Rehabilitation of Mature Gas Fields in Romania: Success Through Integration of Management Processes and New Technology

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Abstract

Nature oil and gas fields are difficult to rehabilitate effectively because of the economics of declining production. Many fields are abandoned prematurely when their life could be prolonged significantly through application of new technology. Romgaz (a national exploration and production company) and Schlumberger (an integrated oilfield services company) developed a new business model to overcome these obstacles. The key to success of this model, which is being applied to gas fields in the Transylvanian basin of Romania, is the shared risk and shared reward for the two companies. Integrated management processes addressing the complete system from reservoir to wellbore to surface/transmission facilities and application of new technology (logging, perforation, etc.) have resulted in multifold increases in production.

Key words*: nature oil and gas, management processes*

Introduction

The biggest challenge when considering production enhancement initiatives for mature fields is the marginal nature of the associated economics due to required engineering, low production rates, and project risks. Mature assets seldom attract the required geologic and engineering initiatives required to identify economic opportunities. This results in a lack of investment and a continuing downward production spiral that typically leads to premature field abandonment.

This paper describes how Romgaz and Schlumberger established an alternative commercial arrangement, and together built an effective team that is rejuvenating declining gas assets. This new business model overcomes traditional barriers to effective mature field rehabilitation. The key to the success of this model is risk and shared reward between an operating company and a service company. Several new technologies have been employed during the course of this field rehabilitation project. In addition, the project has spawned multiple improvements in field practices. Details of the project conceptualization, field implementation, and effects on production and reserves recovery are discussed below.

A Unique Management Process Between a National Exploration and Production Company and an Integrated Service Company

Romgaz, in identifying a business model to begin field rehabilitation, was uncertain if a service company would be interested in a long-term risk/reward partnership. The synergies between Romgaz and Schlumberger emerged when both realized that the risks of rehabilitation could be shared, with Romgaz having the knowledge and experience of the asset and Schlumberger possessing new technologies to allow a better understanding of possible opportunities. Each would not take on the risks involved alone. Rather, the risks could be shared and minimized, providing an economic attractiveness for a mature field enhancement project.

Historically, Romgaz, like many other operators, envisioned supplying the engineering and either directing contracted services to be provided or requesting advice on implementing solutions identified by in-house specialists. However, in the past few years, operator/service company relationships have been undergoing changes that Romgaz desired to explore. Recently, service companies began growing problem-solving teams that were attractive to many major oil and gas companies. During the expansion of these multidisciplinary teams, risk-modeling tools were better utilized, allowing service companies to take risks that previously they had been unwilling to accept. Operators were being presented with an alternative source of diverse world-wide multidisciplinary expertise and experience. Over the past several years, operating companies have successfully utilized alliances with service companies to generate value.

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The Romgaz-Schlumberger alliance resulted in benefits to both parties. Romgaz obtained a partner to investigate, evaluate, and implement economic opportunities to obtain incremental gas production, but continued as the operator with ownership of the total asset and its associated reserves and production. It was very important for Romgaz to continue to control the gas sales in order to meet its commitments and financial growth. Schlumberger obtained more influence on how to apply appropriate technologies and a method of payment reflecting its achievement in obtaining financial gain from incremental production. Both Romgaz and Schlumberger share the risked investment. If the alliance is successful, both gain. If the alliance is unsuccessful, then both lose. It is to the advantage of both parties to work together for the achievement of the alliance.

Case Example: Laslau Mare Field, Transylvanian Basin, Romania

In 2003, Romgaz and Schlumberger entered into a long-term risk-sharing association to rehabilitate Laslau Mare gas field in the Transylvanian basin of central Romania (Figures 1 and 2). The field has been producing for more than 25 years and has 51 producing wells out of a total of 72 wells drilled. Gas reservoirs in Laslau Mare field are contained in a Miocene sand-shale sequence in a subtle WNW-ESE elongate anticline formed as a result of underlying salt movement. The reservoir produces dry gas (>99% methane) from depths between 1800 and 3200 meters. Gas rates in individual wells had fallen (Figure 3) from previous highs of 300,000 m^3/d to current rates between 1,000 and 33,000 m^3/day. Estimated recovery with optimal field development is 85 percent of Gas Initially In Place (GIIP).

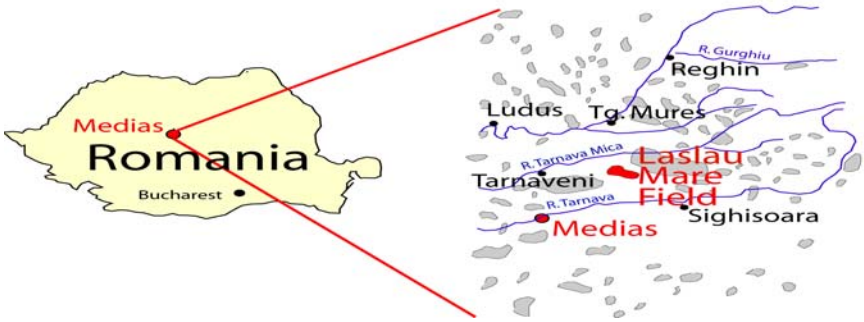

Fig. 1. Location of Laslau Mare gas field in the Transylvanian basin of Romania. Gray areas are other gas fields.

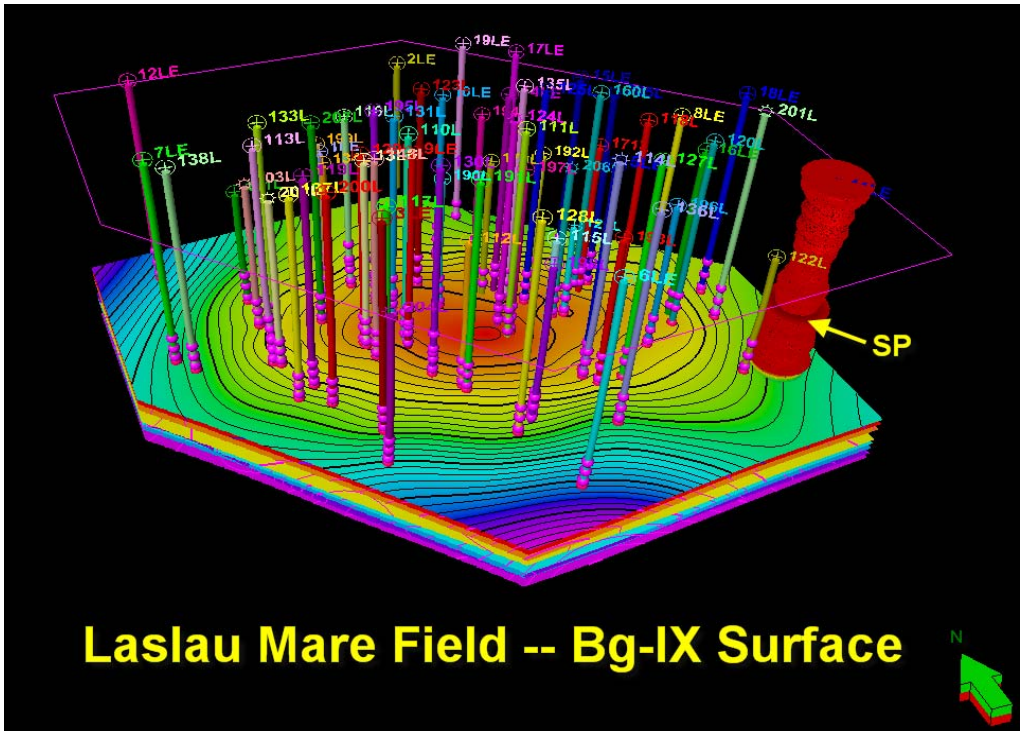

Fig. 2. 3D block diagram showing top of Bulgovian structural surface. Red colors represent the shallowest structural depth.

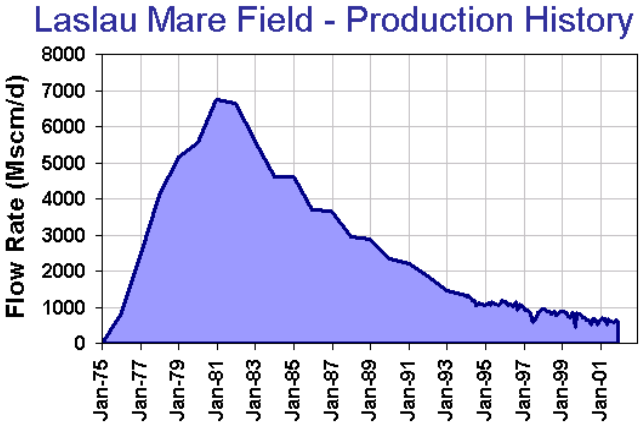

Fig. 3. Plot of monthly average daily production for Laslau Mare field prior to start of rehabilitation project.

Subsurface: High Technology, Low Cost

The initial stage of the project involved compilation and analysis of existing data, focused collection of new data, and well interventions designed simultaneously to increase production and to evaluate the way forward. The complex nature of the vertically stacked sandstone-shale reservoir interval provides opportunities for identification of bypassed reserves and discovery of new production potential. However, the conventional technology and methodology previously used were not capable of delivering the desired results.

Fortunately, significant software and tool developments now make possible rigorous measurement of formations through tubing and behind casing. These innovative, case-hole wireline services facilitate determination of porosity, lithology, shale content, fluid saturation, and pressure. Advanced formation evaluation also aids in identification of additional or initially unrecognized zones and in identification of bypassed hydrocarbons.

RST* (Reservoir Saturation Tool) logging (Figure 4) is being used in Laslau Mare field to identify zones for perforation and re-perforation. ABC* (Analysis Behind Casing) logs, run on two wells in Laslau Mare field, have been used to calibrate and validate interpretations of the RST logs. RST was run through tugging and after tubing removal for calibration in these two wells. Due to the success of this program, RST is now being run without pulling tubing in other wells. This is a significant, innovative new application of this technology. This combination of ABC and RST logging resulted in selection of gas-bearing intervals that were perforated using state-of-the-art PowerJet* technology, resulting in production increases as high as 500 percent in individual wells. These highly successful, multifold increases in production realized on early interventions clearly demonstrate the benefit of the new technology and give every indication of a bright future for the project over the long term.

The long term program for Laslau Mare field includes full-field production optimization. Existing, old open-hole logs are being re-evaluated using newly available software techniques and are being calibrated to results of the new cased hole logging. These data are being used to develop static and dynamic reservoir models, as well as surface facilities models to optimize the development concept from the reservoir through the wellbore to surface facilities and gas transmission for sale.

Surface Facilities: De-bottlenecking, Operational Optimization

In the surface domain, the primary actions have been targeted at system efficiency via de-bottlenecking of facilities and the addition of process flexibility that better aligns facility capabilities with actual mature field operating conditions. The de-bottlenecking occurs in phases, starting with observation and evaluation of pressure drops followed by a program of removal of these and other observable restrictions to production. A PIPESIM* network simulation model was used to identify subtle infrastructure optimizations. The most immediate action involved the compressor station serving the field, where piping was reconfigured to isolate field production to a single bank of compressors, thus allowing better operational control of field production. This resulted in production gains of 20 percent. Other phases of this program involve installation of boost compression to allow a decrease in bottom-hole flowing pressure and corresponding increases in gas production.

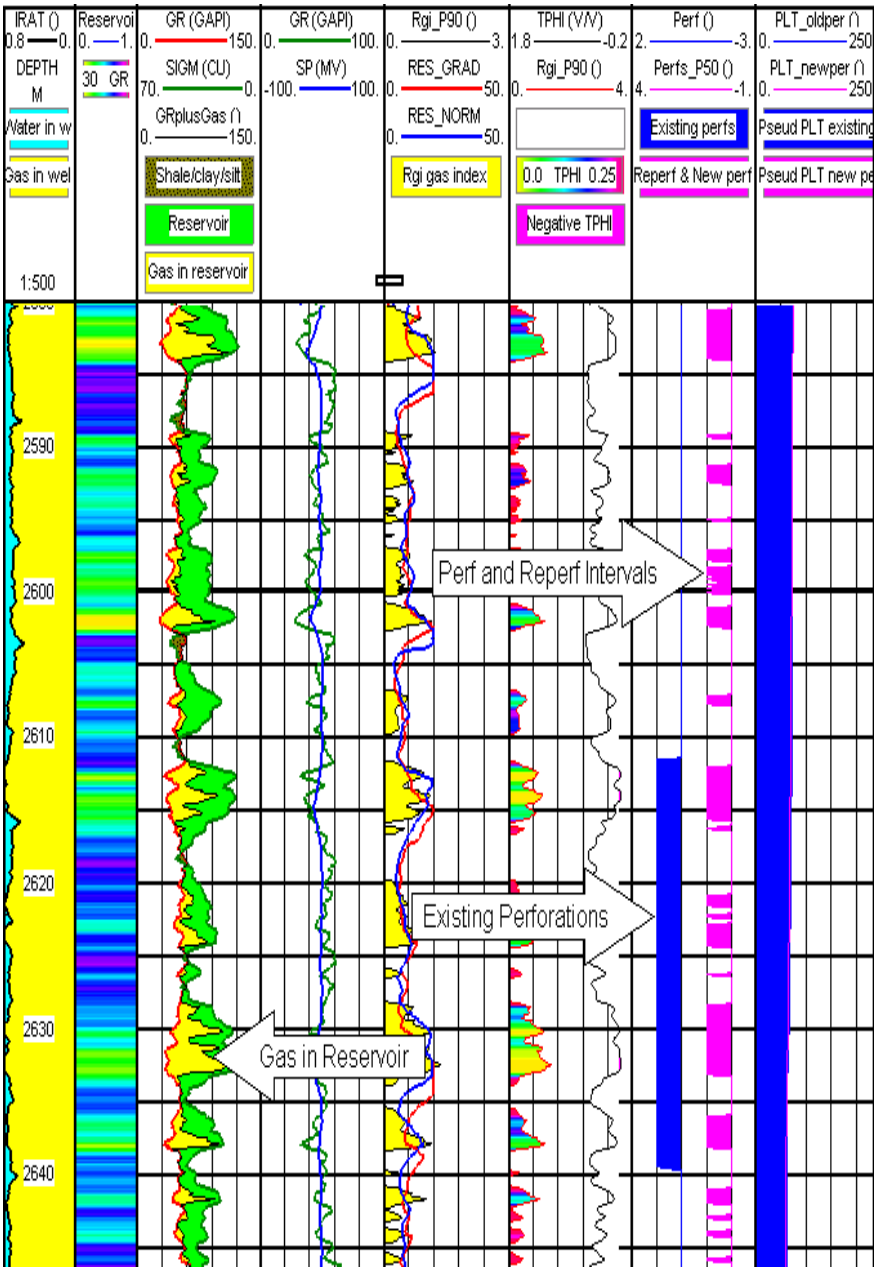

Fig. 4 Interpreted RST log from a well from Laslau Mare field, showing gas saturated intervals (Yellow intervals in third column from left). Zones for new perforation and reperforation are indicated by pink intervals in second column from right. Existing perforated intervals are shown in blue in the second column from the right.

Conclusions: Why Such a Business Relationship is Successful

The Romgaz-Schlumberger mature field rehabilitation association has involved a very intensive communication and negotiation effort by both parties. By building mutual trust, a win-win position was found, and the effort of creativity and innovation grew very positively. A new business relationship was made using both parties' best-in-class organization to create a very favorable working environment. The key to success of the relationship is the shared risk and reward.

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