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Report to Rep. Philip E. Ruppe; by Fred J. Shafer, Director, Logistics and Communications Div.

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Congressional Relevance: Rep. Philip E. Ruppe.

Project PICES (Pacific Intertie Strategic Communications ELF System) was proposed as an alternative ELF (extremely low frequency) communication system to the proposed Project Seafarer. The proposal was to adapt the existing Pacific Intertie system to radiate an ELF signal. Findings/Conclusions: The Department of Defense (DOD) believes the advantages of using the Pacific Intertie as an ELF antenna system are: (1) there are no tap-offs of DC power between terminals; and (2) there are no AC carrier interaction problems. DOD planned a three-stage approach to studying the PISCES concept, but did not complete the studies because it was unable to obtain congressional approval. TRW Systems Group conducted a study of the feasibility of using the Pacific Intertie for ELF transmissions. The conclusion was that Project PISCES is technically feasible for ELF transmissions. The Science Advisory Group of the Defense Communications Agency concluded that, while PISCES is technically feasible, it should be considered as a possible fallback ELF system. These conclusions were based on: indications that the proposed system would not provide desired coverage for all operational areas; uncertainty about conductivity under the Pacific Intertie transmission line; and uncertainties about cost. (RRS)

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UNITED STATES GENERAL ACCOUNTING OFFICE

WASHINGTON, D.C. 20548

LOGISTICS AND COMMUNICATIONS
DIVISION

B-184833

FEB 1 1 1977

The Honorable Philip E. Ruppe
House of Representatives

Dear Mr. Ruppe:

Your letter of October 8, 1976, asked us to provide you certain information relative to using Project PISCES as an alternative extremely low frequency (ELF) communications system to the proposed Project Seafarer. Because the Department of Defense has not been authorized to complete various studies and tests to determine the validity and estimated costs of the PISCES concept, we are unable to provide certain of the requested information. Therefore, as agreed with your office, this report discusses the concept and status of the PISCES proposal.

PROJECT PISCES

Project PISCES (for Pacific Intertie Strategic Communications ELF System) was proposed as a possible ELF communications system. The proposal is to adapt the existing Pacific Intertie system to radiate an ELF signal.

The Pacific Intertie is a high voltage (800,000 volt) direct current power system which began transmitting hydroelectric power in 1970 from the Pacific Northwest to Southern California (from Oregon thru Nevada to California). The power is generated as alternating current (AC) at the Bonneville Hydroelectric Generating Complex at the Dalles Dam on the Columbia River in Oregon. The AC is converted to direct current (DC) at the Bonneville Power Administration's Celilo, Oregon, Converter Station, transmitted to the Los Angeles Department of Water and Power's Sylmar Converter Station, and converted back to AC for use by electric consumers in the Los Angeles area.

The transmission lines between the Celilo and Sylmar stations are 851 miles long. The Pacific Intertie is the only DC transmission line of this magnitude in the United States, and there are only two other systems in existence

comparable to it--one in Africa and the other in Russia. The Intertie in Oregon is owned and operated by the Bonneville Power Administration; through Nevada and in California by the Southern California Edison Company, the Los Angeles Department of Water and Power, and various other municipal utility systems.

Project PISCES has been looked into by the Department of Defense (DOD) as a possible alternative to the proposed Project Seafarer. DOD believes the advantages of using the Pacific Intertie as an ELF antenna system include (1) there are no tap-offs of the DC power between terminals, and (2) there are no AC carrier interaction problems.

DOD planned a three phase approach to studying the PISCES concept, but did not complete the studies because it was unable to obtain congressional approval. Phase I was a feasibility study--a conceptual and technical or "paper" analysis of the feasibility of using DC lines for ELF communication. This phase was completed in December 1975 and is the only part of the DOD plan undertaken. Phase II would have been a demonstration phase--feasibility demonstration and preliminary design hardware fabrication, and Phase III would have been a full-scale validation test.

In June 1975, the Defense Communications Agency (DCA) contracted with TRW Systems Group to conduct the study (Phase I) of the feasibility of using the Pacific Intertie for ELF transmissions. The conclusion of that study was that Project PISCES is technically feasible for ELF transmissions and several PISCES configurations could be used as an ELF transmitter. It also indicated that experiments could be performed to verify whether the assumptions made in the study were correct. The study had assumed certain bulk properties of the earth under the transmission line, in particular the conductivity.

DOD had planned to conduct experiments to verify the assumptions used in the study to calculate antenna efficiency and pattern. After such tests, DOD would have been able to characterize the performance of the powerline as a transmitter based on measured performance instead of predicted performance.

Following the TRW report, DCA had the PISCES concept reviewed by three members of its Science Advisory Group in

April 1976. The Science Advisory Group provides advice and technical expertise to DCA on the areas of telecommunications, command and control systems, and automatic data processing. Its members are chosen from the private sector based on their experience and expertise in those areas. The PISCES review team concluded that, while PISCES is technically feasible for ELF transmissions, it should be considered as a possible fall-back ELF system if the Michigan Project Seafarer should not be approved, and that further research and development on PISCES should be restricted to analytical studies to help refine cost uncertainties. These conclusions were based in part on: (1) indications that the proposed system would not provide the desired coverage for all operational areas--particularly the Mediterranean and the Western Pacific, (2) uncertainty about conductivity of the earth under the Pacific Intertie transmission line, and (3) uncertainties about cost. The review group stated that extensive and costly PISCES experiments were not warranted and should be deferred.

Although there have been discussions between TRW and DOD officials concerning the Science Advisory Group's comments on the TRW study and report, TRW has not formally responded to the Group's comments. According to DOD officials, certain technical disagreements expressed informally by TRW have a rational basis, but the differences cannot be resolved without further testing and study of the PISCES concept.

DOD is interested in PISCES because the Pacific Intertie is an existing system and, if it could be used as an ELF transmission system, construction costs would be minimal. DOD officials believe, however, that there would be substantial other costs in adapting the Intertie to transmit an ELF signal, including the PISCES transmitter operating hardware--the transmitter, coupling and tuning the system, line inductors, switch gear, and transmission line--and the installation and checkout of PISCES on the Pacific Intertie. TRW reported a number of possible configuration adaptations, but to determine which, if any, would transmit ELF signals effectively, additional study and tests would be required. Consequently DOD is unable to estimate which, if any, of the proposed configurations would be usable or to make any reliable cost estimations.

Because of the lack of information on PISCES and the inherent differences in the two systems, the cost for PISCES cannot be compared with the estimated cost of Seafarer.

The PISCES concept differs from Seafarer in several aspects. PISCES is basically north-south oriented and as such would give off one type of signal radiation pattern. Seafarer is proposed as a grid, and as such would give off a different pattern. Although it would not be entirely accurate, a comparison of PISCES with a one directional Seafarer (north-south or east-west) would be more realistic than a comparison of PISCES with the proposed Seafarer (north-south and east-west). DOD officials believe that any cost comparisons between PISCES and Seafarer have to take into account the performance potentials of both systems.

According to DOD officials, the costs of and arrangements to use the Pacific Intertie, either for testing or for adapting the Intertie for ELF transmissions, had not been fully discussed with the owners of the Intertie. No formal agreements had been reached concerning lease or use cost, and DOD is without a basis for estimating such cost. Because the practicality of the Intertie as an ELF transmitting system is unknown, DOD cannot make a reliable estimate of the costs for using the Intertie or for operation and maintenance of a PISCES system. Agreements for necessary land use had not been worked out with the owners of the Intertie, where they own the land, or with the lessors of the land, where the Intertie has lease agreements for its use.

CURRENT STATUS

During hearings on its fiscal year 1977 budget request, DOD requested congressional approval to conduct further studies of the PISCES concept. The Senate and the House-Senate Conference authorization committees both withheld authority for further PISCES studies. In the appropriation review, the House Appropriations Committee reported its view that alternatives to Seafarer should be investigated, and included \$2.4 million in the fiscal year 1977 budget for the study of alternatives to Seafarer. The Senate Appropriations Committee likewise approved the study of alternatives. The appropriations Conference report states that

"* * * The conferees also believe the PISCES experiment should be conducted before making a final decision on the SEAFARER program. If the Navy can gain the concurrence of the authorizing committees, the conferees would not object to the Navy using \$2,300,000 of the \$14,800,000 provided in fiscal year 1977 to conduct the PISCES experiment."

On September 26, 1976, the Senate Committee on Armed Services wrote the Deputy Secretary of Defense that,

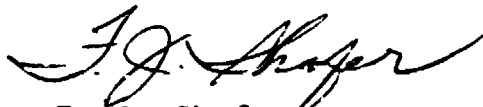
"Unfortunately, the appropriations conference appropriated only \$14.8M for the Seafarer program instead of the \$27.2M which was authorized. The appropriations conferees also expressed their view that the PISCES experiment should be conducted before making a final decision on Seafarer and indicated that Navy could use \$2.3M of the Seafarer appropriations for PISCES if the authorizing committees concurred.

We do not concur.* * *

DOD officials informed us that the Senate Armed Services Committee's letter effectively stopped further study of PISCES as an ELF transmission system.

We trust this information will prove satisfactory for your needs. If we can be of further assistance, please let us know.

Sincerely yours,



F. J. Shafer
Director