



MRC
TURKEY



Technical Requirements of Geothermal Exploration in the RSM

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Phases of Geothermal Development

- Reconnaissance/ Exploration
- Appraisal/Conformation drilling
- Project Design (concept design)
- Construction and field development
- Operation
 - Monitoring, modelling, management
- Shut-down and abandonment

Steps in geothermal exploration

1. Review and study of existing data
2. Studies of surface manifestations and Geochemical studies
3. Geological Exploration
4. Geophysical Exploration
5. Exploration Drilling and flow testing
6. Preliminary Resources Evaluation

Eol – Technical Information

- Conceptual model and list of data behind the conceptual model.
- Drilling plan
- References demonstrating previous drilling experience and CVs of key experts.
- If there are already exploration wells, provide an indication of the information from these wells.

Indicator	Unit	Value
Gross capacity per well	MWe or MWth	
Gross conversion efficiency (for power plants only)	%	
Expected average flow rate per well	kg/s	
Estimated reservoir temperature	°C	
Estimated depth of the well (True Vertical Depth-TVD)	m (from surface)	
Diameter of the well at target depth	" (inch)	
Well type (vertical/directional)	-	
Wellhead location of the wells under RSM	N E coordinates (ED50-UTM-6° coordinate system)	
Expected/predicted CO2 emissions	g CO2/kWh	

Eol – Conceptual Model

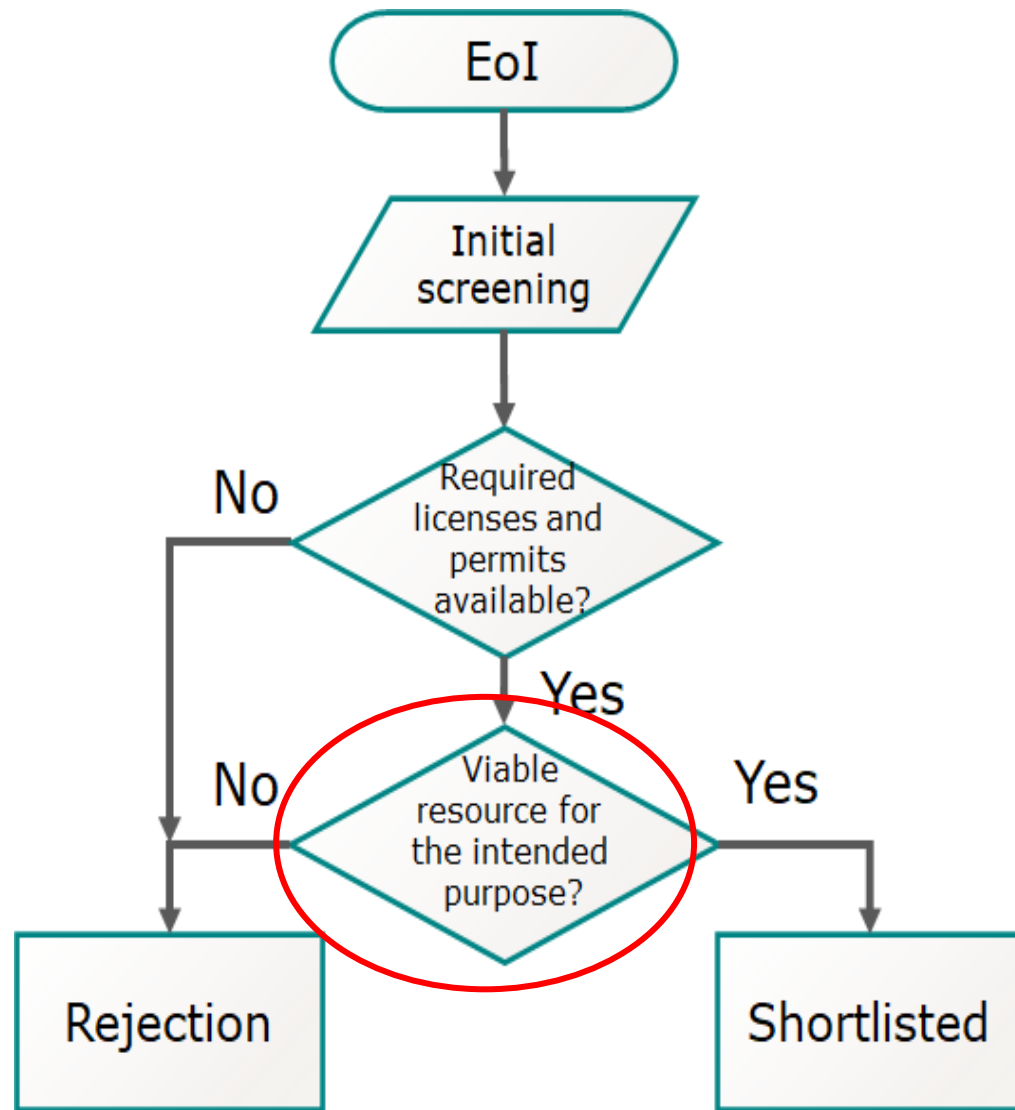
A brief description of the local conceptual model. The conceptual model shall outline the following, if available:

- Regional map showing the concession and surface manifestations
- Structural settings
- Expected stratigraphy
- Expected reservoir rocks and caprock if applicable
- Predicted size and thickness of reservoir (boundaries)
- Conceptual flow dynamics (recharge, up-flow, outflow)
- Well targets

Eol – Drilling Plan and Well Design

Brief description of:

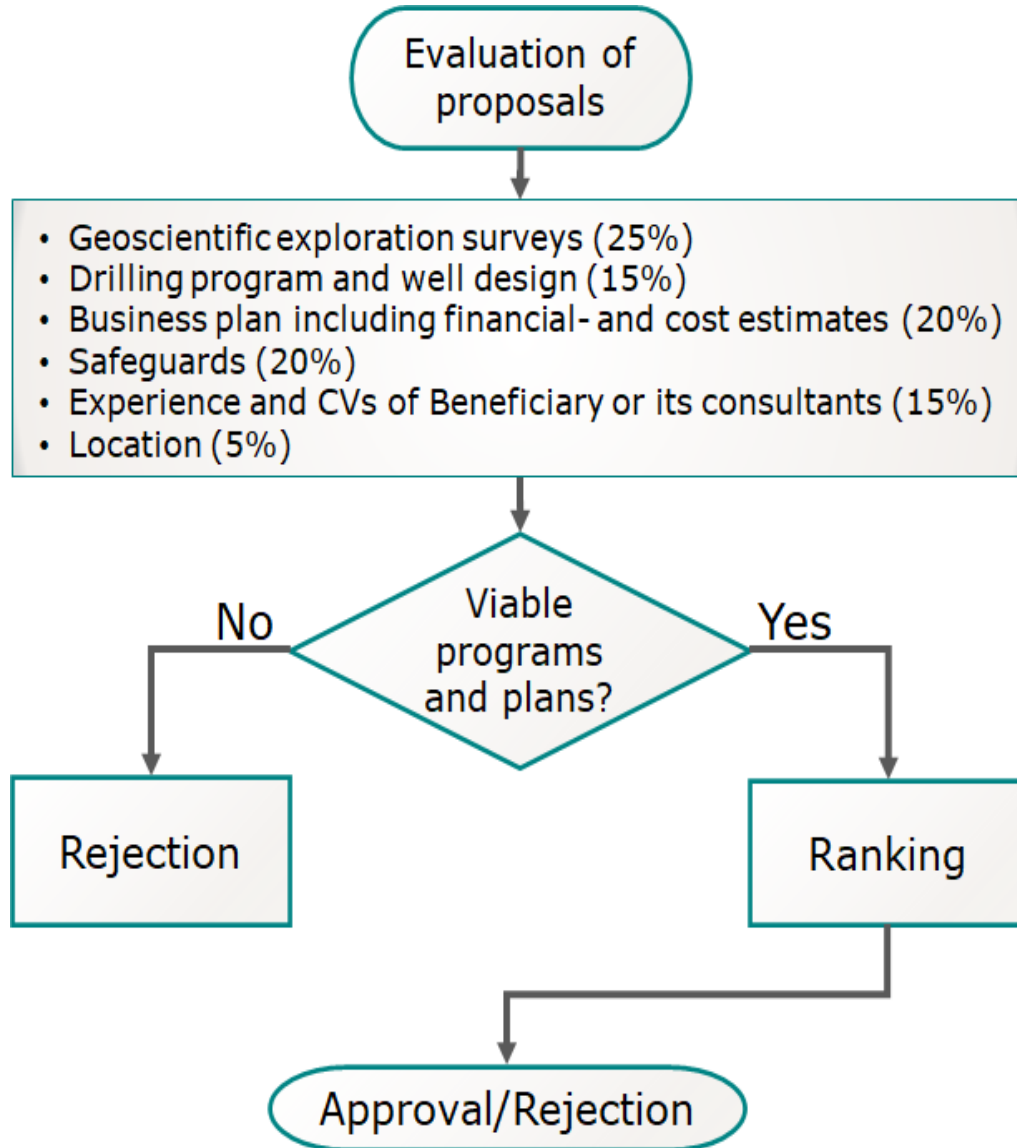
- Depth of wells
- Directional or vertical
- Predicted stratigraphic and structural conditions
- Expected Temperature and Pressure conditions
- Information on offset well data (if available)
- Expected drilling diameters and casing program
- Potential for encountering kicks/gas kicks
- Estimated drilling time
- Water supply available for drilling
- Wastewater handling / storage / disposal
- Drilling mud handling / storage / disposal



EoI Evaluation

- Data and information from each application will be used to assess the probability of finding a viable resource to support the needs of the applicant's business plan (items 3 and 4 in Table on slide 5).
- This step of the evaluation process will concentrate on two main aspects of the applicant's program which include:
 - a) the credibility of the conceptual models based on the surface exploration data
 - b) the intended use of the geothermal energy as described in the business model.

Evaluation Process



Applications will be evaluated using the scoring and ranking protocol described for each of the following categories of information:

- Geoscientific exploration data and the resulting conceptual model
- Drilling programs and well designs
- Business plan, including financial- and cost estimates
- Safeguards
- Geothermal experience of the Beneficiaries or its consultants
- Location

Scoring and Ranking of Applications*

- As the RSM is eligible for developers holding licenses for different resources and different utilization approach, relevant exploration data may vary between projects. Thus, appropriateness of the methods used will be evaluated in each case.
- In general, there are less exploration data requirements for low temperature resources, for direct use applications, than for power production from intermediate to high temperature resources

No.	Items to be evaluated	Points
1	Appropriateness of exploration methods used	20
2	Completeness of surface exploration studies	20
3	Data quality	20
4	Quality of conceptual models and applicability of drilling targets	30
5	Preliminary resource assessments	10

* Chapter 3.2 in BM

Evaluation process

Completeness of surface exploration will be used to evaluate if important methods in one or more geoscientific disciplines is missing

- **Data quality** will be evaluated where possible.
- **Quality of conceptual models** will be evaluated based on data interpretation and completeness of the models.

Information on geology, hydrology and topography

- • Geological maps
- • Structural maps (tectonic maps)
- • Geothermal maps (surface manifestations)
- • Infrastructure maps (roads, licensing area, wells, other relevant infrastructure)
- • Hydrogeological information (groundwater level, flow directions, chemical composition, source regions, etc.)
- • Topographic maps
 - Aerial photos, satellite photos, LiDAR data, infrared photos etc. for remote sensing
 - Heat-flow maps (both remote sensing and direct soil measurements)
- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Information on geochemical surface exploration data

- Chemical analyses from geothermal surface manifestations (solids)
- • Chemical analyses from springs, both hot (water, steam, gas) and cold
- • Chemical data interpretation (including use of geothermometers)
- Isotope analyses
- Soil gas-flux analyses (CO₂, H₂S, Radon, etc.)
- Chemical information on rocks

- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Information on geophysical exploration

- Resistivity (TEM, MT, Schlumberger etc.). Essential for high temperature fields
 - Gravity
 - Reflection seismic (2D/3D) if already available
 - Seismicity (macro- and micro natural seismicity)
 - Magnetic data
-
- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Information on wells in the area (if available)

- list of wells
- location (map)
- design, including depth, diameter, casings, etc.
- temperature logs
- information on testing (flow- and injection testing); mass flow, pressure (water-level or well-head), temperature
- monitoring data (mass flow, pressure (water-level or well-head), temperature) if well has been utilized
- chemical content of fluid
- stratigraphic information
- drilling reports

Information on geothermal resource assessments

- heat-flow and natural output estimates
- • conceptual models
- volumetric assessments (P90)
- • pre-feasibility- or feasibility studies
- assessments based on well-testing results
- other modelling studies (simple modelling, numerical modelling, etc.)
- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Delivery of data

- The data submitted to the RSM should be in digital form, such as PDF, Word, Power point, Excel format or as scanned figures and text. All documents shall be delivered through a link on the RSM website. Paper documents are not accepted, unless digitally scanned.
- Tentative English translation of key documents in Turkish is appreciated