

USR RESOURCES LLC



CHINA CASE HISTORIES

Update: October 2024



COUNTRY OVERVIEW

- 90%+ of USR wells drilled in **Daqing Oilfield**, China's largest onshore oilfield, operated by subsidiaries of China National Petroleum Corporation (CNPC)
- 36% of country's total domestic onshore crude oil production (Hart Energy):
 - 18,200 MMbbl cum. oil production since 1950 discovery to present
 - 3,870 sq mi supergiant sandstone reservoir (one of few supergiant in the world)
 - 2,906 sq mi exploration area
 - 1,584 sq mi oil-bearing area
- Average daily production 1st half 2023 (State Council website):
 - 602,000 bopd
 - 574 MMcf natural gas





USR DRILLING OVERVIEW

- Issue first USR licensee, start-up jointly owned by USR Resources LLC
- Work under turnkey contracts for CNPC, the world's 3rd largest O&G company
- Use 5 land rigs 350-750 HP, up to 3-rig simultaneous drilling in "leap-frog" mode
- Cover 58 blocks to date, across multiple oilfields, in China's provinces of Heilongjiang, Xinjiang, Hebei and in Mongolia
- Complete 160 wells to date (Jul 2019 spud - Sep 2024 present)
 - 13m ROC min.
 - 7m min. displacement to pay-zone landing
 - 330m lateral section length max.
 - 2-7/8" – 3-1/2" pre-slotted or articulated pre-slotted completion
4-1/2" Curve, 3-7/8" Lateral hole size (Ultra Short Radius)
 - 3-1/2" cemented liner completion, perforation, fracking
4-1/2"-4-5/8" hole size (short radius)
 - Swellable packer
 - Successful trial with CTU drilling in lateral section
 - Successful well interception (toe to toe) with USR drilling assisted by Magnetic Ranging technology, converting two vertical oil wells to a geothermal U-Shape well profile
- Drain multiple types of residual oil
 - Skim top of thick oil layer
 - Place Hz section accurately above the underlying OWC
 - Landing outside water coning radius, acidized or fracked area
 - Revitalize imperfection of waterflooded producers
 - Access bypassed oil between wells and oil trapped at edge of fault



PRODUCTION SUCCESS CASES

CASE #	APPLICATION
1	INCREASE RECOVERY FACTOR First 5 Wells' Four-Year Production
2	INCREMENTAL OIL vs HOLE LENGTH THROUGH PAY First 30 Wells In China & Wells In Other Countries
3	CNPC EVALUATION OF 45 WELLS First 45 Wells' Proof of USR Technology Application
4	ACCESS NEAR-FAULT STRANDED RESERVE Example: Well #84, Block #28
5	BYPASS DAMAGE CASING & INCREASE RECOVERY Example: Well #94
6	GEOHERMAL "U-SHAPE" WELL CONVERSION Connect Wells #111, 112
7	LOW-PERM DEEP USR Well (GWD STEERING) Example: Well #116, Block #47, Hebei Province
8	PRE USR vs POST USR PRODUCTION 126 Wells Production



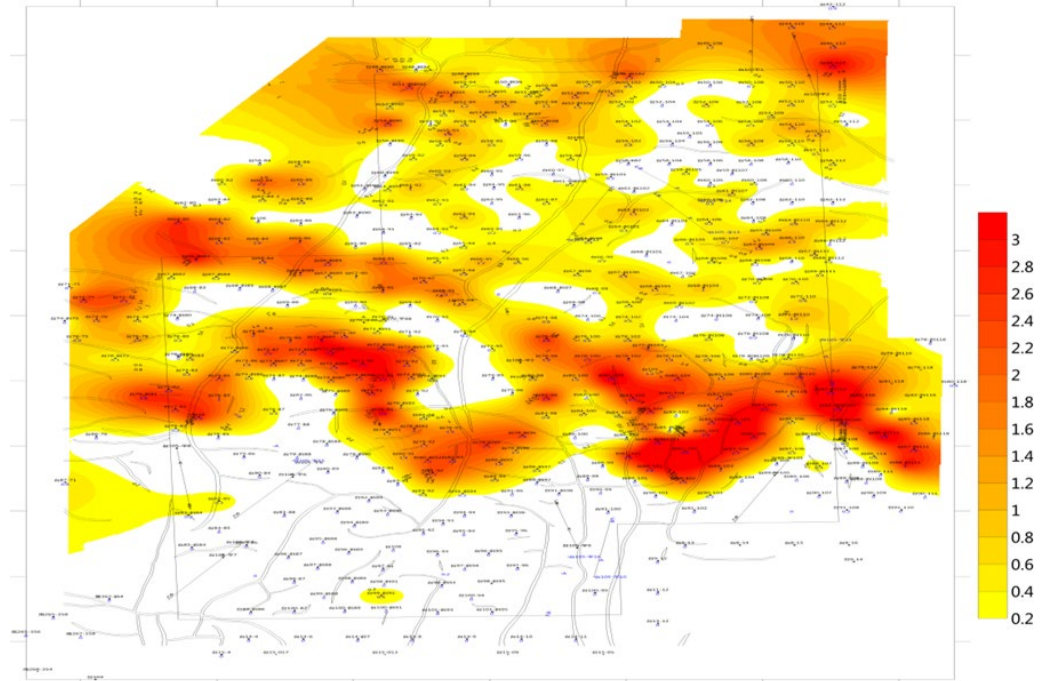
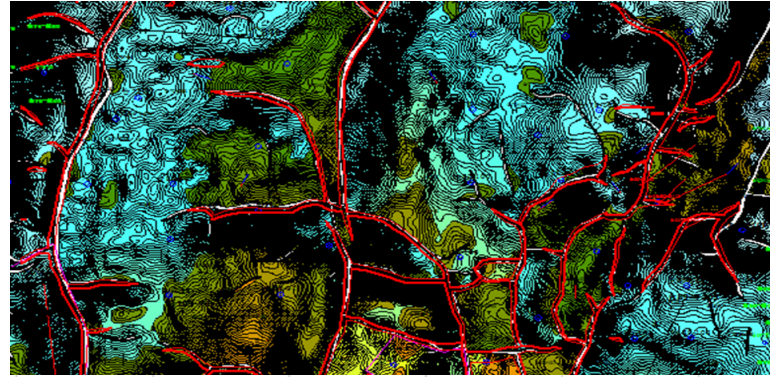
CASE I – INCREASE RECOVERY FACTOR

First 5 Wells' Four-Year Production, Block #1 of Field #1

FIELD OVERVIEW (Block #1 of Field #1):

- 5.26 MMbbls reserve
- 19.35 km² oil bearing area
- 212 development wells
- 264,076 bbl per well average controlled reserve (300m x 300m square pattern)
- 2.81m effective thickness PI sandstone layers PI1-6 (main pays PI4, PI5)
- 18.9% avg. porosity (13.4-21.8%)
- 22.3 mD effective permeability
- 60% oil saturation

Structure map at Top of PI Reservoir



PI52 sand unit thickness distribution map (2.8m maximum) 5



CASE I – INCREASE RECOVERY FACTOR

First 5 Wells' Four-Year Production, Block #1 of Field #1

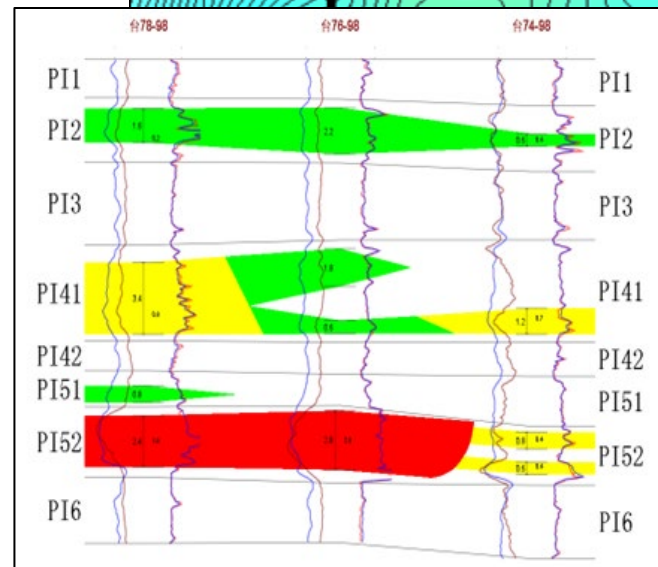
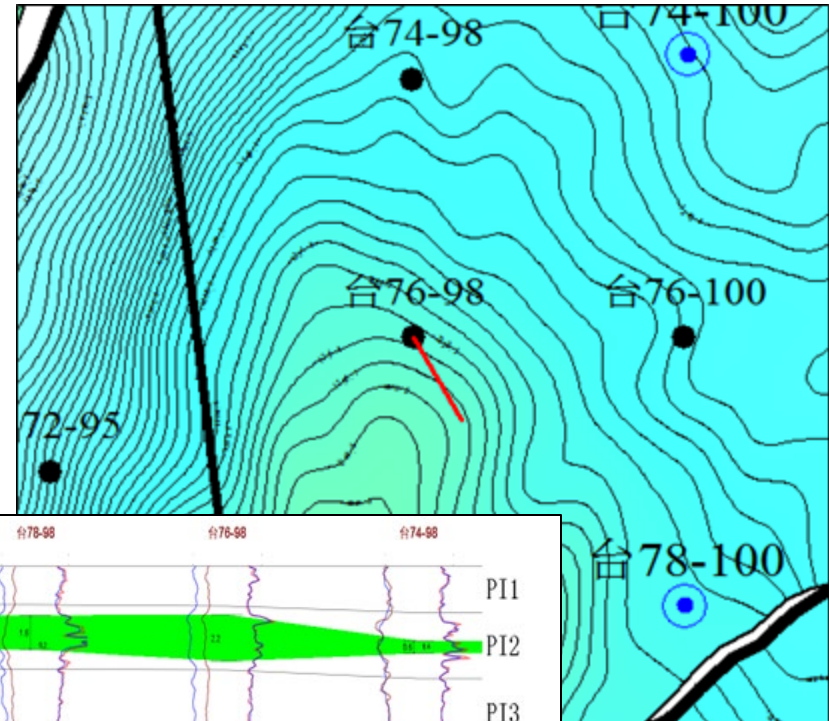
WELL HISTORY (Well #1 to #5):

- Low recovery factors attributed to rapid decline in individual wells, due to the fault development and incomplete water flooding pattern.
- Significant oil reserves remaining in near-fault area, not exposed to flood front.
- Unsuccessful fracking to increase water injection to flood out the remaining oil.

USR OBJECTIVES (Well #1 to #5):

- To place horizontal wells toward residual oil-rich area by using USR drilling technology from existing wells (re-entry sidetrack).
- To increase drainage area and increase oil production.

Well #5 – Top structure PI52 target layer



Well #5 – X Section



CASE I – INCREASE RECOVERY FACTOR

First 5 Wells' Four-Year Production, Block #1 of Field #1

5 Wells Jul-Aug 2019:

- De-completion
- Whipstock, window milling
- USR curve, lateral sidetrack drilling
- Completion
- Rig move, rig up, rig down

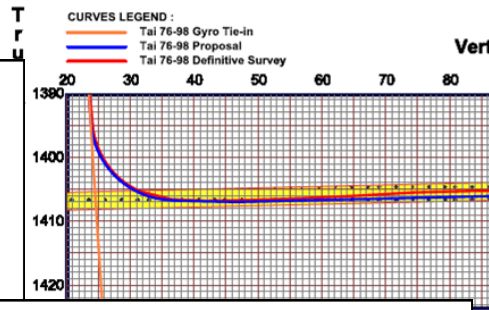
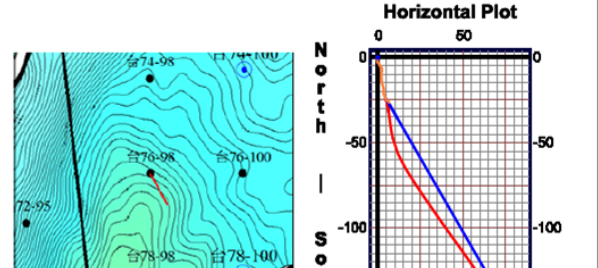


TAI 76-98 - DEFINITIVE SURVEY

Field, Company: Totaui, Daqing Fanning
 Tie-in Survey Ref: File received 14-May-2019
 North Reference: Grid Azimuth
 Magnetic Dec.: -10.68° (West of TN)
 Grid Convergence: +1.27° (East of TN)

Depth Reference: ORT
 ORT-GL: 4.50 m
 GL-MSL: 126.66 m
 Target Objective: PI52
 Target Thickness: 2.80 m

Whipstock, 5-1/2" 17# Casing Gyro Oriented to 140° Grid azimuth
 Window: Top whipstock 1390.1, Bottom 1394.0, Rathole to 1396.1 (KOP)
 4-1/2" Curve: 1414.0 EOC, 13.9 m ROC (4.533°/m DLS)
 3-7/8" Lateral: 1535.2 Well TD

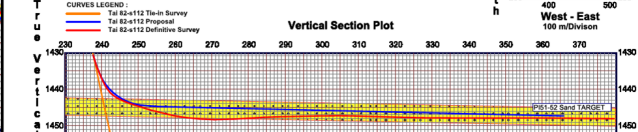
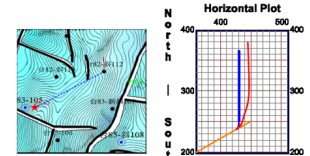


TAI 82-S112 - DEFINITIVE SURVEY

Field, Company: Totaui, Daqing Fanning
 Tie-in Survey Ref: File received 14-May-2019
 North Reference: Grid Azimuth
 Magnetic Dec.: -10.68 deg (West of TN)
 Grid Convergence: +1.27 (East of TN)

Depth Reference: ORT
 ORT-GL: 3.90 m
 GL-MSL: 125.04 m
 Target Objective: PI52
 Target Thickness: 5.30 m

Whipstock, 5-1/2" 17# Casing MWD Oriented to 37.50° Grid azimuth
 Window: Top whipstock 1538.0, Bottom 1542.0, Rathole to 1544.5 (KOP)
 4-1/2" Curve: 1563.5 EOC, 15.4 m ROC (4.483°/m DLS)
 3-7/8" Lateral: 1682.3 Well TD

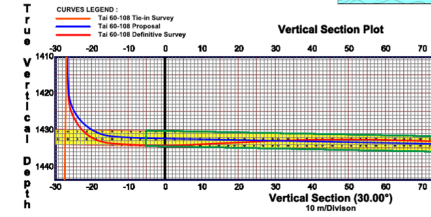
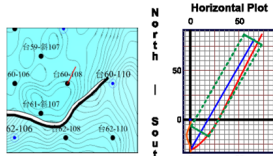


TAI 60-108 - DEFINITIVE SURVEY

Field, Company: Totaui, Daqing Fanning
 Tie-in Survey Ref: File received 14-May-2019
 North Reference: Grid Azimuth
 Magnetic Dec.: -10.68 deg (West of TN)
 Grid Convergence: +1.27 (East of TN)

Depth Reference: ORT
 ORT-GL: 4.00 m
 GL-MSL: 137.70 m
 Target Objective: PI44-42
 Target Thickness: 4.30 m

Whipstock, 5-1/2" 17# Casing Gyro Oriented to 28.34° Grid azimuth
 Window: Top whipstock 1414.8, Bottom 1417.0, Rathole to 1419.5 (KOP)
 4-1/2" Curve: 1442.0 EOC, 15.8 m ROC (4.149°/m DLS)
 3-7/8" Lateral: 1568.8 Well TD

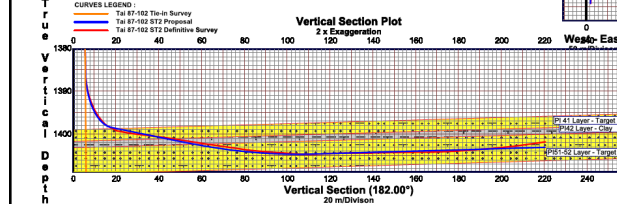
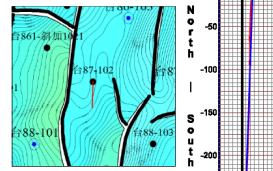


TAI 87-102 ST2 - DEFINITIVE SURVEY

Field, Company: Totaui, Daqing Fanning
 Tie-in Survey Ref: File received 14-May-2019
 North Reference: Grid Azimuth
 Magnetic Dec.: -10.68° (West of TN)
 Grid Convergence: +1.27° (East of TN)

Depth Reference: ORT
 ORT-GL: 3.70 m
 GL-MSL: 125.04 m
 Target Objective: PI52
 Target Thickness: 6.20 m

Whipstock, 5-1/2" 17# Casing Gyro Oriented to 162° Grid azimuth
 Window: Top whipstock 1380.5, Bottom 1383.5, Rathole to 1386.5 (KOP)
 4-1/2" Curve: 1407.5 EOC, 15.1 m ROC (4.094°/m DLS)
 3-7/8" Lateral: 1608.0 Well TD

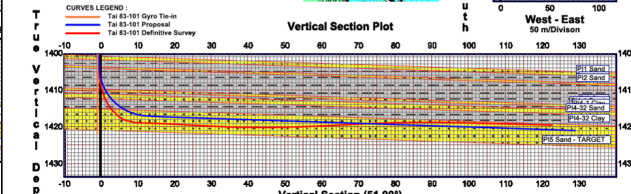
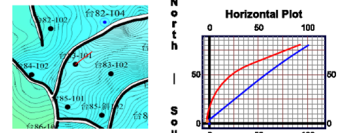


TAI 83-101 - DEFINITIVE SURVEY

Field, Company: Totaui, Daqing Fanning
 Tie-in Survey Ref: File received 14-May-2019
 North Reference: Grid Azimuth
 Magnetic Dec.: -10.68° (West of TN)
 Grid Convergence: +1.27° (East of TN)

Depth Reference: ORT
 ORT-GL: 3.65 m
 GL-MSL: 125.03 m
 Target Objective: PI51-52
 Target Thickness: 5.20 m

Whipstock, 5-1/2" 17# Casing Gyro Oriented to 140° Grid azimuth
 Window: Top whipstock 1396.1, Bottom 1402.1, Rathole to 1404.2 (KOP)
 4-1/2" Curve: 1427.5 EOC, 14.9 m ROC (4.189°/m DLS)
 3-7/8" Lateral: 1545.0 Well TD





CASE I – INCREASE RECOVERY FACTOR

First 5 Wells’ Four-Year Production, Block #I of Field #I

PRODUCTION RESULTS (Well #1 to #5):

- 117,515 bbl cum. from Jul-Aug 2019 to Aug 2023 (production is ongoing)
- Electrical usage (beam pump) pre-USR 88.3 kWh/tonne vs post-USR 27.6 kWh/tonne

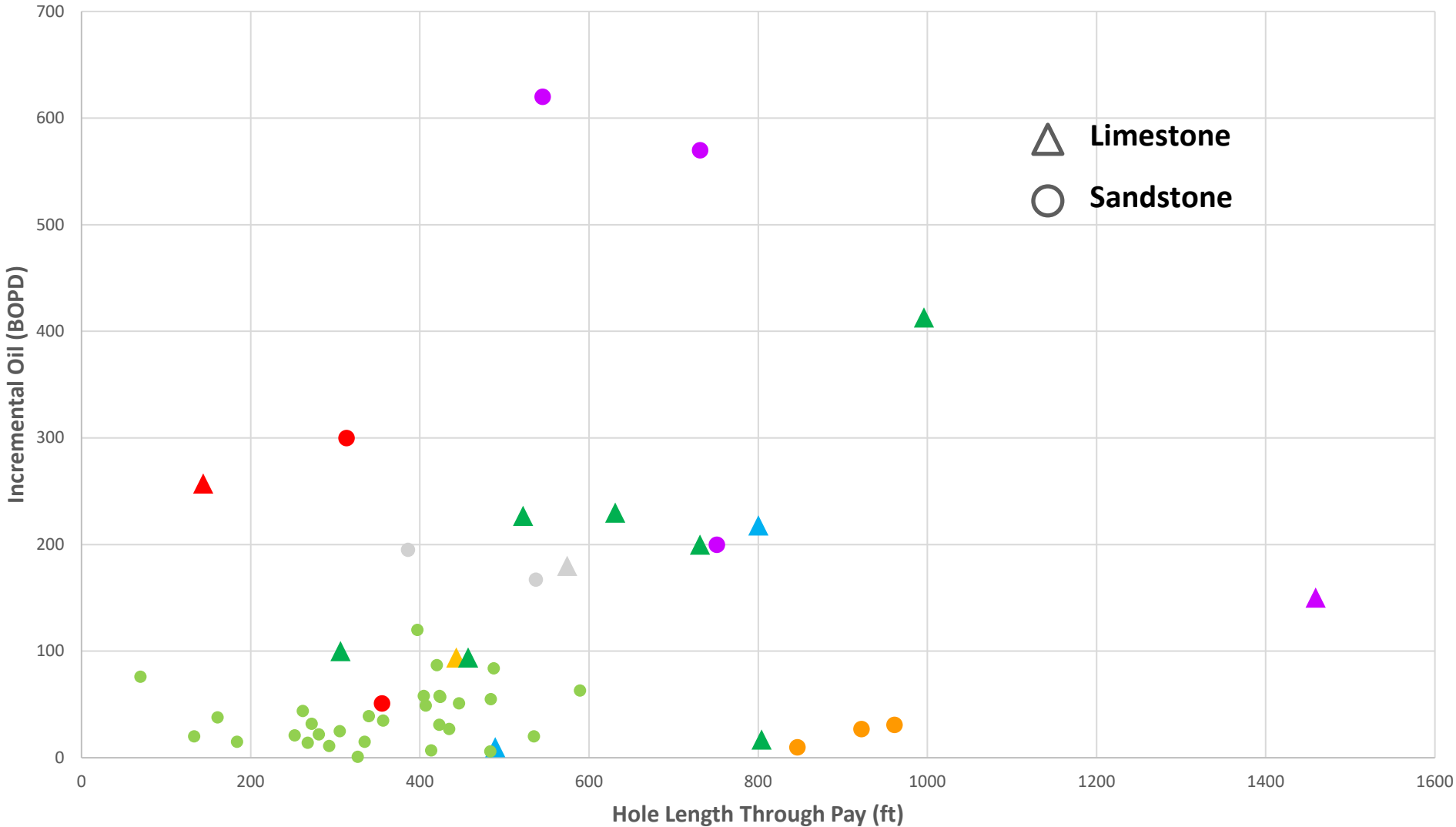
	ORIGINAL WELL							USR RE-ENTRY SIDETRACK (Prod. Data as at Aug 2023)					
	LAST PRODUCTION			CUMULATIVE				USR Completion Date	Lateral Length (m)	Water %	Liquid Energy Consumption kWh/tonne	Daily Oil tonne/day BOPD	Cum. Incremental Oil Production tonne bbl
USR Drilling Sequence No.	Original Well Last Production Date	OWR %	Daily Oil tonne/day BOPD	Liquid Energy Consumption kWh/tonne	Cum. Water Production tonne bbl	Cum. Oil Production tonne bbl	% Recovery of 264,076 bbl/well Reserve						
1	2019	0%	0.4 3	112.5	366 2,302	10,946 79,633	30%	11 Jul 2019	127	15%	18.8	7.0 51	3,775.5 27,466
2	2019	21%	1.5 11	42.1	1,011 6,359	10,508 76,446	29%	23 Jul 2019	129	6%	17.1	8.0 58	3,121.4 22,708
3	2019	20%	2.4 18	28.3	6,663 41,910	16,487 119,944	45%	2 Aug 2019	201	22%	42.9	8.7 63	3,882.7 28,246
4	2019	0%	0.3 2	166.7	0	12,561 91,382	35%	12 Aug 2019	130	9%	23.0	7.8 57	2,348.7 17,086
5	2019	33%	0.4 3	91.7	2,101 13,215	11,449 83,292	32%	27 Aug 2019	121	15%	36.4	11.9 87	3,025.4 22,009
					TOTAL:	450,697				TOTAL:		316	117,515



CASE 2 – INCREMENTAL OIL vs HOLE LENGTH THROUGH PAY

First 30 Wells In China & Wells In Other Countries

Incremental Oil (BOPD) vs Hole Length Thru Pay (ft)



● Oman (PDO) ▲ Oman (Daleel) ● India (ONGC) ▲ Turkey (PEMI) ▲ Oman (OXY) ▲ Indonesia (Citric Seram) ● Gabon (Perenco) ● Myanmar (MOGE) ● China (CNPC)



CASE 3 - CNPC EVALUATION OF 45 WELLS

First 45 Wells' Proof of USR Technology Application

CNPC VALIDATES THE USR TECHNOLOGY APPLICATION FOR ITS FIELDS

CNPC DAQING OILFIELD CO., LTD.
APRIL 30, 2021

(EVALUATION OF 45 WELLS DRILLED JUL 2019 – SEP 2020)

“...Proof of Application of USR Technology ... make the precise targeting tapping of oilfield reserves possible...has several unique innovations...quickly adjust the well orientation while drilling to ensure the probability of drilling to the oil reservoir...resulting in a high utilization rate of the oil reservoir...multi-directional multi-branch drilling in the same layer and the multi-layer multi-branch drilling in a single well are realized so as to achieve the maximum control and tapping of the reservoirs through one well and improve the development efficiency...Between 2019 and 2020, 45 wells with ultra-short radius horizontal drilling were successfully tested in Daqing Oilfield and all indicators met the design requirements. This technology can achieve precise tapping of remaining oil when being applied in old wells and reduce the number of wells deployed to save land acquisition when being applied in new area development. The development and application of this technology has filled the gap of ultra-short radius horizontal drilling technology in China...”

超短半径水平钻井技术成果应用证明

大庆辰平钻井技术服务有限公司研发的超短半径水平钻井技术是一项油田精准靶向挖潜的新技术，属于国内首创技术，整体处于国际领先水平。创新的随钻测量技术、钻井轨迹随钻调整技术使油田储量精准靶向挖潜成为了现实。具有靶前位移短、轨迹控制程度高、储量损失少、储层钻透率高的特点；技术核心优势是可定方位、定深度、定长度对油气储量进行靶向挖潜。与以往同类技术对比具有多项独特创新：1、独有的MWD随钻测量技术实时反馈井斜、方位信息，使得井下轨迹信息可视；2、独有的多弯角泥浆马达+钛合金钻杆+遥控动力水龙头组合，可随钻进行井斜、方位快速调整，确保油层钻透率；3、造斜阶段的超高造斜率可达7.6°/米，仅以小于30米的曲率半径将直井变成水平井，仅以20米的水平位移就可迅速进入油层，油层利用率；4、水平钻进距离达到200米以上，以往超短半径水平井仅能钻进几十米；5、实现同层多方向多分支及单井多层多分支钻井，利用一口井实现对储量最大程度的控制和挖潜，提升开发效益。

2019-2020年在大庆油田成功进行了45口超短半径水平钻井试验，各项指标完全达到设计要求。该项技术用于老井可实现剩余油精准挖潜，用于新区开发可减少布井数量，节约土地征用。这项技术的研发和应用，填补了国内超短半径水平钻井技术的空白。



大庆油田有限责任公司技术管理部
2021年4月30日



CASE 4 – ACCESS NEAR-FAULT STRANDED RESERVE

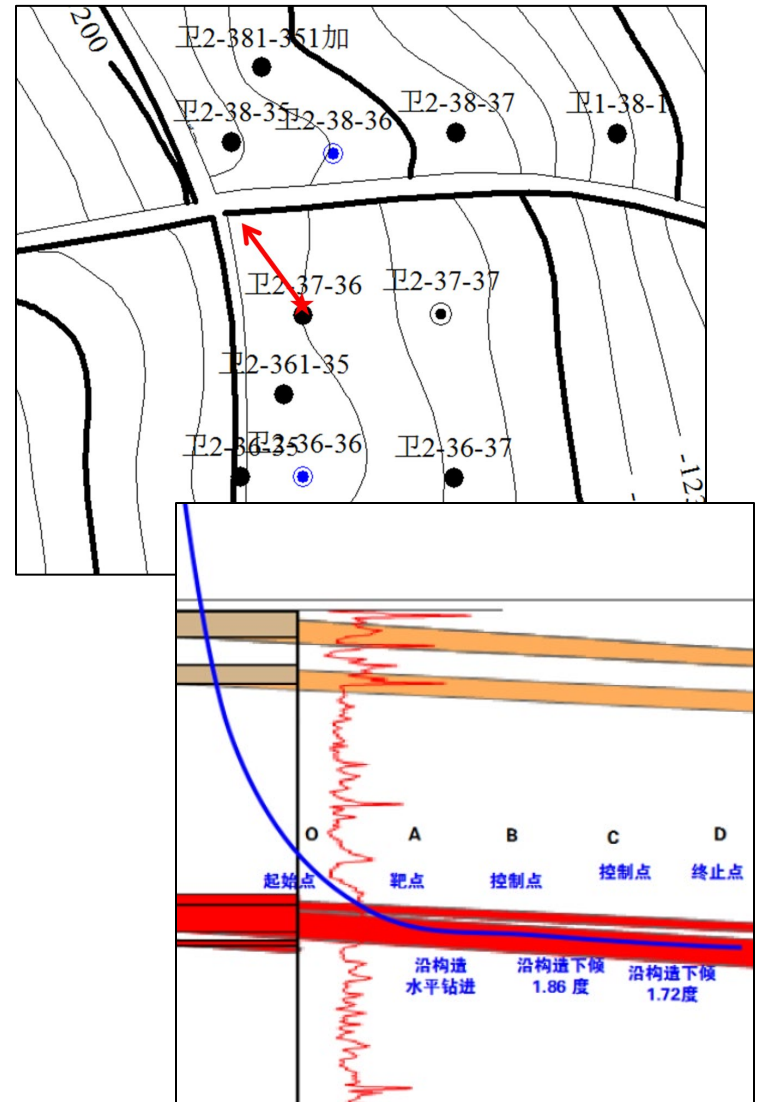
Example: Well #84 in Block #28

HISTORY:

- 1 bopd, 87.5% water when shut-in
- 19.8% Recovery Factor
- 165m to nearest fault
- Potential for additional recovery at near-fault

OBJECTIVES:

- To place 120m lateral length into the area bounded by two faults using USR drilling technology (re-entry sidetrack a vertical well).
- To drain the stranded reserve trapped in the corner of the two faults

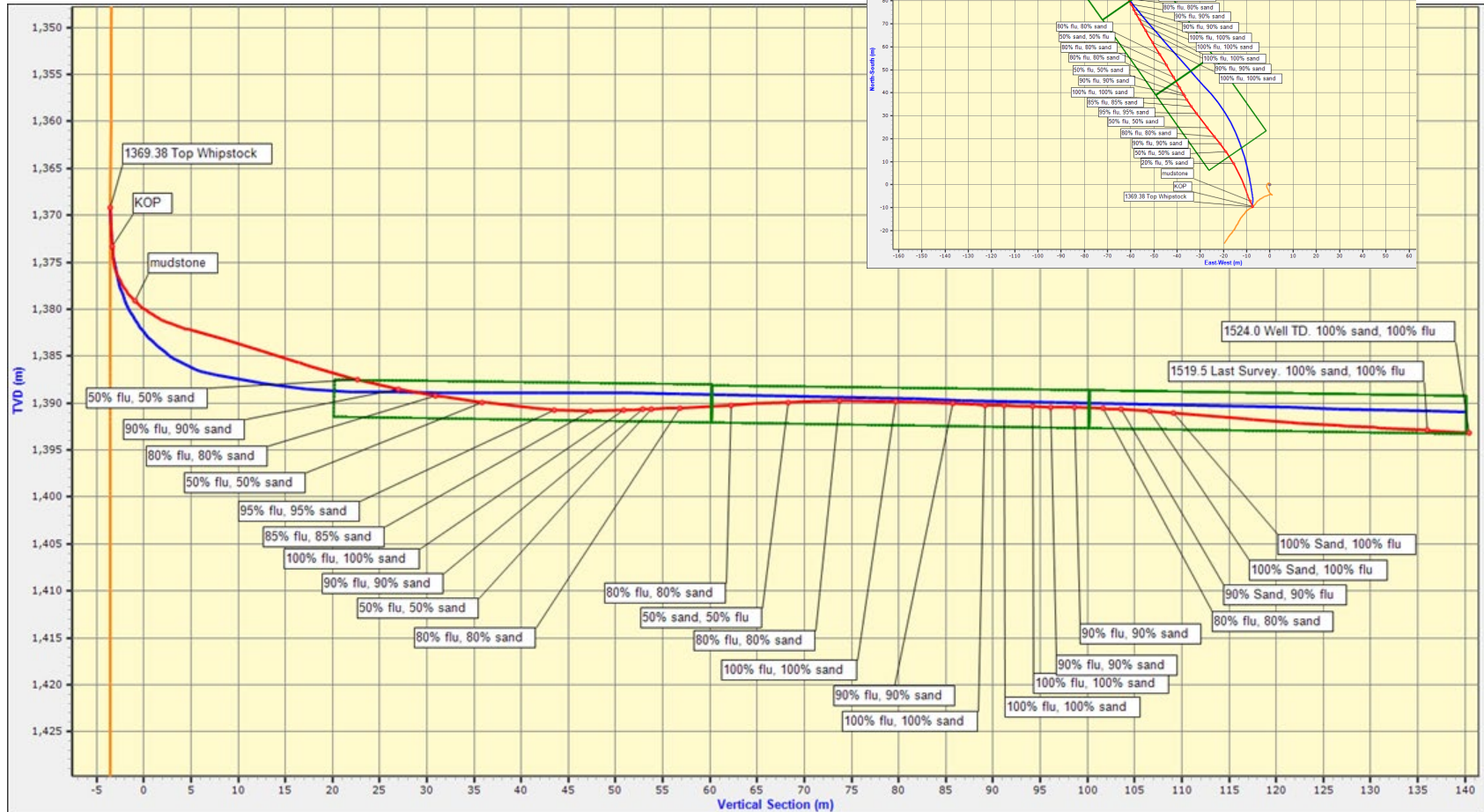




CASE 4 – ACCESS NEAR-FAULT STRANDED RESERVE

Example: Well #84 in Block #28

Steering with mudlogging





CASE 4 – ACCESS NEAR-FAULT STRANDED RESERVE

Example: Well #84 in Block #28



Wei 2-37-36 - DEFINITIVE SURVEY

Field, Company: North of Wei 16 Block, QingXin Oilfield Dev.
 Tie-in Survey Ref: Client Survey File 27-Mar-07
 North Reference: Grid Azimuth
 Magnetic Dec.: -11.058° (West of TN)
 Grid Convergence: +1.45° (East of TN)

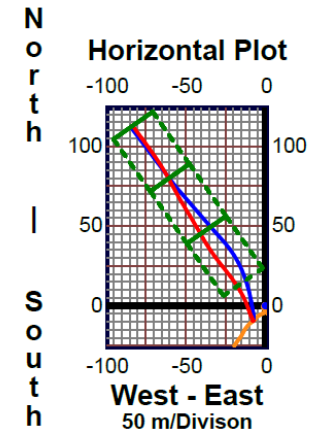
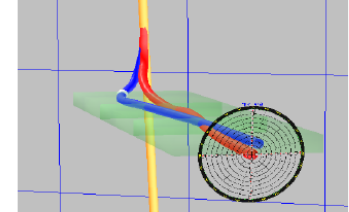
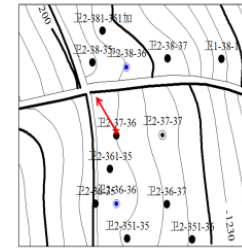
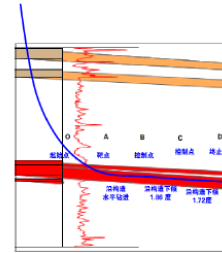
Depth Ref.: ORT
 ORT-GL: 3.65 m
 GL-MSL: 142.15 m
 Target Objective: P151-52
 Gross Thickness: 4.0 m
 Eff. Thickness: 4.0 m

Whipstock 5-1/2" 17# Casing Gyro Oriented to 5° Grid Azimuth
 Window: Top whipstock 1369.4, Bottom 1371.7, Rathole to 1373.5 (KOP)
 4-1/2" Curve: 1387.0 EOC, 12.5 m ROC (5.591°/m DLS)

Control Point as Targets Along 325.0° Dip Direction, Plan Azimuth

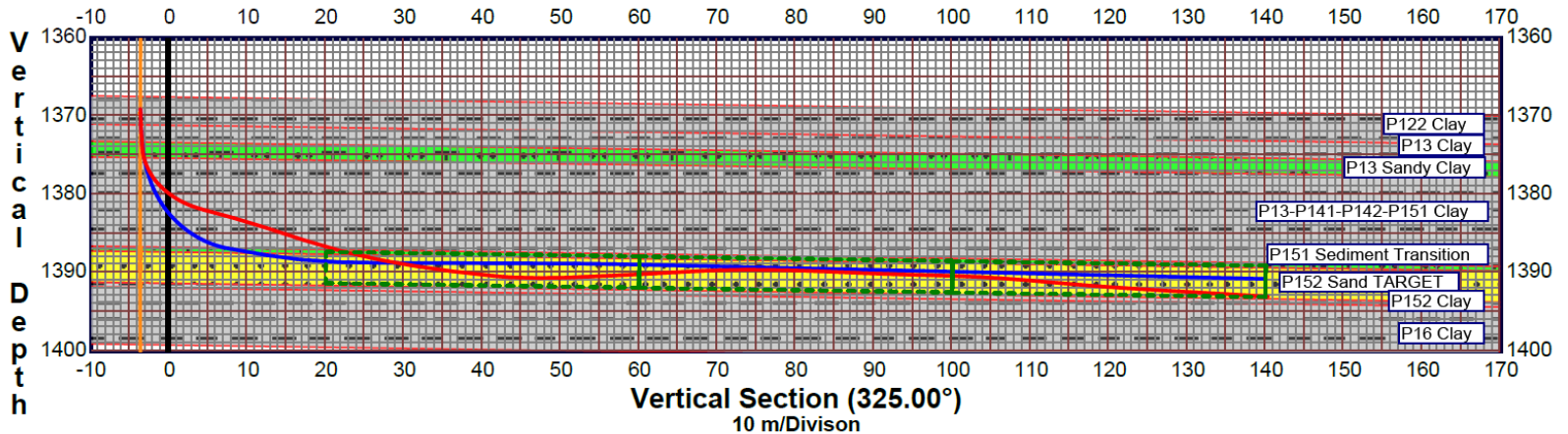
Target	m TVD	m VS	Dip Angle	Actual mMD	Distance To Target
A- Landing	1388.40	16.45	Down 0.82°	1399.1, 2.7 m Above, 7.6 m Left	
B	1389.00	56.45	Down 0.82°	1439.7, 1.5 m Below, 7.0 m Left	
C	1389.90	96.45	Down 0.82°	1479.8, 0.5 m Below, 3.6 m Left	
D-TD	1389.90	96.45	Down 0.82°	1520.0, 2.0 m Below, 3.9 m Right	

Actual TD @ 1524.0- Trajectory Explores and Follows Excellent Sand and HC Show in Cutting Samples



- TRU E**
- CURVES LEGEND :**
- Wei 2-37-36 Client Gyro Tie-in
 - Wei 2-37-36 Proposal
 - Wei 2-37-36 Definitive Survey

Vertical Section Plot



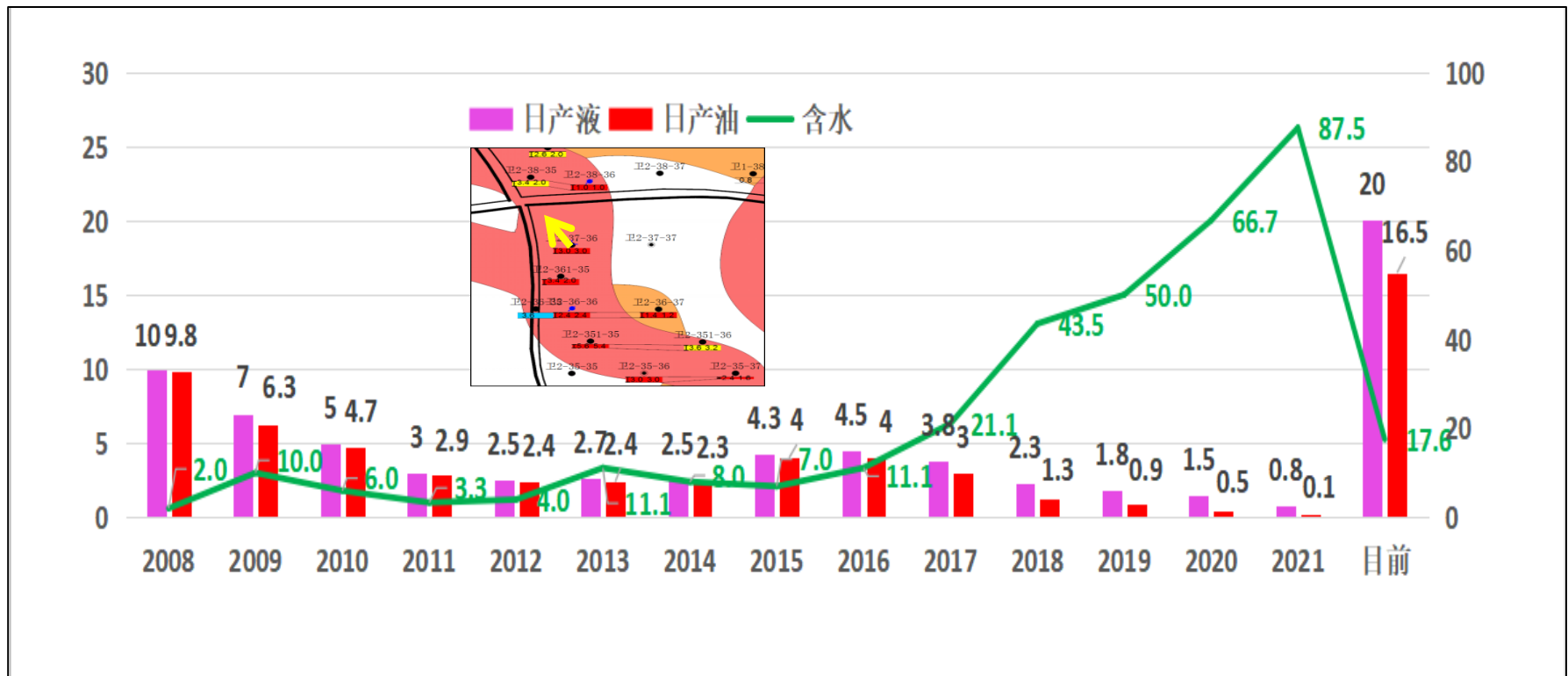


CASE 4 – ACCESS NEAR-FAULT STRANDED RESERVE

Example: Well #84 in Block #28

RESULT:

- 120 bopd initial rate, 17.6% water





CASE 5 – BYPASS CASING DAMAGE & INCREASE RECOVERY

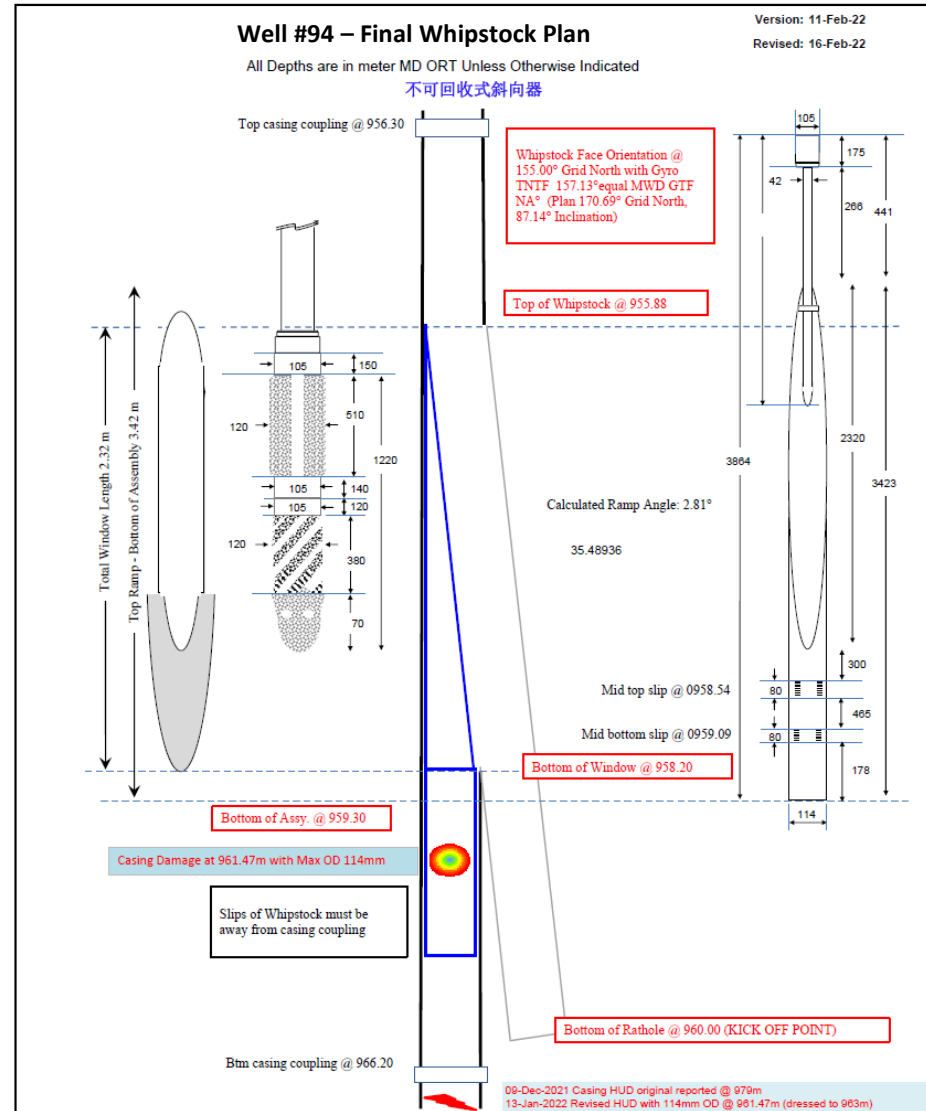
Casing Damage Well #94

HISTORY:

- 1 bopd, 85.5% water when shut-in.
- Casing damage @ 961.5m HUD (No-Go). Suspect casing parted @ 979.0m. Casing size 5-1/2" 17#. Potential candidate for P&A.
- Potential for additional recoverable oil with horizontal sidetrack

CASING EXIT:

- Set 5-1/2" whipstock @ 956m TOW, 959m bottom of whip assembly. Mill window.



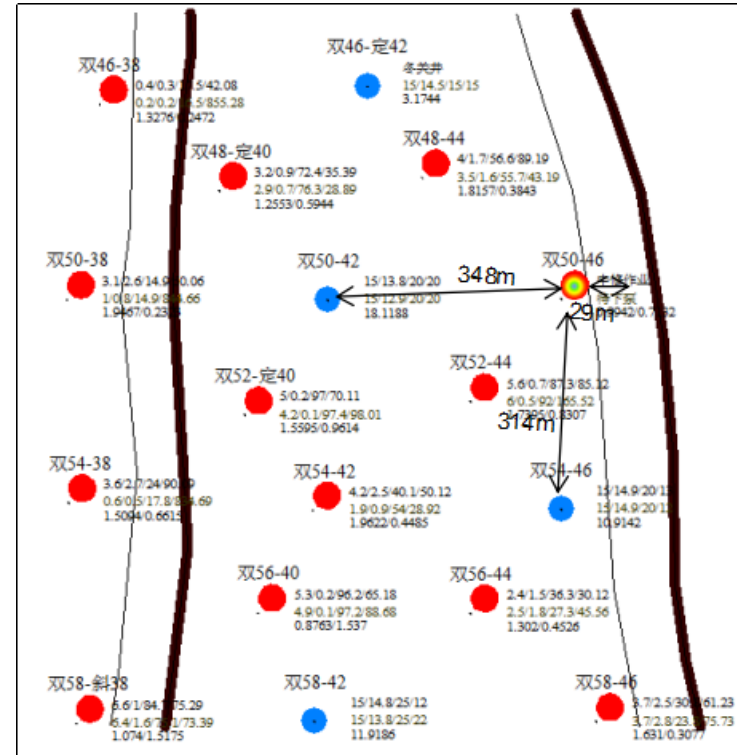


CASE 5 – BYPASS CASING DAMAGE & INCREASE RECOVERY

Casing Damage Well #94

DRILLING & COMPLETION:

- Sidetrack 4-1/2" short radius, 4-1/2" x 120m horizontal section.
- Run 3-1/2" pre-perf liner.





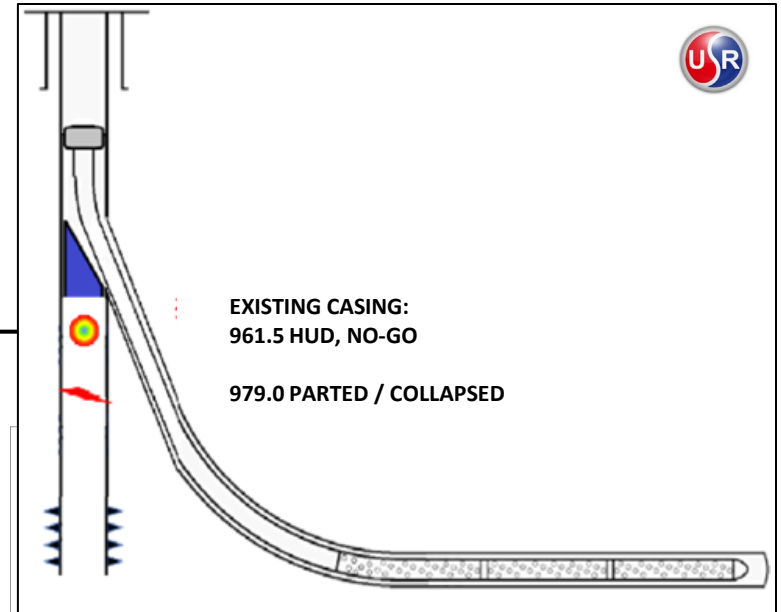
CASE 5 – BYPASS CASING DAMAGE & INCREASE RECOVERY

Casing Damage Well #94

Well Profile

ST Hole	mMD ORT	Inc °	GAz °	mTVDORT	m VS	DLS °/30m
Top Window	955.88	1.70	318.43	955.73	-9.60	
Btm Window	958.20	4.52	155.00	958.05	-9.54	
KOP	960.00	2.30	155.00	959.84	-9.44	
End Curve1	965.00	10.90	170.69	964.79	-8.77	55.5
End Curve2	1007.50	7.43	247.97	1006.58	-3.66	19.3
End Curve3	1069.50	90.90	157.61	1048.34	33.38	54.8
TD	1177.00	84.00	175.50	1052.44	140.15	13.2

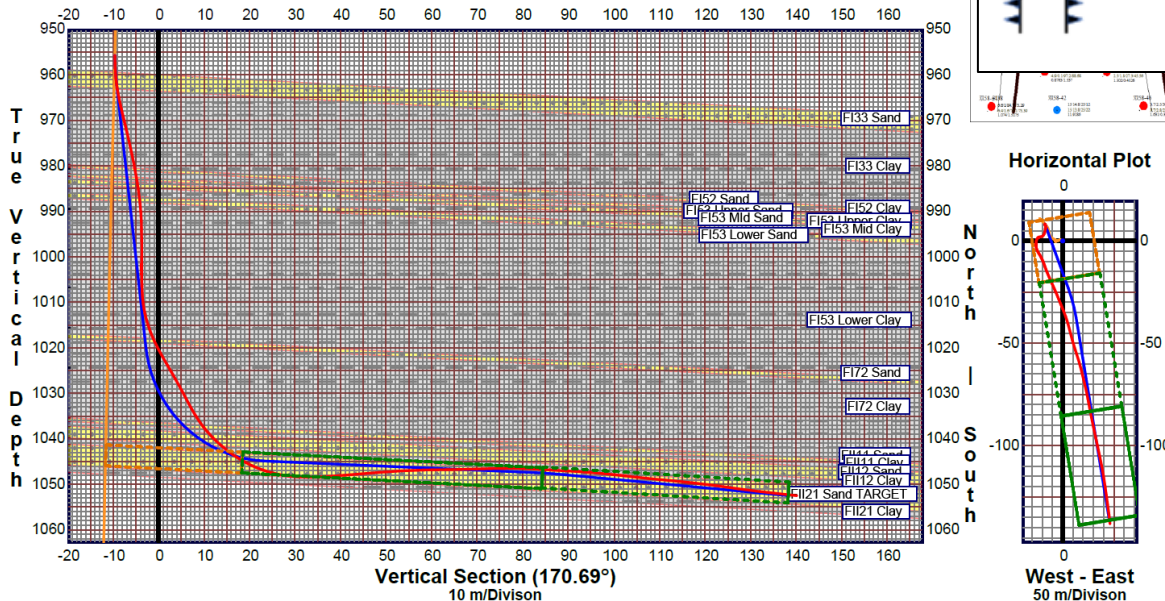
Completion Diagram



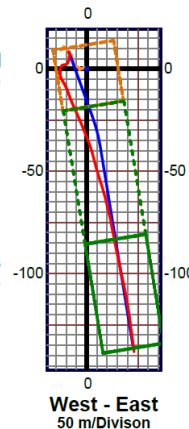
WELL #94 – DEFINITIVE SURVEY

CURVES LEGEND :
 — Shuang 50-46 Client 21-Mar-03 Tie In
 — Shuang 50-46 Proposal V1.0
 — Shuang 50-46 Definitive Survey

Vertical Section Plot



Horizontal Plot



RESULT:

- Change scrap well to a 17 bopd IP well



CASE 6 – GEOTHERMAL “U-SHAPE” WELL CONVERSION

Connect Wells #111 and #112, Block #38

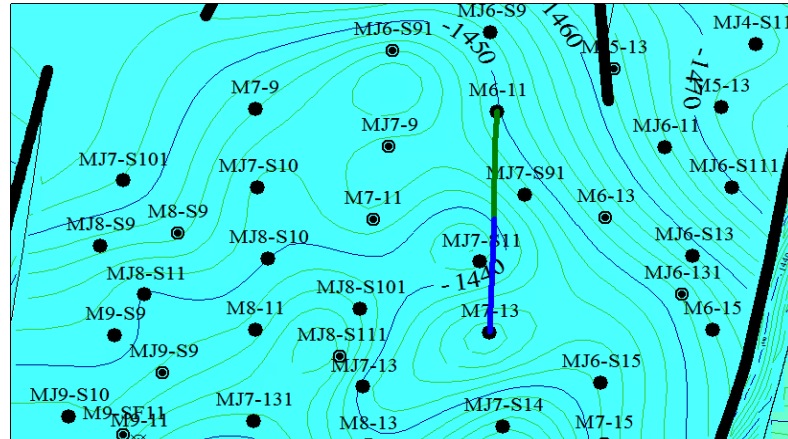
FIELD OVERVIEW:

- Surface temperature, 3°C annual average, **-20°C coldest month, -37°C extreme, 225 days sub-zero.**
- Reservoir temperature 75.6°C - 94.4°C, average 5.153°C/100m belongs to the **high geothermal gradient as the heat source.**
- Two vertical oilwells near production plant and village were selected for geothermal conversion.
- Target is sand-mudstone, fluvial delta settlement with river sandstone as the effective reservoir.
- 12% effective porosity.
- 1.0 mD average air permeability.
- Maximum principal stress direction 80°-110° Gaz (near east-west).
- Micro fracture permeability reaches 84 times of the matrix.

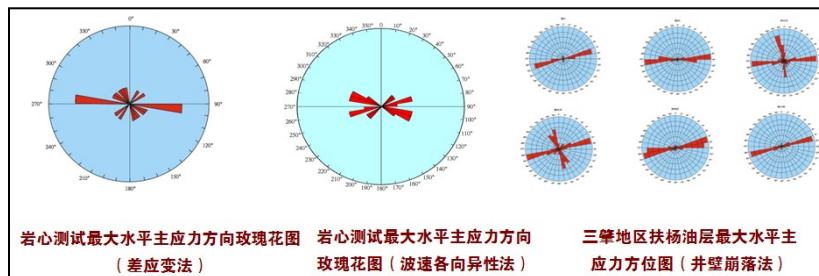
225 days sub-zero



Hz sidetrack a north well to south and the south well to north



Maximum principal stress direction 80°-110° Gaz (near east-west)





CASE 6 – GEOTHERMAL “U-SHAPE” WELL CONVERSION

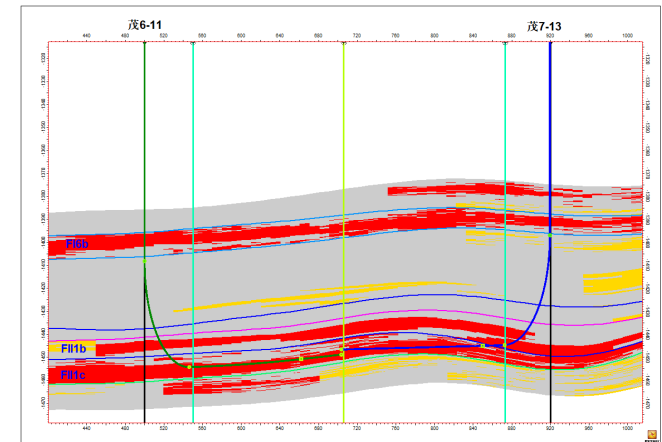
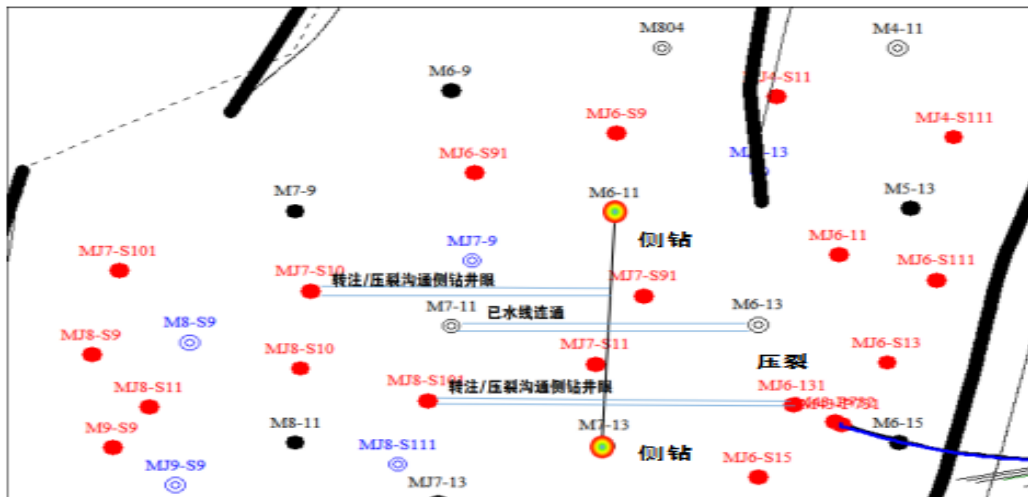
Connect Wells #111 and #112, Block #38

WELL SELECTION CRITERIA:

- Reservoir development with sufficient thickness meeting volumetric requirement with good connectivity, no-fault and east-west fracture development.
- Formation temperature relatively high, as the heat source.

SELECTED WELLS:

- Target is FII1b-FII1c sand-mudstone, fluvial delta settlement with river sandstone as the effective reservoir.
- Two vertical wells #111, #112 (2.7-4.3m effective, 5.8-7.8m gross thickness), near to production plant and village were selected for geothermal test wells.

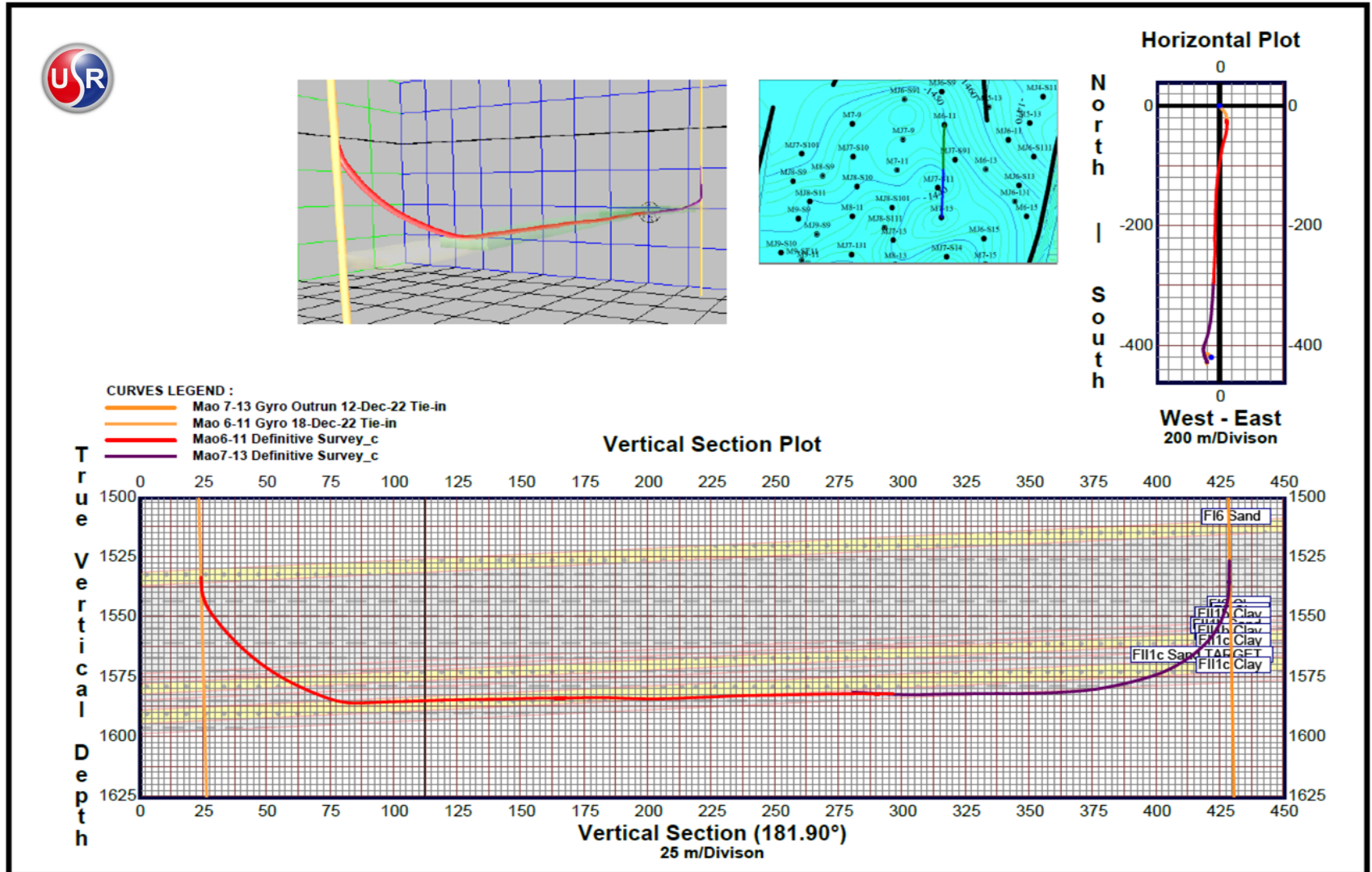




CASE 6 – GEOTHERMAL “U-SHAPE” WELL CONVERSION

Connect Wells #111 and #112, Block #38

Well intersection assisted by Magnetic Ranging Technology (3rd Party)





CASE 6 – GEOTHERMAL “U-SHAPE” WELL CONVERSION

Connect Wells #111 and #112, Block #38

Well intersection assisted by Magnetic Ranging Technology (3rd Party)

- Enables drillers to more accurately position wells in relation to one another.
- Uses one well as a magnetic target, and the well being drilled ranges its distance to the target.
- Passive Magnetic Ranging (PMR) estimates the distance and direction from the position of the MWD in the drilling well to a target well with the presence of a casing, liner, BHA (fish), or any drilling equipment.

DRILLING WELL
USR MWD on W/LINE WET CONNECT

TARGET WELL
GYRO-MAGNETIC MWD





CASE 6 – GEOTHERMAL “U-SHAPE” WELL CONVERSION

Connect Wells #111 and #112, Block #38

RESULTS:

注采井统计表

Geothermal U-Shape Well Mao7-13, Mao6-11

分类	日期 date:	8.25	8.26	8.27	8.28	8.29	8.30	8.31
Water Injecting Well 注入井	注入压力 (MPa) inject pressure	8.0	7.6	7.2	7.5	6.6	7.0	6.9
	注入排量 (m ³ /h) inject rate	9.0	9.0	9.2	9.3	8.0	9.6	9.8
	注入温度 (°C) water temp	32	32	32	31	31	31	33
Water Producing Well 采出井	采出排量 (m ³ /h) production	8.0	8.6	8.5	9.0	9.0	8.7	8.7
	采出温度 (°C) return temp	54	55	52	52	52	52	52



CASE 7 – LOW-PERM DEEP USR WELL (GWD STEERING)

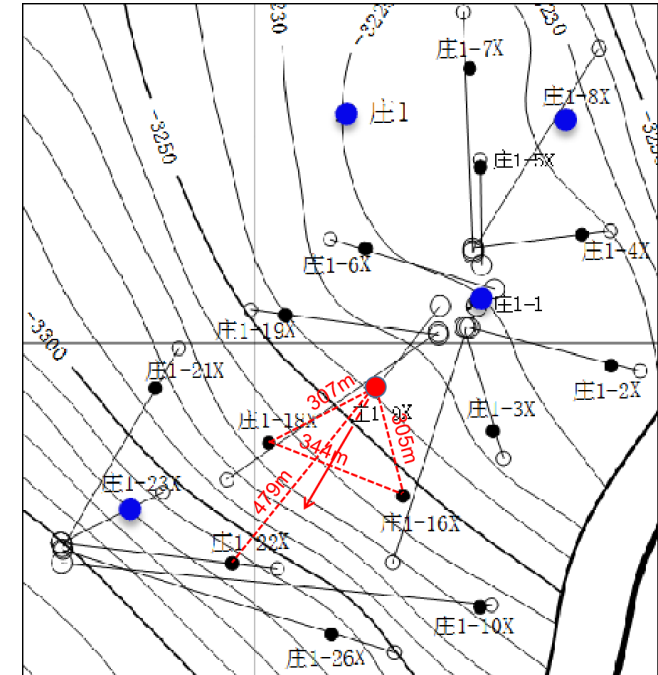
Example: Well #116, Block #47, Hebei Province

HISTORY:

- 12.7% avg. porosity, 9.0 mD permeability, 120° C BHST
- 23 bopd, 69% water last production.

OBJECTIVES:

- To increase recovery by sidetracking the existing well thus increasing recovery of the remaining oil.

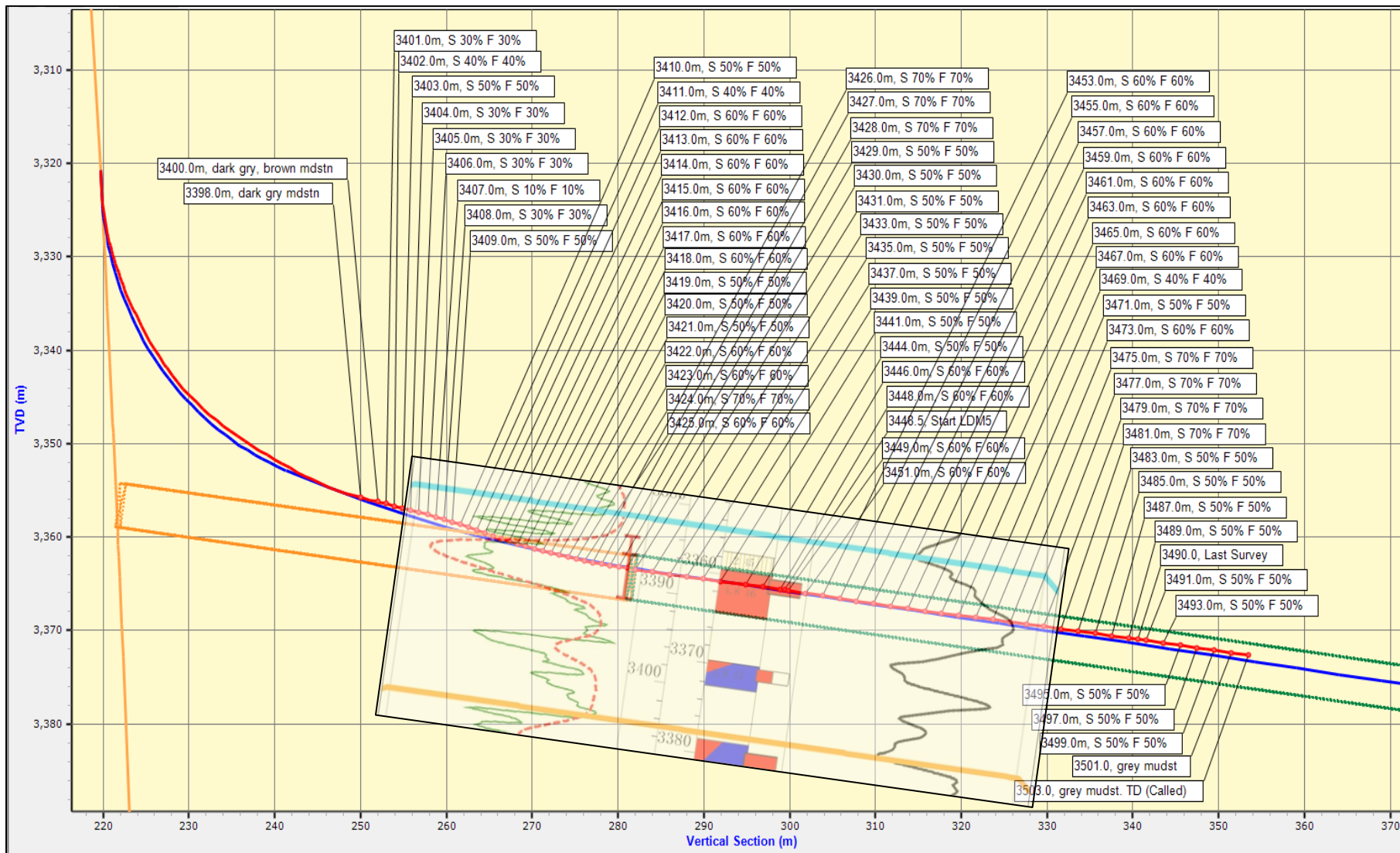




CASE 7 – LOW-PERM DEEP USR WELL (GWD STEERING)

Example: Well #116, Block #47, Hebei Province

Crossed hard calcareous layer (0.4 m/hr). Called early TD (sand pinch out)

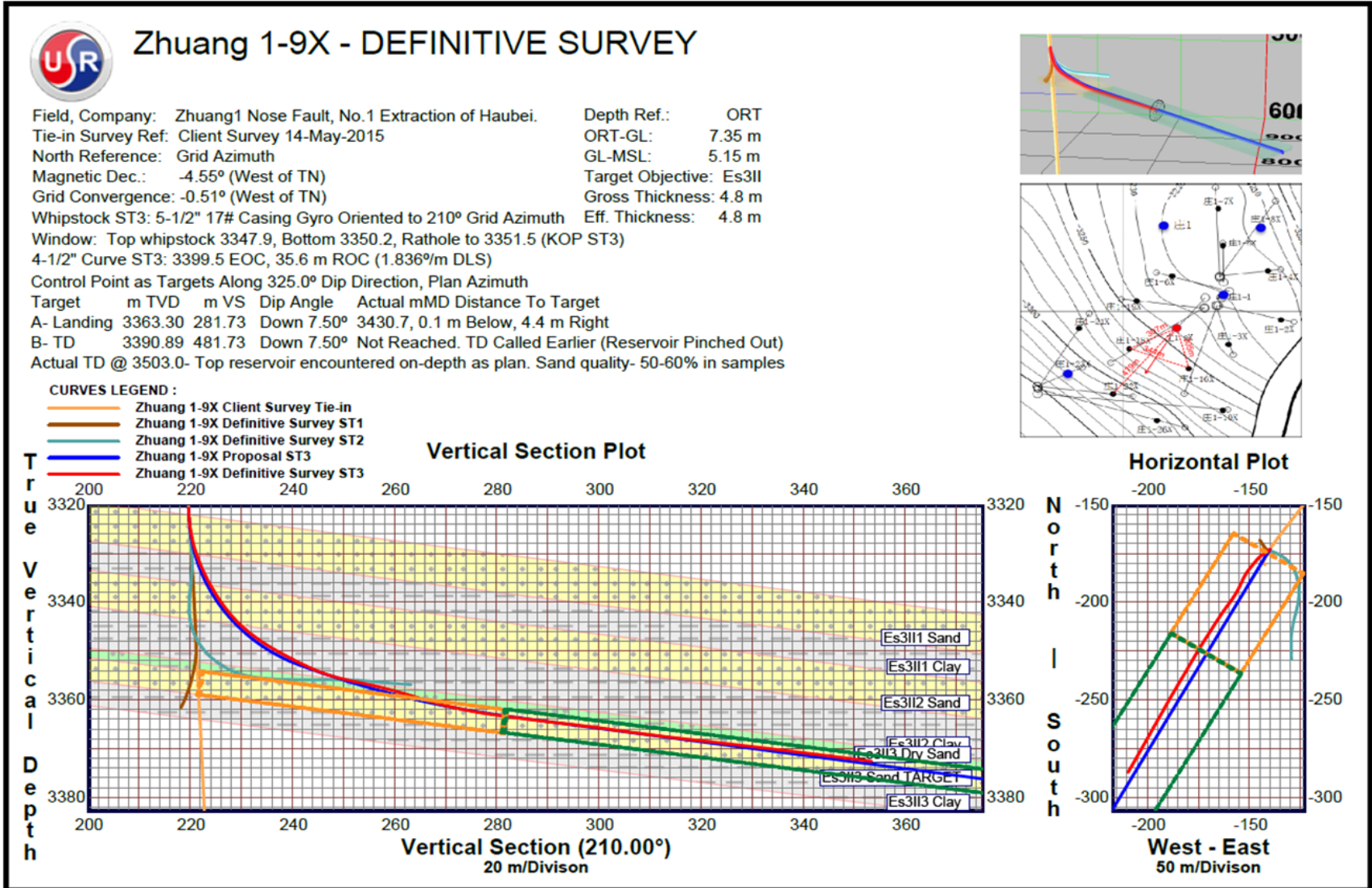




CASE 7 – LOW-PERM DEEP USR WELL (GWD STEERING)

Example: Well #116, Block #47, Hebei Province

One of deepest USR wells to date (3355 KOP, 3503m TD)





CASE 7 – LOW-PERM DEEP USR WELL (GWD STEERING)

Example: Well #116, Block #47, Hebei Province

RESULT:





CASE 8 – PRE USR vs POST USR PRODUCTION

126 Wells Production

Cumulative Oil 592,792 bbl from 114 out of 126 wells with production data over Jun 2019 to Apr 2024

LAST PRODUCTION PRIOR TO USR (PRE USR) vs POST USR - CNPC, CHINA

