

1.

We're taking the POV of TigerKing Oil in this question, so we'll try to maximize NPV of the project given fixed costs and revenues from selling oil. However, there are other perspectives we can take. For one, we can view this from TigerKing's lender perspective, with limited capital, comparing the estimated return of this project to other potential projects that they can fund. Another perspective is Kazakhstan government, looking to make money by leasing resources to TigerKing Oil by maximizing lease cost, maximizing percentage cut from revenue, and minimizing oil production cap while still making the project attractive for the bidding company.

2.

Lease cost = \$400M
Equipment installation cost = \$260.44M

Equipment	Cost	Factor	Total Cost
Turbine	33.2	2.5	83
Compressor	24.8	2.8	69.44
Vessel+Tank	25.6	2.7	69.12
Valve	7.2	3.8	27.36
Switchgear	4.8	2.4	11.52
Sum			260.44

Total fixed costs = Lease cost + Equipment installation cost
= \$400M + \$260.44M
= \$660.44M

3.

Since lease cost is fixed, and operating cost is per barrel, only equipment costs changes with size:
Use power sizing equation, with $x = 0.67$

$$\frac{\text{Cost of equipment A}}{\text{Cost of equipment B}} = \left(\frac{\text{Size (capacity) of equipment A}}{\text{Size (capacity) of equipment B}} \right)^x \quad (1-3)$$

Old equipment = 36k bbl/d
New equipment = 41k bbl/d
Cost of new equipment = Cost of old equipment * (New equipment size / Old equipment size) ^x
= \$260.44M * (41k / 36k) ^{0.67}
= \$284.15M
Additional cost = Cost of new equipment - Cost of old equipment
= \$284.15M - \$260.44M
= \$23.71M

There may be benefit to increasing facility size, since it cost less to produce additional oil due to decreasing rate of change in equipment cost increases. However, it also means investing more present money, which is generally worth more than future money.

4.

Both options' running revenue per barrel is the same:

Revenue per barrel = (Oil selling price - Operation cost - Transport cost) * Government cut
= (\$19.5 /bbl - \$4.5 /bbl - \$1.25 /bbl) * (1 - 10%)
= \$12.375 /bbl

Since interest rate is compounded annually, we have to consider revenue and project lifetime in a yearly basis. We can find revenue per year and project lifetime as follows:

Revenue per year = Barrel per day * 365 * Revenue per barrel

Project lifetime = Days to 100M capacity

= 100M bbl / (Barrel per day * 365)

We can summarize what we know so far as follows:

Facility plan	Fixed cost (\$M)	Barrel per day	Revenue (\$M) per year	Project lifetime (y)
Old plan	660.44	36000	162.6075	7.61
New plan	684.15	41000	185.191875	6.68

Since calculating NPV requires equal project lifetime, we need to consider time difference:

- Least common multiple of the two lifetimes (3387527.1 days) is too large to be useful for comparison.
- Since the difference is small, we can just pick the longer time (7.61 years) as the lifetime we're using to analyze. We'll just say there's no cash flow during the last 0.93 year in the new plan. Compared to picking the shorter lifetime as analysis period, this is more fair and beneficial to the old plan since the last year of production is not cut off. Therefore, if this analysis puts new plan out ahead, then it's very obvious that the new plan is better.
 - Note that with the new plan, we can take that money and reinvest a year earlier than in the old plan, but we won't consider that so to make analysis more fair to old plan.
- If the old plan comes out ahead or the difference in PV is not significant, we can consider other analysis strategies.

Pick 7.61 years as analysis period:

Old plan NPV = PV of fixed cost + PV of cash flow
 = - \$660.44M + \$162.61M(P/A, 15%, 7.61)
 = - \$660.44M + \$162.61M * 4.37
 = \$49.38M

New plan NPV = PV of fixed cost + PV of cash flow
 = - \$684.15M + \$185.19M(P/A, 15%, 6.68)
 = - \$684.15M + \$185.19M * 4.05
 = \$65.09M

Difference = \$15.71M
 = 31.81% of old plan NPV

31.81% is a significant difference between project NPV. Given that the new plan NPV is 131.81% of the old plan NPV in an analysis that is more fair to old plan NPV calculation, we can say that new plan provides better NPV.