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-- THIS IS THE FIRST SPE COMPARISON PROBLEM,"COMPARISON OF SOLUTIONS TO A

-- THREE-DIMENSIONAL BLACK-OIL RESERVOIR SIMULATION PROBLEM", REPORTED

-- BY AZIS AND [ODEH](odeh.pdf) AT THE SPE SYMPOSIUM ON RESERVOIR SIMULATION ,

-- JANUARY 1981. IT IS A NON SWELLING AND SWELLING STUDY. A REGULAR

-- GRID WITH TWO WELLS (INJECTOR AND PRODUCER) AND AN IMPES SOLUTION METHOD

-- IS USED FOR THIS SIMULATION.THE PRODUCTION IS CONTROLLED BY FLOW RATE

-- AND MIN. BHP. OIL RATE, GOR, PRESSURE AND GAS SATURATION ARE TO BE REPORTED.

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**RUNSPEC**

[TITLE](Keywords/T/TITLE.docx)

ODEH PROBLEM - IMPLICIT OPTION - 1200 DAYS

[DIMENS](Keywords/D/DIMENS.docx)

10 10 3 /

[NONNC](Keywords/N/NONNC.docx)

[OIL](Keywords/O/OIL.docx)

[WATER](Keywords/W/WATER.docx)

[GAS](Keywords/G/GAS.docx)

[DISGAS](Keywords/D/DISGAS.docx)

[FIELD](Keywords/F/FIELD.docx)

[EQLDIMS](Keywords/E/EQLDIMS.docx)

1 100 10 1 1 /

[TABDIMS](Keywords/T/TABDIMS.docx)

1 1 16 12 1 12 /

[WELLDIMS](Keywords/W/WELLDIMS.docx)

2 1 1 2 /

[NUPCOL](Keywords/N/NUPCOL.docx)

4 /

[START](Keywords/S/START.docx)

19 'OCT' 1982 /

[NSTACK](Keywords/N/NSTACK.docx)

24 /

--[FMTOUT](Keywords/F/FMTOUT.docx)

--[FMTIN](Keywords/F/FMTIN.docx)

[UNIFOUT](Keywords/U/UNIFOUT.docx)

[UNIFIN](Keywords/U/UNIFIN.docx)

--[NOSIM](Keywords/N/NOSIM.docx)

**GRID** ================================================================

-------- IN THIS SECTION , THE GEOMETRY OF THE SIMULATION GRID AND THE

-------- ROCK PERMEABILITIES AND POROSITIES ARE DEFINED.

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-- THE X AND Y DIRECTION CELL SIZES ( DX, DY ) AND THE POROSITIES ARE

-- CONSTANT THROUGHOUT THE GRID. THESE ARE SET IN THE FIRST 3 LINES

-- AFTER THE EQUALS KEYWORD. THE CELL THICKNESSES ( DZ ) AND

-- PERMEABILITES ARE THEN SET FOR EACH LAYER. THE CELL TOP DEPTHS

-- ( TOPS ) ARE NEEDED ONLY IN THE TOP LAYER ( THOUGH THEY COULD BE.

-- SET THROUGHOUT THE GRID ). THE SPECIFIED MULTZ VALUES ACT AS

-- MULTIPLIERS ON THE TRANSMISSIBILITIES BETWEEN THE CURRENT LAYER

-- AND THE LAYER BELOW.

[INIT](Keywords/I/INIT.docx)

-- ARRAY VALUE ------- BOX ------

[EQUALS](Keywords/E/EQUALS.docx)

'DX' 1000 /

'DY' 1000 /

'PORO' 0.3 /

'DZ' 20 1 10 1 10 1 1 /

'PERMX' 500 /

'MULTZ' 0.64 /

'TOPS' 8325 /

'DZ' 30 1 10 1 10 2 2 /

'PERMX' 50 /

'MULTZ' 0.265625 /

'DZ' 50 1 10 1 10 3 3 /

'PERMX' 200 /

/ EQUALS IS TERMINATED BY A NULL RECORD

-- THE Y AND Z DIRECTION PERMEABILITIES ARE COPIED FROM PERMX

-- SOURCE DESTINATION ------- BOX ------

[COPY](Keywords/C/COPY.docx)

'PERMX' 'PERMY' 1 10 1 10 1 3 /

'PERMX' 'PERMZ' /

/

-- OUTPUT OF DX, DY, DZ, PERMX, PERMY, PERMZ, MULTZ, PORO AND TOPS DATA

-- IS REQUESTED, AND OF THE CALCULATED PORE VOLUMES AND X, Y AND Z

-- TRANSMISSIBILITIES

[RPTGRID](Keywords/R/RPTGRID.docx)

1 1 1 1 1 1 0 0 1 1 0 1 1 0 1 1 1 /

**PROPS** ===============================================================

-------- THE PROPS SECTION DEFINES THE REL. PERMEABILITIES, CAPILLARY

-------- PRESSURES, AND THE PVT PROPERTIES OF THE RESERVOIR FLUIDS

----------------------------------------------------------------------

-- WATER RELATIVE PERMEABILITY AND CAPILLARY PRESSURE ARE TABULATED AS

-- A FUNCTION OF WATER SATURATION.

--

-- SWAT KRW PCOW

[SWFN](Keywords/S/SWFN.docx)

0.12 0 0

1.0 0.00001 0 /

-- SIMILARLY FOR GAS

--

-- SGAS KRG PCOG

[SGFN](Keywords/S/SGFN.docx)

0 0 0

0.02 0 0

0.05 0.005 0

0.12 0.025 0

0.2 0.075 0

0.25 0.125 0

0.3 0.19 0

0.4 0.41 0

0.45 0.6 0

0.5 0.72 0

0.6 0.87 0

0.7 0.94 0

0.85 0.98 0

1.0 1.0 0

/

-- OIL RELATIVE PERMEABILITY IS TABULATED AGAINST OIL SATURATION

-- FOR OIL-WATER AND OIL-GAS-CONNATE WATER CASES

--

-- SOIL KROW KROG

[SOF3](Keywords/S/SOF3.docx)

0 0 0

0.18 0 0

0.28 0.0001 0.0001

0.38 0.001 0.001

0.43 0.01 0.01

0.48 0.021 0.021

0.58 0.09 0.09

0.63 0.2 0.2

0.68 0.35 0.35

0.76 0.7 0.7

0.83 0.98 0.98

0.86 0.997 0.997

0.879 1 1

0.88 1 1 /

-- PVT PROPERTIES OF WATER

--

-- REF. PRES. REF. FVF COMPRESSIBILITY REF VISCOSITY VISCOSIBILITY

[PVTW](Keywords/P/PVTW.docx)

4014.7 1.029 3.13D-6 0.31 0 /

-- ROCK COMPRESSIBILITY

--

-- REF. PRES COMPRESSIBILITY

[ROCK](Keywords/R/ROCK.docx)

14.7 3.0D-6 /

-- SURFACE DENSITIES OF RESERVOIR FLUIDS

--

-- OIL WATER GAS

[DENSITY](Keywords/D/DENSITY.docx)

49.1 64.79 0.06054 /

-- PVT PROPERTIES OF DRY GAS (NO VAPOURISED OIL)

-- WE WOULD USE PVTG TO SPECIFY THE PROPERTIES OF WET GAS

--

-- PGAS BGAS VISGAS

[PVDG](Keywords/P/PVDG.docx)

14.7 166.666 0.008

264.7 12.093 0.0096

514.7 6.274 0.0112

1014.7 3.197 0.014

2014.7 1.614 0.0189

2514.7 1.294 0.0208

3014.7 1.080 0.0228

4014.7 0.811 0.0268

5014.7 0.649 0.0309

9014.7 0.386 0.047 /

-- PVT PROPERTIES OF LIVE OIL (WITH DISSOLVED GAS)

-- WE WOULD USE PVDO TO SPECIFY THE PROPERTIES OF DEAD OIL

--

-- FOR EACH VALUE OF RS THE SATURATION PRESSURE, FVF AND VISCOSITY

-- ARE SPECIFIED. FOR RS=1.27 AND 1.618, THE FVF AND VISCOSITY OF

-- UNDERSATURATED OIL ARE DEFINED AS A FUNCTION OF PRESSURE. DATA

-- FOR UNDERSATURATED OIL MAY BE SUPPLIED FOR ANY RS, BUT MUST BE

-- SUPPLIED FOR THE HIGHEST RS (1.618).

--

-- RS POIL FVFO VISO

[PVTO](Keywords/P/PVTO.docx)

0.001 14.7 1.062 1.04 /

0.0905 264.7 1.15 0.975 /

0.18 514.7 1.207 0.91 /

0.371 1014.7 1.295 0.83 /

0.636 2014.7 1.435 0.695 /

0.775 2514.7 1.5 0.641 /

0.93 3014.7 1.565 0.594 /

1.270 4014.7 1.695 0.51

5014.7 1.671 0.549

9014.7 1.579 0.74 /

1.618 5014.7 1.827 0.449

9014.7 1.726 0.605 /

/

-- OUTPUT CONTROLS FOR PROPS DATA

-- ACTIVATED FOR SOF3, SWFN, SGFN, PVTW, PVDG, DENSITY AND ROCK KEYWORDS

[RPTPROPS](Keywords/R/RPTPROPS.docx)

1 1 1 0 1 1 1 1 /

**SOLUTION** ===============================================================

-------- THE SOLUTION SECTION DEFINES THE INITIAL STATE OF THE SOLUTION

-------- VARIABLES (PHASE PRESSURES, SATURATIONS AND GAS-OIL RATIOS)

------------------------------------------------------------------------

-- DATA FOR INITIALISING FLUIDS TO POTENTIAL EQUILIBRIUM

--

-- DATUM DATUM OWC OWC GOC GOC RSVD RVVD SOLN

-- DEPTH PRESS DEPTH PCOW DEPTH PCOG TABLE TABLE METH

[EQUIL](Keywords/E/EQUIL.docx)

8400 4800 8500 0 8200 0 1 0 0 /

-- VARIATION OF INITIAL RS WITH DEPTH

--

-- DEPTH RS

[RSVD](Keywords/R/RSVD.docx)

8200 1.270

8500 1.270 /

-- OUTPUT CONTROLS (SWITCH ON OUTPUT OF INITIAL GRID BLOCK PRESSURES)

[RPTSOL](Keywords/R/RPTSOL.docx)

1 11\*0 /

**SUMMARY** ===============================================================

-------- THIS SECTION SPECIFIES DATA TO BE WRITTEN TO THE SUMMARY FILES

-------- AND WHICH MAY LATER BE USED WITH THE ECLIPSE GRAPHICS PACKAGE

------------------------------------------------------------------------

--REQUEST PRINTED OUTPUT OF SUMMARY FILE DATA

[RUNSUM](Keywords/R/RUNSUM.docx)

-- FIELD OIL PRODUCTION

FOPR

-- WELL GAS-OIL RATIO FOR PRODUCER

WGOR

'PRODUCER'

/

-- WELL BOTTOM-HOLE PRESSURE

WBHP

'PRODUCER'

/

-- GAS AND OIL SATURATIONS IN INJECTION AND PRODUCTION CELL

BGSAT

10 10 3

1 1 1

/

BOSAT

10 10 3

1 1 1

/

-- PRESSURE IN INJECTION AND PRODUCTION CELL

BPR

10 10 3

1 1 1

/

**SCHEDULE** ===============================================================

-------- THE SCHEDULE SECTION DEFINES THE OPERATIONS TO BE SIMULATED

------------------------------------------------------------------------

-- CONTROLS ON OUTPUT AT EACH REPORT TIME

[RPTSCHED](Keywords/R/RPTSCHED.docx)

0 0 0 0 0 0 0 0 0 0

0 2 0 0 2 /

--IMPES

-- 1.0 1.0 10000.0 /

-- SET 'NO RESOLUTION' OPTION

[DRSDT](Keywords/D/DRSDT.docx)

0 /

-- SET INITIAL TIME STEP TO 1 DAY AND MAXIMUM TO 6 MONTHS

[TUNING](Keywords/T/TUNING.docx)

1 182.5 /

1.0 0.5 1.0E-6 /

/

-- WELL SPECIFICATION DATA

--

-- WELL GROUP LOCATION BHP PI

-- NAME NAME I J DEPTH DEFN

[WELSPECS](Keywords/W/WELSPECS.docx)

'PRODUCER' 'G' 10 10 8400 'OIL' /

'INJECTOR' 'G' 1 1 8335 'GAS' /

/

-- COMPLETION SPECIFICATION DATA

--

-- WELL -LOCATION- OPEN/ SAT CONN WELL

-- NAME I J K1 K2 SHUT TAB FACT DIAM

[COMPDAT](Keywords/C/COMPDAT.docx)

'PRODUCER' 10 10 3 3 'OPEN' 0 -1 0.5 /

'INJECTOR' 1 1 1 1 'OPEN' 1 -1 0.5 /

/

-- PRODUCTION WELL CONTROLS

--

-- WELL OPEN/ CNTL OIL WATER GAS LIQU RES BHP

-- NAME SHUT MODE RATE RATE RATE RATE RATE

WCONPROD

'PRODUCER' 'OPEN' 'ORAT' 20000 4\* 1000 /

/

-- INJECTION WELL CONTROLS

--

-- WELL INJ OPEN/ CNTL FLOW

-- NAME TYPE SHUT MODE RATE

WCONINJ

'INJECTOR' 'GAS' 'OPEN' 'RATE' 100000 /

/

-- YEAR 1

TSTEP

1.0 14.0 13\*25.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

25.0

/

-- YEAR 2

RPTSCHED

0 0 0 0 0 0 0 0 0 0

2 2 0 0 2 /

TSTEP

13\*20.0 7\*13.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

14.0

/

-- YEAR 3

RPTSCHED

0 0 0 0 0 0 0 0 0 0

2 2 0 0 2 /

TSTEP

17\*10.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

12.5

/

-- 912.50 --> 1000.0

RPTSCHED

0 0 0 0 0 0 0 0 0 0

2 2 0 0 2 /

TSTEP

8.5 16\*5.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

5.0

/

-- 1000.0 --> 1100.0

RPTSCHED

0 0 0 0 0 0 0 0 0 0

2 2 0 0 2 /

TSTEP

19\*5.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

5.0

/

-- 1100.0 --> 1200.0

RPTSCHED

0 0 0 0 0 0 0 0 0 0

2 2 0 0 2 /

TSTEP

19\*5.0

/

RPTSCHED

1 1 1 1 1 0 2 1 2 0

2 2 0 0 2 /

TSTEP

5.0

/

IMPLICIT

TUNING

10 /

/

/

TSTEP

10.0 /

END ================================================================