hughes Glomar Explorer* for use in deep-ocean mining operations to begin late in the fall of 1978. Also, a number of government agencies

have been planning future use of the *Glomar Explorer* for other deep-ocean projects compatible with her unique characteristics.

As a final note, we can find tangible proof in such projects as AZORIAN that the intelligence profession is dynamic and alive—keeping pace with the rapid advances of science and technology, and applying the proper mixture of tradecraft to these advances to make them serve our purposes and yield the information this country needs.







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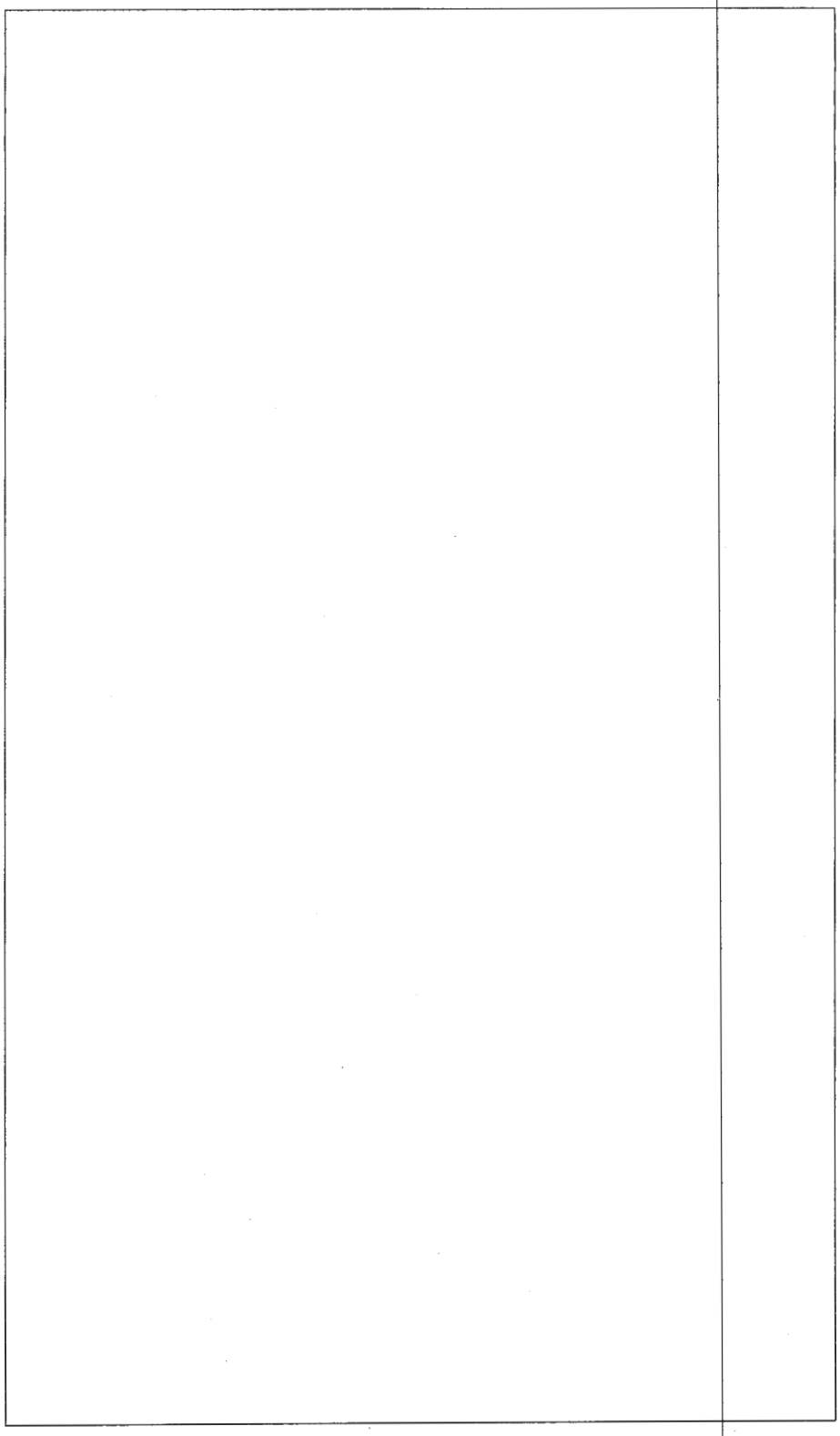

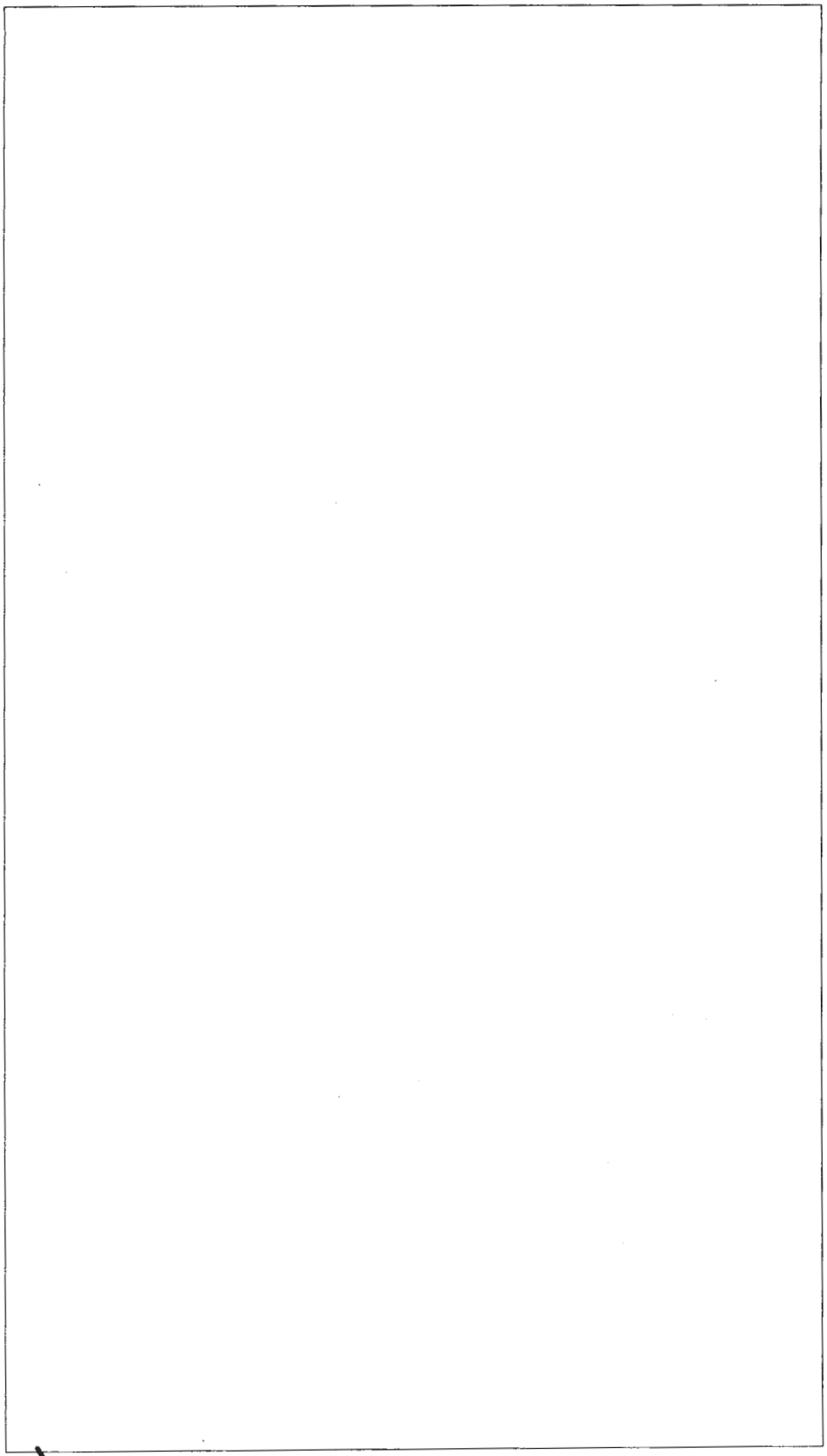

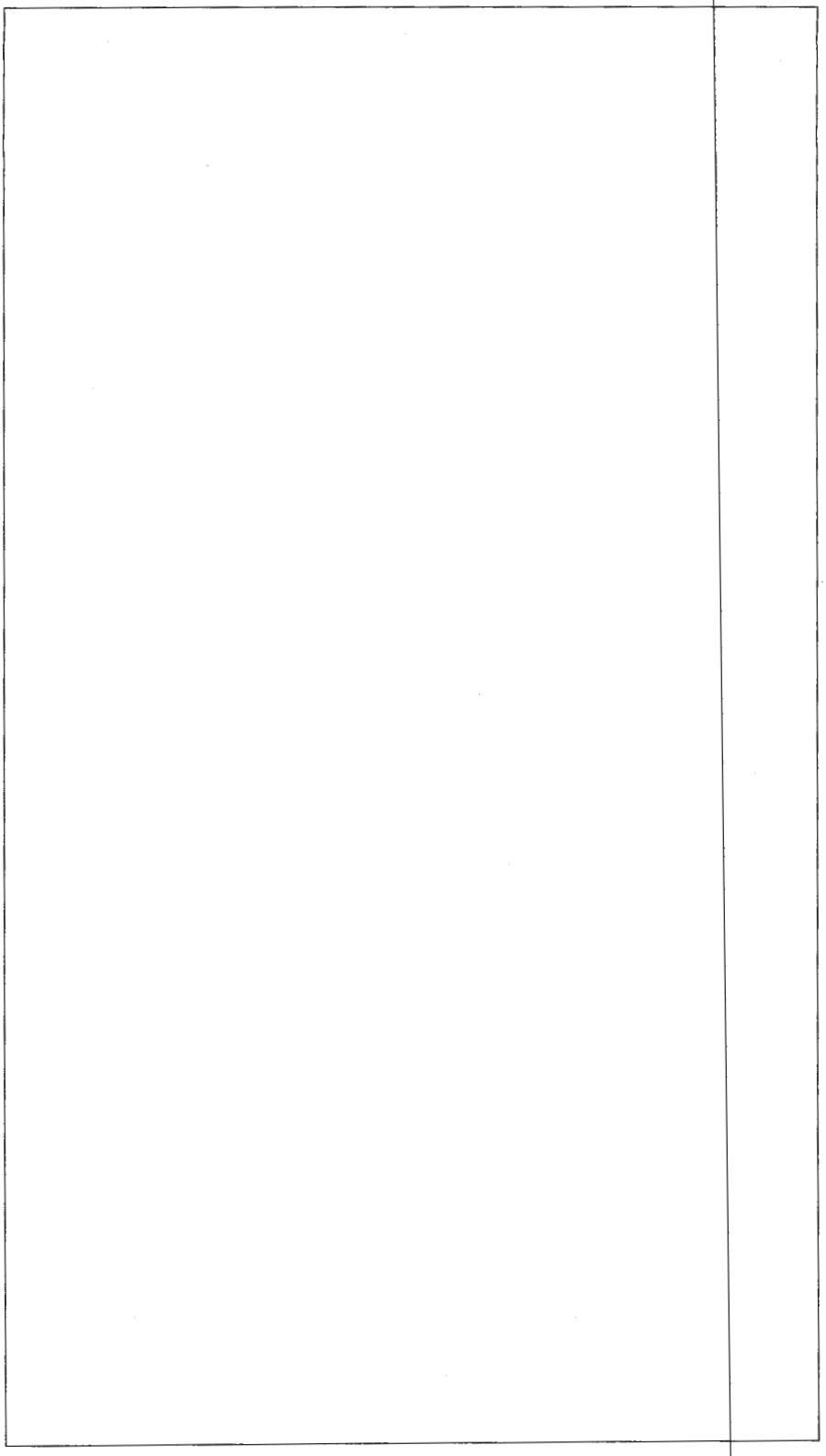

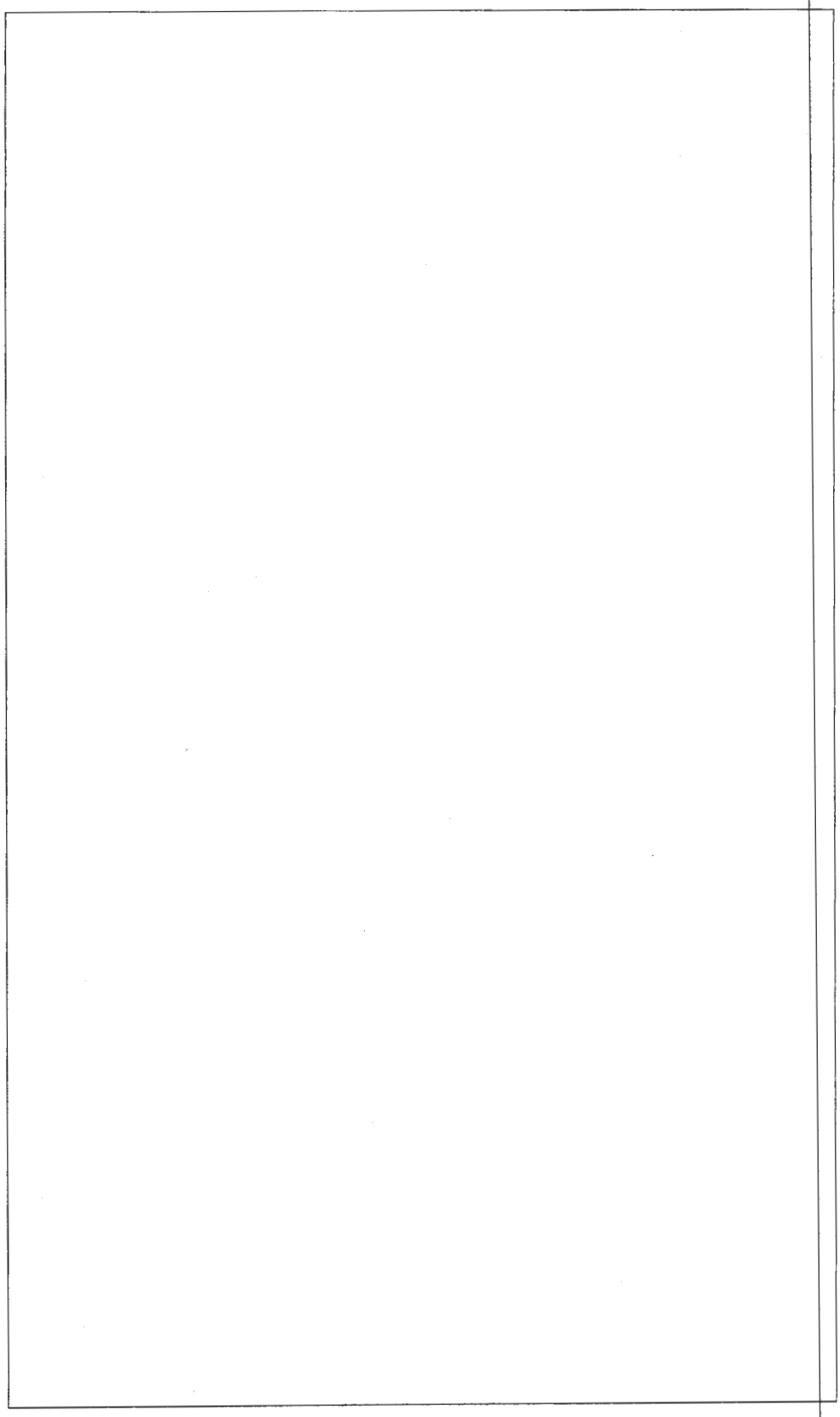

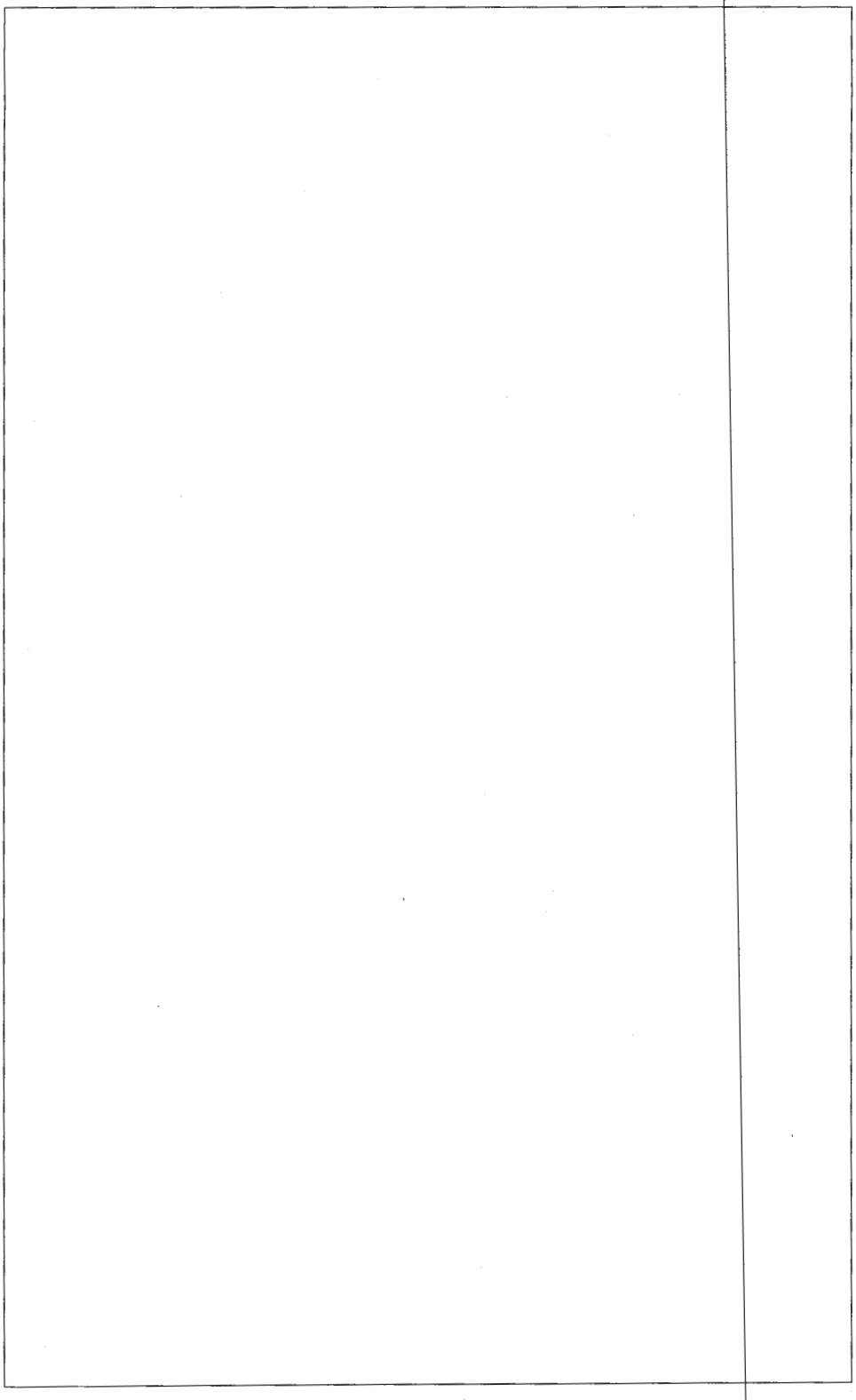

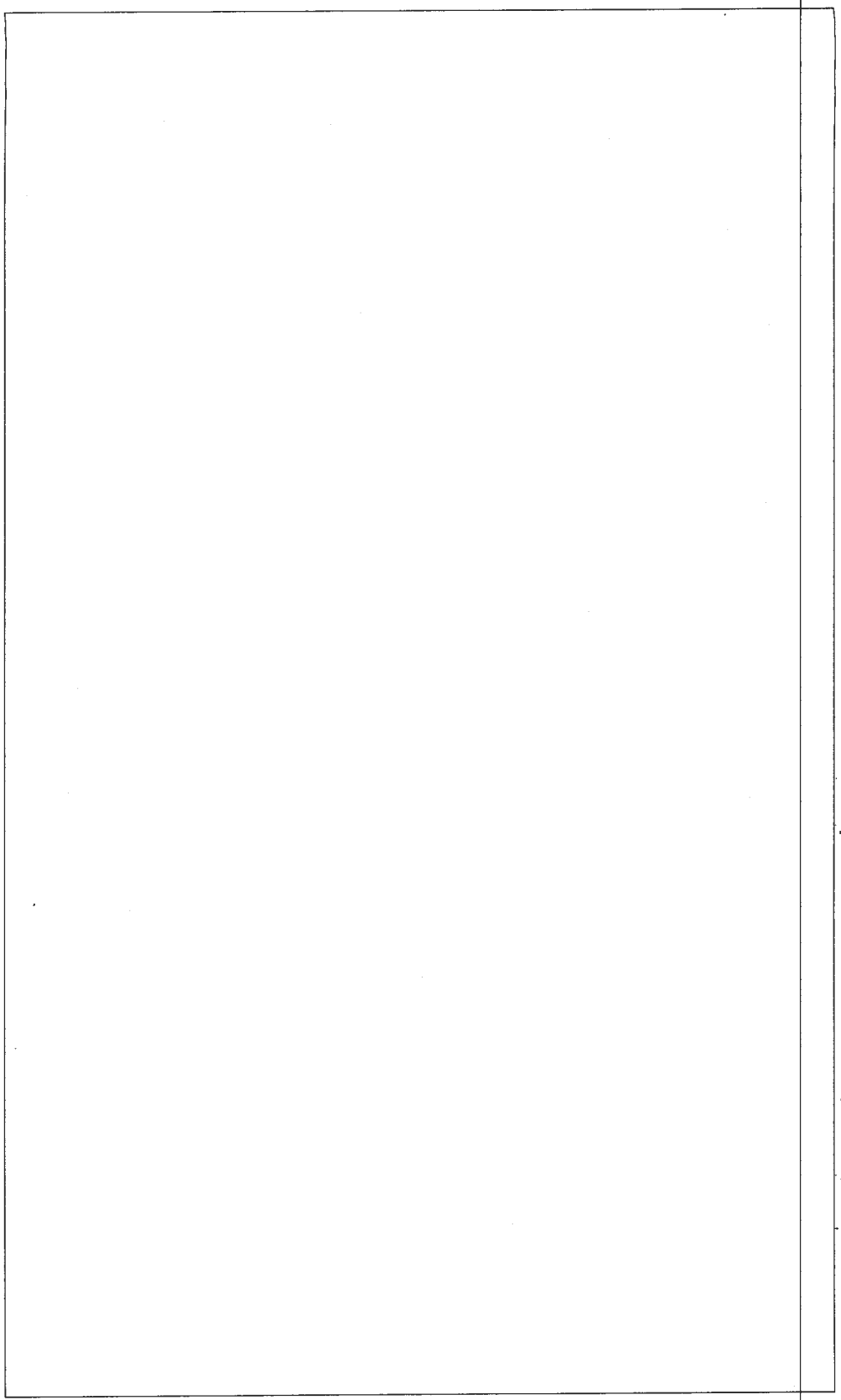

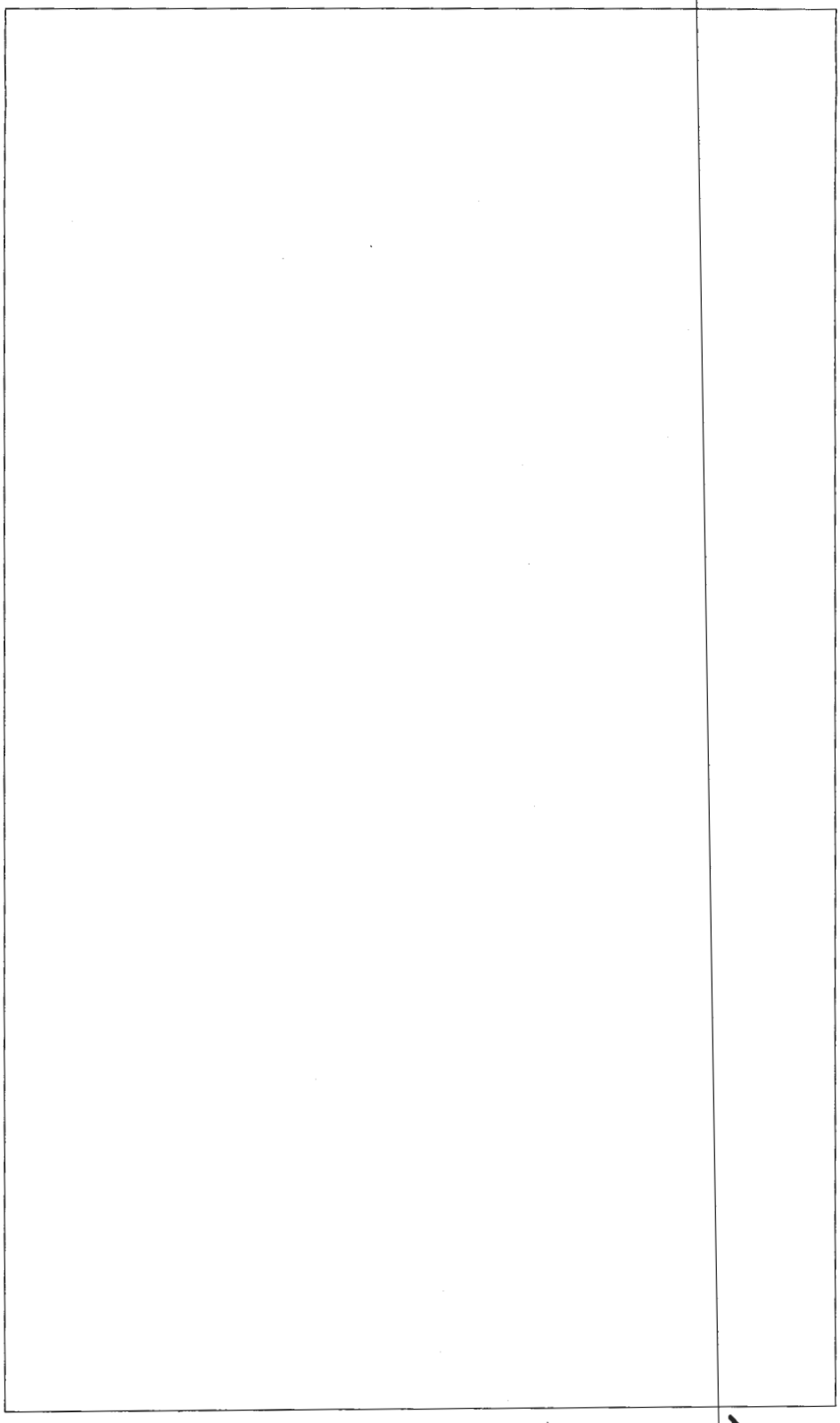

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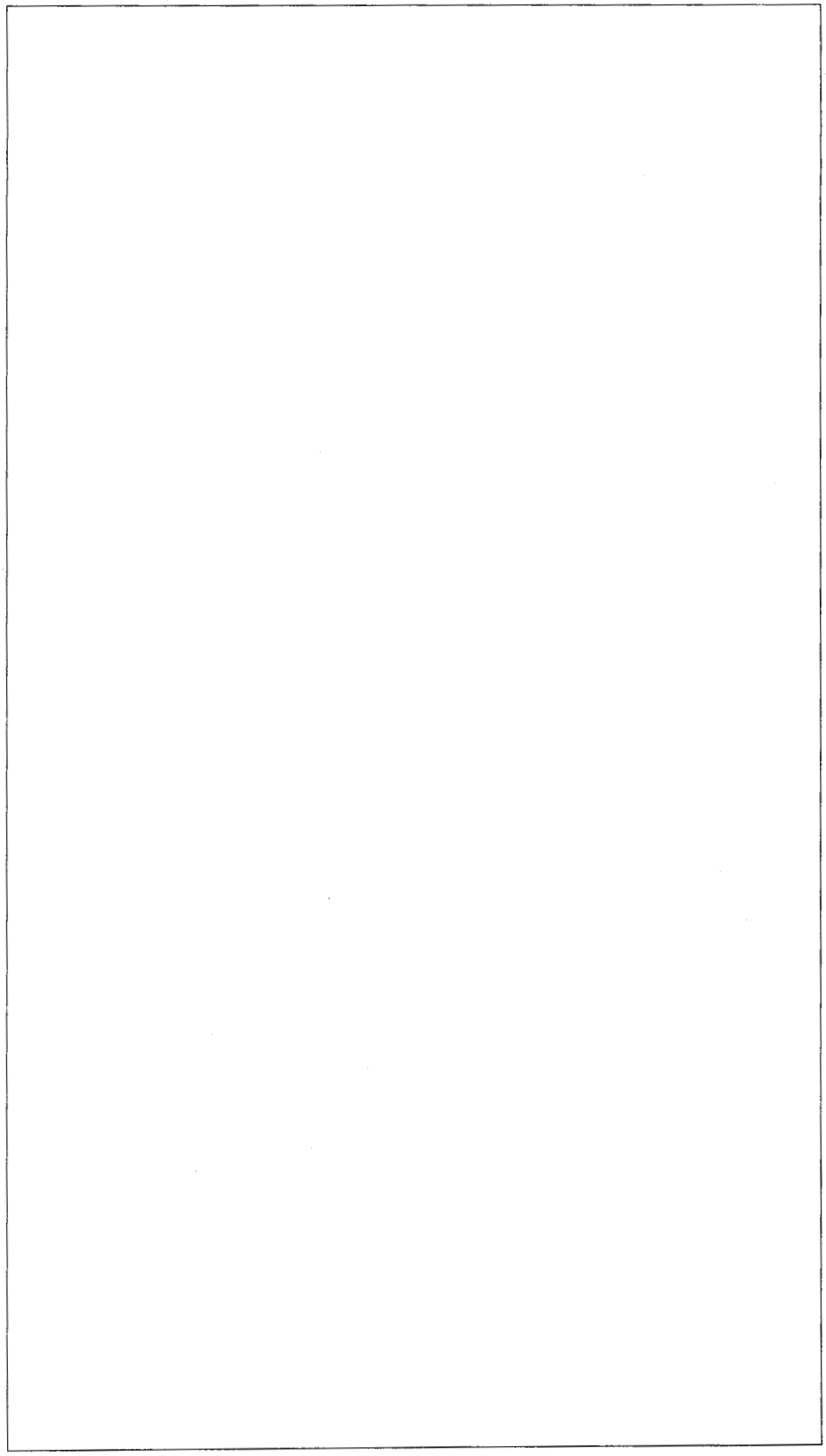

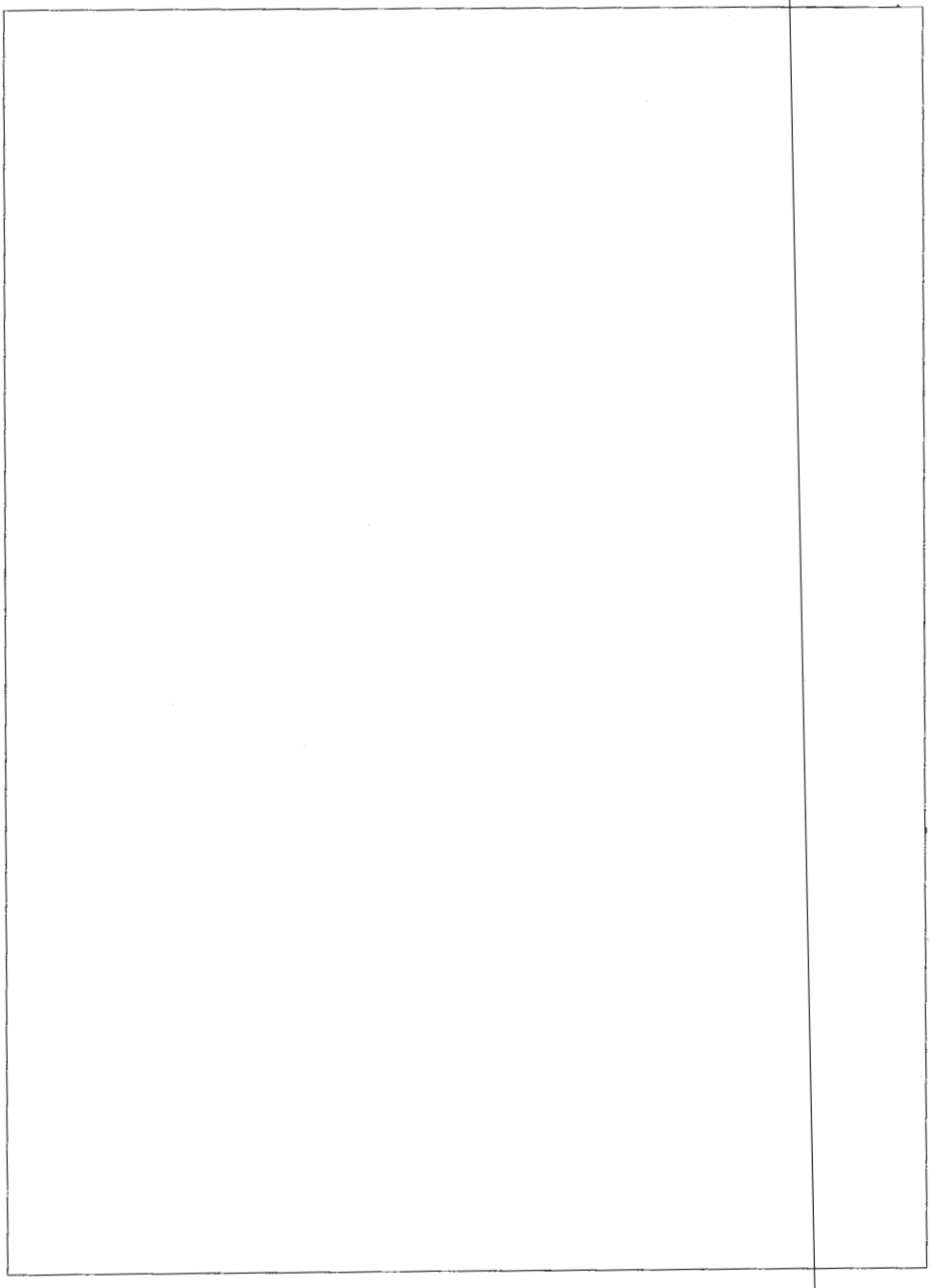

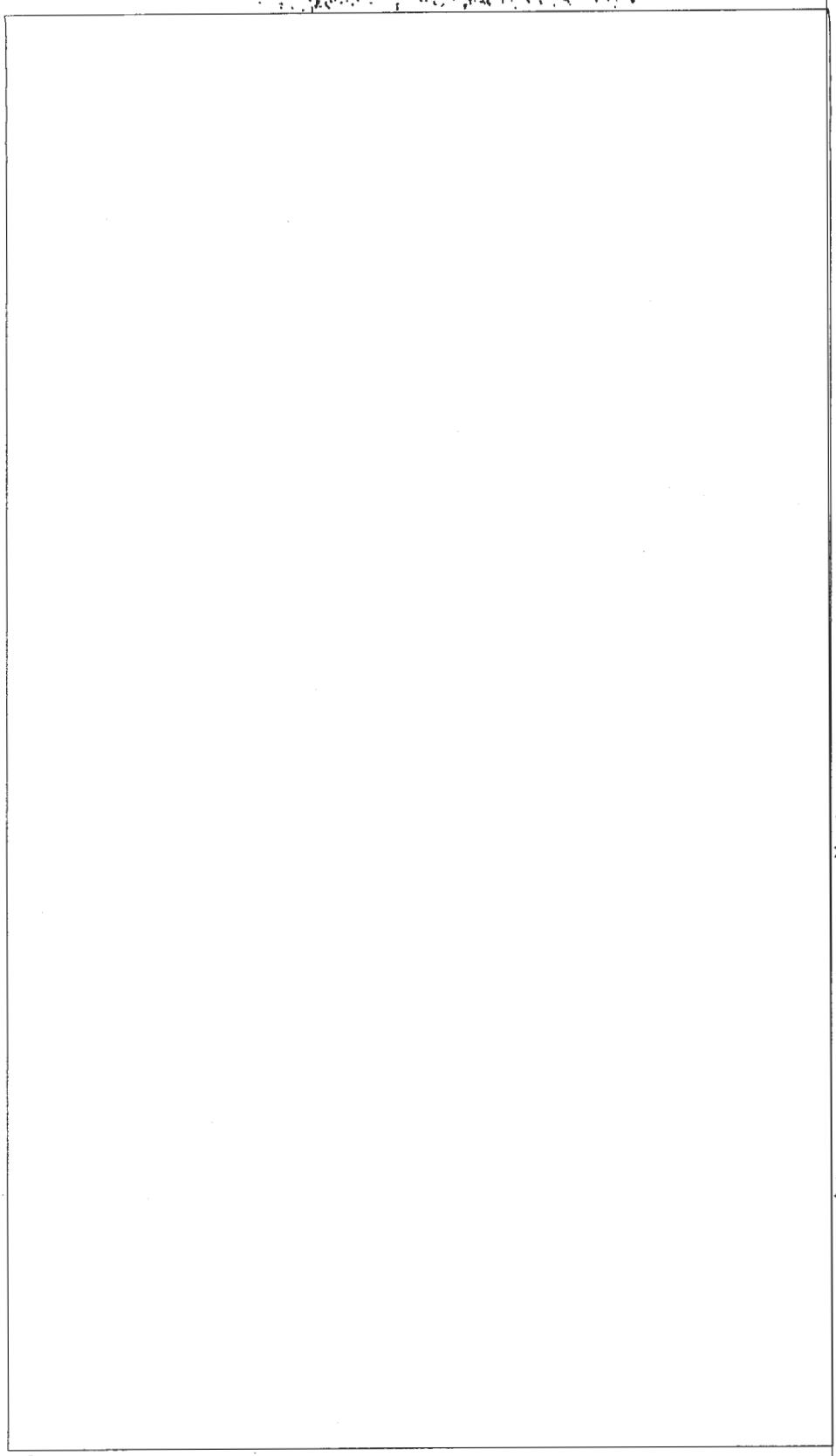

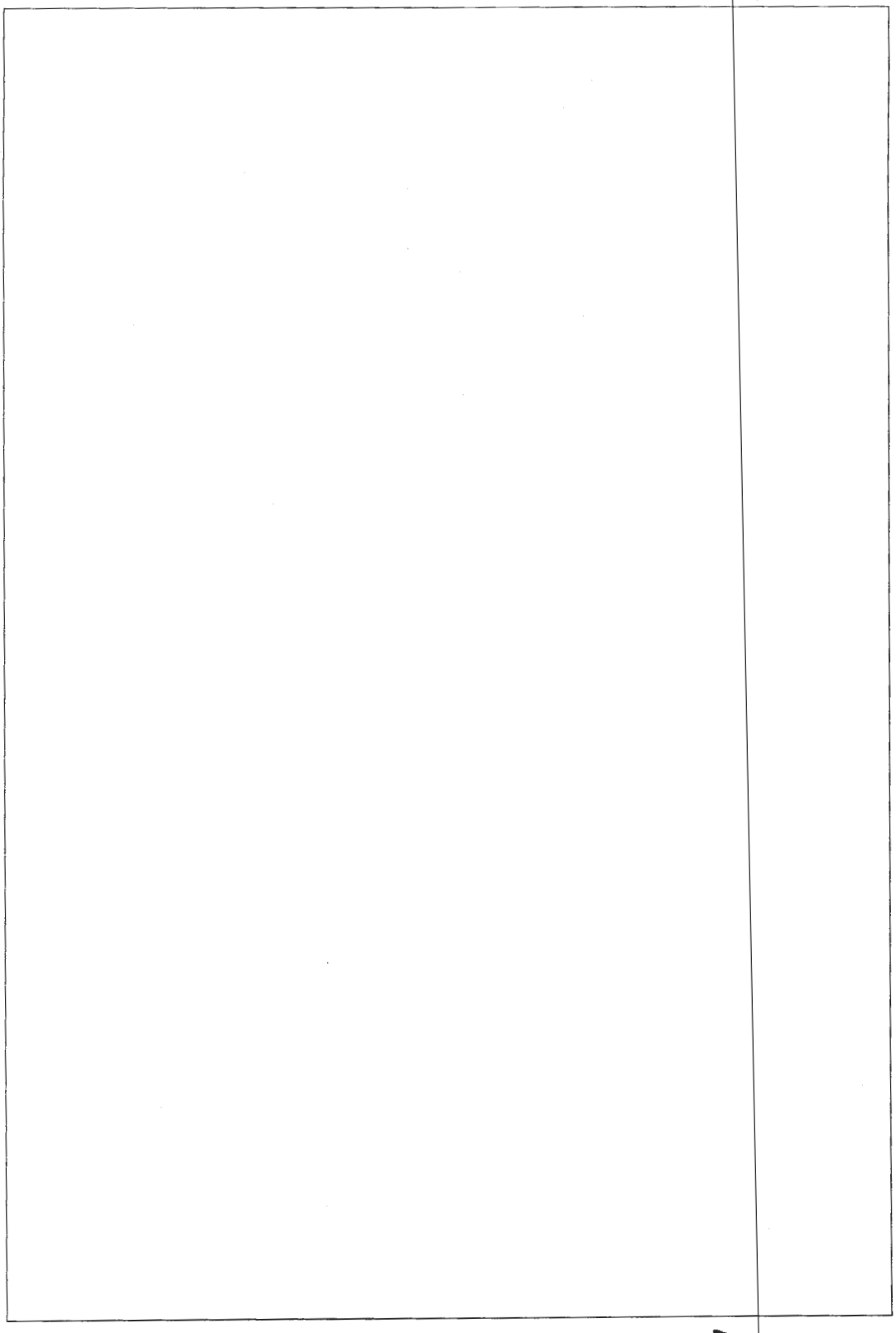

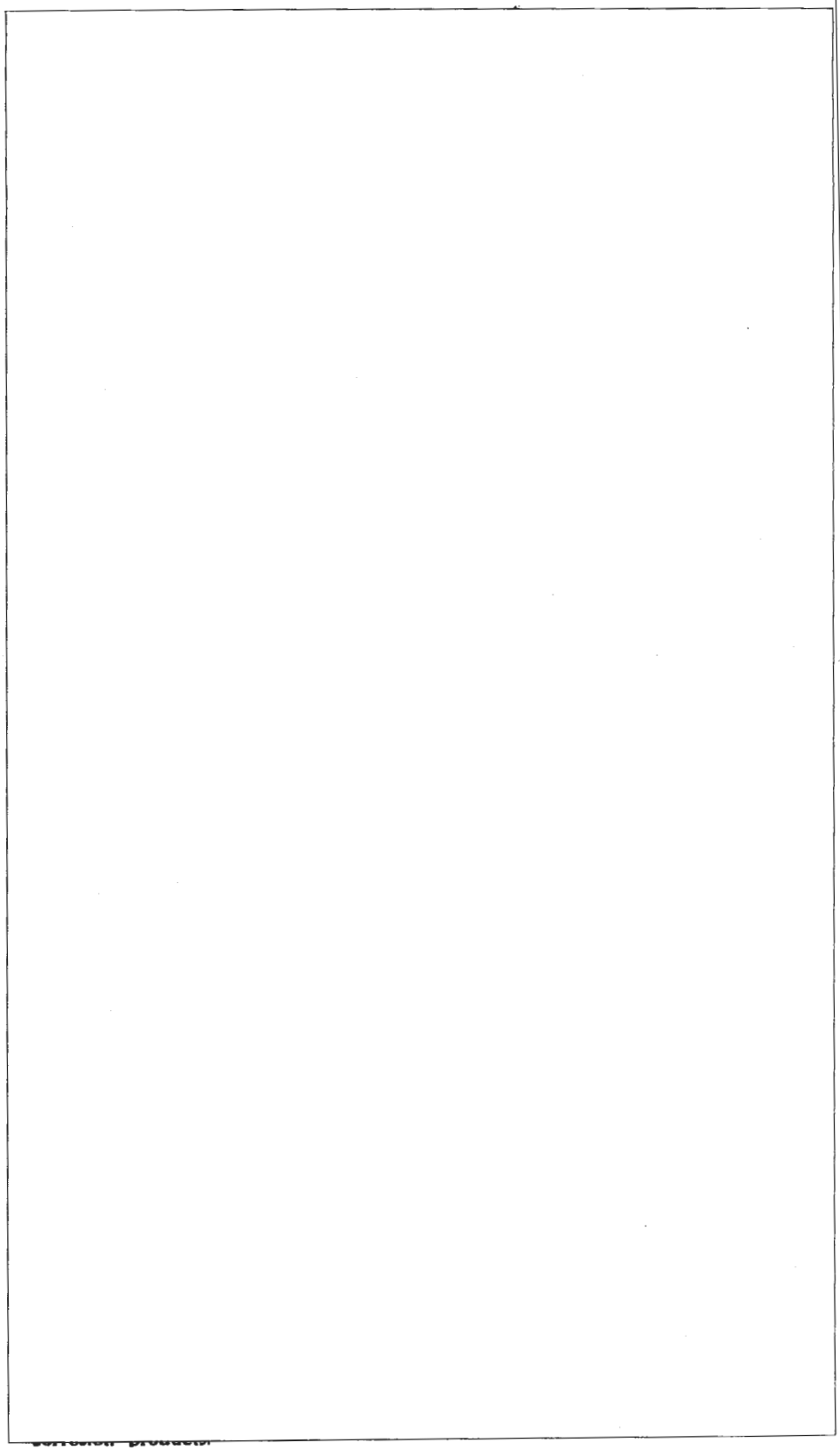

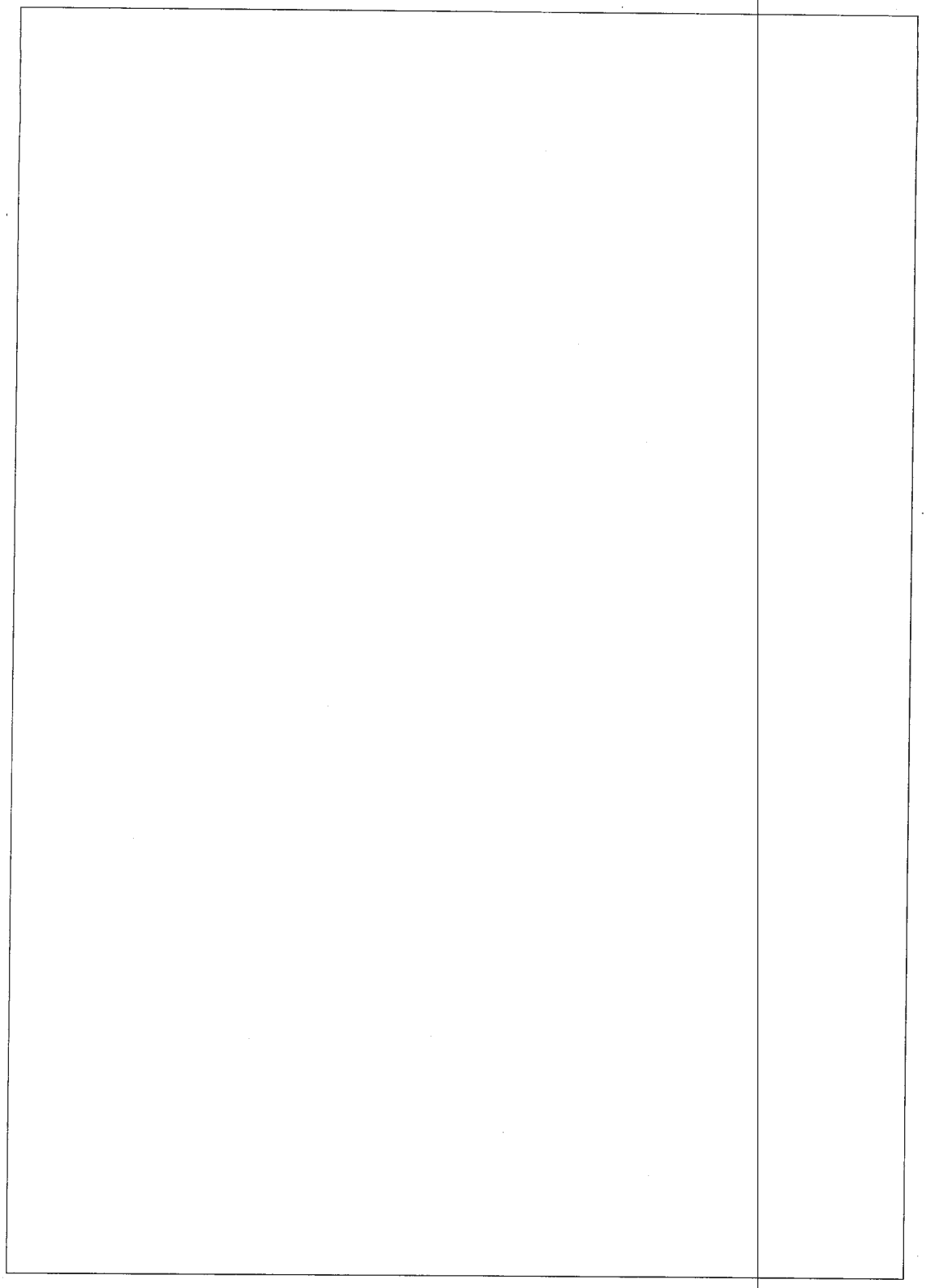

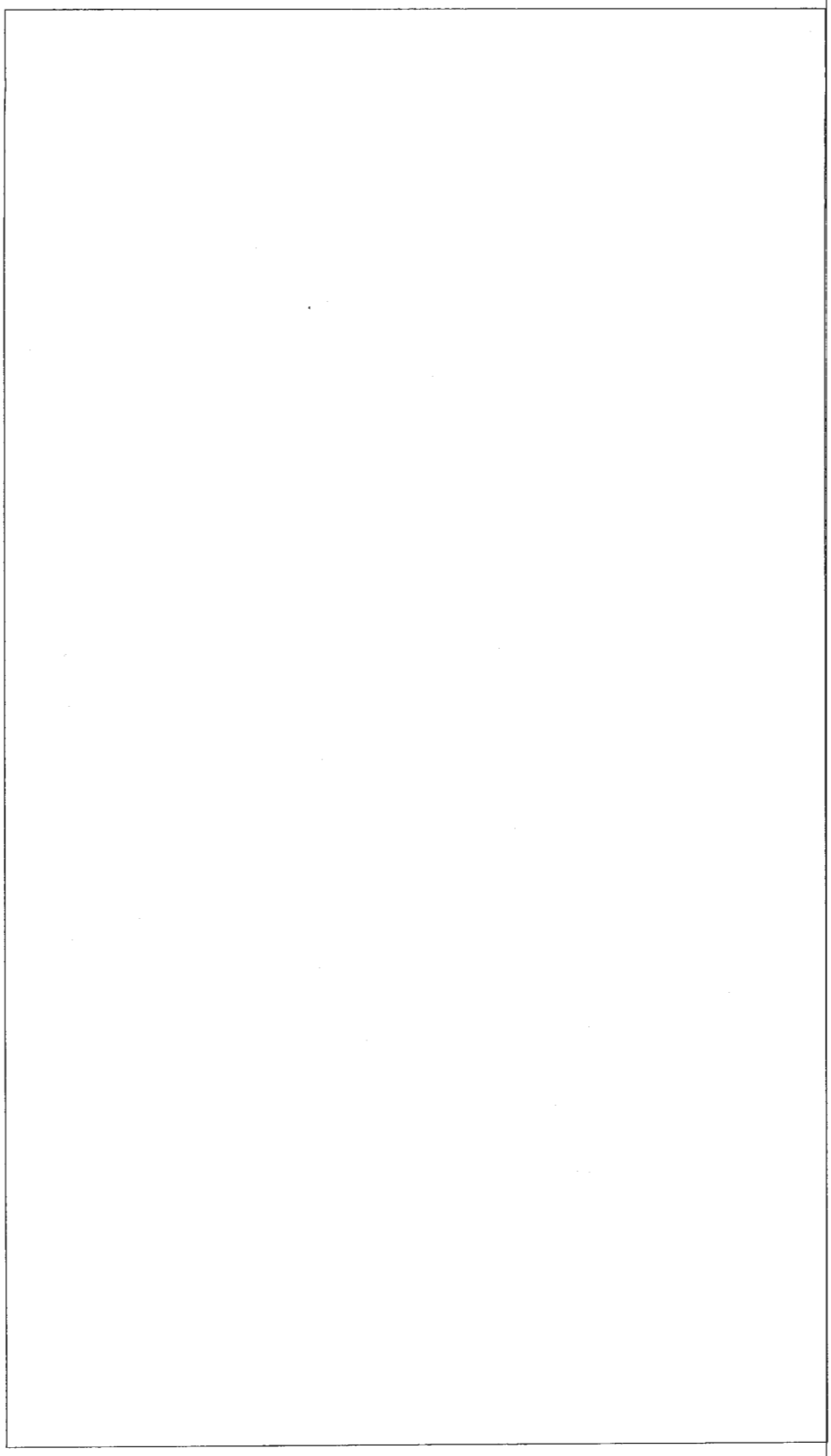

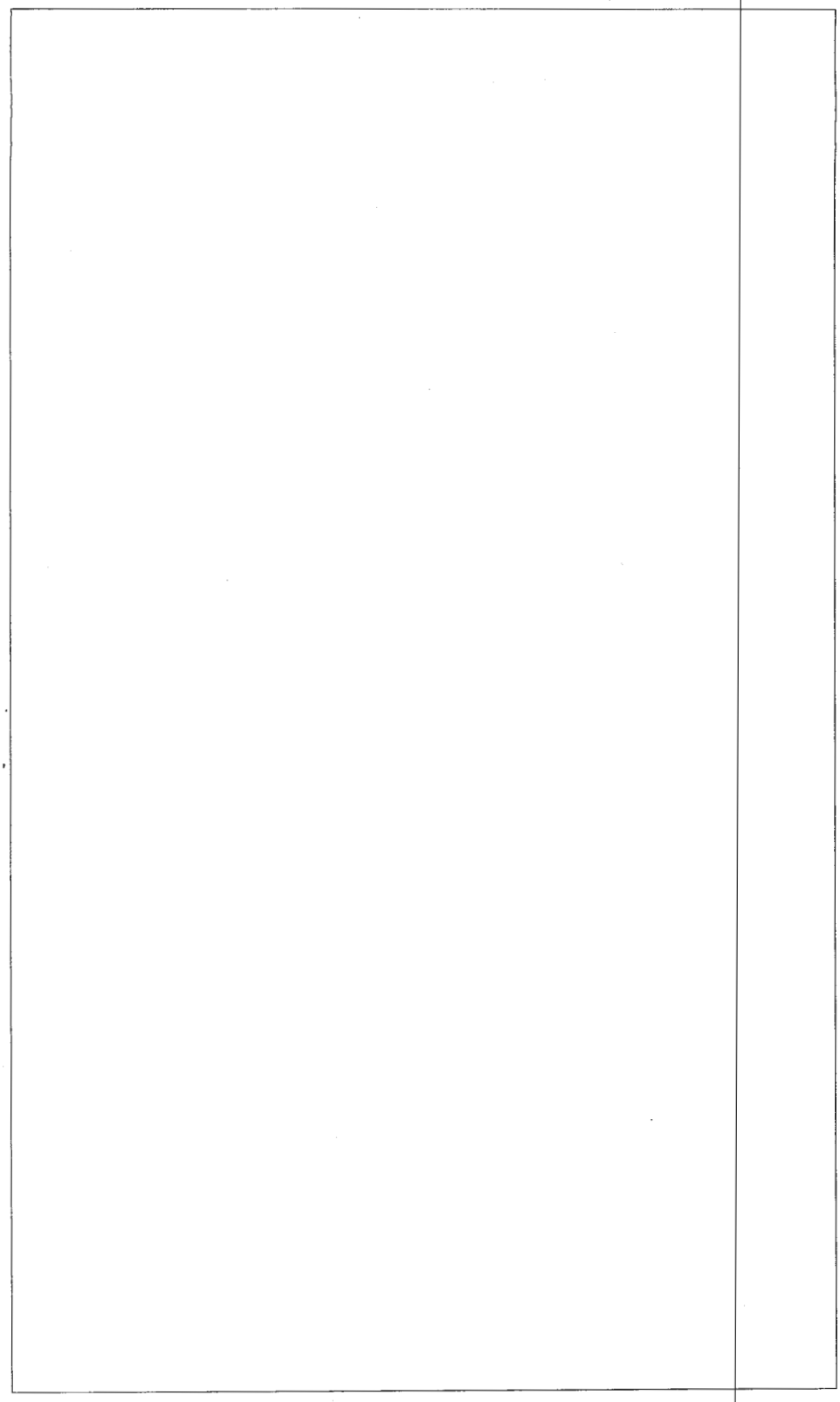

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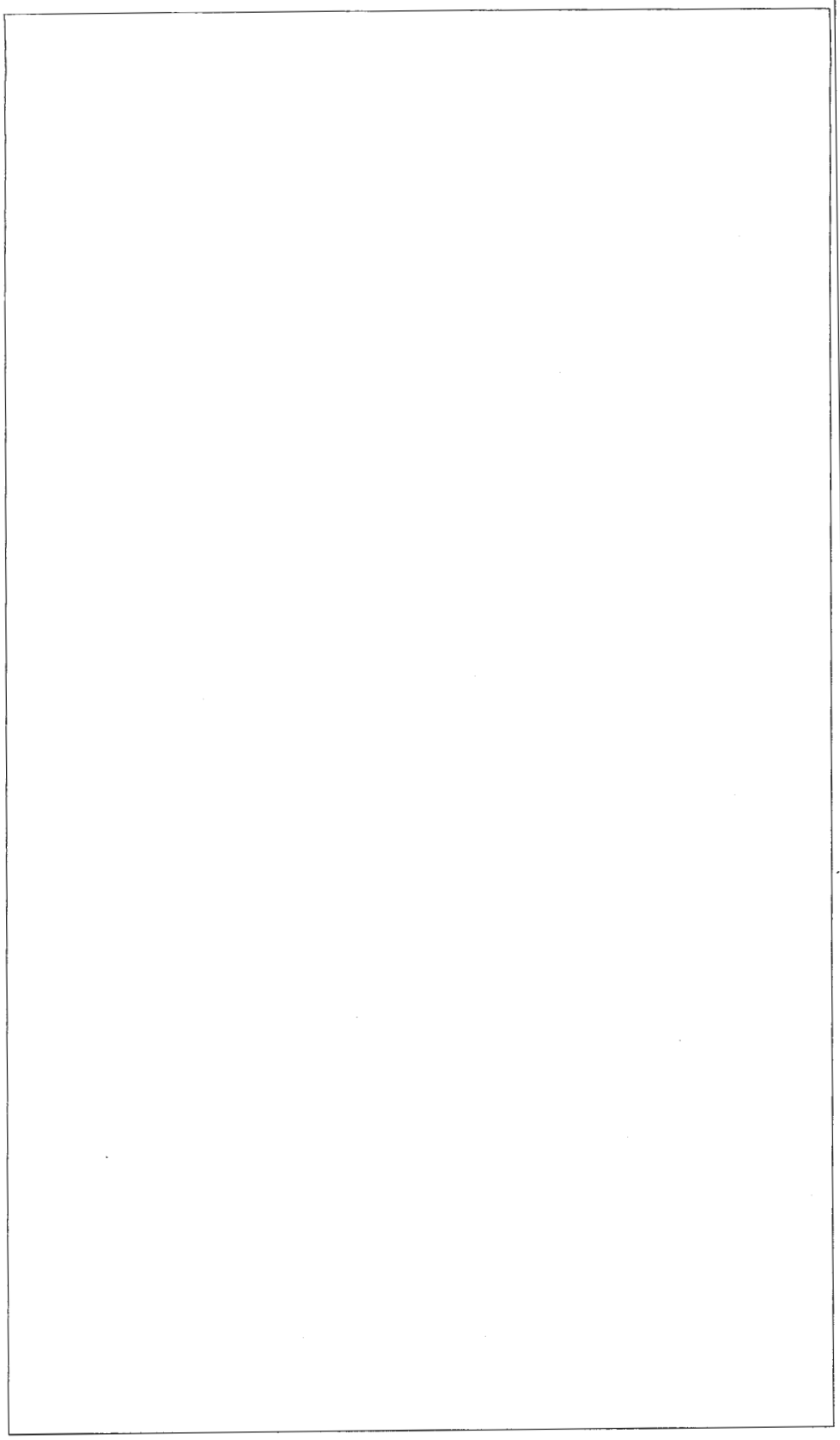
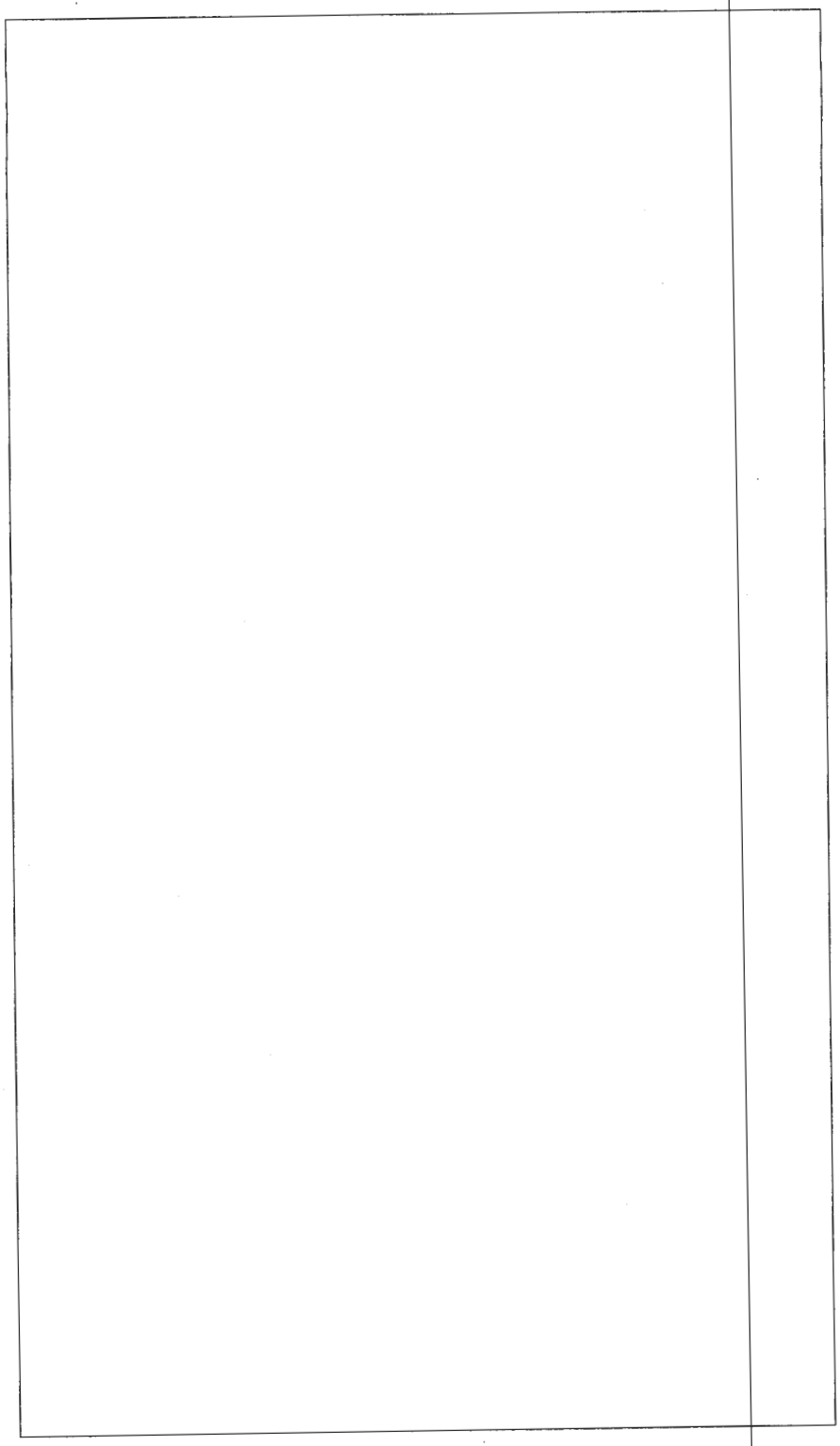
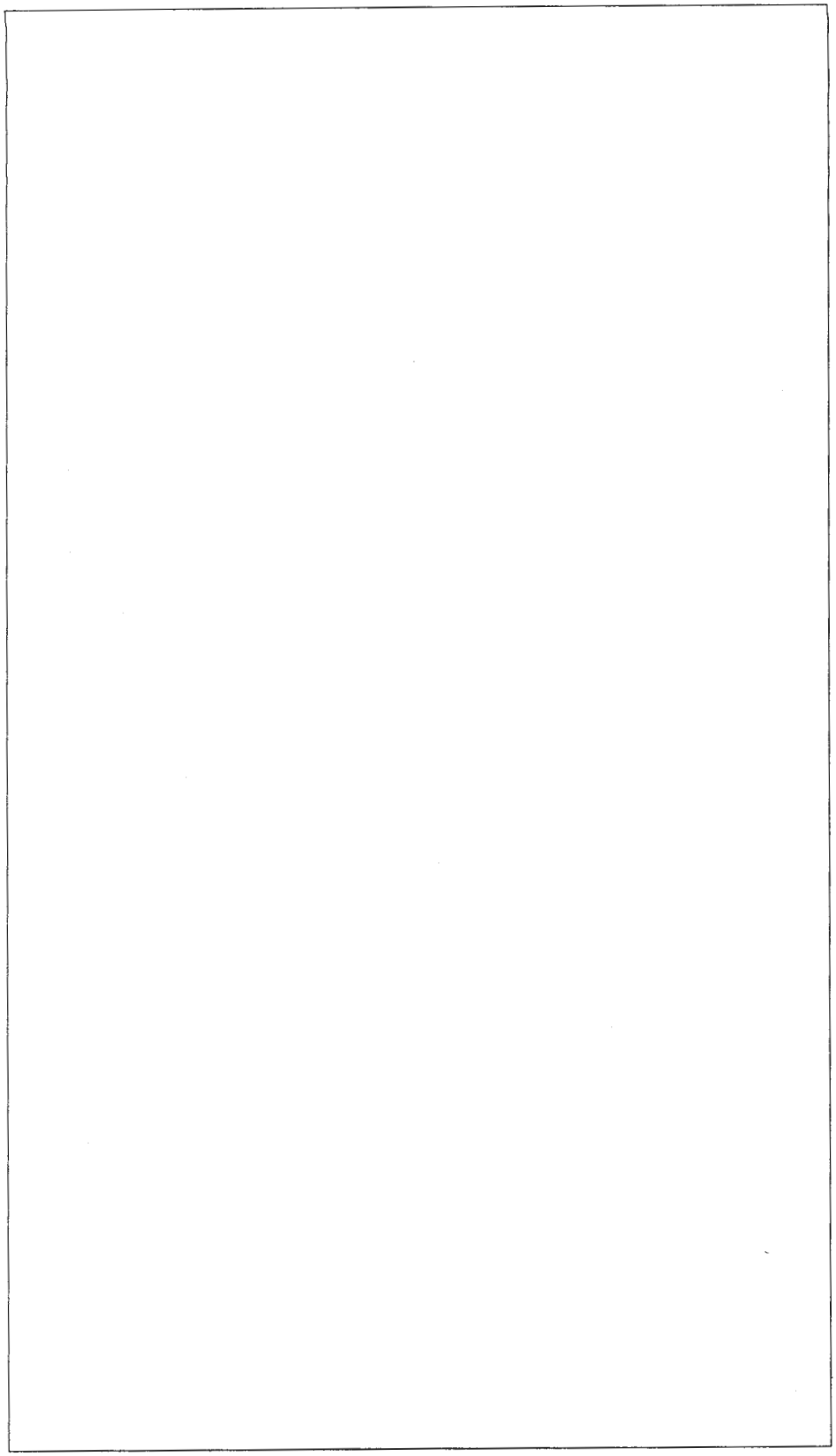
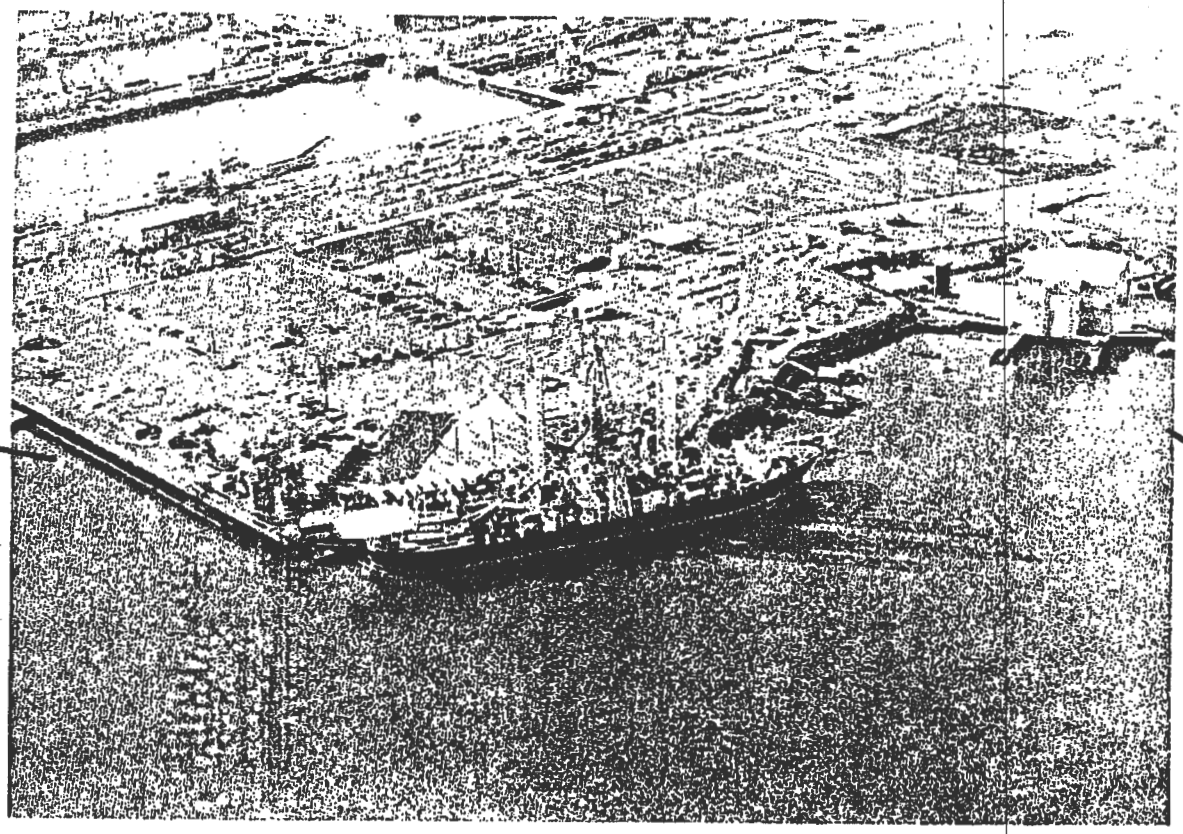
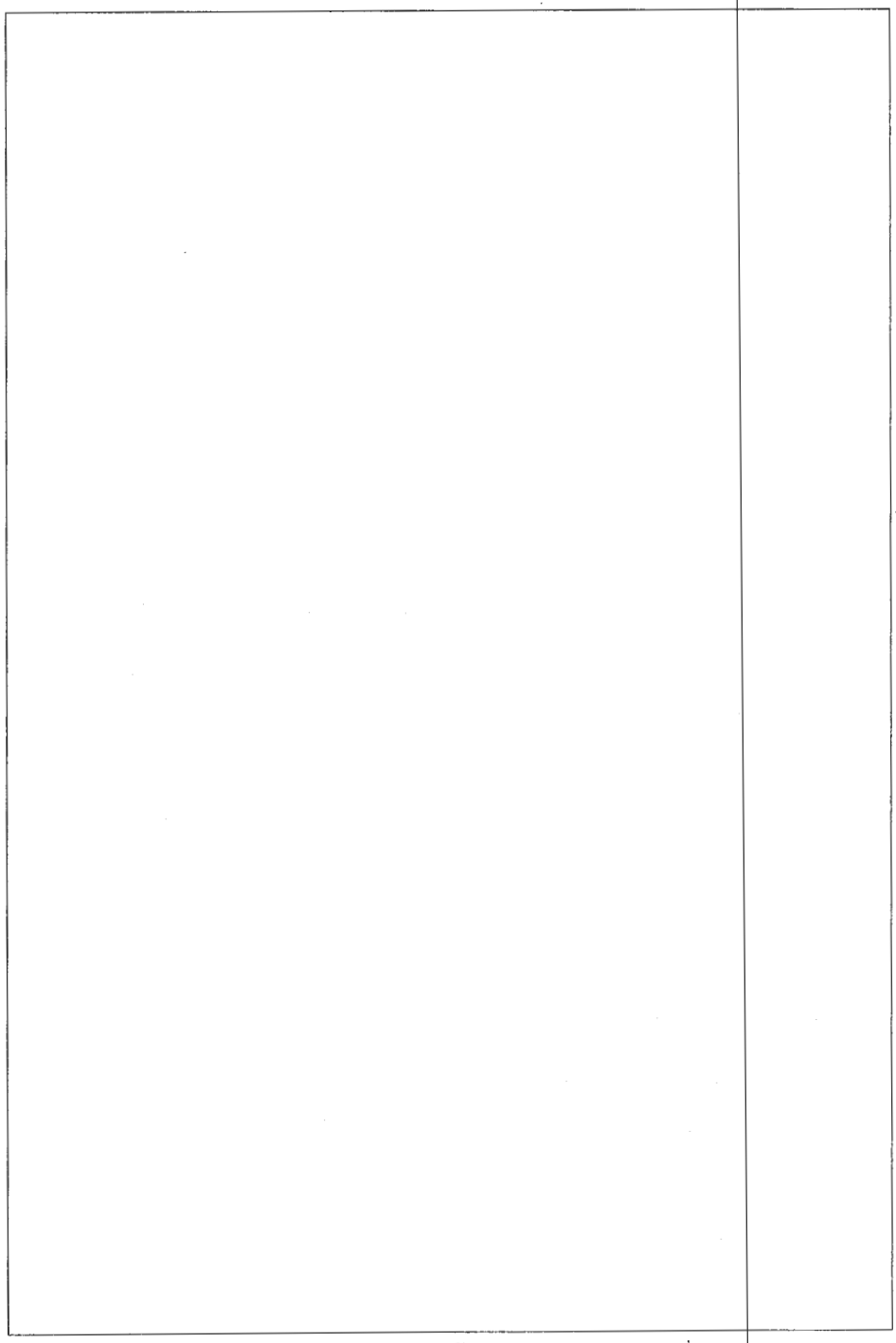








Frontispiece—The Hughes GLOMAR EXPLORER at its operational base, Pier E, Long Beach Harbor. In the background, the U.S. Naval Shipyard, Long Beach. At the far right, the hangar containing Howard Hughes' "Spruce Goose."



How the secrets of the clandestine recovery of a Soviet submarine were preserved

SECURITY: HIDDEN SHIELD FOR PROJECT *AZORIAN*

[redacted]

The technological feats accomplished in building and operating the *Hughes Glomar Explorer* and maintaining the Hughes deep-ocean mining cover were the "up front" elements of Project AZORIAN.* But behind the scenes equally important activities were taking place, quietly and professionally.

One of staunchest, most dedicated groups participating in AZORIAN was CIA's Office of Security. Their policies and their procedures provided the day-to-day shield which protected the program and the myriad of people working on it. It was the individual security officers assigned to the program who implemented the policies and procedures, or often quickly improvised new ones on the spot in unusual situations. They provided the rivets that held the security shield together and in place.

The immediate purpose of the security shield was to prevent the leakage of information to the news media. Its ultimate purpose, of course, was the denial to the Soviets of any shred of knowledge about the true objectives of the program.

The first security officer on the scene set the tone and standards for security from Day One. He was followed by more than 20 others who were assigned for varying lengths of time directly to the AZORIAN project and its related activities. They were supported by the unheralded troops in the Office of Security's field offices and in the trenches at Headquarters who did the routine legwork and deskwork so essential to the maintenance of a successful security program. The dedication and hard work of all the officers made it possible for the program to run as long as it did without the erosion of the cover story and without a breakdown in program security.

Establishing the Security Base

The [redacted] agreement which established AZORIAN as a priority program was signed 19 August 1969. It gave the security management responsibility to the Director of Security, CIA, who would act for the Director of Central Intelligence. The Director of Security had already asked the chief of his [redacted] to assume day-to-day responsibility for the compartmentation which would be necessary to protect program information. The first security officer had been assigned to the embryonic [redacted] and had been drawing up the over-all security plan as well as the specifics for the AZORIAN program. It was the security plan that was code-named JENNIFER, and because this word would appear on the cover of all AZORIAN-related documents, among those on the fringes of the program it came to be synonymous with the project itself.

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* The story of the *Hughes Glomar Explorer* is told in *Studies in Intelligence* Volume 22 No. 3, Fall 1978. Other aspects of the AZORIAN program are dealt with in Volume 23 No. 2 and No. 3, Summer and Fall 1979.

By 15 July 1969 a draft of the security plan [redacted] and on the day the AZORIAN project agreement was signed the first JENNIFER security guide was issued. This policy paper was a 13-page directive covering the background of the program, general security policy, personnel security, personnel restrictions and requirements, physical security, contracting and funding security, communications security and public information control. The second security directive was issued on 12 December 1969 and spelled out procedures for handling program documents in government and industry. Industrial aspects of security were to grow increasingly important as the commercial nature of the AZORIAN cover plan unfolded.

The program manager had a philosophy about security that proved to be invaluable; it was especially applicable to the movement into a new world of commercial cover and security for a major technical effort. This philosophy was that security would be involved in every aspect of the program, including planning, from the very first. Security was not to be used just to clean up a mess or tamp down flaps after they developed. It was to be part of all program deliberations. The imprimatur of security was to be obtained before any action was taken. In this way many potential problems were avoided or finessed without causing a stir. The security officers responded to the philosophy with an attitude of, "How can we help you solve your problem?" In this way a healthy and mutual respect developed between the engineers and their enormous engineering problems and the security officers who were charged with protecting "Mission Impossible" from disclosure.

Design and Development

As the program moved out of the formative stage into design and development, there was an increasing demand for security approvals on contractor employees. A concerted effort was made to restrict the numbers of individuals briefed on AZORIAN in order to limit the targeting and penetration opportunities available to industrial and foreign espionage. But the program couldn't be done in a vacuum; contractors had to have access to the program. Because it was an ostensibly commercial effort, all industrial personnel had to be investigated by the Office of Security without showing government interest. To have shown a U.S. Government footprint during a background investigation would have blown the cover. Approximately [redacted] investigations were done. All personnel approved for access met the strict security criteria for AZORIAN. It was the largest effort of this type ever undertaken by the Office of Security.

Within the security approval for the program, three levels of access were established based on the need-to-know principle. The highest level gave full program knowledge and was limited to those who needed the information to carry out their part of the program and to those going on the mission. The more remote one's activity or involvement, the lower his access approval.

Mechanisms were developed to obtain other special security approvals. Certain commercially employed individuals needed [redacted] but it had to be granted without widespread knowledge within the [redacted] It would not make sense to be granting [redacted] to Global Marine or Hughes Tool Company employees. The Office of Security worked out an arrangement with their counterparts [redacted] to have these clearances granted and at the same time limit the knowledge of it to a handful of AZORIAN-cleared people [redacted] It was the use of this kind of procedure that allowed AZORIAN to go ahead on a very rapid time scale.

During this stage of the program another landmark security decision was made. This was the so called "team spirit approach." Contractor personnel at the top level were to be considered full members of the team. What the government knew, they would know within the area relevant to contractors. And on board ship there were to be no second-class citizens. This policy was kept, and the only information withheld from top-level contractors (they were told in general terms what was being withheld) concerned primarily [redacted]. All information on the target and its value was explained, particularly on the nuclear weapons problem, and all questions were answered on this potentially hazardous situation. Later on, in the spring of 1975, after AZORIAN was blown in the news media but [redacted] this team spirit philosophy produced its rewards. Contractor personnel were offered money—as much as $1500—for stories, but none of the ship's crew succumbed. One man who was on the program as an office employee for four months did talk to the press at that time, apparently on his own volition. The team spirit concept also drew out of everyone involved an effort above and beyond the call of duty. Several hazardous tasks were performed and nothing extra was sought. Future programs of this nature could profit immensely from the application of the team spirit approach to security.

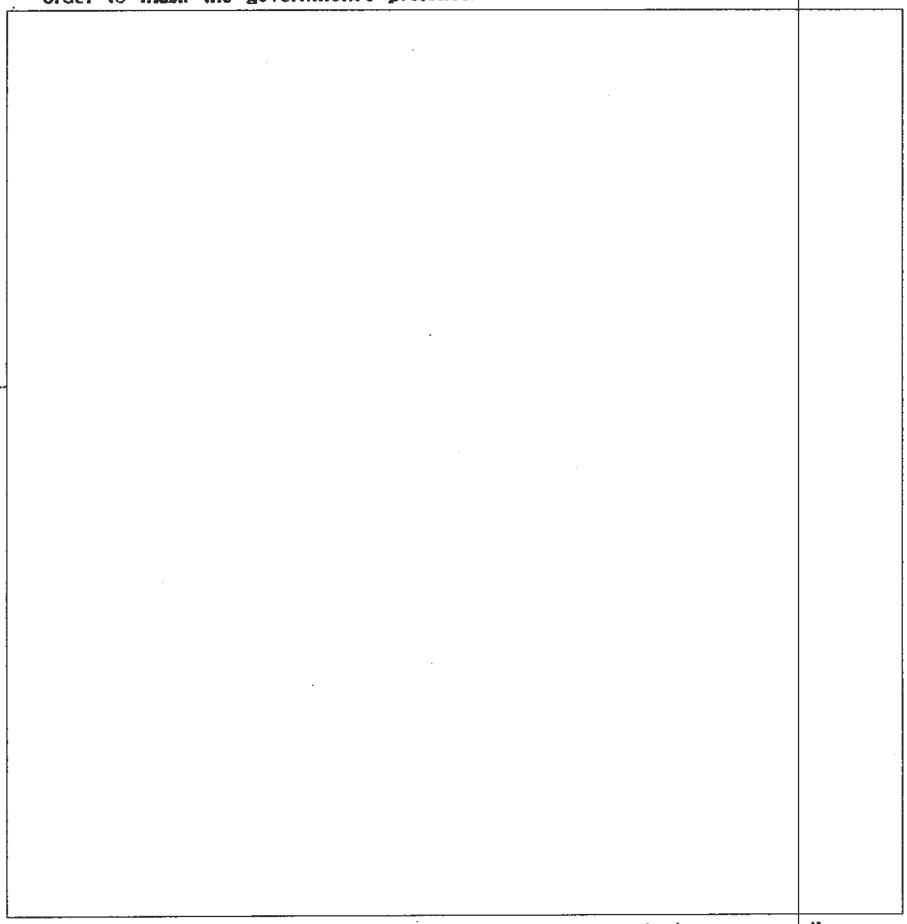
Security personnel handled almost all the briefings of people, both government and industrial, coming onto the project. The briefings were not just time-consuming; they were the first aspect of AZORIAN that newcomers encountered, and it was important that they be done right. Likewise, as people left the program, security officers gave them their final briefing. It was the last and, perhaps, most lasting impression people would have of the project. It, too, had to be done just right. Just one disgruntled individual, either as he came on the program or as he left, could blow AZORIAN out of the water. It is a tribute to the security officers that no such incident occurred.

During the design and development phase a more commercial flavor was coming into the program, and it became necessary to use individuals with industrial security experience. The program office [redacted] was staffed with a cadre of security officers [redacted] Others were hired and integrated into Global Marine and Summa (the successor to Hughes Tool.) The senior commercial security officer on the West Coast became the alter ego for the senior Headquarters security officer. Often these security officers were used as generalists and advisors to give commercial guidance on methods that should be used. The U.S. Government footprint was to be avoided while at the same time the government's seal of approval had to be obtained.

[redacted]

Hardware Acquisition

While management was preparing material for the never-ending reviews of the program, security was being burdened by a never-ending demand for security access approvals from contractors. Hardware acquisition was beginning, and that meant even more personnel involvement; operating crews for the *Glomar Explorer* were being recruited, and still more background investigations were required. All were being done by the Office of Security without showing government interest. To add to the load, the Agency technical, planning, and contracting officers were traveling more frequently to visit contractors. The work schedules had to be met; face-to-face meetings were required. It wouldn't do for the contractors to continually troop into Washington, D.C. The Agency people had to visit the contractors at their home plants or at neutral meeting places. Stringent security measures were required to permit these activities to occur without damaging cover. Every detail had to be examined in order to mask the government's presence.



Security provided support of all types to meetings that took place in cities all over the country. No task was too small or ignoble if it meant protection for AZORIAN. Many of these meetings were attended by very senior government officials as well as by senior corporate officials, some of whom were closely allied with Howard Hughes. The cover would never have held if meetings between officials at this level had

become public knowledge. Rooms, apartments, and meeting places were obtained.

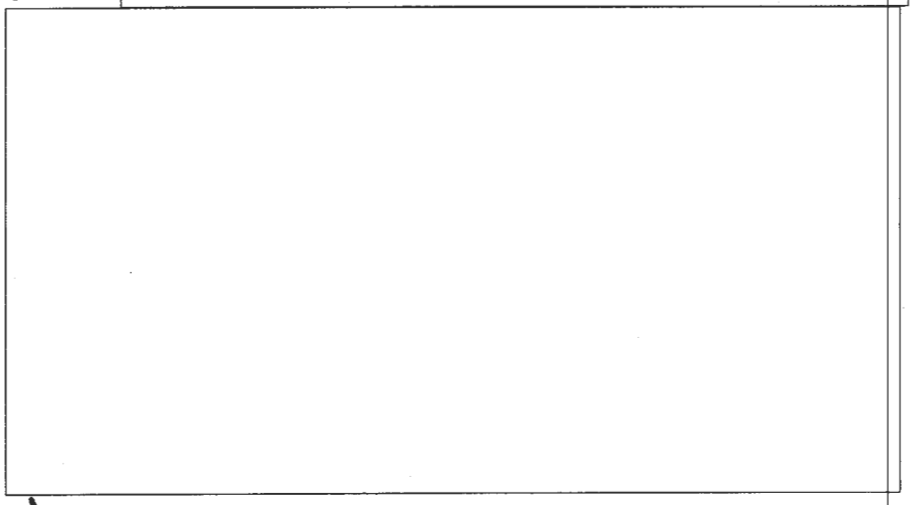
Security officers acted as chauffeurs getting the high and mighty as well as the not-so-high and mighty to meetings. They served as caterers, too, providing a food service so that meetings could continue through the lunch and dinner hours when necessary. Security handled the glamorous with aplomb, the mundane with professionalism, and the trivial with a smile.

Along with the steady flow of people around the country, there was a cascade of documents that required movement. In the government world, there were the usual security classification stamps. To move all these documents securely among the many contractor and government offices was an onerous task. This was made worse by the spate of aircraft hijackings that was taking place in the early 1970's. Security officers spent many hours in order to keep the information moving. The ability to move documents almost immediately was one more factor which helped to keep the program on schedule.

Testing

As the hardware took shape and became pieces of operating equipment, this equipment had to be tested, and government employees would be heavily involved in all aspects of the testing phase. They would be in charge of at-sea operations and also be members of the various working crews. There was also essential equipment to be loaded aboard which could not stand public scrutiny. For each problem the security officers devised a successful solution.

For those going on the *Glomar Explorer* it was the that offered protection.



[redacted]

Equipment that needed protection from disclosure also was put on the ship in a secure way. [redacted]

Government visitors to the ship during the at-sea testing phase moved under the constant and watchful eye of security officers. [redacted]

An extra hazard during the testing phase tried security's mettle. This was the labor strife at the pier stemming from the Marine Engineers Beneficial Association's attempt to unionize the crews working for Global Marine. The Global Marine management people were adamantly opposed to the union, and the case went to the National Labor Relations Board (NLRB), which scheduled hearings and pondered whether to conduct a union shop election among Global Marine's employees. The hearing process was long, tedious, and full of delays, and all the while CIA had to walk a tightrope and maintain a neutral posture. Global Marine was notorious for its swift firing of employees who did not meet management's strict standards, and some of the *Glomar Explorer's* crew were union sympathizers; on the other hand, unionization of GMI at this stage, and the imposition of hiring hall procedures, would complicate the background investigation process and crew selection. For a while the government considered taking the union leaders into its confidence and asking their help in preserving AZORIAN's security.

Two incidents particularly stretched the security officers' nerves during the proceedings: Early on, the union forces, including some strong-arm types, appeared at the gate to the pier and things got quite tense; the non-union crew members were not

shrinking violets either. The union gang slashed a few tires and strewed nails on the roadway, but the security people kept their cool and no fight erupted. Meanwhile, during a recess in the NLRB hearings, some union lawyers were heard to mutter that the DOMP was not what it purported to be. A union member was able to reassure the alarmed security officers that the comments were just so much hot air; there was no problem with the DOMP cover.

Finally, as the AZORIAN project neared completion, the NLRB hearings worked their own way to a conclusion, and Global Marine remained non-unionized. More important to the government, CIA had been able to preserve its involvement from public exposure without affecting the course of the labor negotiations.

Operations

The D-day for the mission approached rapidly. The Headquarters and program office members of security were working on the security annexes to the mission plans. All contingency situations had security connotations. There were casualty and accident plans to be drawn up. [redacted] How was the port call to be handled? [redacted] How was the crew change going to be conducted at either Midway or Hawaii? Security strategies and procedures for these situations were formulated and incorporated into the mission plans. Wives of the government employees going on the mission were given limited briefings concerning the absence of their husbands. Security officers were to be their point of contact if any of them had problems they couldn't cope with. There was flurry of last-minute activity which assured that mission readiness was achieved.

The mission director adopted the program manager's philosophy about the role of security in the program. On board the *Glomar Explorer*, the security officer was part and parcel of all management discussions, and no actions were planned without seeking this security officer's advice and counsel. In this way potential security problems were exposed and resolved before they became flaps.

During the mission one of the mundane jobs was the routine destruction of classified paper, most of it generated [redacted] This problem had first surfaced [redacted] The solution then was to hand-tear small amounts of paper into tiny pieces and dump them over the side [redacted] One night while the paper was being dumped the old axiom "don't spit into the wind" was relearned at the cost of anxious moments spent gathering up tiny pieces of paper from the main deck. A few weeks later while under surveillance [redacted] unclassified paper trash (mostly old invoices) dumped overboard by the Global Marine supply man was promptly collected by the inquisitive Soviet crew. Thanks to these lessons, the security officer aboard the *Glomar Explorer* had a paper shredder which he used to turn all classified paper into a powder-like material which was dumped overboard at night. He was also in charge of the emergency destruction procedures. [redacted]

[redacted]

The security officer worked with the ship's crew to be sure that the well area was secure from visual observation as well-as Soviet satellite surveillance. In his work with the crew, the security officer became the crew's morale officer, [redacted]

[redacted] His success in generating crew support and confidence was a very positive factor in keeping the crew together during the periods of Soviet surveillance and later on when the news media were on to the program.

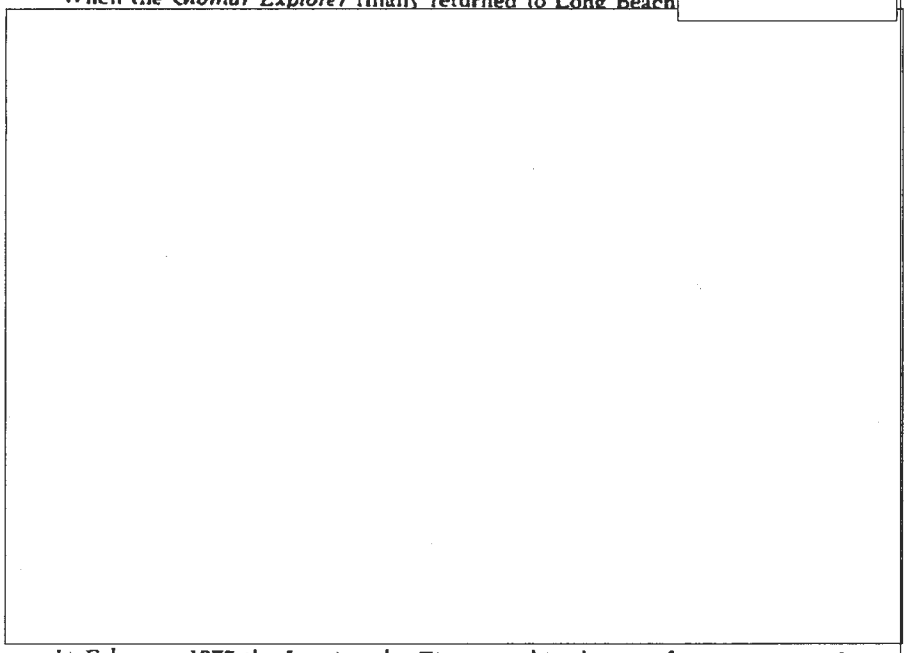
One of the hairier aspects of the on-board security officer's job was his intimate involvement in the precautions against any aggressive actions by the Russians. When the Soviet range ship *Chazma* was diverted from its homeward-bound course to give the *Glomar Explorer* a close-in examination, it was the security officer who directed the stacking of boxes and barrels on the ship's helicopter pad prior to the appearance of *Chazma*. [redacted]

The security officer was also charged with investigating any attempts by outsiders to penetrate the ship's security while at sea, a seemingly unlikely circumstance addressed seriously by the mission's contingency planners. Observing that it is customary for ships with doctors aboard to respond to calls for medical help from nearby vessels, it had occurred to the security planners that a suspicious or merely curious captain could fake a medical emergency to get some of his men inside the *Glomar Explorer*. And, indeed, a request for medical aid was received while the *Explorer* was at the recovery site from the British freighter *Bel Hudson*, which signaled that one of its crew had suffered an apparent heart attack. After some soul-searching deliberations, the mission director responded to the call and the *Bel Hudson* altered course to meet the *Glomar Explorer* and lay to. The doctor, a medical technician and the security officer went over to look at the victim who, it turned out, was in shock from a minor injury after a fall. He was brought back for treatment and in an hour or so was returned to the British vessel. The security officer was satisfied that the British captain's request was legitimate and that no penetration effort had been attempted.

While the mission was under way, Headquarters security personnel were caught up in the damage assessment of the robbery at the Romaine Street offices of the Summa Corporation. Eventually they had to call in the FBI, which in turn enlisted the Los Angeles Police Department in an attempt to get back a program-related document that supposedly was obtained in the burglary. The document never came to light, but the Romaine Street robbery and the LAPD's attempts to retrieve the document ultimately resulted in the *Los Angeles Times* story which first broke the cover of the program. [redacted]

When the mission ended [redacted] the security people had the task of returning a crew [redacted] and exchanging them at the island of Maui for a fresh crew. The exchange was effected without any erosion of the cover story, but [redacted]

When the *Glomar Explorer* finally returned to Long Beach



In February 1975 the *Los Angeles Times* combined in one front-page story four sure-fire attention grabbers: the unsolved Romaine Street robbery, Howard Hughes, the CIA, and the recovery of a sunken Soviet submarine. According to the *Times*, the CIA had attempted to recover a Soviet submarine from the depths of the Atlantic Ocean with a ship that Hughes had built with government money. The *Times* managed to link these rumors with a detailed recapitulation of the eight-month-old robbery of the Hughes office on Romaine Street in Encino, in which the burglars had made off with cash and "sensitive papers." Despite the obvious errors in the account, it focused the attention of other journalists on the *Glomar Explorer*. For a while DCI William Colby, by personally appealing to the senior managers of the nation's news media, managed to hold the line against further revelations, but in March Jack Anderson went on national television with his version, and the press floodgates were opened.

The *Glomar Explorer* was soon a fortress besieged as local, regional and national news people poured into the Long Beach area. Helicopters carrying network television crews hovered over the ship. Reporters frequented the Long Beach bars and tried all the arts and tricks of their trade to find knowledgeable sources and persuade them to talk. Waterfront hangers-on were plied with drinks and prostitutes were enlisted in attempts to buy crew lists. Crew members were pestered, badgered and propositioned. The security team gave repeated crew briefings on the dangers of any kind of conversation with people from the news media; their admonition was: "Don't answer any question, no matter how trivial, about the *Glomar Explorer* or its purpose." And the crew and other workers on the program responded by holding the line, even when the press got after their families at home or came at them directly with offers of substantial sums of money.

Only one internal breach marred the record, and security quickly tracked it down. A story appearing in the *New York Times* early in April 1975, though it contained much that was wrong and was designed to be provocative, revealed

information that must have been obtained from an insider. Clues in the story pointed in one direction, particularly an incidental reference to the issuing of a pair of boots to a new crew member. The logistics records were searched, the receipt for the boots found, and the leaker uncovered. He was an office worker who had been on the program only four months in 1974, resigning shortly before he would have been dismissed. He had not been on the ship, but he had a younger brother among the "B" crew, the one that had met the ship in Hawaii to relieve the recovery crew and help [redacted] Under the influence of his older brother, the crew member had discussed aspects of the mission, but it was the older brother who went to the *New York Times* with his own cockeyed, contentious version. Security could do nothing at the time except redouble its warnings to the crew members and everyone else connected with the program to maintain the "no comment" policy.

In 1978 the older brother struck again. He was the co-author of a book about the project, a book mixed with fact and fancy. Although he had signed a secrecy agreement, he had not submitted his manuscript to CIA for review as his secrecy agreements with the Agency required. So far, he has gotten away with the breach of his signed agreement and his word; to prosecute him, the government would have to reveal further classified information, define the factual material in the book, and thus compound the security breaches left ambiguous by the author's uninformed errors and inventions.

Other incidents occurred [redacted] The Long Beach Harbor Patrol had official access to the pier, and on one occasion a uniformed Harbor Patrol officer accompanied by a civilian drove to the gangway leading up to the main deck of the ship. The civilian jumped out and began to take pictures—a strictly forbidden activity—and then quickly drove away. Security, through the Global Marine superintendent, phoned the Harbor Patrol and explained what had happened. The Harbor Patrol authorities, chagrined, investigated and found the officer responsible for the intrusion. The film was returned undeveloped with an apology. The guilty officer allegedly was helping a college friend do a story on the types of ships in the Long Beach Harbor.

[redacted]

Security measures on the ship were increased in reaction not only to the press investigations, but to a wave of bombing threats in the general Los Angeles area. The concern for security was reinforced after a Catalina tour boat was targeted and destroyed by a radical group at a pier in the nearby Los Angeles Harbor. Howard Hughes and his reported relationship with CIA made the *Glomar Explorer* a natural target for the radicals, and security mounted a deck watch to warn of any suspicious approaches to the ship from the harbor channel. Anti-swimmer nets were made and kept handy on the main deck to be used against any swimmers approaching the ship. The guard force at the pier gate was increased, and packages, sacks or bags going on the pier had to be opened, inspected, and stamped by security. No explosives were going to go on the ship through either deliberate attempts or the duping of innocents.

Vigilance against Soviet observation and espionage was maintained. Russian ships were constantly docking at a pier directly across the channel. Precious little shipping activity seemed to be taking place around them, and as someone said, they probably [redacted] The opening of hatches which would expose the well area to photographic surveillance had

to have the approval of the security officer. Yet no overt or covert interest in the *Glomar Explorer* by the Russian ships was ever observed.

[redacted]

Phase-out

[redacted] There would be only one last trip to sea for the *Explorer* and its crew, and that would be for the purpose of a final clean-up [redacted] A few days prior to departure, the tax assessor of Los Angeles County slapped a tax lien on the ship fo[redacted] He had in effect seized the vessel and was going to put it up for sale at public auction on 27 August. The assessor sent a watch keeper to the pier to prevent the ship from departing. While he was watching the ship, the on-board security officer was watching him. The eyeball-to-eyeball confrontation was resolved within a day by the necessary legal maneuvers. The *Glomar Explorer* departed the pier on 20 August for her final clean-up.

Meanwhile, although the government maintained its "no comment" stance after the Jack Anderson expose' in March, the newspapers continued to trumpet the story, playing and replaying articles combining the wildest of speculations, inventions, half-truths, conjectures and fragments of the facts. In this they inadvertently served the security interests of the government, for it looked very much as if the Soviets were as confused about the mission's purpose and degree of success as were ordinary American newspaper readers. It was security's job to keep it that way; there was to be no confirmation or denial of any of the stories circulating in the press.

This became a delicate task as the program phase-out began. Crew members and other workers were laid off, since only a small maintenance force was to be kept on the ship. The debriefings by security had to be done in a way that would minimize the chances that employees would leave the program with a grudge against it; news stories could easily result from such sources. The debriefings were conducted professionally and with empathy toward the work force. No leaks to the press resulted from the crew roll-off procedures.

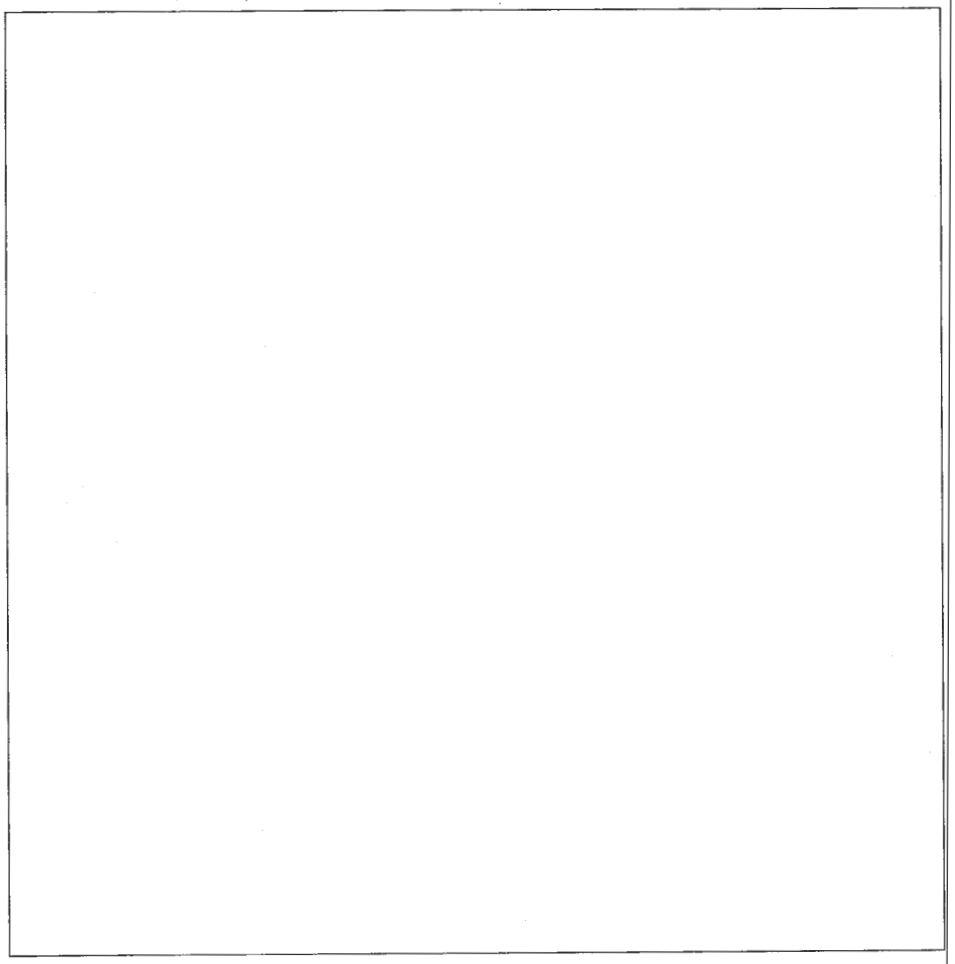
A serious effort was made to find alternate uses for the ship; the General Services Administration undertook this responsibility along with Global Marine, Inc. When tours of the ship were arranged for interested parties, it was security's job to make sure the critical spaces were avoided. The control center was the only major portion that needed protecting [redacted]

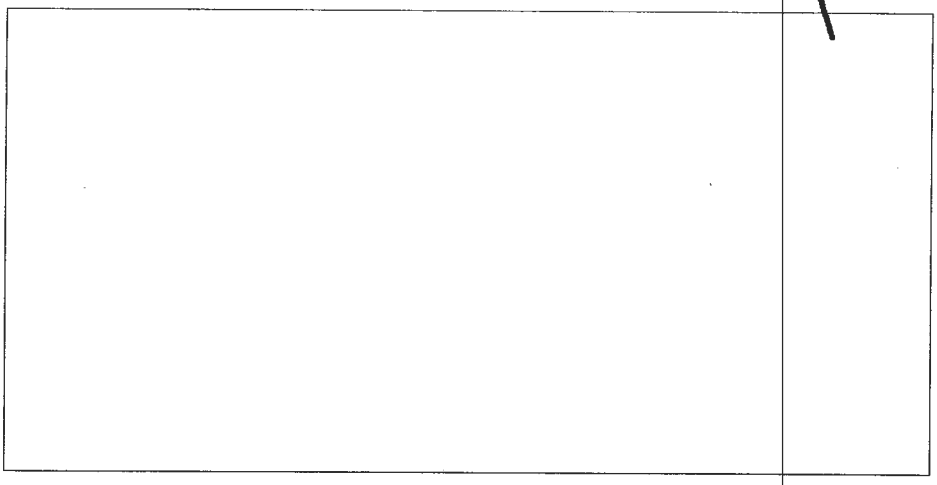
Global Marine was permitted to make a commercial movie about the *Glomar Explorer* in order to advertise its capabilities. Richard Anderson from the *Six Million Dollar Man* television series was the narrator. Again some glamour returned to the ship, and again security had to be alert to prevent any would-be movie stars among the

crew from making unauthorized film debuts. Also, certain areas of the ship had to remain protected from the camera's sweeping eye.

In November 1975 the government's on-board staff security officer was removed and replaced by a former employee hired on contract. By now the ship was in a configuration in which there was essentially no chance for erosion of security. Efforts to find alternate uses had not been successful, and there was little activity on board other than routine maintenance. Finally, when the U.S. Navy took over control of the *Glomar Explorer* and started the mothballing process a staff security officer returned to the ship during the turnover activities to conduct a physical inspection in conjunction with officers from the Navy and the Maritime Administration.

After a couple of years in mothballs, the *Glomar Explorer* was reactivated for legitimate deep-ocean mining tests. While the ship was in drydock for refurbishment some material was found in a remote part of the well that looked suspiciously like remnants of Soviet canned goods, either cabbage or carrots, left over from the exploitation of the submarine. The item was quickly and carefully sequestered by some of the ship's crew who had remembered their lectures on security and radioactive contamination. A team of experts was sent to examine the find. It turned out to be non-radioactive sauerkraut of U.S. origin.





Valediction

It has been said that a program designed to have no risk has the best security. Too often this implies no action and no results. AZORIAN was a high-risk program, full of action and results. The security afforded it was the best.

This entire article is classified SECRET NO FOREIGN DISSEM.

In March 1968 a Soviet submarine was lost with all hands 16,500 feet below the surface of the Pacific Ocean. On 8 August 1974 [redacted] *that submarine was brought to the surface in the* [redacted] *a recovery system designed and developed specifically for that mission. The story of Project AZORIAN was told in Volume 22 Number 3 (Fall 1978) of* Studies in Intelligence. *This article, the last in a series, recounts, in language understandable to the general reader, the technological marvels that were the essence of the project.*

ENGINEERING FOR AZORIAN

[redacted]

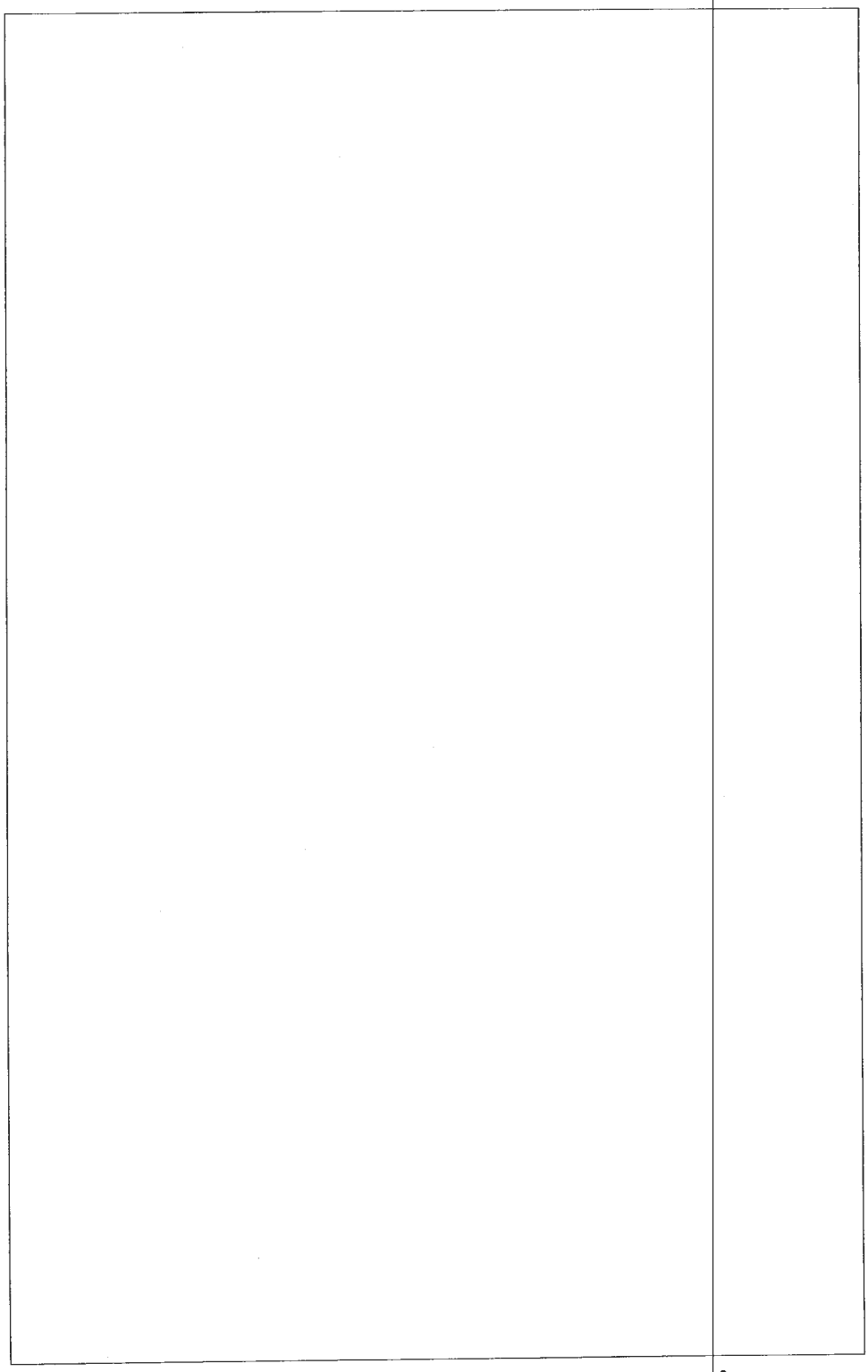
The engineering aspects of the AZORIAN program were a challenge which many thought rivaled that of a space program. It had been said that we knew more about the backside of the moon than the bottom of the ocean. Now the CIA engineers and management were being asked to undertake in an unstudied abyss an engineering marvel: in one gigantic effort, pull an estimated 3,920,000 pounds of wrecked submarine out of the ocean bottom and lift it intact over three miles into a surface ship. Never had such a feat been accomplished. CIA was being tasked to do it in not only a poorly understood environment, but also in record time. And no one was to know about it. If the United States could get its hands on the Soviet submarine's code books and machines, the nuclear weapons, the strategic plans, and . . . well, it was just plain too good to be true. Their potential value was inestimable. To have it all tomorrow would hardly be soon enough. These were the pressures CIA felt, especially the line managers and engineers.

There is no way to describe the engineering for Project AZORIAN without bringing in facts and figures. To many people, this promises to be dull, boring and tranquilizing. Yet to ignore them leaves a gaping hole in the AZORIAN story. For it was these very facts and figures, so fascinating to the engineer and so fearsome to the layman, that proved the project's feasibility. They and the engineers who made them a reality were the true underpinnings of Project AZORIAN.

Feasibility Studies

Because the target was judged to be of great value to the intelligence community, the higher echelons of the U.S. Goverment had decided it was a "go" situation before the technical feasibility studies were completed. Those were the days in which it was assumed American technology could solve any problem. The Agency engineers studied three methods of lifting the target: direct lift; trade ballast/buoyancy; and *in situ* generation of buoyancy. [redacted]

[redacted]



[redacted] The original *Studies In Intelligence* article describes these early efforts and recounts the story of the program in detail.

Impinging on the feasibility studies was the fact that the recovery system was to be used in a one-time effort. There was no way in which a full-scale test could be run within the time, fiscal, or design constraints. To design, build, and test the recovery and lift equipment for multiple use would have increased the costs to an unacceptable level. AZORIAN would be a single-shot, go-for-broke effort.

To turn a "go" situation into a "go" decision for the U.S. Government, three fundamental questions needed to be answered. One of the answers was provided early in 1970 by the drilling ship *Glomar Challenger*, operated by Global Marine Inc. for the National Science Foundation. The question was, "Can a large surface ship maintain a position accurately enough at sea in order to lower a string of pipe to an exact geographic position on the ocean bottom?" The answer was a resounding yes. The *Challenger* rig had drilled a hole in the deep ocean floor, withdrawn the drill bit, and then successfully re-entered the hole. This feat required maintaining the surface ship within a circle whose radius was of the order of 15 feet.

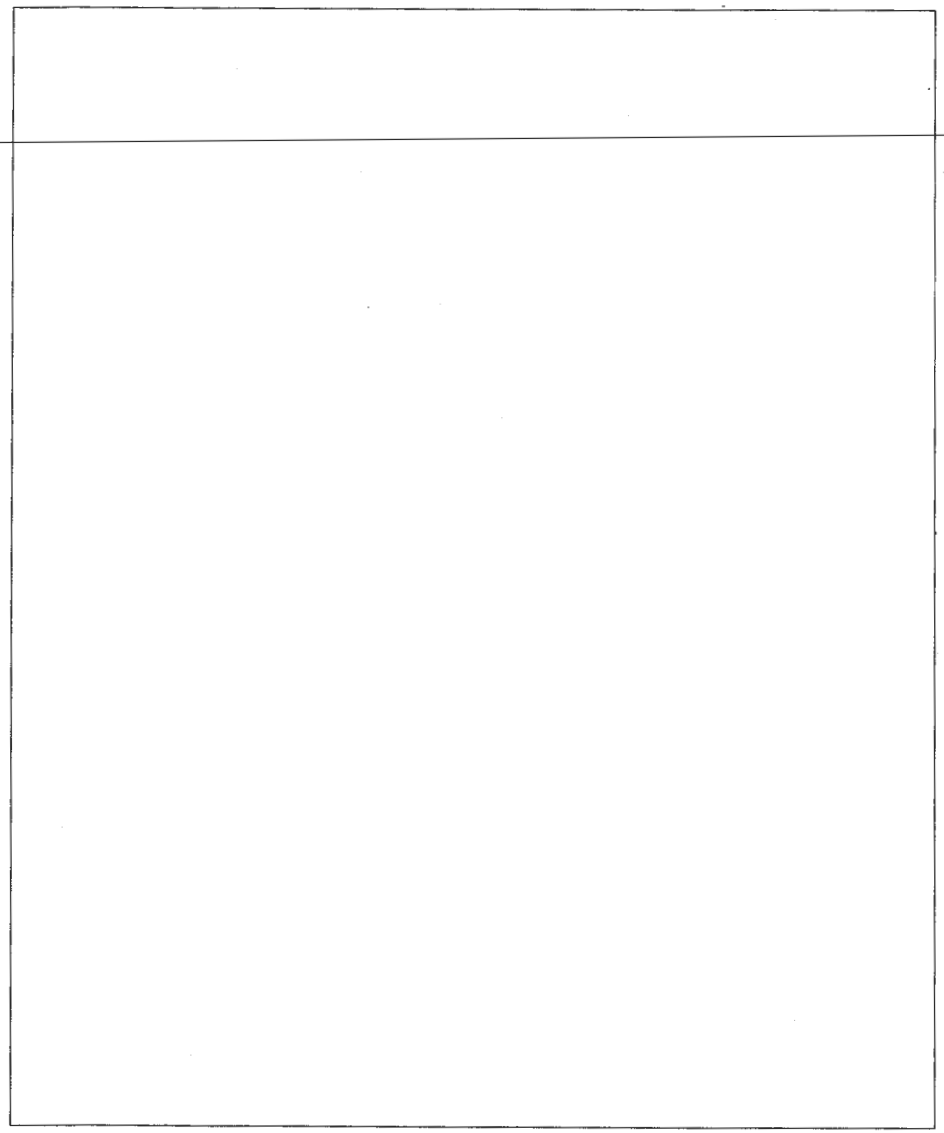
The other two questions involved the heavy lift portion of the recovery system, in particular the heavy lift pipe. One question concerned the ability to make pieces of pipe of the requisite strength and quality in large numbers. The other concerned the effects on the ship and its drilling platform if the pipe string should break while under maximum load. This could transform a controlled, 17-million-pound, relatively static load into an uncontrolled dynamic one. Or, as the Deputy Director, Research and Engineering for the Department of Defense (a nuclear physicist) stated when first advised of the magnitude of the effect, "That's the energy equivalent of setting off a nuclear explosive of 8 kilotons." Needless to say, such an analogy did not lessen the concerns of management. Satisfactory answers to these questions and others were not in hand in the early days. They were arrived at later. But the lack of answers at this time did not stall the program, thanks to an important decision made by management.

A Courageous Decision

The project managers made a key decision in the fall of 1970: design and construction of the hardware would proceed on a concurrent basis. Several factors led to this decision. There were perishable aspects to the program including the cryptographic material being sought, the cover and the security. The yearly two-month weather window for the operation also was a factor. A delay of two months in the design and construction meant a 12-month slip in the operation. A delay of this magnitude would add maintenance costs to the program and magnify the chances of cover and security erosion. Nothing was simple; all factors were inextricably tied together. With the knowledge available at the time, the only prudent decision was to go ahead on a concurrent basis. To wait until all technical risks were resolved would mean not only more dollars, but perhaps no mission at all.

In October 1970 the engineering staff faced 11 major unknowns or technical risk areas. Problems existed in all elements of the program and included such basic items as the exact dimension and condition of the target, the ship design, the working machinery to provide the lift capability, the pipe string, [redacted] The unknowns and their individual solutions presented a frightening array of interfaces still to be resolved.

Four to eight months for each of the 11 unknowns were estimated as necessary to get better definitions; they totaled 60 months in all. If the engineers had to wait for a



sequential resolution of each of the risk areas, at least three to four years could be added to the schedule. Furthermore, the entanglement of each of the items with all the rest meant that a solution to one affected all the others. No final solution could be obtained until all were resolved. The only way to handle the situation was to start the design and construction on a concurrent basis, recognizing that changes would have to be made and that the designs would have to be kept flexible to accommodate them. In fact, senior management at the national level recognized that in some cases we might have to build the hardware in order to resolve the problems; design alone would not be able to do it. This proved to be prescience of the first order with regard to the pipe handling system and also the ship itself.

The concurrent design/construction philosophy that kept flexibility in the program paid off handsomely in an area that was not fully anticipated in the fall of 1970. [redacted] To fit the target inside the ship required that the well be widened, which in turn added 10 feet to the beam—the width—of the ship. While this caused a dollar increase in the program, the other alternative would have been more costly. [redacted] In this aspect alone, program costs would have been greater than those under the concurrent design/construction philosophy because of the additional year of program activity.

It took a high order of vision and courage for the program managers and engineers to go with the concurrent design/construction philosophy. They recognized that it would mean changes and cost increases from the baseline of October 1970, and that they could incur ex post facto criticism of their decision. But they made the decision, they stuck to it, and it proved vital to the program. Without it, the project might have died in birth or incurred costs far in excess of what they turned out to be.

Engineering Organization

The interwoven and potentially chaotic engineering responsibilities for design and construction were managed by a four-level planning structure (see Chart). The highest level (0) was the over-all recovery system, the totality of the hardware. The next level (1) contained the four principal hardware systems and contractors, which were the surface ship system (Global Marine), [redacted] the pipe string system (Summa/Hughes Tool Co.), [redacted] These were broken down into their major components for the next lower level (2). For example [redacted] Finally the lowest level (3) to be controlled by CIA project engineers contained the major components of Level 2. Obviously, the levels could go on *ad infinitum*, but it was concluded that major decisions would not go below Level 3; therefore, the lower levels were supervised by contractor engineers under the direction of Agency engineers.

Project AZORIAN was managed by the [redacted] of CIA's Directorate of Science & Technology. Within [redacted] the engineering group was headed by [redacted] His deputy was [redacted] who later took part in the mission as Deputy for Recovery. [redacted] staff comprised only seven additional engineers, an incredibly small number to manage this complex and costly system. Needless to say, each of them was "a rambling wreck and a helluva engineer."

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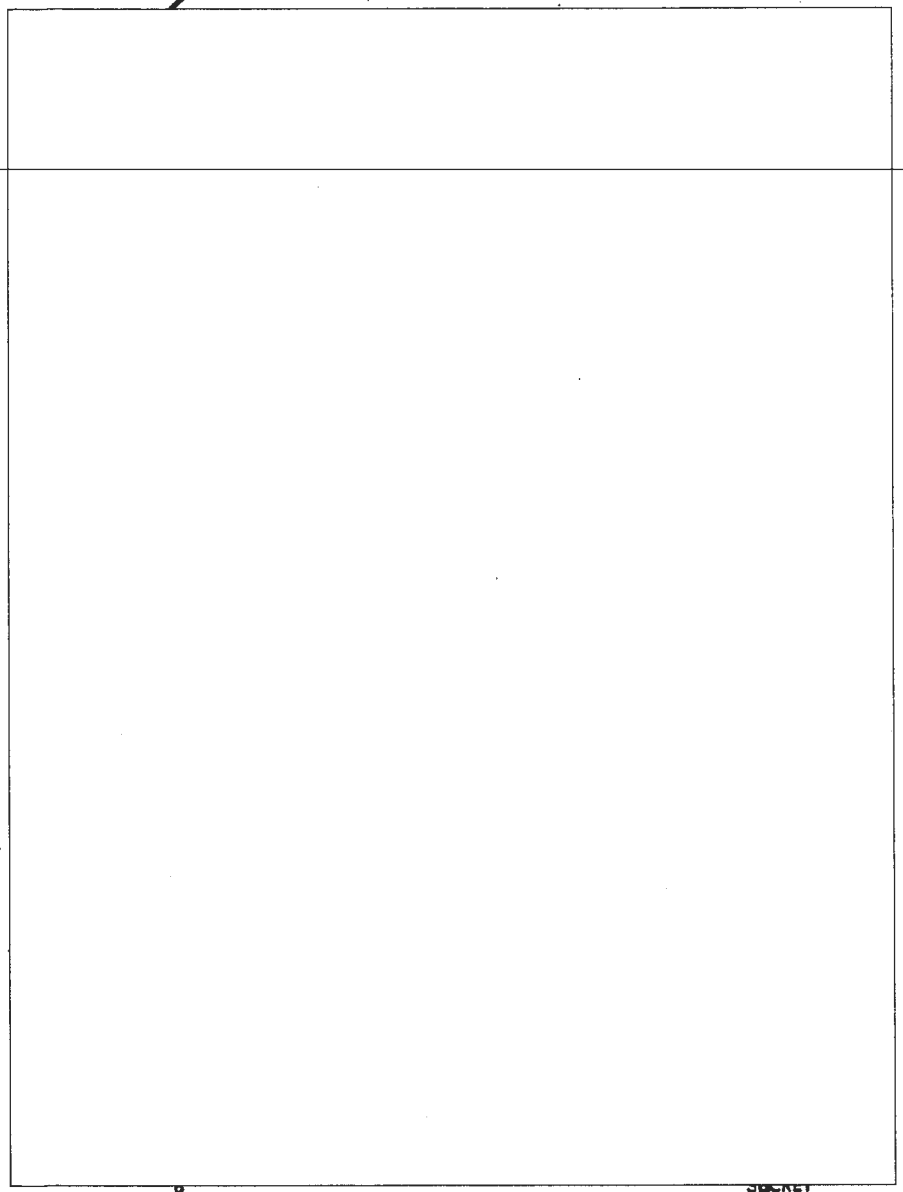
Engineering for AZORIAN



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The Surface Ship

The *Hughes Glomar Explorer*, or as it come to be known, the HGE, was created from the vision in one man's mind. John Graham of Global Marine was the chief designer and supervisor of construction. It was the culmination of his career as a naval architect. For anyone who had anything to do with the design and construction of the HGE, John was the hub around which all engineering activity took place. A man who was often frustrating to work with, he was nevertheless single-minded in his efforts to construct a ship that would do a salvage job heretofore believed impossible.

a. **Requirements**

Stated simply, the requirement on the surface ship system (the HGE) was to pick up 3,920,000 pounds (1750 tons or the equivalent of a World War II light destroyer) from the ocean floor, lift it over 3 miles to the surface, and place it within the bowels of the ship. [redacted] All this was to be done covertly. The HGE had to provide space [redacted] It also had to provide berthing for the [redacted] crew for up to 100 days at sea.

These general requirements were translated into detail lists of very specific design requirements for each of the lower system levels. To give some flavor of what these requirements were like, two examples are presented:

Ship Underway

Sea State	Storm conditions with significant wave height of 103 feet
Wind Velocity	100 knots
Temperature	40-105°F
Pitch	15°
Roll	60°

Static Hold (Fail/Safe While Lifting Target)

Sea State	12 foot sea, 18 foot swell
Wind Velocity	50 knots
Temperature	40-105°
Pitch	15°
Roll	22°
Heave	32 Feet
Drill Floor	
Gimbal Pitch	10°
Gimbal Roll	17°
Heave Compensator	14 Feet Working
Dead Load	17,750,000 Lbs.
Live Load	19,750,000 Lbs.
Overload (Max.)	29,800,000 Lbs.

Lists similar to these two examples were compiled for each of the sub-systems which, in total, comprised the surface ship system. Besides being interwoven among themselves, these requirements were also tied into all the other requirements of the other Level 1 systems.

b. Construction of the HGE

During the spring of 1970 contractors were being selected to design and build the major elements of the HGE. Global Marine, because of its experience as a ship designer and fleet operator in offshore and deep ocean activities, was selected to design and build the HGE with a subcontract to Sun Shipbuilding and Drydock Co. The initial visual assessment of the Sun Shipyard in Chester, Pa., was made from a Metroliner as it rumbled close by enroute to Philadelphia. The lift system was done by Global Marine with a subcontract to [redacted] Global Marine also became the total system integrator. The success of the *Glomar Challenger* was another factor favoring the selection of Global Marine. They had designed, built and operated this ship for the National Science Foundation. She had an outstanding record of service and had been a huge scientific success.

By mid-1970, with the heavy lift systems concept defined, total system design was initiated. The concurrent design/construction philosophy required continual compatibility assurance among all the elements and extremely accurate initial design weight estimates. Rigid weight budgets were placed on the massive machinery of the lift system. Equipment was being sized relative to the estimated weights of the target [redacted] 16,700 feet of drill pipe. Any erroneous estimate resulting in a major hardware overweight could stall the lift system, which would not be tested under full load until the mission. As it was, and in spite of some increases and some decreases, the system element weight estimates proved accurate in terms of the total lift. The estimated weight of the target proved conservative.

Although system design continued into late 1971 with the publication of the major element specifications, a few long lead-time items were ordered starting in November 1970. Major long lead-time procurement began in March 1971. This included materials (steel) for the ship hull, ship center well, A-frame, gimbal platforms, gimbal bearings, and the 5-foot-diameter by 20-foot-long heave compensation and heavy lift system cylinders. These latter items required from 15 to 18 months lead time and were needed for installation in the fall of 1972.

One problem incurred in the procurement cycle was the "Buy American" policy. A very few small items [redacted] were available only from a sole source. Two major procurements were a more severe problem and required the appropriate permission to buy foreign. [redacted] Adding spice to the latter case was the delivery of the cylinders [redacted] by a Communist bloc freighter.

The major elements of the system were already undergoing bid evaluation and vendor selection during late 1970 and early 1971. [redacted] This required widening the center well of the ship from its 69-foot width to 74 feet. This, for geometric, structural and stability reasons, increased the beam from 106 to 116 feet (now making passage through the Panama Canal impossible). The ship's length was also increased to 589'-7" at waterline or 618'-8" overall. These dimensional changes were driven as much by stability requirements as by geometric and structural considerations. Without them, the ship's self-righting capability when it rolled in heavy seas under worst-case loading conditions would be marginal. Worst-case loading would occur at the beginning of target recovery after the target had been freed from the bottom, with the combined total load estimated at 16,300,000 lbs. hanging off the gimbal platform 100 feet above

the waterline. Anti-roll tanks also were incorporated in the ship's design to further improve stability in heavy seas.

By late 1971 work on hardware for all the major elements of the ship system had started at the same time the engineering specifications were being completed. The ship's keel was laid on 16 November. Final designs were frozen after confirmation and re-confirmation through simulation, analysis, and model testing.

The builders of the heavy lift system were well into testing components and systems during the spring and summer of 1972. When one of the lifting yokes failed under a proof load, metallurgical and structural investigation of the failure dictated a change from the T-1 steel specified by the designers to the more forgiving HY-100 steel. The tests surfaced this problem in time for two new HY-100 yokes to be built and delivered to the ship for installation without seriously disrupting the schedule.

Other major equipment was arriving at the Sun Shipyard by fall 1972 for installation as the hull neared completion. On 4 November 1972 the ship was launched, installed briefly in drydock to have its false bottom removed and the well gates installed, then tied dockside for resumption of equipment installation. Figures 3 through 10 depict construction activities during this period.

The intense activity at the Chester, Pa. shipyard and the pace of related construction programs were reviewed weekly by managers meeting in nearby Philadelphia, where they charted current progress, determined what corrections were

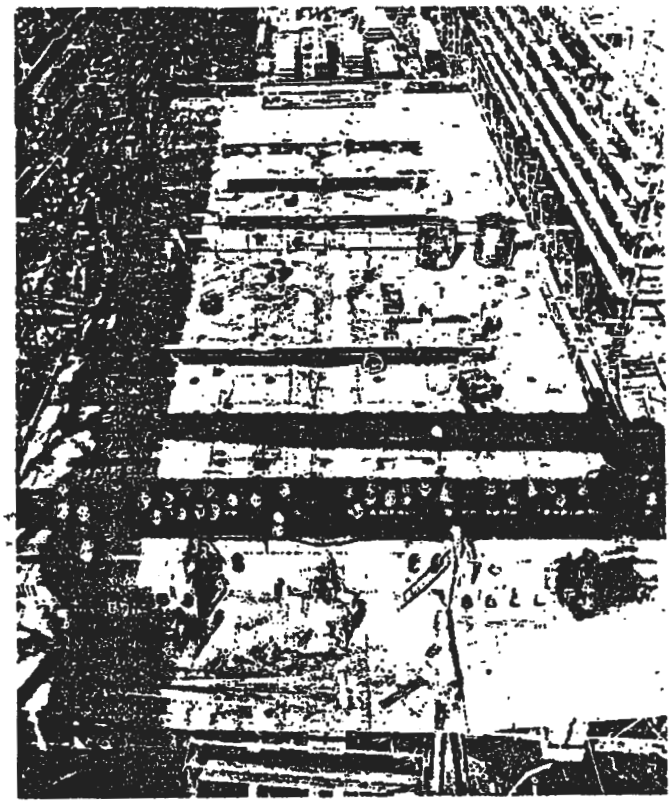

Figure 3. The first stage of construction—laying down the docking well gates

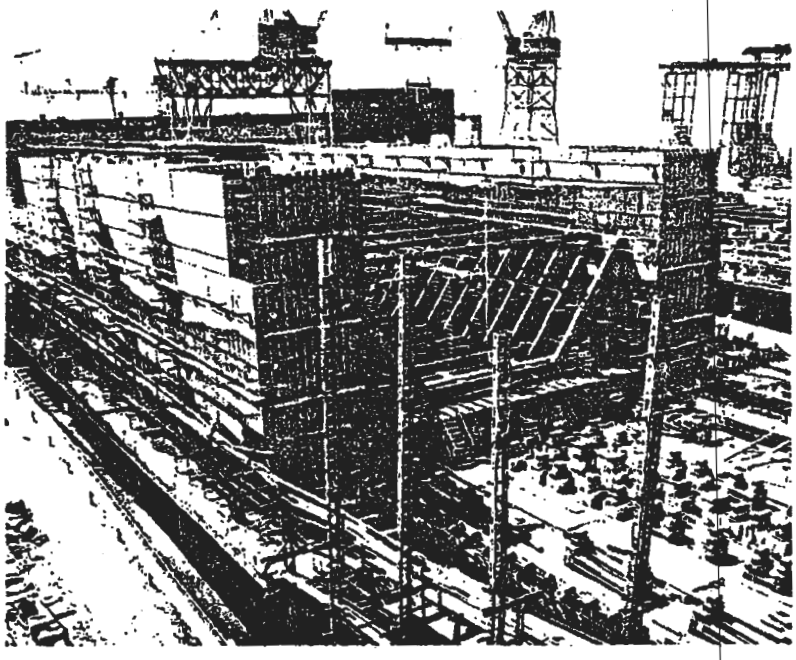

Figure 4. Wing walls going up from the gates and forming the sides of the docking well

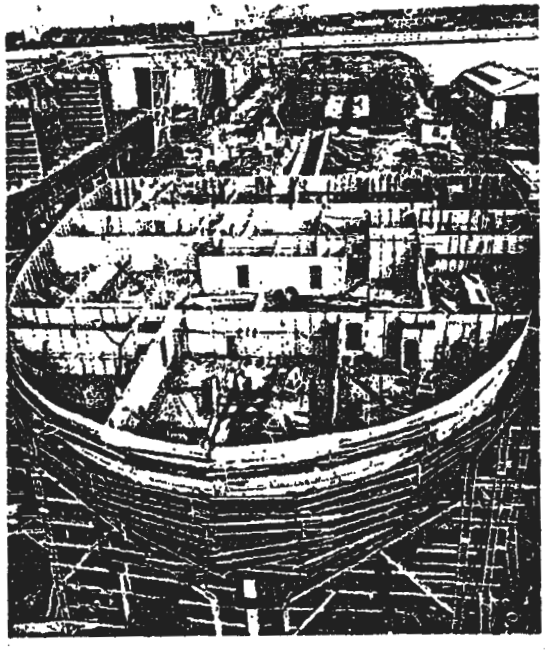

Figure 5. Interior construction looking forward from the stern

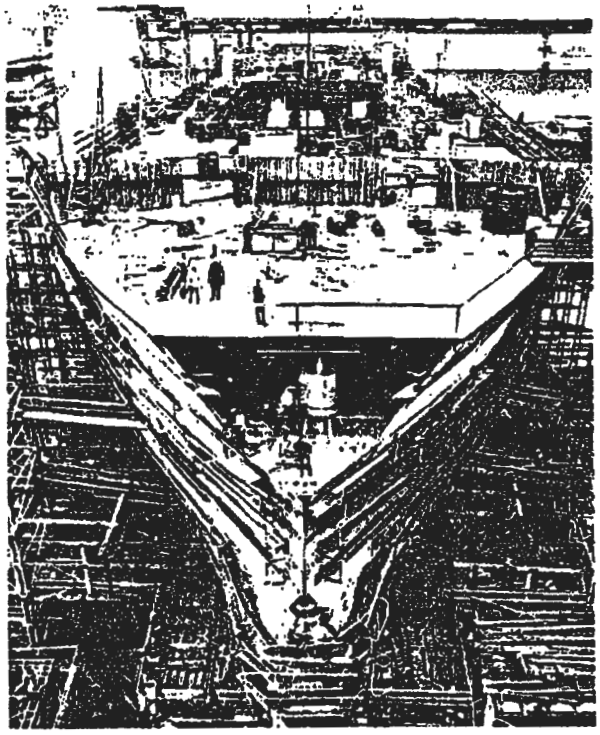

Figure 6. The bow in final stages of construction

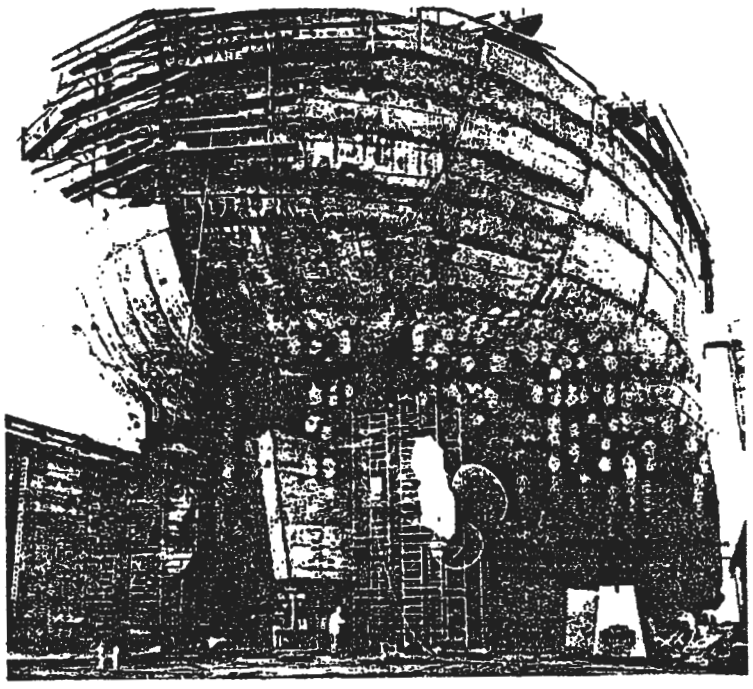

Figure 7. A view of the stern showing the twin propellers

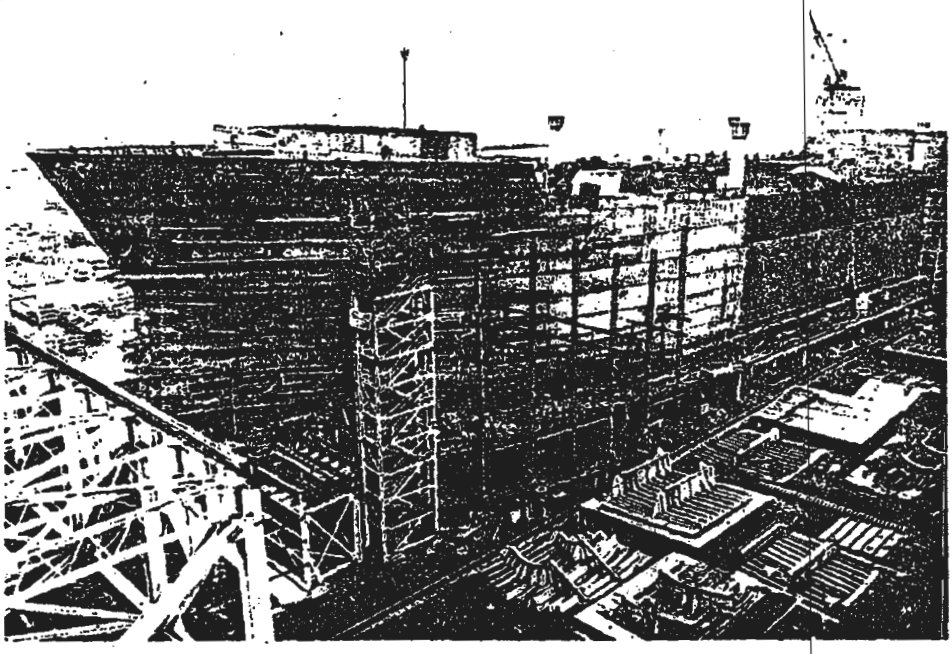

Figure 8. Final hull work including painting

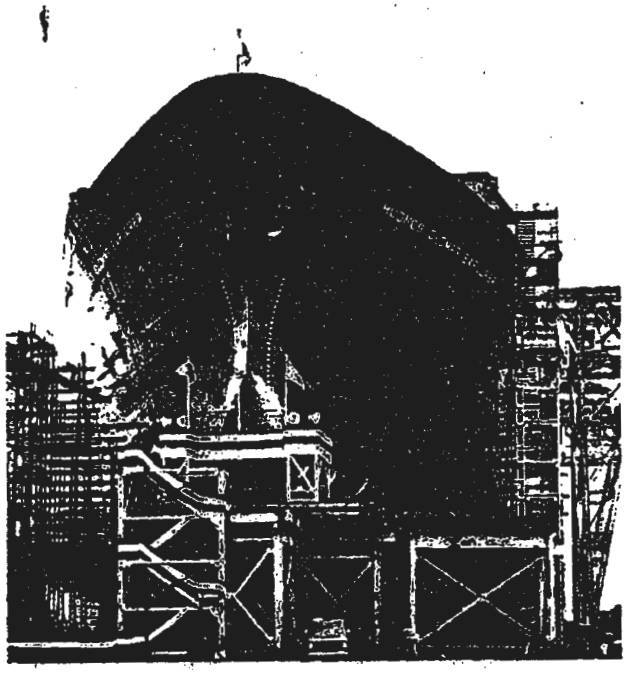

Figure 9. Almost ready for the launching ceremony

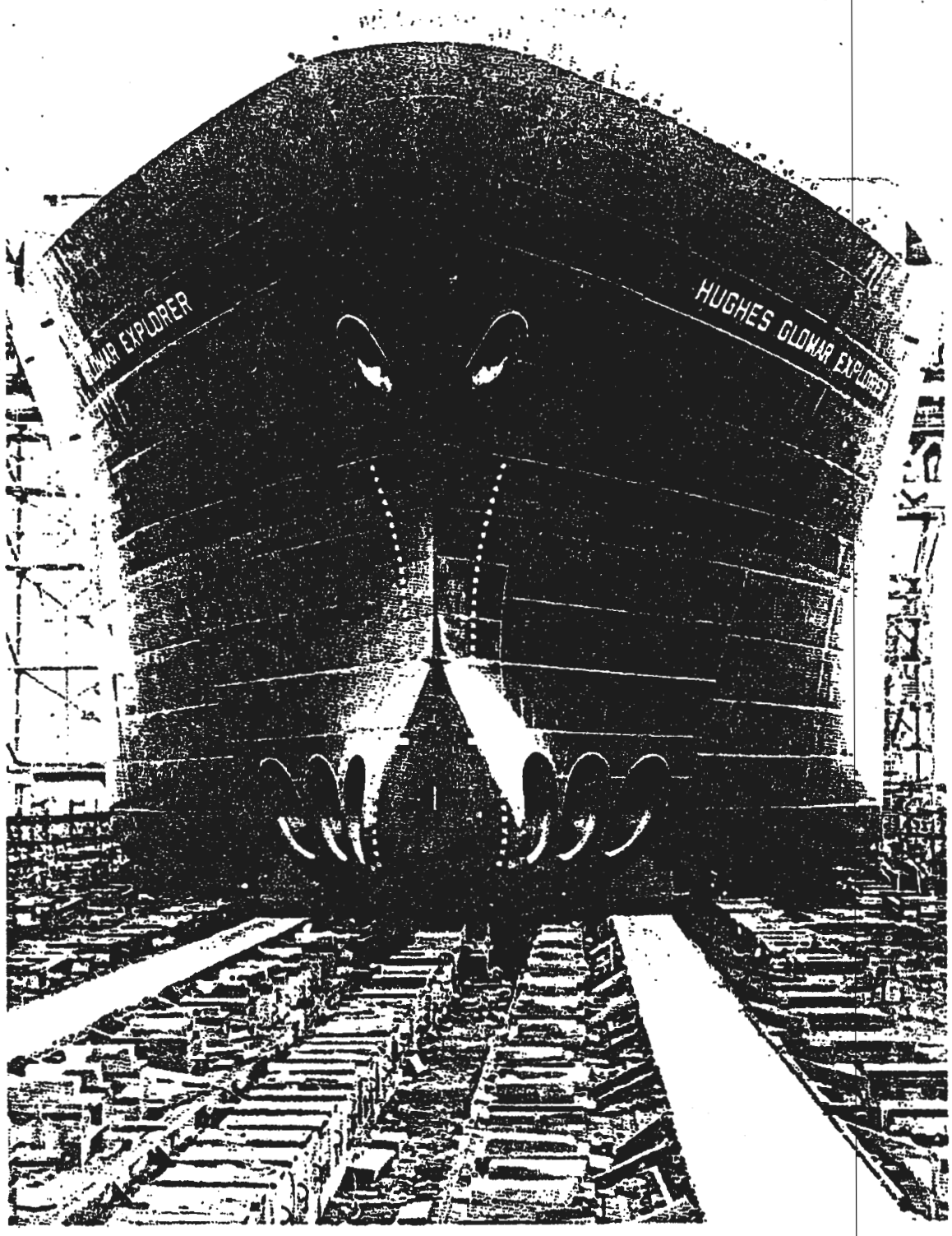

Figure 10. Sliding down the ways

necessary, and passed these on to all program managers. After each session, detailed scheduling meetings would be held the next day at the shipyard to focus on the progress and problems of the HGE.

By January 1973 the HGE engines were running and shore power was disconnected. The 800 tons of gimbal platforms and bearings, which had been concurrently pre-assembled pierside, were installed on top of the shipboard heave compensation cylinders with the Sun 800 barge crane (Figures 11 thru 14). The Sun 800, specially constructed by Sun for this lift, was the largest capacity (800 tons) barge crane on the East Coast (Figure 15). Later, because the ship's derrick was too tall to pass under the Delaware Memorial Bridge, this crane followed the HGE downriver to set the derrick aboard after the ship had cleared the bridge.

It was a busy time and the headquarters engineering representatives found themselves more often at the shipyard than anywhere else. The magnitude and complexity of the installations were greater than the initial shipyard estimates—more manpower and more time were being consumed. Continued meetings were held with shipyard management in an effort to keep electricians, pipe fitters, mechanics, welders, and their foremen working on board the HGE in the face of stiff competition from other ships also under construction. It required the clearance and briefing of a Sun Shipyard vice president (he was also the production manager) to improve the situation.

During February and March 1973, installation of major recovery system component plumbing, wiring, and lift system control equipment continued. The

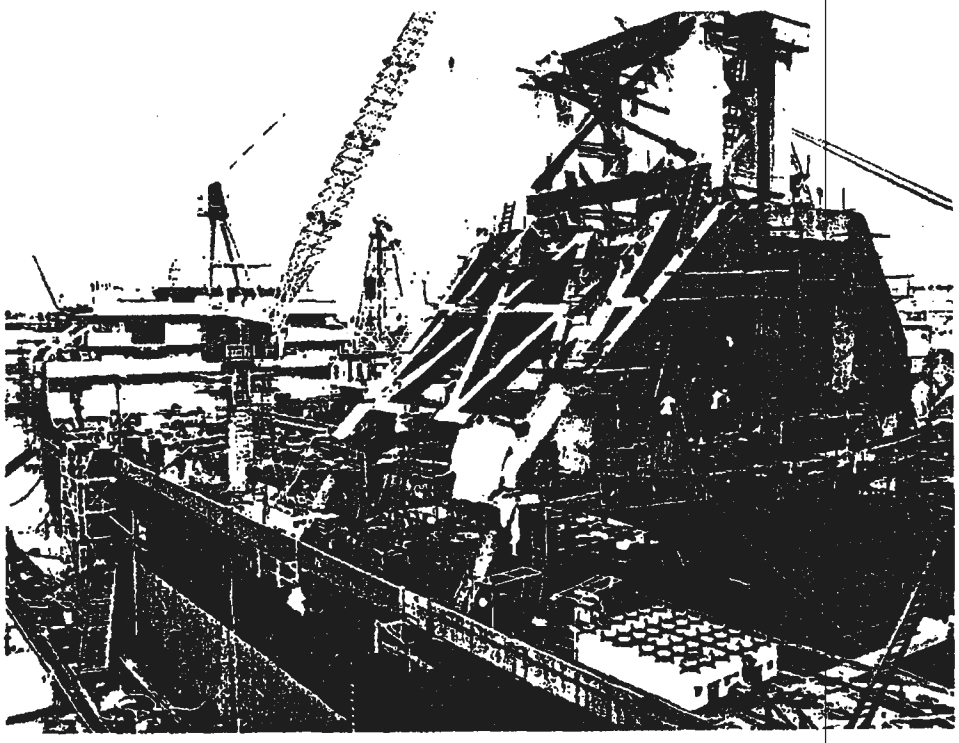

Figure 11. A-frame structure which provided the load path from the lift system to the ship

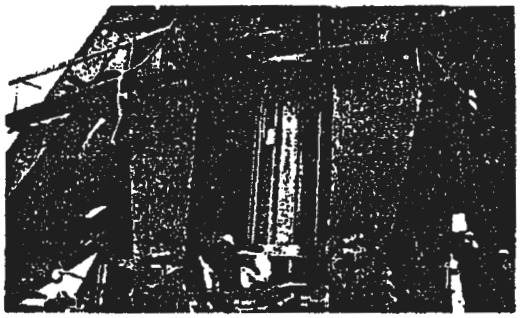

Figure 12. Aft heave compensator cylinder. This is one of the shock absorbers which removed the up-and-down motion of the ship from the recovery mechanism.

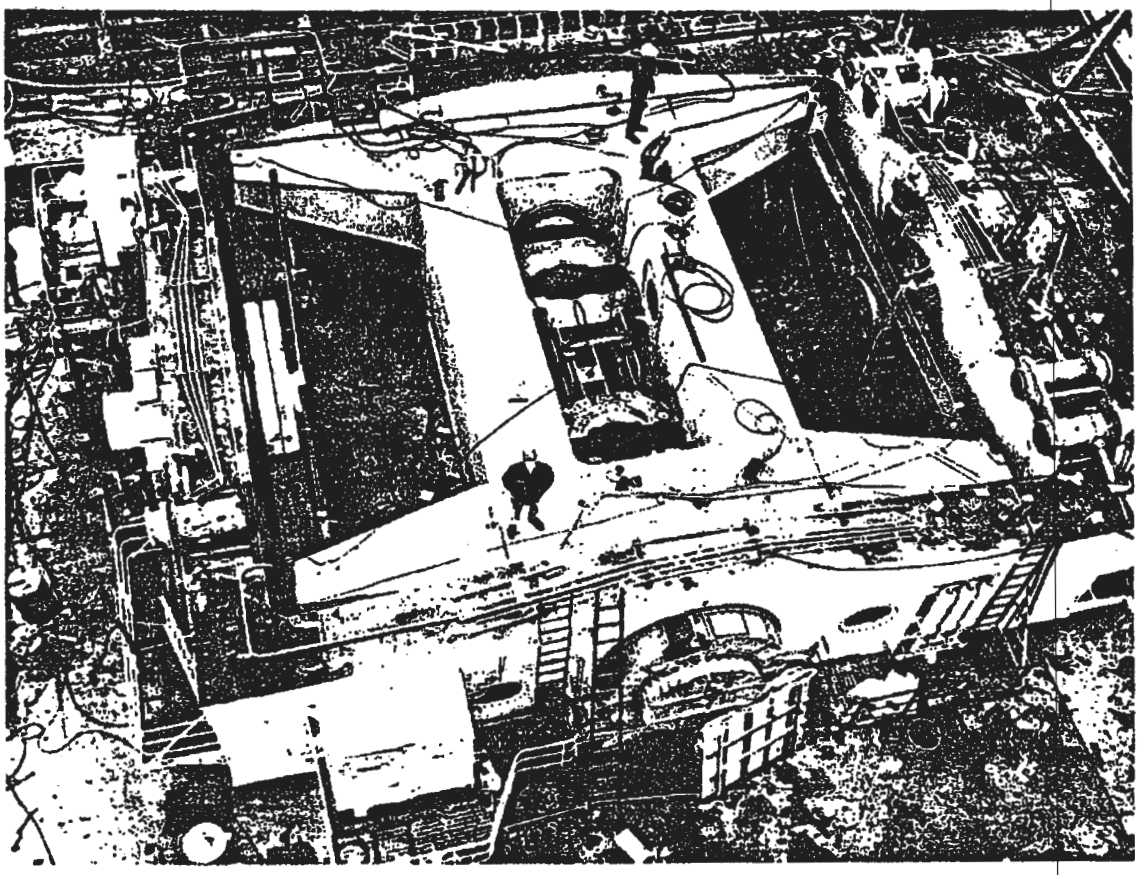

Figure 13. Inner and outer gimbals which removed the roll and pitch motion

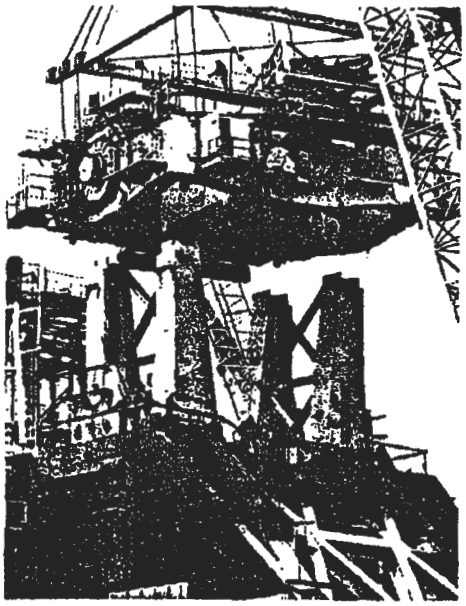

Figure 14. Gimbals being set on the A-frame

docking legs were installed and welded. The rig floor had been installed and was receiving equipment for the draw works. Coast Guard representatives were following all activities. Tie-down castings were installed in the well floor. These would later be changed to weldments* because the porous castings absorbed leakage from well-gate ballast. The balance of shipyard effort was devoted to dock trials of basic ship's systems in preparation for the builder's sea trials on 12 April.

The period after builder's trials (which were successful in demonstrating the intended basic ship's systems) from mid-April to 24 July 1973 marked the completion of the recovery system installation and the initiation of its dock trials. After extensive hydro-testing to 4500 pounds per square inch and rework, the heave compensation system held pressure. The piston rods with their yokes supporting the 800 tons of gimbal platforms and lift system finally made the 15-foot trip up the guides from full low to full high position and back down again, The heave compensation system had completed dockside checkout.

Like the heave compensation system, the heavy lift system required several cycles of hydro-testing, repair, and retest before the system held pressure. The flanged joints were a particular concern. Their surfaces had to be perfectly machined and aligned in order to hold the proof test pressure of 4500 psi. After considerable rework, this system held pressure and was ready for final dockside test. Finally both sets of the lift cylinders with their rods and yokes were stroked 15 feet, but not without damage to the upper yoke. An out-of-synch condition between the two piston rods caused the yoke to tilt and bear against one of the rods. Metallurgical and structural assessment showed the damage was repairable and the yoke stiffener plate was repaired in place.

With completion of the stroking, the lift system testing had progressed as far as was feasible while the HGE was still dockside. Little shipyard testing was done on the pipe handling system because of the intensive shipyard activity on other systems. In

* Weldment: structure formed by welding individual pieces of steel into a desired shape—Editor.

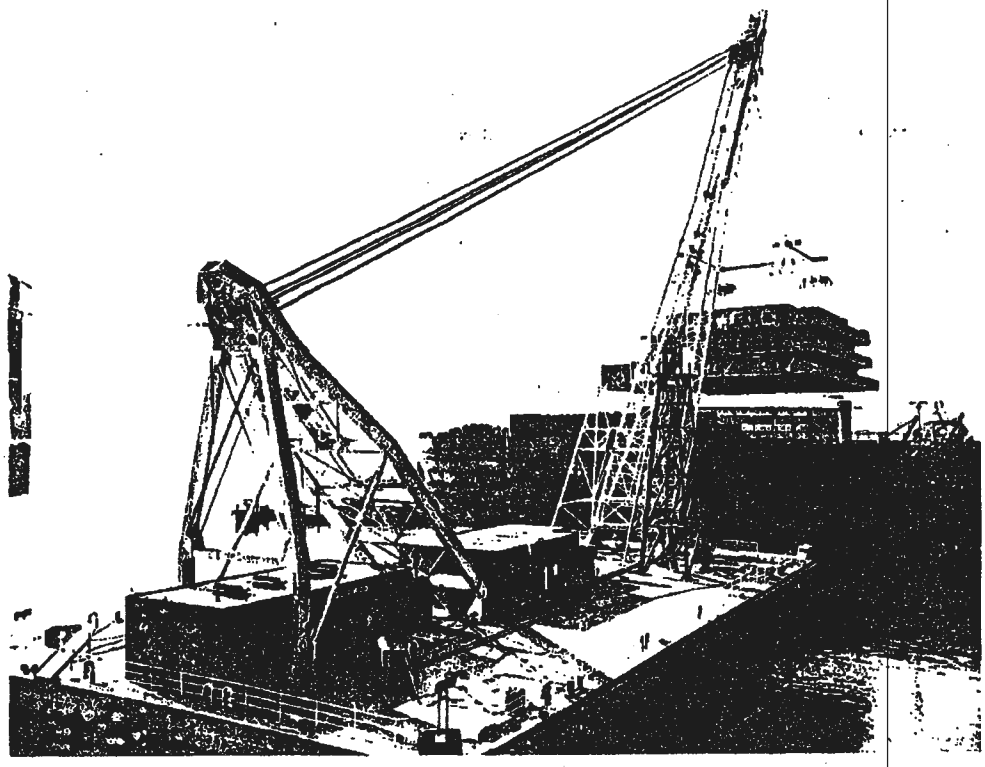

Figure 15. The barge crane, Sun 800, lifting on the prefabricated aft deck house

fact, there was nothing more at all that could be done in the yard, and the HGE departed the Sun Shipyard on 24 July 1973 for further sea trials (Figure 16). Construction of this remarkable ship had been completed in the equally remarkable time of 20 months after laying of the keel.

[redacted]

c. HGE Technology and Cost

The HGE and its associated sub-systems created a number of significant technical achievements and breakthroughs. The ship was the first one to be designed and analyzed using finite element analysis (approved by the American Bureau of Shipping). It had the largest (199 feet by 74 feet) center well with movable gates. The 24,500 horsepower diesel electric marine power system was the largest built that used 4100-volt alternating current coupled to silicone-controlled rectifiers. The use of jack-up type legs, derived from the offshore oil industry, as the docking mechanism solved the problem of mating two massive bodies in a seaway and was an important breakthrough.

The heavy lift system was the largest and most powerful (8000 tons) lift system ever built. The pipe handling system was the largest automatic one in use and could store and assemble 60-foot pipe sections averaging about 15 tons each. The heave compensator and gimbal platform were the largest in the offshore industry. They supported 10,000 tons and isolated them hydraulically and pneumatically from ship motion. This in turn permitted precise bottom operations to be carried out with highly accurate positioning while the surface ship was responding to wave and wind forces.

The cost (in millions) of the surface ship system were:

	[redacted]
basic ship	
heavy lift	
docking legs	
spares	
Total	

The World's Largest Submersible

The *Hughes Mining Barge-1*, known as the HMB-1, was and still is the world's largest submersible. During its construction in San Diego, President Nixon was photographed in front of it giving a speech about U.S. Government support to the American shipbuilding industry. Presidential publicity for the HMB-1 was not a planned part of the cover program, and the Agency received only 24 hours notice of the visit. Fortunately, no undue attention on AZORIAN resulted from the photograph and speech, which were featured in many newspapers.

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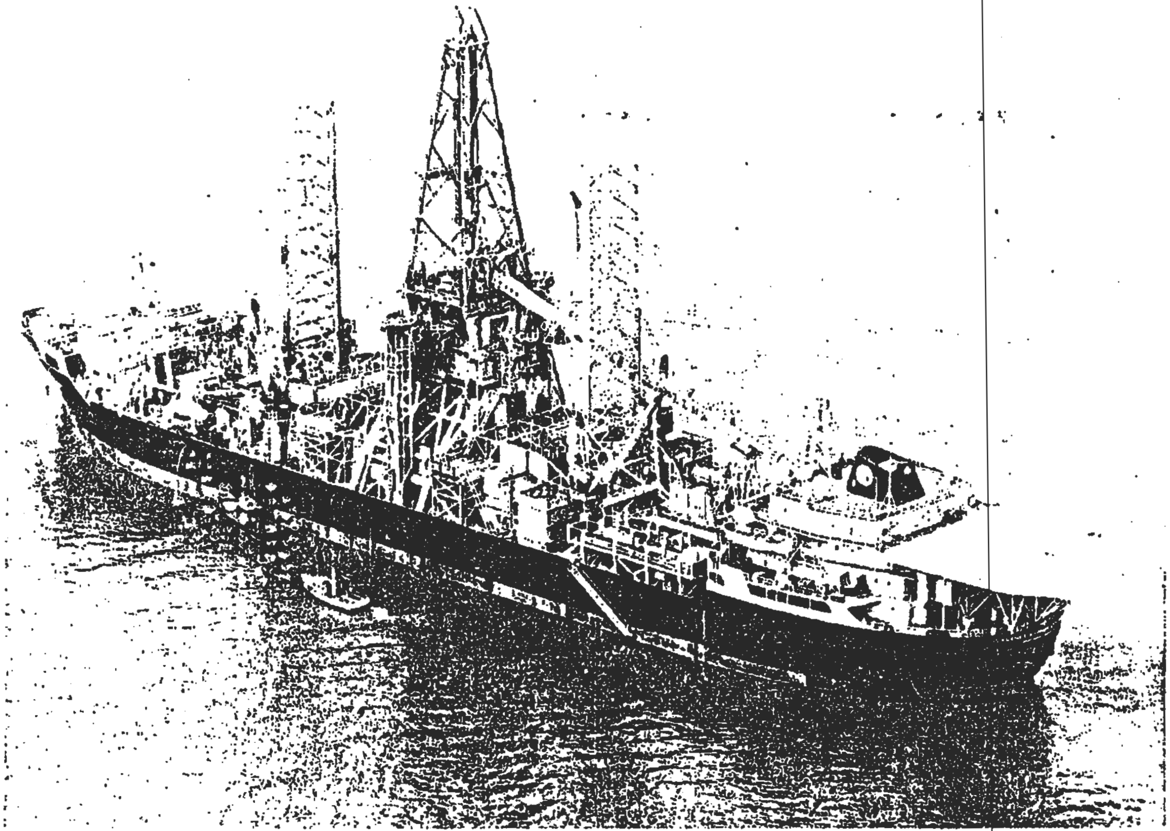

Figure 16. The final product

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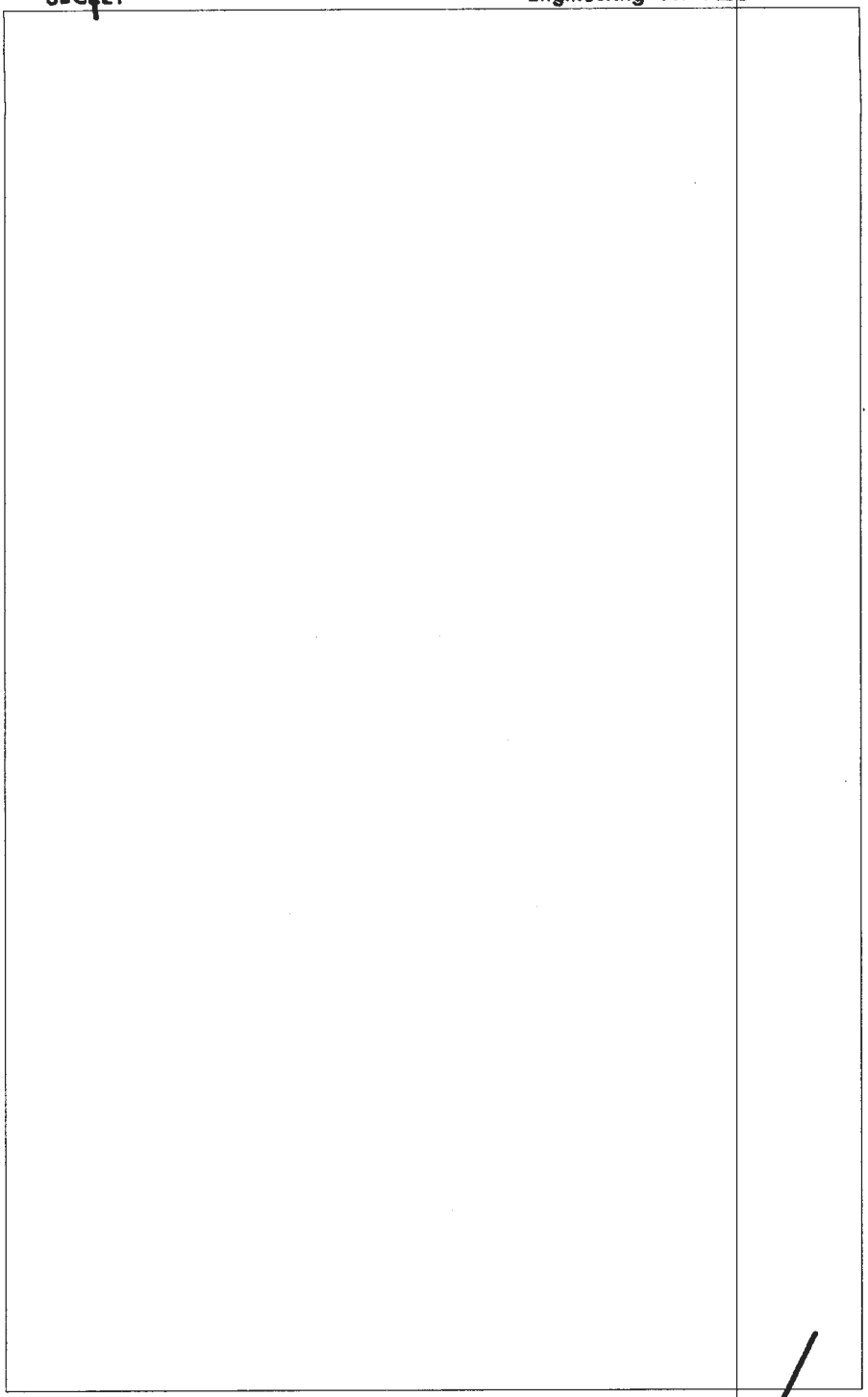
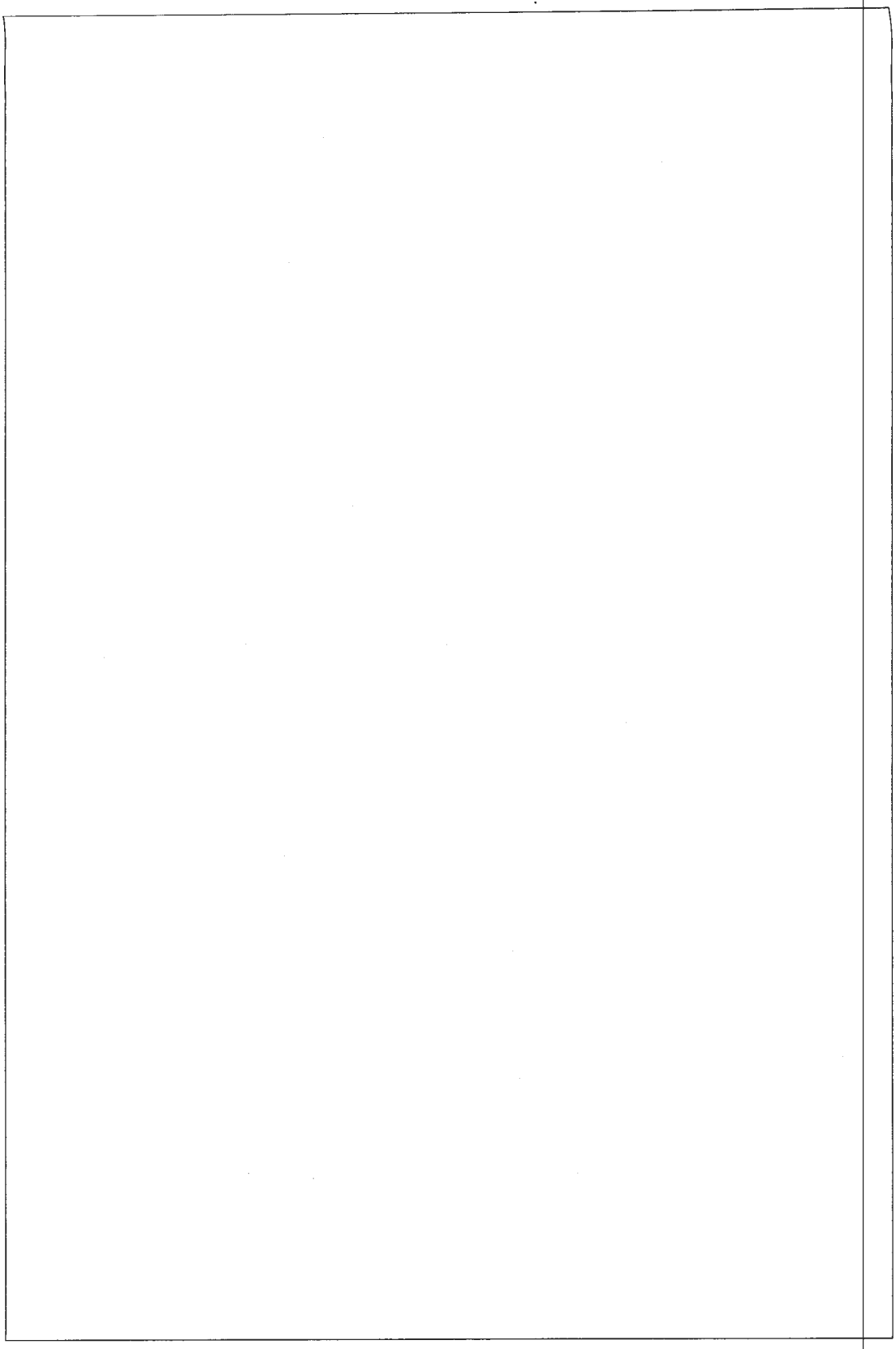
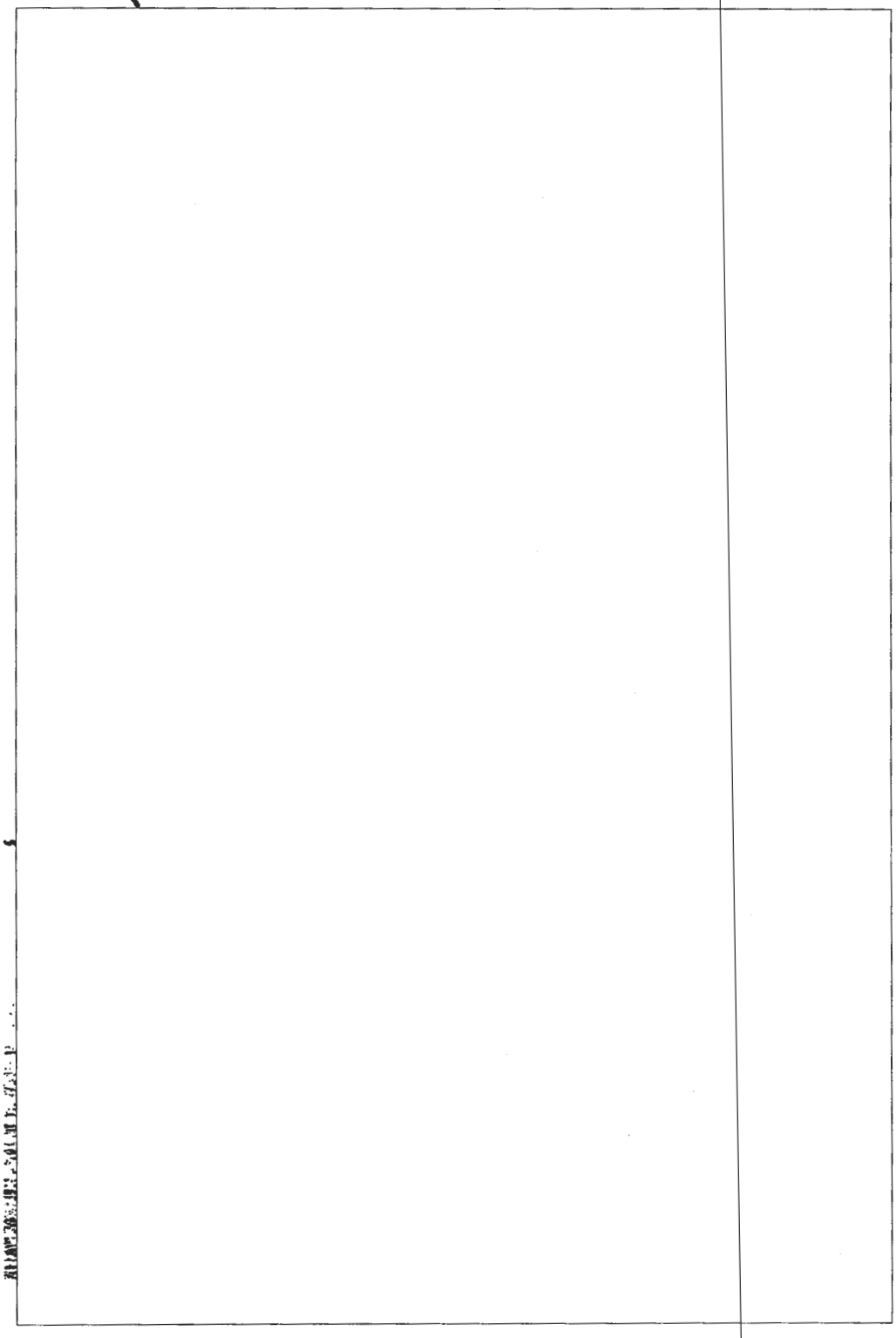
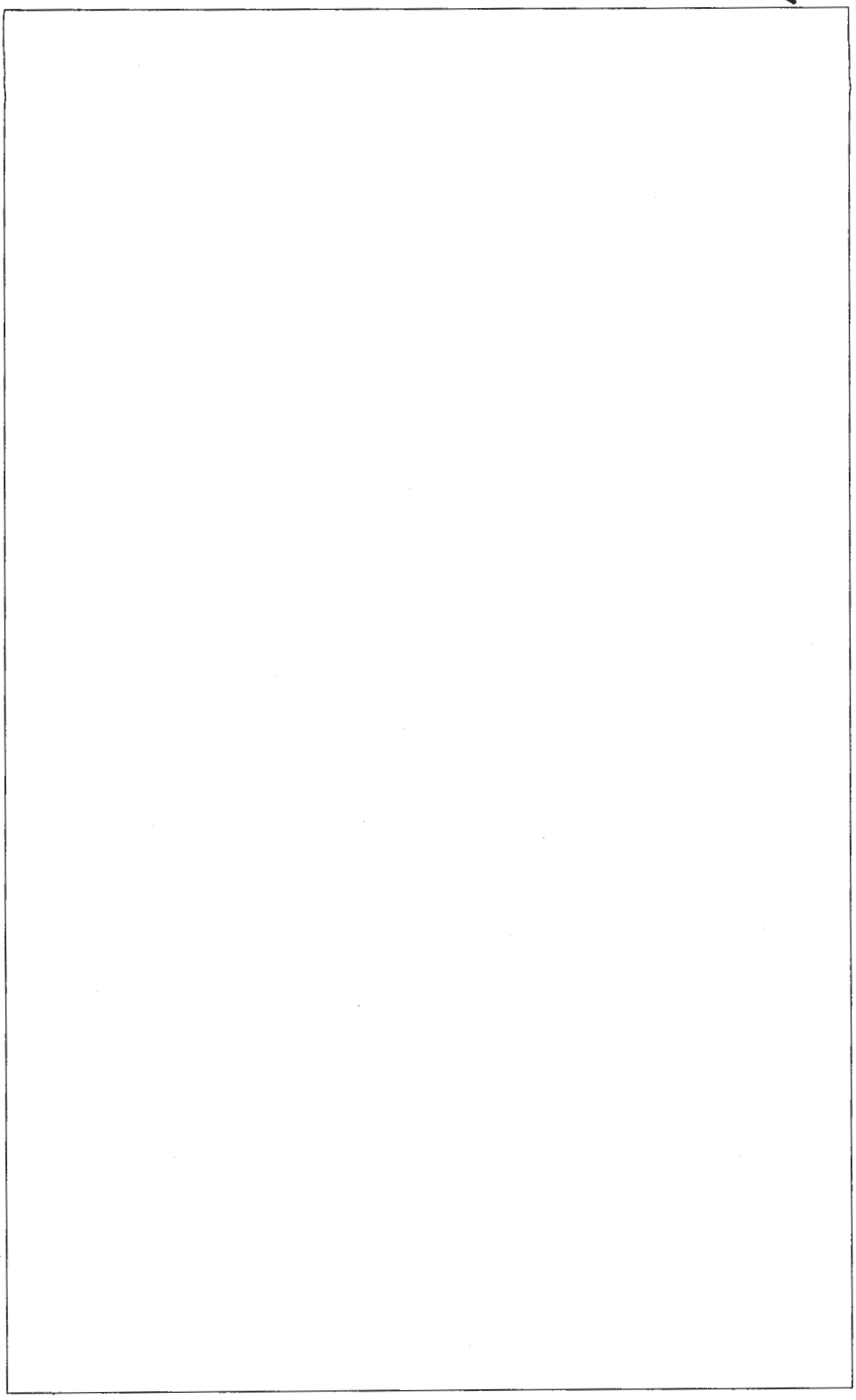
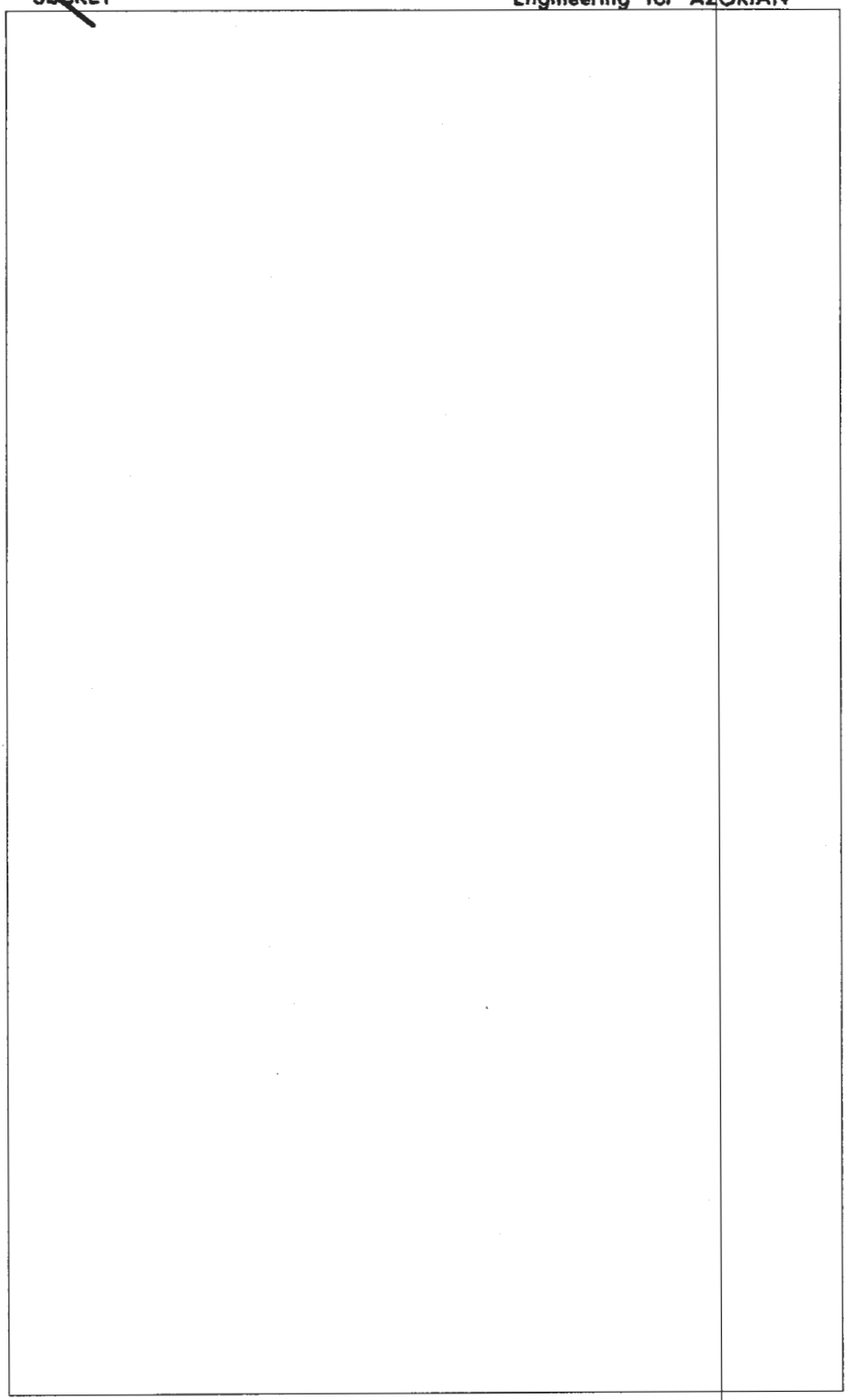
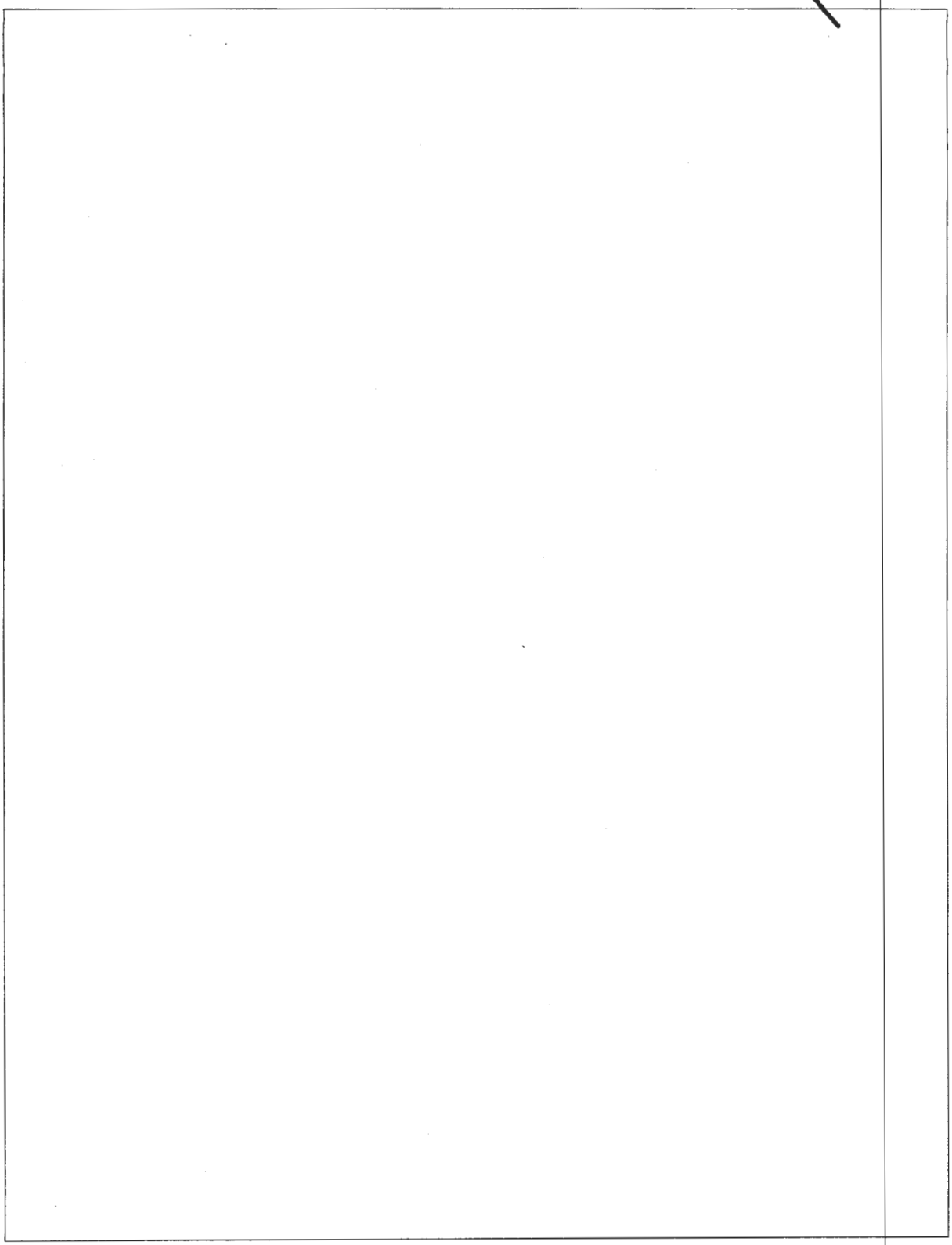


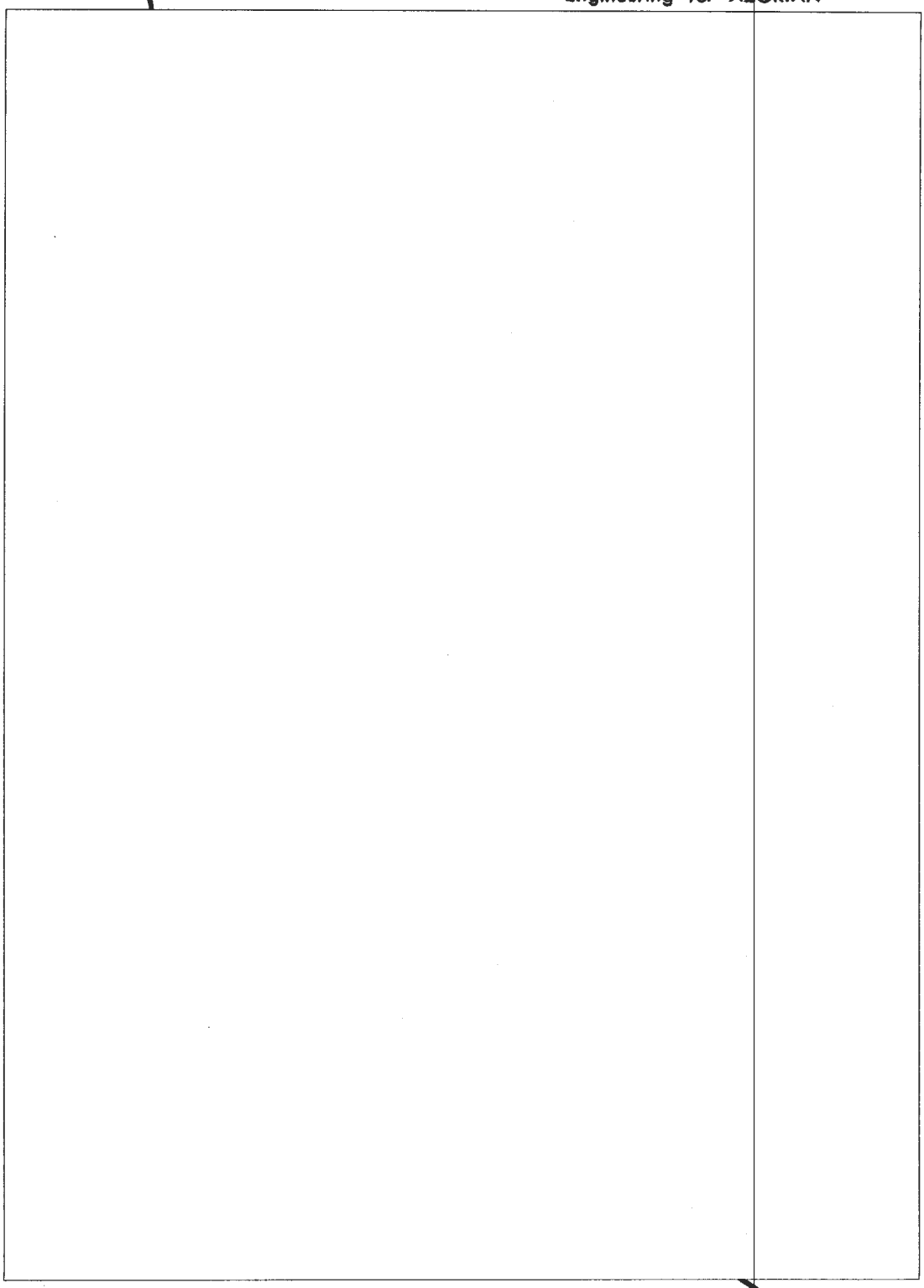


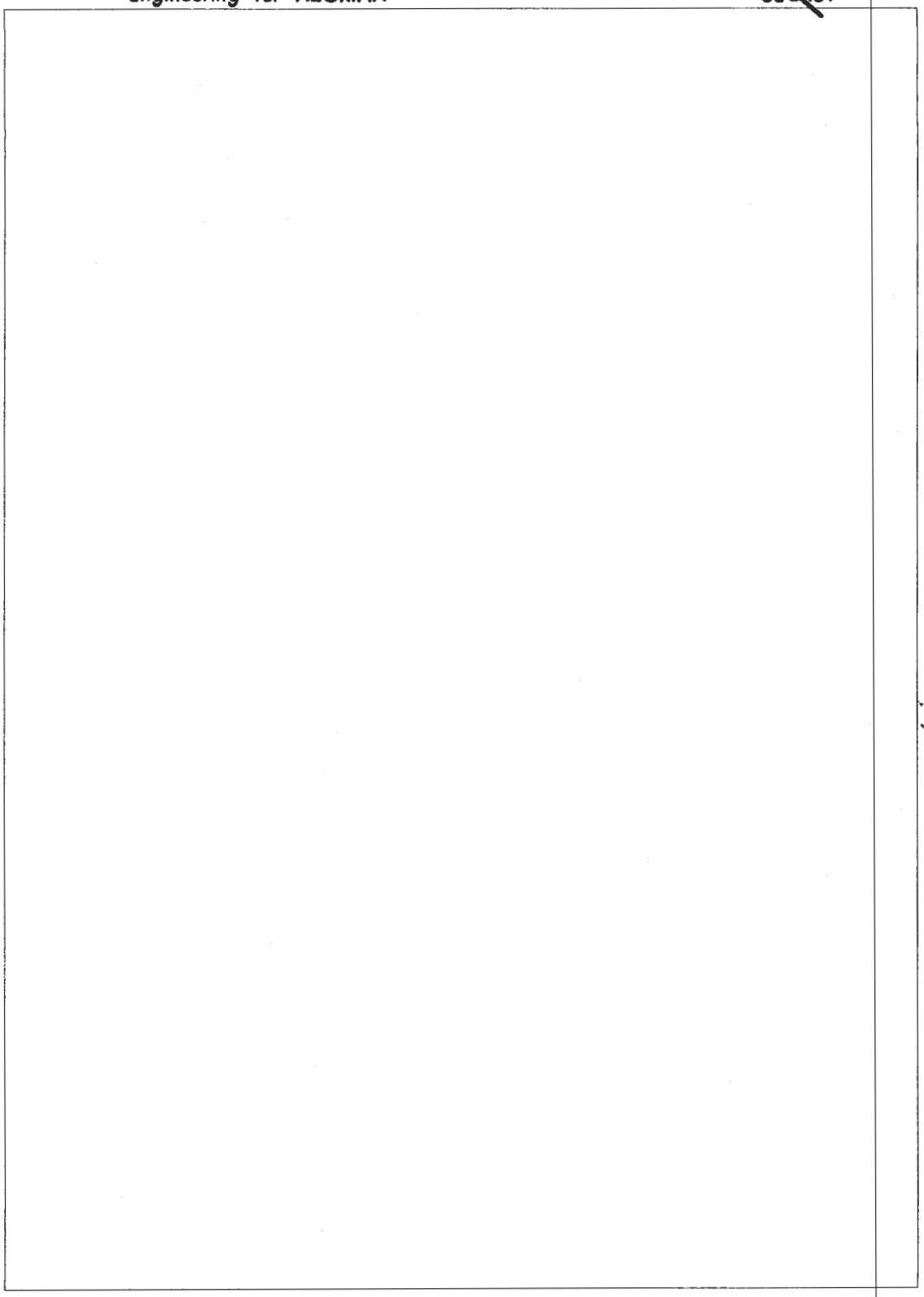


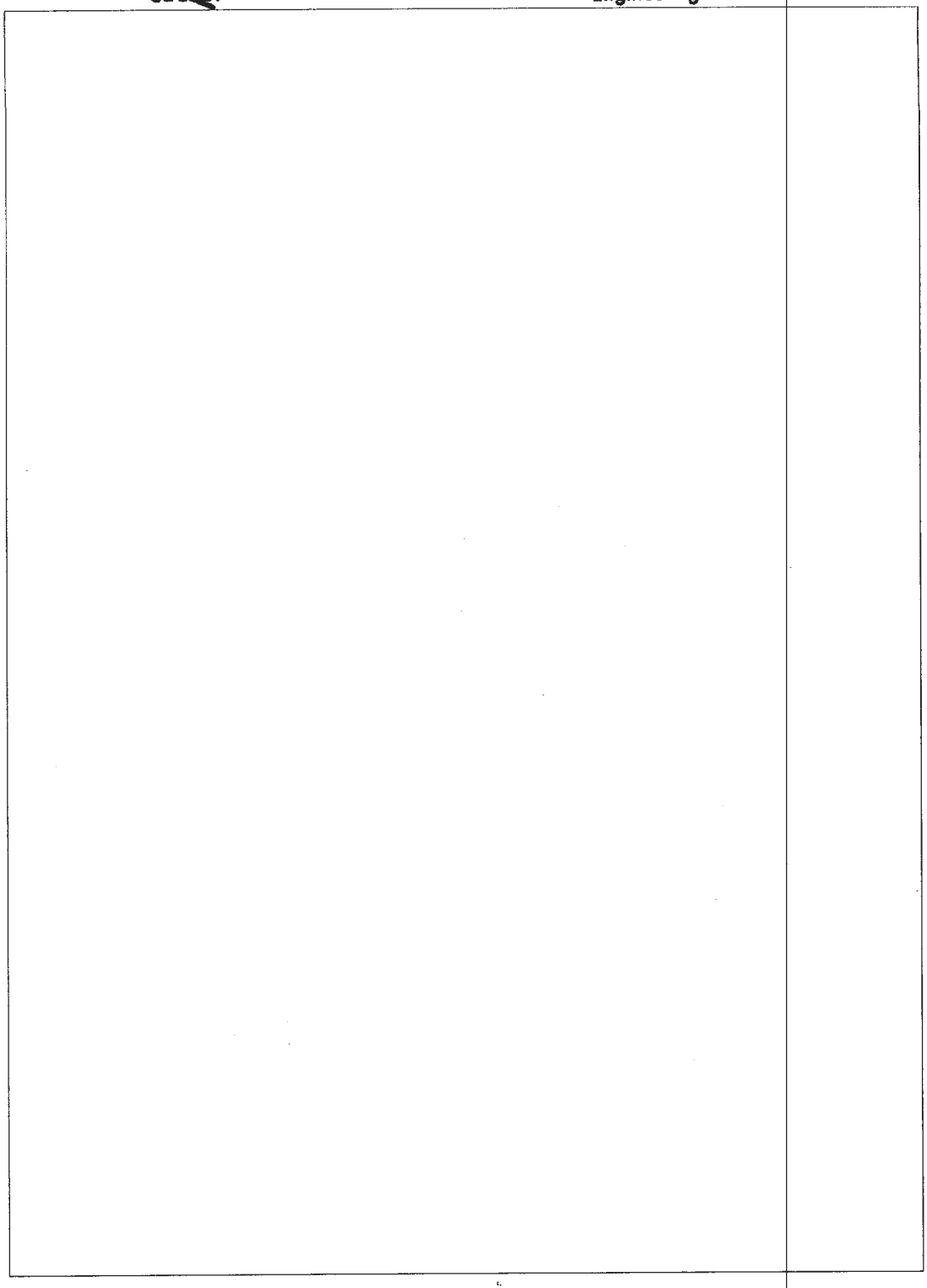


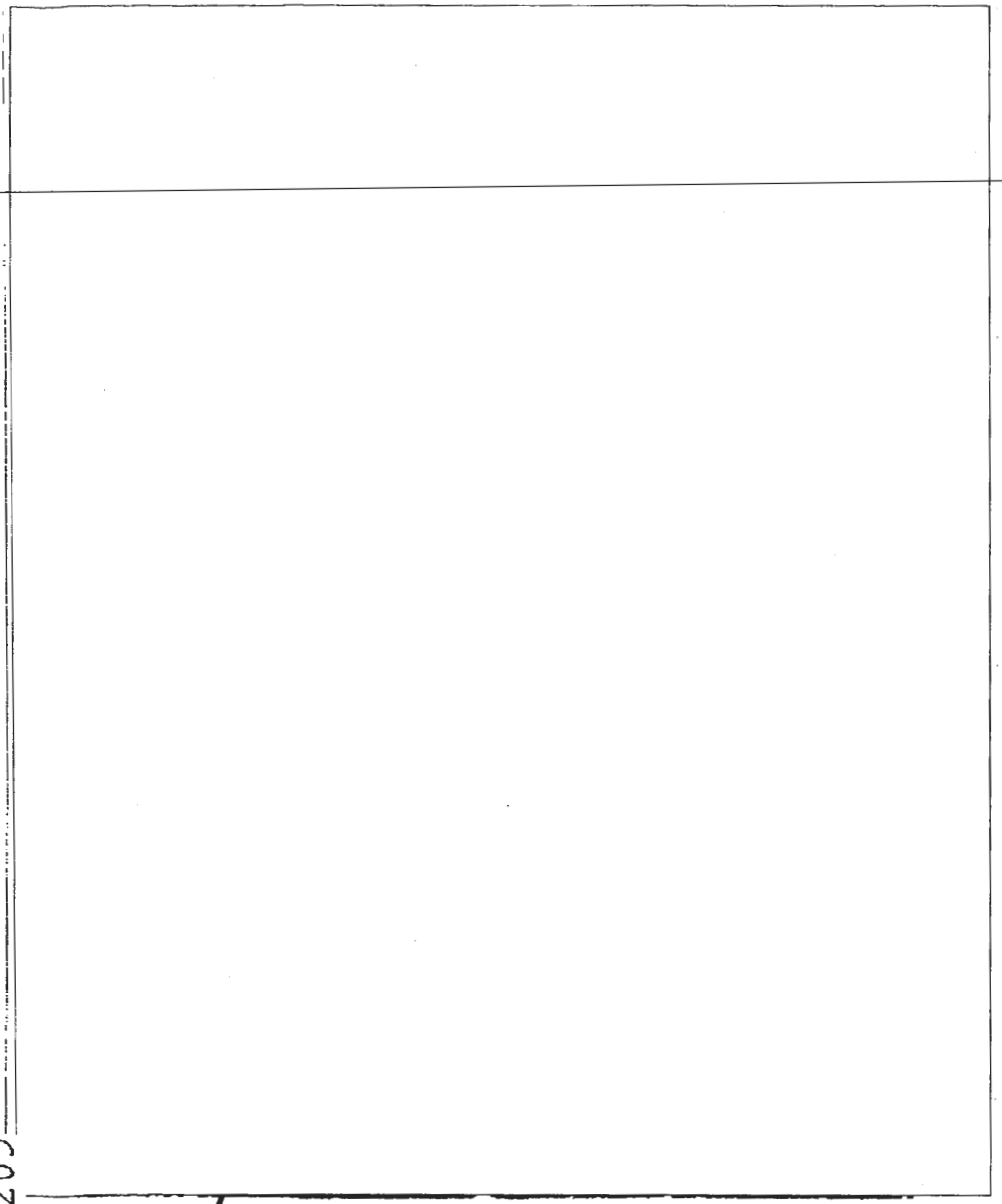


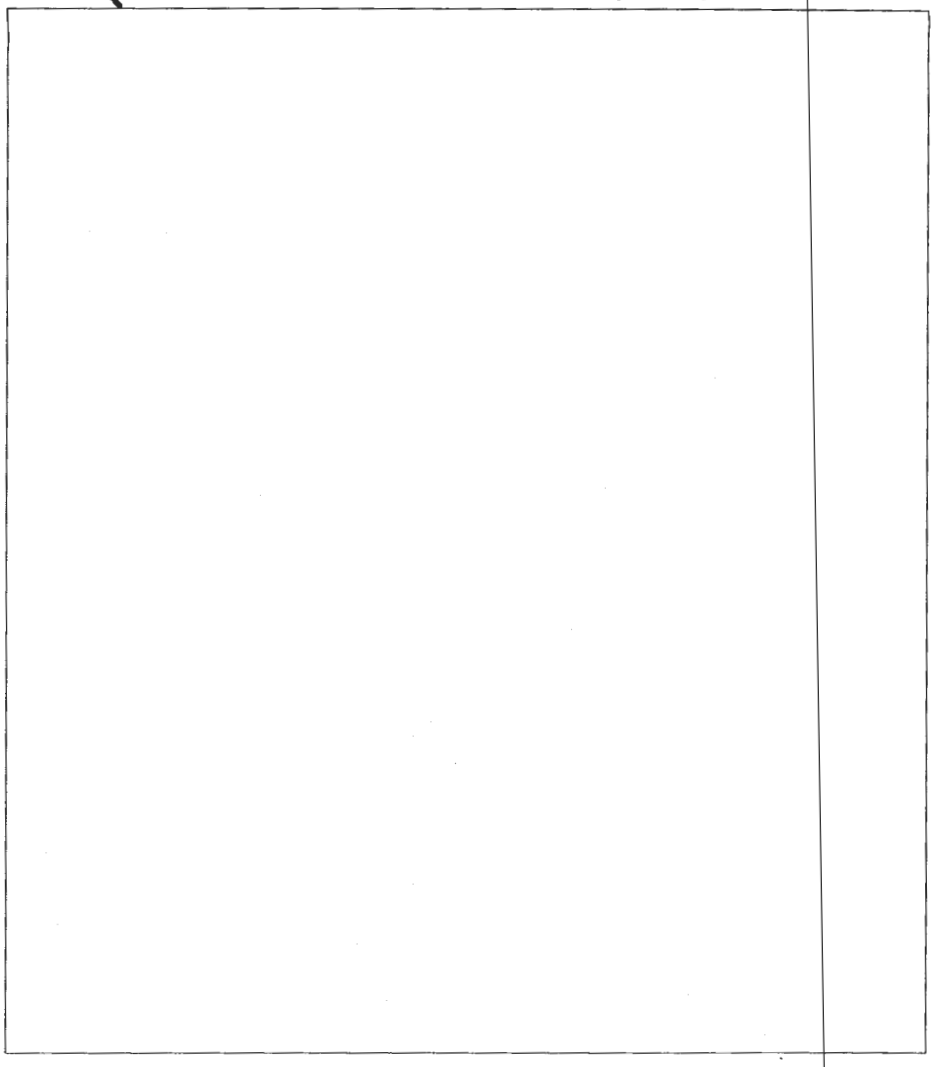












Hanging by a Thread

There was clearly a single-point failure mechanism in the approved recovery scheme—the heavy lift pipe. If it failed, not only would the mission end abruptly but major damage would be done to the HGE. The sudden release of energy to the upper portion of the pipe string would create havoc on the drill floor and cause severe injury to the men operating it. The pipe had to be designed with a good safety margin, and it had to be built perfectly. Tight quality control and proof testing would be mandatory. The Hughes Tool Company was selected as the prime contractor for this critical portion of the hardware. It would be almost inconceivable that a Hughes-sponsored mining adventure would not use its own company, Hughes Tool Company, to provide the drill pipe. These pioneers in the oil field and mining supply business had long experience manufacturing drill bits and had a thorough knowledge of pipe machining and metallurgy. Hughes Tool Company was the right combination of technical expertise and cover logic.

a. **Requirements**

The principal requirement on the heavy lift pipe was to provide enough strength to lift the target object [redacted] while sustaining its own weight and any dynamic forces added through sea motion. Early CIA studies had concluded that it would not be possible to manufacture a pipe that could meet these strength requirements. Global Marine [redacted] convinced the Agency engineers that the requisite strength could be achieved, but the proof still was in the making. The maximum estimated load on the pipe was 17,126,00 pounds during fail-safe hold conditions.

Other design requirements on the pipe were specially designed screw threads to hold the pipe pieces together. The roots of these threads were highly stressed. The design allowed the joint to be made up to a final torque of 300,000 foot-pounds in about one and one-half rotations of the pipe. To keep the weight of the pipe string down, it was designed in six diameters varying from 15⅛ inches to 12¾ inches. The design also spelled out a protective outer coating—to prevent corrosion from degrading pipe strength—and a zinc coating on the threads to lessen the chances of thread galling and sticking.

b. **Construction**

The closest technology for the pipe string was that used in making 16-inch gun barrels for battleships. Since battleships were resting in their Valhalla, there was no current 16-inch gun barrel activity to draw upon. But the Army did produce from their Watervliet Arsenal a metallurgist who knew gun barrel technology. The Army brought him to Washington on very short notice and, for him, no apparent reason. He was totally surprised when two CIA officers picked him up at the Pentagon and took him off for briefings. Perhaps he was thinking that the Agency was going to duplicate a circus feat and hurl agents, like cannonballs, into denied territory. After hearing a description of the AZORIAN program and the metallurgical problems, the Army metallurgist was very helpful, especially in the evaluation of the manufacturing process and the manufacturers to be used on the pipe.

The Hughes Tool Company sought out potential contractors to pour, forge, and trepan (cut the center hole in) the rough pieces. Hughes itself would do the final machining, coating, and proof testing. From the candidate steel companies, they chose (with Agency approval) [redacted]

[redacted]

The steel selected to furnish the high strength was formally called AISI 4330V (mod.). This meant that it was a standard, well-known alloy steel that was modified by the addition of vanadium. Vanadium was added to give the proper strength, ductility, and toughness properties to the steel. Its minimum yield strength was 125,000 pounds per square inch. There was much concern over the ability to make forgings of the size required and at the same time maintain uniformity of material properties throughout the forging. The forging process was followed closely by Hughes, Agency engineers, and metallurgical consultants who were hired for their expertise.

Nothing about this single-thread failure mechanism was taken for granted. Several one-eighth scale pieces of pipe were made and subjected to scaled model tests.

The testing machine was computer-controlled with a program that mimicked the load condition imposed on the pipe by ocean forces. The goal of the test program was the completion of four life-cycles of testing without indications of fatigue cracking in the specimen. Each life-cycle was defined as 340,000 individual load cycles, which was equivalent to 940 hours of operation. During testing six life-cycles were successfully completed before fatigue cracking began. These results indicated a high probability that the pipe would successfully survive the estimated operational time (testing plus mission), which was 250,000 cycles or 690 hours.

The final, full-scale proof test of the heavy lift pipe further demonstrated the "take nothing for granted attitude." After Hughes had finished the final machining, coating, and color coding for size, they also subjected each piece to a proof test of 125% of its maximum expected load. This meant that the largest pieces would be loaded to 21,460,000 pounds. To do this required the design and the construction of a special proof test machine for the Hughes facility in Houston. [redacted] designed and supervised the construction of the machine. It was the largest tensile test machine ever built. On 30 January 1972 the design engineer with much trepidation initiated the first full-load test of the pipe and the machine. Neither failed. Nor did they ever fail, even once, during the tensile testing of the 584 finished and delivered pieces (Figures 26 and 27). This was a fine tribute to the design effort and the quality control that went into the production of the pipe string. As the pieces were completed in Houston, they were assembled into 60-foot doubles and loaded on rail cars for shipment to the HCE (Figure 28).

[redacted]

c. Pipe String Technology and Cost

The forgings, from which the basic pieces were cut, were the largest members ever produced to such high strength, ductility, and fracture toughness requirements. Stringent metallurgical controls and inspections were required throughout the manufacturing process. The large pipe threads had a unique design which accommodated a high-load capacity simultaneously with a quick make/break connection. The proof test machine was the largest in the world. It had a maximum load capacity of 24,000,000 pounds.

The pipe string was designed, built, tested, and delivered in a 29½ month period from 29 May 1971 to 15 October 1973. Forging and machining required 21½ months, testing 8 months, and deliveries took place over the last 7 months. All pieces were at the pier well before the first sea trials took place in January 1974. Total costs, including the proof test machine, [redacted]

[redacted]

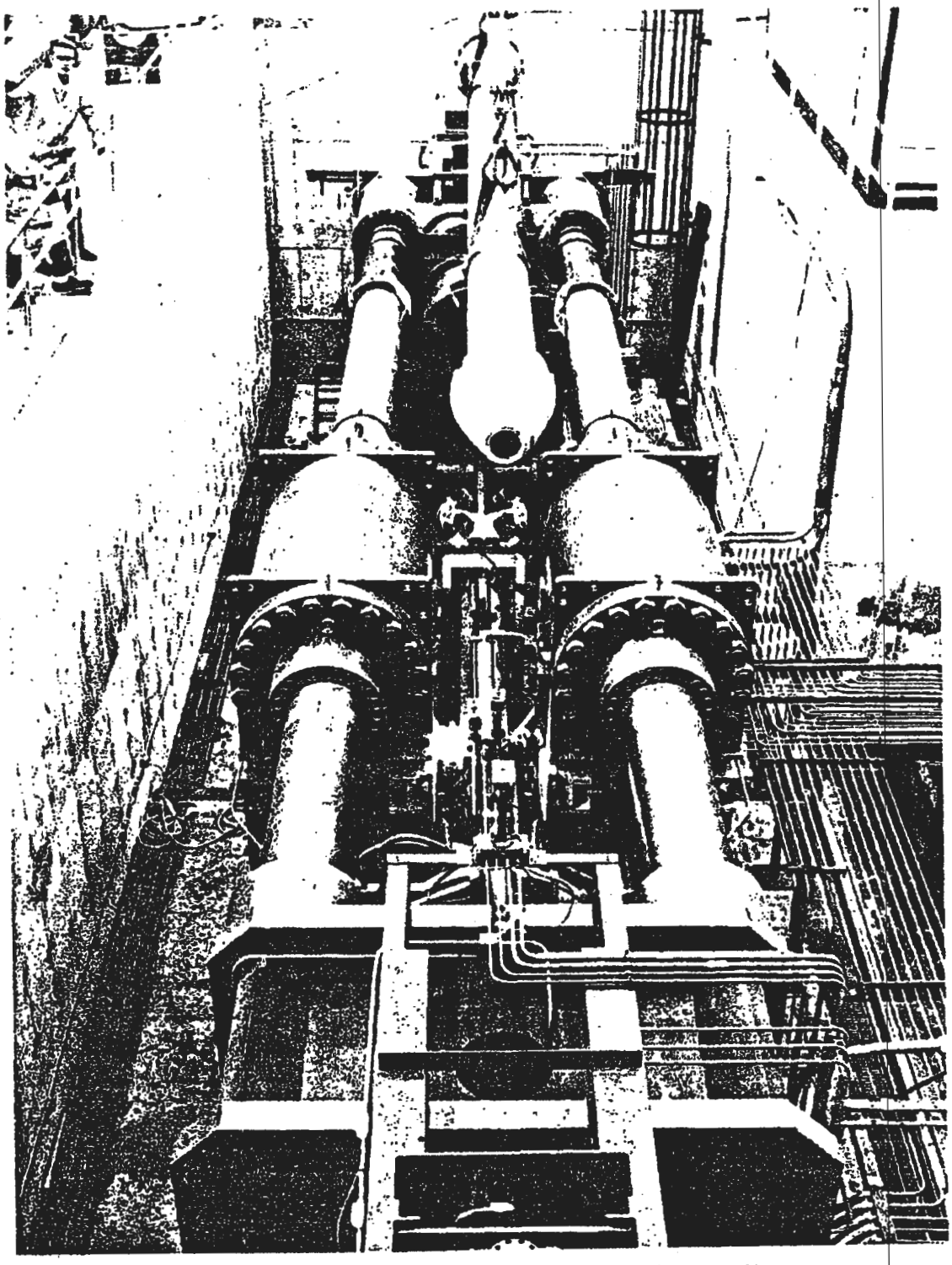


Figure 26. Piece of pipe being lowered into the proof test machine

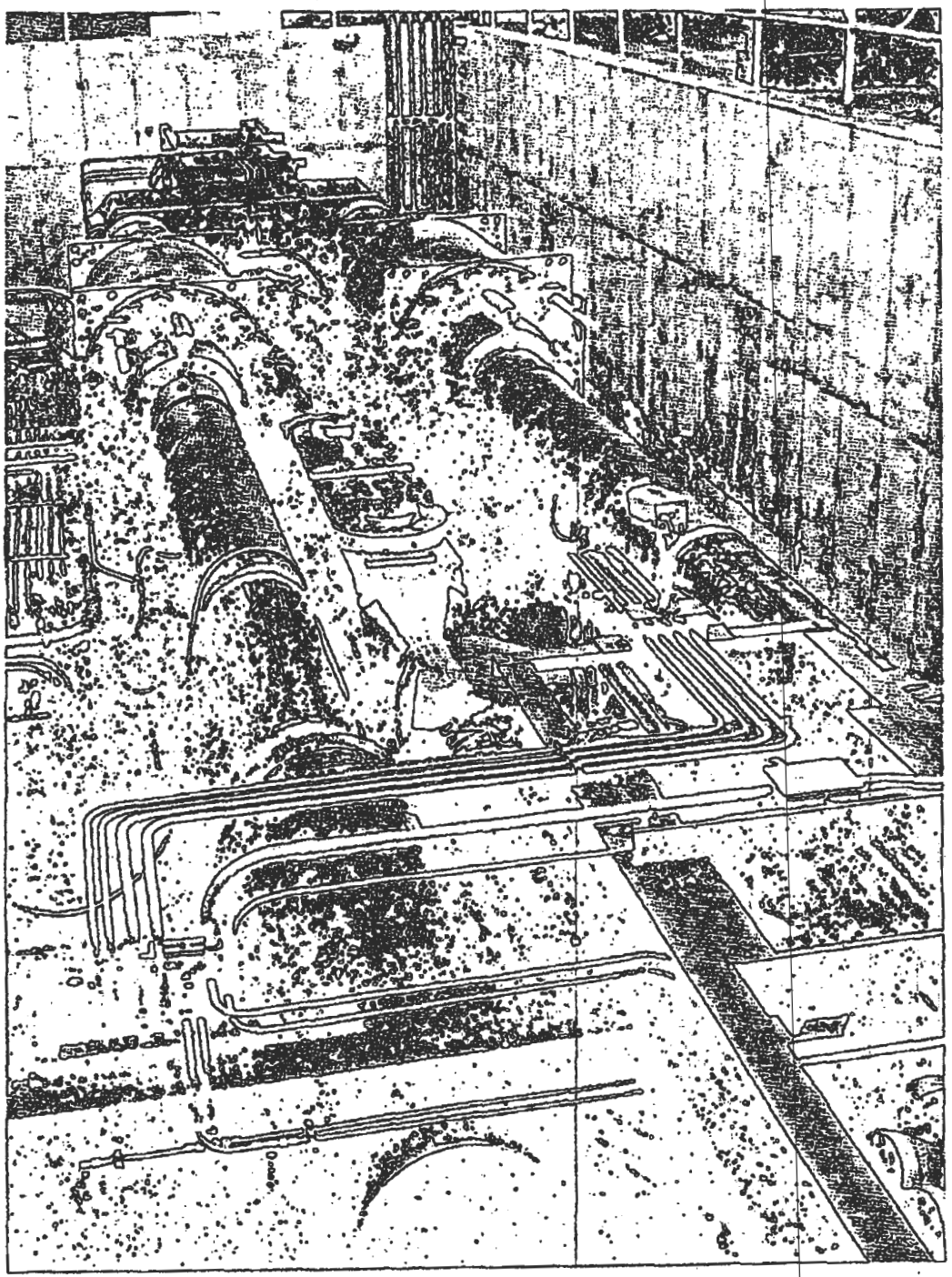


Figure 27. The Dutchman, first piece of pipe in the string, under load in the proof test machine

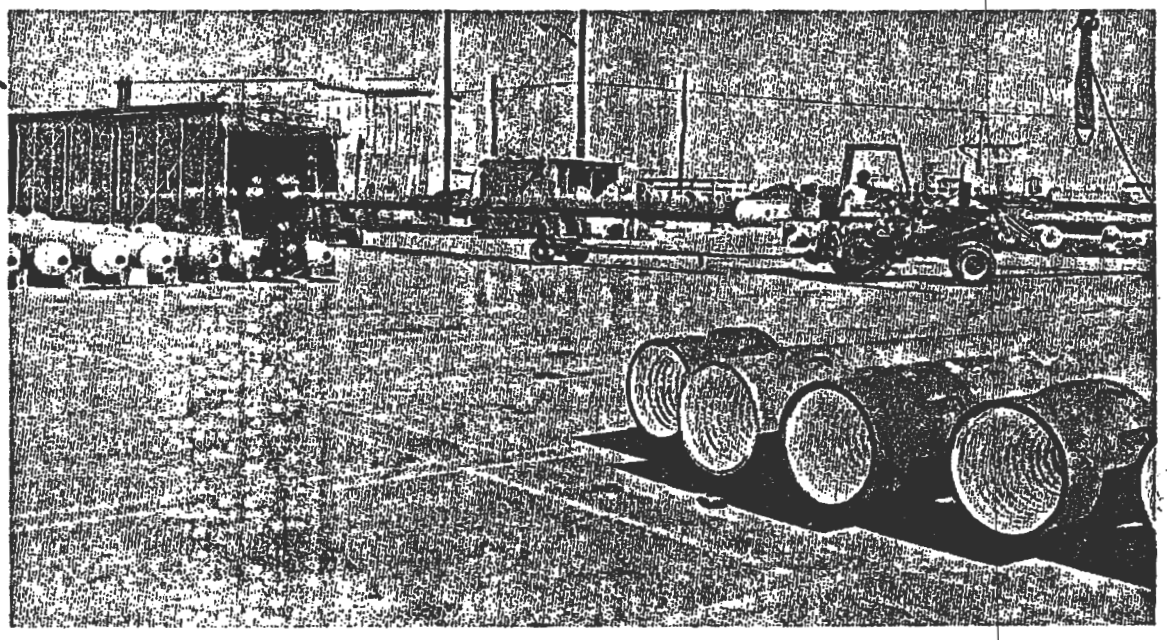
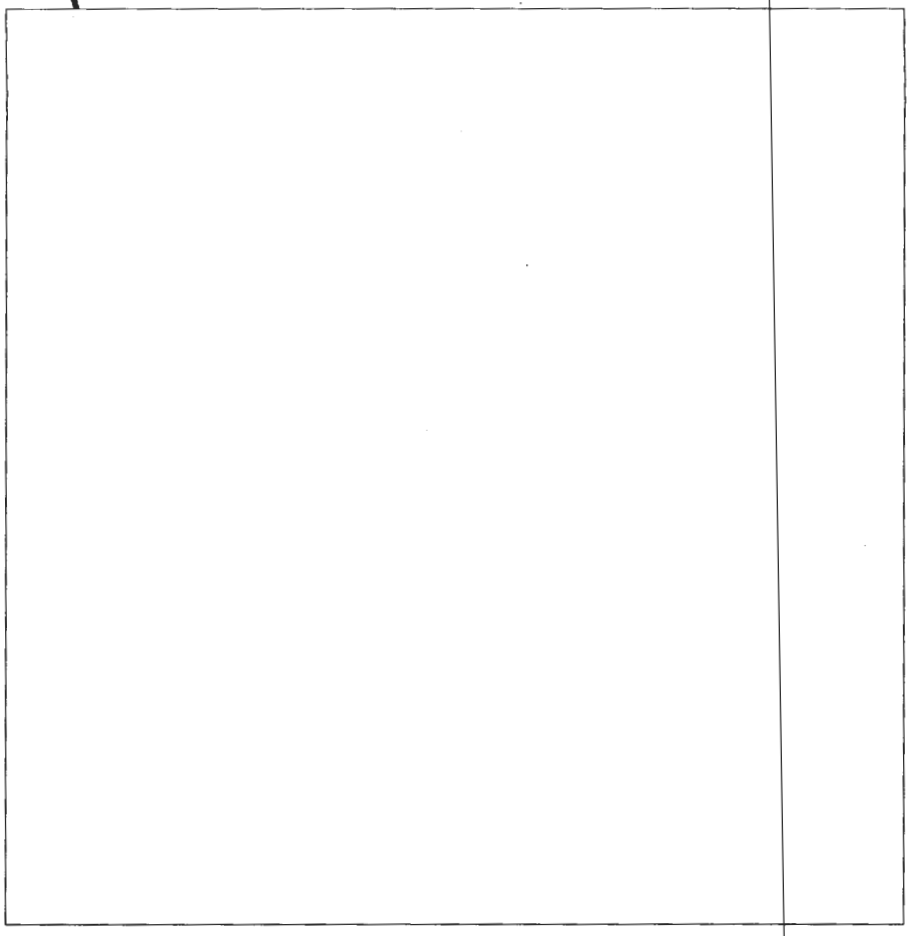


Figure 28. Pipe at Pier E showing pipe assembled into doubles 60 feet long. Threads are coated with a titanium dioxide/silicon oil coating to prevent seizure.



Field Engineering

As engineers know, all the design and laboratory testing in the world cannot anticipate each and every problem that will surface when you "go to the field." It is here that Yankee ingenuity and Kentucky windage come to the fore. AZORIAN was no exception to this general rule. A few examples should make the point. Engineering purists may want to skip the next few paragraphs; those of a more practical bent will understand and should find beauty in them.

After the first deployment of the pipe string during integrated systems test off Catalina Island, some of the threaded joints connecting two pieces of pipe were frozen together. No amount of applied force from the shipboard detorquing machine could loosen the joints. The immediate problem was to devise a method to unscrew the pieces of pipe without damaging them. Next, the cause of the problem and a solution for it had to be found.

A retired Navy engineering officer solved the immediate problem. He quickly designed what was probably the world's largest and strongest spanner wrench. (Figure 29 shows the super wrench in action.) Made from high-strength steel and operated with a manual hydraulic jack, Super Wrench could deliver one million foot-pounds of force to the pipe joints. This force plus a judicious heating of the outer surface of the

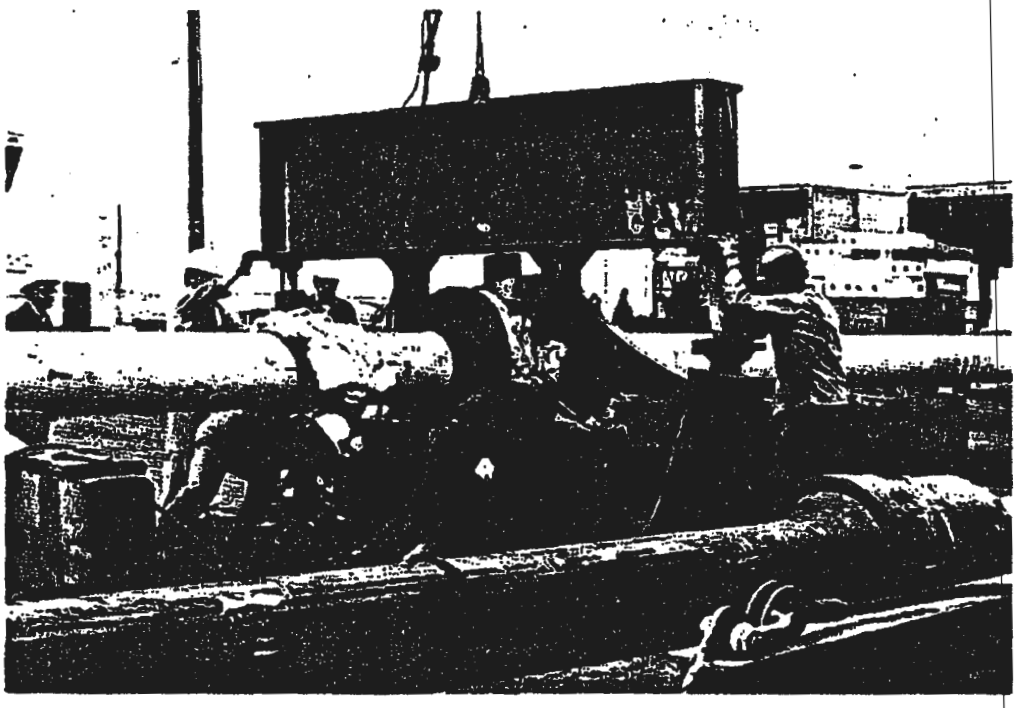


Figure 29. Super wrench being readied to free a stuck joint

pipe joint produced the desired effect with no serious damage to the threads (Figure 30).

As for the cause of the problem, it was determined that inadvertently a natural battery had been built into the threaded joint. The surfaces of the thread were coated with zinc and then covered with a normal oil field lubricant to prevent galling and sticking. Red lead was a constituent of the lubricant, and this together with the zinc formed the two opposing plates of a battery. All that was needed to complete the battery was an electrical conducting medium to connect the two. Even with tightly threaded pipe joints, enough sea water was forced into the joint to provide the electrical path. The resulting corrosion caused the threads to lock.

Immediate testing of alternate lubricants was started. One, a very sticky, gooey synthetic called Aqua-Lube, proved to have insufficient holding power. The final solution was a witches' blend of titanium dioxide, silicon dioxide, and zinc chromate in a silicone oil. After testing on the one-eighth scale model pipe, this new lubricant was used successfully on all the joints—but only after each full-scale joint had been thoroughly cleaned of the red lead and Aqua-Lube mixtures, perhaps one of the messiest jobs mankind has ever undertaken (Figure 31).

Another and quite different problem occurred during the operation in which the HGE

The squid had returned to Catalina for their annual frolic in the shallow waters of Isthmus Cove (Figure 32).

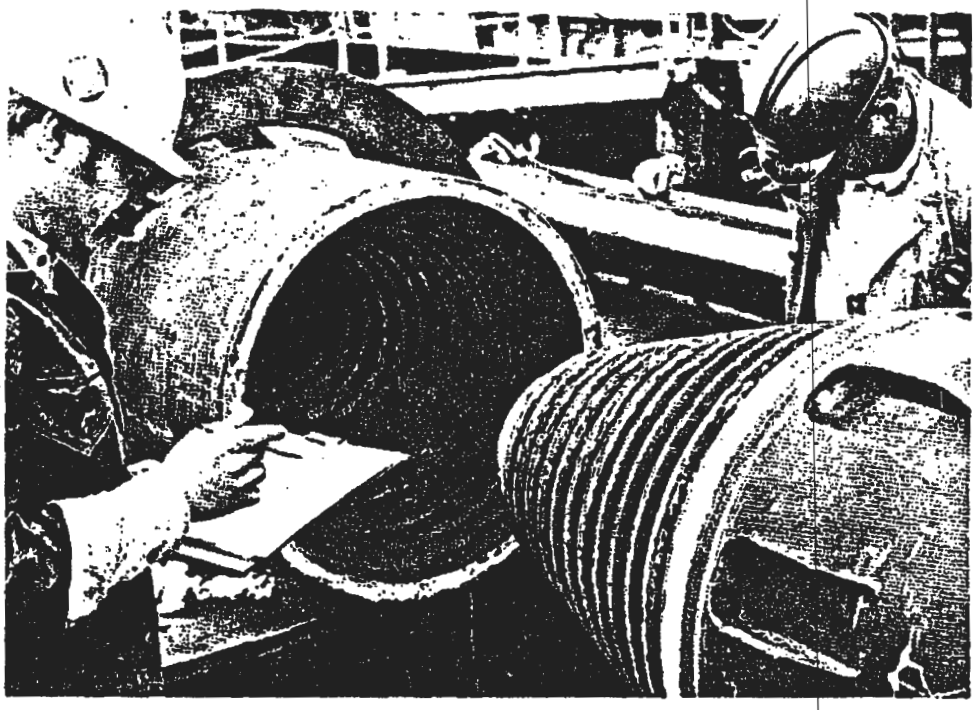


Figure 30. Examining red lead coated threads for damage

[redacted] the well gates shut, the pumps started removing the water from the well. This lasted only a short while; the pumps were constantly clogged with ecstatic squid, and no headway could be made in removing the water. Finally, the HGE was moved out of the cove to deeper water, the gates reopened, and lights hung over the side (it was the middle of the night) to draw the squid out of the well. Light seems somehow to discourage encounters of the sexual kind. Out came the squid; the gates were reclosed, and the pumps were free of squid except for a very few stragglers. There had been no text book solution available to the engineers for this problem. It was an exercise left entirely to the reader.

One last example from the mission will show still another form of engineering fixes—using a man to replace a device. Two large cylindrical devices called heave compensators absorbed the up-and-down motion of the sea and kept the rig floor (the pipe deployment area) at a constant level. These shock absorbers were located under the rig floor, fore and aft, and had a total stroke of 14 feet. It was critical that they move in unison, for if they got out of synchronization, the rig floor would be canted, not only causing metal-to-metal contact (and damage) but also putting a severe strain on the deployed pipe string.

Devices called rotapulsers measured the amount of stroke in each of the heave compensator cylinders. The measurement in each rotapulser was made by a wire which was on a pulley and a distance counter. This information was constantly fed to the control center for the lifting operation and was used to automatically keep the two cylinders in synchronization. Various problems had been experienced with the rotapulser, but on one occasion during the mission the wires failed. The cylinders got

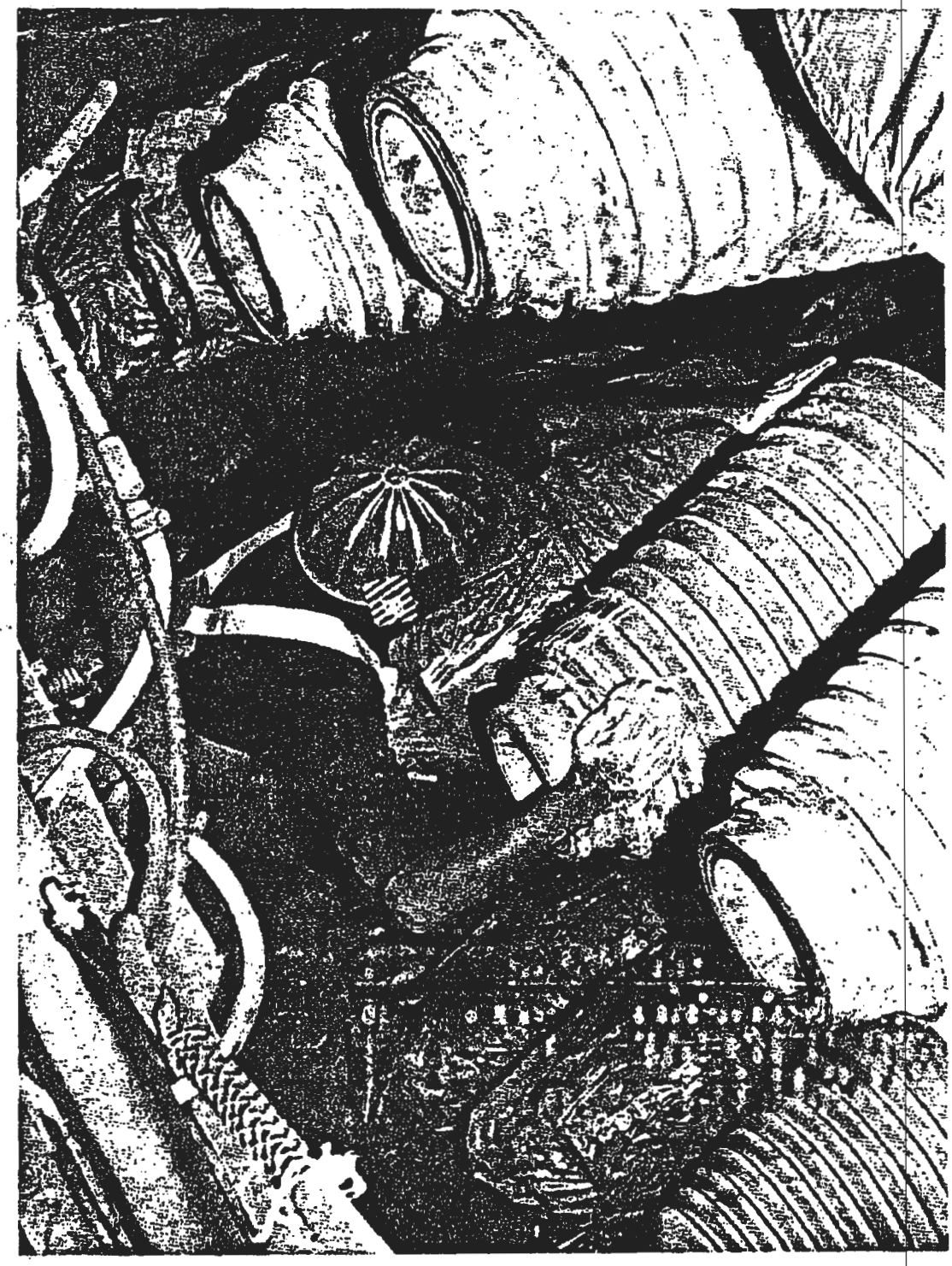


Figure 31. Applying Aqua-Lube to the threads. It didn't work and had to be removed.

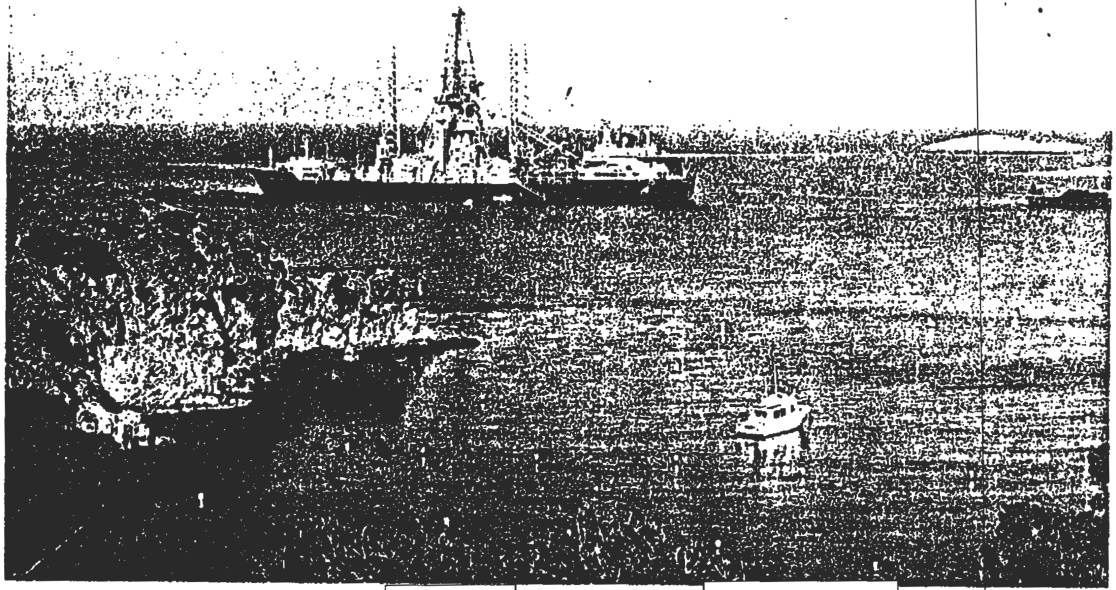


Figure 32. The HGE [redacted] at Isthmus Cove, Catalina [redacted]

out of "synch," and the resulting metal-to-metal contact caused an impressive display of sparks and noises as well as real damage. It was not a mission-ending failure, but because the operation was in a critical phase, it had to continue while the wires were replaced.

To gather the position information needed to keep the heave compensators in unison, a quite simple method was devised. Yardsticks were affixed to the ship near the moving cylinders and a welding rod was used as an indicator needle. One man with a headset telephone was stationed at each of the cylinders to read out the position of the rod on the yardstick as the cylinders moved up and down. The men at the other end of the phone in the heavy lift control center could then control the relative position of the two cylinders. It was a simple but effective solution to a nasty problem.

Later calculation showed that the wires failed at their predicted life cycle. The number of accumulated cycles on the wires had exceeded the original predictions—a small fact easily overlooked in the stress of solving larger and more pressing problems.

The Price Tag

Charges of exorbitant cost escalation have been levied on the engineering procurement for Project AZORIAN. The most critical one claimed that the Agency sold the program on the basis of a [redacted] initial estimate. Charges such as this one were made without a careful examination of what actually took place. Here is the real history of the cost growth of Project AZORIAN:

a. **Fall 1969 and Spring 1970-** [redacted]

[redacted]

b. **October 1970-** [redacted]

The initial concept of a system for covertly lifting the target by the use of heavy lifting equipment mounted on a large surface ship had now been developed. Equally important, however, was the development of management and cover concepts using the image of Howard Hughes and the more plausible cover of a commercial deep ocean mining effort. These initially-estimated costs were based on incomplete data and on recovery projected for FY 1973. Estimates were obtained by scaling up the cost of an existing smaller vessel (the *Glomar Challenger*). The estimates totaled [redacted]

[redacted]

On 16 November 1970 the procurement of certain long-lead-time equipment was authorized for the first time. Some people, therefore, argue that the [redacted] estimate should be taken as the cost base. Those who would do that should remember that the initiation of procurement of long-lead items does not constitute a full program go-ahead. This type of procurement contract can be stopped with relatively small default penalties. Also there were still 11 major unknown or technical risk areas facing the engineers at this time. Resolution of these would almost certainly increase costs. Senior national-level management was advised of these, as was the ExCom. In fact, a five-month hold on major procurements was placed on the program two weeks after authorization for certain long-lead items was obtained.

c. March 1971–[redacted]

During the period from October 1970 through March 1971 systems specifications and a total scenario for the project were being developed. The figure of [redacted] was the first estimate given to ExCom based on preliminary engineering design studies and, as such, could be considered as a base cost reference point. Improvement of [redacted]

d. August 1971–[redacted]

Estimates presented at the March 1971 ExCom meeting had listed a number of uncertainties and costs that further definition would refine. Based on a year-long detailed [redacted] As described earlier, this required a significant redesign of the surface ship and capture vehicle. Additional cost growth was experienced due to strengthening of the lift shoulder of the pipe string. These cost increases caused the ExCom, in August 1971, to undertake a total review of the AZORIAN project and to order a moratorium on major procurement actions. The moratorium included deferring the keel laying of the surface ship. After a full review of target value, program costs, cover and risks, on 1 October 1971 the ExCom decided to proceed with the AZORIAN Project.

There were still a few uncertainties in the engineering areas: work needed to be done on the control system and the fail-safe portions of the heavy lift system; the [redacted] was not finalized nor were the operator displays, the [redacted] The software for the computer system was just starting and simulation studies were still being run to determine operational red-lines for the equipment.

Since ExCom decided finally to proceed with AZORIAN and the keel was laid in November, the dollar estimate at this time, [redacted] could serve as the cost base. The keel laying was a most significant event. It would be difficult to explain stopping ship construction after this occurred, and cancellation now would be costly in both a dollar and a credibility sense.

e. April 1972–[redacted]

Contracts were made definite with the four prime contractors. The new program increases derived from funding required for engineering change proposals, proof-test equipment, increased costs associated with the construction barge, and increases to cover post-acquisition handling. An argument can be made that the basis for cost growth should be taken from this base, at which the contracts were made definite.

At this time also a major program review was undertaken by the Special Projects Staff in order to remove any "gold plating" from the hardware or any other aspect of the project. There was great pressure to make an attempt to keep the total costs under [redacted] At the same time, ExCom again reviewed and approved the continuation of AZORIAN.

f. August 1972—[redacted]

This increase was caused principally by structural modifications to the surface ship needed to meet U.S. Coast Guard specifications, which were prerequisite to obtaining cover-related maritime risk insurance. The overall costs were estimated as follows:

Hardware	[redacted]
Cover/Support	
Operations	

A furious debate was going on at this time over AZORIAN. A strong effort was mounted by senior [redacted] officials to kill the program. ExCom decided to go to the 40 Committee for a political assessment on running the operation in 1974. The upshot of all this was that President Nixon wrote a letter praising the project and approving its continuation. All debate on AZORIAN ended.

g. October 1974—[redacted]

The final hardware aquisition costs of Project AZORIAN totaled approximately [redacted] They were broken down as follows:

[redacted]

Other costs associated with the total program were:

Mining Machine	[redacted]
Cover/Support	
Operations	

These brought the total costs for AZORIAN to [redacted] million as of October 1974. An additional [redacted] The overall costs for the six and one-half year project were [redacted]

h. Summary

There are five points in time in the AZORIAN program that could be used to establish a cost base on which to calculate cost escalations. Of these five, two are really not valid. The first estimates of late 1969 and early 1970, in fact, are meaningless. They were based on a concept that wasn't used, and no program approvals or decisions were made on their merit. The charge that AZORIAN was sold as a [redacted] project is thus without foundation. The next estimate, [redacted] made in October 1970, also had little validity. It was made without having preliminary engineering or a total program scenario in hand. No major procurements were authorized; they were in fact expressly forbidden. Limited long-lead procurement was authorized at this time, but it cannot be said that full program approval was obtained.

The three remaining reference points, (a) March 1971 at [redacted] (b) August 1971 at [redacted] and (c) April 1972 at [redacted] are valid, and arguments can be made for all three. Using the March 1971 date as a basis for cost, the escalation would be [redacted] percent; for August 1971, [redacted] percent; and for April 1972, [redacted] percent (based on the costs of AZORIAN only). Of the three, the April 1972 date has the least persuasive argument for it. Although this was the time that the major contracts were definitized, all the important planning and engineering work that leads to a cost estimate had been done prior to this. The date is really a bookkeeping bench mark for finalizing contracts.

In the view of the project managers, the only valid dates for setting a base cost estimate are March 1971 and August 1971. By March a total scenario had been developed covering all essential elements of the program and the preliminary engineering had been completed. Although major long-lead procurements had been authorized, the ExCom had been made aware that significant engineering uncertainties remained and that their resolution could increase the costs. By August most of these solutions had been worked out and their price tags estimated; a major one was the required redesigning of the ship's hull. ExCom ordered the keel laying postponed until a thorough review was conducted, but the review was favorable and the keel was laid as planned in November 1971.

The estimate of [redacted] made in August 1971, then, is the best point from which to calculate cost escalation, for it was then that the ExCom authorized the keel laying, a momentous undertaking after which it would be difficult to abandon the ship construction. Calculating from this point, the cost escalation for AZORIAN registers as [redacted] percent.

A Final Word

The equipment developed for Project AZORIAN lives on. After a short period in mothballs, the HGE was reactivated as an honest-to-goodness mining ship. A consortium led by Lockheed is using the ship and the pipe string to test a mining machine. Some tests have been completed and others are in the offing. The National Science Foundation is planning on converting the HGE to a deep ocean drilling ship. Their program is one to explore the ocean margins for scientific and economic purposes. It will be a large program carried out through 1989 with a cost in the neighborhood of $600 million.

The world's largest submersible (HMB-1) has been used by the Department of Energy in their ocean thermal energy conversion program. The San Francisco Bay base for the HMB-1 is being used by the U.S. Coast and Geodetic Survey as an operational location.

Recently, the Nuclear Regulatory Commission has made inquiries about using the proof test machine to test steel plate.

The same technology developed for the AZORIAN simulator was used recently to construct a simulator to train operators to emplace a huge offshore oil platform. The platform, costing $750 million, was constructed in several hundred feet of water off the Lousiana Coast. In this way the training procedures and hardware developed for AZORIAN have played a role in helping to develop the oil resources of the United States.

So the labor of love created by a group of Agency managers and engineers has borne a continuing reward. Let us hope that Agency officials of the future will be blessed in kind.

This entire article is classified SECRET