

Abandonment of Groundwater Monitoring Wells in BNPP Site

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1.0 PURPOSE

A groundwater monitoring program for the groundwater level measurements is planned to satisfy applicable regulatory requirements, US NRC Reg. Guide 1.132 and to confirm the hydrogeological characteristics determined from the previous investigations.

Considering stable groundwater monitoring system in Barakah NPP site and completion of major construction, it is considered that groundwater monitoring and monitoring wells are not necessary for the purpose of long-term site characterization.

Through this long-term project, the intended purposes were achieved by identifying hydrogeological characteristic of the site and verifying of site stabilization. Accordingly, groundwater monitoring project end up and sixteen (16) wells shall be abandoned except for the two (2) monitoring wells installed in the HZ-1 that can be used for other purpose.

2.0 SCOPE OF WORK

Two tasks have identified related to the abandonment of sixteen (16) groundwater monitoring wells except MW207A and MW209A and maintenance of two (2) groundwater monitoring wells at the Barakah NPP Site.

Task 1: Abandonment of groundwater monitoring wells

- Mobilization and Start-up (including preparation of related document, measurement of groundwater level, removal of protective fence/outer casing and purging of the wells)
- Stabilization Grouting
- Destructive Drilling
- Closure Grouting
- Check the abandonment result (including leakage) and demobilization

Task 2: Maintenance and Repair of Groundwater Monitoring Wells

- Inspection (including appropriate photo showing current status) of external appearance and performance of MW207A and MW209A
- Maintenance and repair of damaged and failure monitoring wells when necessary

Task 3: Report

- Preliminary (draft) work report
- Abandonment work report

3.0 METHOD OF PERFORMANCE

Schedule

The schedule for the basic tasks shall be until 24 weeks from the Execution Date of the Contract, as follow:

Items		Weeks															
		1~10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mobilization (including PTW&HSE Training, Equipment inspection etc.)																	
1. Stabilization Grouting 2. Destructive Drilling 3. Closure Grouting	MW210 Series																
	MW401 Series																
	MW402 Series																
	MW211D																
	MW403 Series																
	MW207 Series																
Demobilization																	
Preparation of Abandonment Report																	

Method of Performance

General

Acquisition of the CICPA Pass to enter the site

Preparation of related document and completion of safety training program

Measurement of groundwater level and removal protective fence/outer casing

Task 1: Abandonment of groundwater monitoring wells

Abandonment of groundwater monitoring wells shall be performed in accordance with appropriate procedure as the removal of protective outer casing, stabilization grouting, destructive drilling to a depth of EL.-10.0 m (below 5 m of basement rock), and pressurized water purging of the boreholes. Vacated borehole in the upper parts shall then be grouted to completed seal the borehole. The

destructive drilling depth is determined by considering the thickness of HZ-1 (Hydrostratigraphic Zone) and depth of basement rock (Engineering Layer 2). The well shall pressure grouted using tremie pipe concrete placement methods and properly sealed. The procedure of abandonment can be changed according to the site situation.

Task 1-1: Removal protective outer casing and stabilization grouting

Prior to destructive drilling, the protective outer casing shall be removed and then the open borehole in targeted monitoring wells shall be grouted in place with a mixture of Portland cement and bentonite. This mixture should consist of a maximum of 60 liters (L) of water per 100 kilograms (kg) of cement, with no more than 5 percent bentonite powder by weight. Any significant deviation from this prescribed mixture must be approved and documented by appropriate personnel.

Grout shall be mixed in a tub or barrel and placed from bottom in the borehole to the ground surface by pumping through a tremie pipe or tube. The emplaced grout shall then be allowed to harden for at least 24 hours, to ensure that the existing well boring is stabilized.

Task 1-2: Destructive drilling and vacated borehole purging

Destructive drilling of the grout stabilized well boring shall be conducted. It should be noted specifically that the targeted boreholes shall be destructively drilled (reamed) to approximately 25 centimeters (cm) diameter. Large portion of bit must be equal to or larger than diameter of original borehole. It is anticipated that the drill string shall follow the existing well alignment (i.e., the least resistive path within the existing boring) during reaming and thereby maintain verticality. Nonetheless, destructive drilling shall utilize an appropriate centralizer (fit within the open casing and boring) to minimize any deviation from the existing well alignment, and drill rig mast verticality shall be assessed by visual inspection. Casing and annular material shall be drilled out to EL. -10.0 m of well through destructive.

Drill cuttings shall also be monitored to ensure proper tool placement. Namely, reamed well boring shall be flushed with a quantity of fresh water equivalent to at least three times volume to be destructively drilled.

Task 1-3: Closure grouting

Vacated wells shall be grouted and closed with a cement and bentonite mixture, as described in **Task 1-1**. Borehole grout placement shall be terminated at the ground surface and a short length of steel rod (e.g., rebar) shall then be embedded in the grout mixture to facilitate relocation of the boring with a metal detector. Emplaced grout shall be allowed to harden for approximately 24 hours. if leakage is

occur, additional grout shall then be added to restore any shrinkage, as necessary. The fully grouted cavity shall, in turn, be marked with a survey stake labeled with the monitoring well identification number.

Note that pertinent closure grouting details shall be recorded on a standardized borehole grout log.

In all cases, the following information shall be clearly provided:

- The monitoring well identification number
- The approximated well boring volume
- The grout mix ratio
- The tremie pipe placement (embedment) depth
- The total volume of grout emplaced

Any unusual conditions encountered during the grouting process shall be similarly documented on the log sheet.

Task 2: Maintenance and Repair of Groundwater Monitoring Wells

Task 2-1: Inspection of External Appearance and Performance of Wells

The current conditions including external appearance and performance of groundwater monitoring wells shall be inspected monthly during operating period of groundwater monitoring wells. Any type of changes compared to the previous condition shall be checked and notified. The inspection results shall be reported in detail with Groundwater Monitoring Well Inspection Sheet (see *Appendix 2*) and relevant photos, if needed.

Task 2-2: Maintenance and Repair of Damaged and Failed Monitoring Wells

If maintenance and repair work are needed based on the inspection results, Contractor shall notify and take proper measures, appropriately

Maintenance and repair activities may include followings, but not limited to;

- Maintain the cleanliness at/around groundwater monitoring wells
- Fixing of any loose parts of monitoring wells
- Rust Removal
- Painting on the exterior and fence to prevent corrosion
- Inner casing repair/replacement
- Inner cap repair/replacement

- Protective outer casing repair/replacement
- Protective outer cap repair/replacement
- Protective fence repair/replacement
- And, any action to improve the measurement accuracy and protection

Task 3: Monitoring Well Abandonment Report

Short Letter Reports shall be prepared with details related to the well abandonment efforts within 23 weeks after the Execution Date. This report shall include copies of the completed borehole grout log sheets.

Deliverables

- A preliminary (draft) abandonment report shall be provided within 23 weeks after the Execution Date.
- A final abandonment report shall be provided within 24 weeks after the Execution Date.

4.0 QUALIFICATION REQUIREMENT

- Contractor shall have experience of drilling investigation in BNPP site.
- Contractor shall have experiences of abandonment of groundwater monitoring wells.

[Attachment 1 – Man Power Plan]

Name	Position	Experience in relevant field (year)	Qualification (Degree, License)

- Proposed personnel shall not be changed without prior approval of KEPCO E&C. In case of unavoidable personnel change, the Contractor shall submit an alternative man power plan with similar or equivalent level of expertise and obtain approval from KEPCO E&C.