

## **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    |           | Exploratory well number | C ( 10 )    |

|  |                           |                                                                                                                   |                               |
|--|---------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------|
|  | General Records           | Basic information of the exploratory well (including drilling method)                                             | C ( 200 )                     |
|  | 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 <sup>3</sup> )                                                                                 | 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 / Magnetism               | 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 | Image file ( .jpg 、 .png ) | Resolution of 300 dpi or higher           |

|                                                                                              |                     |                                                    |                            |                                 |
|----------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------|----------------------------|---------------------------------|
|                                                                                              |                     | distance vs. time or distance vs. 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<br>MT:400~10 <sup>-4</sup> Hz<br>/decade<br>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 <sup>2</sup>                                            | 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 <sup>+</sup> , Mg <sup>2+</sup> , Ca <sup>2+</sup> , K <sup>+</sup> , Li <sup>+</sup> , Si <sup>4+</sup> (SiO <sub>2</sub> ), F <sup>-</sup> , Cl <sup>-</sup> , CO <sub>3</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , B <sup>3+</sup> ; isotopes must include at least δ <sup>18</sup> 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 <sub>2</sub> 、 CO 、 CO <sub>2</sub> 、 CH <sub>4</sub> 、 He 、 H <sub>2</sub> 、 O <sub>2</sub> 、 HCl 、 NH <sub>3</sub> 、 H <sub>2</sub> S 、 SO <sub>2</sub>                                                                                                                                                                                                                | 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 :<br>Y :                                     |
|                       |                 |             |                    |           |           | X :<br>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 <sup>3</sup> )                                                                                 | 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              | F ( 6,1 ) 、 Image file ( .jpg 、 .png ) |



|                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                    |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
|                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                            | (wt%), total enthalpy (kJ/kg), production characteristic curve                                                                                     |                      |
|                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                            | 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 ( $\Omega$ -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 <sup>+</sup> , Mg <sup>2+</sup> , Ca <sup>2+</sup> , K <sup>+</sup> , Li <sup>+</sup> , Si <sup>4+</sup> (SiO <sub>2</sub> ), F <sup>-</sup> , Cl <sup>-</sup> , CO <sub>3</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , B <sup>3+</sup> .<br>Isotopes shall include at least $\delta^{18}\text{O}$ , $\delta\text{D}$ . | Sampling coordinates (X,Y,Z), temperature, pH, conductivity, anion/cation concentrations, isotopes                                                 | CSV format data file |
| Non-condensable Gas Composition Analysis                                                                                                   | Ar 、 N <sub>2</sub> 、 CO 、 CO <sub>2</sub> 、 CH <sub>4</sub> 、 He 、 H <sub>2</sub> 、 O <sub>2</sub> 、 HCl 、 NH <sub>3</sub> 、 H <sub>2</sub> S 、 SO <sub>2</sub>                                                                                                                                                                                                                                           | Sampling coordinates (X,Y,Z), wellhead temperature, wellhead pressure, separator temperature, separator pressure                                   | CSV format data file |
| 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 :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>Y :                                     |
|                     |                 |             |                    |           |           | X :<br>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