

JICA 環境社会配慮助言委員会 第 102 回全体会合

2019 年 5 月 10 日（金） 14:00～17:00

JICA 本部 1 階 111・112 連結会議室

議事次第

1. 開会

2. WG スケジュール確認

3. ワーキンググループ会合報告および助言文書確定

- (1) フィリピン国新マクタン橋建設事業（協力準備調査（有償））スコーピング案（4 月 26（金）開催）

4. モニタリング段階の報告

- (1) ケニア国オルカリア V 地熱発電開発事業（有償資金協力）

5. その他

6. 今後の会合スケジュール確認他

- ・次回全体会合（第 103 回）：2019 年 6 月 3 日（月） 14:00 から（於：JICA 本部）

7. 閉会

以上

ケニア共和国

オルカリアV地熱発電事業 モニタリング報告

2019年5月10日
国際協力機構
アフリカ部アフリカ第一課

1. 事業の背景

- 2014年5月 ケニア政府から本事業に係る要請受領
- 2014年7月 本事業に係る協力準備調査を開始
- 2015年7月 審査ミッション派遣
- 2016年3月 E/N締結・L/A調印
- 2017年10月 着工（2020年3月完工予定）



2. 事業概要

【事業の目的】

ケニア中部のナクル郡オルカリア地熱地帯において、出力140 MWの地熱発電所を建設することにより、同国における電力供給の増加及び安定化を図り、もって投資環境の改善及び同国の経済発展に寄与するもの。

【プロジェクト対象地域】

ナクル郡オルカリア地熱地帯(ナイロビ北西約120km)

【事業概要】

- (1) 地熱発電所(出力70 MW×2基)建設
- (2) 気水輸送管設備一式建設
- (3) 開閉所、送電線(約5km)及び付帯施設建設
- (4) 生産井及び還元井の掘削

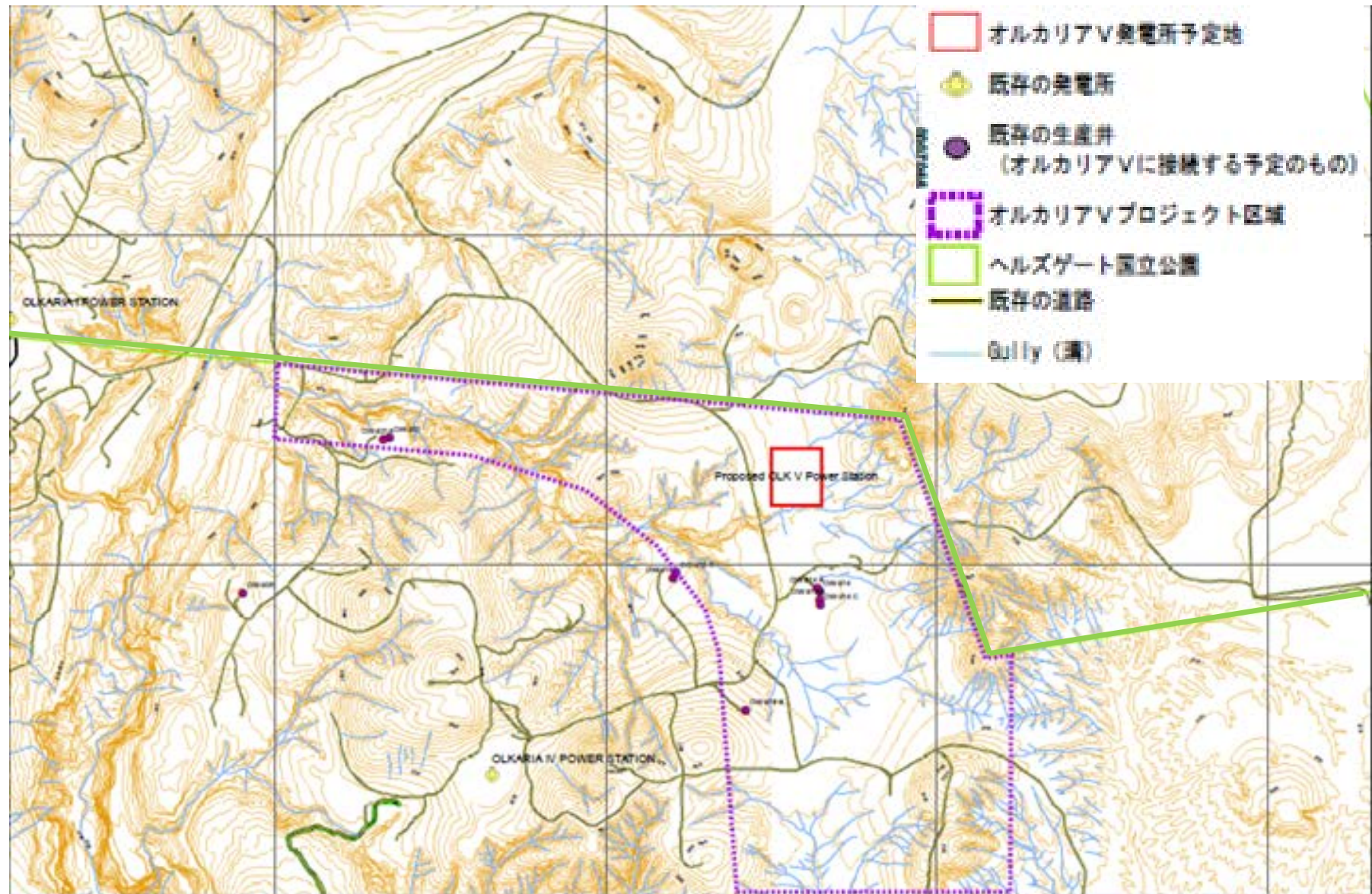
※借款対象は(1)～(3)のみ。(4)及びコンサルティングサービスは、実施機関が自己資金で実施。

【実施体制】

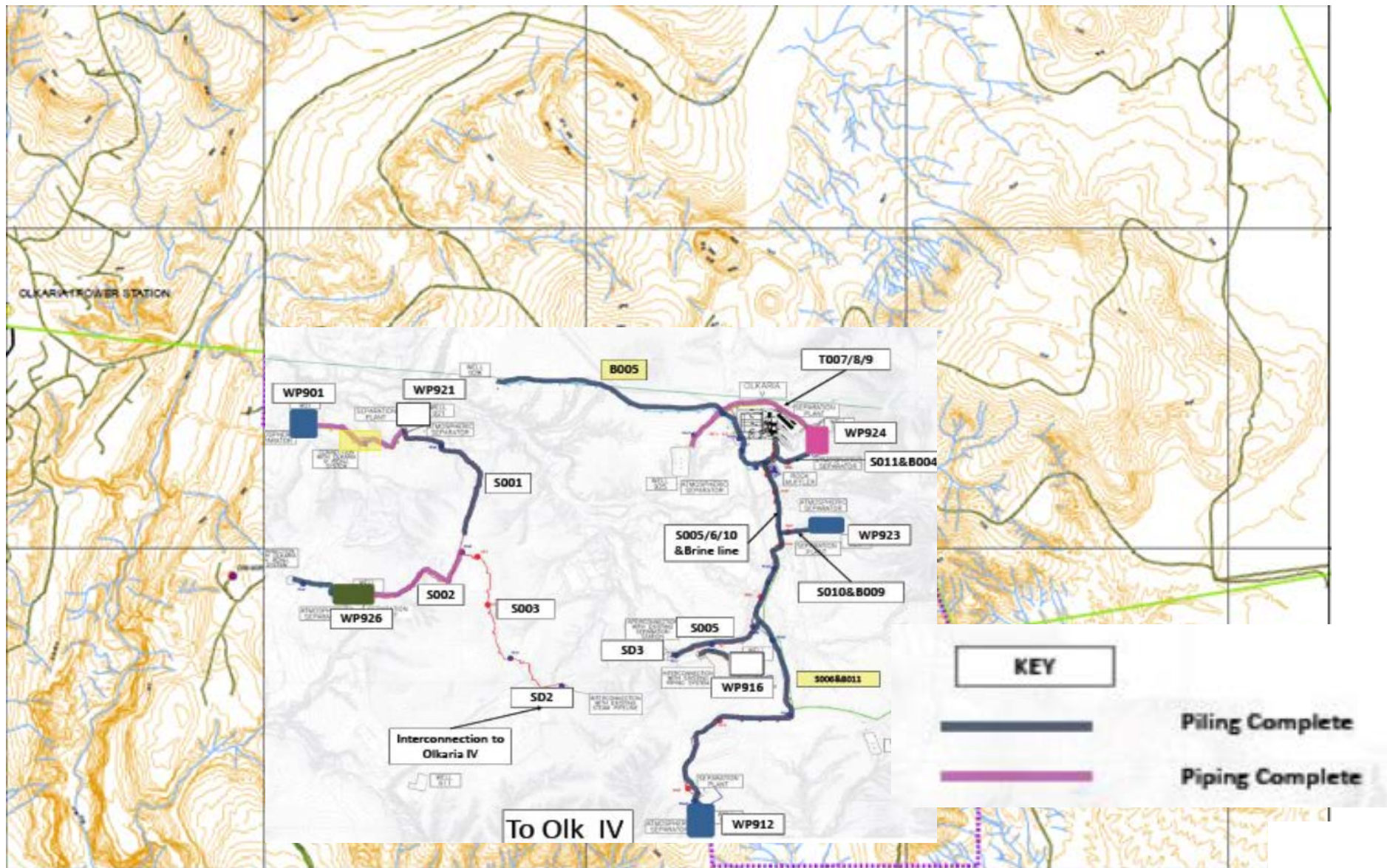
借入人・事業実施機関: ケニア発電公社 (Kenya Electricity Generating Company: KenGen)

保証人: ケニア共和国政府 (Government of the Republic of Kenya)

3. 事業対象地域(建設前)



3. 事業対象地域（建設中の施設）



4. 環境社会配慮面の情報

(1) 適用ガイドライン

国際協力機構環境社会配慮ガイドライン(2010年4月公布)

(2) カテゴリ分類:A

(3) 分類根拠

本事業は、国際協力機構環境社会配慮ガイドライン(2010年4月公布)に掲げる地熱セクターに該当するため

(4) 主な環境社会配慮の事項

施工中の大気、騒音、廃棄物、国立公園への影響

(5) モニタリング結果の公開

環境モニタリング結果: JICA公開について合意

4. 環境モニタリング項目（建設段階）

環境項目	項目	地点	頻度	責任機関
大気質	TSP、SO ₂ 、CO、H ₂ S、CO ₂ 、CH ₄	事務所や居住地域の周辺	毎日	請負業者／KenGen
地表水	TSS、COD、BOD、DO、pH、油分、フェノール	雨水の排出口、地域の飲み水、ナイバシャ湖	毎月（3連日）	請負業者／KenGen
騒音	dB	騒音の影響を受けやすい地域	毎日（井戸掘削、噴出試験において夜間にも騒音が発生する場合は、昼夜ともに実施）	請負業者／KenGen
廃棄物	家庭ごみ、金属のスクラップ、汚泥	ごみ処理場	年4回	請負業者／KenGen
土壌浸食	目視による確認	プロジェクト区域全域	隔週	請負業者／KenGen
国立公園	野生生物の定期的モニタリング・植生変化の目視観察	国立公園内	隔週	Kenya Wildlife Services (KWS)／KenGen※ ¹
水利用	KenGenでの産業用及び生活用の水利用量 ナイバシャ湖の水位	取水地点 ナイバシャ湖	毎日／年4回報告	KenGen

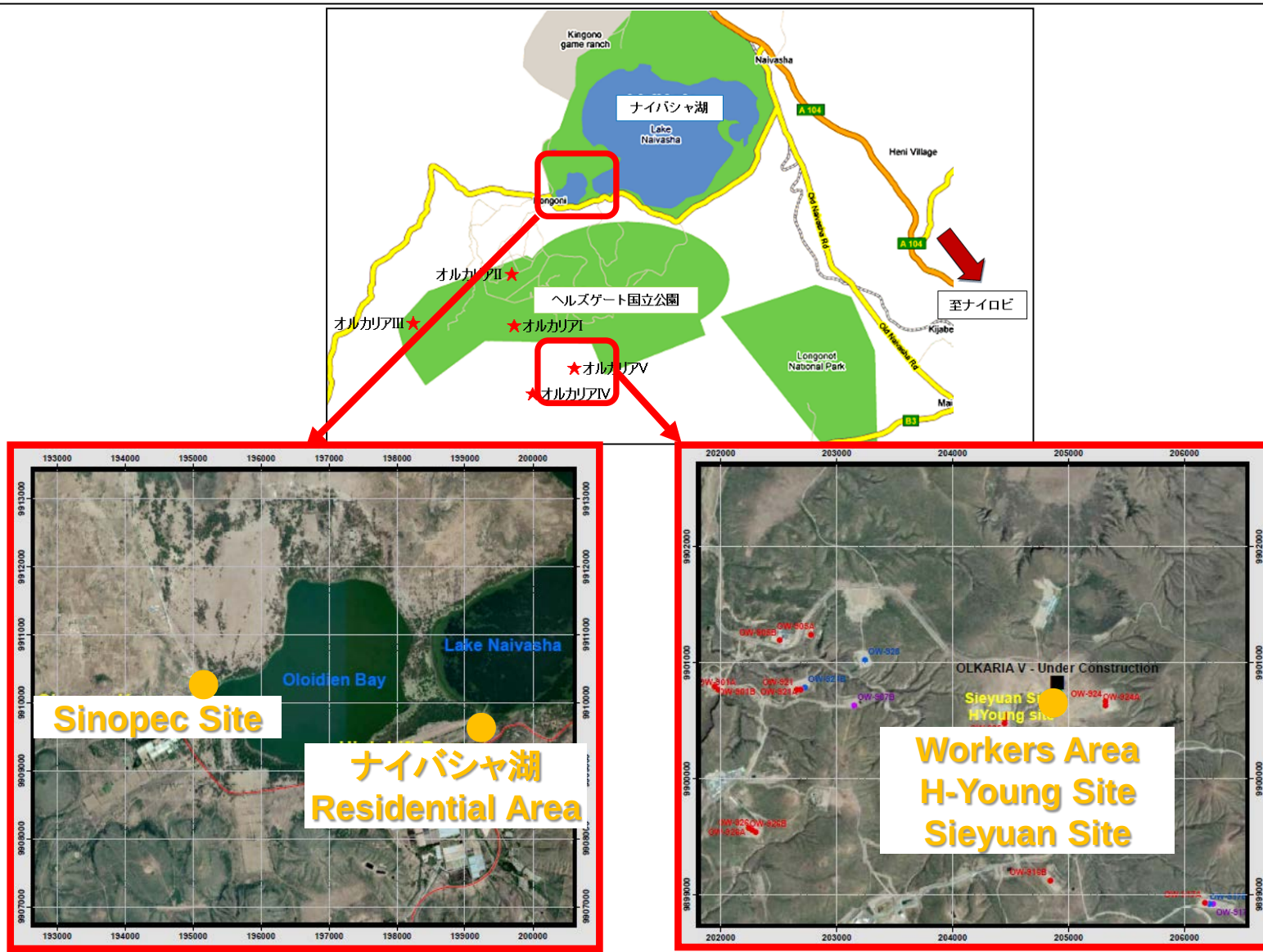
※1 モニタリングはKWSが実施し、KenGenがこのデータを活用する。

5. 環境モニタリング結果（建設段階）

環境項目	項目	確認結果
大気質	TSP、SO ₂ 、CO、H ₂ S、CO ₂ 、CH ₄	問題なし
地表水	TSS、COD、BOD、DO、pH、油分、フェノール※	1つの工事サイトにおける飲料水の検査結果のpHが基準値を下回っているが、この工事サイトでは購入した飲料用ペットボトルを配布しており、同ペットボトルの値がpHの基準を下回っていたとのこと。本事業における影響ではなく、また、日本の水道基準では、5.8-8.6となっており、飲料用としても問題ないと考えられる。
騒音	dB	問題なし
廃棄物	家庭ごみ、金属のスクラップ、汚泥	問題なし
土壌浸食	目視による確認	問題なし
国立公園	野生生物の定期的モニタリング・植生変化の目視観察	・建設の際生じた土の保管場に浸食性の高い <i>Nicotiana Glauca</i> 等の植物が発生しているが、工事の完了とともに除去する予定。 ・小型アンテロープの子どもが保護され、KWSに引き渡される事例有。
水利用	KenGenでの産業用及び生活用の水利用量 ナイバイシャ湖の水位	問題なし

※ フェノールは、助言委員会での指摘を踏まえモニタリング項目から削除予定。

別添：環境モニタリング結果 (サンプリングポイント)



別添：環境モニタリング結果（許認可）

OLKARIA V GEOTHERMAL PROJECT Environment and Social Monitoring Form

Appendix 6

The latest results of the below monitoring items shall be submitted to JICA as part of attachment to Progress Report on once at Pre-construction phase and on quarterly basis at Construction Phase, and on annually base at Operation Phase. The items, standards for contract, measurement points, and frequency for each monitoring parameter are established based on the ESIA Report. Should there be any changes to the Original plan, such change shall be reviewed and evaluated by the environmental consultant.

(1) General

1) Phase of the Project

- Please mark the current phase.

☐ Pre-Construction Phase ☒ Construction Phase ☐ Operation Phase

2) Obtainment of Environmental Permits

Name of permits	Expected issuance date	Actual issuance date	Concerned authority	Remarks (Conditions, etc.)
Water abstraction permits for Olkaria	Permit for domestic water abstraction issued on 26 th July, 2017 (Permit Ref. no. WRMA/20/NSA/2GD/23/S)	Permit for abstraction of 795.4m ³ /day of water for domestic use was issued on 26 th July 2017, and is valid till 26 th July 2022.	Water Resources Authority (WRA)	-The permits for domestic and industrial/commercial water abstraction are valid up to 2022.
	Permit for commercial/industrial water abstraction for Olkaria issued on 24 th May 2017. (Permit Ref. no. WRMA/20/NSA/2GD/22/S)	Permit for abstraction of 8,000 m ³ /day of water for commercial & industrial use was issued on 24 th May 2017, and is valid till 24 th May 2022.		
EIA license	Variation of license validity period issued on 14 th March 2019	-Original license dated 12 th September 2014, -1 st variation of EIA license validity period	National Environment Management Authority (NEMA)	KenGen has acquired variation of the EIA license validity period issued on 14 th March 2019, valid for an additional 24 months (up to 14 th March 2021).

別添：環境モニタリング結果（大気質①）

(2) Monitoring Results

1) Air Quality

(A) Hydrogen Sulphide

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Standards for Contract	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
Residential Area	H ₂ S	ppm	0.001	0.002	0.1		0.1*/(24h)	Daily	Using gas detectors	Limit not exceeded
Workers Area	H ₂ S	ppm	0.002	0.004	10		10**/(24h)	Daily	Using gas detectors	Limit not exceeded

*) WHO Hydrogen Sulphide Guideline for ambient air quality.

**) WHO Hydrogen Sulphide Guideline for worker.

(B) Sulfur Dioxide

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Frequency	Method	Remarks
Residential Area	SO ₂	ppm	0	0	Quarterly	Using testo emission analyzer model 350	Not detectable
Workers Area	SO ₂	ppm	0	0	Quarterly	Using testo emission analyzer model 350	Not detectable

(C) Carbon Monoxide

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Frequency	Method	Remarks
Residential Area	CO	ppm	0	0	Quarterly	Using testo emission analyzer model 350	
Workers Area	CO	ppm	0.33	1	Quarterly	Using testo emission analyzer model 350	Emission due to operation of the diesel generators

別添：環境モニタリング結果（大気質②）

(D) Carbon Dioxide^①

Location ^②	Item ^②	Unit ^②	Measured Value (Mean) ^②	Measured Value (Max.) ^②	Frequency ^②	Method ^②	Remarks ^②
Residential Area ^①	CO ₂ ^①	ppm ^①	0 ^①	0 ^①	Quarterly ^①	Using testo emission analyzer model 350 ^②	Not detectable ^①
Workers Area ^①	CO ₂ ^①	ppm ^①	0 ^①	0 ^①	Quarterly ^①	Using testo emission analyzer model 350 ^②	Not detectable ^①

(E) Methane^①

Location ^②	Item ^②	Unit ^②	Measured Value (Mean) ^②	Measured Value (Max.) ^②	Frequency ^②	Method ^②	Remarks ^②
Residential Area ^①	CH ₄ ^①	ppm ^①	N/A ^①	N/A ^①	Daily ^①	Using gas detectors ^②	We have requested for a specialized equipment for monitoring CH ₄ gas. The data will be collected and shared by Mid-March 2019 ^① .
Workers Area ^①	CH ₄ ^①	ppm ^①	N/A ^①	N/A ^①	Daily ^①	Using gas detectors ^②	We have requested for a specialized equipment for monitoring CH ₄ gas. The data will be collected and shared by Mid-March 2019 ^① .

(F) Total Suspended Particles^①

Location ^②	Item ^②	Unit ^②	Measured Value (Mean) ^②	Measured Value (Max.) ^②	Frequency ^②	Method ^②	Remarks ^②
Residential Area ^①	TSP ^①	µg/m ³ ^①	5 ^①	8 ^①	Weekly ^①	Using particulate matter in air analyzer equipment ^②	According to Environmental Management and Coordination (Air Quality) Regulations of 2014, the ambient air quality tolerance limit for Total Suspended Particles over a 24-hour time weighted average at residential areas is 200 µg/m ³ The measured levels do not exceed this limit ^① .
Workers Area ^①	TSP ^①	µg/m ³ ^①	117 ^①	299 ^①	Weekly ^①	Using particulate matter in air analyzer equipment ^②	According to Environmental Management and Coordination (Air Quality) Regulations of 2014, the ambient air quality tolerance limit for
						equipment ^②	Total Suspended Particles over a 24-hour time weighted average at industrial areas is 500 µg/m ³ The measured levels do not exceed this limit ^① .

別添：環境モニタリング結果（水質①）

2)Water Quality

Measurement Point: Important water body

- Are there any effluents to water body in this monitoring period? ☐ Yes, ☒ No

If yes, please attach "KenGen Analysis Data Form for Effluent Quality Analysis" and fill in the items not to comply with NEMA Guideline (Environmental Management and Coordination (Water Quality) Regulations of 2006).

↓

(A) Effluent Water Quality (Outlet)

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Standards for Contract	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
.	TSS	mg/L	.	.	30*	.	-	Monthly	Sampling	.
.	COD	mg/L	.	.	50*	.	-	Monthly	Sampling	.
.	BOD	mg/L	.	.	30*	.	-	Monthly	Sampling	.
.	DO	mg/L	.	.	None	.	-	Monthly	Sampling	.
.	pH	-	.	.	6.5-8.5*	.	-	Monthly	Sampling	.
.	oil	mg/L	.	.	Nil*	.	-	Monthly	Sampling	.
.	phenol	mg/L	.	.	0.001*	.	-	Monthly	Sampling	.

*) Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

↓

Note: There was no effluent discharge from the project site within the Jan-Feb-Mar period

別添：環境モニタリング結果（水質②）

(B) Local Drinking Water Supply Source (Ambient)⁴⁾

Location ⁴⁾	Item ⁴⁾	Unit ⁴⁾	Measured Value (Mean) ⁴⁾	Measured Value (Max.) ⁴⁾	Country's Standard ⁴⁾	Standards for Contract ⁴⁾	Referred International Standard ⁴⁾	Frequency ⁴⁾	Method ⁴⁾	Note (Reason of excess of the standard) ⁴⁾
Sieuyan Site ⁴⁾	TSS ₅	mg/L ₅	ND ₅	5	30* ₅	5	5	Quarterly ₅	Sampling ₅	5
	COD ₅	mg/L ₅	153.66 ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	BOD ₅	mg/L ₅	51.20 ₅	※	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	DO ₅	mg/L ₅	1.65 ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	pH ₅	- ₅	6.20 ₅	5	6.5-8.5* ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	oil ₅	mg/L ₅	Nil ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	phenol ₅	mg/L ₅	<0.001 ₅	5	0.002 ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	Lead ₅	Mg/l ₅	<0.001 ₅	5	0.01 ₅	5	5	5	5	5

*) Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

Note Sieuyan provides bottled water to the workers, and the analysis results are for bottled water.⁴⁾

Location ⁴⁾	Item ⁴⁾	Unit ⁴⁾	Measured Value (Mean) ⁴⁾	Measured Value (Max.) ⁴⁾	Country's Standard ⁴⁾	Standards for Contract ⁴⁾	Referred International Standard ⁴⁾	Frequency ⁴⁾	Method ⁴⁾	Note (Reason of excess of the standard) ⁴⁾
H-Young Site ₅	TSS ₅	mg/L ₅	ND ₅	5	30* ₅	5	5	Quarterly ₅	Sampling ₅	5
	COD ₅	mg/L ₅	230.40 ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	BOD ₅	mg/L ₅	76.80 ₅	※	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	DO ₅	mg/L ₅	2.08 ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	pH ₅	- ₅	6.88 ₅	5	6.5-8.5* ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	oil ₅	mg/L ₅	Nil ₅	5	None ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	phenol ₅	mg/L ₅	<0.001 ₅	5	0.002 ₅	5	5	Quarterly ⁴⁾	Sampling ₅	5
	Lead ₅	mg/L ₅	<0.001 ₅	5	0.01 ₅	5	5	5	5	5

*) Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

Note: Lot 2 Contractor (H-Young) has a water treatment plant at the site, and the water is treated through reverse osmosis process.⁴⁾

※ 数値の誤り。後日提出された再検査結果では問題ない値となっている。

別添：環境モニタリング結果（水質③）

Location ⁴⁾	Item ⁴⁾	Unit ⁴⁾	Measured Value (Mean) ⁴⁾	Measured Value (Max.) ⁴⁾	Country's Standard ⁴⁾	Standards for Contract ⁴⁾	Referred International Standard ⁴⁾	Frequency ⁴⁾	Method ⁴⁾	Note (Reason of excess of the standard) ⁴⁾
Sinopec Site ⁴⁾	TSS ₅	mg/L ₅	ND ₅	..	30* ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	COD ₅	mg/L ₅	192.0 ₅	..	None ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	BOD ₅	mg/L ₅	64.4 ₅	※	None ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	DO ₅	mg/L ₅	1.87 ₅	..	None ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	pH ₅	- ₅	7.63 ₅	..	6.5-8.5* ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	oil ₅	mg/L ₅	Nil ₅	..	None ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	phenol ₅	mg/L ₅	<0.001 ₅	..	0.002 ₅	..	- ₅	Quarterly ⁴⁾	Sampling ₅	..
	Lead ₅	mg/L ₅	<0.001 ₅	..	0.01 ₅	..	- ₅	Quarterly ⁴⁾	..	..

*) Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

Note: Lot 1 Contractor (Sinopec) has a water treatment plant.⁴⁾

⁴⁾

⁴⁾

(C) Important Water Bodies (Ambient)⁴⁾

Location ⁴⁾	Item ⁴⁾	Unit ⁴⁾	Measured Value (Mean) ⁴⁾	Measured Value (Max.) ⁴⁾	Country's Standard ⁴⁾	Standards for Contract ⁴⁾	Referred International Standard ⁴⁾	Frequency ⁴⁾	Method ⁴⁾	Note (Reason of excess of the standard) ⁴⁾
Lake Naivasha at Oserian Jetty ⁴⁾	TSS ₅	mg/L ₅	2 ₅	..	30* ₅	..	- ₅	Monthly ₅	Sampling ₅	..
	COD ₅	mg/L ₅	144 ₅	..	None ₅	" ₅	- ₅	Monthly ₅	Sampling ⁴⁾	..
	BOD ₅	mg/L ₅	48 ₅	※	None ₅	" ₅	- ₅	Monthly ₅	Sampling ⁴⁾	..
	DO ₅	mg/L ₅	1.60 ₅	..	None ₅	..	..	Monthly ⁴⁾	Sampling ⁴⁾	..
	pH ₅	- ₅	7.75 ₅	..	6.5-8.5* ₅	..	..	Monthly ⁴⁾	Sampling ⁴⁾	..
	Oil ₅	mg/L ₅	Nil ₅	..	None ₅	..	..	Monthly ⁴⁾	Sampling ⁴⁾	..
	Phenol ₅	mg/L ₅	<0.001 ₅	..	Nil* ₅	..	..	Monthly ⁴⁾	Sampling ⁴⁾	..
	Lead ₅	Mg/L ₅	<0.001 ₅	..	0.01 ₅	..	..	..	Sampling ⁴⁾	..

*) Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

※ 数値の誤り。後日提出された再検査結果では問題ない値となっている。

別添：環境モニタリング結果（騒音）

4) Noise

Noise Level

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Standards for Contract	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
Residential Area	Leq (day)	dB(A)	43.5	46.1	50 (6am-6pm)*		55 (6am-10pm)***	Daily	Spot measurement	Average noise levels do not
									using noise meter	exceed the limit
Residential Area	Leq (night)	dB(A)	N/A	N/A	35 (6am-6pm)*		45 (10pm-6pm)***	-	-	We do not have night activities
Workers Area	Leq (day)	dB(A)	64.9	70.3	85 (8hrs)**		-	Daily	Spot measurement using noise meter	Noise levels do not exceed the occupational threshold

*) Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations of 2009 for Residential Area (Outdoor).

**) Occupational Safety and Health Act (OSHA) 2007 for Worker (8 hrs).

***WHO Noise Guideline for Residential Area (Outdoor).

別添：環境モニタリング結果（廃棄物）

5) Solid Waste

Measurement Point: Disposal Sites for Sludge (including drilling mud)

- Are there any wastes of sludge in this monitoring period? ☒ Yes, ☐ No

If yes, please report the amount of sludge and fill in the results of solid waste management Activities.

Item	Generated from	Unit	Value	Solid Waste Management Activities
Amount of Domestic refuse	Site offices and dining area for workers on site	Kgs	8kg per day	The contractor has provided a waste containment site where he holds the waste before final disposal.
Clinic waste	H-Young clinic	Kgs	4kgs in the quarter	Transport to <u>Finlays</u> Incinerator
Plastic waste	Cooling tower fills	Kgs	3,500 per quarter	Transported by licensed waste handler
Rock wool	Steam line	m ³	5 per quarter	At domes holding site. To be disposed by a licensed waste handler
Iron waste	cuttings	Kgs	300	At domes holding site. To be disposed by a licensed waste handler
Timber	Packaging	Kgs	6000 per quarter	The metallic scraps are accumulated up to a maximum of 20 tones and transported back to the contractors scrap yard for disposal at Nairobi.
Amount of metallic scraps	Power plant steel fixing construction (rebars)	<u>Tonnes</u>	6 ton	The metallic scraps are accumulated up to a maximum of 20 tones and transported back to the contractors scrap yard for disposal at Nairobi. During the period under review, only 6 <u>tonnes</u> had accumulated due to reduced rebar activities
Amount of Sludge	Oil spills from diesel generators and equipment maintenance	<u>Litres</u>	1400 <u>litres</u>	Transported back to Nairobi to be used for heating purposes of the contactor's boilers asphalt additives once they accumulate to a maximum of 1000litres. In the period under review we had 220litres on site.

別添：環境モニタリング結果（国立公園）

8) Protected Areas and Ecosystems

Item	Monitoring Results during Report Period	Note (issues to be arisen and its measures, if any)
Flora (both in and around the HG National Park)	-Controlled excavation of the sites to minimize impacts on flora -Grassing along slopes to restore habitats -Invasive plant species (such as <i>Nicotiana glauca</i>) have colonized disturbed areas such as spoil banks.	Control/Remove invasive plant species
Fauna (both in and around the HG National Park)	-A baby Klipspringer antelope was rescued stuck on loose soil along OW-917 to OW-922 HDPE pipe route, and was later handed over to Kenya Wildlife Service (KWS)	-
Hell's Gate National Park	-Review of Hell's Gate-Mt. Longonot Ecosystem Management Plan 2017 -2027 is ongoing	The review covers geothermal resource development and conservation
Landscape	-Controlled excavation of the sites to minimize landscape changes. Top soil piled for future use in rehabilitation of degraded/cleared sites. -Landscaping of the disturbed sites in has commenced at the power plant area -The steam pipes claddings are coated with colours that camouflage to the	
	surrounding environment	