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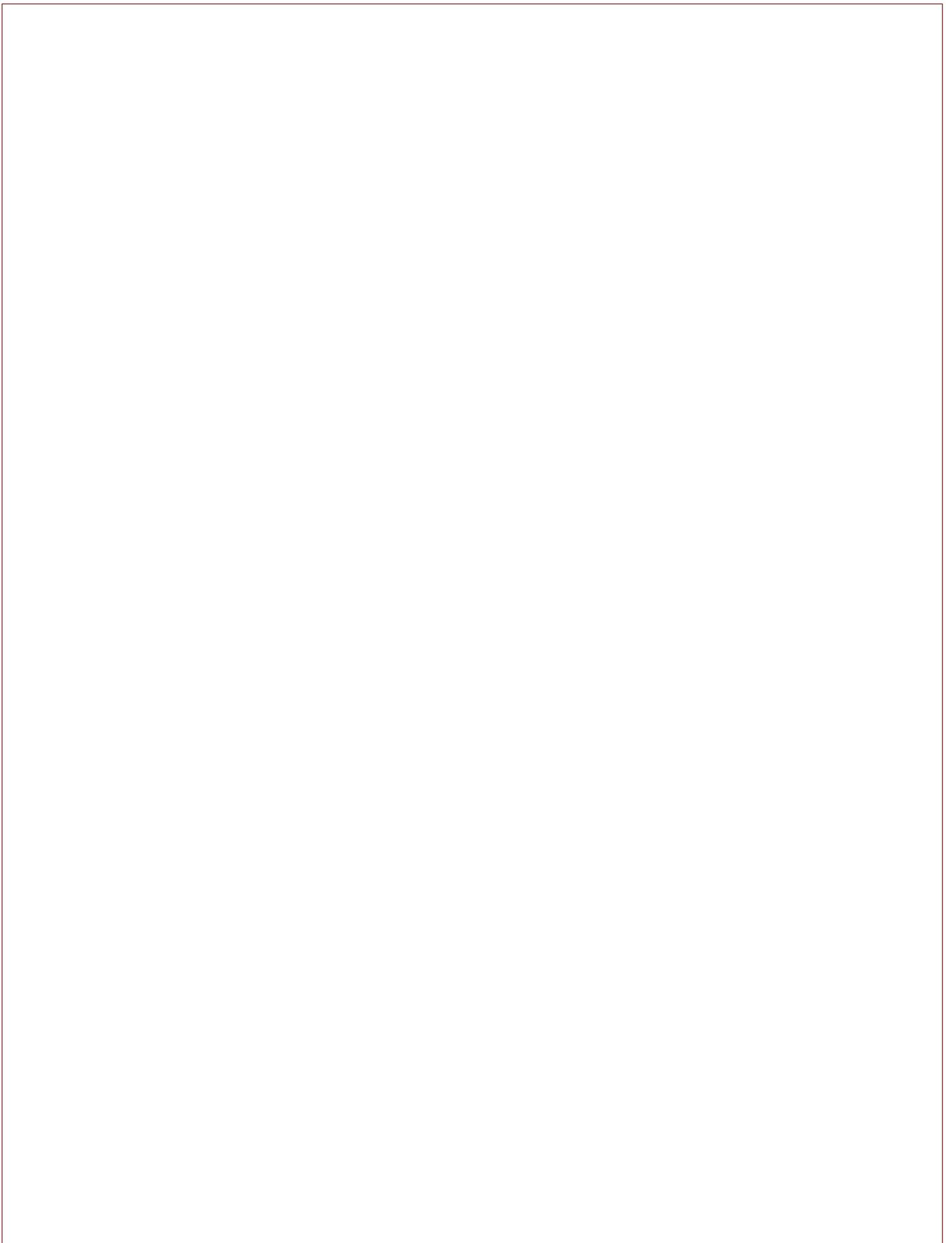
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PETROLEUM AUTHORITY OF BRUNEI DARUSSALAM

Brunei Darussalam Oil and Gas Exploration and Production Guidelines Volume 5: Exploration Guideline



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This guideline sets out the approach the Authority is likely to take, taking into account that each application will be assessed on its fact, case-by-case.

This guideline will be reviewed by the Authority from time to time, and amended as appropriate in light of further development, changes in law or practice.

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Abbreviations

In this guideline, the following abbreviations are referred:

ArcGIS	Arc Geographical Information System
CRS	Common Risk Segment
DST	Drill Stem Test
EIA	Environment Impact Assessment
EP	Exploration Production
EMV	Estimated Monetary Value
EXP	Expectation
FDP	Field Development Plan
HIIP	Hydrocarbon Initially in Place
HSSE	Health Safety Security Environment
HWC	Hydrocarbon Water Contact
IRR	Investment Rate of Return
MSV	Mean Success Volume
NOWO	Notice of Well Operation
PDA	Post Drill Analysis
PMA	Petroleum Mining Agreement
PoS	Possibility of Success
PPP	Pore Pressure Prediction
PSA	Production Sharing Agreement
PVT	Pressure Volume Temperature
QI	Quantitative Interpretation
RF	Recovery Factor
UR	Ultimate Recovery

1. Introduction to Exploration Guideline

This guideline is developed for the Exploration technical evaluation process and aim to provide the Exploration technical overview and its application in the upstream value chain. This guideline will also benefit the Authority and the Operators as a tool to improve opportunity realization and to perform quality maturation and assurance of any exploration projects. Further, the maturation and evaluation processes performed by different Operators can be consistently regulated by the Authority to pave the way for a better and faster decision-making and time-saving process with clarity and transparency.

1.1 Exploration Activities

The exploration activities that are currently undertaken by the Authority are those involving hydrocarbon resources within Brunei Darussalam, initiated by the acreage application and award of identified petroleum areas to respective Operators.

Upon award of respective petroleum areas, any exploration or petroleum activities will be carried out by its respective Operator. The Authority acts as a regulator as per the respective PSA or PMA. The Authority as the custodian to all exploration activities within Brunei Darussalam will efficiently manage the exploration portfolio and technical processes in accordance with the respective PSA or the PMA.

A regular technical session between the Authority and its Operators is necessary to achieve common understanding on the technical progress and/or final assessment from amongst others, the integration of the seismic data with wells and any geological data incorporating results of any special studies to deliver a continuous update of geological subsurface model.

This is also aimed to generate a ranked portfolio of prospects from which future drilling locations will be selected. Exploration wells that have been drilled, the results to be fully integrated and thus the prospectivity of the area is continuously re-evaluated by its Operators and updated to the Authority.

2. Exploration Evaluation Process

The Exploration Evaluation Process forms an early part of the hydrocarbon maturation process and it is aimed:

1. To define key activities and action plans in executing exploration projects.
2. To ensure and perform quality maturation assurance of exploration projects.
3. To enable better and faster decision making, time-saving with clarity and transparency.
4. To manage expectation of the deliverables and its respective documentation by the Operators in term of data, presentations and progress reports submissions.

This will also enable the achievement of value creation by having rigorous prospect evaluation carried out by the Operators and their partners. The Operator will achieve the delivery of prospective resources evaluation based upon three exploration technical process below:



This Exploration Guideline will allow the Authority and its Operators to focus on the project’s critical technical and business risk elements and learning points at each technical phase. In addition, each respective technical engagement will act as mechanisms for the Operators to communicate with the Authority on the key deliverables of each Exploration project under evaluation.

Authority engagement is required at every milestone of the exploration maturation process. For an Operator with multiple leads and prospects maturation, any engagement related to the deliverables consisting of Early Framing (LEADS), volumetric and risk report submission and Ready to Drill confirmation as described below under Figure 1 is to form an agenda item of the recurring Quarterly engagement between the Authority and said Operator.

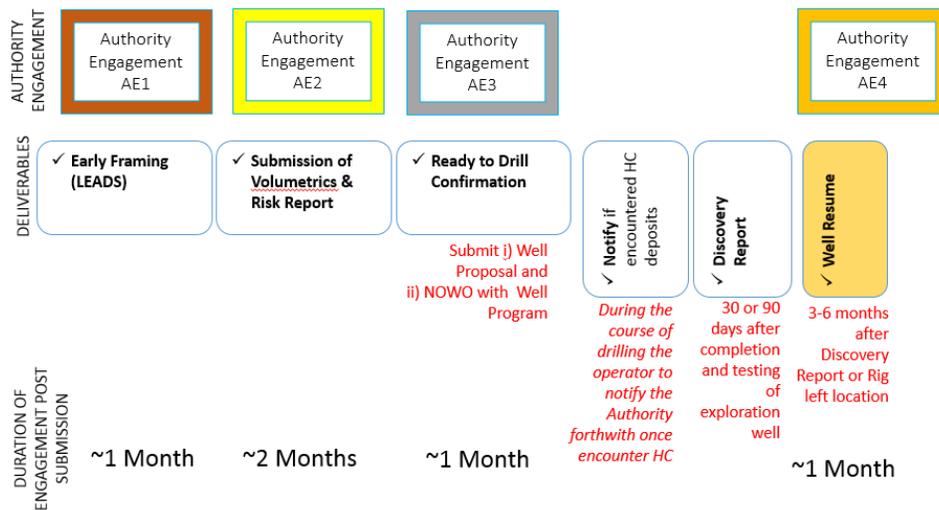


Figure 1: Exploration maturation process with Authority Engagement.

** Timelines above vary in accordance with that stipulated in a PMA or PSA respectively

2.1 Prospectivity Phase

2.1.1 Technical Submission

The Operators are to carry out technical regional evaluation work incorporating Play Base Evaluation at Play classified as Class 8, Lead as Class 7 and Prospect as Class 6 (hereinafter referred to as 'evaluation work'). The Operator is to submit the names of lead/prospect (including that of any new leads/prospects) to the Authority for approval.

Operators are required to present their evaluation work to the Authority. This must be accompanied by a submission of the **Block Evaluation Technical Report** and **Resource Classification Report Annually in Q1** as per the requirement stipulated in Volume 2 Reserve and Resource Classification and Reporting Guideline_Rev4 (Reference 1).

In the Reserves and Resource Classification Report, Operators shall deliver:

- Prospective Resource Volume for **all** exploration portfolio identified Play (Class 8), Leads (Class 7) and Prospects (Class 6) stating risk volume categorized into 1U, 2U, MSV and 3U category with in place and recoverable resources without cut-off (**Appendix A**).
- Identify key geological exploration plays and potential trap styles
- Prospect & Lead maps to show Preliminary Structural Depth and/or Time maps of main objective levels with P10, P50 and P90 with Possible Hydrocarbon Water Contact (HWC) including Maximum Spill Leak Point and labeled and scaled at 1:10000
- 1:10000 scaled cross-section at random lines across any identified Plays, Leads & Prospects locations
- Establish Play characterization, tectono-stratigraphic framework and key sequence stratigraphy.
- Develop Play evolutionary history including source rock maturation, reservoir and seal distribution.
- Assess overall Petroleum System of the Basin.

The Authority also requests for the digital copy of the following documents:

- Regional horizons and fault interpretations (depth and time) in any compatible format or commercially available software
- Regional maps and Plays, Leads and Prospects outlines/polygons at per reservoir objectives in ArcGIS or any compatible format and to include any potential leads and prospects straddling blocks within Brunei and/or cross international border
- Seismic Volume(s) used in the Basin and Play Phase evaluation
- Velocity Model
- Final Basin Modelling study report
- Other seismic attribute volumes and any special study report

2.1.2 Technical Presentation

Presentation of Prospectivity Technical evaluation progress to the Authority is to be scheduled annually and as and when required by the Authority. Recommendations from the Authority shall be recorded and shall be considered by the Operators for implementation.

High Level Engagement on the selected prospect to be drilled with the Authority must be conducted not less than one month prior to submission of the Annual Work Programme and Budget as per Volume 1 Annual Work Programme and Budget Guideline (Reference 2).

2.2 Well Proposal

2.2.1 Technical Submission

A prospect is classified as Class 6 and where there is any drill ready Prospect identified, Operators are to submit the Well Proposal not later than 30 days before well spud or earlier. Prospect Phase comprises activities that Operators are working on to identify and mature leads to prospects and following further technical prospect evaluation to obtain drill ready status. The Exploration Well Proposal documentation shall be submitted to the Authority with a cover letter.

It is recommended that the content of the Exploration Well Proposal shall include the following information:

- Well name
- Well location with the approved datum and Projection coordinates CRS, complete with geodetic parameters information
- Well objectives
- Regional Geology, Petroleum System and Key Stratigraphic markers
- Time to depth conversion applied (if used)
- QI study in support of the technical evaluation of the prospect
- Prognosed Depth (well tops) at objective targets with uncertainties
- Prognosed type log (formation to be expected)
- Pore Pressure Prediction (PPP)/ temperature and fracture gradient analysis*
- Gross Depositional Environment maps and/or Paleogeographic maps
- Structural time and depth maps of all objective levels with P10, P50 and P90 Possible Hydrocarbon Water Contact (HWC) including Maximum Spill Leak Point to be labeled and scaled at 1:10000
- Structural or Stratigraphic cross-section across proposed well location
- Interpreted seismic line crossing through proposed well location
- Hydrocarbon resource assessment, estimated reservoir input parameters and geological risk factors applied

- Prospective Resources: Un-risked and Risked Volume In-Place and Ultimate Recoverable with their ranges of possibilities (1U, 2U, MSV and 3U) and the recovery factor applied (with and without commercial cut-off applied)
- Well cost (Dry and Success case)
- Well cost versus days and Depth versus days
- Provide Preliminary Well and Casing Design
- Provide Proposed Well trajectory and Total Depth criteria and/or sidetrack decisions criteria.
- Provide Data acquisition strategy
- Provide Well Evaluation Program (cuttings, sampling, well test and wireline logging)
- Provide a summary of EIA, Sea Bed survey and Shallow Hazard Assessment
- Potential HSSE hazards and its mitigations
- Notional Development plan and its high level Economic and Commercial screening
- Well Plug and Abandonment programme as per Volume 11: Decommissioning & Restoration Guideline (Reference 3)

** All data submission is to be in a metric format which is acceptable to the Authority*

The Authority also requests for both the hard and digital copies of:

- Subsurface model: horizon and fault interpretation (depth and time) in any compatible format or commercially available software
- Prospect outline at per reservoir objectives in ArcGIS or any compatible format and to include any potential prospects straddling blocks within Brunei Darussalam and/or cross international border
- Final Sea bed survey data
- Final Shallow Hazard Interpretation
- Seismic Volume(s) used in the prospect evaluation
- Velocity Model
- Other seismic attribute volumes
- Proposed well trajectory
- Prospect Summary Sheet
- Well Proposal (Final)
- Final EIA and Shallow Hazard Reports
- Any special study report (QI report, HDVA report, economic & commercial report)
- Any other documents or information deemed relevant for the purposes of the Well Proposal

2.2.2 Technical Presentation

Notice of any amendment/s in **Pre-Spud** to the submitted Well proposal must be given and notified to the Authority as soon as possible. Any deviation in the Well Proposal in relation to the Pre-Spud operations, will require immediate notification and re-submission of Well Proposal to the Authority. The presentation of the Final Exploration Well Proposal and Drilling Programme to the Authority is to be scheduled **at least 30 days** prior to the start of well operation.

NOTE 1: (i) During the course of drilling, Operators are to notify promptly the Authority once any hydrocarbon is encountered and/or becoming aware of the same and (ii) Operators to follow details pertaining to the daily reporting guidelines during Well Drilling Operation as per Volume 6 Drilling Guideline (Reference 4)

NOTE 2: A separate engagement with the relevant team from the Authority in relation to the proposed well Plug and Abandonment programme is to be undertaken prior to the approval of the said programme as stipulated in Volume 11: Decommissioning & Restoration Guideline.

2.3 Well Resume

2.3.1 Technical Submission

After the completion of drilling an Exploration well, the Operator shall submit to the Authority the Discovery notification report as per the terms of the respective PMAs/PSAs confirming whether there is any discovery of commercial or non-commercial interest and stating the preliminary contingent resource (in-place and ultimate recovery) for any results in a discovery of Petroleum of potential interest.

Operators are required to deliver a complete Well Resume **not later than 6 months** after the rig release or well drilling has completed. The Well Resume shall include, but is not limited to, the following information:

- Basic Well data
- Well Summary Sheet
- Final well location with Geomatics CRS, complete with geodetic parameters information.
- Geological Summary
- Updated structural cross section and/or seismic section along the well trajectory
- Final time and depth objective maps containing both actual versus prognosis
- Final Well petrophysical analysis and well completion/composite logs
- Formation pressure test results and any PVT results (if ready)
- DST data (if acquired)
- Geophysical QI studies (if ready)
- Cuttings and Sidewall core description and Biostratigraphy study (if ready)

- Discovered Hydrocarbon Resource Assessment with In-Place and Ultimate Recoverable with their ranges of possibilities (1C, 2C, MSV and 3C)
- Final Well to seismic tie
- Final Borehole Temperature data
- Final well cost vs days and depth vs days
- Well Operations: Data Acquisition, Geohazard with HSSE summary
- Highlight and Lowlights on Drilling Operation
- Implication of well results: Prognosis vs actual, Prospectivity and Follow up activity
- Well Plug and Abandonment Report as per Volume 11: Decommissioning & Restoration Guideline (Reference 3)
- Conclusions and learning points including recommendations.

All data submission is to be in metric format which is acceptable to the Authority. If the well results are pending any geological analysis or studies that may take longer than 6 months, preliminary well results must be included. The geological analysis or studies report shall be submitted as an addendum once it is available. The Authority also requests for the hard and digital copies of other reports provided by service companies, including (but not limited to):

- Final Wireline Data Acquisition and Processed report
- Final Petrophysical Evaluation report
- Final Formation Test (PVT) report
- Final Mudlogging report
- Final Prevue or Formation test while drilling report
- Final Flair or Gas reading while drilling report
- Final Biostratigraphy or Core Analysis report
- Final Geophysical QI report
- Final DST Result (if any)
- Final HSSE Report
- Any special study reports relevant for the purposes of Well Resume.

2.3.2 Technical Presentation

Presentation of the Well Resume technical evaluation to the Authority is to be scheduled not more than **one month** after the submission of the Exploration Well Resume.

2.3.3 Discovery Notification

The Operator shall notify the Authority forthwith on any hydrocarbon encountered and on becoming aware of the same during the course of drilling operation.

In the event of a crude oil discovery an Appraisal Plan is to be submitted to the Authority for approval as per the conditions stipulated under the respective PSA/PMA.

In the event of a natural gas discovery an Appraisal Programme (which shall include a gas commercialisation plan as per the PMA and a Gas marketing Plan as per the PSA) are to be submitted to the Authority for approval.

In the event of there being no viable gas market, a Gas Marketing Plan and a Gas Holding Area application are to be submitted to the Authority for approval in line with the requirements of the respective PSA and as further elaborated in Volume 7 Field Development Guideline (Reference 5).

3. Exploration Extension

In relation to any Exploration Period extension by the Operators, the Operators shall seek approval in writing from the Authority in accordance to the terms stipulated in a respective PSA or PMA. For avoidance of doubt, the Authority shall be under no obligation whatsoever to agree to such extension proposed by the Operator.

4. Hydrocarbon Resource Assessment

Hydrocarbon resource assessment is another primary deliverable of Exploration and Production Technical Maturation. The results of the hydrocarbon resource assessment mainly define the actual value of acreage to ensure continuity of the life-cycle of exploration activities to be carried out by the Operators.

The respective acreage value will depend on:

1. Technically matured subsurface evaluation;
2. Economic good business opportunity and its strategic values; and
3. Proper technical and business risks assessment.

The Operators shall provide the level of technical evaluation of the exploration portfolio in the acreage as follows:

- 1) **Prospect** (Class 6) – Defined as the undiscovered hydrocarbon volumes associated with prospect which are structurally and geographically defined and considered viable drilling targets. This includes all prospects beyond the exploration license period.
- 2) **Lead** (Class 7) – Defined as the undiscovered hydrocarbon volumes associated with leads with potential accumulation that requires more data acquisition and/or evaluation to further understand the structure and geology of the projects. This includes all leads beyond exploration period
- 3) **Play** (Class 8) – Defined as the undiscovered hydrocarbon volumes associated with plays which are of conceptual nature. This includes all plays expected to be explored beyond exploration license period

4.1 Volumetric Reporting Requirement

The Authority require the Operators to report the following volumes as part of an Exploration Annual Prospectivity Portfolio Report submission.

- The volumetric estimation of hydrocarbons contained in a reservoir and a structure is the point at which all the data that went into the geological model of the reservoir is converted into numbers which express the amounts of hydrocarbon present. This is also called **Hydrocarbon Initially in Place (HIIP) Volume**.
- This forms the basis for the next step in the evaluation of a prospect or field, i.e. the estimation of how much of the volumes in place can actually be ultimately recovered from a single and multiple reservoir and is called **Ultimate Recoverable (UR) Volume**.

$$\text{Ultimate Recoverable (UR) Volume} = \text{Hydrocarbon Initially in Place (HIIP) Volume} * \text{Recovery Factor (RF)}$$

- In the volumetric estimation, **HIIP** and **UR** volumes are further classified into:

- **Mean Success Volume (MSV)** – Average volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir in the total volumetric distribution within given uncertainties of total volumetric distribution;
- **Base Case Volume (2U)** – **Base** case or P50 volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir in the total volumetric distribution within given uncertainties of total volumetric distribution;
- **Expectation Volume (Exp MSV)** – Average volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir multiplied by a technical/geological PoS within given uncertainties of total volumetric distribution;

$$\text{Expectation Volume (Exp MSV)} = \text{Mean Success Volume (MSV)} * \text{PoS}$$

or

$$\text{Expectation Volume (Exp 2U)} = \text{Base Case Volume (2U)} * \text{PoS}$$

- Volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir have three uncertainties of total volumetric distribution defined as High, Base and Low Estimates;
- **Low Case Volume (1U)** – Low case or P90 volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir in the total volumetric distribution within given uncertainties of total volumetric distribution; and
- **High Case Volume (3U)** – High case or P10 volume that can be present initially in place or ultimately recovered in an accumulation from a single or multiple reservoir in the total volumetric distribution within given uncertainties of total volumetric distribution.

The final volumetric assessment is required to be presented to the Authority annually with the latest submission being by Q1 of each respective year.

5. Reporting Timelines

Hydrocarbon resource reporting is one of the main EP processes that ensure audit trail records of newly defined resources and/or produced hydrocarbons by new volumes. It is to ensure the EP business is able to maintain the reserves replacement ratio and assures the continuity and sustainability of oil and gas production and profits.

The Operator is required to include the Hydrocarbon resource report as part of respective requirements under current PMAs/ PSAs following the reporting timelines as below:

1. The Operator shall submit the Final Well Proposal to the Authority not later than 30 days prior to spud or earlier.
2. After the completion of an Exploration well drilling, if there is any discovery (commercial or non-commercial) the Operator shall submit to the Authority the discovery notification/report with a written statement stating the preliminary contingent resource (in-place and ultimate recovery) in a discovery of Petroleum of potential interest as per the terms of the respective PMAs/PSAs.
3. The Operator shall submit the Well Resume (together with other relevant reports as mentioned in paragraph 2.3.1) to the Authority not more than 6 months or as per the timeline specified in the respective PMAs/PSAs after the rig release or completion of well drilling.
4. The Hydrocarbon Resource Assessment as per Volume 2 Reserves and Resources Classification and Reporting Guidelines_Rev4 (Reference 1) shall be submitted to the Authority annually by Q1 of each respective year (Reference to be made to Appendix A).

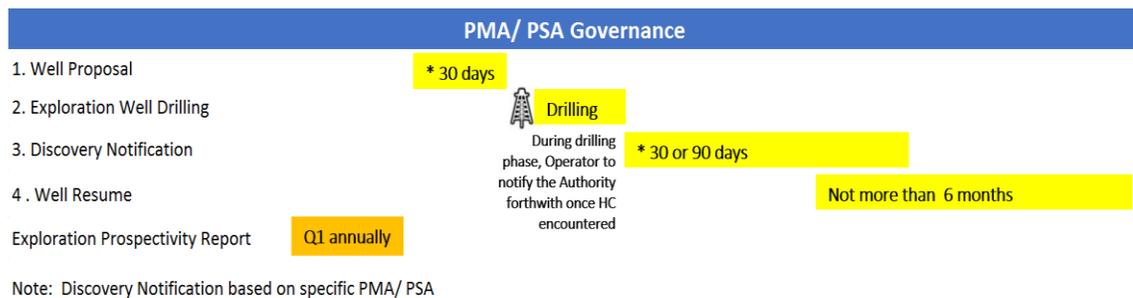


Figure 1: Reporting Timeline

At the end of an Exploration well which resulted in the discovery of potential interest, the Operators should follow up with a rapid maturation funnel including any Appraisal Plan and Gas Marketing Plan in accordance to the terms of a respective PSA or PMA as per Volume 7: Field Development Guideline (Reference 5)

References

In this guideline, the following references are referred:

Reference 1	Volume 2: Reserves and Resources Classification and Reporting Guideline Rev4
Reference 2	Volume 1: Annual Work Programme and Budget Guideline
Reference 3	Volume 11: Decommissioning & Restoration Guidelines
Reference 4	Volume 6: Drilling Guideline
Reference 5	Volume 7: Field Development Guideline

Appendices

In this guideline, the following appendix is referred:

Appendix A	Hydrocarbon Resource Assessment (Exploration Prospectivity Report) Table
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