Development of a North Marmara Field Offshore Turkiye: A Case Study

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ABSTRACT
After the discovery of natural gas at the first well in North-Marmara (NM-1) offshore field in the Sea of Marmara in 1988, studies were conducted to determine the options for an efficient field development. The field is 2.5-3 kms far from land and has water depths around 35-50 meters. One of the first decisions made during the study was to further test the field by drilling a deviated path into the reservoir from onshore. Unfortunately, at that date it was rather difficult to perform an Extended Reach Drilling (ERD) Wells. Since the well was dry no further work was performed on this field until 1995.

Majority of the natural gas consumed in Turkey is mostly imported as LNG or dry gas. By 1995 the increase in demand for natural gas combined with increases in natural gas prices made development of the North Marmara offshore field more feasible. An additional argument in favor of the North Marmara field development is that once the field is exhausted it can be used as an underground gas storage facility during the off-peak gas use during the summer months and supplement the gas consumption during the peak use in winter months. Consequently 5 more wells were drilled, 1 vertical and 4 deviated wells, using a jack-up rig from the same offshore location.

KEY WORDS: Drilling, ERD, gas field, reservoir as storage facility, offshore Turkey

INTRODUCTION
History of offshore drilling in Turkey dates back to the mid-960s. A total of 26 offshore wells have been drilled to date, 4 wells in the Black Sea, 10 wells in the Sea of Marmara, 3 wells in the Aegean Sea, and 9 wells in the Mediterranean Sea. The first Turkish offshore commercial gas discovery occurred in 1988 with the drilling of the first exploration well (i.e., Phase 1 work) in North Marmara Field (NM-1 - See Figure 1/A and Figure 1/B). The North Marmara field is very close to land and the farthest point of the reservoir is about 3 kms from shore (See Figure 2).

TPAO's decision to drill the second well from land in 1988 was based on proximity of the field. Due to lack of experience and the characteristics of the drilling equipment, the desired well path could not be achieved and the directional drilling resulted in only 421 meters of lateral displacement, instead of the desirable 1200 meters to reach the gas-bearing zones of Sogucak limestone formation. As a result, further plans for drilling the wells from land were suspended until completion of a detailed study. The studies on well designs and paths were completed and the budget for the project prepared by the end of 1995, which resulted in the decision to drill 5 new offshore wells in order to start up production. TPAO drilled the five wells in a two-year period (i.e., Phase 2 work) and the production started with an average 0.5 MMm3/d (design production capacity of 1.9 MMm3/d) in October 1997.

This field is very close to the major gas consumption area (i.e., Istanbul - See Figure 1/B) and TPAO is currently working on the ways to evaluate the alternate scenarios for the rapid depletion of the field and the use of the reservoir as an underground gas storage facility (i.e., Phase 3 work) to supplement the gas consumption during peak use during the winter months.

DRILLING
The first North Marmara field well was drilled from a jack-up drilling rig "Penrod-58" in 1988 following the award of a contract to Penrod Inc. for three different offshore exploration projects in Turkey. The decision to award the contract was primarily based on economics rather than technical merits. Penrod-58 was mothballed in Kavalla; Greece for three long years, unmanned and not maintained, requiring substantial rig modifications prior to the start of a drilling program.

After Penrod-58 was brought to the North Marmara field site further maintenance/upgrade work had to be performed prior to drilling. A summary of the Phase 1 and Phase 2 drilling programs is as follows:

(A) Phase 1 Drilling Program

(1) North Marmara-1 (NM-1) Vertical Well
At the entrance to Sogucak Limestone in 1143 meters, a gas kick was encountered and the mud weight had to be increased up to 98 lb/cu ft in order to stop the kick. After running the 9-5/8 inch casings to 1141 meters, two intervals (i.e., 8-1/2 inch hole at 1141-1158m and 1190-1261m) were tested with DST tools. This first well proved to have a good gas production capacity and the well was shut-in for further evaluations in the future.

(2) North Marmara-2 (NM-2) Deviated Well
The NM-2 well, the second well drilled in 1988, is an onshore well intended to test the northern section of the field to north-west extension. NM-2 is almost 2.5 km from NM-1 in north-west direction (See Figure 2). This drilling rig had to be placed in the middle of a beautiful and crowded resort and the political pressures resulted in the