

Computer Aid to Production

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Abstract

The manual allocation of oil and gas production to individual wells, comparison of production and allowables, maintenance of well test records and other related reporting have been converted to a computer system. In addition to eliminating routine and time-consuming manual production allocations and reporting, pilot testing of this system has resulted in more accurate and more timely production data which should be more useful to all concerned.

Basic well production and battery data are submitted by the field gaugers, along with necessary control data furnished by the production accountants to the data processing section. These data, which are key-punched, together with data maintained on master well and battery magnetic tape records, comprise the input to the IBM 1401 data processing equipment. Processing is done at specified intervals during the month. Printed output, which includes individual well and battery net production, comparison of production and allowables, and other tabulated production data are furnished to the proper personnel.

Results to date have been good and the transition has been smooth. However, the progress made so far is only the initial phase of the over-all system. Computer calculation of well-test liquid and gas volumes from basic observations made by the gauger, i.e. gauge readings, time, etc.; refinement of well test summaries; and further reduction of manual preparation and verification are immediate objectives. Future objectives include the addition

of other operating areas to the system, computer calculation of run tickets, maximum machine preparation of those reports now prepared manually, and improved data transmission methods.

From the start, it has been planned to proceed "step-wise" in attaining a complete computer production aid system. This approach appears to offer many advantages in introducing changes in methods and procedures, and indoctrinating field personnel to the computer system.

Introduction

Initial objectives of this project were to convert the manual allocation of production to wells, preparation of the production vs allowable report and other associated reporting to a computer system using the IBM 1401 data processing equipment. Successful conversion to a workable machine system would provide more timely net production data and reduce routine and time-consuming manual preparation.

These objectives represent only the initial phase of the complete system. Many changes in methods and procedures, forms, data flow, etc. will be necessary. Therefore, it was planned to proceed to put the complete system into use step by step. This approach was felt to offer the best chance for over-all success of the total system (Fig. 1).

It was necessary that pilot testing of the initial program be conducted in a representative field or area. Satisfactory solution of the initial objectives through a pilot program would provide a sound basis for future additional work and for general application.

Computer Equipment

This system was designed for use with the IBM 1401 data processing equipment. The speed of this equipment plus the ability to handle both punched cards and magnetic tape makes it ideal for this type of application, i.e., processing large volumes of data. Equipment presently in use includes the IBM 1401 Central Processing Unit, IBM 1402 Card Read-Punch, IBM 1403 Printer and four IBM 7330 magnetic tape units.

All new data is introduced by punched cards, while all master records are maintained on magnetic tape. No other input media have been used.

The IBM 1401 equipment uses the stored program concept to handle data. To date, 13 machine programs are required to process data and give the desired results.

Discussion

Pilot Field

The computer system is currently being tested at the Lafourche Division's Bay Marchand field. This field was chosen for pilot testing because it was felt it was neither the most nor the least complicated to account for. The field has both inshore and offshore wells and presents a variety of problems in accounting for the production—a large number of streams (650); gas wells, flowing and gas-lifting oil wells, water injection wells; water-flood projects (6); jointly-operated wells; commingled leases; and metered production. There are only eight tank batteries involved; however, daily-operated oil production is upwards of 76,000 B/D.

Fieldwide pilot testing of this system was started Feb. 1, 1963. (Fig. 2).

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Input

Input data to this system is obtained from the gauger's daily report, and from other card-punching schedules prepared by the field production accountants. These are submitted, as necessary, to data processing for card punching and subsequent introduction to the computer system. (Fig. 2).

The gauger's daily report, in order to be used as an input form to the system for direct card-punching, required revision in order to satisfy both operational and machine requirements. However, this has resulted in eliminating many possible errors since the basic well data does not have to be transcribed to another punching schedule. This report form is now pre-printed by data processing prior to distribution to the field. Pre-printed data includes company well serial

number (basic identification code), lease name and well number, location codes and the date. Here again, possible coding errors by the gauger have been eliminated and repetitions daily information does not have to be copied.

The other punching schedules, which were designed for this system, are prepared by the production accountants and, as necessary, with the assistance of the production engineers. One form is used in setting up this system in any new field or area. It contains essential basic well information and is prepared only once for each well. The other two schedules pertain to wells and batteries, respectively. Entry of new wells or recompletions and control codes, corrections of well production and allowable data, and when necessary, changing

a well from one battery to another are accomplished on one schedule. The battery schedule is used to set up new batteries and furnished current battery production data and/or corrections.

All input forms have been designed to be as simple as possible. Also, by combining data on the forms, the number of punching schedules that must be prepared and handled has been kept to a minimum.

Output

To date, the output data from this system includes the production vs allowable report; a monthly well test summary; a listing of oil, solution gas, condensate, and gas well gas production by wells and leases; well locator cards; input cards for preparing the company "Summary of Well Production" report; and an estimate of oil to hold in the tanks at month end to cover overproduction. (Fig. 2).

The production vs allowable, or "over-under" report, is prepared at specified intervals during the month and at month end. It lists all wells, compares the net production and allowable, and indicates the amount of over or under production. Also shown are the date of last choke change, number of tests taken for the month, and the date and amount of the last test.

Net production under the manual system is available only at month end, which is too late insofar as accurately adjusting over or under produced wells for that month. With the computer system, all reports reflect net production compared to an allowable automatically adjusted for prior cumulative overproduction. The advantage is obvious. No gross-to-net corrections have to be made, net production is more current, and more timely well adjustments can be made.

The well test summary lists, by wells, all test data and pertinent remarks relative to production fluctuations and/or downtime. Some difficulty has been experienced in this report, primarily in the timing and in the "remarks" that were originally noted by the gauger. It is hoped that this trouble has been eliminated. Test data are arranged in the same sequence as the Louisiana Conservation Department's "Monthly Well Potential Report" which is filed bi-monthly for allowable purposes. This should facilitate preparation of this report by the production engineers.

The listing of net oil, solution gas, condensate, and gas-well gas, by wells

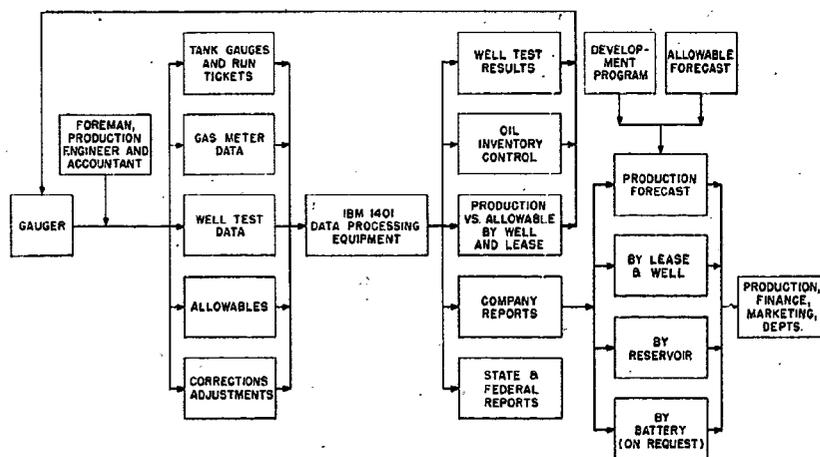


Fig. 1—Complete computer aid system.

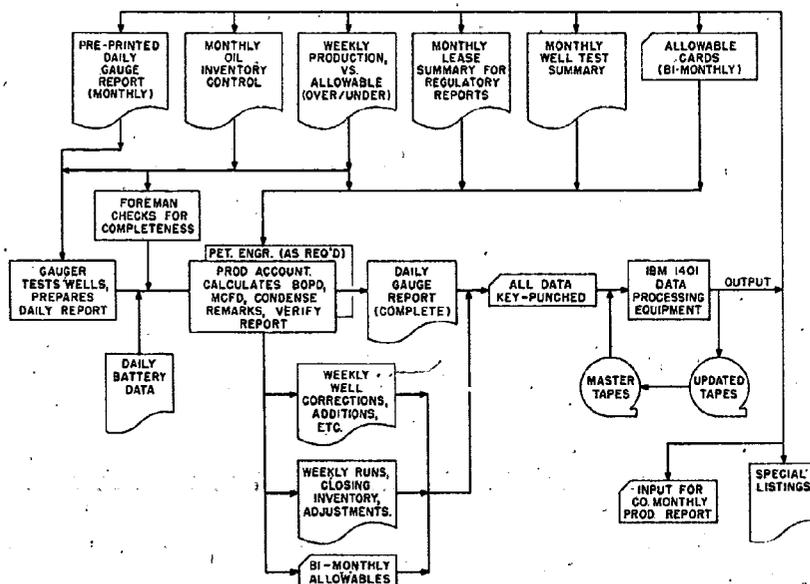


Fig. 2—Schematic diagram showing initial phase or present computer system.

presents all data totaled by sand, lease, organization unit and by battery. Also totaled are the number of producing streams. This was done to facilitate preparation of many federal, state and company reports. At this time it is not economical for data processing to prepare these reports since there are so few final copies for this single area and since it involves purchase and stocking of special forms adaptable to the IBM 1403 printer.

The estimate, by leases, of the amount of oil to hold at month end to cover overproduction is obtained by protecting the last test and allowable, adjusting for current over or under production and correcting by the most recent allocation factor. In critical situations, this listing should aid in the prevention of inadvertently running "hot oil."

Solution gas allocation is also accomplished through the computer system. During this, and other processing, input cards for preparation of the company "Summary of Well Production" report are obtained. These data, heretofore, have been key-punched from a production accounting schedule. This schedule should eventually be eliminated.

Well locator cards simply contain all description information and codes pertaining to each well. Each time a correction is entered, a new card is written. Thus, a current file of all basic well information is available at all times.

To date, no special forms are required as all output is printed on stock paper. Eventually, with machine preparation of final reports directly (federal, state, company) this will be necessary.

General Procedure

On the pre-printed and pre-dated daily gauge report, all basic well information, including well test data and any remarks pertinent to production fluctuations or downtime, is entered by the gauger. No tank gauges, sales etc. are reported since all storage and runs to pipelines are handled from one terminal. These data are submitted separately. (Fig. 2).

The daily gauge reports are received in the area office during the day after "gauge-off" time at 7:00 a.m. Operating personnel at Bay Marchand feel it necessary in order to properly operate their business, to retain the reports for a day in order that all foremen have a chance to examine them. While this is a delay,

it also helps to insure that all well and test data have been entered.

Reports are received in the division office the next day. All well tests are calculated and/or verified by the production accountants. All remarks are checked and condensed, if possible. Gas charts from the well tests are read, and test gas volumes calculated and entered on the gauge report. Upon completion, this report is mailed to the data processing section for key-punching and subsequent processing.

For the Bay Marchand field, allocation of production to wells and preparation of the production vs allowable report is done weekly. Thus, on each "cut-off" day, the production accountants must also submit a weekly total of oil runs and oil inventories plus all necessary well or battery corrections. Since all storage and sales are handled from one terminal, there are only some eight run tickets per day. Therefore, computer calculation of gross-to-net oil runs is not economical at this time. Net runs, closing inventory and all other well and battery adjustments and corrections are submitted on the appropriate punching schedule.

All data received in data processing are key-punched for immediate or future processing. Weekly processing includes the calculation of net production, allocation of production to wells based on well tests, and preparation of the production vs allowable report. The finished report, listing all wells by appropriate gauger groupings, is mailed back to the field. It is received the next day, in time for crew change, which is also done weekly. As of now, each weekly report is received by the field on Wednesday and covers the period up to 7:00 a.m. of the previous Sunday morning. This is still one to two days ahead of the manual preparation and reflects net instead of gross production.

At least four days before month end, the listing of the estimate, by leases, of the volume of oil to hold at month end to cover overproduction is furnished to the field.

Month-end processing includes the well test summary; listing of oil, solution gas, condensate, gas well gas and producing streams; and solution gas allocation. All reports are furnished to the proper personnel. Month-end processing also furnishes input cards for the company "Summary of Well Production" report.

Every other month end, pre-punched allowable cards are furnished

the field production accountants. After the new allowables are indicated on the cards by the field, they are returned to data processing; allowables are punched in the same card, and the data is entered during the first weekly processing.

Results

Results to date have been good and the system so far has been well received. Pilot testing has resulted in more accurate and more timely production data in addition to eliminating routine and time-consuming production allocations and reporting. The fine cooperation of the operating personnel has contributed much to this success.

The progress made so far represents only the initial phase in developing the complete computer production aid system. Immediate objectives, or the second phase, of the system are presently in the process of being set up for pilot testing (Fig. 3). These include the computer calculation of well-test liquid and gas volumes from basic observations made by the gauger, i.e., opening and closing gauge or meter readings, time on and off, etc., and further refinement of the well test summary. This will necessitate redesign of the gauger's daily report so basic observations and pertinent remarks can be key-punched directly. However, this will allow direct entry of test data into the system without verification or calculation by the production accountants. Manual preparation will be further reduced, and it should speed up the flow of input data.

Thorough pilot testing of the different phases will provide the basis for future work and the general application of the system.

Future Objectives

Future objectives already planned for introduction at the proper time include the computer calculation of run tickets, maximum machine preparation of production reports now prepared manually, improved data transmission methods and expansion of the system to include other operating areas.

Some preliminary work has already been done on the calculation of run tickets by computer. Presently, it cannot be justified because of the small number being handled by the pilot test field. Although testing is planned, this will probably not be completed

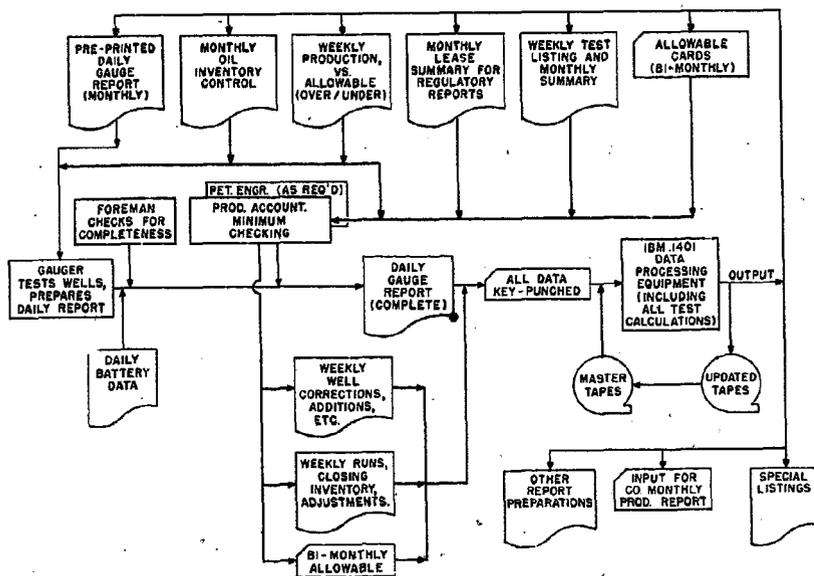


Fig. 3—Schematic diagram of second phase of computer system—computer calculation and direct entry of well-test data.

until other operating areas are included in the system.

Many final company, state and federal reports will be prepared as the system is refined and expanded. Some of the necessary data are now available. However, since it involves purchase and stocking of special "printer" forms, it has been decided to wait until at least one more area is included in the system before proceeding along this line.

At present, most of the data flow is handled by U. S. mail and the company aircraft. Some areas, because of their location, will undoubtedly require some type of remote automatic transmission equip-

ment. However, cost appears to be the determining factor here.

It is not planned to include any additional operating areas until the basic system and refinements have been thoroughly tested.

Conclusions

From the beginning, it was planned to proceed step by step towards attaining a complete computer production aid system. Accomplishments have been significant so far; however, there is still much to be done. This approach is felt to be the best and, as such, stands the best chance for overall success.

Naturally, any new system, and particularly a new computer system,

requires changes in methods and procedures. The introduction of only a few changes at one time results in a minimum of disruption, yet provides a good basis for the next few changes that have to be made. Operating personnel are thus properly indoctrinated to the new system, and maximum over-all benefits are obtained.

Our operating personnel appreciate this type of approach as evidenced by their excellent cooperation.

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