

Annex 6 Materials to Be Submitted by Holders of Geothermal Energy Exploration Permits or Geothermal Energy Development Permits and Submission Deadlines

Pursuant to Paragraph 1, Article 15-4 of the Renewable Energy Development Act, holders of Geothermal Energy Exploration Permits or Geothermal Energy Development Permits shall provide geothermal energy exploration or development data before the expiration of each permit period.

I. Instructions for Completion

- (I) This format is established in accordance with Paragraph 1, Article 15-4 of the Renewable Energy Development Act.
- (II) A holder of a Geothermal Energy Exploration Permit shall, before the expiration of the Validity Period of Permit, complete the “Exploration Data Submission Format” and submit it to the central competent authority.
- (III) A holder of a Geothermal Energy Development Permit shall, before the expiration of the Validity Period of Permit, complete the “Development Data Submission Format” and submit it to the central competent authority.
- (IV) If the holder of a Geothermal Energy Exploration Permit or Geothermal Energy Development Permit fails to submit the required materials within the prescribed period, the case shall be handled in accordance with Paragraph 2, Article 20-1 of the Renewable Energy Development Act.

II. Exploration Data Submission Format

(I) Drilling Data for Exploration Wells (Required Submission Items)

Survey Item	Data Type	Submission Content	Data Format
Drilling	General Records	Exploratory well number	C (10)
		Basic information of the exploratory well (including	C (200)

		drilling method)	
	Measurement Records	Exploratory well coordinates (TWD97/TM2 two-degree zone coordinates and elevation)	F (10.2)
	Drilling Process Records	Start date of drilling (year, month, day)	YYYYMMDD
		Completion date of drilling (year, month, day)	YYYYMMDD
		Total drilled depth (m)	F (8,1)
		Drill string specifications (including inner and outer diameters of drill pipes, drill bits, and casings)	C (20)
		Lost circulation depth (m)	F (8,1)
		Grouting volume (m ³)	F (10,1)
	Visual Geological Records	Recording unit and professional personnel (engineer)	C (32)
		Description of rock or soil properties (per ASTM 1997: American Society for Testing and Materials specifications)	C (200)
		Types of rock discontinuities (per GS: Geological Society of London code classification)	C (2)
		Dip angles of discontinuities (degrees)	I (2)
		Fracture index (FI = number of fractures / length drilled or calculated)	I (3)
		Degree of rock weathering (per ISRM: International Society for Rock Mechanics code classification)	C (1)
		Geological column	Image file(s) (.jpg 、 .png)
	Production Testing	Downhole temperature and pressure profiles	Image file(s) (.jpg 、 .png)

		Discharge test results: total flow (tons/hr), steam flow at wellhead (tons/hr), non-condensable gases (wt%), total enthalpy (kJ/kg), production characteristic curves	F (6,1) 、 image file(s) (.jpg 、 .png)
		Formation transmissivity (darcy-meter), permeability (millidarcy), and post-completion skin factor	F (6,1)
Borehole Geophysical Logging (Not required if not conducted)	Electric well logging (minimum 1 record per 0.1 m)	Resistivity (Ω-m)	F (6,1)
		Natural potential (mV)	F (6,1)
		Temperature (°C)	F (6,1)
Note 1: In the data formats, F = floating-point number, C = character, I = integer.			
Note 2: In the format (m, n), m is the character width, n is the number of decimal places.			
Note 3: “Total drilled depth” refers to the full drilled length, not vertical depth.			
Note 4: Where no core samples are obtained, core-related data need not be submitted. Geological interpretation using drill cuttings shall be performed, and a geological column shall be prepared.			

(II) Surface Survey Data – Geophysical and Geochemical (optional items; if not performed, state the reason)

1. Interpretive Maps and Text Materials (including survey point coordinates and equipment descriptions)

Survey Item	Parameter	Data Type	Data Format	Data Content
Magnetotellurics	Resistivity	2D resistivity cross-section	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	Distance, depth, resistivity

		Resistivity horizontal slice	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	X, Y resistivity
		3D resistivity model	CSV format data file	X, Y, Z resistivity
Vertical Electrical Sounding	Resistivity	Depth distribution of vertical resistivity	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	Depth, resistivity
Electrical Resistivity Tomography	Resistivity	2D resistivity cross-section	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	„Distance, depth, resistivity
		3D resistivity model	CSV format data file	X, Y, Z resistivity
Gravity / Magnetics	Density / magnetic permeability	Gravity/magnetic anomaly	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	X, Y, Z gravity/magnetic anomalies
		Gravity/magnetic anomaly profile and model	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
			CSV format data file	X, Y, Z gravity/magnetic anomalies
		3D density/magnetic permeability model	CSV format data file	X,Y,Z density/magnetic permeability model
Reflection Seismics	Velocity	2D stacked seismic section (a seismic reflection interpretation of distance vs. time or distance vs.	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher

		depth)		
Microseismic Method	Velocity	3D geology-based velocity model	CSV format data file	X,Y,Z velocity
Other geophysical methods		Physical parameter data or models from exploration	CSV format data file	X,Y,Z physical values
Water Quality Analyses	Chemical Parameters	Piper diagram	Image file (.jpg 、 .png)	Resolution of 300 dpi or higher
Note: X and Y are TWD97/TM2 two-degree zone coordinates; Z represents elevation information.				

2. Measurement Data

Survey Data	Parameter	Measurement Requirement	Data Format	Data Content
Magnetotellurics	Resistivity	AMT: 10k~1 Hz MT:400~10 ⁻⁴ Hz /decade At least 5 frequency points/decade	EDI format data file	Impedance tensor for each frequency band
Vertical Electrical Sounding	Resistivity	Electrode half-spread not less than 500 m	CSV format data file	Apparent resistivity for each electrode position
Electrical Resistivity Tomography	Resistivity	Theoretical depth at least 200 m; electrode spacing less than 10 m	URF format data file	Current and potential at each electrode array position
Gravity / Magnetics	Density / Magnetic permeability	At least 4 measurement points per km ²	CSV format data file	X, Y, Z gravity/magnetic anomaly values

Reflection Seismics	Velocity	Survey line at least 800 m; geophone spacing less than 5 m)	SEG-Y format data file	Seismic time series for each channel
Microseismic Method	Seismic catalog	Lateral location error is less than 1,000 m	CSV format data file	Hypocenter location (X,Y,Z), date (YYYYMMDD), time (hhmmss), Richter magnitude
Other Geophysical Methods			CSV format data file	X,Y,Z physical values
Water Quality Analysis	Chemical parameters	Anions/cations must include at least Na ⁺ , Mg ²⁺ , Ca ²⁺ , K ⁺ , Li ⁺ , Si ⁴⁺ (SiO ₂), F ⁻ , Cl ⁻ , CO ₃ ²⁻ , HCO ₃ ⁻ , SO ₄ ²⁻ , B ³⁺ ; isotopes must include at least $\delta^{18}\text{O}$, δD	CSV format data file	Sampling coordinates (X,Y,Z), temperature, pH, conductivity, anion/cation concentrations, isotopes
Non-condensable Gas Composition Analysis	Chemical parameters	Ar 、 N ₂ 、 CO 、 CO ₂ 、 CH ₄ 、 He 、 H ₂ 、 O ₂ 、 HCl 、 NH ₃ 、 H ₂ S 、 SO ₂	CSV format data file	Sampling coordinates (X,Y,Z), wellhead temperature, wellhead pressure, separator temperature, separator pressure
Note: X and Y are TWD97/TM2 two-degree zone coordinates; Z represents elevation information.				

(III) Borehole Deviation Survey Report

Exploratory Well No.:						Site:
Measured Depth (m)	Inclination (°)	Azimuth (°)	Vertical Depth (m)	+N/-S (m)	+E/-W (m)	Projected Coordinates of the Measurement Point
						X : Y :

						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :
						X :
						Y :

Explanation of Fields:

1. Measurement point: Refers to the position of the measuring instrument along the wellbore path.
2. Measured depth: Refers to the length along the wellbore path, not vertical depth; recorded to two decimal places.
3. Inclination (Inclination): Refers to the angle between the wellbore path and the vertical line; recorded to two decimal places.
4. Azimuth: Refers to the angle between the wellbore path and magnetic north; recorded to two decimal places.
5. Vertical depth: Refers to the vertical depth of the measurement point; recorded to two decimal places.
6. +N/-S: Refers to the north-south offset of the measurement point relative to the wellhead origin at the ground surface; recorded to two decimal places.
7. +E/-W: Refers to the east-west offset of the measurement point relative to the wellhead origin at the ground surface; recorded to two decimal places.
8. Projected coordinates of the measurement point: Refers to the TWD97 two-degree-zone coordinates of the measurement point vertically projected to the ground surface; recorded to two decimal places.

III. Development Data Submission Format

*Data for each well must be submitted

(I) Drilling Data for Geothermal Wells

Survey Item	Data Type	Submission Content	Data Format
Drilling of production or reinjection wells	General Records	Geothermal well number	C (10)
		Basic information of the geothermal well (including drilling method)	C (200)
	Measurement Records	Coordinates of the geothermal wellbore (TWD97/TM2 two-degree zone coordinates and elevation information)	F (10.2)
	Drilling Process Records	Drilling start date (Gregorian year, month, day)	YYYYMMDD
		Drilling completion date (Gregorian year, month, day)	YYYYMMDD
		Total drilled depth (m)	F (8,1)
		Drill string specifications (including inner and outer diameter of drill pipes, drill bits, and casings)	C (20)
		Lost circulation depth (m)	F (8,1)
		Grouting volume (m ³)	F (10,1)
	Visual Geological Records	Recording unit and professional personnel (engineer)	C (32)
		Description of rock or soil properties (per ASTM 1997: American Society for Testing and Materials specifications)	C (200)
		Geological column	Image file (.jpg 、 .png)
	Production Testing	Downhole temperature-pressure profile	Image file (.jpg 、 .png)

		Discharge test: total flow (tons/hr), wellhead steam flow (tons/hr), proportion of NCG in total flow (wt%), total enthalpy (kJ/kg), production characteristic curve	F (6,1) 、 Image file (.jpg 、 .png)
		Formation transmissivity (darcy-meter), permeability (millidarcy), post-completion skin factor	F (6,1)
		Reinjection well water injection test: injectivity index (tons/hr/bar), maximum wellhead injection pressure (bar) and corresponding flow (tons/hr)	F (6,1)
Borehole Geophysical Logging (not required if not performed)	Electric well logging (at least one record per 0.1 m)	Resistivity (Ω -m)	F (6,1)
		Natural potential (mV)	F (6,1)
		Temperature ($^{\circ}$ C)	F (6,1)
Water Quality Analysis	Anions/cations shall include at least: Na^+ , Mg^{2+} , Ca^{2+} , K^+ , Li^+ , Si^{4+} (SiO_2), F^- , Cl^- , CO_3^{2-} , HCO_3^- , SO_4^{2-} , B^{3+} . Isotopes shall include at least $\delta^{18}\text{O}$, δD .	Sampling coordinates (X,Y,Z), temperature, pH, conductivity, anion/cation concentrations, isotopes	CSV format data file

Non-condensable Gas Composition Analysis	Ar 、N ₂ 、CO 、 CO ₂ 、CH ₄ 、 He 、H ₂ 、O ₂ 、 HCl 、NH ₃ 、 H ₂ S 、SO ₂	Sampling coordinates (X,Y,Z), wellhead temperature, wellhead pressure, separator temperature, separator pressure	CSV format data file
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Note 1: In the data format column, F indicates floating-point values (including decimals), C indicates character, and I indicates integer.

Note 2: In the notation (m, n), m is the character width, and n is the number of decimal places.

Note 3: Total drilled depth refers to the entire drilled length of a single well, not the vertical depth.

(II) Geothermal Well Deviation Survey Report

Geothermal Well No:				Site:		
Measured Depth (m)	Inclination (°)	Azimuth (°)	Vertical Depth (m)	+N/-S (m)	+E/-W (m)	Projected Coordinates of the Measurement Point
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :
						X : Y :

						X :
						Y :
						X :
						Y :

Explanation of Fields:

1. Measurement point: Refers to the position of the measuring instrument along the wellbore path.
2. Measured depth: Refers to the length along the wellbore path, not vertical depth; recorded to two decimal places.
3. Inclination: Refers to the angle between the wellbore path and the vertical line; recorded to two decimal places.
4. Azimuth: Refers to the angle between the wellbore path and magnetic north; recorded to two decimal places.
5. Vertical depth: Vertical depth: Refers to the vertical depth of the measurement point; recorded to two decimal places.
6. +N/–S: Refers to the north–south offset of the measurement point relative to the wellhead origin at the ground surface; recorded to two decimal places.
7. +E/–W: Refers to the east–west offset of the measurement point relative to the wellhead origin at the ground surface; recorded to two decimal places.
8. Projected coordinates of the measurement point: Refers to the TWD97 two-degree-zone coordinates of the measurement point vertically projected to the ground surface; recorded to two decimal places