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ANALYSIS OF NON-PRODUCTIVE TIME IN GEOTHERMAL DRILLING - CASE STUDY MENENGAI FIELD IN KENYA

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ABSTRACT

Non Productive Time (NPT) is the main cause of drilling project delays. There are numerous occurrences or eventualities that cause stoppage of drilling operations or marginal reduction in advancement of the drilling progress leading to Non Productive Time (NPT).

These occurrences are either observable or unobservable and could be due to; the physical characteristics of the well, geology, drilling parameters of the well, operator experience, wellbore quality, equipment downtime, well planning and execution, team communication, leadership, or project management skills. Hard abrasive rocks, high temperature and abrasive fluids found in the geothermal environment present unique drilling challenges. Too often the best drilling practices used to address trouble zones are limited to a few conventional methods which offer a narrow range of effectiveness making geothermal drilling the single most expensive component and can account for up to 50% of geothermal resource development cost.

Non Productive Time (NPT) is directly proportional to drilling cost and if uncontrolled could lead to escalation of costs sometimes beyond budgetary allocation. The need to maintain NPT at a minimum cannot be overemphasized hence aim of this paper to carry out an analysis on the Non-productive time experienced while drilling geothermal wells in Menengai Field.

INTRODUCTION

According to Rabia (2002 p.15) the time required for any routine or abnormal operation which is carried out as a result of a failure is defined as Non Productive Time (NPT). NPT in the drilling industry is viewed as a measure of things that go wrong. Anything outside the original well plan should be considered as NPT.

Rather than use NPT as a performance metric of what has gone wrong it can be used to identify things that can be done better. Accurate calculation of NPT is essential for any improvements in future drilling operations. Daily NPT records should be checked against historical trends to arrive at solutions. NPT is calculated as the time from when the problem occurred to the time when operations are back to prior to the problem occurring. NPT activities in drilling include wait on water, repairs, fishing, unscheduled bit change, reaming under gage hole, stuck pipe etc.

Geothermal Development Company (GDC) was formed by the Government of Kenya as a Special Purpose Vehicle to fast track the development of geothermal resources in the country. GDCs mission is to provide steam for the generation of 5,000MW of geothermal power by 2030 this translates to approximately 1400 steam wells being drilled by 2030. From a project management point of view any reduction in the time used to drill a well can result in huge savings and timely completion of projects.

Time Analysis

The analysis of NPT in drilling geothermal wells in Menengai was accomplished by analyzing secondary data obtained from drilling logs, DDRs and well completion reports. The daily drilling report (DDR) reports the drilling progressing in summarized format by providing brief information on; well details, planned start and completion dates, current depth, meters drilling in 24 hours and the current status. The drilling log records all the drilling activities in hourly basis.

Four wells were sampled for NPT analysis by considering the following;

- That the sampled wells were drilled by different drilling Rigs
- Actual drilling duration exceeded planned drilling duration

- That the sampled wells were separate from each other by a distance of at least a kilometer.

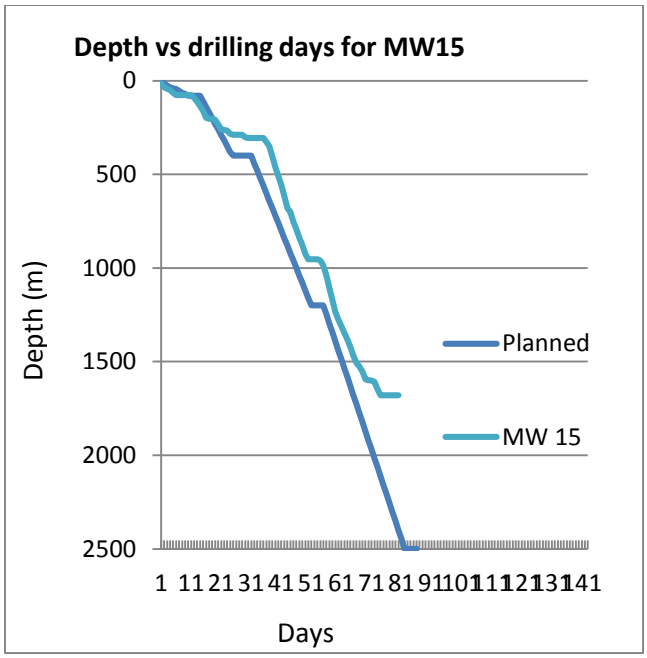
The NPT analysis carried out a detailed comparison of the planned and actual drilling duration for wells MW-15, MW-16, MW-19, and MW-20. Every deviation of actual from planned was closely scrutinized to establish the true cause of delay. The drilling log and the DDR were the main source of information complimented by information gathered through interviewing drilling personnel on site.

A step-by-step approach was adopted in the analysis of non-productive time for each well whereby a progressive analysis was carried out from the first day (Spud-in date) to the completion date. The data collected was tabulated in order to make the following inferences;

- What % NPT comprise the total drilling duration
- Which is/are the main causes of NPT
- Which section of the hole has the highest NPT
- What is the main cause of NPT in 26'' section, 17½" section, 12¼" section, and 8½" section

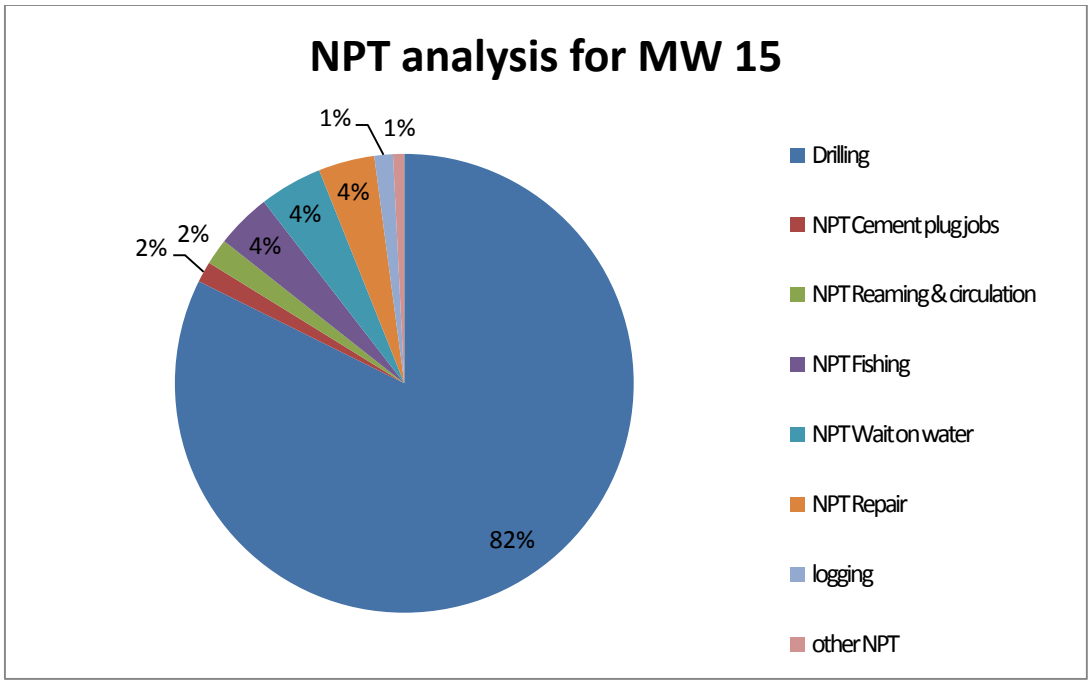
MW15

DRILLING PLOT MW-15 PLANNED vs ACTUAL



MW-15 NPT ANALYSIS BY SECTION

HOLE SECTION	26''		17 ½''		12 ¼''		8 ½''		Total time (hrs)	% Total time
Activity	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time		
Drilling	170	83.3	350.4	60.8	487.5	96.7	563	90.3	1570.9	82.3
NPT Cement plug jobs	14	6.9	14	2.4	0	0	0	0	28	1.4
NPT Reaming & circulation	4	2	8	1.4	11	2.2	12	1.9	35	1.8
NPT Fishing	0	0	0	0	0	0	0	0	74	3.8
NPT Wait on water	0	0	84.58	14.7	0	0	0	0	84.58	4
NPT Repair	16	7.8	30	5.2	5.5	1.1	24	3.8	75.5	3.9
Logging	0	0	0	0	0	0	25	4	25	1.3
other NPT	0	0	15	2.6	0	0	0	0	15	0.7
Total	**204**	**100**	**576**	**100**	**504**	**100**	**624**	**100**	**1908**	**100**



MW-15 NPT ANALYSIS – RANKING BY SECTION

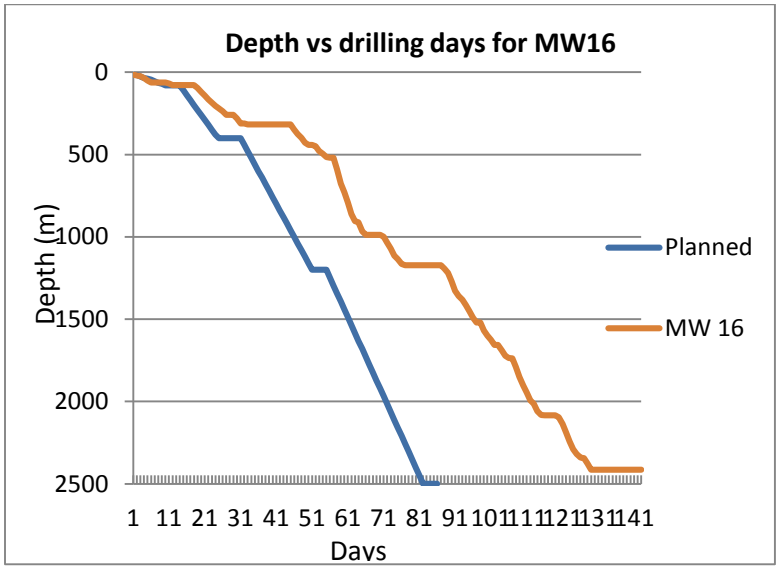
	HOLE SECTION	% of TOTAL NPT
1	17½" Hole Section	72.28
2	8½" Hole Section	11.54
3	26" Hole Section	10.89
4	12¼" Hole section	5.29

MW-15 NPT ANALYSIS – RANKING BY CAUSE

	NPT CAUSE	% of TOTAL NPT
1	Wait on water	27.1
2	Wait on repair	24.2
3	Fishing	23.7
4	Reaming and circulation	11.2
5	Cement plug jobs	9.0
6	Other	4.4

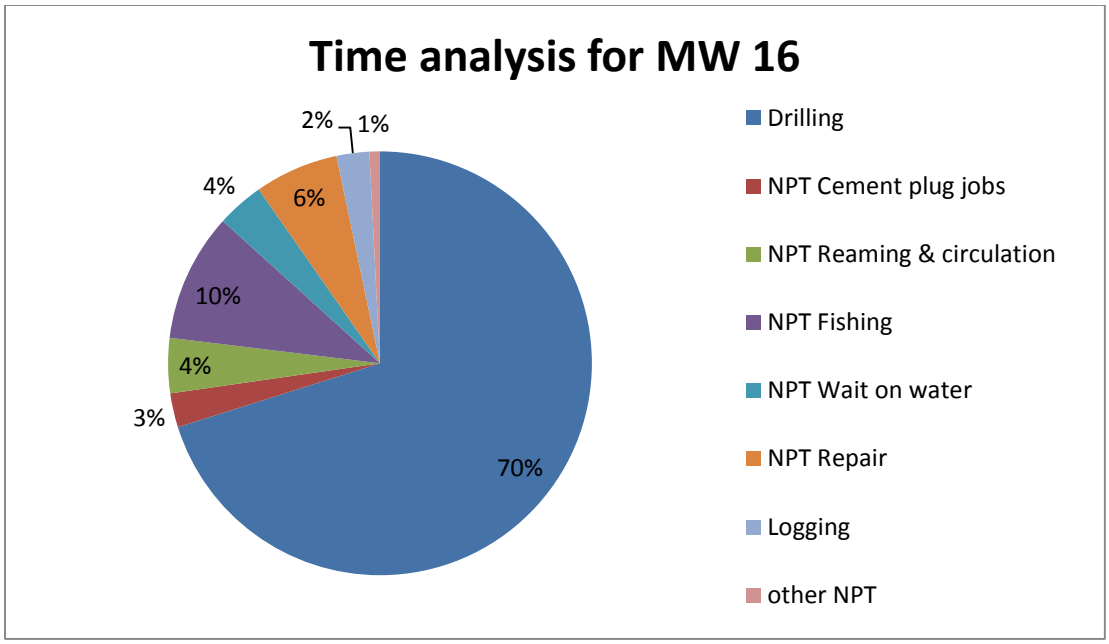
MW 16

DRILLING PLOT MW-16 PLANNED vs ACTUAL



MW-16 NPT ANALYSIS BY SECTION

HOLE SECTION	26''		17 ½''		12 ¼''		8 ½''		Total time (hrs)	% Total time
Activity	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time		
Drilling	173	84.8	490	59.6	697	70.8	1045.5	73.8	2405.5	70.2
NPT Cement plug jobs	0	0	57	6.9	33	3.4	0	0	90	2.6
NPT Reaming & circulation	7	3.4	84	10.2	33	3.4	20	1.4	144	4.2
NPT Fishing	20.5	10	0	0	146	14.8	167.5	11.8	334	9.8
NPT Wait on water	1.5	0.7	82.5	10	4	0.4	35	2.5	123	3.6
NPT Repair	2	1	108	13.1	47	4.8	61	4.3	218	6.4
Logging	0	0	0	0	0	0	84	5.9	84	2.5
other NPT	0	0	0	0	24	2.4	3	0.2	27	0.8
Total	**204**	**100**	**821.5**	**100**	**984**	**100**	**1416**	**100**	**3425.5**	**100**



MW-16 NPT ANALYSIS – RANKING BY SECTION

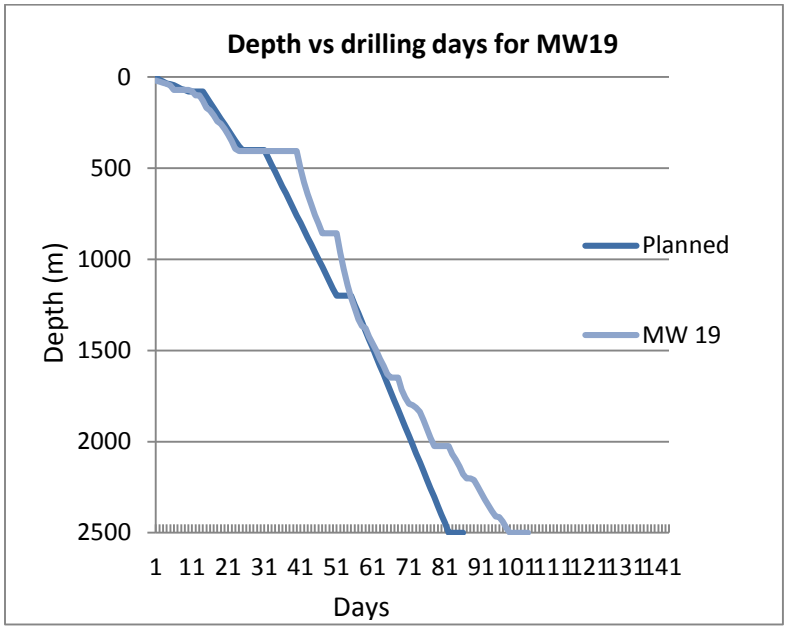
	HOLE SECTION	% of TOTAL NPT
1	17½" Hole Section	35.4
2	12¼" Hole section	30.7
3	8½" Hole Section	30.6
4	26" Hole Section	3.3

MW-16 NPT ANALYSIS – RANKING BY CAUSE

	NPT CAUSE	% of TOTAL NPT
1	Fishing	35.7
2	Wait on repair	23.3
3	Reaming and circulation	15.4
4	Wait on water	13.1
5	Cement plug jobs	9.6
6	Other	2.9

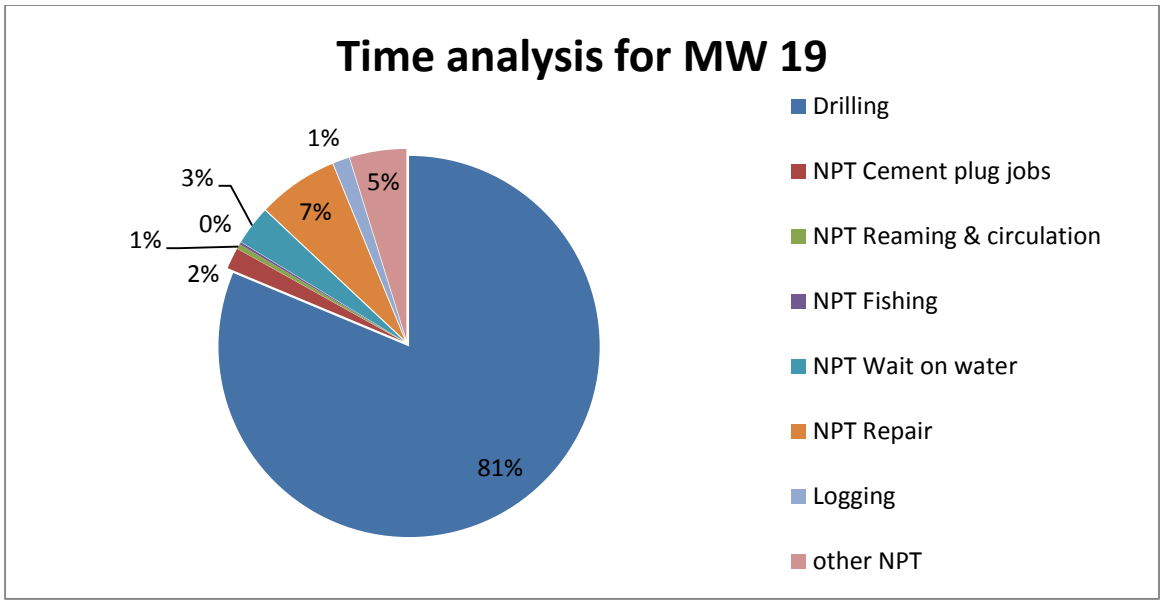
MW 19

DRILLING PLOT MW-19 PLANNED vs ACTUAL



MW-19 NPT ANALYSIS BY SECTION

HOLE SECTION	26''		17 ½''		12 ¼''		8 ½''		Total time (hrs)	% Total time
Activity	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time		
Drilling	201	95.7	381	82.6	337	62.3	1077	86.7	1996	81.3
NPT Cement plug jobs	0	0	28	6.1	15	28	0	0	43	1.8
NPT Reaming & circulation	0	0	0	0	0	0	10	0.8	10	0.4
NPT Fishing	2	1	0	0	0	0	0	0	2	0.2
NPT Wait on water	0	0	0	0	54	10	28	2.3	82	3.3
NPT Repair	7	3.3	50	10.8	69	12.8	41	3.3	167	6.8
Logging	0	0	0	0	11	2.0	24	1.9	35	1.4
other NPT	0	0	0	0	55	10.2	62	5	119	4.8
Total	**210**	**100**	**461**	**100**	**541**	**100**	**1242**	**100**	**2454**	**100**



MW-19 NPT ANALYSIS – RANKING BY SECTION

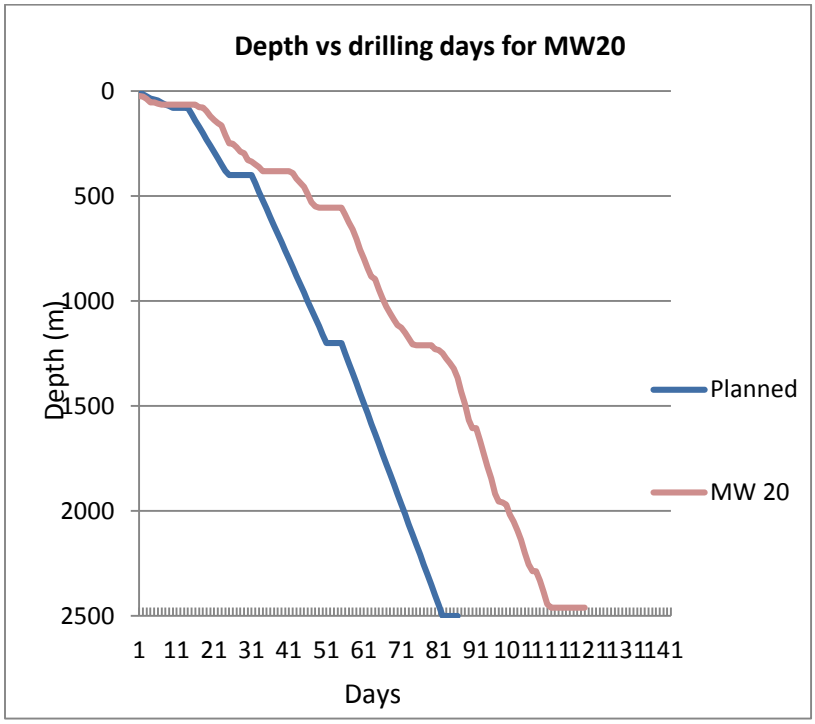
	HOLE SECTION	% of TOTAL NPT
1	12¼" Hole section	45.6
2	8½" Hole Section	33.3
3	17½" Hole Section	18.9
4	26" Hole Section	2.1

MW-19 NPT ANALYSIS – RANKING BY CAUSE

	NPT CAUSE	% of TOTAL NPT
1	Wait on repair	39.5
2	Other	28.1
3	Wait on water	19.4
4	Cement plug jobs	10.2
5	Reaming and circulation	2.4
6	Fishing	0.5

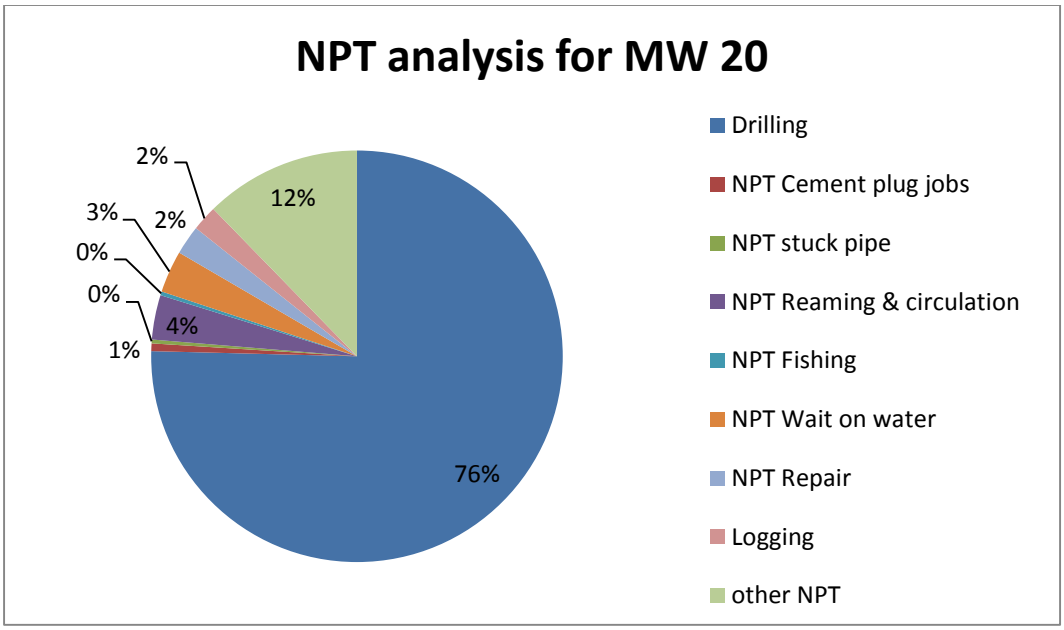
MW 20

DRILLING PLOT MW-20 PLANNED vs ACTUAL



MW-20 NPT ANALYSIS BY SECTION

HOLE SECTION	26''		17 ½''		12 ¼''		8 ½''		Total time (hrs)	% Total time
Activity	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time	Time (hrs)	% time		
Drilling	184.5	51.4	576.5	90.5	604.5	62.2	780.36	88.8	2145.86	75.4
NPT Cement plug jobs	0	0	0	0	16	1.6	0	0	16	0.6
NPT stuck pipe	1.43	0.4	0	0	0	0	7	0.8	8.43	0.3
NPT Reaming & circulation	58.5	16.3	0	0	42	4.3	7	0.8	100.5	3.5
NPT Fishing	9.5	2.6	0	0	0	0	10	0.8	9.5	0.3
NPT Wait on water	69	19.2	0	0	0	0	0	0	93	3.3
NPT Repair	1.5	0.4	36.67	5.8	7	0.7	24	2.7	64.17	2.3
Logging	0	0	0	0	12	1.2	19	2.2	60	2.0
other NPT	34.75	9.7	24	3.8	290.5	29.9	48	5.5	349.25	12.3
Total	**359.2**	**100**	**637.2**	**100**	**972**	**100**	**878.36**	**100**	**2846.71**	**100**



MW-20 NPT ANALYSIS – RANKING BY SECTION

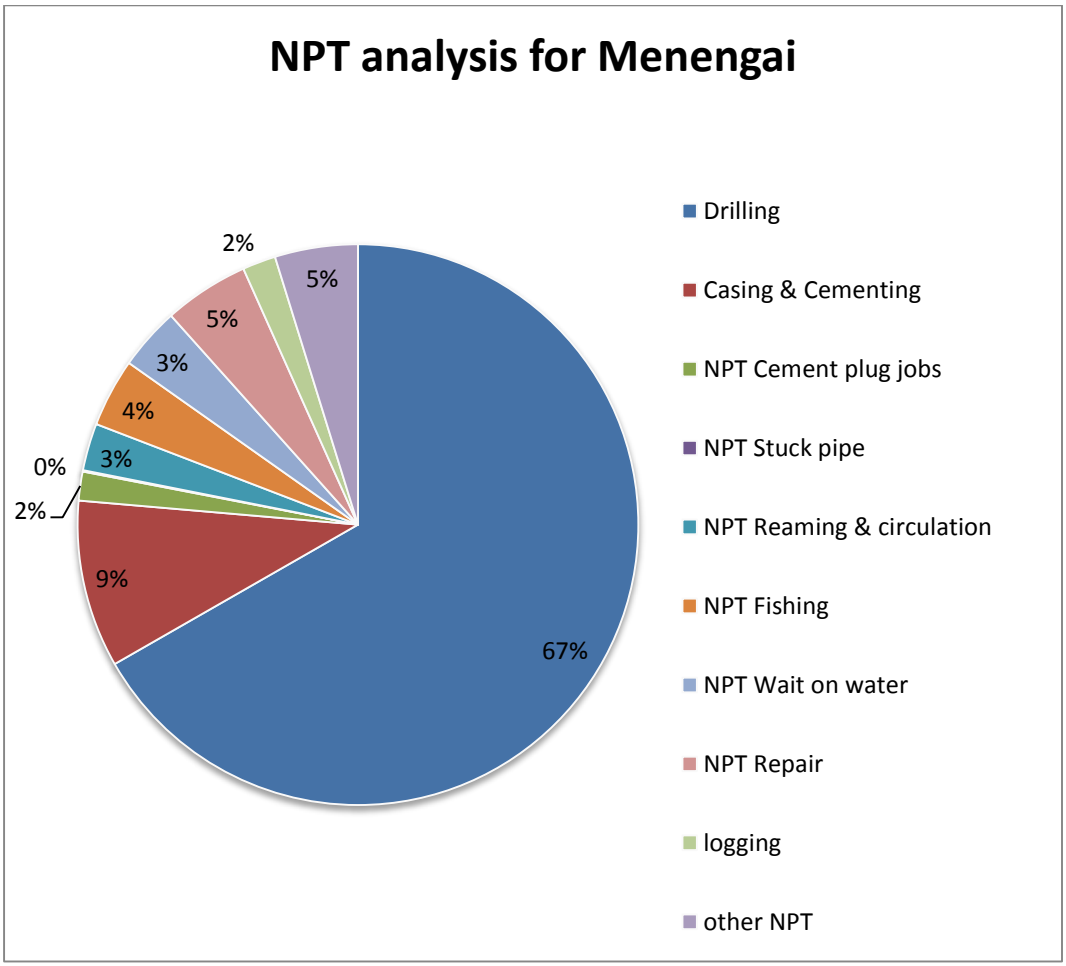
	HOLE SECTION	% of TOTAL NPT
1	12¼" Hole section	55.5
2	26" Hole Section	27.3
3	8½" Hole Section	9.5
4	17½" Hole Section	7.8

MW-20 NPT ANALYSIS – RANKING BY CAUSE

	NPT CAUSE	% of TOTAL NPT
1	Other (Milling + tubular inspection)	54.5
2	Reaming and circulation	15.7
3	Wait on water	14.5
4	Wait on repair	10
5	Cement plug jobs	2.5
6	Fishing	1.5
7	Stuck pipe	1.3

SUMMARY ANALYSIS OF NPT IN MENENGAI

Activity	Drilling	Casing & Cementing	NPT Cement plug jobs	NPT Stuck pipe	NPT Reaming & circulation	NPT Fishing	NPT Wait on water	NPT Repair	logging	other NPT	Total
Percent (%)of total drilling time	66.8	9.7	1.7	0.1	2.7	4.0	3.6	4.9	1.9	4.8	100.0
Percent (%) of total NPT			7.7	0.4	12.5	18.1	16.5	22.7		22.1	
NPT Ranking			6	7	5	3	4	1		2	



CONCLUSION

NPT in Menengai accounts for 23.5% of the total drilling time. Like in many land rigs wait on repairs remains the biggest challenge in Menengai this is partly as a result of long government procurement process that has to be initiated every time there is unforeseen breakdown. Formation challenges resulting to lost circulation, stuck pipe, fishing operations, hole cleaning problems is also a major contributor to NPT.

With the global average for NPT standing at 20%, GDCs case is very close. This means that if substantive time savings are to be achieved, efforts should also be directed towards increasing the 76.5% time spent on drilling.

RECOMMENDATIONS

In order to reduce the NPT level, appropriate measures need to be determined and applied to address the various NPT causes. Addressing NPT causes should be prioritized according to the level of contribution of each particular NPT cause, starting from highest contributor to the lowest contributor. If the first three (3) biggest NPT contributors are effectively addressed, the total NPT will be reduced by almost 50%, and in effect reduce drilling cost and time.

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