Republic of Iraq
Federal Board of Supreme Audit (FBSA)

Sub.\Performance Evaluation Report on MoO Policy

For developing Maysan Oil Company's Oilfields

(Noor and Amara oilfields) for (2012 – 2017)

Pursuant to the stipulations of item (Second)/article (6) of FBSA Law no. (31) for (2011) (amended), and in execution of Administrative Order no. (5863) issued (March 18th, 2018) on performance evaluation of MoO policy for developing Maysan Oil Company’s oilfields (Noor and Amara oilfields) for evaluation period (2012 – 2017), and in accordance with adopted standards and indicators, and taking into consideration the data and information provided to us by MoO and its affiliates, and the information and indicators deduced from field visits, tables, statements, disclosures, and statistics submitted to us, the specialized team has carried out its tasks, and has the following notes:

1- Introduction
   a- Scope of work

   The specialized team, formed according to the aforementioned Order, has identified applicable data samples regarding MoO and its affiliates as follows:
   - Ministry of Oil (MoO)
     • Minister’s office
     • Office of Deputy Minister on Extraction Affairs
     • Inspector General Office
     • Technical Department
     • Department of Studies, Planning, and Follow-up
     • Department of Reservoirs and Fields Development
   - Affiliated companies
     • Maysan Oil company (MOC)
b- **MoO tasks**

Pursuant to its law no(101) of 1976, MoO is tasked with managing oil sector by carrying out several operations that include exploration, well drilling, and extracting oil and gas (as its main tasks is to increase crude oil and gas production).

c- **The mission of Maysan Oil Company (MOC)**

MOC aims at participating in sustaining national economy in oil sector by developing and producing oil and gas from its operation area designated in the 2\textsuperscript{nd} chapter/Article Third, for local consumption and export purposes in order to achieve the goals of development plans and those of MoO.

- **Tasks of MOC**

  In order to achieve its tasks, MOC carries out the following activities in accordance with MoO Law no.(101) 1976 (amended) and law no.(156) 1979 (amended):

  1- Production and treatment of crude oil to separate associated gas.
  2- Storing and pumping crude oil to points of export within the activities of Basrah oil company in Al-Basrah Governorate.
  3- Producing and processing associated gas.
  4- Executing well-logging, restoring and recompleting oil-wells and other activities related to drilling and oil well restorations.
  5- Operating and maintaining storage and pumping facilities.
  6- Developing oil fields to sustain production, and increase its rates in accordance with MoO plans.
  7- Managing and carrying out all technical and service operations that support its activities.
  8- Executing any activities within its designated area that are in accordance with MoO’s plans.
d- **Evaluation subject matter and its effect on society**

The issue (subject matter) has been identified depending on statistical groups and technical reports on extractive operations and gas, and via risk matrix and the accumulated experience of the specialized team owing to their work in the extractive sector: the lack of clear policy that MoO and MOC should adopt for developing national effort oil-fields of MOC has led to inefficient utilization of available resources in these fields and the lack of optimal utilization that should have participated in sustaining national economy.

e- **Policies of MoO to address the problem**

We could not ascertain that MoO has established any clear future plans for the two fields (Noor and Amara) due to the lack of inclusive detailed reservoir studies; and all plans that have been implemented during the evaluation period (2012 – 2017) are based on available drilling equipment and allocated financial resources.

2- **Evaluation approach**

In order to identify the causes of the main problems, the specialized team has conducted the following measures during the planning phase:

a- **Risk analysis**

Through examining data and statistical groups for (2011 – 2016) provided to us by MoO/Department of Studies letter no. (1512) on 10th of April, 2018; and the preliminary meetings with DGs of MoO affiliates, and the preparatory study, the main problem has been identified which is the subject of this performance audit (low efficiency of national efforts oil fields of MOC (Noor and Amara oil fields), and examining the causes of this problem in the attached matrix (attachment 1) to highlight the materiality degree of secondary problems that give rise to the main one:
- The lack of detailed reservoir studies for the two fields, and the lack of a clear development plan to utilize available resources of crude oil and gas.
- Wasting associated gas by flaring in both oil fields.
- The lack of drilling equipment in addition to the fact that existing operational ones are timeworn.
- Obsoleteness of control equipment and systems, and pumps, as well as the lack of water and sediment treatment units in Noor oil field.
- Low efficiency of calibration activities of custody transfer meters.
- Low level of safety and environment aspects in both oil fields.

b- The Purpose of Evaluation
The main purpose of this performance evaluation is to participate in overcoming the problem of low efficiency of the two fields and low production capacity of oil and gas as this, when treated, will plug the gap in local demand on power and to define the actual causes of the problem, and to formulate corrective recommendations.

c- Audit questions
Q1- what is MoO policy for developing National Efforts oil fields (Noor and Amara) for (2012 – 2017)?
Q2- what is the annual production rate during the said period (2012 – 2017)?
Q3- what is the number of productive wells (drilled and completed) in (2012 – 2017)?
Q4- what is MoO’s plan for developing the two oilfields and utilizing oil and gas?
Q5- what are the allocations budgeted for the development of the two fields?
Q6- how many idle wells are there during the period of (2012-2017)?
Q7- what is the number of wells that have been drilled but have not commenced production during (2012-2017)?
Q8- what are the crude oil quantities, whether planned or produced, for each year of the said period?
Q9- what are the amounts of money expended on drilling?
Q10- Does MOC uses gas or water injection systems?
Q11- is there any well that has stopped producing after a year of their drilling or less?
Q12- what is the summary of the reservoir studies on the two fields, supported by geological profiles with depths?
Q13- what are the development studies prepared by MOC for the two fields?
Q14- what is the total processing capacity of oil treatment station for the two fields?
Q15- what are the lab test samples of the crude oil produced from the two fields with test results of water and sediment, salts, and asphaltene?
Q16- what is the cost of a single well in average for national efforts oil fields, and IOCs oil fields that are within MOC’s scope of work?

**d- Audit standards**

- Iraqi Code for Property System (type of system used for financial calculations).
- API standard issued by American Petroleum Institute and the National metering system.
- Standards applied to the processes of designing, manufacturing, and operating metering equipment and systems such as (ASTM) American Society for Testing Materials, and (ANST) American National Standards Institute.
- Marketing criteria guide for Iraqi petroleum products.
- Bureau Veritas company as for blueprints and factory tests.
- Terms and regulations of the Iraqi Society for health and vocational Safety.
- Rules and regulations issued by MoO and MOC regarding the development of the two oil fields.

3- Performance Evaluation Outcomes
Due to the increasing need to raise production quantities from national endeavor oilfields as production from IOC’s oilfields increases, our audit team have examined development plans and the extent of their effectiveness and execution; the result of reservoir observation of the two fields are as follows:

A- Amara oilfields
This field is located in Maysan Southern governorate (10) Km southeast Amarah city and (10) Km northwest Halfayah oilfield, and (30) Km southeast Kumait oilfield. The filed is (18) km long and (4.5) km wide; its formations were discovered through seismic surveys performed by Iraqi National Petroleum Company in (1973-1974). When the first exploration well was drilled in 1985, the results proved the existence of hydrocarbons accumulations in the formation of (Al-Khaseeb, Mishrif, Nahr Omar, Artawi, Al-Yamama). Then, there were several drilling operations in the following years. Yet, the study has proved that the three main reservoirs are (Mishrif, Al-Khaseeb, Nahr Omar) constitute 93.5% of the total reserve of the field, while the reserve of (Artawi and Al-Yamamà) constitutes (6.5%) of the total quantity. The field has a degassing unit with a capacity of (4000 bbl/day) and two Separators (S1 and S2) in addition to another test separator. These separators separate gas from crude oil received from oil wells then gas proceed to flaring while crude to wet oil treatment unit for processing and then exporting. The capacity of wet oil treatment unit is (20000) bbl./day; it comprises two separators: the first is a dehydrator, and the second is a desalter that utilizes static electricity and de-emulsifier after
heating up the crude oil by (water path heater H100). There are two tanks to store treated oil the capacity of each is (5000)m³ and there 6 electric pumps connected to the tanks for exporting crude oil with a capacity of (13000 – 22000) bbl/day taking into consideration that the capacity of the units is (19500)bbl/d. The table below shows the wells of Amara oil field and the specifications of each well.

<table>
<thead>
<tr>
<th>WELL no.</th>
<th>CHOCK SIZE</th>
<th>PRODUCTION Bbl/d</th>
<th>W.H.P KG/CM²</th>
<th>API</th>
<th>SALT Mg/L</th>
<th>B.S.W WATER%</th>
<th>SED%</th>
<th>EM%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM1</td>
<td>28/64</td>
<td>1600</td>
<td>55</td>
<td>14.2</td>
<td>45994</td>
<td>14</td>
<td>NIL</td>
<td>8</td>
</tr>
<tr>
<td>AM3</td>
<td>20/64</td>
<td>1700</td>
<td>125</td>
<td>12</td>
<td>15660</td>
<td>2.4</td>
<td>NIL</td>
<td>11.6</td>
</tr>
<tr>
<td>AM4</td>
<td>20/64</td>
<td>1680</td>
<td>80</td>
<td>16.6</td>
<td>38222</td>
<td>12</td>
<td>NIL</td>
<td>6</td>
</tr>
<tr>
<td>AM5</td>
<td>32/64</td>
<td>380</td>
<td>28</td>
<td>24.3</td>
<td>1635</td>
<td>NIL</td>
<td>NIL</td>
<td>0.6</td>
</tr>
<tr>
<td>AM6</td>
<td>16/64</td>
<td>660</td>
<td>100</td>
<td>14.3</td>
<td>66065</td>
<td>30</td>
<td>NIL</td>
<td>10</td>
</tr>
<tr>
<td>AM8</td>
<td>42/64</td>
<td>2135</td>
<td>60</td>
<td>22.9</td>
<td>1230</td>
<td>0.4</td>
<td>NIL</td>
<td>0.2</td>
</tr>
<tr>
<td>AM9</td>
<td>32/64</td>
<td>2840</td>
<td>80</td>
<td>2301</td>
<td>1044</td>
<td>0.3</td>
<td>NIL</td>
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</tr>
<tr>
<td>AM10</td>
<td>32/64</td>
<td>2050</td>
<td>125</td>
<td>29.8</td>
<td>7424</td>
<td>NIL</td>
<td>NIL</td>
<td>5</td>
</tr>
<tr>
<td>AM11</td>
<td>32/64</td>
<td>1200</td>
<td>53</td>
<td>20</td>
<td>6210</td>
<td>0.2</td>
<td>NIL</td>
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</tr>
<tr>
<td>AM13</td>
<td>42/64</td>
<td>2000</td>
<td>50</td>
<td>22.4</td>
<td>580</td>
<td>0.9</td>
<td>T</td>
<td>0.1</td>
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<tr>
<td>AM14</td>
<td>32/64</td>
<td>720</td>
<td>50</td>
<td>22.3</td>
<td>493</td>
<td>0.8</td>
<td>NIL</td>
<td>0.4</td>
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<tr>
<td>AM15</td>
<td>32/64</td>
<td>2500</td>
<td>70</td>
<td>23.8</td>
<td>2308</td>
<td>0.127</td>
<td>NIL</td>
<td>NIL</td>
</tr>
</tbody>
</table>
Topographic map showing Amara field location

**B- Noor oil field**

This field is located in Maysan Governorate: 17Km north of Al-Amarah, 40 Km off the Iranian borders, and 25 Km south Bazergan oil field and northwest Al-Halfaya oilfield. The field is a fold that extends northwest-southeast direction, its length is around 30Km and its width is 15Km. This formation was discovered via seismic survey of Al-Amarah – Al-Halfawiyah area during (1974 – 1974). Thereafter the first exploration well(Nur-1) was drilled in 1977. The preliminary explorations showed that there are potentially commercial oil gatherings in (mishrif and Nahr Omar) formation that considered the main reservoir and presence of insignificant oil presence in Al-Saadi, Al-Maudud, Al-Zubair, Artawi, and Al formations. Test results showed the presence of formation water in Al-Jiraibi, Al-Furat and Al-Khaseeb formations. Noor field station contains a degassing unit with a capacity of (40000 bbl/d);
it is consisted of three degassing stages (S1, S2, S3) in addition there is a test separator; it separates gas from the crude oil that is received from oil wells; then gas is flared while crude oil is transferred to Bazergan site for treatment and exporting afterwards, as the treatment units in Noor field are incomplete, and there are two tanks with a capacity of (5000 m$^3$) and electric export pumps with a capacity of (20000 bbl/d) and gas pumps with a capacity of (22000 bbl/d) noting that the station capacity is (8950 bbl/d). The following table shows the specifications of Noor field wells.

<table>
<thead>
<tr>
<th>WELL no.</th>
<th>CHOCK SIZE</th>
<th>PRODUCTION Bbl/d</th>
<th>W.H.P KG/CM$^2$</th>
<th>API</th>
<th>SALT Mg/L</th>
<th>B.S.W</th>
<th>WATER%</th>
<th>SED%</th>
<th>EM%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOL</td>
<td>32/64</td>
<td>450</td>
<td>25</td>
<td>22.9</td>
<td>1264</td>
<td>0.6</td>
<td>NIL</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>NO2</td>
<td>32/64</td>
<td>1200</td>
<td>51</td>
<td>23.2</td>
<td>3886</td>
<td>0.6</td>
<td>NIL</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>NO4</td>
<td>32/64</td>
<td>1015</td>
<td>26</td>
<td>22.5</td>
<td>92</td>
<td>0.05</td>
<td>NIL</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>NO6</td>
<td>28/64</td>
<td>715</td>
<td>28</td>
<td>17.6</td>
<td>29128</td>
<td>10</td>
<td>NIL</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>NO8</td>
<td>28/64</td>
<td>750</td>
<td>51</td>
<td>23.4</td>
<td>3079</td>
<td>0.2</td>
<td>NIL</td>
<td>2.2</td>
<td></td>
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<tr>
<td>NO12</td>
<td>32/64</td>
<td>1870</td>
<td>50</td>
<td>22.7</td>
<td>394</td>
<td>NIL</td>
<td>T</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>NO13</td>
<td>32/64</td>
<td>2040</td>
<td>50</td>
<td>27.6</td>
<td>12296</td>
<td>1</td>
<td>NIL</td>
<td>7</td>
<td></td>
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<tr>
<td>NO14</td>
<td>32/64</td>
<td>550</td>
<td>15</td>
<td>23.3</td>
<td>158</td>
<td>0.1</td>
<td>NIL</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

Topographic map showing Noor field, its wells and central processing facility
The reservoir thickness is about (229) meters in Amara oilfield and the average thickness of the cover that holds oil is (15)m and the average porosity of the cover is (18%) and its saturation is (21%)oil density is (31 API) and gas to oil ratio is 1010 scf/bbl.

The production from this reservoir is from the following wells (Amara-3, Amara-6, and Amara-10). The total accumulated production up to 2016 was (13.0496) mmbbl. 2016 production was (1.394)mmbbl with average of (3.814) kbbl.

**Mishrif Reservoir:**

The breadth of this formation is about (319) m in oil well (Amara-1) and about (408)m in well (Amara-2). It is decreased towards the west as it measures about (323)m in well (Abu Amoud Alsharqi-1) and (298)m in well (Abu Amoud-2) while it slightly increases towards the east where Its thickness reaches about (416)m in well (Halfaya-3). The average thickness of the cap that holds oil is (91.5) m and its water saturation is (56%) with an API value of 23 and gas to oil ratio is 610 scf/bbl.

- The formation has been evaluated according to survey into upper Mishrif and Lower Mishrif. With regard to the reservoir properties, the important section is Upper Mishrif as it the section that contains oil while lower Mishrif contains water. These results are arrived at by testing well (Amara-1) and well logs of (Amara-2).

- The production from Mishrif reservoir has been via (Amara-4) and (Amara-8), (Amara-1), (Amara-9) and (Amara-11) connected to a degassing unit. The accumulated production up to the end of 2016 is (12.0907)mmbbl, and the production up to the end of 2016 has reached (3.2745)mmbbl

**Al-khasib reservoir**

The overall thickness of the formation is about (78) m and the net average of the cap that contains oil is (43.5) m and its saturation ratio is (27.7%). Its density is (24) API, and gas to oil ratio is 673 scf/bbl.
Crude production from this reservoir is via well (Amara-5) which is connected to a degassing station. The accumulated production up to the end of 2016 is (3.054) mmbbl, while the production of 2016 till its end is (0.520547) mmbbl with average of (1.426) kbbl/d.

D- We have noticed low production averages of Noor and Amara oilfields/national efforts when compared to production of IOC operated oilfields that are within MOC designated area. In addition, these fields have no development plans:

**First:** MoO and MOC have no development plan for Noor and Amara oilfields according to MOC letter no. (6699) dated April 22nd, 2018 as there are no detailed reservoir surveys and studies for these two oilfields to encompass all reservoirs. MOC has stated in its letter no. (990) dated May 5th, 2018 that all currently available studies are lapsed, partial, and related to one reservoir for each oilfield, while Amara oilfield consists of three reservoirs (Mishrif, Al-Khasib, and Nahr Omar), and Noor consists of two reservoirs (Mishrif and Nahr Omar). On the other hand, OIC operated fields within MOC’s area have constantly updated overall detailed reservoir surveys and studies in order to accurately assess the status of these oil reservoirs that may experience changes due to drilling and production processes. This has positive effects on production processes and preserves the stability of the reservoir without depleting. Moreover, such surveys and studies will participate in determining the best approach to deal with such reservoirs regarding drilling techniques and well depths and distribution, techniques applied to preserve reservoir pressure, and production rates plan.

**Second:** MoO currently has no plan to carry out a seismic survey for the two fields that would, when carried out, identify the general features of the subterranean strata and locate hydrocarbons traps, via which a plan can be put for oil wells locations and distribution, and this will minimize the need for
exploration activities (drilling costly exploration wells), which will positively affect the costs of oil fields operations.

Third: the lack of field testing lab equipment, especially for core tests (stratigraphic survey) through which samples of subterranean rocks are taken for analysis and examination to collect geological and geophysical data related to reservoir studies.

Fourth: lack of sufficient allocations by MoO needed for implementing all studies and development plans and their requirements like evaluation or appraisal wells in addition to field tests and geological surveys according to which the overall field development approach may be determined including drilling operations and reservoir sustainment, surface structures. Moreover there are scarce financial allocations with difficulties in disbursement for the purposes of developing field utilization operations especially drilling requirements (that include tubes, casing, mud and cementing material, wellheads, blowout plugs, drilling bits... etc) according to MOC letters no. (783) and (990) dated April 4th, and May 9th, 2018 respectively.

Fifth: MOC does not have a realistic plan for drilling wells, restoration and distributing them on aforementioned fields. Alternatively, well locations are determined by the department of reservoirs and fields development. The number of wells to be drilled annually is decided based on the available drilling rigs through coordination with Iraqi Drilling Company, according to MOC letter no. (7787) dated 9th /5/2018 in response to our memorandum no.(14) on 7th/5/2018. Moreover, available drilling rigs are old, complicated and their spare parts are hard to find. This has negative effects on their performance as it relatively takes long periods of time to drill wells; a single well drilling operation may take more than six months, a case that negatively
affects the utilization of these fields. The audit team has also noticed the lack of a restoration plan for national efforts wells in contrast with IOC wells that are subject to rigorous plan. The following table shows a comparison between the two during the evaluation period:

Completed and restored drilled wells

<table>
<thead>
<tr>
<th>Year</th>
<th>Completed wells (national effort) Noor+Amara</th>
<th>Drilled wells (IOC) in Halfaya/petrochina</th>
<th>Drilled wells (IOC) in Bazrgan-Mecca by Cnooc</th>
<th>Restored well (national efforts) MOC</th>
<th>Restored wells (IOC) Halfaya/petrochina</th>
<th>Restored wells (IOC) bazrgan – Mecca Cnooc</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>3.218</td>
<td>30.034</td>
<td>13.886</td>
<td>-</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>2013</td>
<td>3.756</td>
<td>34.327</td>
<td>8.68</td>
<td>-</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>2014</td>
<td>3.17</td>
<td>41.61</td>
<td>17.33</td>
<td>-</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>2015</td>
<td>1.618</td>
<td>41.656</td>
<td>22.25</td>
<td>-</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>2016</td>
<td>2.131</td>
<td>37.23</td>
<td>7.97</td>
<td>-</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>2017</td>
<td>1.435</td>
<td>56.64</td>
<td>14.36</td>
<td>-</td>
<td>65</td>
<td>27</td>
</tr>
</tbody>
</table>

According to MOC letter no.(7787) dated 9th/5/2018

**Sixth:** as a result of all aforementioned factors, production rates and development of Amara and Noor fields are as follows:

1. Low daily and annual production rates for the two fields with no sign of improvement during the evaluation period (2012-2017). The production rate for Amara has been 8000 bbl/day at best except for 2016 when the rate was about 15000 bbl/day; yet, the rate dropped again in 2017. A Noor field production rate was 10000 bbl/day at best for the said period. On the other hand, we find significant surge in production rates of IOC oilfields as the production of Halfaya field has risen from 54172 bbl/day in 2012 to (230050 bbl/day) in 2017. The following table and chart show production rates for the national efforts two fields (Noor and Amara) versus IOC oil fields within MOC’s designated area.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
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<td>Amara</td>
<td>1274205</td>
<td>1480447</td>
<td>2277522</td>
<td>2827073</td>
<td>2688222</td>
<td>5189175</td>
<td>1493319</td>
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</tbody>
</table>
(2) As there are no reservoir studies to identify the proper mechanism for drilling and developing the productivity of these fields and according to the content of MOC letter no.(7787) dated 9th/5/2018 and its attached letter issued by Technical Affairs Department no(6699) dated 22nd/4/2018, and due to the nature of MOC oilfields which are characterized by medium quality crude (22-24 API) and high density and salinity, several technical issues have risen, and no clear approach on how to deal with them have yet been arrived at, which has negative impacts on the way these fields are developed; the most significant among which are:
(a) High rate of asphaltene in crude oil (heavy crude) that causes stoppages in crude flow and loss of pressure inside the well.

(b) The problem of producing sand in Nahr Omar reservoir (extracted crude has sand coming up with it) which results in stopping production in several wells (Noor 3, 5, 7) currently to avoid damaging surface facilities, like degassing units, and corroding chokers, tubes, and wellheads. We recommend making haste to undertake an updated overall study and survey that encompasses all technical details related to production, reservoirs, current and anticipated problems in order to identify an appropriate and economically efficient mechanism for the proper utilization and sustainment of both fields as well as considering using other extraction technique such as submersible pumps or using gas lifts as the nature of the reservoir may dictate.

(3) Through field visits and examining technical reports we have been provided with via MOC letter no (7787), the evaluation team noticed that associated gas currently produced from both fields is entirely flared. In addition, MOC and MoO both have no plan in the meantime to utilize this gas, or any mechanism to transfer it to any treatment plant in other oilfields that are under the control of MOC whether operated by IOC or National Efforts, due to the scarcity of such plants. Currently, MOC plan is to wait for the completion of the Central Treatment Complex to be built in Halfaya field by Petrochina company, that, when completed, will collect associated gas produced from MOC fields; this means that in the meantime, a source of energy is being wasted pointlessly. The following table shows produced and flared quantities during the evaluation period.
E- The issue of floods in Noor oilfield

First: in winter, water floods have significant effect on fields’ development as such events may hinder drilling operations, paving ways and explorations ...etc. Noor field is located within the territory of Al-Sanaf seasonal marshland; it is usually flooded with water during rain seasons. There is a study prepared by the Ministry of Water Resources in 2002 to protect that field from floods. Then, a committee was formed by MoO to enter into a contract with the studies and engineering centers affiliated with the Ministry of Water Resources to update the study titled “Protecting Noor Oilfield from Floods” as stated in MoO letter issued by Department of Studies, Planning and Follow-up no(6142) dated 11th/12/2017. This study stresses the importance of erecting an earthen barrage around the field with necessary bridges for roads and canals for flood water. These works require arranging for proper approvals from other ministries, i.e the ministry of Agriculture and the Ministry of Environment and other related entities. As these approvals were not provided, the study is still incomplete.

Second: Ministry of Agriculture objects to constructing such barrage as it will cutoff watering source for the neighboring lands which are contracted farming lands. The lagging study of environmental impact prepared by MOC led to lagging measures to be taken with Ministry of Environment.
Third: an agreement has been entered into between the Center of Reviving Marshlands and MoO committee (Committee on Disposal of Flood waters of Noor field), and the representatives of both sides have agreed on the following:

(1) Providing the aforementioned center with shape files for the Noor field site by Petroleum Exploration Company.

(2) Addressing the committee formed according to order (22) for 2015 as an affiliation to the Secretariat of the Council of Ministers, to study construction Noor field barrage.

F- Field visits
First: crude oil specifications in Amara and Noor fields
The specifications of extracted crude have significant importance in designing surface utilities and determining their appropriate specifications as they are related to the type of crude they deal with. Therefore, the crude is examined in labs and the results are taken into consideration when designing degassing stations and in this regard we have the following:

(1) Monthly reports on crude tests for pipelines (28 inch and 42 inch) done by Department of Research and Quality Control, provided to us by MOC letter no(7787) do not show water content, while the aforementioned letter states that they do.

(2) Outdatedness of the pumps used in Noor oilfield where old gas reciprocating pumps (since the 1970s) are still used to pump crude oil to export points; these pumps are not compatible with installed meters as they do not provide continuous stable flow.

(3) As most of the equipment in both fields is old and lacking spare parts, maintenance is carried out by using remodeled parts or scavenging.

Second: Metering and Custody transfer systems
Installing and operating meters and Custody transfer equipment has a great importance for MoO and its affiliates as it represents
an obligation towards executive and control authorities in the State. Several meters have been visited at both fields in presence of the crew of supplying company (FMC) on 18\textsuperscript{th}/5/2015, as the following pictures show:

Commissioning and second final operation of the systems were finalized on 14\textsuperscript{th}/6/2015, witnessed by the technical staff of the supplier i.e. FMC company, and were approved on 1\textsuperscript{st}/7/2015; we have the following notes:

a) Calibration of meters (A200 and A201) with serial nos. (T65691602FT and T65691603FT) respectively, is not possible
as the calibration criteria could not be attained, as stated below:

1) The absence of required upper and lower flow limits to provide calibration requirements in both fields, as technical reports state that flow limits should be as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>Production bbl</th>
<th>Lower flow limit (min)</th>
<th>Upper flow limit (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noor</td>
<td>8000</td>
<td>10000</td>
<td>40000</td>
</tr>
<tr>
<td>Amara</td>
<td>16000</td>
<td>10000</td>
<td>40000</td>
</tr>
</tbody>
</table>

These limits are not achieved in both fields as the table shows, where the production rate in Amara field is (16000) bbl/d, which does not meet the upper flow limit required for meter calibration, while Noor production is 8000 bbl/d which does not meet minimum flow limit for calibration.

2) Untreated crude of Noor field, as there is no treatment unite, makes meter calibration not possible as the installed metering system cannot work with untreated crude even if the flow criteria are achieved.

3) The use of reciprocal pumps in Noor field does not provide stable flow which is one of calibration requirements.

4) An alarm signal is active in the control panel of the metering systems of the two fields indicating that there is a fault in the systems’ batteries; yet, no remedial action has been taken. These photos show the alarm:
Third: field equipment:

Control system

Control system plays a crucial role in automatically executing tasks and to maintain the safety of units and employees. In this regard, we have the following:

- Lack of modern up-to-date automated control systems, as the currently installed ones are old and manual and onsite, where readings are checked by employees who work on site in shifts which endanger the safety of workers and equipment.
A photo that shows the local fluid level meter

- Local control unit is out of order. This unit is related to treating wet oil in Amara degassing station.
Flare

We noticed that the present flare is not a typical one, with an inappropriate flashing method and short flare pole when compared to typical one which height should not be less than 25 meters with auto ignition. The currently installed flare is 6 meters tall which has negative effects on the workers and environment as the photo shows:

Treatment units:

- Treatment and degassing units in Amara field are outdated with relatively low capacity as the productivity of wet crude treatment units hardly exceed (20000)bbl/d which is not commensurate with future plans that aim at increasing production.

- The lack of wet crude treatment units in Noor degassing station, as the station only contains an old three-phase degassing unit. The crude is then transferred with its impurities to Bazergan Separator Unit (owned by Cnooc
Company) where the crude is separated from water and sediment, then treated crude is pumped to exports points.

Fourth: Control tour visits to Amara and Noor fields

When making site visits to those two fields, we noticed the following:

(1) Noor degassing unit
- There is an oil contamination underneath the second pump.
- There are multiple oil contaminations near the meters.
As MOC /environment department letter states the issues are still pending.

(2) Amara degassing station
- Electrical pumps: there is an oil leakage under the old and new electric pumps.
- Water box: there is oil leakage near the water box.
- Oil leakage underneath the valve that leads to the flare
- Oil ponds: they contain large quantities of crude oil.
- Crude oil feedback pump: there is oil leakage near it.
- Chemical barrels: stored unsystematically.
- There are pipes abandoned inside and outside the station as well as concrete blocks.
- Household trash gathered in empty chemical barrels.
(3) There are no warehouses for chemical storage in both fields.

(4) No standard store yards for damaged materials in both fields.

(5) The locations of the degassing stations of the two fields are not standard as there are no paved roads for vehicles or pedestrians inside the fields to link
administrative buildings with surface facilities. Moreover, the entrances are substandard, as shown:

Fifth: safety and environment

Safety equipment has developed through time and diversified to become nowadays a highly effective group. Like other industries, oil industry is a high-risks one. Well drilling is one of the most dangerous worksites; therefore, it is crucial for those who work on these sites to have a detailed knowledge of safety regulations with strict observance of such regulations. There also should be
knowledge of rescue and protection measures in this industry which is a set of rules and regulations prescribed to protect man and environment in case there is a breach of safe limits of control of processes or operations. We have in this regard the following:

(1) Environment
By examining MOC lab test reports during site visit to MOC headquarters during (5th-10th/5/2018), these tests show an air pollution caused by the substandard gas flare which emits carbon compounds that spread through air and cause health problems once inhaled by those onsite. Thus, the old substandard flare should be replaced with a modern one that conforms to health standards. Moreover, there is a soil pollution issue caused by improperly disposed industrial waste water in ponds which is harmful to environment. Therefore, there must be standard disposal ponds according to health standards as stated by MOC /Environment department dated 3rd/5/2018. This issue is still unsettled.

(2) Safety
The audit team has not seen a personal gas detector in both fields which indicates the level of pollution in the area by sounding voice alarms conforming to the type of gas spreading (Co, H2S,...). MOC letter no(7787) states that the environment department runs some tests in Amara Field using portable gas tester, and these test have indicated the presence of gas (H2S) leaking out of valves with a ratio of (7ppm) while the acceptable limit is (5ppm). There are no gas readings near the sites of the workers.
In Noor field, the portable gas detector show a gas (H₂S) leakage near the pumps up to (50 ppm), while the reading 10 meters off the pumps was (6ppm).

4- Conclusions

1) Both MoO and MOC have no clear development plan for Noor and Amara fields because there are no updated detailed reservoir studies for those fields.
2) MoO has no plan for running seismic surveys for the two fields which describe the general formation of the subterranean strata of the earth.
3) MOC does not have any field lab tests especially core tests and geological tests needed for collecting geological and geophysical data of the reservoir studies.
4) No obvious settlement for the problem of flood water in Noor field because of floods which hinders development operations.
5) No calibration activities are run for the two fields as the technical criteria for calibration have not been attained.
6) There are no modern control systems cabinets in the field, as the company applies manual control system which jeopardizes both workers and equipment.
7) Flares are substandard which endangers the life of workers during flaring in addition to the hazardous carbon emissions.
8) Outdatedness of processing and treatment and degassing units in Amara station which has low capacity exacerbated by the fact that Noor field has no treatment station.
9) Inadequate safety and environment measures for both fields as sulfur gas leakages and oil leakages have been noticed on fields degassing stations.

5- Recommendations

1) Preparing reservoir study in details for the two fields encompassing all oil reservoirs to account for any changes that have happened due to drilling and production operations.
2) Including the two fields in MoO’s plans for seismic surveys so as to have knowledge about subterranean formations and to locate hydrocarbons traps and to determine best approach to utilize them.

3) Set up plans to develop MOC’s labs and equipping them with field test equipment needed for better execution of tasks.

4) Make haste regarding the issue of flood water that partially cover Noor fields by coordinating with competent authorities (Ministry of Water Resources and Marshland revival Center) as this issue has negative impact on development efforts of the field.

5) Solving the issue of meters calibration in both fields as these are crucial for financial calculations.

6) Providing electronic control systems in the fields as they are vital for better control over the field operations.

7) Make haste to set up standard flares to protect workers.

8) Developing treatment stations and degassing units in both fields in harmony with production plans.

9) Exerting more efforts regarding safety measures in both fields by providing safety equipment and observing environmental consideration inside the fields.