

*H. L. Lewis*

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Project Whirlwind  
Servomechanisms Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

SUBJECT: PROGRESS REPORT, PROJECT 6751, NOVEMBER 13, 1950 to MARCH 2, 1951

To: J. W. Forrester

From: J. D. Porter and C. W. Adams

Date: March 14, 1951

Abstract: During the period from November 13, 1950, to January 29, 1951, work on Project 6751 -- the application of a digital computer to underground oil reservoir problems -- was directed towards gaining familiarity with the problems and the work which has been done elsewhere. Since that time, active programming of a particular simplified version of the problem has been underway and will be ready for trial runs on Whirlwind I in the near future.

The weeks from November 13, 1950 to January 29, 1951, were spent in further investigation of the available literature. Most of this consisted of reports by Prof. J. von Neumann and by Dr. D. Shreve, the reports having been made available by Mr. T. V. Moore of the Standard Oil Development Company, through Dr. P. S. Williams, director of the Carter Oil Company Research Laboratory. Through Mr. Moore and Dr. Williams, arrangements were made for a visit to the Carter Lab. to discuss the details of the work being done by the group under Dr. W. A. Bruce. During this period, also, Forrester, Everett, Adams and Porter had an informal conference with Prof. W. K. Lewis about the general scope of the problem.

During the week of January 29 - February 2, 1951, C. Adams and J. Porter visited the Carter Oil Research Lab. in Tulsa in an attempt to determine the precise nature of the oil reservoir depletion problem being studied there. This problem consists largely in the determination of the variations in the pressure distribution, the saturation distribution, and the gas-oil ratio of an underground oil reservoir accompanying the production of a prescribed amount of oil at specified levels. The problem as defined, with only the most essential approximations, by D. Shreve of the Carter Lab. is very complex; the Carter people themselves have not yet devised a stable numerical method of solution for it. However, a simplified version of the problem is being attempted numerically by Dr. Shreve and his associates on desk computers. This version requires about 4 man days (with duplicate checking) to compute

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one time step, and one complete solution (corresponding to one set of initial conditions) will involve computing perhaps a few hundred such time steps. It was agreed that we would program this version of the problem, and that the Carter people would supply typical data, regarding us as consultants (unpaid) in dealing with any confidential information.

However, even in the simplified approach the problem requires a considerable amount of internal data storage and will not fit easily into 256 registers. Our present plan is to break each time step in the solution into five parts and to read the program for each part into storage as needed. When more storage becomes available the number of tapes will of course be reduced. In the meantime we hope to acquire sufficient experience to determine whether our present 15-binary-digit register length, equivalent to about  $4\frac{1}{2}$  decimal digits, is adequate.

The calculations themselves break down very conveniently into five parts. The first two parts involve extrapolation over half of a time step. The next two carry the extrapolation to the end of the time step. The fifth part is concerned mainly with typing or punching out the results desired. A program has been written for the first part. In writing a program for the second part, Porter has encountered certain discrepancies in the sample data supplied by Dr. Shreve. We have written to him, and we expect that his reply will clear up these difficulties. In the meantime we shall continue to program, neglecting these questionable parts.

Signed

J. D. Porter

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Signed

C. W. Adams

C. W. Adams

JDP:CWA:ajg