```
-- =====================================================================
-- THIS IS THE FIRST SPE COMPARISON PROBLEM,"COMPARISON OF SOLUTIONS TO A
-- THREE-DIMENSIONAL BLACK-OIL RESERVOIR SIMULATION PROBLEM", REPORTED
-- BY AZIS AND ODEH 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.
-- =====================================================================
RUNSPEC
TITLE
    ODEH PROBLEM - IMPLICIT OPTION - 1200 DAYS

DIMENS
   10   10   3 /

NONNC

OIL

WATER

GAS

DISGAS

FIELD

EQLDIMS
    1  100  10   1   1 /


TABDIMS
    1   1  16  12   1  12 /


WELLDIMS
    2   1   1   2 /
```

Comment [M1]: Specify run title

Comment [M2]: Means 10 cells in x direction, 10 and 3 in y and z direction, respectively.

Comment [M3]: Disallow non-neighbor connections

Comment [M4]: Indicates that the run contains oil

Comment [M5]: Run contains water

Comment [M6]: Run contains GAS

Comment [M7]: Run contains dissolved gas in live oil

Comment [M8]: Field units are to be used

Comment [M9]: Dimensions of equilibration tables, with 5 parameters;
P1: NTEQUL,value= 1 (default)
P2: num. of depth, value= 100 (def. of Eclipse 100)
P3: The maximum number of depth nodes in any RSVD, RVVD, RSWVD, RTEMPVD, PBVD or PDVD table entered in the SOLUTION section to define the initial Rs, Rv, Tr, Pb or Pd versus depth, value= 10
P4: TVDP, value = 1 (default)
P5: TVDP, value=1
Note: this part is usually prepared after setting the equilibrium tables!

Comment [M10]: **Table dimensions**, The data consists of up to fifteen items, describing the sizes of saturation and PVT tables used in the run, and also the number of fluid-in-place regions.
Note: this part is usually prepared after setting the equilibrium tables!

Comment [M11]: **Well dimension data**, The data consists of up to 10 items, describing the dimensions of the well data to be used in the run.

NUPCOL
   4 /

START
  19 'OCT' 1982 /

NSTACK
   24 /

--FMTOUT

--FMTIN

UNIFOUT

UNIFIN

--NOSIM

GRID   ===
-------- IN THIS SECTION , THE GEOMETRY OF THE SIMULATION GRID AND THE
-------- ROCK PERMEABILITIES AND POROSITIES ARE DEFINED.

-- 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
--   ARRAY VALUE   ------- BOX ------
EQUALS
   '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   /

Comment [M12]: Number of iterations to update well targets.

Comment [M13]: Specifies a start date.

Comment [M14]: Linear solver stack size

Comment [M15]: Indicates that output files are formatted.

Comment [M16]: Indicates that input files are formatted.

Comment [M17]: Indicates that output files are unified.

Comment [M18]: Indicates that input files are unified.

Comment [M19]: Turn off simulation.

Comment [M20]: Requests output of an INIT file.

Comment [M21]: Set array to a constant in current box.

/   EQUALS IS TERMINATED BY A NULL RECORD

-- THE Y AND Z DIRECTION PERMEABILITIES ARE COPIED FROM PERMX
--   SOURCE DESTINATION ------- BOX ------
COPY
    '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
 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
   0.12 0   0
   1.0 0.000010 /

-- SIMILARLY FOR GAS
--
-- SGAS KRG PCOG
SGFN
   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

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Comment [M22]: Copies data from one array to another.

Comment [M23]: Controls on output from GRID section. Interpretation of argument:
1st place: (1) report X direction grid block sizes
2nd place: (1) report Y direction grid block sizes
3rd place: (1) report Z direction grid block sizes
4th place: (1) report X direction permeabilities
5th place: (1) report Y direction permeabilities
6th place: (1) report Z direction permeabilities
7th place: (0) Do not report X trnsmsblty mltplrs
8th place: (0) Do not report Y trnsmsblty mltplrs
9th place: (1) report Z trnsmsblty mltplrs
10th place: (1) report grid block porosities
11th place: (0) Do not report grid block N2G ratios
12th place: (1) report grid block top depths
13th place: (1) report grid block pore volumes
14th place: (1) report grid block center depths
All the others defaults to 0 (off).

Comment [M24]: Water saturation functions including relative permeabilities & capillary.

Comment [M25]: Gas saturation functions.

```
--
-- SOIL   KROW    KROG
SOF3
   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
    4014.7   1.029     3.13D-6       0.31        0 /

-- ROCK COMPRESSIBILITY
--
--   REF. PRES   COMPRESSIBILITY
ROCK
    14.7      3.0D-6      /

-- SURFACE DENSITIES OF RESERVOIR FLUIDS
--
--     OIL   WATER   GAS
DENSITY
    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
   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
```

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Comment [M26]: Oil saturation functions (three-phase).

Comment [M27]: Water PVT functions.

Comment [M28]: Rock compressibility.

Comment [M29]: Fluid densities at surface conditions.

Comment [M30]: PVT properties of dry gas (no vaporized oil).

```
  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

```
  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  /
/
```

> **Comment [M31]:** PVT properties of live oil (with dissolved gas).

-- OUTPUT CONTROLS FOR PROPS DATA
-- ACTIVATED FOR SOF3, SWFN, SGFN, PVTW, PVDG, DENSITY AND ROCK KEYWORDS
RPTPROPS
1 1 1 0 1 1 1 1 /

> **Comment [M32]:** Controls on output from PROPS section.

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
   8400   4800 8500   0   8200   0   1   0   0 /

> **Comment [M33]:** Equilibration data specification.

-- VARIATION OF INITIAL RS WITH DEPTH
--
-- DEPTH   RS

RSVD
    8200 1.270
    8500 1.270 /

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

-- 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

6

```
-- CONTROLS ON OUTPUT AT EACH REPORT TIME
RPTSCHED
  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
 0 /

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

Comment [M37]: Controls on output from SCHEDULE section.

Comment [M38]: Maximum rate of increase of solution GOR.

Comment [M39]: Sets simulator control parameters.

Comment [M40]: General specification data for wells.

Comment [M41]: Well completion specification data.

```
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   ============================================================
```