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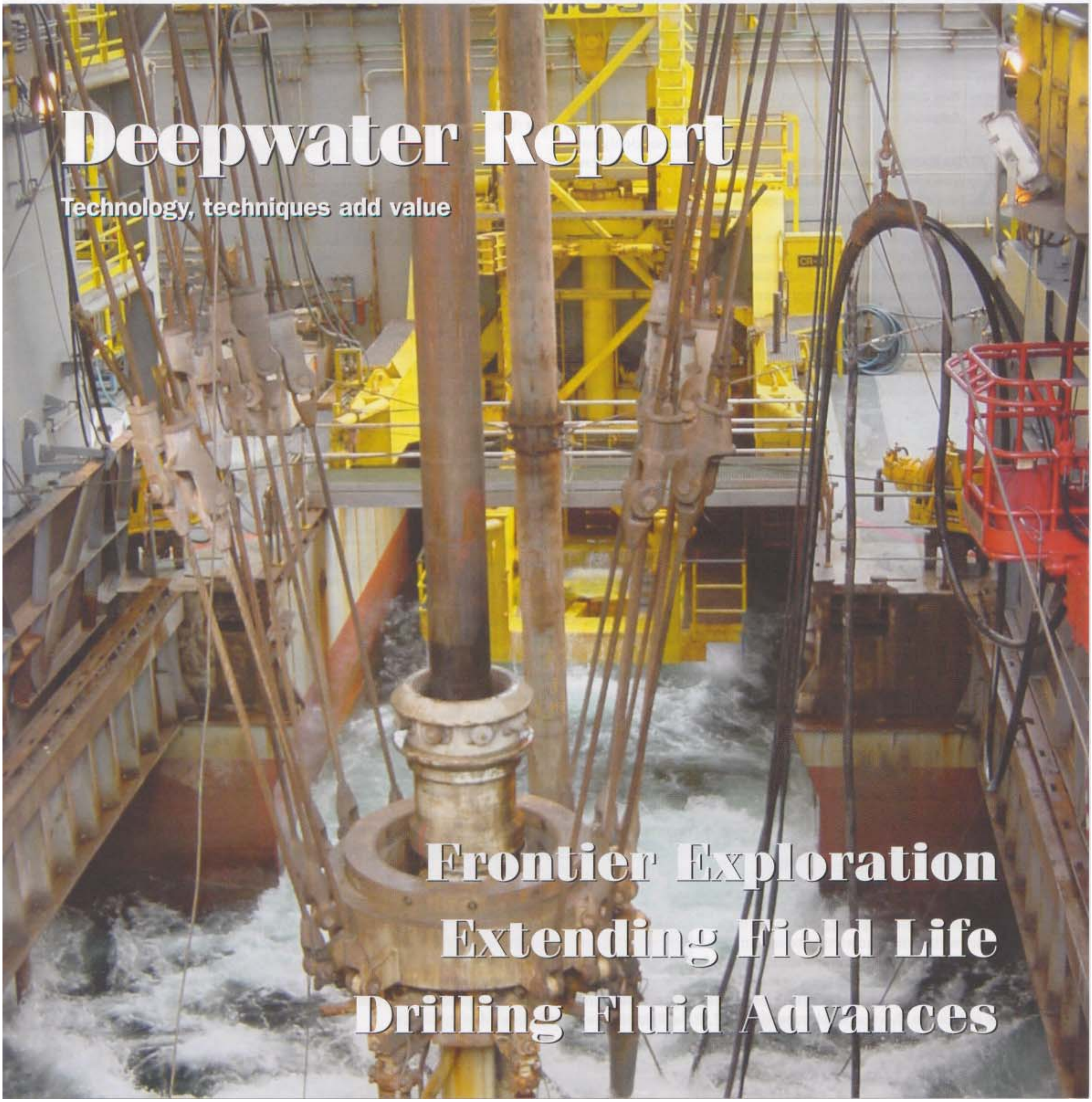

Well optimization extends reservoir life

Field automation means fewer failures, less downtime and more efficient use of personnel.

AUTHORS

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XTO Energy is a domestic producer with a history of acquiring properties where technology can be used to increase profitability and consequently extend the life of the reservoir. XTO optimizes assets through drilling, workovers, and cost reductions. This article focuses on reducing operating costs using well optimization technology.

Since operating costs are a contributing factor to the cost per barrel of production, minimizing operating costs reduces the production cost per barrel. Production cost per barrel is defined as field overhead expense coupled with costs associated with the operation of the producing wells, including workovers, utilities, repairs, maintenance, chemical treatments, and labor.

Profitability of the asset can decrease as well production declines (as represented by the decline curve in Figure 1). Eventually, the well becomes unprofitable and is temporarily or permanently abandoned. By reducing production costs, the well is immediately more profitable and the economic life of the reservoir is extended.

By using both hardware and software as a single system, XTO is able to reduce production costs by incorporating the optimization system into their organization. Each morning, the well specialist uses the software to review data scanned from producing wells fitted with intelligent controllers to make informed decisions about which wells need attention that day. He then prioritizes an action plan to address well conditions that are less than optimal. Finally, the appropriate personnel and resources are dispatched to these high priority wells with knowledge based on data received from rod pump controllers (RPCs) and analyzed with the desktop software system. This process reduces the time to trouble shoot a problem well and significantly reduces mean time to repair (MTTR). This is because quickly finding problems often results in failures that are less catastrophic when they do occur.

For example, when a well consistently pumps off and cycles several times per day, but suddenly runs continuously twenty-four hours per day with out pumping off, the production optimization system immediately identifies the change. This condition usually means that the fluid level is remaining at a high level, which could indicate a change in reservoir behavior or more likely, a tubing leak. Finding and repairing the leak minimizes deferred production and eliminates the excess cost of pumping an inefficient well.

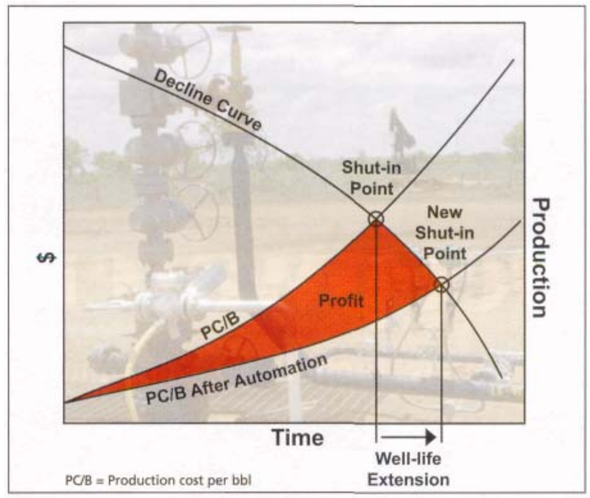
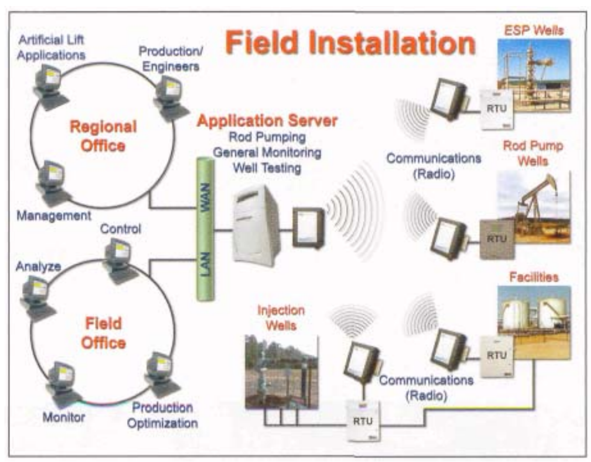


Figure 1. By reducing production costs, the well is immediately more profitable and the economic life of the reservoir is extended.

The Fields

XTO uses production optimization systems in two West Texas fields, the Prentice North East Unit and the Cornell Unit. XTO assumed operations of the Prentice field in 1994. The beam pumped well count increased from 85 to 145 by the end of 2002. The field was equipped with rod pump controllers manufactured by eProduction Solutions and a supervisory control and data acquisition (SCADA) software system. The initial SCADA system was beneficial, but due to software limitations, an automation/optimization software system from Case Services was installed in 1998 to maximize the benefits from the RPCs.

The Prentice field currently produces 3200 bopd and 65,000 bwpd with an average water cut of 95%. Currently, there are 149



OPTIMIZATION SYSTEM COMPONENTS

Field Item	Hardware	Software
Rod pumped well	Rod pump controller	Monitor, control, and analysis software
ESP well	Remote terminal unit	Monitor software
Injection well	Injection controller	Monitor, control, and analysis software
Well testing facilities	Programmable logic controller	Well test monitor and control software
Communication	Dedicated radio	

Figure 2. The components of the optimization system are listed in the table above and illustrated in the figure above (Figure 2).

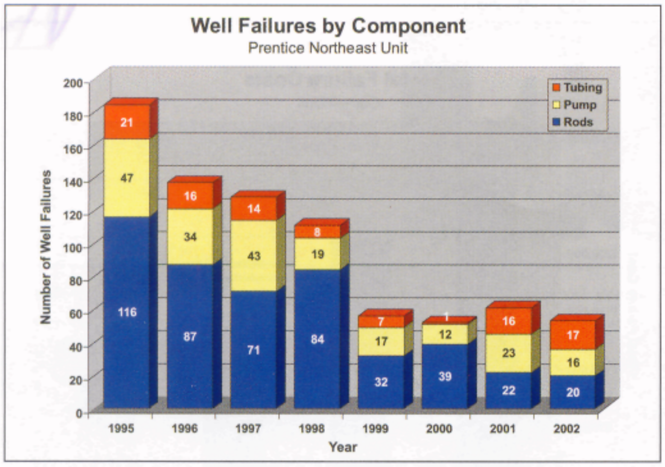


Figure 3. Well failures by component in NE Prentice Unit.

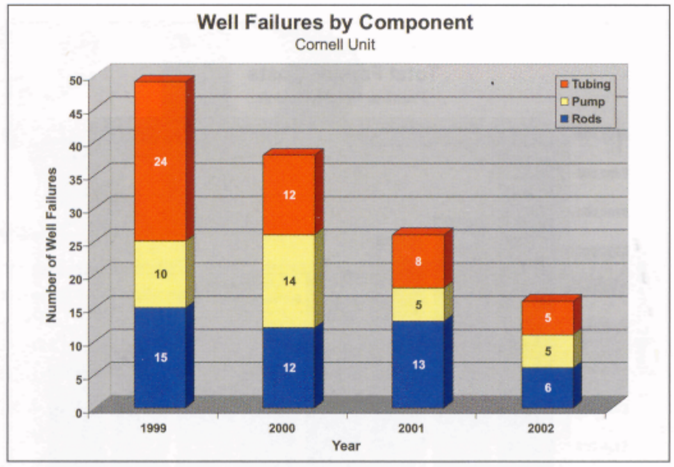


Figure 4. Well failures by component in Cornell Unit.

rod pumped wells and 53 ESP wells. The average well depth is 6900 feet.

XTO took over operations of the Cornell field in August 2000. All 60 wells were equipped with rod pump controllers, but none of the controllers were in service. After repairing and re-commissioning the rod pump controllers, an automation/optimization software system from Case Services was installed. At the end of 2002, 67 wells were automated with hardware and software.

The Cornell field produces 1600 bopd and 15,500 bwpd with an average water cut of 91%. Currently, there are 67 rod pumped wells and 1 ESP well. The average well depth is 5100 feet.

eProduction Solutions (eP) provides fully integrated production optimization systems like the one used by XTO Energy at these locations. In addition, eP provides installation, support, and training for the entire system, which simplified deployment. This allowed XTO to immediately realize measurable savings associated with the investment.

- Benefits of Well Optimization
- XTO realized savings to production costs in the following ways:
- Reduction in well failures
- Reduced down time
- More efficient use of personnel
- Utility cost reduction
- Reduction in well failures

The combination of intelligent hardware control at the well site and software analysis at the desktop provides a system that allows the operator to fine tune well operations to minimize fluid pound and maximize equipment life. By using the information provided by the system (e.g. surface cards, down-hole cards, run-times, and gear box torque), the operator can monitor, analyze, and control the operation of each well.

The routine review of the well's operating parameters assures that the well is producing optimally and does not exceed the stress limits of the lifting system. This leads to a substantial reduction in the average failure rate.

The "management by exception" feature of the software further reduces well failures by predicting problems before they occur. The operator sets warning limits (high, high-high, low, and low-low) that can indicate whether a particular monitored point is out of range or dangerously high (exceptions). Wells that have exceptions are displayed in a separate window so the operator does not need to search through the entire list of wells to identify those that need immediate attention.

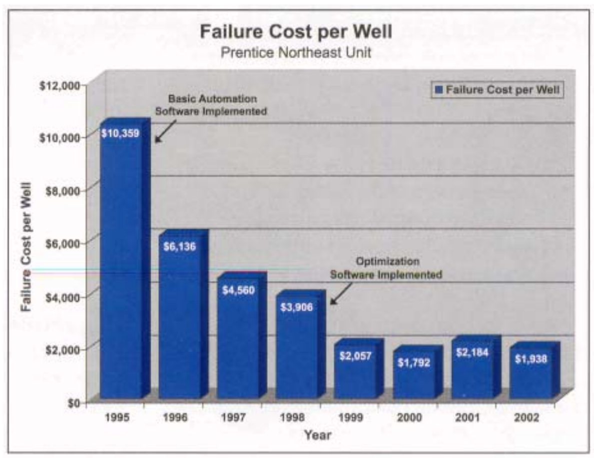
Reduced down time

By using a totally integrated decision management system, the operator is able to immediately determine when a well is down. Alarms provide instant notification of faulty conditions and a call out system can notify the appropriate personnel quickly; with the goal of getting wells back on production as soon as possible.

When wells do fail, the operator is able to send a crew to the well armed with knowledge from the history recorded in the software. From this information, the repair crew has an accurate idea of the problem before traveling to the well. This allows a maintenance crew to have the necessary resources to repair the problem in one trip.

More efficient use of personnel

Because the operators are able to identify problems and potential problems from the



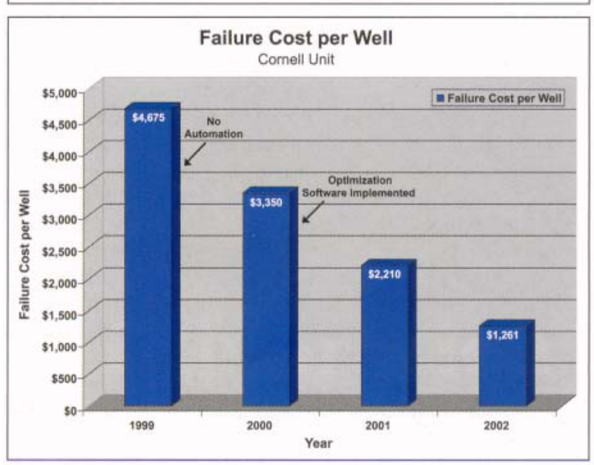


Figure 5 and 6. Failure costs per well are shown for each unit. Total failure costs for Prentice NE were cut from $880,500 to $281,000 over the same period. At Cornell, total failure costs dropped from $280,500 to $84,500 in 4 years.

Figure 7. Total failure cost in NE Prentice Unit.

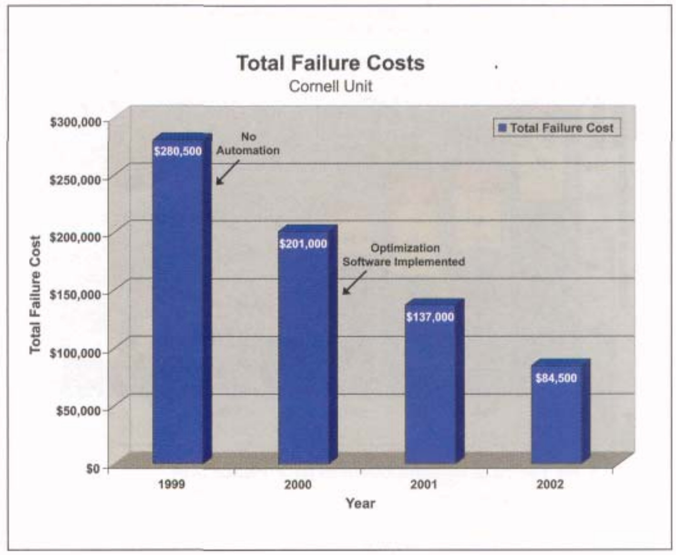


Figure 8. Total faiure costs in Cornell Unit.

office, the need to send employees to monitor wells is reduced. While visits to the well are still needed, the frequency is decreased. Now, rather than having personnel out searching for problems, they are able to maximize their time by fixing current problems and preventing future problems.

Utility cost reduction

Numerous papers and studies have shown that rod pump controllers can reduce electrical consumption and therefore electrical costs by as much as 40%. XTO couples the rod pump controller technology with optimization software to gain the maximum savings.

The rod pump controller saves electrical costs by reducing run time (while maintaining or sometimes increasing production). When operated on timer, the well can be pumped off but still running. Essentially, the well is using electricity to operate a pump that is yielding no fluid. The rod pump controller senses pump off and shuts the well down until the reservoir raises the fluid level in the well bore.

The software provides the user with the ability to optimize the rod pump controller to minimize electrical costs. The user can analyze the well and make changes to parameters remotely so that the well runs the optimum amount of time.

Cost Benefits of Well Optimization

The cost benefits were measured by the decrease in rod, pump, and tubing failures as presented in the diagrams below (Figures 3 and 4).

The reduction in failures resulted in a substantial decrease in failure costs. The charts below (Figures 5, 6, 7 and 8) show the failure cost on a per-well and total basis. The data that provides the numbers of wells is taken directly from field records. The costs per repair are based on a constant cost per repair that was derived from field experience. A significant portion of the reduction in failure costs is due to the implementation of the basic SCADA software system and the accelerated savings from the automation/optimization system.

Even as the total number of wells increased, the total number of well failures decreased. The failure rate per well decreased significantly (Figure 9 and 10).

Intangible Benefits

In addition to the savings from the reduction of failures, several intangible benefits were noted. These benefits are based on field experience. While there is no hard data to quantify the results, general cost savings were realized beyond the savings from failure reduction.

Water injection management efficiencies

By using injection-monitoring hardware at the well site and injection software at the desktop, the operator knows almost immediately when water break-through occurs and can pinpoint the source. Such knowledge allows for optimum reservoir injection management.

Meeting injection targets is enhanced by the quick identification of plugged injection meters. With this knowledge, meters are cleaned in a timely manner and injection goals can be achieved on schedule.

Injection monitoring was used to diagnose the results of a new well completion. The completion resulted in 100% water production. Logs were unsuccessful in determining the source of the water. Monitoring of offset injectors suggest the problem is due to communication behind pipe to an upper zone that is flooded in the offset injectors. A workover to repair the well is being evaluated.

Chemical treatment management

By monitoring the size of the dynamometer card, the well analyst is able to determine when friction is building up in the pump. Comparing the cards before, during, and after chemical treatments allows the analyst to determine the optimum time to treat the well, rather than treating the well on a scheduled basis.

Conclusion

After making a calculated investment in technology and reevaluating how it could positively impact the operational organization, profitability of these two XTO fields dramatically increased. Consequently, they have extended the economic life through substantial savings in operating costs. While automation and optimization systems are not by themselves the answer to extending reservoir life, the key is technology that is exploited by individuals who understand the use of automation and analysis on a daily basis.

XTO chose to supply the tools to reduce operating expense and extend reservoir life. The significant improvements derived from that cost reduction will allow XTO to produce oil long after it would have, had it chosen to continue operating its assets using traditional methods. ESP

For more information call eProduction Solutions at 281-348-1000, or visit our web site at www.ep-solutions.com.