

## SAUDI ARABIAN OIL COMPANY



أرامكو السعودية  
Saudi Aramco

## CROSS COUNTRY PIPELINE PROJECT DEPARTMENT

## CONSTRUCTION SCOPE OF WORK

FOR

BI-10-01861

SOUR WATER PIPELINE FROM JUAYMAH NGL FRACTIONATION PLANT  
TO RAS TANURA REFINERY

ISSUED FOR CONSTRUCTION

AUGUST-2019

Prepared by:



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CONSTRUCTION SCOPE OF WORK NARRATIVE SOUR WATER PIPELINE - JNGLF TO RT REFINERY JNGLF/RTR PLANT	
JU'AYMAH	
SAUDI ARABIA	
JO / EWO: 10-01861-0001	
DWG. TYPE DOC	
PLANT NO. INDEX R83 A	
DRAWING NO. RE-663716	
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ISSUED FOR CONSTRUCTION  
KBR-AMCDE  
09-Oct-2019

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SAUDI ARABIA

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## 1.0 INTRODUCTION

The purpose of the facilities is to support Saudi Aramco's corporate objective to intensify the focus on safety and protection of the environment by providing facilities to reliably transport 120 GPM sour water from Ju'aymah NGL Fractionation Plant (JNGLF) for treatment at sour water stripping facilities at Ras Tanura Refinery (RTR).

## 2.0 PRESENT SITUATION

Presently, JNGLF plant receives ethane-plus and propane-plus NGL feeds from gas plants and NGL recovery facilities throughout the Kingdom. The feed is fractionated into various products which are either utilized in Kingdom by petrochemical industry in Jubail or exported. The products include ethane, propane, butane, pentane and natural gasoline.

Sour water generated from the propane and butane product treating units contains more than 10 parts per million (ppm) of hydrogen sulfide (H<sub>2</sub>S) and 1ppm ammonia (NH<sub>3</sub>) is continuously discharged from JNGLF to a marine effluent stream. The sour water is diluted with returned sea water coolant before discharge via a sea water return line. The current practice of dilution with cooling water is not in compliance with COMPANY standards as a treatment process for sour water.

Removal of trace H<sub>2</sub>S and water is critical to meeting the specifications for propane and butane. H<sub>2</sub>S removal is accomplished through the use of ADIP solvent absorption. The regeneration of the ADIP solvent results in the generation of sour water at the ADIP Regenerator Reflux Drum.

The dehydration process utilizes molecular sieves and the beds are regenerated utilizing heated propane or butane. The regeneration stream and water is recycled to the depropanizer and debutanizer reflux drums. The free water that collects in the reflux drums is also a source of sour water.

The sour water generated from all four NGL fractionation trains is sent via a common sour water collection header to degassing drum D-792 where the sour water is degassed to flare header pressure. The degassed sour water is then pumped out on level control to the cooling water return line and subsequent marine discharge. The caustic degassing drum D-784 is utilized as a short term backup for D-792 during maintenance periods.

Ras Tanura Refinery supplies refined products to the Eastern and Central Regions

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of Saudi Arabia. Sour water is produced at several locations throughout the refinery where water is in contact with hydrogen sulfide (H<sub>2</sub>S). Sour water stripping is used to remove H<sub>2</sub>S and NH<sub>3</sub> from sour water containing more than 10 ppm H<sub>2</sub>S. The Refinery is currently equipped with one sour water stripper (J78-C-301) with a capacity of 460 GPM.

BI-10-01330, Install Sour Water Stripper-RTR, will install an additional 500 GPM of sour water stripping capacity (ERC 6/19), bringing the total refinery stripping capacity to 960 GPM. In addition, sour water surge tanks J78-D602/603/607 provide 190,000 BBL of sour water storage to ensure reliable operation of the stripping facilities. The table below provides a breakdown of all present and future RTR sour water sources. The estimated future average flow is 853 GPM.

RTR SW Sources	Design Flow GPM (BPD)	Remarks
<b>Plant 15</b>	350	Future
<b>Plant 488/493</b>	53.6	Existing
<b>Plant J24</b>	55	Existing
<b>Plant J06</b>	7	Existing
<b>Plant J58</b>	12	Existing
<b>Plant J72</b>	15.4	Existing
<b>Plant J78</b>	2.8	Existing
<b>Plant J80</b>	120	Existing
<b>Plant J85</b>	63	Existing
<b>Plant J88</b>	130	Existing
<b>NGL Plants 10/490</b>	30	Existing
<b>CF &amp; AP</b>	100	Future
<b>Total</b>	939 (32,190)	853 (29, 25) Avg. Flow

## 3.0 LOCATION ANALYSIS

### 3.1 Facilities Location

The pipeline and associated facilities shall be constructed on the existing Saudi Aramco facilities and pipeline corridors. Tie-in construction works and process equipment shall be executed inside the battery limits of JNGLF and

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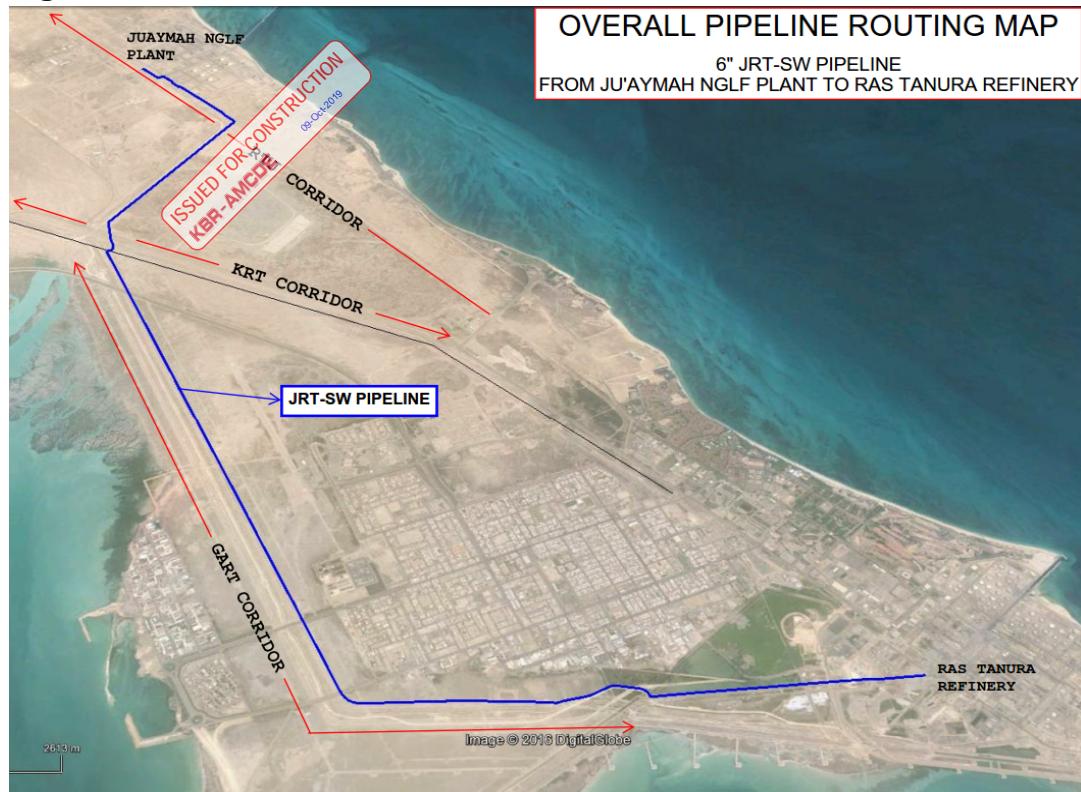
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RTR. JNGLF is located on the Arabian Gulf approximately 13 kilometers north-west of RTR.

The new 6" sour water pipeline JRT-SW from JNGLF to RTR will be laid along the existing RTJ and GART pipeline corridors as shown in the below Figure-1 'Overall Pipeline Routing Map'. All of the construction locations already have good road suitable for the access and egress of construction equipment, personnel and materials.

The new pipeline will pass under existing fences, security patrol roads and five major roads (including main Rastanura Highway, 614). All fence and major road crossings shall use thrust boring whilst the other pipeline crossings shall use open-cut methodology. All fence penetration plan shall be reviewed and approved by ISSD.

**Figure-1**



### 3.2 Temporary Construction Facilities

Construction Site shall be located appropriate distance from industrial Facilities with the spacing as per SAES-B-055.

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The CONTRACTOR shall be responsible for obtaining access to utilities such as electric power, communication, potable, and non-potable water required to support their temporary facilities and to complete project activities

Temporary construction offices and lay-down yards will be located and constructed by the CONTRACTOR with guidance from SAPMT and Loss Prevention Department (LPD) during the construction phase. Generally, temporary construction offices, equipment lay-down areas, and construction trailers shall be located at a safe location 500meter away from the SA facility plant perimeter fence.

- CONTRACTOR shall identify, secure rights for, lease or purchase, and complete filing of permit applications and securing necessary government permits for the lands required for the establishment and operation of the construction main site offices, temporary offices and all construction support facilities, for the entire project duration.
- Temporary facilities shall not be located less than 2 KM, but not more than 5 KM from the Pipeline corridor. Temporary Site facility shall be accessible by paved asphalt to provide easy access to SAUDI ARAMCO and CONTRACTOR personnel.
- CONTRACTOR shall secure the area for temporary facilities to be used by SAUDI ARAMCO and CONTRACTOR in either Juaimah or Ras Tanura areas, unless the CONTRACTOR receives written direction otherwise from the Company Representative for different locations. CONTRACTOR shall identify the land selected for the project and present to SAUDI ARAMCO for review and approval. CONTRACTOR is solely responsible for the cost incurred for the lease or purchase of land.
- The location of the SAUDI ARAMCO Main Site Offices shall be located as follows:
  - One (1) SAUDI ARAMCO Main site Office shall be located in either Juaimah or Ras Tanura areas.
  - The temporary facilities locations layout including, but not limited to, Lay Down yard, Fabrication yard, SAPMT site office and Contractor site office are subject to approval by COMPANY Representative.

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- CONTRACTOR shall make temporary facilities available and ready for use by SAUDI ARAMCO from the Notice to Proceed date until WORK is complete to the satisfaction of SAUDI ARAMCO.
- CONTRACTOR shall furnish, install, maintain and operate the temporary facilities, equipment and services for use by SAUDI ARAMCO and CONTRACTOR
- CONTRACTOR shall be responsible for planning to the most efficient use of the lands' spaces and shall determine the layout of all facilities within the scope of WORK subject to the approval of the Company Representative.
- CONTRACTOR is solely responsible for any development and improvement made to the lands that is necessary for the purpose of the project and returning the lands to their original or better condition upon project completion.
- CONTRACTOR is ~~solely responsible for all contractual obligations between itself and Land's Owner.~~ SAUDI ARAMCO is not a party to the lease contract and shall not be held liable for any damage or be a party to disputes, claims, litigations, between the CONTRACTOR and Land Owner.

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.CONTRACTOR shall indemnify, defend and hold harmless SAUDI ARAMCO from any claims, disputes, litigation, damages that arise between Land Owner and CONTRACTOR.

## Civil/Structural

1. CONTRACTOR shall provide all the temporary site facilities not limited to CONTRACTOR's office, Laydown area, parking, generator, water tank including Grading and Paving. The CONTRACTOR responsibility to secure the land.
2. CONTRACTOR shall bear the rent of the land which is to be hired for the purpose.
3. CONTRACTOR shall prepare a detailed Plot plan of the location showing all the temporary facilities required and shall be submitted to SA and shall get prior approval from SA before the construction of temporary construction site facility.
4. CONTRACTOR shall take care of gas detection, fire detection, HVAC

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Emergency response plan during the preparation of temporary construction facilities.

## Electrical

1. CONTRACTOR has to verify on site nearest power tapping point. CONTRACTOR has to provide power cabling from the power source towards the proposed temporary camp.
2. Unless otherwise power tapping point is not available for the electrical load of the temporary office, CONTRACTOR has to bring their own power generator and distribution boards.

## Telecommunication

The communication requirement for the Temporary Construction Office shall be provided by CONTRACTOR

Due to the short length of the pipeline and its proximity to population centers, corridor construction camps are not necessary. The CONTRACTOR shall utilize their own or local accommodation facilities and site temporary construction offices at either Ju'aymah or the Refinery.

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### 3.3 Construction Utilities

Utilities available on the JNGLF / RTR sites at the construction area include electric power, steam, utility water and firewater, potable water, and instrument air. Worksite electricity is available at 480 volts or lower within JNGLF and RTR battery limit. CONTRACTOR shall provide all temporary transformers needed for construction purposes. Utilities like air and nitrogen for purging required for construction and pre-commissioning activities shall be supplied by CONTRACTOR. All utilities required within the pipeline corridor will have to be provided by portable or mobile equipment by the CONTRACTOR.

### 3.4 Topology and Soils

Construction work will be at the existing plant R84 Fractionation center at JNGLF and the existing plant J87 sulfur recovery unit at RTR.

The terrain along the proposed JNGLF to RTR pipeline right-of-way is relatively flat with an average elevation of 4 meters and consists of sand and sand covered sabkha. The ground water is approximately at a depth of

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1.0 to 3.0 meters, almost directly below the existing sabkha surface.

The CONTRACTOR shall refer to geotechnical investigation report 2016/37 to determine the sub-surface conditions on the proposed facility site. Dewatering equipment may be required in areas where the water table is high.

### **3.5 Site Weather Conditions**

The meteorological and seismic design data for the Juaymah and Ras Tanura areas stated in SAES-A-112 shall be used for this project.

### **3.6 Land Use Permits**

The LUP of new JRT-SW pipeline (LUP #49423) was provided by COMPANY. However, due to some minor modifications based on actual site conditions COMPANY standards requirements, the LUP is modified and submitted along with waivers for approval.

## **4.0 INTERFACES**

This Budget Item shall be executed with minimal disruption to hydrocarbon supply and plant operations. As much as possible, the project shall liaise with Proponent department (JNGLF), pipeline operations Northern Area Pipelines Department (NAPD), and RTR plant operations to align all construction tie-in activities with a view to optimize all plant tie-in connections. To the extent practicable, all physical tie-ins shall be executed with zero impact to plant operations.

### **4.1 Related Budget Items**

BI-10-01330 Install Sour Water Stripper – RTR (ERA 6/19) establishes the additional sour water stripping capacity at RTR that makes the sour water pipeline from JNGLF to RTR a feasible option. BI-10-01330 will provide the physical tie-point valve for connection to the stripping facilities at RTR to enable cold tie-in to sour water collection header.

### **4.2 Project Physical Interfaces**

The following physical interfaces are listed and related project drawings.

Piping / Pipeline

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## Ju'aymah NGL Fractionation Plant (JNGLF PLANT R84)

This project will provide the physical interface at the sour water degassing drum (R84-D-792) and the caustic degassing drum (R-84-D-784) at JNGLF. Tie-ins will be made on the sour water degassing drum at the outlet nozzle and existing piping for the new sour water transfer pumps suction piping and minimum flow recycle lines for both vessels. The tie-in to the cooling water return line shall be maintained for emergency bypass of system to a safe location.

## Ras Tanura Refinery (RTR Plant J87)

This project will have physical interface with 8-inch sour water collection header 8"-SOW-1325-1CS4P06 provided by BI-10-01330 in Plant-J87 (upstream of Sulfur Recovery Unit), inside RTR. In addition this budget item will provide a physical tie-in point for the relief valve discharge to the same sour water header.

## 4.2.1 Electrical

## INTERFACE AT JNGLF

- 4.2.1.1 Existing 3HP Spent Water Pump Motor R84-GM-791A fed from cubicle no. 3RH of existing 480V Control-gear R84-P-755 located in Substation #27 shall be disconnected and cubicle no. 3RH shall be converted to spare motor feeder. All control cables wiring in Substation relay panels, local PB stations and wiring in DCS/ESD/Marshalling cabinets associated with existing Spent Water Pump Motors shall be demolished. For direct buried portion of underground cables for which demolition becomes impractical, the cables for that portion shall be abandoned in place.
- 4.2.1.2 Existing space cubicle no. 4RD of existing 480V Control-gear R84-P-755 located in Substation #27 shall be utilized by installing new MCCB of 100AF/100AT rating to feed new 25HP Sour Water Pump Motor R84-GM-0957A through new Adjustable Speed Drive R84-027-AFD-001.
- 4.2.1.3 Existing 3HP Spent Water Pump Motor R84-GM-791B fed from cubicle no. 3RH of existing 480V Control-gear R84-P-756 located in Substation #27 shall be disconnected and cubicle no. 3RH shall be converted to spare motor feeder. All

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control cables wiring in Substation relay panels, local PB stations and wiring in DCS/ESD/Marshalling cabinets associated with existing Spent Water Pump Motors shall be demolished. For direct buried portion of underground cables for which demolition becomes impractical, the cables for that portion shall be abandoned in place.

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- 4.2.1.4 Existing space cubicle no. 3RK of 480V existing Control-gear R84-P-756 located in Substation #27 shall be utilized by installing new MCCB of 100AF/100AT rating to feed new 25HP Sour Water Pump Motor R84-GM-0957B through new Adjustable Speed Drive R84-027-AFD-002.

4.2.1.5 Existing 3HP Spent Water Pump Motor R84-GM-791C fed from cubicle no. 1BFB of existing 480V Control-gear R84-P-754 located in Substation #27 shall be disconnected and cubicle no. 1BFB shall be converted to spare motor feeder. All control cables wiring in Substation relay panels, local PB stations and wiring in DCS/ESD/Marshalling cabinets associated with existing Spent Water Pump Motors shall be demolished. For direct buried portion of underground cables for which demolition becomes impractical, the cables for that portion shall be abandoned in place.

4.2.1.6 New Sour Water Pump Motors (R84-GM-0957A/B), instrumentation digital junction box (R84-78-DJB-1004), and Adjustable Frequency Drives (R84-027-AFD-001 & R84-027-AFD-002) shall be grounded as per requirements of SAES-P-111. This grounding shall be interfaced with existing ground grid of Substation #27.

## RAS TANURA PLANT (RTR Plant J87)

- 4.2.1.7 Instrument homerun cables (IC-2262 & IC-2263) shall be routed from existing ESD marshalling cabinet (J87-ESD-MC-01) of existing PIB of Plant J87 to the new instrumentation digital and analog junction boxes (J87-ESD-DJB-2001 & J87-ESD-AJB-2001) to the existing ESD Marshalling Cabinet (J87-ESD-MC- 01) located in the existing Plant J87 PIB.
  - 4.2.1.8 Grounding for the new instrumentation digital and analog junction boxes (J87-ESD-DJB-2001 & J87-ESD-AJB-2001) shall be carried out as per requirements of SAES-P-111.

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This grounding shall be interfaced with existing grid.

## 4.3 Project Operations Interfaces

### 4.3.1 Process Operating Interfaces

CONTRACTOR shall make sure all equipment and plant shutdowns shall be coordinated with the proponent organization and other departments as required. Pre-commissioning, shutdown, commission and startup procedures shall be implemented in such a manner that they will minimize disruptions to the existing operations.

Hot switchovers shall be avoided through proper planning of all plant and equipment shutdown activities.

## 4.4 Demolition Activities:

CONTRACTOR shall develop a detailed demolition procedure for all piping and civil works including but not limited to cutting, staging, lifting, provision of temporary supports and dumping of demolished existing sour water piping materials and pumps. The demolition procedures shall be submitted to COMPANY for review and approval. All demolition works shall be done in accordance with the approved demolition procedures.

Prior to demolition activities, the Sour Water Degassing Drum (R84-D-792) shall be isolated and incoming sour water from various sources shall be diverted to the Caustic Degassing Drum (R84-D-784).

Proponent shall carry-out isolation, flushing and purging of existing sour water piping and the CONTRACTOR shall be handed over a sour fluid free piping system. CONTRACTOR shall provide necessary support to the proponent. CONTRACTOR shall coordinate with the proponent to ensure that the area is free of any leaks prior to start of demolition works.

CONTRACTOR shall carryout all the required demolition activities only after Proponent authorization that the individual plants or risk areas are safely shutdown and available for removal and replacement of the specified equipment. Refer to Demolition Drawings.

The new facilities shall be installed to the extent possible prior to making the tie-in connections to minimize the Sour Water Degassing Drum shutdown.

Demolition procedures shall allow change-over from existing to new facilities. Further, the procedures shall address safe and orderly integration of the new system. All construction activities must be properly

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planned and sequenced to ensure continuous operation of the existing facilities during the construction period.

## 5.0 DESIGN OBJECTIVES

This project will provide facilities to collect and transport sour water from JNGLF to RTR to allow for its safe treatment and disposal. Sour water collection and pumping facilities shall be provided at JNGLF. A pipeline will connect JNGLF to the RTR sour water stripping facilities to allow removal of hydrogen sulfide (H<sub>2</sub>S). The combined JNGLF and RTR stripped water shall be discharged to Industrial Waste Water Treatment Plant (J37).

## 6.0 GENERAL PROJECT DESIGN BASIS

### 6.1 Process

This design basis has been developed from the Project Proposal, as well as site surveys and existing plant drawings/documents.

### Sour Water Sources and Flowrates

Table 1 shows the ~~various~~ sources of sour water generated at JNGLF, their average and peak flowrates and the combined stream flowrate. Sour water from all four NGL fractionation modules flow to sour water degassing drum (R84-D-792). These are the sources of sour water to be transferred from JNGLF to RTR.

**Table 1 – Sour Water Sources and Flowrates**

JNGLF Sour Water Sources		Maximum Flow GPM (BPD)	Average Flow GPM (BPD)	Remarks
ADIP Regeneration Section Module I		10.0	6.2	Continuous
ADIP Regeneration Section Module II		10.0	6.2	Continuous
ADIP Regeneration Section Module III		10.3	6.5	Continuous

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ADIP Regeneration Section Module IV	13.0	6.8	Continuous
Module I Dehydrators Regen	14.0	0.8	Batch
Module II Dehydrators Regen	14.0	0.8	Batch
Module III Dehydrators Regen	14.0	0.8	Batch
Module IV Dehydrators Regen	19.0	1.1	Batch
<b>Average Flowrate GPM (BPD)</b>		<b>29.2 (1000)</b>	
<b>Peak Flowrate GPM (BPD)</b>	<b>104.3 (3570)</b>		

**Battery Limit Conditions**

Existing vessels and in-plant piping operating and design conditions are as follows:

**Table 2 – Battery Limit Conditions**

Description	Operating Condition		Design Condition	
	Pressure (psig)	Temperature (°F)	Pressure (psig)	Temperature (°F)
Sour Water Degassing Drum (R84-D-792)	5-8	40 to 145 (normal operation)	50	-45 to 285
		150 (emergency case)		
		Up to 235 (upset)		
Caustic Degassing Drum (R84-D-784)	5	30 to 145	50	-45 to 185
Salt Water Return (3"-P-7183-1A1)	35	120	65	245
BI-10-01330 RTR SW Header (8"-SOW-1325-12LC0U)	25	125	75	190

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## Sour Water Properties

Sour water composition varies based on JNGLF operation. Sour water transfer facilities and pipeline shall be designed to tolerate the variation in sour water composition shown in Table-3. This was taken from twelve samples taken from a sampling station at the discharge of existing Spent Water Pumps R84-G-791A/B/C.

**Table 3 – Sour Water Composition Range**

Description	H2S (PPMw)	NH3 (PPMw)	pH	Solids Concentration (mg/L)
Average	135.1	123.6	7.6	253.7
Minimum	1.0	6.7	6.7	6.0
Maximum	333.4	450.0	8.9	988.0

For the sizing of SOLIDS COLLECTION VESSEL, twice the value of average solids concentration (500 mg/L) has been considered to optimize the plot space and maximize the maintenance intervals.

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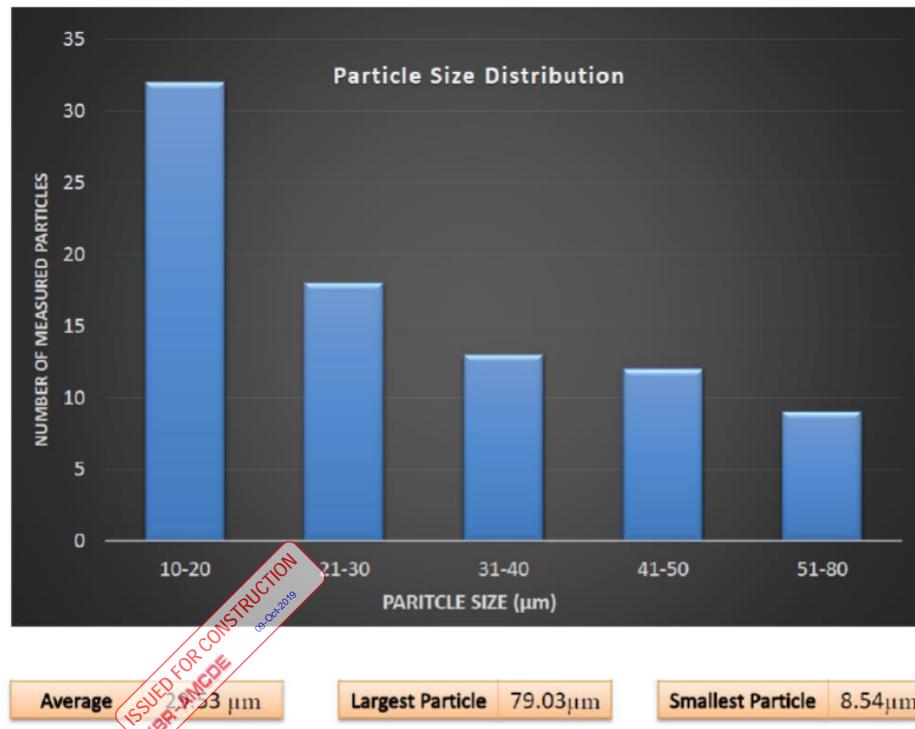
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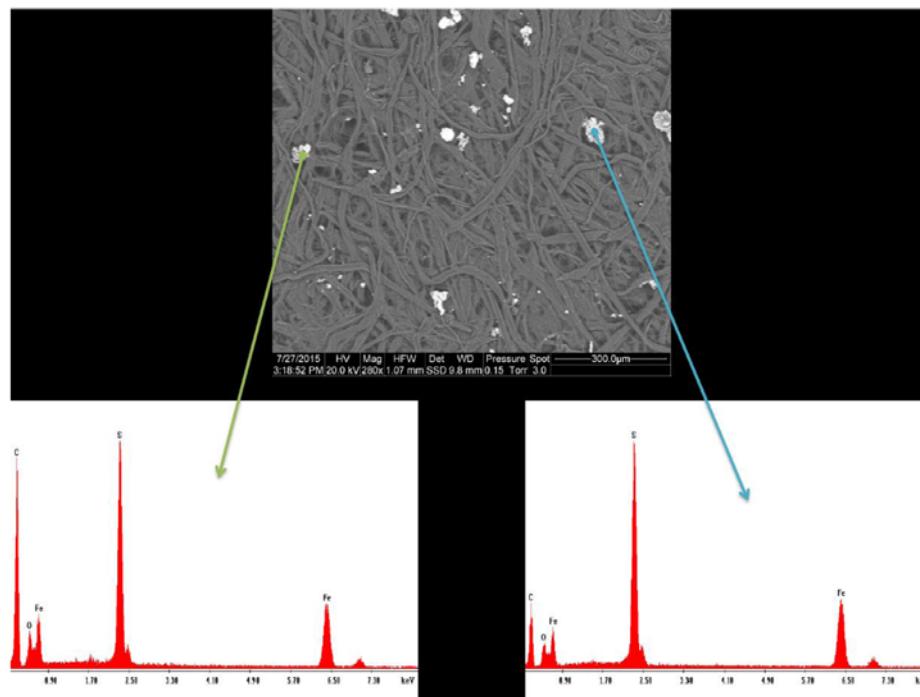
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Particle size distribution and composition analysis are shown in Figure 2.

**Figure 2 – Sour Water Particle Size Distribution**



**Figure 3 – Sour Water Solids Composition Results**



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Table 4 below shows the sour water properties.

**Table 4 – Sour Water Properties**

Description		Sour Water
Temperature, °F	Normal	120
	Maximum	200
Specific Gravity		0.9886
Vapor Pressure, psia	Normal	1.78
	Maximum	13.35
Viscosity, cP		0.5886

## 6.2 Piping / Pipeline

All piping inside JNGLF Plant and Ras Tanura Refinery are designed and constructed in accordance with ASME B31.3, SAES-L-310 and SAES-L-350 respectively. And the pipeline is designed in accordance with ASME B31.4, SAES-I-410, SAES-L-450, SAES-L-620 and SAES-L-650

As a corrosion protection method, a combination internally FBE coated carbon steel (temp. max. 90 °C) and 6MO materials (temp. above 90 °C) are selected for the above ground in-plant piping inside JNGLF and RTR. Internal FBE coating shall be provided as per as per APCS-102B of SAES-H-002. Flanges shall be provided at every pipe joints (12m max.) and at pipe bends and elbows as required to facilitate the internal FBE coating.

All piping and piping components intended for sour water use shall be suitable for sour service and comply with the requirements NACE MR 0175 / ISO 15156 in addition to COMPANY Saudi Aramco Materials System Specifications.

All above grade piping shall be applied with the external protective coating system in accordance with SAES-H-001 and coating map RE-663796.

The new non-metallic buried pipeline shall be procured, designed and constructed in accordance with 01-SAMSS-042, SAES-L-620 and SAES-L-650 respectively and manufacturer recommendations and manual.

The material for 6" JRT-SW pipeline is Glass Reinforced Epoxy (GRE) or Reinforced Thermosetting Resin (RTR - Epoxy Resin) as per 01-SAMSS-042 which are recommended most suitable non-metallic material based on the service (sour water) properties and design conditions. The

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recommended joint type for the selected GRE pipe and fittings is Threaded Joint.

The last 400 meters (approx.) long section of the JRT-SW pipeline after crossing RT north terminal asphalt road will be installed above grade with Internally FBE coated carbon steel pipe material.

The buried metallic portions of pipeline shall be externally FBE coated as per APCS-104B of SAES-H-002. As per COMPANY Consulting Services Department (SA-CSD) confirmation through COMPANY approved coating manufacturers, APCS-104B and APCS-113A can be exposed in Sabkha soil up to a maximum temperature of 90°C (194°F). Only those coatings approved under APCS-104B plus APCS-113A with confirmed suitability shall be used in these conditions. If any rocky area identified ARO composite material shall be used instead of APCS113A.

The following Table-5 summarizes the design parameters for non-metallic JRT-SW pipeline.

**Table 5 – JRT-SW Pipeline Design Parameters**

		Description	Units	Non-Metallic Pipeline	
DISCIPLINE ENGINEER MAK		Type of Fluid	-	Sour Water	
PROJECT ENGINEER MAT		Pipeline Length (approx.)	KM	16	
CERTIFIED AOO		Installation type		Buried	
CONSTRUCTION AGENCY AOO		Pipeline Material	-	Glass Reinforced Epoxy (GRE) / RTP (evaluate option)	
OPERATIONS AAA		Pipeline Size	Inches	6	
EDSD VERIFICATION BY _____ DATE: _____		Wall Thickness	Inches	As per Manufacturer	
CONTROL NUMBER BY _____ DATE: _____		MAOP	psig	185	
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		Flow rate	GPM	120	
		Flange Rating	ASME Class	150	
		Pipeline Location Class	-	2	

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Notes:

The last 400m (approx.) long section of pipeline after crossing RT north terminal asphalt road will be installed above grade with CS-Int. FBE coated pipe material.

CONTRACTOR shall evaluate using of RTP instead of RTR for the 6" pipeline.

Also, as stated in the below table, for some locations, the CONTRACTOR shall evaluate, confirm and construct the best option of the construction of 6" pipeline to be either above or below the existing pipelines.

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SI. No.	Location	Station point	Type of crossing	Existing pipe construction type	Crossing details	Existing P/Ls	Remarks.				
1	RTJ Corridor	1+602	Buried, over the existing pipe	Buried	RA-663802.004	RTJ pipelines	Total of 2 U/G P/Ls				
2	KRT corridor Existing A/G pipelines	4+463	Buried, under the existing P/Ls	Above ground pipelines	RA-663802.004	KRT-1/2/3 &BRT-1/2	Total of 5 A/G P/Ls				
3	KRT corridor Existing U/G pipeline	4+463	Buried, over the existing pipe	Buried	RA-663802.004	Not identified	Total of 1 U/G P/L				
4	GART corridor Existing U/G pipelines	14+045	Buried, over the existing pipe	Buried	RA-663802.004	New KRT-2/3 Gart corridor	Total of 2 U/G P/Ls KRT-2&3				
5	GART corridor Existing A/G pipeline	14+400	Buried, under the existing P/Ls	Above ground pipelines	RA-663802.004	QRT-12	Total of 1 A/G P/L				
6	GART corridor Existing U/G pipelines	15+600	Buried, over the existing pipe	Buried	RA-663802.004	Not identified	Total of 2 U/G P/Ls				

### 6.3 Electrical

Refer Electrical Design Basis document no – PE-P70003 for details.

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## 7.0 Temporary Offices

### 7.1 Civil/Structural

CONTRACTOR shall provide all the temporary site facilities not limited to SA offices, CONTRACTOR's office, Laydown area, parking, generator, water tank including Grading and Paving.

CONTRACTOR shall bear the rent of the land which is to be hired for the purpose.

CONTRACTOR shall prepare a detailed Plot plan of the location showing all the temporary facilities required and shall be submitted to SA and shall get prior approval from SA before the construction of temporary construction site facility.

CONTRACTOR shall take care of gas detection, fire detection, HVAC Emergency response plan during the preparation of temporary construction facilities.

### 7.2 Electrical

CONTRACTOR has to verify on site nearest power tapping point. CONTRACTOR has to provide power cabling from the power source towards the proposed temporary camp. Low Voltage 0.6kV/1kV (1.2kV), Cu/XLPE/PVC cable shall be provided, installed, pre-commissioned and commissioned.

Unless otherwise power tapping point is not available for the electrical load of the temporary camp, CONTRACTOR has to bring their own power generator and distribution boards.

### 7.3 Instrumentation

Contractor shall provide fire alarm systems for the temporary facilities in compliance with MSAER and relevant NFPA standards.

### 7.4 Telecommunication

It will be finalized based on final location of the temporary facility.

This section describes the scope of providing Communication Services (Voice and Data) to the Temporary Offices under this project.

Telecommunication scope for Temporary Offices is limited to the provision of Outside Plant Cables until the Temporary Site Office and to provide tie-in to existing COMPANY Corporate Network.

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## 8.0 CONTRACTOR GENERAL SCOPE OF WORK

- a) This Scope of Work shall be read in conjunction with applicable project drawings and other documents.
- b) CONTRACTOR shall develop a detailed cut over plan and shutdown, testing, pre-commissioning, commissioning, start-up and performance verification procedures during the Construction phase. CONTRACTOR shall submit these to COMPANY for review and approval and revise them as necessary.
- c) This Scope of Work shall be read in conjunction with the relevant project drawings and drawings and referenced COMPANY standards and procedures. In case of conflict between project drawings & documents and MSAER, the more stringent requirements shall be followed.
- d) CONTRACTOR shall be fully responsible for all aspects of the project. Any errors and/or omissions in any part of the work shall be corrected by CONTRACTOR without any additional cost to COMPANY.
- e) CONTRACTOR shall provide all mechanical equipment, piping/pipeline, civil/structural, electrical, control systems and instrumentation requirements as per project drawings and deliverables.
- f) CONTRACTOR scope shall include any other requirements not spelled out, but are essential to complete the project. CONTRACTOR shall carry out all works - materials procurement, transportation to site, construction/installation, testing, pre-commissioning, and commissioning and shall be according to requirements stated in the Contract schedules, Project Proposal, COMPANY standards and procedures, and standards referred therein. Any and all requirements stated in any set of documentation, even if not in the other, shall be part of project scope and shall be comply with by CONTRACTOR. The most stringent requirements stated in the above documentation shall govern.
- g) The scope of the contract shall be procurement, installation, material delivery to the construction site equipment and including as-built, maintenance until turnover; construction and installation (including work permits to perform work within the JNGLF & RTR) of the equipment and materials including the required testing and pre-commissioning to provide a complete fully functional facility that is mechanically complete and can obtain a COMPANY Mechanical Completion Certificate and Performance

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Acceptance Certificate.

- h)** CONTRACTOR shall supply all Materials/equipment required to complete this project.
- i)** CONTRACTOR shall purchase all Materials, equipment from COMPANY approved vendors only. CONTRACTOR will be responsible for undertaking the NMR's 601/602/603 technical review submittal and verifying that the vendor supplied equipment and materials meet all project requirements. CONTRACTOR shall supply all tools, tackles, construction equipment; provide temporary works etc. for installation, construction and testing.
- j)** CONTRACTOR will be responsible for undertaking the NMR's 601/602/603 Technical Review Submittal and verifying that the Vendor supplied Equipment and Materials meets all Project requirements
- k)** CONTRACTOR shall prepare Material Requisitions and quotation requests as per COMPANY Standards and Procedures for all materials. CONTRACTOR shall not place Purchase Order for materials prior to approval of COMPANY.
- l)** Inspection and Testing of materials shall be performed as per applicable COMPANY Inspection Requirement form A-175. CONTRACTOR shall arrange with his sub suppliers to comply with these requirements by stating on all sub suppliers' purchase order COMPANY's intention to inspect material in accordance with COMPANY standards.
- m)** CONTRACTOR shall provide critical spare parts for the supplied materials / equipment in accordance with SAEP-3101.
- n)** CONTRACTOR shall provide three (3) sets of bounded project record books after completion of the Project as per SAEP-122. The Project record book shall contain all project drawings, Inspection records of construction, Inspection records and Operation/Maintenance manual of materials.
- o)** CONTRACTOR shall provide all Non Material Requirement (NMR-602/603), Operation and Instruction Manuals of materials and Project Record book in electronic format (Acrobat Reader).The table of contents with link shall be provided to view all drawings and documents.
- p)** CONTRACTOR shall carryout site visit inspection along with Loss Prevention Dept. (LPD) representatives to visit the area to assess the difficulty of lifting and working on live and congested space.

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- p) CONTRACTOR shall be responsible for updating all IFC design drawings to include vendor data prior to construction.
- q) CONTRACTOR shall note that the detailed design package was developed without vendor data. CONTRACTOR shall update the design details as required as per NMR's received from Vendor.

## 8.1 SURVEY AND ROUTING

The initial topographic survey has been completed during Project Proposal. CONTRACTOR shall verify the topographic survey of the proposed route on priority basis based on the alignment sheets provided in the design package and start the ground work for construction accordingly. CONTRACTOR shall perform all necessary survey of the intended pipeline route, terrain, grade and vertical profile required to support pipeline construction.

CONTRACTOR shall stake the proposed pipeline route, its related facilities and right of way limits prior to construction per COMPANY standards. CONTRACTOR shall check and verify all dimensions and elevations at each site work location.

CONTRACTOR shall do the reference to all the proposed new facilities with the bench mark of each plant and co-ordinates shall be established accordingly.

**Note:** As per the approved LUP for the JRT-SW pipeline route, the pipeline is crossing the Ras Tanura Highway below the Security Check Point. However, this check point will be relocated under LUP-48379 as confirmed by SAPMT.

## 8.2 RIGHT-OF-WAY (ROW)

CONTRACTOR shall construct the pipeline within the specified pipeline corridor and confine all construction operations within the ROW. CONTRACTOR shall be responsible for conducting all surveys required to determine orientation and true location of existing pipelines and related facilities.

Contractor shall construct new ROW on one side of the pipeline up to KM14.100. From KM-14.100 to 16.262 existing right of way shall be refurbished to use for the new 6" pipeline.

## 8.3 HIGHWAY AND ROAD CROSSING

All pipeline highway/road crossings and plant fence crossings which require

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trenchless installation are identified in the Pipeline Alignment Sheets.

Below explained the road crossing,

SI. NO.	LOCATION	STATION POINT	TYPE OF CROSSING	TYPE OF PIPE
1	JNGL plant fence	0+772.22	Thrust boring	6" RTR with 12" CS sleeve
2	Ju'aymah road	4+360	Thrust boring	6" RTR with 12" CS sleeve
3	Rastanura highway	5+614	Thrust boring	6" RTR with 12" CS sleeve
4	Abdul Aziz street	10+928	Thrust boring	6" RTR with 12" CS sleeve
5	King Saud road	11+776	Thrust boring	6" RTR with 12" CS sleeve
6	Rastanura terminal road	15+916	Thrust boring	6" RTR with 12" CS sleeve
7	Rastanura Plant SSD fence	16+305	Thrust boring	6" CS pipe

All road crossings shall be in accordance with SAES-L-460. Pipe sleeve shall be provided for RTR pipeline at road crossings in accordance with SASD AC-036660.002 and details shown on project drawings.

## 8.4 WELDING

CONTRACTOR shall carry out all welding work in accordance with the latest editions of ASME B31.3 for plant piping and ASME B31.4, API 1104 for pipeline and COMPANY Engineering Standards SAES-W-011 and SAES-W-012. In addition to CONTRACTOR welding procedures, a weld map identifying specific utilization of welding procedures shall be submitted to the COMPANY Representative for approval. In case of conflict between specifications, most stringent conditions apply. Welding procedures shall be submitted to the COMPANY Representative for approval. In case of conflict between specifications, most stringent conditions apply.

**Welding Procedures:** Prior to welding, written welding procedure, qualification, specifications for each welding procedure used shall be submitted to the COMPANY Representative for review and approval in accordance with applicable SA Standards. The CONTRACTOR shall

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comply with SAES-W-012 for pipelines SAES-W-011 for plant piping for welding requirement of metallic piping.

For sour service application, all welding related requirements of NACE MR0175 / ISO 15156 shall be followed. Moreover, for sour service carbon steel welding consumables containing more than 1.1% mass fraction nickel are not acceptable.

## 8.5 PAINTING AND COATING

The summary of work that shall be performed by the CONTRACTOR covered by this scope comprises but not limited to the following:



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- 8.5.1** Painting coating requirement for the various component under this project shall be performed as per project document RE-663796.

**8.5.2** CONTRACTOR shall store, mix and apply painting and coating material in accordance with vendor's recommended practice and as outlined in Saudi Aramco Engineering Standards SAES-H-001, SAES-H-102, SAES-H-002, SAES-H-002V and SAES-H-101V.

**8.5.3** CONTRACTOR shall supply all mixing, cleaning, spray, and other applicable materials and all equipment required to perform painting.

**8.5.4** CONTRACTOR shall also be responsible for providing all instruments and tools required to verify paint dry film thickness.

**8.5.5** CONTRACTOR shall meet all the requirements of with regard to atmospheric conditions prior to painting.

**8.5.6** CONTRACTOR is responsible for cleanup of all paint cans and debris associated with painting at the jobsite at the end of each working day.

**8.5.7** CONTRACTOR is responsible for cleanup and repainting, to the satisfaction of the COMPANY Representative of all overspray or spilled paint.

**8.5.8** Painting and internally / externally coating work including surface preparation shall be done in accordance with SAES-H-001, SAES-H-102, SAES-H-002, SAES-H-101V and SAES-H-002V.

**8.5.9** Above ground carbon steel piping shall be painted in accordance with SAES-H-001.

**8.5.10** All above ground carbon steel in-plant piping including metallic sections of pipeline shall be Internally FBE coated in accordance with APKS-102B of SAES-H-002.

**8.5.11** Underground carbon steel piping shall be externally FBE coated in accordance with APKS-104B of SAES-H-002. Only those coatings approved under APKS-104B with confirmed suitability to exposure in sabkha soil up to a maximum temperature of 90°C (203°F) shall be used.

**8.5.12** CONTRACTOR shall adhere to color-coding as specified in SAES-B-067.

**8.5.13** All metallic pipes used as sleeve for nonmetallic pipe at thrust bore sections shall be externally FBE coated with APKS-104B first layer and APKS-113A top layer in accordance with SAES-H-002. APKS-104B shall be abraded prior to top coating with APKS-113A as per the requirements of SAES-H-002.

**8.5.14** Holiday test shall be performed as per the requirements of SAES-H-002, SAES-H-200, SAES-H-201 AND 12-SAMSS-007.

**8.5.15** All painter and sandblaster shall be certified as per SAEP-316.

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**8.5.16** All structural steel shall be galvanized in accordance with 12-SAMSS-007. If coating on top of galvanizing is required, it shall be in accordance with SAES-H-001

## 8.6 Testing, Pre-Commissioning and Commissioning

- 8.6.1** CONTRACTOR shall prepare all documentation required for the submission of a Partial and Final Mechanical Completion Certificate prior to commencing the Testing, Pre-Commissioning and commissioning of the systems.
- 8.6.2** CONTRACTOR shall provide testing and commissioning assistance including labor, tools and equipment for the performance of all necessary checks, tests, adjustments, repairs and modifications for the final acceptance of facilities.
- 8.6.3** Testing equipment shall be calibrated and certified by a recognized third party testing agency. No valid seals shall be broken.
- 8.6.4** The COMPANY Representative shall witness the pre-commissioning tests.
- 8.6.5** Check for alignment of shaft, levels, proper tightness of bolts, nuts, screws and other support and fastening devices.
- 8.6.6** Functional tests of the complete installation shall be carried out.
- 8.6.7** Proper tools shall be used during installation of equipment.
- 8.6.8** A critical lift plan shall be provided for the review and approval of Loss Prevention Department.
- 8.6.9** CONTRACTOR shall perform the functional test for DCS / ESD Modifications in co-ordination with vendor.

## 8.7 Hydrostatic Testing

- 8.7.1** CONTRACTOR shall Hydrostatically Test Piping in accordance with SAES-L-150, SAES-A-004, SAES-A-007 and project drawings (RA-663795.001/002).
- 8.7.2** Non-Metallic pipeline hydrostatic testing shall be in accordance with SAES-S-070.
- 8.7.3** CONTRACTOR shall provide all material required for Hydrotesting and produce a blind list for operations. He shall also supply all materials for isolating and blinding the piping systems.
- 8.7.4** CONTRACTOR shall contact the COMPANY Project Inspection Department for requirements and approval of a detailed PRE / POST hydrostatic test package and submit procedure to the COMPANY for approval at least 30 days before testing.
- 8.7.5** Hydrostatic Testing shall be witnessed by the COMPANY and CONTRACTOR shall provide complete and detailed record of the

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tests.

- 8.7.6** CONTRACTOR shall provide all the in-line testing materials including but not limited to spectacle plates, blind flanges, temporary gaskets & bolting, caps, plugs, Gauges and other materials/instruments. The CONTRACTOR shall install these materials for Hydrostatic Testing.
- 8.7.7** CONTRACTOR shall provide all the temporary instruments for the Hydrostatic Test, including but not limited to pressure gauges, relief valves which shall be calibrated, inspected and certified prior to testing. The CONTRACTOR shall provide documents certifying that calibration has been carried out by the COMPANY approved testing laboratory not less than 7 days before start of testing.
- 8.7.8** Prior to start of Hydrostatic Testing, CONTRACTOR shall isolate or remove all instrumentation and equipment not included in the Hydrostatic Test. CONTRACTOR shall ensure that all such equipment removed, is not damaged during their removal and storage using approved procedures. CONTRACTOR shall reinstall removed equipment and instrumentation after completion and acceptance of each Hydrostatic Test.
- 8.7.9** CONTRACTOR shall observe all Pressure Testing Safety Precautions per G.I. #0002.102 Checklist for Pressure Testing Safety and shall clear all personnel not involved in the test from the immediate area.
- 8.7.10** CONTRACTOR shall locate and repair leaks and shall retest until no leaks occur. System shall be de-pressurized prior to repairing leaks.
- 8.7.11** CONTRACTOR shall test all existing piping system requiring revalidation due to tie-in weld(s).
- 8.7.12** CONTRACTOR shall do service test at design pressure for utility connections like raw water, air and cooling water.

## 8.8 Commissioning requirement and check

Required Labor and equipment shall be provided by CONTRACTOR whilst commissioning all Mechanical/Electrical Equipment's with below following and not limited activities.

- 8.8.1** Physical Equipment Check: Check all items related to the installation and site before energizing each equipment's including not limited to, all barriers, plates, doors and locks are in place, if use properly installed and each equipment should be grounded.
- 8.8.2** Preparing and Energize the Equipments: Follow all codes and regulations related to servicing and installing each equipment. Failure to follow may result in short circuit and electrical arcing, check all the

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items related to the electrical connections and systems based on manufacturer recommendation before energizing each equipment.

- 8.8.3** While energizing equipment; CONTRACTOR to make sure use of appropriate Personal Protective Equipment (PPE) and follow safe electrical rules and work practices for electrical installations as described in industrial and COMPANY standards and other industrial best practices.
- 8.8.4** Final testing check: All instrumentation of each equipment is working properly and the readings are within specifications levels, check all instantaneous protections that are turndown during previous testing are reset.
- 8.8.5** Commissioning of existing affected loops shall be tested for full functionality prior to start up.
- 8.8.6** In addition to the above requirements, CONTRACTOR shall be responsible for the following:
  - 8.8.6.1** CONTRACTOR shall provide qualified engineers and designers in the relevant disciplines, technical and non-technical staff in sufficient numbers to ensure that the detailed design engineering, procurement and installation of new equipment to meet the CONTRACT Milestone dates and adequately support the CONTRACT completion date.
  - 8.8.6.2** CONTRACTOR shall provide studies, inspection record book, analysis and other activities required to produce detailed design drawings which adequately describe the facilities to be installed and shall result in facilities "fit-for-purpose" and constructed in accordance with all the CONTRACT specifications, standards and referenced industry documents, material specifications, reports, procedures, design and construction schedules which support the Milestone dates and the construction completion date, project record books, as-built drawings & equipment operating and maintenance manuals.
  - 8.8.6.3** All WORK shall be executed as per Saudi Aramco Engineering Standards (SAES), Saudi Aramco Material System Specifications (SAMSS), Saudi Aramco Standard Drawings, Saudi Aramco Drafting Manual, other Saudi Aramco Standards & Specifications and relevant industry standards. Further to the provisions of the CONTRACT documents, CONTRACTOR shall furnish without limitation

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- all facilities, tools, labor, supervision, technical and professional services, material, equipment, testing materials, testing equipment, supplies, startup spares, and shall perform all operations and incidentals required to detail design, procure, deliver, install, construct and test the Project facilities.
- 8.8.6.4 CONTRACTOR shall update drawings by incorporating new facilities and as-built it upon completion. CONTRACTOR shall produce area as-built prior to proceeding with detailed design. The WORK to be performed by CONTRACTOR is the complete detailed design, testing, procurement, construction, installation; pre-commissioning and commissioning of CONTRACTOR provided materials.
- 8.8.6.5 This Package -The documents and drawings attached with this package are the starting point for CONTRACTOR for construction. CONTRACTOR shall review, verify, modify, revise and prepare additional detailed engineering documents and drawings based on site conditions during construction.
- 8.8.6.6 CONTRACTOR shall adjust the work schedule to complete works during Startup / Pre-commissioning and commissioning activities. This could necessitate working more than one shift in one work day during plant shutdown period. This would not entail any change order or any additional compensation for the work during shutdown.
- 8.8.6.7 The scope shown in one drawing or document is considered part of CONTRACTOR's scope even if any other relevant drawings/documents do not cover that item. This Project Scope of Work shall be read in conjunction with project drawings and Contract. In case of conflict between project drawings/documents and Saudi Aramco Standards, the more stringent requirements shall be followed.
- 8.8.6.8 CONTRACTOR shall purchase all Materials, equipment's from Saudi ARAMCO approved vendors only. CONTRACTOR shall conduct review of NMR 601, 602 & 603 for all materials. CONTRACTOR shall supply all tools, tackles, construction equipment; provide temporary works etc. for installation, construction and testing.
- 8.8.6.9 CONTRACTOR shall prepare Material Requisitions and quotation requests as per SAUDI ARAMCO Standards and Procedures for all materials. CONTRACTOR shall not place

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Purchase Order for materials prior to approval of  
COMPANY.

8.8.6.10 All deviations to standards shall be provided to COMPANY for review and resolution. The deviations shall not impact the safety, operability and maintainability of the Materials/Equipment.

8.8.6.11 For Procurement of Materials, CONTRACTOR shall submit minimum three (3) technical quotations for approval by COMPANY. CONTRACTOR shall not purchase materials without written approval from COMPANY. Technical quotations shall list all exceptions and /or, additions to applicable project Drawings and COMPANY Specifications. If there is no exception to specifications, CONTRACTOR shall make a statement to that effect.

8.8.6.12 Inspection and Testing of materials shall be performed as per applicable COMPANY Inspection Requirement form A-175. CONTRACTOR shall arrange with his sub suppliers to comply with these requirements by stating on all sub suppliers' purchase order COMPANY's intention to inspect material in accordance with COMPANY standards.

**8.8.6** CONTRACTOR shall provide critical spare parts for  
CONTRACTOR supplied items in accordance with SAEP-  
3101.

8.8.6.14 CONTRACTOR shall provide Materials Packing and Storage for CONTRACTOR supplied items in accordance with COMPANY standards.

8.8.6.15 CONTRACTOR shall provide three (3) sets of bounded project record books after completion of the Project as per SAEP-122. The Project record books shall contain all project drawings, Inspection records of construction, Inspection records and Operation/Maintenance manuals, vendor drawings & manuals.

8.8.6.16 It will be part of vendor scope to provide technical support and on-site training for all new equipment to the Operators after commissioning.

8.8.6.17 CONTRACTOR shall provide all Non Material Requirement (NMR-602/603), Operation and Instruction Manuals of materials and Project Record book in electronic format (Acrobat Reader). The table of contents with link shall be provided to view all drawings and documents.

#### 8.8.6.18 Critical equipment crane lift plan, requirement for crane for

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lifting and handling of new equipment's. CONTRACTOR has to bring their own lifting equipment to move the equipment's.

8.8.6.19 CONTRACTOR shall identify and outline materials lay down areas for sub-contractor on layout drawings a site location.

## 8.9 Survey Work

CONTRACTOR shall perform the required survey work to include the following:

- 8.9.1** CONTRACTOR shall be responsible for field verification of existing conditions before replacement with equipment's.
- 8.9.2** CONTRACTOR shall be responsible in providing all necessary instruments, replacement specialist engineers, technicians, and labor for the survey in collecting the existing conditions whilst preparation of correct layout/GA drawings/sketches of the project facilities.
- 8.9.3** CONTRACTOR shall implement the recommendations of Value Improvement Practice Sessions conducted during Project Proposal design stage ~~Construction~~ to be completed in accordance with Saudi Aramco Construction Safety Manual (CSM).
- 8.9.4** CONTRACTOR shall not perform any lifting activities when the wind speed is above 30 knots and shall plan for other alternative activities by not affecting the Project schedule and shall not consider this as stand-by time.
- 8.9.5** CONTRACTOR shall prepare one week Look-ahead schedule considering weather forecast for works related to Crane Operation.
- 8.9.6** CONTRACTOR shall transport all demolished material at the designated area assigned by COMPANY representative.
- 8.9.7** CONTRACTOR shall prepare emergency response plan during construction phase for COMPANY approval.
- 8.9.8** CONTRACTOR shall comply with PID and VID requirements of this project.
- 8.9.9** CONTRACTOR will provide well trained COMPANY Certified work permit receiver, Three (3) COMPANY certified work permit receivers that should be present at all times.

## 8.10 Quality Control and Quality Assurance

- 8.10.1** CONTRACTOR shall submit to the COMPANY Representative his initial QA/QC plan within 30 days of contract signature. The plan shall define the policies, objectives and responsibilities for QA in conjunction with action designed to provide and produce consistent

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workmanship which meets the levels of quality required.

**8.10.2** It is the responsibility of CONTRACTOR to comply with all relevant codes, practices, procedures and specifications listed in this Scope of Work.

**8.10.3** CONTRACTOR shall prove the competency of all craftsmen and supervisory staff as required by the COMPANY.

**8.10.4** CONTRACTOR shall provide scaffolding plan and activities.

**8.10.5** QA/QC Documentations shall be maintained and made available to COMPANY representative also including but not limited to:

- a) Welder's qualifications
- b) CONTRACTOR quality control procedures for fabrication, procurement, coating and workmanship.
- c) Material certification.
- d) All test procedures and results.
- e) Any COMPANY approved deviation from governing standards, codes and designated practices.

## 8.11 Studies/Reports and Other Documents Requirements

CONTRACTOR shall conduct and revalidate Value Improvement Practice workshop sessions as per SAEP-367 during Construction which includes but not limited to:

### 8.11.1 Lesson Learn Implementation (LLI) /Lesson Learn Collection (LLC) Workshop session

LLI is a structured approach to the lessons learned from previous projects. It entails a systematic search of COMPANY Project management Lessons Learned knowledge base and the pitfall prevention tool website including other reliable sources to identify lessons learned applicable to a specific project. Subsequently, the project team develops mitigation strategies and action plan and monitor the implementation of action plan. This activity will minimize repeat problems and will build the project on successfully.

LLI workshop has been conducted during detailed design phase to ensure that the beneficial experience form previous projects are captured in this project without redoing the same mistakes or re-inventing the same solutions.

The CONTRACTOR shall perform LLI/LLC at the start of Construction. The CONTRACTOR shall engage COMPANY approved consultant to perform LLI. The LLI study shall address the higher-level issues of projects.

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For the report, refer to deliverables doc no. PE-A10001 (Lessons Learned Report).

### 8.11.2 Project Risk Management (PRM) Workshop session

The CONTRACTOR shall revalidate PRM done during detailed design stage. The Project Risk Management (PRM) deliverable shall provide a way to identify adverse events to which it is exposed and reduce their likelihood or impact. The PRM defines the methodology being applied to identify and mitigate risks and include specific project risks with related mitigation actions and owner (risk register). The CONTRACTOR shall identify risks, capture them in a risk matrix, evaluate the risks qualitatively and quantitatively, develop mitigation actions, assign responsibility for mitigation. The PRM shall be and further evaluated during construction.

For the report, refer to deliverables doc no. PE-A10003 (Project Risk Management (PRM)).

### 8.11.3 Constructability Review Workshop session

**CONTRACTOR** shall perform constructability during Construction stage.

The **CONTRACTOR** shall perform the following:

- Submit a project specific constructability program for COMPANY review & approval.
- Maintain an accurate log that lists constructability issues highlighting the benefits, and schedule / cost impact, if any.
- Implement the Constructability concept of Construction Industry Institute (CII).

Refer to CII publications, as well as COMPANY's database of lessons learned on previous projects. COMPANY will assist the CONTRACTOR, upon request, in accessing such information.

### 8.11.4 Tie-ins and Cut-over Plans Reports

The CONTRACTOR shall perform Tie-ins and Cut-over Plans Reports during detail construction.

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## 8.11.5 ETAP Study

8.11.5.1 ETAP study report (Including Load Flow, Motor Starting and Short Circuit studies) has been performed. For details, refer ETAP Study Report Doc No. RE-663846.

ETAP Report for Arc Flash & Relay Coordination Studies has been performed. For details, refer ETAP Study Report Doc No. RE-663847.

## 8.11.6 EIA Study

CONTRACTOR shall comply with all the recommendation in the EIA report during construction phase.

## 8.11.7 Topo survey

CONTRACTOR shall re-check & perform the Topo Survey for proposed pipeline route.

## 8.11.8 Geo-Tech Report

CONTRACTOR shall utilize the Geo-Tech report **2016/37** prepared during project proposal and recommendations shall be followed during Construction Phase.

## 8.11.9 Underground Radar Survey

CONTRACTOR shall re-check the underground radar survey. If required, perform underground radar survey at location of proposed equipment.

## 9.0 PROJECT DESCRIPTION

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## **9.1 General Requirements**

### 9.1.1 Mechanical

#### 9.1.1.1 General

The Mechanical work shall include but not limited to all necessary work to support and provide complete function of the Facilities. The works shall be carried out in accordance with the applicable Saudi Aramco Engineering Standards (SAES), other Saudi Aramco Standards & Specifications and relevant Industry Codes & Standards.

### 9.1.1.2 Procurement

The detailed technical requirements, scope of supply, applicable Saudi Aramco standards and specifications and applicable industry codes and standards have been specified in individual equipment datasheets and technical specifications. All mechanical equipment shall comply with their respective equipment datasheets and technical specifications.

~~CONSTRUCTION~~ Equipment supplied as per manufacturer standard shall comply with all applicable industry codes and standards.

**CONTRACTOR** shall ensure that selection, design, material, fabrication / manufacturing, testing and inspection, surface preparation and painting, erection, installation, pre-commissioning, commissioning and start-up of mechanical equipment meets the requirements of all applicable latest **COMPANY** standards, specifications and procedures.

In case of conflicting requirements among equipment datasheets, technical specifications, COMPANY standards and specifications and applicable Industry Codes, the most stringent requirement shall be applicable.

Listed below is the general scope of work applicable to all mechanical equipment required for the project.

CONTRACTOR's scope of work for procurement of equipment listed in PD-A70001 shall include but not be limited to the following:

- a) Review all mechanical design and drawings of the bid package, technical bid evaluation and vendor selection. Any change required in the design, arrangement, selection of material and scope of supply shall be the

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responsibility of the CONTRACTOR to be brought to the attention of COMPANY for resolution.

- b) Procure and supply all materials and mechanical equipment required for the project, except those specifically stipulated in schedule "G" of the contract as supplied by COMPANY. Scope will also include equipment shipment (inland and sea transport) from the manufacturer's shop to the designated site.
- c) Fabricate, assemble, erect, install, test, inspect, mechanical completion and pre-commission of all mechanical equipment including all auxiliaries and ancillary equipment required for the Project.
- d) Provide ladders, platforms, and stairways in accordance with COMPANY standards considering acceptable access and egress requirements per SAES-B-054.
- e) Surface preparation, primer, painting, touch up painting including supply of primer and paints as required for all equipment including COMPANY supplied equipment.
- f) Provide short and long term preservation procedures and preserve the supplied equipment for storage at site until installation/pre-commissioning is completed.
- g) Furnish/ obtain from suppliers performance/mechanical guarantee for the equipment wherever required.
- h) Prepare and submit all drawings and documents in prescribed COMPANY formats in accordance with COMPANY procedures for COMPANY review, approval & record.
- i) Perform detailed technical bid evaluation of firm bids received from COMPANY approved manufacturers and select acceptable vendors.
- j) Submit copies of purchase orders (PO) to COMPANY for review, approval & record.
- k) Issue Purchase Orders (PO) to selected vendors, incorporating all changes as agreed during bid evaluations.
- l) Submit vendor data NMR 601, NMR 602, and NMR 603

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to COMPANY PMT for review and comments.

- m) Review and approve vendor data NMR 601, NMR 602, and NMR 603 including comments from COMPANY PMT.
- n) Coordinate with vendors during fabrication phase of the package including design review meetings, pre-inspection meetings, progress meetings and any vendor visits.
- o) Prepare erection and installation procedures, pre-commissioning plan, commissioning and start-up procedures and submit to COMPANY for review & approval.
- p) Prepare operation and maintenance manuals and submit to COMPANY for record in compliance with the requirements of SAEP-122.
- q) ~~ISSUED FOR CONSTRUCTION  
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Hand over all certified final and as-built data (electronic & hard copies) to COMPANY document management system.  
Submit spare part data packages to COMPANY, for approval.
- s) Undertake site visits as necessary to collect the data required to perform the work.
- t) Prepare transportation and rigging plan for critical lifts.
- u) Review and approval of manufacturer's installation, operation and maintenance manuals.
- v) Turn-over all certified final and as-built data to Engineering Drawings Services Division (EDSD) for submission by SAPMT to Saudi Aramco Corporate Drawings Management System.
- w) CONTRACTOR shall also carry out any other required activity not specifically listed above but required for completion of the work.
- x) CONTRACTOR shall procure and supply all equipment, material and services only from COMPANY approved vendor/ supplier.

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## 9.1.1.3 Construction / Installation

CONTRACTOR's construction scope of work for equipment listed in PD-A70001 shall include but not be limited to the following:

- a) Provide a detailed construction procedure and site execution plan including milestones.
- b) Provide quality plan and safety plan in accordance with SAUDI ARAMCO safety manual and inspection schedule.
- c) Provide inspection and test plan including field inspection checklist.
- d) Obtain all necessary permits including hot and cold work permits, confined space entry permits etc. in accordance with COMPANY site requirements.
- e) Perform all site activities including supply of manpower, tool, tackles, scaffolding, cranes, vehicles, consumables, transportation of equipment and supervision for all mechanical equipment and packages up to mechanical completion.
- f) Coordinate with vendors to finalize the shipping arrangement and unloading point at site.
- g) Install mechanical equipment and packages including alignment check in accordance with manufacturer's erection and installation procedure.
- h) Coordinate with vendor to finalize the extent of transportation modules, routing study, and receive prefabricated/modularized components at site assembly yard. Further assembly shall be carried out at site assembly yard prior to erection to minimize site work.
- i) Conduct field welds, field assembly, field NDT and field hydrostatic test, as required.
- j) Surface preparation and equipment touch up paint for damaged area.
- k) Perform pre-commissioning per manufacturer's plan and COMPANY pre-commissioning checklist under vendor supervision.

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- I) Perform mechanical completion (MCC) and turn-over.
- m) Provide assistance during commissioning and start-up of mechanical equipment under vendor supervision.
- n) Provide necessary training to SA operation personnel by vendors/manufacturers, as required.
- o) Site cleaning and obtain site release with approval from COMPANY.
- p) Demobilize the team.

## 9.1.2 Civil/Structural

The Civil works shall include but not limited to all necessary works to support and provide a complete functional facility. The work shall be done in accordance with the latest applicable Saudi Aramco Engineering Standards (SAES) and American Building Code requirements for Reinforced Concrete (ACI), other Saudi Aramco Standards & Specifications and relevant Industry Codes & Standards

**9.1.2.1 The CONTRACTOR** shall plan and execute the work as per Saudi Aramco Procedures and Standards.

**9.1.2.2** The CONTRACTOR shall submit a detailed project execution plan for COMPANY approval prior to the start of work.

**9.1.2.3** The CONTRACTOR shall carry out site surveys to verify actual field conditions, dimensions and elevations, review all design and Vendor drawings and recommendations.

**9.1.2.4** CONTRACTOR shall install temporary barricade during the entire execution stage.

**9.1.2.5** The CONTRACTOR shall provide all the temporary site facilities and offices including PMT offices and shall bear the rent of the land which is to be hired for the purpose. Plot plan of the location showing all the temporary facilities required shall be submitted to PMT and shall get prior approval from PMT.

**9.1.2.6** The CONTRACTOR shall carry out all excavations for foundations and underground facilities as required to complete the works in accordance with SAUDI ARAMCO

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Engineering Standards SAES-A-114 and SAES-Q-005 and shall excavate to the levels and depths specified in the drawings and/or SAUDI ARAMCO Standards

- 9.1.2.7 Care shall be taken to avoid damage to existing underground facilities during excavation work. The CONTRACTOR shall provide protection for the existing underground facilities as per section 5.5.3 of SAES-A-114. This is especially important when crossing other existing pipelines and cables. If CONTRACTOR encounters pipes, cables, concrete or other obstructions not indicated on the drawings, CONTRACTOR shall immediately inform the SAUDI ARAMCO Representative and subsequent construction operations shall continue in accordance with instruction issued by the SAUDI ARAMCO Representative.
- 9.1.2.8 CONTRACTOR shall be responsible for location and protecting all kinds of underground facilities, all kinds of cables, buried facilities by the Saudi Aramco Approved methods whether shown or not in the drawings prior to excavations.
- 9.1.2.9 Excavations shall be limited to the minimum necessary to perform the Work. CONTRACTOR shall obtain approval prior to excavation from Saudi ARAMCO Representative. All excavation shall be hand excavation
- 9.1.2.10 All fill material utilized on this project around and under foundations shall be select fill. The type of fill material and fill compaction shall be in accordance with SAES-A-114. In place density tests shall be performed as directed by the COMPANY Representative to ensure compliance with the compaction requirements.
- 9.1.2.11 CONTRACTOR shall load and haul all sand and marl required for the WORK from a borrow pit approved by SAUDI ARAMCO.
- 9.1.2.12 CONTRACTOR is responsible to locate the borrow pit and get approval from SAPMT.
- 9.1.2.13 CONTRACTOR shall provide, construct temporary access and haul roads. Prior to construct roads CONTRACTOR

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shall obtain written approval from Saudi Aramco of the new routing and type of construction to be used.

9.1.2.14 CONTRACTOR shall locate, get approval from SAPMT and transport ready-mix concrete which shall conform to SAUDI ARAMCO Material Specifications 09-SAMSS-097 and from a source approved by SAUDI ARAMCO Representative. All concrete work shall conform to SAUDI ARAMCO Engineering Standard SAES-Q-001.

9.1.2.15 CONTRACTOR shall supply and ensure that structural concrete as per SAES-Q-001. Exposure condition shall be read in conjunction with geotechnical report file No 2016/37 A minimum compressive strength of 32 Mpa after 28 days shall be obtained unless otherwise specified on the project drawings. Cement shall be Type I cement with micro silica. One set of four (4) test cylinders shall be made for each 50 CU.M. Of concrete or portion thereof, poured on any day. All four test cylinders in a set shall be taken from the same truck load of concrete. These cylinders shall be tested per SAES-Q-001 by SAUDI ARAMCO approved third party Testing Agencies. Test results shall be provided to the SAUDI ARAMCO Representative within 48 hours from the test date.

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9.1.2.16 All concrete reinforcement bars shall be (FBE) Fusion bonded epoxy coated mild steel deformed bars with a minimum yield strength of 60 KSI as per SAUDI ARAMCO Engineering Standard SAES-Q-001 & 09-SAMSS-106.

9.1.2.17 Anchor bolt must be hot-dip galvanized as per SAES-Q-005, Para 4.8 & 12-SAMSS-007, Para 5.2. Anchor bolts in concrete foundations shall be installed per the drawings and shall not touch the reinforcement rebar steel. A minimum clear distance of 100mm from the edge of the concrete to the anchor bolt shall be maintained.

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- 9.1.2.18 All non-shrink grout shall be applied under base plates of equipment and supports in accordance with SAES-Q-010 and manufacturer's recommended procedures. Grout shall be poured in a high fluidity range and shall be free of voids and air pockets. CONTRACTOR shall follow grout manufacturer's recommended procedure precisely.
- 9.1.2.19 Sub-base, aggregate base & asphalt material and compaction shall be in accordance with SAES-Q-006.
- 9.1.2.20 CONTRACTOR shall restore any adjacent facilities damaged such as berm, marl road, asphalt road etc. All existing facilities at the WORK site shall be carefully protected from damage.
- 9.1.2.21 CONTRACTOR shall rectify any marl road damaged during construction/ installation of pipeline at road crossing and construct camel crossings and access road where required.
- 9.1.2.22 CONTRACTOR shall be responsible for obtaining all kinds of Work Permits for all Road crossing activities from Saudi Aramco & related 3rd parties.
- 9.1.2.23 CONTRACTOR shall be responsible to transport all the wastage materials resulted from construction and excess material to Saudi Aramco approved dump site & reclamation yard respectively.
- 9.1.2.24 All co-ordinations with PDD, Operations and other SA departments shall be through SAPMT.
- 9.1.2.25 CONTRACTOR shall take special care to prevent damaging of underground cables (wherever applicable) while excavating for foundations
- 9.1.2.26 CONTRACTOR shall supply and install new Civil /Structural facilities in accordance with Saudi Aramco Standards, procedures and specification to meet project objectives.
- 9.1.2.27 All structural steel fabrication and erection shall comply with the requirements of SAES-M-001, Saudi Aramco Material Specification 12-SAMSS-007, 12-SAMSS-008 and the American Institute Specification for Design, Fabrication and

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Erection of Structural Steel (AISC).

9.1.2.28 All structural steel items shall be galvanized materials as per 12-SAMSS-007, Para 5.2

9.1.2.29 All structural steel material for Wide flange shapes and WT shapes shall be ASTM- A992/ A992M OR ASTM- A572/ A572M. All other structural steel material shapes shall be ASTM -A36/A36M as per 12-SAMSS-007, Para 4.2

9.1.2.30 All structural steel welding shall be in accordance with ANSI/AWS D 1.1/D 1.1M – 2004 “Structural Welding Code for Steel” Skip or stitch welds shall not be made.

9.1.2.31 All existing facilities at the work site shall be carefully protected from damage.

9.1.2.32 CONTRACTOR shall consider dewatering on area applicable as per site conditions during construction.

## 9.1.3 Pipeline Piping

The CONTRACTOR's scope of work shall consist of, but is not limited to the following:

- Procurement, supply, fabrication, testing, installation, inspection and pre-commissioning and commissioning of new piping/pipeline as well as tie-ins and modifications to existing piping and pipe supports as per project drawings.
- CONTRACTOR shall provide and install above grade piping using 6MO material for sour water pumps suction and discharge piping up to the inlet block valve of Hydrocyclone separators.
- CONTRACTOR shall perform all plant piping in JNGLF and RTR in accordance with SAUDI ARAMCO Engineering Standards SAES-L-310, SAES-L-350 and other applicable standards referenced in those standards and as per standards listed in section 11.0. In case of a conflict the more stringent code shall apply. CONTRACTOR shall adhere to all safety standards while carrying out his work

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- d. The non-metallic buried pipeline shall be procured, designed and constructed in accordance with 01-SAMSS-042, SAES-L-620 and SAES-L-650 respectively and manufacturer recommendations and manual.
  - e. Vendor shall conduct stress analysis study on underground 6" RTR pipe and provide locations for thrust anchor.
  - f. Demolition of existing piping or supports wherever required to erect new piping as per project drawings.
  - g. Isolation of existing system piping as required for any tie-ins within the CONTRACTOR'S Scope of Work.
  - h. Cleaning/purging of existing piping system for demolition works.
  - i. Non-destructive testing (NDT) for welds per project drawings.
  - j. Painting and coating of all piping and structural steel supports.
  - k. Preparation of "As-Built" drawings related to this project hard and soft files.
  - l. All other work required which may be required to provide a complete operational facility.
  - m. Installation of scaffolding for isolation of piping and installation of tie-ins.
  - n. CONTRACTOR's scope includes provisional installation of required safety tags.
  - o. Obtain work permits as required.
  - p. Installation of kilometer markers along the pipeline.
  - q. Supervision of any sub-Contractor by the CONTRACTOR.
  - r. Site cleanup.

#### 9.1.3.1 The WORK will be performed in an area inside the plant and

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				e. Vendor shall conduct stress analysis study on underground 6" RTR pipe and provide locations for thrust anchor.									
				f. Demolition of existing piping or supports wherever required to erect new piping as per project drawings.									
				g. Isolation of existing system piping as required for any tie-ins within the CONTRACTOR'S Scope of Work.									
				h. Cleaning/purging of existing piping system for demolition works.									
				i. Non-destructive testing (NDT) for welds per project drawings.									
				j. Painting and coating of all piping and structural steel supports.									
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in the pipeline corridor where there are other operating facilities such as pipelines, piping systems, electric conduits, etc. The CONTRACTOR shall ensure that these process/utilities systems are not damaged by the construction activities.

- 9.1.3.2 Any utilities encountered that causes the interruption of the construction shall be reported to the COMPANY Representative who will give the necessary direction on how to proceed further. Existing utilities damaged during construction shall be repaired and restored by the CONTRACTOR without additional cost to the COMPANY.
- 9.1.3.3 The CONTRACTOR shall provide all necessary vehicles for transportation of personnel, utilities equipment and materials to and from the JOB SITE.
- 9.1.3.4 The CONTRACTOR is responsible for the security and protection of all equipment, tools and materials at the JOB SITE until installation is complete and accepted by COMPANY. The CONTRACTOR shall be responsible for the project both ON-SITE and OFF-SITE including all stock material issued to him for use on this project.
- 9.1.3.5 Materials that are removed from the JOB SITE shall be hauled back to the CONTRACTOR materials yard. Any of these materials left at the end of the job shall be transported to the COMPANY designated yard or stored as directed by the COMPANY Representative.
- 9.1.3.6 The CONTRACTOR shall perform a site survey to fully understand the project facilities to be provided. Particular attention shall be paid to identifying any hidden or underground utilities or any other obstructions encountered during the execution of the project which are not shown in project drawings.
- 9.1.3.7 The CONTRACTOR shall be responsible for verifying all dimensions, angles, and elevations prior to fabrication and installation.

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- 9.1.3.8 The CONTRACTOR shall carry out all WORK in close liaison with the COMPANY Representative and shall coordinate with other CONTRACTORS executing related work at each site to meet the project requirements.
- 9.1.3.9 Where required, all structures under demolition or construction shall be provided with not less than one approved portable fire extinguisher at each stairway on all floor levels where combustible materials have accumulated. An approved portable fire extinguisher shall be provided in every storage and construction shed. The building official is authorized to require additional approved portable fire extinguishers where special hazards exist, such as flammable or combustible liquid storage hazards.
- 9.1.3.10 The CONTRACTOR shall procure and construct non-metallic buried sour water pipeline in accordance with 01-SAMS-042, SAES-L-620, SAES-L-650 and project drawings.
- 9.1.3.11 All piping inside JNGLF Plant and Ras Tanura Refinery shall be procured and constructed in accordance with SAES-L-310, SAES-L-350 and project drawings.
- 9.1.3.12 The in-plant piping for this project will be installed above ground on the supports while the other existing pipes are in operations. The minimum spacing between pipes in plant area shall be in accordance with AC-036207.
- 9.1.3.13 The CONTRACTOR shall be responsible for the location of all field welds.
- 9.1.3.14 The piping material shall be suitable for sour water to provide design service life and shall comply with SAES-L-132 and the requirements of NACE MR-01-75/ISO 15156.
- 9.1.3.15 The welding of piping shall be performed in accordance with SAES-W-011, SAES-W-012 and all the welding related requirements of NACE MR0175/ISO 15156 shall be followed for sour service application.

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9.1.3.16 Vents and drains shall be provided for piping system in accordance with SAES-L-310 and SAES-L-410. The drain connections shall be located more than 600 mm from any support. For vibration service, bracing shall be provided for connections.

9.1.3.17 All above ground metallic CS piping shall be painted in accordance with SAES-H-001 and project coating map document RE-663796.

9.1.3.18 All buried metallic pipeline sections shall be internally and externally FBE coated as per SAES-H-002.

9.1.3.19 The above ground metallic piping shall be internally FBE coated (per SAES-H-002) as per the scope shown in the project drawings.

9.1.3.20 Valves ~~shall comply with SAES-L-108 and valve data sheets provided under this project. The operating platform for valves shall be provided as per SAES-B-054.~~

9.1.3.21 All piping shall be tested in accordance with SAES-L-150, SAES-A-004, SAES-A-007 and project drawings.

9.1.3.22 All flanges, gaskets and bolting shall comply with SAES-L-109. The bolting of flanged joints shall be as per SAEP-351.

9.1.3.23 The existing fire protection system (fire monitors, hydrants and hose reels) is sufficient and shall be used for protection of new sour water pumps and Hydrocyclone separators.

9.1.3.24 Demolition procedures and hydro-test procedures to be developed during construction and submit for review and approval and activities shall commence only approved as per procedures.

9.1.3.25 Specifications for preventative maintenance and storage requirements of specialty items shall be provided.

9.1.3.26 CONTRACTOR shall consider pre-fabricated piping spools with flanges (including gaskets & stud bolts) in the piping in

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order to reduce tie-in shutdown time and in-field hydrostatic testing and any field welding at site. Any additional flanges added shall be procured by the CONTRACTOR without any additional cost to Saudi Aramco.

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9.1.3.27 All pipe supports should be located with coordinates and elevations.

9.1.3.28 The pipeline route as stipulated on the drawings as per approved LUP (LUP #49423) shall be surveyed and staked by the CONTRACTOR. For any changes in the original routing requirement the CONTRACTOR get approval from Saudi Aramco prior to construction.

9.1.3.29 CONTRACTOR shall provide the following information to formulate a Preliminary Master Rigging Plan:

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- a) Plot Plans showing equipment arrangement, access, structures and other obstructions.
  - b) Equipment arrangement and design drawings with center of gravity locations.
  - c) Proposed mode of transportation for major pieces of equipment; i.e. water, highway and delivery schedule.

9.1.3.30 The materials provided in the project detail design document shall be further verified by CONTRACTOR and find out the additional materials required for the completion of the project.

9.1.3.31 CONTRACTOR to provide water for hydro-test and all other construction activities for the project from Saudi Aramco approved source. CONTRACTOR in coordination with Saudi Aramco may dispose the hydro-test water at the existing plant available facilities/evaporation ponds or construct a temporary evaporation pond, if required, and get the location approval from Saudi Aramco as per standard procedures.

9.1.3.32 The CONTRACTOR shall dewater the pipeline in accordance with SAEP-327 Disposal of Waste Water from cleaning, flushing and hydrostatic testing. The CONTRACTOR shall prepare a water disposal plan and

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submit it to Saudi Aramco for approval prior to start of filling.

9.1.3.33 The CONTRACTOR shall construct marl lined temporary evaporation pond(s) in accordance with SAEP-327. Temporary fencing and post guards shall be installed as required to secure the disposal pit(s). The security measures shall remain in place until the water has evaporated. Upon completion of the work, the CONTRACTOR shall demolish the temporary drain ponds and restore the area to its original condition. The number, size and location of ponds shall be determined by the CONTRACTOR and included in the water disposal plan. All piping required for the dewatering system shall be CONTRACTOR supplied.

## 9.1.4 Electrical

This section describes CONTRACTOR's scope of work for procurement, supply, fabrication, installation, testing, inspection, pre-commissioning, assistance to commissioning and start-up of electrical work and packages under this scope.

9.1.4.1 The Electrical work shall include but not limited to all necessary works to support and provide a complete functional facility. The works shall be done in accordance with Saudi Aramco Engineering Standards (SAES), other Saudi Aramco Standards & Specifications, and relevant Industry Codes & Standards and to the satisfaction of Saudi Aramco Representative.

9.1.4.2 All supply, installations, testing & commissioning of equipment & materials under this project shall conform to relevant Saudi Aramco standards & material specifications.

9.1.4.3 CONTRACTOR shall supply, install and test all electrical equipment for a complete operable system as shown in the drawings and specifications.

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- 9.1.4.4 CONTRACTOR shall build samples of typical installation as a model to be inspected and approved to minimize the re-work.
  - 9.1.4.5 CONTRACTOR shall have at the jobsite a responsible Electrical Supervisor, who is skilled in installation, testing, calibration, pre-commissioning, commissioning work and electrical safety.
  - 9.1.4.6 Installation of the electrical equipment shall be carried out in accordance with requirements shown on the project construction drawings and other project documents provided by Saudi Aramco and forming part of the construction contract. Any deviations from contract documents shall be made only after receiving prior written approval from the Saudi Aramco representative.
  - 9.1.4.7 CONTRACTOR to ensure that all engineering purchased tagged equipment such as control panels and junction boxes shall be purchased with identification tags attached.  
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  - 9.1.4.8 CONTRACTOR to make Cable Drum Schedule for ease of cable cutting, cable pulling and cable termination.
  - 9.1.4.9 CONTRACTOR to ensure that all instrument grounding must be connected to an isolated ground system whereas the electrical system grounding shall be connected to a common ground grid.
  - 9.1.4.10 All electrical installation shall meet the electrical area classification in which they are installed as per SAES-B-068.
  - 9.1.4.11 Any penetrations through fire rated walls, floors, ceilings or partitions shall be sealed with fire-stops in accordance with clause 6.1.4 of SAES-B-014 and clause 15.3 of SAES-P-104.

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9.1.4.12 Installation shall follow good engineering practices and shall be in accordance with NFPA-70 and the relevant Saudi Aramco engineering standards, material specifications and standard drawings.

9.1.4.13 CONTRACTOR shall be responsible for transporting, unloading, storing and safeguarding all materials and equipment. He shall provide an efficient stock record system to prevent losses. Any damage to instruments and equipment subsequent to acceptance by CONTRACTOR shall be at the CONTRACTOR's own expense. CONTRACTOR shall ensure that all instruments and materials are stored in a suitable, secure, dry and weather proof structure.

9.1.4.14 CONTRACTOR shall maintain close consultation with Saudi Aramco Maintenance/ Operation department representatives for demolition/ construction to ensure safety and to avoid damage and unnecessary shutdown.

9.1.4.15 CONTRACTOR shall plan and execute the work so that all the existing facilities remain in service, CONTRACTOR shall schedule work activities to avoid shutdown of existing facilities.

9.1.4.16 Before CONTRACTOR leaves the job site, following the completion of construction work, CONTRACTOR shall remove all spoil; scrap debris etc. produced by his construction activities and transport it to approved dumping site.

9.1.4.17 Saudi Aramco reserves the right to have, at all times, Saudi Aramco Representatives who will inspect the work to ensure the quality and progress of all work.

9.1.4.18 CONTRACTOR shall install cable and conduits, fittings in accordance with SAES-P-104 & SAES-J-902 and project construction drawings.

9.1.4.19 All Electrical Installation work shall be carried out in accordance with latest edition of National Electric Code

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(NFPA-70 2017) & applicable Saudi Aramco Standards  
SAES-P-104, SAESP-111 & SAES-J-902.

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- 9.1.4.20 Spare conduit entries of boxes that enclose electrical equipment or devices shall be plugged.
- 9.1.4.21 New Supplementary Ground Grid shall be connected to existing Ground Grid at two connections as per SAES-P-111.
- 9.1.4.22 Conduit to be installed above ground shall meet the requirements of SAES-P-104 Section 8.2.
- 9.1.4.23 Conduits sealing shall be performed in accordance with Section 15 of SAES-P-104.
- 9.1.4.24 The layout drawings indicate the approximate locations of equipment and cable/cable tray/conduit routes. CONTRACTOR shall determine the exact location of each item on site to facilitate safe access for maintenance, avoid interference with piping or other mechanical equipment.
- 9.1.4.25 CONTRACTOR shall support the above ground conduit per article 344-30 & other relevant sections of National Electric Code NEC-2017. The wiring capacity of the conduit shall be in accordance with the NEC-2017. No conduit of less than 3/4" size shall be used in any part of the installation.
- 9.1.4.26 All Direct Buried conduits and fittings shall be PVC coated rigid galvanized steel where-as all above ground conduits shall be Rigid Steel Galvanized.
- 9.1.4.27 All conduits shall be threaded. All threading of conduit connection shall be tapered (NPT). Threads of plugs, conduits, cable glands, etc. shall be lightly lubricated with a rust preventive grease equivalent to Crouse Hinds thread lubricant.

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9.1.4.28 Duct banks with PVC conduit, under areas with frequent traffic, such as road and parking lots inside plant shall be reinforced concrete with a minimum design compressive strength of 28 Mpa or 4000 psi shall be used.

9.1.4.29 The minimum crossing or parallel clearance between direct buried cables, conduits and underground piping shall be maintained as per SAES-P-104 para. 10.13.

9.1.4.30 Cable cleats shall be non-magnetic.

9.1.4.31 The PVC conduits exposed to direct sunlight shall be sunlight or UV resistant. Reference: NEC Article 300.6.C1.

9.1.4.32 CONTRACTOR to ensure that for installation of grounding wire in substation buildings, specifications should permit installation of conduit for grounding wire under the slab with slab penetration inside the building flush with top of slab; the other end of the conduit should penetrate the grade beam just below finished grade

9.1.4.33 CONTRACTOR to ensure that underground Electrical Plan drawings should show the location and elevations of all conduits, cables, ducts, etc., and also any underground piping crossing these underground ducts.

9.1.4.34 CONTRACTOR to ensure that conduit connections to equipment should be flexible as opposed to rigid. Rigid conduit is difficult to align prior to equipment installation and requires more labor and material than flexible conduit to make connections.

9.1.4.35 CONTRACTOR to ensure that conduit stub-ups under raised floors or in termination rooms for instrument wiring should be located near doors when possible to make wire pulling less costly. Avoid stub ups directly under equipment if possible.

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9.1.4.36 CONTRACTOR shall develop Energization Packages of Adjustable Frequency Drives (AFDs) and submit them for proponent review & approval in ample time before energizing the equipment.

9.1.4.37 CONTRACTOR shall develop Energization Packages of newly installed 480V MCCBs in existing 480V MCCs and submit them for proponent review & approval in ample time before energizing the equipment.

9.1.4.38 Separation of power and instrument cables shall meet the requirements of SAES-J-902 Section 14.2.

9.1.4.39 Instrument Grounding for the new field instrumentation, digital and analog junction boxes and instrument cables shall be carried out as per the requirements of SAES-J-902 and SAES-P-111. The new grounding systems shall be interfaced to the existing grounding systems.

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9.1.4.40 CONTRACTOR personnel installing fire stopping or sprayed fire-resistant materials (SFRM) shall be qualified as per CAES-M-100, Sec 701.2.

9.1.4.41 Metallic conduits shall be grounded at both ends.

9.1.4.42 CONTRACTOR shall ensure that all conduits are protected from weather and mechanical damage during storage and installation at site. Conduit openings around cables shall be sealed with duct seal compound.

9.1.4.43 The whole of the conduit installation shall be erected complete, along with associated equipment, inspected, tested for continuity, witnessed and passed by Saudi Aramco Engineer prior to any cables being drawn in. No conduits shall be concealed before inspection and approval by the Saudi Aramco Engineer or Representative.

9.1.4.44 The route and arrangement of all cable trays/conduit runs, positions of equipment, etc., shall be approved by the Saudi Aramco Engineer and shall be generally as shown on the layout drawings. The whole arrangement of cable trays/conduits shall be kept as straight and symmetrical and



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shall comprise a loop-in system from point to point. Cable trays/conduits shall be free from burrs, sharp edges and all other defects.

9.1.4.45 Cable trays shall be copper-free aluminum (aluminum with a maximum of 0.4% copper), or fiberglass. For indoor air conditioned areas galvanized carbon steel is allowed. Cable trays shall be of the ladder (two side-rail) type. Cable tray installed outdoors shall have ventilated covers. Only flanged type covers shall be used and secured with stainless steel (grade 316 in sever corrosive areas and 304 in other areas) banding and fasteners, one band per  $\frac{1}{2}$  m of cover length, with a minimum of six bands per cover. Cable trays run vertically in outdoor areas shall have covers on both sides. Cable tray system shall be used to support cables or raceways only.

9.1.4.46 *Cable trays* shall be designed, manufactured, rated, tested and installed in accordance with NEMA VE 1 and NEMA VE

9.1.4.47 Junction boxes etc. and conduit accessories are to be kept free from the ingress of foreign matter, concrete, plaster etc. A swab shall be drawn through all the conduits before cables are drawn-in. Under no circumstances shall any conduit installation be dismantled for cabling.

9.1.4.48 Cable trays/conduits must have mechanical and electrical continuity across all junctions/joints. All tallow/ cutting compound shall be cleaned from the cable trays/conduit threads to ensure earth continuity.

9.1.4.49 It shall be the responsibility of CONTRACTOR to ensure that all conduits are to be so arranged with draw-in boxes to allow either an easy draw-in or 'out' of any one or all of the conductors run in the conduit. Where bends or sets are required, they shall be made cold from the conduit in the approved standard manner.

9.1.4.50 All work shall be inspected by the Saudi Aramco representative as and when each portion is completed. All

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inspection shall be recorded. The inspection shall include but not limited to the following:

- a. Cable trays installing (prior to pulling of cables)
- b. Conduits installation (prior to pulling of cables)
- c. Sealing (prior to pouring)
- d. Grounding
- e. Termination

9.1.4.51 After the materials have been installed and connections made, CONTRACTOR shall carry out the examinations and test to ensure the work has been properly executed.

9.1.4.52 CONTRACTOR shall physically check all electrical terminations and other fastening devices to ensure that no damage has occurred during installation.

9.1.4.53 CONTRACTOR shall carry out the insulation and continuity checks of all wiring to ensure proper interconnection of all equipment and devices.

9.1.4.54 CONTRACTOR shall durably mark all power cables once installed with heat shrink sleeve type wire markers indicating phase, circuit voltage and conductor number and size.

9.1.4.55 CONTRACTOR shall install grounding system for the electrical equipment, enclosures, conduits and steel structures as required by National Electrical Code and in accordance with Saudi Aramco engineering standard SAES-P-104, SAESP-111 and project drawings.

9.1.4.56 All grounding conductor leaving the equipment to adjacent equipment or grounding plate shall be protected by 25 mm or 38 mm diameter PVC conduit embedded in the concrete and rises up to assigned location as per layout drawings.

9.1.4.57 CONTRACTOR shall ensure that all PVC conduits run for the grounding system are installed prior to the pouring of the concrete.

9.1.4.58 Extreme care shall be taken to avoid damage to existing

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underground facilities. If during excavation CONTRACTOR encounters any pipes, cables, concrete or other obstructions not indicated on the drawings, CONTRACTOR shall then continue in accordance with subsequent instructions from SAUDI ARAMCO Representative. Any damage to existing underground facilities caused by CONTRACTOR or his SAUDI ARAMCO approved Sub-Contractors, shall be promptly corrected to original conditions at no extra cost to SAUDI ARAMCO.

9.1.4.59 CONTRACTOR shall terminate cable with cable glands and termination kits as required, including permanent tags.

9.1.4.60 Instrument cables shall be run in a separate trench and shall not be mixed with electrical power and control cables.

Wherever electrical and instrument cables are routed in the same trench, cable separation requirement between power, control and instrument cables shall be maintained as per SAES-902.

**9.1.4** All electrical installation work shall be carried out in compliance with National Electrical Code (NEC-2017) and applicable Saudi Aramco Engineering Standards SAES-P-104, SAES-P-111, SAES-J-902 and as required by the Project Drawings. Any deviation must first be approved by Saudi Aramco Representative prior to its implementation.

9.1.4.62 All associated electrical materials and work that are required for this project, whether shown or not on the drawings shall be supplied and installed by CONTRACTOR unless specified otherwise. All the necessary equipment/structural support, trenching/excavation, shoring, backfilling and restoration works (to match existing) shall be part of CONTRACTOR's scope.

9.1.4.63 CONTRACTOR shall, as part of his full responsibility and scope, carry out site surveys to verify actual field conditions. CONTRACTOR shall also check all the requirements, aspects and details necessary for coordinating with new or existing systems of electrical works.

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9.1.4.64 CONTRACTOR shall install all the necessary grounding rods, grounding cables, grounding test pit, grounding connections and tie-in to existing grounding grid as necessary.

9.1.4.65 CONTRACTOR shall prepare tie-ins schedule as per project documents and meet the project requirements.  
CONTRACTOR shall verify the location of tie-ins prior to execution.

9.1.4.66 CONTRACTOR shall ensure that all PVC conduits run for the grounding system are installed prior to the pouring of the concrete

9.1.4.67 CONTRACTOR shall test the equipment ground connections to verify a metallic path exists between all the electrical equipment and ground

9.1.4.68 CONTRACTOR shall field test cables in accordance with AES-P-104 for continuity and insulation level

- Prior to backfilling
- Before commissioning

9.1.4.69 CONTRACTOR shall prepare and issue to the Saudi Aramco Representative a signed report covering the test.

9.1.4.70 Power and control cables for electrical equipment being removed or demolished and not intended to be re-used shall be removed. If removal of these cables is deemed impractical by Saudi Aramco representative, both ends of the cables shall be coiled, taped and abandoned in place and cables and conduits shall be labeled at both ends to confirm location and noted on as built drawings.

9.1.4.71 CONTRACTOR shall excavate and backfill the cable trench as per project cable routing drawings. All direct buried cable/trench work shall be carried out in accordance to Saudi Aramco standard drawing AD-036874.

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9.1.4.72 CONTRACTOR shall be responsible for identification and location of all existing below grade services and shall take all necessary precautions to avoid damage to such services during the trenching and backfilling.

9.1.4.73 After compaction of the trench, CONTRACTOR shall install cable route markers in accordance with the project cable routing layouts & Saudi Aramco standards drawings AB-036326 and AB-036273.

9.1.4.74 CONTRACTOR shall provide cable/cable tray/conduit tagging materials engraved and installed in accordance with project detail drawings & Saudi Aramco standard/library drawings. All power cables shall be identified as per SAES-P-104.

9.1.4.75 CONTRACTOR shall inspect all equipment's in accordance with vendor drawings and specifications before the installation and shall advise the Saudi Aramco representative of any inadequacies.

9.1.4.76 Upon completion of the installation, CONTRACTOR shall test the equipment for proper operation in accordance with the vendor instruction and specification such that any obvious inadequacy may be identified and corrected before commissioning.

9.1.4.77 Since during hot summer months, temperature on top of equipment would be very high and CONTRACTOR may need to work during evening and night time to meet project schedule and therefore it is the responsibility of CONTRACTOR to provide portable generator and/or made suitable arrangement for construction lighting for the hazardous area as applicable.

9.1.4.78 CONTRACTOR shall follow all the necessary safety and general precautions including, but not limited to, the following

- Shall obtain necessary work permits to work on and near the vicinity of existing electrical equipment.

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- b) Shall "Lock-out" the disconnecting switches/breakers in "OFF" position while working on the respective downstream electrical circuits.
- c) Shall provide necessary "Hold Tag" on the devices as required by the safety standard/Procedures.
- d) Works shall be carried out very carefully to avoid any damage or impact on the existing devices/ equipment's.
- e) Shall plan and coordinate to minimize the outage period prior to shutdown of circuits for dismantling, relocation and/or connection of devices/ equipment's.
- f) CONTRACTOR shall submit to Saudi ARAMCO a request for inspection for all Electrical works. It is CONTRACTOR scope to insure that all inspections conducted are properly documented and are duly signed by Saudi AAMCO Representative.

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Execute the process of Excavation Request Form as per SAEP-378 Appendix E.2 for all direct burial cables to be installed.

- h) All conduit entries shall have to be done through bottom entry for all junction boxes and panel boards.

9.1.4.79 The project documents and drawings are complementary and are not to be used separately.

9.1.4.80 Specific reference may be made in the following sections of the project scope to sections of these codes, standards and specifications. This does not relieve CONTRACTOR of his obligation to comply with the requirements of all applicable section of codes, standards and specifications. Standards and specifications listed in are not all inclusive; portions of other Saudi Aramco, Industry, National and international Codes shall also be applied as appropriate.

9.1.4.81 All components and accessories required for the completion and successful operation of the WORK covered under the

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OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS, BY DRAWING COMPLETION CERTIFICATE (DCG) NO. <u>10-018610001</u>			
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PROJECT ENGINEER	CERTIFIED	CONSTRUCTION AGENCY	OPERATIONS
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DATE: <u>AUG-2019</u>	DATE: <u>AUG-2019</u>	DATE: <u>AUG-2019</u>	DATE: <u>AUG-2019</u>
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REVISION CERTIFICATION THIS INDICATES THAT REV. NO. <u>00</u>	EDSD VERIFICATION BY <u>JU'AYMAH</u>	CONTROL NUMBER <u>10-018610001</u>	DATE: <u>AUG-2019</u>

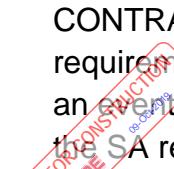
CONSTRUCTION SCOPE OF WORK NARRATIVE	DWG. TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
SOUR WATER PIPELINE - JNGLF TO RT REFINERY	DOC	R83	A	RE-663716	62 OF 125	00
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scope of this PROJECT, either specified in detail or not, shall be engineered, tested, manufactured, supplied and installed by CONTRACTOR as necessary based on SA Standards. Contract price should include all these.

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CONSTRUCTION AGENCY	AOO	OPERATIONS
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DATE: <u>AUG-2019</u>	DATE: <u>AUG-2019</u>	DATE: <u>AUG-2019</u>
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DESCRIPTION	ENG	CERT
JO/EWO	PMT	OPRNS
ISSUED FOR CONSTRUCTION	MAT	AOO
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9.1.4.82 The engineering and specification of equipment/materials supplied under this PROJECT shall be in accordance with this Project Scope and Technical Specifications and SA Standards. If the equipment/material either does not conform with specifications or is not acceptable to SA based on past operating experience/any other reason, CONTRACTOR shall propose alternative equipment/material for review and acceptance by SA. However, in case of a conflict in the requirements, CONTRACTOR shall bring this to the attention of the SA and shall obtain approval of such applicable requirements for this PROJECT in writing from the SA. CONTRACTOR shall have no right to decide on his own the requirements in case of such a conflict, and in case of such an eventuality, he will be doing so at his own risk and cost as the SA reserves the right to reject any or the complete part of such work arising out of CONTRACTOR's own decision.



9.1.4.83 All design parameters and materials to be used in this project shall be in conformity with the applicable Saudi Aramco Standards and SAMSS respectively.

9.1.4.84 CONTRACTOR shall arrange pre-execution meeting as walkthrough with SA operations to understand the project requirement and shall be addressed in cut over as well as execution plan.

9.1.4.85 All metalwork that is part of electrical equipment or associated with wiring systems must be connected to grounding system as per SAES-P-111. Equipment grounding conductors will be positioned against equipment foundation to avoid exposure to damage or to ensure that they do not constitute tripping hazard.

9.1.4.86 The bending radius of the cable will not be less than 12 (twelve) times its overall diameter.

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## 9.1.5 Instrumentation

# **Demolition Work.**

- #### 9.1.5.1 Reference Demolition Drawings.

Demolition P&ID : NA-B45155-026A.

Demolition P&ID : NA-B45155-031A.

Demolition P&ID : NA-B45155-032A.

Demolition ILD : RB-103917-001.

Demolition ILD : RB-103917-001A.

Demolition ILD : RB-103917-002A.

- 9.1.5.2 CONTRACTOR shall remove existing H2S Detector 78-AT-2015A (North Side of Pump G-791A) and associated Field Cable IC-4031 between the H2S Detector and existing Junction Box 220-E97-EJB1.

- 9.1.5.3 CONTRACTOR shall remove existing H2S Detector 78-AT-2015B (South Side of Pump G-791B) and associated Field Cable C-4035 between the H2S Detector and existing Junction Box 220-E97-EJB1.

- ~~ISSUED  
KERN~~ 9.1.5 CONTRACTOR shall remove all existing instrumentation and cables and control loops associated with existing Spent Water Pumps R84-G-791A, B & C.

- 9.1.5.5 CONTRACTOR shall remove the following instrumentation and cables associated with Sour Water Degassing Drum (R84-D-**792**):

- a) 78-FE and FI-441.
  - b) 78-TW and TG-454.
  - c) 78-TW and TS-410.
  - d) 78-FE, FT, FIC & FCV-448
  - e) 78-PT, PIC, PY & PCV-421.
  - f) 78-PG-477.
  - g) 78-LS-425 & UC-442.
  - h) 78-FE, FT and FI-449.

- 9.1.5.6 CONTRACTOR shall supply and install all required instrument and control systems in compliance with project documents and drawings and COMPANY MASER (cut-off date July 2017).

## Reference Demolition Drawings

P&ID: NA-B45155-026A.

P&ID: NA-B45155-031A.

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P&ID: NA-B45155-032A.  
ILD: RB-103917-001.  
ILD: RB-103917-001A.  
ILD: RB-103917-002A.

## **Construction Work**

- 9.1.5.7 All field instruments shall be supplied from COMPANY approved vendors and COMPANY approved model numbers (i.e. from COMPANY 9COM list).

9.1.5.8 CONTRACTOR shall remove existing H2S Detector 78-AT-2015A (North Side of Pump G-791A) and associated Field Cable IC-4031 between the H2S Detector and existing Junction Box 220-E97-EJB1

9.1.5.9 All Instrument cables shall be procured in compliance with 34-SAMSS-913 and installed and terminated in compliance with Project documents and drawings and in compliance with the relevant MSAER. CONTRACTOR shall remove existing H2S Detector 78-AT-2015B (South Side of Pump G-791B) and associated Field Cable IC-4035 between the H2S Detector and existing Junction Box 220-E97-EJB1. CONTRACTOR shall remove all existing instrumentation and cables and control loops associated with existing Spent Water Pumps R84-G-791A, B & C.

9.1.5.10 All Instrument testing and pre-commissioning/commissioning shall be performed by CONTRACTOR and witnessed by COMPANY. CONTRACTOR shall complete all instrument loop checks and functionality checks in the presence of the relevant COMPANY representatives who shall sign-off the associated approval certificates.

CONTRACTOR shall remove the following instrumentation and cables associated with Sour Water Degassing Drum (R84-D-792)

- a) 78-FE and FI-441
  - b) 78-TW and TG-454
  - c) 78-TW and TS-410
  - d) 78-FE, FT, FIC & FCV-448
  - e) 78-PT, PIC, PY & PCV-421
  - f) 78-PG-477

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- g) 78-LS-425 & UC-442  
 h) 78-FE, FT and FI-449  
 i) 78-LS-412

9.1.5.11 CONTRACTOR shall provide all necessary wiring and cross wiring and this shall be supplied and installed in accordance with SAES-J-902.

9.1.5.12 CONTRACTOR shall visit site and analyze the possibility of cost / time saving via installing similar size new stand pipes with necessary provision for installing new instruments in caustic degassing drum and sour water degassing drum prior to modifying or dismantling the existing stand pipe.

9.1.5.13 CONTRACTOR shall supply and install all instruments in accordance with the Project drawings and documents, MSAER (Mandatory Saudi Aramco Requirements & cut-off date March 31st 2017), the latest revisions of relevant International codes, standards and specifications and any specification instrument vendor installation/warranty/guarantee requirements.

9.1.5.14 CONTRACTOR shall ensure that all Instrument impulse tubing runs are adequately supported and protected from mechanical damage and vibration as per the MSAER and good engineering practice.

9.1.5.15 All underground installations shall use PVC coated conduits and fittings.

9.1.5.16 Installation of electrical equipment in hazardous locations shall comply with the NEC-2017 (National Electric Code NFPA 70) and methods of protection shall be marked and shall be in compliance with NEC Article 505 requirements.

9.1.5.17 All electrical connections and entries shall comply with requirements of SAES-J-902.

9.1.5.18 Power Cables shall be 0.6kV/1kV (1.2kV) – Cu/XLPE/PVC.

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REVISION CERTIFICATION	THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS. BY DRAWING COMPLETION CERTIFICATE DCCN NO. 10-018610001	DATE:				

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9.1.5.19 CONTRACTOR shall install all underground cable and conduit in accordance with Saudi Aramco Standard drawing AD-036874 and installation of direct buried cable & conduit as per SAES-P-104.

9.1.5.20 CONTRACTOR shall mount instruments and junction boxes and route instrument tubing, cables, cable tray and conduit to provide safe and good access and egress for operations and maintenance activities and to minimize the risk of damage if tools or equipment are accidentally dropped.

9.1.5.21 Field instruments shall be installed as near to the point of control as practicable and shall be easily accessible from ground floor level, walkways or permanent access platforms.

9.1.5.22 CONTRACTOR shall use Instrument tubing bends where practicable to reduce the number of tube fittings in accordance with good construction practices and instrument tubing shall be cut using proprietary tube cutters and all rough sharp edges/ends removed.

9.1.5.23 The CONTRACTOR shall develop Loop packages for all the I/O loops and these package contents shall be agreed and approved by the project instrument engineer prior to Loop check. Moreover a hardcopy of all the loop packages shall be available in CCR for loop checks.

9.1.5.24 Project document controller shall ensure than any changes that occur during loop checks are red-lined in the master drawing immediately.

9.1.5.25 Signed off and approved loop packages shall be requirement for PSSR (Pre-startup safety review)

9.1.5.26 CONTRACTOR shall arrange for an integrated FAT for the ESD &DCS system replicating the existing control at JNGLF. They shall arrange to rent all the other DCS components required to ensure a fully functional DCS/ESD testing.

9.1.5.27 All installation of electrical/electronic equipment in hazardous areas shall be in accordance with the requirements of NEC-2017, NEMA, ICS 6, NEMA 250 and IEC 144.

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- 9.1.5.28 All cable shall be direct buried and shall withstand high corrosive & salinity environment.
- 9.1.5.29 CONTRACTOR shall supply and install all required hardware (whether or not listed in the material take off lists) which is required to complete the work to the total satisfaction of COMPANY.
- 9.1.5.30 CONTRACTOR shall ensure that all field instrument information is available at the associated (J87/R84) CCRs.
- 9.1.5.31 CONTRACTOR shall supply and install all necessary field instruments, junction boxes and cables required for the project and shall provide all necessary associated design, engineering, fabrication, procurement, configuration, programming, integration, inspection, testing, pre-commissioning, commissioning, performance verification and documentation activities.
- 9.1.5.32 Project document controller shall ensure than any changes that occur during loop checks are red-lined in the master drawing immediately.
- 9.1.5.33 CONTRACTOR shall arrange for an integrated FAT for the ESD &DCS system replicating the existing control at JNGLF. They shall arrange to rent all the other DCS components required to ensure a fully functional DCS/ESD testing.
- 9.1.5.34 CONTRACTOR shall arrange for an integrated FAT for the ESD &DCS system replicating the existing control at JNGLF. They shall arrange to rent all the other DCS components required to ensure a fully functional DCS/ESD testing.
- 9.1.5.35 CONTRACTOR shall provide signed off and approved loop packages shall be requirement for PSSR (Pre-startup safety review)

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<b>CONSTRUCTION AGENCY</b> AOO  DATE: AUG-2019								
<b>OPERATIONS</b> AAA  DATE: AUG-2019								
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9.1.5.36 CONTRACTOR shall develop Loop packages for all the I/O loops and these package contents shall be agreed and approved by the project instrument engineer prior to Loop check. Moreover a hardcopy of all the loop packages shall be available in CCR for loop check

9.1.5.37 CONTRACTOR shall provide the services of all necessary expert engineers and Vendor Representatives at site during installation, testing, pre-commissioning, commissioning and performance verification activities.

9.1.5.38 CONTRACTOR shall supply, install and wire a new H2S Detector (R84-AIT-2015A) on the North Side of Pump R84-G-785A and associated AWG 16 Triad Field Cable (IC-4031) between the H2S Detector and existing Junction Box 220-E97-EJB1.

9.1.5.39 CONTRACTOR shall supply, install and wire a new H2S Detector (R84-AIT-2015B) on the South Side of Pump R84-G-785B and associated AWG 16 Triad Field Cable (IC-4035) between the H2S Detector and existing Junction Box 220-E97-EJB1.

9.1.5.40 CONTRACTOR shall procure, install and wire two new H2S Detectors (78-AT-2015A & B) and associated one triad Instrument Cables (IC-4031 & 4035) and connect these to existing Junction Box 220-E97-EJB1. Refer to JB Instrument Interconnection Diagram NB-53816-019 and ILDs RB-103917 Sheets 001 & 002 for further information.

9.1.5.41 CONTRACTOR shall procure an Orifice Plate (R84-78-FE-0562) and install it in the line to the Hydrocyclone Separators (4 INCH-SOW-9433-1LE0P06). CONTRACTOR shall procure, install and wire a DP Transmitter (R84-78-FIT-0562) and connect it to the existing DCS via a new CONTRACTOR supplied Junction Box (R84-78-AJB-1001) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0001) and onward to the DCS via a CONTRACTOR supplied AWG 18 six pair Homerun Cable (IC-0041). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-001 for further information.

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9.1.5.42 CONTRACTOR shall procure an Orifice Plate (R84-78-FE-0561) and install it in the Sour Water Transfer Pump Discharge Header line (4 INCH-SOW-9426-1LE0P06). CONTRACTOR shall procure, install and wire a DP Transmitter (R84-78-FIT-0561) and connect it to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1001) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0003). CONTRACTOR shall procure and install a pneumatic Minimum Flow Recycle Control Valve with SMART Valve Positioner (R84-78-FV and FY-0561) and connect it to the new CONTRACTOR supplied Junction Box (R84-78-AJB-10001) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0003). R84-78-FIT and FY-0561 shall be connected to the DCS via a CONTRACTOR supplied AWG 18 six pair Homerun Cable (IC-0041). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-002 for further information.

9.1.5.43 CONTRACTOR shall procure an Orifice Plate (R84-78-FE-0563) and install it in the SOW Transfer Pump Recycle line (4 INCH-SOW-9435-1LE0P06) and connect it to a CONTRACTOR procured, installed and wired DP Transmitter (R84-78-FIT-0563) and connect it to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1001) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0004). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-001 for further information.

9.1.5.44 CONTRACTOR shall procure a Thermowell (R84-78-TW-0471) and install it in the existing one inch N15 Nozzle in the Sour Water Degassing Drum (R84-D-792). CONTRACTOR shall procure and install an RTD (R84-78-TE-0471) and install it in R84-78-TW-0471. CONTRACTOR shall procure and install an AWG 16 RTD Triad Cable (IC-0006) and connect it to RTD (R84-78-TE-0471) and a CONTRACTOR supplied and installed Temperature Transmitter (R84-78-TIT-0471) and connect it to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1003) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0005). R84-78-TIT-0471 shall be connected to the DCS via a CONTRACTOR supplied AWG 18 twelve pair Homerun

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CONSTRUCTION AGENCY AOO	DATE: AUG-2019
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Cable (IC-0042). CONTRACTOR shall procure and install a pneumatic Temperature Control Valve with SMART Valve Positioner (R84-78-TV and TY-0471) and connect it to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0007). R84-78-TIT and TV-0471 shall be connected to the DCS via a CONTRACTOR supplied AWG 18 twelve pair Homerun Cable (IC-0042). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-004 for further information.

9.1.5.45 CONTRACTOR shall procure, install and wire a Local Level Indicator (R84-78-LI-0840) and a GWR Level Transmitter (R84-78-LIT-0840) on the Sour Water Degassing Drum (R84-D-792) and connect them to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1003) via two CONTRACTOR supplied one pair AWG 16 Instrument Cables (IC-0008 & 0009) and connect onward to the DCS via a CONTRACTOR supplied AWG 18 twelve pair Homerun Cable (IC-0042). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-005 for further information.

9.1.5.46 CONTRACTOR shall procure, install a GWR Level Transmitter (R84-78-LIT-0424) on the Sour Water Degassing Drum (R84-D-792) and connect them to a new CONTRACTOR supplied Junction Box (R84-78-ESD-AJB-1008) via CONTRACTOR supplied one pair AWG 16 Instrument Cables (IC-0034) and connect onward to the ESD via a CONTRACTOR supplied AWG 18 twelve pair Homerun Cable (IC-0065). Refer to Instrument Block Diagram RA-663740-002 for further information.

9.1.5.47 CONTRACTOR shall procure, install and wire a Local Level Indicator (R84-78-LI-0841) and a GWR Level Transmitter (R84-78-LIT-0841) on the Caustic Degassing Drum (R84-D-784) and connect them to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1003) via two CONTRACTOR supplied one pair AWG 16 Instrument Cables (IC-0010 & 0011) and connect onward to the DCS via a CONTRACTOR supplied AWG 18 twelve pair Homerun Cable (IC-0042). Refer to Instrument Block Diagram RA-663740-001 and ILD

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RB-663764-006 for further information.

**9.1.5.48** CONTRACTOR shall procure, install a GWR Level Transmitter (R84-78-LIT-0412) on the CAUSTIC Water Degassing Drum (R84-D-784) and connect them to a new CONTRACTOR supplied Junction Box (R84-78-ESD-AJB-1008) via CONTRACTOR supplied one pair AWG 16 Instrument Cables (IC-0034) and connect onward to the ESD via a CONTRACTOR supplied AWG 18 twelve pair Homerun Cable (IC-0065). Refer to Instrument Block Diagram RA-663740-002 for further information.

**9.1.5.49** CONTRACTOR shall procure, install and wire a Differential Pressure Transmitter (R84-78-PDIT-0956) across the Hydrocyclone Separators (R84-D-0953A & B) and connect it to a new CONTRACTOR supplied Junction Box (R84-78-AJB-1003) via a CONTRACTOR supplied one pair AWG 16 Instrument Cable (IC-0012) and connect onward to the DCS via CONTRACTOR supplied AWG 18 twelve pair Homerun cable (IC-0042). Refer to Instrument Block Diagram RA-663740-001 and ILD RB-663764-007 for further information.

**9.1.5.50** If there are insufficient spare DCS/ESD I/O channels, CONTRACTOR shall procure, install and wire new ones.

## 9.1.6 Telecommunication

CONTRACTOR shall provide the following communication facilities for CONTRACTOR temporary facility.

**9.1.6.1** CONTRACTOR shall be responsible for all work for this project unless otherwise specified.

**9.1.6.2** CONTRACTOR shall be responsible for obtaining all Saudi Aramco Work Permits and all Non-Saudi Aramco Work Permits required for the execution of the WORK, SAUDI ARAMCO shall provide assistance with obtaining Government or other agencies permits, as needed.

**9.1.6.3** Prior to the start of any excavation work by machine, all

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CONSTRUCTION SCOPE OF WORK NARRATIVE		DWG. TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.						
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underground facilities including oil, gas and/or water pipes, telephone or power cables shall be positively identified in the field by hand digging, visually verified by SA (Saudi Aramco), the operating department of the concerned agency for Saudi Aramco or Non-Saudi Aramco Facilities.

- 9.1.6.4 Extreme caution shall be taken when crossing all cables especially Government cables, in consideration of their importance and the levy of large fines for accidental cutting of the cable. Any fines shall be strictly CONTRACTOR'S responsibility.
- 9.1.6.5 When unexpected utility lines are discovered, CONTRACTOR shall immediately notify Saudi Aramco SA Representative for determination of utility "owner".

## 9.2 Demolition Work

### 9.2.1 Mechanical Ju'aymah NGL Fractionation Plant (JNGLF)

- 9.2.1.1 CONTRACTOR shall demolish three (3) existing Sour water transfer pumps (R84-G-791A/B/C) as shown in the project demolition drawings.

#### Reference drawings

Demolition P&ID : NA-B45155.032A  
 Demolition Plot Plan : NA-B44918.001A

### 9.2.2 Civil/Structural

#### 9.2.2.1 Juaymah NGL Fractionation Plant

- a) CONTRACTOR shall demolish the existing concrete paving to accommodate the new foundations as per drawings NA-B55356-001.
- b) CONTRACTOR shall demolish the existing foundation for pumps R84-G-791A and B as per drawings NA-B55356-001.
- c) CONTRACTOR shall demolish the existing catch basin

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and shall relocate the underground piping and provide new catch basin.

- d) Contractor shall make demolition in the existing platform in order to accommodate level transmitter. The demolition will be mainly but not restricted to grating.

### 9.2.3 Piping

## Ju'aymah NGL Fractionation Plant (JNGLF)

- 9.2.3.1 CONTRACTOR shall demolish the existing Sour water transfer pumps (R84-G-791A/B/C) including all connected piping up to the extent shown in the project demolition drawings.
  - 9.2.3.2 CONTRACTOR shall remove the existing cylinder rack adjacent to the area in order to accommodate the new Hydrocyclone separators and make access to existing equipment in that area.

Demo. P&ID: Caustic Degassing Drum NA-B45155 Sh.031A  
Demo. P&ID: Sour Water Degassing NA-B45155 Sh. 032A  
Demo. Plot Plan: Rerun Area NA-B44918 Sh. 001A  
Demo. Piping Plan: Sour WTR Transfer NA-B50661 Sh. 001A

#### 9.2.4 Electrical

- 9.2.4.1 The Spent Water Pump Motor R84-GM-791C shall be demolished. Power and control cable associated with this pump shall also be demolished and removed but if demolition becomes impractical for the buried portion of cables associated with this pump, these shall be abandoned in place.

Refer drawing no. NA-B53759.006 Rev. 02A

- 9.2.4.2 The Spent Water Pump Motor R84-GM-791A shall be demolished. Power and control cable associated with this pump shall also be demolished and removed but if demolition becomes impractical for the buried portion of

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cables associated with this pump, these shall be abandoned in place.

Refer drawing no. NA-B53759.003 Rev. 10C

- 9.2.4.3 The Spent Water Pump Motor R84-GM-791B shall be demolished. Power and control cable associated with this pump shall also be demolished and removed but if demolition becomes impractical for the buried portion of cables associated with this pump, these shall be abandoned in place.

Refer drawing no. NA-B53759.004 Rev. 07B

## 9.2.5 Instrumentation

### JU'AYMAH (R84)

#### Demolition:

#### Reference Drawings:

- NA-B45155.032 Demo. Piping & Instrumentation Drawings  
NA-B45155.031 Demo. Piping & Instrumentation Drawings

- 9.2.5.1 For all the instruments that are demolished, the CONTRACTOR shall coordinate with DCS vendor to delete all the configuration including schematic and reports in the DCS system.
- 9.2.5.2 For all the instruments that are demolished, the CONTRACTOR shall coordinate with DCS vendor to delete all the configuration including schematic and reports in the PI system (both corporate & local PI).
- 9.2.5.3 For all the instruments connected to ESD system that are demolished, the contractor shall delete all the configuration including bypasses in the ESD system.
- 9.2.5.4 CONTRACTOR shall all the associated cables along with the fittings up-to the junction box for instruments that are to demolish as per demolition drawings.
- 9.2.5.5 For all the instruments that are demolished, the

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9.2.5.17 CONTRACTOR shall disconnect the existing gas detector AIT-2015A & AIT-2015B and replace with new to the new pump area.

9.2.5.18 CONTRACTOR shall demolish the existing cables between existing gas detector AIT-2015A & AIT-2015B and existing junction box.

9.2.5.19 CONTRACTOR shall demolish the existing flow control valve FCV-448 with associated its cables located at existing recycle line.

9.2.5.20 CONTRACTOR shall demolish the existing flow element, indicator & transmitter FE/FI/FIT-449 with associated its cables located at existing recycle line.

## 9.2.6 Telecommunication

No Demolition work is anticipated.

## 9.3 Project Requirements – New Work

### 9.3.1 Mechanical

9.3.1.1 CONTRACTOR shall provide and install two (2) Hydro Hydrocyclone Separator Unit (R84-D-0953A/B).

Reference Drawings:

P&ID	RA-663723-001
Plot Plan	RA-663791-001
Technical Specification	PE-A70003
Data Sheet	RD-663734
Data Sheet	RD-663736
Data Sheet	RD-663737

9.3.1.2 CONTRACTOR shall provide and install two (2) Sour Water Transfer Pumps (R84-G-0957A/B) with Adjustable Frequency Drive (AFD), motors and associated accessories.

Reference Drawings:

P&ID	NA-B45155-032
Plot Plan	RA-663791-001

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BY DRAWING COMPLETION CERTIFICATE					
DCG NO. 10-018610001					

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JU'AYMAH

SAUDI ARABIA

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## SAUDI ARABIAN OIL COMPANY

Technical Specification PE-A70002  
 Data Sheets RE-663735  
 RE-663842

## 9.3.2 Civil/Structural

## 9.3.2.1 Juaymah NGL Fractionation Plant

- a) CONTRACTOR shall provide foundations for the new pumps which shall involve but not limited to excavation and backfilling as per drawings:  
 RA-663820-001  
 RA-663824-001
- b) CONTRACTOR shall provide foundations for the new Hydrocyclone separator which shall involve but not limited to excavation and backfilling as per drawings:  
 RA-663820-001  
 RA-663824-001
- c) CONTRACTOR shall provide foundations for the new pipe supports which shall involve but not limited to excavation and backfilling as per drawings:  
 RA-663820-001  
 RA-663821-001  
 RA-663822-001  
 RA-663823-001
- d) CONTRACTOR shall provide concrete anchor thrust block for the new proposed pipe which shall involve but not limited to excavation and backfilling as per drawing:  
 RA-663825-001 & RA-663828-001
- e) CONTRACTOR shall relocate the catch basin and associated underground pipes to accommodate the proposed pipe support foundations and other equipment foundations.
- f) CONTRACTOR shall reinstate the paving to original condition after construction of proposed foundation by

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CONSTRUCTION SCOPE OF WORK NARRATIVE	DWG. TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
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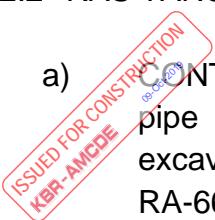
# SAUDI ARABIAN OIL COMPANY

following Saudi Aramco standards not limited to backfilling and concreting.

- g) CONTRACTOR shall provide structural pipe supports for proposed new 4 inch pipe as per the piping plan, which shall but not limited to providing structural steel, fabrication and installation.
- h) CONTRACTOR shall provide structural supports for proposed Hydrocyclone filter as per the piping plan, which shall but not limited to providing structural steel, fabrication and installation.
- i) Contractor shall provide supports for level transmitter by providing supports in the platform.

### 9.3.2.2 RAS TANURA REFINERY

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CONSTRUCTION AGENCY					
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- a) CONTRACTOR shall provide foundations for the new pipe supports which shall involve but not limited to excavation and backfilling as per drawing:  
RA-663826-001 & 002  
RA-663827-001
- b) CONTRACTOR shall provide structural pipe supports for new pipe on the existing pipe rack at certain locations as per the piping plan which shall but not limited to providing structural steel, fabrication and installation.
- c) All pipe support shall be constructed as per piping drawings. CONTRACTOR shall ensure that all pipe supports to be constructed shall be in reference to that shown on piping drawings. This will also involve bit limited to excavation, backfilling etc.

### 9.3.3 Piping / Pipeline

#### Ju'aymah NGL Fractionation Plant (JNGLF)

All piping inside JNGLF plant shall be constructed in accordance with

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## SAUDI ARABIAN OIL COMPANY

SAES-L-350.

CONTRACTOR shall design, supply, install, pre-commissioning and commissioning of Sour Water Transfer system piping at Rerun Area of JNGLF in accordance with applicable Saudi Aramco and industrial standards. The facility shall have the following piping installation but not limited to:

- 9.3.3.1 CONTRACTOR shall provide and install suction piping 4"-SOW-9421/9422/9423-1SV0P02 from the existing Sour Water Degassing Drum (R84-D-792) to the new Sour water transfer pumps (R84-G-0957A/B).
- 9.3.3.2 CONTRACTOR shall provide and install piping 6"-SOW-9431-1SV0P02 from the existing Caustic Degassing Drum (R84-D-784) outlet header (@ Tie-in 06A/B) to the new Sour Water Transfer Pumps (R84-G-0957A/B). And modify existing 10"-C-7232-1A1 suction piping.
- 9.3.3.3 CONTRACTOR shall provide and install discharge piping 4"-SOW-9424/9435/9433-3SV0P02 from the new Sour Water Transfer Pumps (R84-G-0957A/B) to the new Hydrocyclone Separators (R84-D-0953A/B).
- 9.3.3.4 CONTRACTOR shall provide and install minimum flow recycle piping 2"/3"-SOW-9426/9434-3SV0P02, 2"-SOW-9435/9432-1SV0P02 from the new Sour Water Transfer Pumps (R84-G-0957A/B) to the existing Sour Water Degassing Drum (R84-D-792) at tie-in #004A/B and Caustic degassing drum (R84-D-784) at tie-in #005A/B.
- 9.3.3.5 CONTRACTOR shall provide and install by-pass line 4"-SOW-9437-1LE0P06 for new Hydrocyclone Separators (R84-D-0953A/B).
- 9.3.3.6 CONTRACTOR shall provide and install 4" above ground internally FBE coated piping 4"-SOW-9429-1LE0P06 from the Rerun area (new Hydrocyclone Separators location) to the existing RTJ pipeline corridor. The pipe will be routed in the existing E/W pipe-way.
- 9.3.3.7 CONTRACTOR shall provide cooling water piping 1"/2"-W-

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DISCIPLINE ENGINEER MAK	DATE: AUG-2019
PROJECT ENGINEER MAT	DATE: AUG-2019
CERTIFIED AOO	DATE: AUG-2019
CONSTRUCTION AGENCY AOO	DATE: AUG-2019
OPERATIONS AAA	DATE: AUG-2019
REV. NO. <u>00</u>	DATE: 10-01861 10-018610001
CERTIFICATION NUMBER BY: _____ DATE: _____	ISSUED FOR CONSTRUCTION KBR-AEDEA 08-Oct-2019

CONSTRUCTION SCOPE OF WORK NARRATIVE SOUR WATER PIPELINE - JNGLF TO RT REFINERY JNGLF/RTR PLANT	DWG. TYPE DOC	PLANT NO. R83	INDEX A	DRAWING NO. RE-663716	SHT.NO. 80 OF 125	REV.NO. 00
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CONSTRUCTION AGENCY AOO	DATE: AUG-2019	DATE	DATE
OPERATIONS AAA	DATE: AUG-2019	PMT	PMT
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20312/20313-1BD0U from existing line 2"-W-7001-1A1D (@ tie-in # 013A/B) to new sour water pumps R84-G-0957A/B casing.

- 9.3.3.8 CONTRACTOR shall provide and install underground non-metallic drain piping 4"-P-9422-1FE0U from the new sour water pumps and Hydrocyclone separators to the existing header 4"-P-7193-1A1 (@ tie-in # 011A/B).
- 9.3.3.9 CONTRACTOR shall provide and install raw water line 1"-RW-20308-1BD0U from the existing 1"-RW-7001-1E1 to the new Hydrocyclone separators.
- 9.3.3.10 CONTRACTOR shall provide and install drain line 2"-P-9445-1LE0P06 from new Hydrocyclone separators to the new buried drain header 4"-P-9442-1FE0U.
- 9.3.3.11 CONTRACTOR shall provide and install blowdown line 2"-BD-9443-1LE0P06 from new Hydrocyclone separators to existing header 6"-BD-7080-1L1 (@ tie-in #016).   
ISSUED FOR CONSTRUCTION  
BY: KER-MAK  
DATE: 10-01861
- 9.3.3.12 CONTRACTOR shall provide instrument air supply (1"-IA-1CG0U) to new control valves TV-0471, FV-0561 & ZV-1072. CONTRACTOR shall field verify the nearest tie-in point (in coordination with SA) and field route the instrument air supply line. Field support shall be provided as per site condition.
- 9.3.3.13 CONTRACTOR shall provide 2" connection from existing stand pipes to install new level transmitters LIT-0412 & LIT-0424 on both D-784 & D782 drums respectively.
- 9.3.3.14 CONTRACTOR shall execute all new tie-in connections to the existing piping system in coordination with SA. Tie-in procedure shall be prepared by Contractor for review and approval of SA. Saudi Aramco shall provide Contractor with the gas free system prior to tie-in. CONTRACTOR shall provide labor and equipment to Saudi Aramco during existing line isolation works.
- 9.3.3.15 CONTRACTOR shall externally paint all above grade piping as per SAES-H-001.

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9.3.3.16 CONTRACTOR shall perform hydrostatic test for all piping as per SAES-L-150, SAES-A-004 and SAES-A-007.

### Reference drawings

PFD	:	RA-663719.001
P&ID	:	NA-B45155.031, NA-B45155.032
		RA-663723-001
Plot Plan	:	NA-B44918.001
Area Plot Plan	:	RA-663791.001
Piping Plan	:	NA-B50661.001
		NA-B50662.001
		NA-B50671/2/3.001
		NA-B50665.001
		NA-B42779.001
		NA-B42780/1/2/3/4/5/6/7/8/9.001
		NA-B42790/1.001
		NA-B42811/2.001
		NA-B42794.001
		NA-B55662.001
KER-MCNS G Utility Layout	:	RB-663799.001/002/003
Site-in Index	:	
Painting/Coating	:	RE-663796.001 &002
Schedule	:	

### New Sour Water JRT-SW Pipeline

The new non-metallic buried pipeline shall be procured, designed and constructed in accordance with 01-SAMSS-042, SAES-L-620 and SAES-L-650 respectively and manufacturer recommendations and manual.

Also CONTRACTOR shall evaluate using RTP pipe instead of RTR as provided in the design documents.

9.3.3.17 CONTRACTOR shall provide and install 6", non-metallic, approximately 16 kilometers long buried sour water pipeline (JRT-SW) from the existing RTJ corridor inside JNGLF Plant up to Ras Tanura North Terminal asphalt road crossing (approximately 400 meters outside RTR fence).

9.3.3.18 CONTRACTOR shall provide and install 6", above grade and buried internally FBE coated carbon steel pipeline section

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CONSTRUCTION SCOPE OF WORK NARRATIVE SOUR WATER PIPELINE - JNGLF TO RT REFINERY JNGLF/RTR PLANT	DWG. TYPE DOC	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
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with the future scraping provision at the existing RTJ pipeline corridor inside JNGLF Plant. Buried pipeline section shall also be externally FBE coated.

9.3.3.19 CONTRACTOR shall provide and install 6", approximately 400 meters long above grade/buried internally FBE coated carbon steel pipeline section after Ras Tanura North Terminal asphalt road crossing to the future scraping provision location inside Ras Tanura Refinery. Buried pipeline section shall also be externally FBE coated.

9.3.3.20 CONTRACTOR shall provide flanges at every 12m (max.) pipe joints and at pipe bends and elbows as required to facilitate the internal FBE coating for the metallic pipeline sections.

9.3.3.21 CONTRACTOR shall coordinate with the non-metallic pipe vendor/manufacturer for the installation of new non-metallic sour water pipeline and follow the manufacturer installation manuals and instruction guidelines. When making joints, it is necessary to execute the required steps in the correct sequence as per the recommendations.

9.3.3.22 Nonmetallic vendor shall perform stress analysis calculations for the non-metallic pipeline and implement the recommendations and provide the thrust blocks as needed.

9.3.3.23 CONTRACTOR shall provide qualified and certified personnel to work on the installation of non-metallic pipeline systems.

9.3.3.24 CONTRACTOR shall provide and install metallic cased pipe for non-metallic pipeline at all road crossings and SSD fence crossings at JNGLF and Ras Tanura Refinery.

9.3.3.25 CONTRACTOR shall provide cathodic protection for the metallic sections of the pipeline as per SAES-X-400 and CP package.

9.3.3.26 CONTRACTOR shall provide and install kilometer marker at every kilometer station of the pipeline, at road crossings (within 10 meters on both sides of the road), and near

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appurtenances, deflections, junctions and at the end points of the pipeline.

9.3.3.27 CONTRACTOR shall perform hydrostatic testing of newly constructed pipeline at completion of construction based on manufacture instruction on RTR pipe.

## Reference drawings

P&ID : RA-663723-001, PP-220021.001  
Piping Plan : RA-663800.001 to 003  
Pipeline Drawing : RA-663793.001  
Index  
Pipeline Alignment: RA-663794.001 to 011  
Sheets  
Painting/Coating : RE-663796.001 &002  
Schedule

# Ras Tanura Refinery (RTR)

All above-grade in-plant piping inside Ras Tanura Refinery shall be designed and constructed in accordance with SAES-L-310 and SAES-L-350 respectively.

9.3.3.28 CONTRACTOR shall provide and install 4" above ground sour water piping 4"-SOW-2156-1LE0P06 inside RTR from the refinery fence to the sour water tie-in # 002 in Plant J87 of BI-10-01330.

9.3.3.29 CONTRACTOR shall provide and install thermal relief valve piping; inlet: 2"-RL-2151-1LE0P06, outlet: 2"-BD-1366-1LE0P06 from new line 4"-SOW-2156-1LE0P06 to the tie-in #002 in Plant J87 of BI-10-01330.

9.3.3.30 CONTRACTOR shall provide piping tie-ins with BI-10-01330 as shown in the tie-in index and project drawings.

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9.3.3.31 CONTRACTOR shall internally FBE coat all the above grade carbon steel piping as per SAES-H-002. CONTRACTOR shall provide flanges at every 12 meters (max.) pipe joints and at pipe bends and elbows as required to facilitate the internal FBE coating.

9.3.3.32 CONTRACTOR shall externally paint all above grade piping as per SAES-H-001.

9.3.3.33 CONTRACTOR shall perform hydrostatic test for all piping as per SAES-L-150, SAES-A-004 and SAES-A-007.

### Reference drawings

P&ID : PP-220021.001  
 Piping Plan : RA-663800.003 to 006  
 Tie-in Index : RB-663799.002  
 Painting/Coating Schedule : RE-663796.001 &002

#### 9.3.4 Electrical

### JU'AYMAH (JNGL) PLANT

9.3.4.1 Provide 480V power supply to new 40HP Sour Water Transfer Pump Motor R84-GM-0957A by installing new 100AF/100AT MCCB at space cubicle no. 4RD of 480V existing Control-gear R84-P-755 located in Substation #27. This pump shall be controlled by Adjustable Frequency Drive (R84-027-AFD-001) and the AFD shall be communicating will be DCS / ESD.

Reference Drawings:

NA-B53759.003 Rev. 10C Electrical One Line Diagram

RD-663845-001 & 00 Cable & Conduit Schedule

9.3.4.2 Existing 3HP Spent Water Pump Motor R84-GM-791A fed from existing cubicle no. 3RH of 480V existing Control-gear R84-P-755 located in Substation #27 shall be disconnected and cubicle no. 3RH shall be converted to spare motor feeder.

Reference Drawings:

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NA-B53759.003 Rev. 10B Demo. Electrical One Line Diagram

- 9.3.4.3 Provide 480V power supply to new 40HP Sour Water Transfer Pump Motor R84-GM-0957B by installing new 100AF/100AT MCCB at space cubicle no. 3RK of 480V existing Control gear R84-P-756 located in Substation #27. This pump shall be controlled by Adjustable Frequency Drive (R84-027-AFD-002) and the AFD shall be communicating will be DCS / ESD

## Reference Drawings:

NA-B53759.004 Rev. 07B Electrical One Line Diagram  
RD-663845-001 & 002 Cable & Conduit Schedule

- 9.3.4.4 Existing 3HP Spent Water Pump Motor R84-GM-791B fed from existing cubicle no. 3RH of 480V existing Control-gear R84-756 located in Substation #27 shall be disconnected and cubicle no. 3RH shall be converted to spare motor feeder.

## ~~Reference Drawings:~~

NA-B53759.004 Rev. 07A Demo. Electrical One Line Diagram

- 9.3.4.5 Existing 3HP Spent Water Pump Motor R84-GM-791C fed from existing cubicle no. 1BFB of 480V existing Control-gear R84-P-754 located in Substation #27 shall be disconnected and cubicle no. 1BFB shall be converted to spare motor feeder.

## Reference Drawings:

NA-B53759.006 Rev. 02A Demo. Electrical One Line Diagram

- 9.3.4.6 New Adjustable Frequency Drives (R84-027-AFD-001 & R84-027-AFD-002) to be supplied installed and commissioned at Substation #27.

## Reference Drawings:

NA-B53773.001 Rev. 13A Cable Routing Layout

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NA-B53770.001 Rev. \* Equipment Layout Substation #27

9.3.4.7 New power cables (PC-5171 & PC-5172) from existing 480V Control-gears (R84-P-755 & R84-P-756) installed in Substation #27 to new Adjustable Frequency Drives (R84-027-AFD-001 & R84-027-AFD-002) to be installed in Substation #27 (approximately 30M) shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

NA-B53773.001 Rev. 13A Cable Routing Layout

RD-663845-001 &amp; 002 Cable &amp; conduit Schedule no.

9.3.4.8 New power cables (PC-5173 & PC-5174) and control cables (CC-5156 & CC-5157) from Substation #27 to Sour Water Transfer Pump Motors R84-GM-0957A/B (approximately 360M) shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

NA-B53773.001 Rev. 13A Cable Routing Layout

RD-663845-001 &amp; 002 Cable &amp; conduit Schedule no.

NA-B53884.001 Rev. \* Cable Routing Layout

RA-248054.001 Rev. \* Cable Tray Layout

NA-B53904.001 Rev. \* Cable Tray Layout

NA-B53905.001 Rev. \* Cable Tray Layout

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**9.3.4.9** New Instrument Homerun cables IC-0041, IC-0042, IC-0043, IC-0044, IC-0062, IC-0063, IC-0064 and IC-0065 originating from existing Analog DCS Marshalling Cabinet 230-ME-220-2 and Digital DCS Marshalling Cabinet 230-MC-220-1, Digital ESD Marshalling Cabinet 230-MC-211-2 and Analog ESD Marshalling Cabinet 230-ME-211-1 and going to new Field Junction Boxes R84-78-AJB-1001, R84-78-AJB-1003, R84-78-DJB-1002, R84-78-ESD-DJB-1005 and R84-78-ESD-DJB-1006 respectively shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

RA-663741.001      Instrument Block Diagram

NA-B53884.001 Rev. \*      Cable Routing Layout

NA-B53883.001 Rev. \*      Home-run Cable Routing Layout

NA-B53882.001 Rev. \*      Home-run Cable Routing Layout

NA-B54534.003 Rev. \*      Home-run Cable Routing Layout

NA-B53649.001 Rev. \*      Home-run Cable Routing Layout

NA-B53650.001 Rev. \*      Home-run Cable Routing Layout

RA-515776.012 Rev. \*      Cable Tray/Raceway Plan

RD-663762-001, 002 & 003 Cable & Conduit Schedule

**9.3.4.10** New Instrument cables IC-0045, IC-0047 and IC-0048 originating from Analog DCS Marshalling Cabinet 230-ME-220-2, Digital DCS Marshalling Cabinet 230-MC-220-1 and going to Instrument Junction Box R84-78-IJB-1004 located inside Substation #27 shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

NA-B53773.001 Rev. 13A      Cable Routing Layout

RD-663845-001 & 002      Cable & Conduit Schedule

RD-663762-001, 002 & 003      Cable & Conduit Schedule

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RA-663740.001

Instrument Block Diagram

9.3.4.11 New Instrument cables IC-0039 and IC-0040 originating from Adjustable Frequency Drives R84-027-AFD-001 & R84-027-AFD-002 and going to existing Relay Panel 220-RP-220-1 located inside Substation #27 shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

NA-B53773.001 Rev. 13A

Cable Routing Layout

RD-663845-001 &amp; 002

Cable &amp; conduit Schedule

RD-663762-001, 002 &amp; 003

Cable &amp; Conduit Schedule

RA-663740.001

Instrument Block Diagram

9.3.4.12 Grounding shall be provided for New Adjustable Frequency Drives R84-027-AFD-001 & R84-027-AFD-002 and Instrument Junction Box R84-78-IJB-1004 located inside Substation #27 by extending grounding conductor from existing ground bus-bars meeting the requirements of SAES-P-111, latest edition of NFPA-70 (NEC) and Saudi Aramco Library Drawings DD-950022 Sht. 001 through 12.

Reference Drawings:

NA-B53772.001 Rev. 13A Grounding Layout

9.3.4.13 Grounding shall be provided for New Sour Water Transfer Pump Motors R84-GM-0957A/B and associated Local Control Stations & related supporting structure by extending grounding conductor from existing ground grid meeting the requirements of SAES-P-111, latest edition of NFPA-70 (NEC) and Saudi Aramco Library Drawings DD-950022 Sht. 001 through 12.

Reference Drawings:

NA-B53867.001 Rev. 13A Grounding Layout

9.3.4.14 Grounding shall be provided for New Field Junction Boxes R84-78-AJB-1001, R84-78-AJB-1003, R84-78-DJB-1002, R84-78-ESD-DJB-1005 and R84-78-ESD-DJB-1006 and associated supporting structures by extending grounding conductor from existing ground grid meeting the

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## CONSTRUCTION SCOPE OF WORK NARRATIVE

SOUR WATER PIPELINE - JNGLF TO RT REFINERY

JNGLF/RTR PLANT

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requirements of SAES-P-111, latest edition of NFPA-70 (NEC) and Saudi Aramco Library Drawings DD-950022 Sht. 001 through 12.

9.3.4.15 Lighting shall be provided for Hydrocyclone Separator (R84-D-0953A/B) meeting the requirements of SAES-P-123 from existing Lighting Panel R84-LP-220-2 by utilizing the spare circuit CKT-10. Existing Lighting Panel is installed in re-run area in between existing PR-12A and PR-13A.

## RAS TANURA (J87)

9.3.4.16 New Instrument Homerun cables IC-2262 and IC-2263, originating from existing ESD Marshalling Cabinet J87-ESD-MC-01 and going to Field Junction Boxes R84-ESD-DJB-2001 and R84-ESD-AJB-2001 respectively shall be supplied, installed, tested, pre-commissioned and commissioned.

Reference Drawings:

PP-220021.001

Piping & Instrumentation Dwg

RA-663741.001

Instrument Block Diagram

RD-663762-001, 002 & 003

Cable & Conduit Schedule

RA-729502.001 Rev. \* Home-run Cable Routing Layout

RA-729502.002 Rev. \* Home-run Cable Routing Layout

9.3.4.17 Grounding shall be provided for New Field Junction Boxes J87-ESD-AJB-2001 & J87-ESD-DJB-2001 and associated supporting structures by extending grounding conductor from existing ground grid meeting the requirements of SAES-P-111, latest edition of NFPA-70 (NEC) and Saudi Aramco Library Drawings DD-950022 Sht. 001 through 12.

RA-729502.001 Rev. \* Grounding Layout

Lighting shall be provided for new ZV platform meeting the requirements of SAES-P-123 from existing nearby Lighting Panel R84-LP-1.

## PIPELINE CATHODIC PROTECTION

9.3.4.18 CP Test station shall be provided at thrust anchor outside the fence area as per standard drawing AB-036907.

9.3.4.19 Thermite welding of cables to pipe sleeves or structure shall

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9.3.5.5 CONTRACTOR shall provide, install and terminate a new one triad AWG 16 instrument cable (IC-0005) from the new CONTRACTOR supplied RTD (R84-78-TE-0471) to the new CONTRACTOR supplied Temperature transmitter (R84-78-TIT-0471). CONTRACTOR shall also provide, install and terminate a new one pair AWG 16 instrument cable (IC-0006) from the new CONTRACTOR supplied Temperature transmitter (R84-78-TIT-0471) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003).

9.3.5.6 CONTRACTOR shall supply and install a new Temperature transmitter R84-78-TIT-0410 (with an RTD temperature element R84-78-TE-0410 and thermowell R84-78-TW-0410) on the bottom of the existing Sour Water Degassing Drum (R84-D-792) using an existing 2 inch flanged process connection as per the associated project drawings.

9.3.5.7 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0007) from the new CONTRACTOR supplied Temperature control valve (R84-78-TV-0471) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003).

9.3.5.8 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0007) from the new CONTRACTOR supplied Temperature control valve (R84-78-TIT-0471) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003).

9.3.5.9 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0060) from the new CONTRACTOR supplied Temperature control valve (R84-78-TIT-0410) to the new CONTRACTOR supplied Junction Box (R84-78-ESD-JB-1006).

9.3.5.10 CONTRACTOR shall supply and install a flanged orifice plate assembly (R84-78-FE-0562) in the Sour Water line to the Hydrocyclone Separators (4"-SOW-9433-1SV0P) and an associated flow transmitter (R84-78-FIT-0562) as per the associated project drawings.

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9.3.5.11 CONTRACTOR shall also provide, install and terminate a new one pair AWG 16 instrument cable (IC-0001 from the new CONTRACTOR supplied Flow transmitter (R84-78-FIT-0562) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1001)

9.3.5.12 CONTRACTOR shall supply and install a Flow control valve (R84-78-FV-0562) in the Sour Water Transfer Pump Recycle line (2"-SOW-9435-1SV0P) as per the associated project drawings.

9.3.5.13 CONTRACTOR shall supply and install a Restriction Orifice (R84-78-FO-0564) in the Spent Water Return line (4"-SOW-9426-1SV0P) as per the associated project drawings.

9.3.5.14 CONTRACTOR shall supply and install a flanged orifice plate assembly (R84-78-FE-0563) in the Sour Water Transfer Pump Recycle line (2"-SOW-9435-1SV0P) and an associated flow transmitter (R84-78-FIT-0563) as per the associated project drawings.

9.3.5.15 CONTRACTOR shall supply and install a flanged orifice plate assembly (R84-78-FE-0561) in the Sour Water Transfer Pump Discharge Header line (4"-SOW-9426-1SV0P) and an associated flow transmitter (R84-78-FIT-0561) as per the associated project drawings.

9.3.5.16 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0045 from the new CONTRACTOR supplied Flow transmitter (R84-78-FIT-0561) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1001) and a new one pair AWG 16 instrument cable (IC-0003 from the new CONTRACTOR supplied Flow transmitter (R84-78-FIT-0563) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1001).

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9.3.5.17 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0001) from the new CONTRACTOR supplied Recycle control valve (R84-78-FV-0562) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1001)

9.3.5.18 CONTRACTOR shall supply and install an On/Off valve (R84-78-XV-1073) in the Sour Water Transfer Pump Discharge Header line (4"-SOW-9426-1SV0P) as per the associated project drawings and documents.

9.3.5.19 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0019) from the new CONTRACTOR supplied Solenoid valve (R84-78-XY-1073) and two one pair AWG 16 instrument cables (IC-0020) from the Open and Closed Limit Switches (R84-78-XSH & XSL-1073) on the new CONTRACTOR supplied On/Off valve (R84-78-XV-1073) to the new CONTRACTOR supplied Junction Box (R84-78-DJB-1002).

9.3.5.20 CONTRACTOR shall supply and install an Emergency Isolation valve (R84-78-ZV-1071) in the Sour Water Transfer Pump Suction line (4"-SOW-9421-1SV0P) as per the associated project drawings.

9.3.5.21 CONTRACTOR shall also supply & lay the required cable from the ZV-1071 to junction box R84-ESD-DJB-1006 as per project drawings.

9.3.5.22 CONTRACTOR shall supply and install an Emergency Isolation valve (R84-78-ZV-1072) in the Hydro cyclone Separator Discharge Header line (4"-SOW-9429-1LE0P06) as per the associated project drawings.

9.3.5.23 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0056) from the new CONTRACTOR supplied Solenoid valve (R84-78-ZY-1071) and two one pair AWG 16 instrument cables (IC-0057) from the Open and Closed Limit Switches (R84-78-XSH & XSL-1071) on the new CONTRACTOR supplied EIV (R84-78-ZV-1071) to the new CONTRACTOR supplied Junction Box

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(R84-78-ESD-IJB-1006)

9.3.5.24 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0052) from the new CONTRACTOR supplied Solenoid valve (R84-78-ZY-1072) and two one pair AWG 16 instrument cables (IC-0053) from the Open and Closed Limit Switches (R84-78-XSH & XSL-1072) on the new CONTRACTOR supplied EIV (R84-78-ZV-1072) to the new CONTRACTOR supplied Junction Box (R84-78-ESD-IJB-1005).

9.3.5.25 CONTRACTOR shall supply and install five new Junction Boxes (R84-78-AJB-1001, R84-78-AJB-1003, R84-78-DJB-1002, R84-78-ESD-IJB-1005 and R84-78-ESD-IJB-1006) close to the existing Sour Water Degassing Drum (R84-D-792) with suitable mounting support as per the project drawings. The Field Instrument cables shall be connected to and terminated within these Junction Boxes as per the project drawings.

9.3.5.26 CONTRACTOR shall supply and install new Junction Boxes (R84-78-IJB-1004) in existing Substation 27. The new Sour Water Transfer Pumps (R84-G-0957A & B) field Start/Stop/Running/Stopped signal two pair AWG 16 Instrument cables (IC-0031, 0032, 0035 & 0036) shall be connected to and terminated within this Junction Box as per the project drawings.

9.3.5.27 CONTRACTOR shall supply & install pressure indicators PI-0951 & PI-0952 on the suction & discharge piping of the new pump R84-G-0957A as per project drawings.

9.3.5.28 CONTRACTOR shall supply & install pressure indicators PI-0953 & PI-0954 on the suction & discharge piping of the new pump R84-G-0957B as per project drawings.

9.3.5.29 CONTRACTOR shall supply & install pressure indicators PI-0955 & PI-0956 on the inlet & outlet piping of Hydrocyclone R84-D-0953A as per project drawings

9.3.5.30 CONTRACTOR shall supply & install pressure indicators PI-0957 & PI-0958 on the inlet & outlet piping of Hydro cyclone

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- 9.3.5.31 CONTRACTOR shall provide and install one 6 pair AWG 18 Homerun Instrument Cables (IC-0041) from CONTRACTOR supplied Junction Boxes R84-78-AJB-1001 to the existing Analog Interconnection Marshalling Cabinet 230-ME-220-2 located in the NGL CCR Building Rack Room
- 9.3.5.32 CONTRACTOR shall provide and install one 12 pair AWG 18 Homerun Instrument Cables (IC-0042) from CONTRACTOR supplied Junction Boxes R84-78-AJB-1001 and R84-78-AJB-1003 to the existing Analog Interconnection Marshalling Cabinet 230-ME-220-2 located in the NGL CCR Building Rack Room
- 9.3.5.33 CONTRACTOR to provide and install cross wiring cable between analog / Digital marshalling cabinets up to the system cabinets as per the project drawings.
- 9.3.5.34 CONTRACTOR shall provide and install one sixteen pair (IC-0044) and one 8 pair (IC-0043) AWG 18 Homerun Instrument Cable from CONTRACTOR supplied Junction Box R84-78-DJB-1002 to the existing Digital Marshalling Cabinet 230-MC-220-1 located in the NGL CCR Building Rack Room.
- 9.3.5.35 CONTRACTOR shall provide and install two 2 pair AWG 16 Homerun Instrument Cables (IC-0045) from the CONTRACTOR supplied Junction Box R84-78-iJB-1004 to the existing Digital Marshalling Cabinet 230-MC-220-1 located in the NGL CCR Building Rack Room .
- 9.3.5.36 CONTRACTOR shall provide and install two 6 pair AWG 18 Homerun Instrument Cables (IC-0047 & IC-0048) from the CONTRACTOR supplied junction box installed in Substation -27 to the existing Analog Interconnection Marshalling Cabinet 230-ME-220-2 located in the NGL CCR Building Rack Room.
- 9.3.5.37 CONTRACTOR shall provide and install one 18 pair AWG

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18 Instrument Cable (IC-0049) from the existing Analog Interconnection Marshalling Cabinet 230-ME-220-2 to the Rear of the existing DCS System Cabinet (01-KPM-R84-143) both located in the NGL CCR Building Rack Room.

9.3.5.38 CONTRACTOR shall provide and install one 12 pair and one 4 pair AWG 18 Instrument Cable (IC-0050 & IC-0051) from the existing Digital Marshalling Cabinet 230-MCE-220-1 to the Rear of the existing DCS System Cabinet (01-KPM-R84-144) both located in the NGL CCR Building Rack Room

9.3.5.39 CONTRACTOR shall provide and install two one pair AWG 16 Instrument Cables (IC-0039 & IC-0040) from the CONTRACTOR supplied Sour Water Transfer Pumps (R84-G-0957A & B) Local Control Panel Trip Indication Lamps to the existing Interposing Relay Panel (220-RP-220-1) located in existing Substation #27.

9.3.5.40 CONTRACTOR shall supply and install a GWR Level transmitter (R84-78-LIT-0841) on the existing bridle on the existing Caustic Degassing Drum (R84-D-794 with a remote Level indicator (LI-0841) as per the associated project drawings.

9.3.5.41 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0010) from the new CONTRACTOR supplied GWR Level transmitter (R84-78-LIT-0841) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003).

9.3.5.42 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-0011) from the new CONTRACTOR supplied Level Indicator (R84-78-LI-0841) to the new CONTRACTOR supplied Junction Box (R84-78-AJB-1003).

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9.3.5.43 CONTRACTOR shall provide and install two one pair AWG 16 Instrument Cables (IC-0029& IC-0030) from the CONTRACTOR supplied Sour Water Transfer Pumps (R84-G-0957A & B) Local Control Panel Local/Remote Indication Lamps to the new CONTRACTOR supplied Junction Box (R84-78-DJB-1002).

9.3.5.44 CONTRACTOR shall provide, install and terminate a new 6 pair AWG 16 instrument cable (IC-0055) from the new CONTRACTOR supplied EIV (R84-78-ZV-1072) to the ZV-1072 Local Control Panel Open/Close/Partial Stroke Test Pushbuttons(R84-78-HS-1072C,D&E)and Open/ Close/ Ready to Reset Lamps (R84-78-XL-1072A, B & C).

9.3.5.45 CONTRACTOR shall provide, install and terminate a new 6 pair AWG 16 instrument cable (IC-0059) from the new CONTRACTOR supplied EIV (R84-78-ZV-1071) to the ZV-1071 Local Control Panel Open/Close/Partial Stroke Test Pushbuttons (R84-78-HS-1071C, D & E) and Open/Close /Ready to Reset Lamps (R84-78-XL-1071A, B & C).

9.3.5.46 CONTRACTOR shall provide and install one 2 pair and one 4 pair AWG 18 Instrument Cable (IC-0062 & IC-0064) from the CONTRACTOR supplied Junction Box R84-78-ESD-IJB-1005 to the existing ESD Digital Marshalling Cabinet 230-MC-211-2 located in the NGL CCR Building Rack Room.

9.3.5.47 CONTRACTOR shall provide and install one 2 pair and one 4 pair AWG 18 Instrument Cable (IC-0063 & IC-0065) from the CONTRACTOR supplied Junction Box R84-78-ESD-IJB-1006 to the existing ESD Digital Marshalling Cabinet 230-ME-211-2 located in the NGL CCR Building Rack Room.

9.3.5.48 CONTRACTOR shall supply, lay & terminate all the new cross wires from existing marshalling cabinet 230-ME-220-2 & 230-MC-220-1 up to the existing system cabinets 01-KPM-R84-143 & 01-KPM-R84-144 & 01-KPM-R84-522 as per project drawings.

9.3.5.49 CONTRACTOR shall supply, lay & terminate all the new cables from the new AFD's up to the existing relay panel

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220-RP-220-1 for ESD shutdown the pumps as per project drawings.

9.3.5.50 CONTRACTOR shall provide the Analog output card along with FTA and do the cross wiring in co-ordination with vendor as mentioned in the DCS technical specifications.

9.3.5.51 CONTRACTOR shall make the required modifications in the existing system and workstations for DCS/ESD based on the project requirements as specified in PE-J00005 & PE-J00006.

9.3.5.52 CONTRACTOR to provide and install new Gas Detectors AIT-2015A & AIT-2015B to the new Pump Location and provide required coverage as per SAES-J-505.

9.3.5.53 CONTRACTOR shall supply, lay & terminate new cables from Gas Detectors AIT-2015A & AIT-2015B to existing junction box.

9.3.5.54 New instrument homerun cables (IC-0025, IC-0026, IC-0031 (IC-0032) from Substation #27 to Control Room (CCR) (approximately 500M) shall be supplied, installed, tested, pre-commissioned and commissioned.

9.3.5.55 New instrument homerun cables (IC-0041, IC-0042, IC-0043, IC-0044, IC-0045, IC-0047 and IC-0048) from Field Junction Boxes (R84-78-AJB-1001, R84-78-AJB-1003, R84-78-DJB-1002, R84-ESD-DJB-1005, R84-78-IJB-1004 and R84-ESD-DJB-1006) to Control Room (CCR) (approximately 300M) shall be supplied, installed, tested, pre-commissioned and commissioned.

9.3.5.56 New Sour Water Pump Motors (R84-GM-0957A/B), control station, junction boxes etc. shall be grounded as per SAES-P-111 & library drawing DD-950022.

9.3.5.57 New Adjustable Frequency Drive (R84-027-AFD-001 & R84-027-AFD-002), Instrumentation Digital Junction Box (R84-78-DJB-1004) installed at Substation 27 shall be grounded as per SAES-P-111 & library drawing DD-950022.

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Refer drawing no. NA-B53773.002 Rev. 08C.

**RAS TANURA (J87)**

Reference Drawings:

PA-A20009.001.

Piping &amp; Instrumentation Drawing

PA-663741.001

Instrument Block Diagram

9.3.5.58 CONTRACTOR shall provide and install a Thermal Relief Valve (J87-PZV-0801) on the CONTRACTOR supplied Sour Water pipeline (4"-SOW-2156-1LE0P06) from Juaymah NGLF as per the project documents and drawings.

9.3.5.59 CONTRACTOR shall supply and install an Emergency Isolation valve (J87-ZV-1642) on the CONTRACTOR supplied Sour Water pipeline (4"-SOW-2156-1LE0P06) from Juaymah NGLF as per the project documents and drawings

9.3.5.60 CONTRACTOR shall provide, install and terminate a new 6 pair AWG 16 instrument cable (IC-2261) from the new CONTRACTOR supplied EIV (J87-ZV-1642) to the ZV-1642 Local Control Panel Open/Close/Partial Stroke Test Pushbuttons (J87-HS-1642C, D & E) and Open/Close/Ready to Reset Lamps (J87-XL-1642A, B & C).

9.3.5.61 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-2257) from the new CONTRACTOR supplied Solenoid valve (J87-ZY-1642) and two one pair AWG 16 instrument cables (IC-2259 & IC-2258) from the Open and Closed Limit Switches (J87-XSH & XSL-1642) on the new CONTRACTOR supplied EIV (J87-ZV-1642) to the new CONTRACTOR supplied Junction Box (J87-ESD-DJB-2001).

9.3.5.62 CONTRACTOR shall provide, install and terminate a new one pair AWG 16 instrument cable (IC-2260) from the new CONTRACTOR supplied EIV (J87-ZV-1642) Smart Valve Positioner to the CONTRACTOR supplied Junction Box (J87-ESD-AJB-2001)

9.3.5.63 CONTRACTOR shall provide and install two new field ESD Junction Boxes (J87- DJB-2001 & J87-ESD-AJB-2001)

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which shall be installed with suitable mounting support as per the project drawings

9.3.5.64 CONTRACTOR shall provide and install one 2 pair and one 4 pair AWG 18 Instrument Cable (IC-2262 & IC-2263) from the CONTRACTOR supplied Junction Boxes (J87-ESD-AJB-2001 & J87-ESD-DJB-2001) to the Front of the existing ESD Marshalling Cabinet (J87-ESD-MC-01) located in the J87 PIB Rack Room.

9.3.5.65 CONTRACTOR shall make all required modifications to the existing ESD systems and workstation Graphic Displays, Logs and Reports as specified in the project ESD Modification FSD J87-PE-J40031 and in the presence of the relevant COMPANY representatives.

9.3.5.66 CONTRACTOR shall make the required modifications in the existing systems and workstations for ESD based on the project requirements as specified in PE-J00031.

9.3.5.67 New instrument homerun cables (IC-2262 and IC-2263) from KBR-EMC held Junction Boxes (J87-ESD-DJB-2001 and R84-ESD-AJB-2001) to Control Room (CCR) shall be supplied, installed, tested, pre-commissioned and commissioned.

9.3.5.68 New junction boxes (J87-ESD-DJB-2001 and R84-ESD-AJB-2001) shall be grounded as per SAES-P-111 & library drawing DD-950022.

## 9.4 Directives

Safety and Security Directives (SSD), issued by the Saudi Arabian Government High Commission for Industrial Security (HCIS) will govern the Project execution as applicable. In particular, requirements for exit and entry of vehicles, materials and personnel on controlled security gates shall be checked. These directives are reflected in the latest issue of Saudi Aramco Engineering Standards "O" series that are specified for the project, as applicable (refer to section 13). The efforts required for this project will be reviewed by Industrial Security Support Department via Safety and Security Standards Committee. The project facilities will be designed and constructed in accordance with the current Saudi Aramco Standards applicable for fire, safety and loss prevention. Work permits procedures

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SOUR WATER PIPELINE - JNGLF TO RT REFINERY							
JNGLF/RTR PLANT							
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shall be followed in accordance with the requirement of G. I. 2.100.

## **9.5 Safety**

All construction works will be performed in strict compliance with Saudi Aramco's standard safety practices and procedures as outlined in the applicable General Instructions (GI's).

## 9.6 Security

Security on the project during construction will be maintained using the existing procedures and governmental directives. All Engineering works will be performed strictly in accordance with Security and Safety Directives and SAEP-127, Security and Control of Saudi Aramco Engineering Data. All workers and/or visitors to the Saudi Aramco facilities will be required to obtain Saudi Aramco identification Cards through Aramco Security prior to traveling to the construction site. All Vendor representatives will be required to obtain temporary Saudi Aramco ID's. Any such entry will be closely monitored and controlled by the Construction Management and existing security personnel on the Construction Site.

## **10.0 MATERIAL REQUIREMENT**

- a)** CONTRACTOR shall be responsible for the supply and installation of all materials/equipment required for the Construction of this project per drawings. Material take-offs have been prepared for reference only and shall not be considered as contractual documents and cannot be used as a basis for any change order.

**b)** CONTRACTOR shall use the SAUDI ARAMCO material specification for procurement of materials whenever the SAMS stock number is quoted in the material list as reference. CONTRACTOR shall ensure that all materials and equipment conform to the contract cut-off edition of the applicable Saudi Aramco Materials System Specifications (SAMSS). Materials which have not been specified by SAMSS must be approved by Saudi Aramco Representative prior to use. Samples and brochures of these shall be submitted for approval.

**c)** All materials supplied by CONTRACTOR must be approved by SAUDI ARAMCO Representative prior to use. Samples of these materials shall be submitted for approval if required.

**d)** CONTRACTOR shall submit minimum three (3) technical quotations for approval by SAUDI ARAMCO. CONTRACTOR shall not purchase materials

REVISION CERTIFICATION	EDSD VERIFICATION	THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS, BY DRAWING COMPLETION CERTIFICATE (DCC) NO. <u>10-018610001</u>	CONTROL NUMBER BY: _____	DATE: _____
DISCIPLINE FNGINFFR MAK				
DATE: AUG-2019				
PROJECT ENGINEER MAT				
DATE: AUG-2019				
CERTIFIED AOO				
DATE: AUG-2019				
CONSTRUCTION AGENCY AOO				
DATE: AUG-2019				
OPERATIONS				
AAA				
DATE: AUG-2019				
REV. NO.	DATE	JO/EWO	DESCRIPTION	ENG CERT PMT OPRNS
00	AUG-2019	10-01861	ISSUED FOR CONSTRUCTION	MAT AOO ACO AAA

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without written approval from SAUDI ARAMCO. Technical quotations shall list all exceptions and /or, additions to applicable project Drawings and SAUDI ARAMCO Specifications. If there is no exception to specifications, CONTRACTOR shall make a statement to that effect.

- e) CONTRACTOR shall be responsible for all engineering, procurement, vendor inspection, installation, checkout, testing, certificates, pre-commissioning, mechanical completion certificate compliance, and commissioning assistance of all equipment/materials provided for the Project. Equipment system design, selection and installations shall be such as to ensure highest achievable levels of safety, reliability and availability are obtained and maintained for the new facilities within the confines of the relevant codes and standards, area classification and design basis as detailed in the Project Proposal drawings and documents. Saudi Aramco's policy on the use of locally manufactured products will be adhered to and strictly enforced.
- f) Inspection and Testing of CONTRACTOR supplied materials shall be performed as per ~~applicable~~ COMPANY Inspection Requirement form A-175. CONTRACTOR shall arrange with his sub suppliers to comply with these requirements by stating on all sub supplier's purchase order COMPANY ~~intention to inspect material~~ *ISSUED FOR CONSTRUCTION*
- g) Material and products not available from Saudi firms and not manufactured in the Kingdom shall be ordered through locally established importers. The project milestones schedule and material delivery time of major equipment materials will require procurement of long lead materials at early stage of construction.
- h) Consumable materials such as welding rods, powders, etc., and temporary materials such as formwork for foundations and scaffolding are not included in the list and shall be provided by CONTRACTOR.
- i) All CONTRACTOR supplied materials shall be procured by CONTRACTOR from COMPANY approved manufacturer for each Commodity Classification Code (CCC). COMPANY shall provide the list of approved manufacturers after award of Construction Contract.
- j) CONTRACTOR shall provide all Non Material Requirement (NMR-60,602/603), Operation and Instruction Manuals of CONTRACTOR supplied material in electronic format (Acrobat Reader Version 7.0).

REV. NO.	PMT OPSNS	PMT AOO	PMT AAA			
00	ENGG CERT	MAT	AOO	AAC		
<b>DESCRIPTION</b>						
ISSUED FOR CONSTRUCTION						
REV. NO.	DATE	JO/EWO	10-01861	10-01861		
00	AUG-2019					
<b>DISCIPLINE</b>						
FNGINFFR MAK						
DATE: AUG-2019						
<b>PROJECT ENGINEER</b>						
MAT						
DATE: AUG-2019						
<b>CERTIFIED</b>						
AOO						
DATE: AUG-2019						
<b>CONSTRUCTION AGENCY</b>						
AOO						
DATE: AUG-2019						
<b>OPERATIONS</b>						
AAA						
DATE: AUG-2019						
<b>EDSD VERIFICATION</b>						
CONTROL NUMBER						
BY: _____						
DATE: _____						
<b>REVISION CERTIFICATION</b>						
THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS.						
BY DRAWING COMPLETION CERTIFICATE DCCG NO. 10-018610001						

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SOUR WATER PIPELINE - JNGLF TO RT REFINERY							
JNGLF/RTR PLANT							
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- k) CONTRACTOR shall provide critical spare parts and listed for CONTRACTOR supplied items in accordance with SAEP-3101.

## 11.0 APPLICABLE STANDARDS, SPECIFICATION, CODES AND DRAWINGS

The lists of applicable standards for the Job Specification are as follows and all the applicable standards referenced therein: Latest editions of all applicable standards, codes and specifications shall be used. SA Desktop Cutoff date for these standards, codes and specification is **31<sup>st</sup> JULY 2017**.

### 11.1 Saudi Aramco Engineering Standards and Procedures

REV. NO.	DATE	JO/EWO	DESCRIPTION	SAES-A-004	General Requirements for Pressure Testing
				SAES-A-005	Safety Instruction Sheet
				SAES-A-007	Hydrostatic Testing Fluids and Lay-Up Procedures
				SAES-A-100	Survey Coordinates and Datums
				SAES-A-105	Noise Control
				SAES-A-112	Meteorological and Seismic Design Data
				SAES-A-113	Geotechnical Engineering Requirements
				SAES-A-114	Excavation and Backfill
				SAES-A-133	Internal Corrosion Protection Requirements
				SAES-A-135	Establishment of On-stream Inspection (OSI) Program
				SAES-A-202	Saudi Aramco Engineering Drawing Preparation
				SAES-A-204	Preparation of Structural Calculations
				SAES-A-206	Positive Material Identification
				SAES-A-400	Industrial Drainage Systems
				SAES-B-014	Safety Requirements for Plant and Operations Support Buildings
				SAES-B-054	Access, Egress and Materials Handling for Plant Facilities
				SAES-B-055	Plant Layout
				SAES-B-058	Emergency Shutdown, Isolation and Depressuring
				SAES-B-064	Onshore and near shore Pipeline Safety
				SAES-B-067	Safety Identification and Safety Colors
				SAES-B-068	Electrical Area Classification
				SAES-D-001	Design Criteria for Pressure Vessels
				SAES-G-005	Centrifugal Pumps
				SAES-H-001	Coating Selection & Application Requirements for Industrial Points & Equipment
				SAES-H-002	Internal and External Coatings for Steel Pipelines and Piping
				SAES-H-002V	Approved Saudi Aramco Data Sheets for Pipeline and Piping Coatings

REVISION CERTIFICATION THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS. BY DRAWING COMPLETION CERTIFICATE (DCG) NO. 10-018610001	EDSD VERIFICATION CONTROL NUMBER BY: _____ DATE:
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CONSTRUCTION SCOPE OF WORK NARRATIVE SOUR WATER PIPELINE - JNGLF TO RT REFINERY JNGLF/RTR PLANT	DWG. TYPE DOC	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
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REV NO.	DATE	JO/EWO	DESCRIPTION	SAES-H-003	Coating Requirements for Concrete Surfaces					
DISCIPLINE	MAT	AOO	ENGG	SAES-H-101V	Approved Saudi Aramco Data Sheet – Paints & Coating					
PROJECT ENGINEER	CERT	PMT	OPRNS	SAES-H-102	Safety Requirements for Coating Application					
CONSTRUCTION AGENCY	AOO	AAA	AAA	SAES-H-200	Storage, Handling and Installation of Externally Coated Pipe					
OPERATIONS	AAA	AAA	AAA	SAES-H-201	General Specifications for External and Internal FBE Coatings of Pipeline Field Girth Welds					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-J-001	Instrumentation Index					
EDSD VERIFICATION	CONTROL NUMBER	BY:	DATE:	SAES-J-002	List of Inspectable Instruments					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-J-004	Instrumentation Symbols and Identification					
REVISION CERTIFICATION	THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS, BY DRAWING COMPLETION CERTIFICATE DCCN NO. <u>10-018610001</u>	DATE:	DATE:	SAES-J-005	Instrumentation Drawings and Forms					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-J-100	Process Measurement					
DISCipline	FNGINFFR	MAK	DATE:	SAES-J-200	Pressure					
DATE:	AUG-2019	DATE:	AUG-2019	SAES-J-300	Level					
PROJECT ENGINEER	MAT	DATE:	AUG-2019	SAES-J-400	Temperature					
CERTIFIED	AOO	DATE:	AUG-2019	SAES-J-505	Combustible Gas and Hydrogen Sulfide in Air Detection Systems					
CONSTRUCTION AGENCY	AOO	DATE:	AUG-2019	SAES-J-600	Pressure Relief Devices					
OPERATIONS	AAA	DATE:	AUG-2019	SAES-J-601	Emergency Shutdown and Isolation Systems					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-J-700	Control Valves					
EDSD VERIFICATION	CONTROL NUMBER	BY:	DATE:	SAES-J-900	Electrical Systems for Instrumentation					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-L-100	Applicable Codes and Standards for Pressure Piping Systems					
DISCipline	FNGINFFR	MAK	DATE:	SAES-L-105	Piping Line Classes					
DATE:	AUG-2019	DATE:	AUG-2019	SAES-L-108	Selection of Valves					
PROJECT ENGINEER	MAT	DATE:	AUG-2019	SAES-L-109	Selection of Flanges, Stud Bolts and Gaskets					
CERTIFIED	AOO	DATE:	AUG-2019	SAES-L-110	Limitations on Pipe Joints and Components					
CONSTRUCTION AGENCY	AOO	DATE:	AUG-2019	SAES-L-120	Piping Flexibility Analysis					
OPERATIONS	AAA	DATE:	AUG-2019	SAES-L-125	Safety Instruction Sheet for Piping and Pipelines					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-L-132	Materials Selection for Pipelines, Piping and Process Equipment					
DISCipline	FNGINFFR	MAK	DATE:	SAES-L-136	Pipe, Flange, and Fitting Material Requirements					
DATE:	AUG-2019 <th>DATE:</th> <td>AUG-2019</td> <th>SAES-L-150</th> <td>Pressure Testing of Plant Piping and Pipelines</td>	DATE:	AUG-2019	SAES-L-150	Pressure Testing of Plant Piping and Pipelines					
PROJECT ENGINEER	MAT	DATE:	AUG-2019	SAES-L-310	Design of Plant Piping					
CERTIFIED	AOO	DATE:	AUG-2019	SAES-L-350	Construction of Plant Piping					
CONSTRUCTION AGENCY	AOO	DATE:	AUG-2019	SAES-L-410	Design of Pipelines					
OPERATIONS	AAA	DATE:	AUG-2019	SAES-L-420	Scraper Trap Station and Appurtenances					
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SAES-L-450	Construction of On-Land and Near-Shore Pipelines					
DISCipline	FNGINFFR	MAK	DATE:	SAES-L-460	Pipeline Crossings under Roads and Railroads					
DATE:	AUG-2019 <th>DATE:</th> <td>AUG-2019</td> <th>SAES-L-470</th> <td>Trenchless Pipelines Construction Requirements</td>	DATE:	AUG-2019	SAES-L-470	Trenchless Pipelines Construction Requirements					
PROJECT ENGINEER	MAT	DATE:	AUG-2019	SAES-L-610	Nonmetallic Piping in Oily Water Services					
DISCipline	FNGINFFR	MAK	DATE:	CONSTRUCTION SCOPE OF WORK NARRATIVE	DWG.TYPe	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
<i>ISSUED FOR CONSTRUCTION BY S.A.O.C. - JNGLF/RTR PLANT</i>				SOUR WATER PIPELINE - JNGLF TO RT REFINERY	DOC	R83	A	RE-663716	105 OF 125	00
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OPRNS		PMT		AAA					
REV NO.	DATE	JO/EWO	DESCRIPTION	SAES-L-620	Design of Nonmetallic Piping in Hydrocarbon and Water injection Systems				
DISCIPLINE	MAT	AOO	ENGG CERT	SAES-L-650	Construction of Nonmetallic Piping in Hydrocarbon and Water Injection Systems				
PROJECT ENGINEER	CERTIFIED	AAA	PMT AOO	SAES-M-001	Structural Design Criteria for Non-Building Structures				
CONSTRUCTION AGENCY	AOO	AAA	ENGG CERT	SAES-M-006	Saudi Aramco Security & General Purpose Fencing				
OPERATIONS	AAA	AAA	PMT AOO	SAES-N-001	Basic Criteria, Industrial Insulation				
EDSD VERIFICATION	CONTROL NUMBER	BY	DATE:	SAES-O-100	General Requirements Safety and Security				
REVISION CERTIFICATION	THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS. BY DRAWING COMPLETION CERTIFICATE (DCCI) NO. <u>10-018610001</u>	DATE:	DATE:	SAES-O-105	Gates in Perimeter Fences				
<i>ISSUED FOR CONSTRUCTION SAR ARAMCO</i>									
SAES-O-201									
SAES-O-202									
SAES-O-203									
SAES-P-100									
SAES-P-104									
SAES-P-111									
SAES-P-113									
SAES-P-114									
SAES-P-116									
SAES-P-123									
SAES-Q-001									
SAES-Q-005									
SAES-Q-006									
SAES-Q-010									
SAES-Q-011									
SAES-Q-012									
SAES-S-020									
SAES-S-040									
SAES-W-010									
SAES-W-011									
SAES-W-012									
SAES-X-400									

## 11.2 Saudi Aramco Materials System Specifications (SAMSS)

- 01-SAMSS-010 Fabricated Carbon Steel Piping  
 01-SAMSS-025 Specification for Heavy Duty Polytetrafluoroethylene (PTFE) and Perfluoroalkoxy (PFA) Lined Carbon Steel Pipe and Fittings

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JNGLF/RTR PLANT							
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REV NO.	DATE	JO/EWO	DESCRIPTION						
		10-01861	ISSUED FOR CONSTRUCTION						
DISCIPLINE FNGINFFR MAK	MAT	AUG-2019							
PROJECT ENGINEER	CERTIFIED AOO	AUG-2019							
CONSTRUCTION AGENCY AOO	OPERATIONS	AUG-2019							
EDSD VERIFICATION THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS. BY DRAWING COMPLETION CERTIFICATE (DCG) NO. 10-018610001	CONTROL NUMBER BY: _____ DATE:								
<b>CONSTRUCTION SCOPE OF WORK NARRATIVE</b> <b>SOUR WATER PIPELINE - JNGLF TO RT REFINERY</b> <b>JNGLF/RTR PLANT</b>				DWG.TYP <b>DOC</b>	PLANT NO. <b>R83</b>	INDEX <b>A</b>	DRAWING NO. <b>RE-663716</b>	SHT.NO. <b>107 OF 125</b>	REV.NO. <b>00</b>
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## 11.3 Saudi Aramco Standard Drawings

REV. NO.	DATE	JO/EWO	DESCRIPTION	DISCIPLINE	PMT	OPRNS
			ISSUED FOR CONSTRUCTION	FNGINFFR MAK	CERT	AAA
00	AUG-2019	10-01861		MAT	AOO	AAA
<span style="font-size: 2em; color: red; opacity: 0.5;">ISSUED FOR CONSTRUCTION</span> <span style="font-size: 1em; color: blue; opacity: 0.5;">BY DCCN NO. 10-018610001</span>						
<span style="color: green;">DISCIPLINE</span> <span style="color: green;">FNGINFFR</span> <span style="color: green;">MAK</span>						
<span style="color: green;">PROJECT</span> <span style="color: green;">ENGINEER</span> <span style="color: green;">MAT</span>						
<span style="color: green;">DATE:</span> <span style="color: green;">AUG-2019</span>						
<span style="color: green;">CERTIFIED</span> <span style="color: green;">AOO</span>						
<span style="color: green;">DATE:</span> <span style="color: green;">AUG-2019</span>						
<span style="color: green;">CONSTRUCTION</span> <span style="color: green;">AGENCY</span> <span style="color: green;">AOO</span>						
<span style="color: green;">DATE:</span> <span style="color: green;">AUG-2019</span>						
<span style="color: green;">OPERATIONS</span>						
<span style="color: green;">AAA</span>						
<span style="color: green;">DATE:</span> <span style="color: green;">AUG-2019</span>						
<span style="color: green;">EDSD</span> <span style="color: green;">VERIFICATION</span>						
<span style="color: green;">CONTROL NUMBER</span> <span style="color: green;">BY _____</span> <span style="color: green;">DATE:</span>						
<span style="color: green;">REVISION CERTIFICATION</span> <span style="color: green;">THIS INDICATES THAT REV. NO. <u>00</u> OF THIS DRAWING IS COVERED FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS.</span> <span style="color: green;">BY DRAWING COMPLETION CERTIFICATE</span> <span style="color: green;">DCCN NO. 10-018610001</span>						

AA-036025-001	Four-Way Manhole (Electrical) Details
AA-036025-002	Four-Way Manhole (Electrical) Reinforcement Bar List
AA-036322-001	Anchor Bolt Details
AA-036373-001	Polyvinyl Chloride (P.V.C.) Plastic Direct Buried/Encased Conduit In Concrete
AA-036373-002	Polyvinyl Chloride (P.V.C.) Plastic Direct Buried/Encased Conduit In Concrete
AA-036675-001	Direct Buried Cable Installation Det. C. Prot. Cable and Conduit Layout, Service and Maintenance
AA-036794-005	Hole, Standard Communication Maintenance Hole
AB-036273-001	Surface Marker Underground Electric Cable
AB-036319-001	Standard Sign, Danger High Voltage Keep Away
AB-036326-001	Standard Sign, Underground Electric Cable
AB-036766-001	Standard Electrical Symbols One Line Diagram (Power)
AB-036766-002	Standard Electrical Symbols One Line Diagram (Power)
AB-036766-003	Standard Electrical Symbols One Line Diagram (Power)
AB-036766-004	Standard Electrical Symbols - Plan Layout Buried/Underground Cable Route Marker Post and Signs
AB-036897-001	Standard Specification For Shoring Trenches
AB-036899-001	Instrument Symbols
AC-036950-001	Road Crossings for Unrestrained Pipelines
AC-036660-002	Material Guide for Centrifugal Pumps
AD-036821-001	Engineering Drawing Forms Layouts
AE-036625-001	

## 11.4 Saudi Aramco Library Drawings

DA-950091-001	Lighting and Power Plans
DA-950136-001	Standard Details Electrical Manholes and Hand holes
DA-950151-001	General Notes and Instructions
DA-950152-001	Substation Basis and Limitations
DA-950153-002	Floor Plan - Standard Substation 15 m Wide
DA-950154-002	Elevation - Standard Substation 15 m Wide
DA-950155-002	Section - Standard Substation 15 m Wide

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DISCIPLINE FNGINFER MAK DATE: <u>AUG-2019</u>	ENGG MAT AOC AAA REV. NO. <u>00</u> DATE: <u>AUG-2019</u>	PMT CERT AOO AAA REV. NO. <u>00</u> DATE: <u>AUG-2019</u>
DESCRIPTION <i>ISSUED FOR CONSTRUCTION</i>		

DA-950156-002	Roof Plan and Finish Schedule - Standard Substation 15 m Wide
DA-950157-002	Door Schedule - Standard Substation 15 m Wide
DA-950159-002	Typical Connection Details-Standard Substation 15 m Wide
DA-950159-003	Typical Connection Details
DA-950159-004	Typical Steel Plate Embeds Details
DA-950159-005	Typical Steel Plate Accessories Details
DB-950134-001	Straight Two way Joints for 3/C Rubber cable 5KV
DC-950043-001	Electrical Connections For Field-Mounted Instruments
DD-950022-001	Ground Connections Details Ground Rod To Ground Grid
DD-950022-002	Ground Connections Details Ground Grid Conn. Using Compression Connector
DD-950022-003	Ground Connections Details Ground Plate To Ground Grid Using Comp. Conn.
DD-950022-004	Ground Connections Details Fence Post And Gates To Ground Grid
DD-950022-005	Ground Connections Details Lightning Conductor Systems For Buildings
DD-950022-006	Ground Conn. Details Switchboard/Control Panel Ground Bus To Ground Grid
DD-950022-007	Ground Connections Metal Cable Tray To Ground Grid
DD-950022-008	Ground Connections Details Structural Steel To Ground Grid
DD-950022-009	Ground Connections Details Ground Grid Connections Using Thermit Welding
DD-950022-010	Ground Connections Details Ground Plate Assembly Using Thermit Welding
DD-950025-001	Nameplate Details For Instrument Boards
DD-950053-001	Field Mounting Details For Instruments
DA-950214-040	Metering and Protection Low Voltage Control-gear Library Drawing
DE-950149-001	Concrete Slab for Covering Underground Electric Cable

*ISSUED FOR CONSTRUCTION*  
09-Oct-2019  
SBR-AMCDE

## 11.5 Saudi Aramco Best Practices (SABP)

SABP-L-001

Wall Thickness Selection of Transportation Pipelines

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<b>DESCRIPTION</b>  <b>11.6 Saudi Aramco Engineering Procedures (SAEP)</b>	SABP-M-006	Wind Loads on Pipe rack
	SABP-M-007	Steel Pipe rack Design
	SABP-P-040	Adjustable Frequency Drive, Application Qualification Procedure
	SABP-P-041	Guidelines for Conducting Arc Flash Hazard Analysis
	SABP-Q-001	Anchor Bolt Design & Installation
	SABP-Q-002	Spread Footings Design
	SABP-Q-008	Design of Concrete Masonry Walls/Buildings
	SABP-Q-010	Mix Design and Construction of Sulfur Extended Asphalt Concrete
	SABP-T-001	Proactive Monitoring and Alerting Solution
	SAEP-13	Project Environmental Impact Assessments
	SAEP-20	Equipment Inspection Schedule
	SAEP-25	Estimate Preparation Guidelines
	SAEP-27	Pipelines/Piping Hydraulic Surge Analysis
	SAEP-31	Corporate Equipment and Spare Parts Data Requirements
	SAEP-35	Valves Handling, Hauling, Receipt Tests, and Storage
	SAEP-99	Process Automation Networks and Systems Security Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement
	SAEP-302	
	SAEP-140	Project Training Impact Assessment
	SAEP-303	Engineering Reviews of Project Documentation
	SAEP-305	Saudi Aramco Library Drawings
	SAEP-323	Performance Qualification Testing of Contract Welders and Brazers
	SAEP-324	Certification Review and Registration of Project Welders
	SAEP-334	Retrieval, Certification and Submittal of Saudi Aramco Engineering & Vendor Drawings
	SAEP-345	Non-Metallic Composite Repair Systems for Equipment
	SAEP-347	Supplying Material from Stockists
	SAEP-351	Bolted Flange Joints Assembly
	SAEP-352	Welding Procedures Review and Approval

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SAEP-384	Inspection Requirements for In-service RTR Piping and Pipelines
SAEP-407	Qualification of Nonmetallic Pipe Installers, Supervisors and Inspectors
SAEP-1131	Pressure Relief Device Authorization through SAP Workflow
SAEP-1142	Qualification of Non-Saudi Aramco NDT Personnel
SAEP-1151	Inspection Requirements for CONTRACTOR Procured Materials and Equipment
SAEP-1154	Guidelines for CONTRACTOR's Quality Plan
SAEP-1160	Tracking and Reporting of Welding, NDT and Pressure Testing for Capital Projects.
SAEP-3101	Equipment and Spare Parts Requirements for CONTRACTOR Procured Equipment

## 11.7 Saudi Aramco General Instructions

G. I. 2.100	Saudi Aramco Work Permit Instructions
G. I. 2.711	Fire & Safety Watch
G. I. 6.012	Isolation, Lockouts & Use of Hold Tags
G. I. 2.710	Mechanical Completion & Performance Certificates
G. I. 0002.721	Electrical Arc Flash Hazard Mitigation
G. I. 150.000	Industrial Hygiene and Occupational Health Aspects of Environmental Protection Policy
G. I. 401.081	Performance qualification of Welders & Welding Operators
GI 430.001	Implementing the Saudi Aramco Hazardous Waste Code
G. I. 1021.000	Street & Road Closure, Excavations, Reinstatement & Traffic Control
SACSM	Saudi Aramco Construction Safety Manual
Guide # 07-005-2012	Saudi Aramco Safety Management Guide

## 11.8 Industry Standards

ASME Sec VIII, Div. 1 Rules for Construction of Pressure Vessels
ASME SEC II Materials
ASME B31.3 Process Piping
ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and other liquids

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00	AUG-2019	10-01861	ISSUED FOR CONSTRUCTION				ASME B16.5	Pipe Flanges and Flanged Fittings
							ASME B16.9	Factory-Made Wrought Butt Welding Fittings
							ASME B16.10	Face-to-Face & End-to-End Dimension of Valves
							ASME B16.11	Forged Steel Fittings, Socket-Welding & Threaded
							ASME B16.20	Metallic Gaskets for Pipe Flanges
							ASME B16.21	Non-Metallic Gaskets for Pipe Flanges
							ASME B16.25	Butt Welding Ends
							ASME B16.34	Valves Flanged, Threaded and Welding End
							ASME B36.10	Welded & Seamless Wrought Steel Pipe
							ASME B36.19	Stainless Steel Pipe
							API 5L	Specification for Line Pipe
							API 598	Valve Inspection & Testing
							API 599	Metal Plug Valves-Flanged, Threaded and Welding Ends
							API 600	Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas industries
							API 602	Steel Gate, Globe & Check Valves for Sizes NPS 4 and smaller for Petroleum & Natural Gas Industries
							API SPEC 15H	Specification for High Pressure Fiberglass Line Pipe
							ACI 318-201	Manual of Concrete Practice
							AISC-ASD-14TH-ED	American institute of steel construction
							ASTM D-422	Particle Size Analysis of Soil
							ASTM D-698	Standard Methods of Test for Moisture - Density Relations of Soil
							ASTM 572/A572M	Standard specification for high strength low-alloy structural steel for (wide-flange shapes, including WT shapes)
							ASTM A992/A992M	Standard specification for high strength low-alloy structural steel for (wide-flange shapes, including WT shapes)
							ASTM A36/A36M	Standard specification for carbon structural steel for all other structural (shapes, plates, and bars)
							ASTM D-1556	Test for Density of Soil in Place by the Sand Cone Method
							ASTM D-2167	Test for Density of Soil in Place by the Rubber Balloon Method
							ASTM D-2049	Standard Methods of Test for Relative Density of Cohesionless Soil
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DESCRIPTION	IEEE 1100	IEEE Recommended Practices and Requirements for Grounding Sensitive Electronic Equipment (Emerald Book)
	NEMA ICS 6	Industrial Control and Systems Enclosures
	NEMA ICS 7	Industrial Control and Systems, Adjustable Speed Drives
	NEMA MG1	Motors & Generators
	NEMA VE1	Metal Cable Tray Systems
	NEMA VE2	Cable Tray Installation Guidelines
	NFPA 70	National Electric Code (NEC) - 2017
	UL 508C	Standard for Safety, Power Conversion Equipment
	IEC 60146	Semiconductor Converters, General Requirements and Line Commutated Convertors
	IEC 61136	Semiconductor Power Convertors, Adjustable Speed Electric Drive Systems

### Process Industry Practices (PIP)

VEFV1100	Vessel/Heat Exchanger Standard Details
PIP STF05501	Fixed Ladders and Cages Fabrication Details
PIP STF05511	Fixed Industrial Stairs
PIP STF05512	Details for Pipe Railing for Walkway and Working Surface
PIP STF05530	Grating Fabrication Details

### Welding Research Council Bulletins

WRC 297	Local Stresses in Cylindrical Shells Due to External Loadings on Nozzles
WRC 537	Local Stresses in Spherical and Cylindrical Shells Due to External Loadings

## 11.9 Non-Material Requirements (NMRs)

SA-7902	Non-Material Requirements for Pumps
SA-7912	Non-Material Requirements for Electric Rotating Machinery
SA-7907	Nonmaterial Requirements for Instrumentation (General)
SA-7918	Nonmaterial Requirement for Pressure Safety Relief Valves
SA-7919-1	Nonmaterial Requirements for Pressure Vessel
SA-7925	Non Material Requirement for Valves

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	SA-7927	Nonmaterial Requirement for Fabricated Structural Steel
	SA-7930	Additional Nonmaterial Requirement

## 11.10 Inspection and Test Requirements

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175-170200	Motors, Electric: Severe Duty Totally Enclosed Squirrel Cage Induction Motors to 500 HP
175-310520	Pumps: ASME / ISO, Sealless
175-SP000008	Inspection Requirement – Adjustable Frequency Drive System
175-013100	PIPE: Fabrication of Spools; Carbon, Alloy, High Strength Special, Low and High Temperature Steels
175-022501	Flanges: Weldneck, Blind Flanges; Forged Steel & Alloy
175-026100	Butt Welding Pipe Fittings
175-043000	Valve Material Certification Requirements
175-043600	VALVES: Metallic; Includes gate, globe, angle, check, needle, ball, plug, piston, butterfly, and choke
175-060100	GASKETS: Metal, Spiral-Wound or Jacketed
175-091900	COATING: SHOP APPLIED; For Tanks, Piping, Pipelines (and Associated Appurtenances & Fittings), Structures, Process Equipment
175-120100	Steel Structures
175-320300	Positive Material Identification (PMI)
175-321900	Pressure Vessels
175-341900	Safety Relief Valves Conventional and Balanced Types
175-341000	Actuator: Electric 34-SAMSS-718
175-347600	Inspection Requirements for Valves Instrumentation and Thermocouple Extension Cable

## 12.0 GENERAL REQUIREMENTS

### 12.1 Engineering Units

All new drawings will be prepared in metric Units. Modified drawings will use their original units.

### 12.2 Documentation

This project will fully document the control system, new installed instrument

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and auxiliary systems databases, design logic and its implementation. All key drawings, as defined in the Saudi Aramco Drafting Manual, will be supplied in Computer Aided Drafting and Design (CADD) format. CONTRACTOR is to convert the all vendor drawings to Aramco format and upload it to the I-Plant. SA shall submit all design drawings, including "Vendor" drawings in CADD format, updated to as-built status to 'PLANTDOC' drawing system within a maximum of one year after the approval of the Mechanical Completion Certificate (MCC). Any drawings made void will be deleted from the Saudi Aramco Drawings and its database updated by this project.

### **12.3 Inspection**

CONTRACTOR to follow the inspection Converge plan as per SAEP-1150 and Inspection Requirements for CONTRACTOR Procured material and equipments as per SAEP-1151.

### **12.4 CONTRACTOR's Quality Plan**

a) CONTRACTOR shall follow the Quality plan as per SAEP-1154 & ISO 9001.

### **12.5 Waivers**

Waivers are identified for small section of pipeline not complying with standard clearances which are approved.

## **13.0 MATERIAL & EQUIPMENT**

### **13.1 Local Manufacture**

COMPANY's policy on the use of locally manufactured products shall be adhered to and strictly enforced. Locally manufactured products approved by COMPANY as meeting its specifications and standards are listed in the IDD-4A report. The emphasis during construction will be to utilize locally manufactured products wherever possible.

### **13.2 Imported Material/Long Lead Items**

Material and products not available from Saudi firms and not manufactured in the Kingdom will have to be ordered through locally established importers.

CONTRACTOR shall submit status of weekly report for long lead items & other all material supplied by CONTRACTOR.

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## **14.0 QUALITY ASSURANCE / QUALITY CONTROL REQUIREMENTS**

## 14.1 Quality Management

The CONTRACTOR shall implement an effective quality management, which addresses all direct and indirect activities related to the PROJECT to ensure that all contractual conditions are met. Quality planning, quality control, quality assurance and quality improvement shall be part of the CONTRACTOR's quality management. To effectively manage the PROJECT quality, the CONTRACTOR shall develop a clearly defined PROJECT Quality Plan/Quality Program. The PROJECT Quality Plan/Quality Program shall be implemented from PROJECT start until completion and communicated at different levels of the PROJECT organization. In addition, the CONTRACTOR shall also require manufacturers/suppliers to develop and implement Quality Control Plan/Inspection and Test Plan for each major material/equipment.

## ~~14.2 Project Quality Plan / Quality Program~~

- The Project Quality Plan/Quality Program shall set out the specific quality procedures and practices, resources, and all activities (in sequence) relevant to this project. The Project Quality Plan/Quality Program shall address QA/QC activities during design, procurement, manufacturing/fabrication, delivery, storage, construction, installation, testing and commissioning of all items of Work and materials/equipment per Scope of Work and Technical Specification.
  - The Project Quality Plan/Quality Program shall be submitted to SA as part of base design package for review and approval.
  - The Project Quality Plan/Quality Program shall clearly define and address the following:
  - The quality objectives to be attained and the CONTRACTOR's commitment to achieve the objectives in the form of a signed policy statement. The CONTRACTOR's management personnel not lower than the person who signed this CONTRACT shall sign the policy statement.
  - Detailed Project organizational chart and specific allocations of

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responsibilities and authorities during the different phases of the project.

- The CONTRACTOR shall include in the project organizational chart QA/QC engineers and inspectors dedicated to quality assurance and quality control (QA/QC). The QA/QC engineers and inspectors shall report directly to the overall project manager. The QA/QC engineers and inspectors shall have adequate experience in their area of responsibility and shall be responsible for ensuring that all phases of the project are built, tested and commissioned in accordance with the requirements of the Project Scope of Work and Technical Specifications.
- The CONTRACTOR's chief QA/QC engineer shall interface directly with the SA REPRESENTATIVE.
- The CONTRACTOR shall use QA/QC personnel other than those performing or directly supervising the Work. The QA/QC personnel shall not report directly to immediate supervisors responsible for producing the Work being inspected.
- The CONTRACTOR's QA/QC personnel shall be kept free from the pressures of cost, schedule and production and shall be given the necessary authority and independence to perform their roles effectively.

## 14.3 Procurement Control

The CONTRACTOR's Project QA/QC engineers shall review all products and services prior to procurement to ensure conformance to specified requirements. Procurement control shall include source evaluation and selection, source inspection and evaluation of objective evidence of quality furnished by a supplier against the project specification.

These products shall cover major materials/equipment and other items including but not necessarily limited to testing services, fill materials, Portland cement concrete and additives, asphalt concrete, water proofing, steel structures, equipment, electrical materials, plumbing materials, architectural and finishing materials and formwork materials.

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## 14.4 Quality Audit

The CONTRACTOR shall conduct its own internal quality surveillance at appropriate stages (e.g. design, procurement, construction, installation and commissioning stage) of the project to determine compliance to and the effectiveness of the Project Quality Plan/Quality Program. Each element of the Project Quality Plan/Quality Program shall be assessed at least once during the life of the project. The schedule and frequency should be adjusted if one or more of the following conditions exist:

- i. Result of previous surveillance indicates a need to perform them more frequently.
- ii. Significant changes are made in the Project Quality Plan/Quality Program.
- iii. Safety, performance or reliability of an item is questionable due to non-conformance.
- iv. Verification of corrective action implementation.

Personnel conducting the quality surveillance shall be independent of those having direct responsibility for the specific activities or areas being evaluated or assessed.

## 14.5 Non-Conformance Control

The CONTRACTOR shall ensure that items and services, which do not conform to specify requirement, are controlled in accordance with documented procedures to prevent unintended use. The CONTRACTOR shall identify, document, segregate, evaluate and dispose non-conforming items and services after proper notification of concerned personnel within the CONTRACTOR's organization.

The CONTRACTOR's QA/QC engineer/inspector shall re-inspect repaired and reworked non-conforming items. The CONTRACTOR shall not use any repaired item or product unless approved by SA.

Under this clause, the following definitions apply:

- i. Repair – Action taken on a non-conforming product so that it will fulfill

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**BY: AMCD**  
**09-Oct-2019**

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the intended usage requirements although it may not conform to the original specified requirements (ISO 9000:2000).

- ii. Rework – Action taken on a non-conforming product so that it will fulfill the specified requirements (ISO 9000:2000).

The CONTRACTOR shall develop non-conformance report (NCR) form and submit it to the SA for review and comment. The CONTRACTOR's QA/QC engineers/inspectors shall have the freedom to issue NCRs, verify implementation of corrective actions and prevent use of non-conforming items until the deficiency has been satisfactorily resolved. The CONTRACTOR's QA/QC engineer shall submit bi-weekly site QA/QC reports about non-compliances.

a) Corrective Action

*ISSUED FOR CONSTRUCTION BY ESDS DATE: 10-01-861*  
 The CONTRACTOR shall develop, document and implement a system for determining the root cause of non-conformities and identifying the required corrective actions. New procedures or changes to existing procedures resulting from identification of the root cause and potential root cause of non-conformances shall be documented and implemented. Follow-up action shall be taken to verify effective implementation of corrective action. The identified cause and corrective action should be included in the bi-weekly site QA/QC reports that are required to be submitted to SA.

b) Quality Records

The CONTRACTOR shall develop and maintain a system for preparation, maintenance, protection and preservation of quality records. Documents such as inspection reports, field inspection checklist, factory test reports, laboratory test reports, witnessed test reports, inspection logbooks, equipment calibration records/certificates, construction drawings and specifications, approved submittals and non-conformance reports are part of these records. All quality records shall be available at WORKSITE for use and/or reference by the CONTRACTOR and SA Representative.

c) Control of Inspection, Measuring and Testing Equipment

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All measuring and testing equipment and devices, which can affect the quality of construction, shall be controlled and maintained. The CONTRACTOR shall develop and implement a documented calibration control program indicating equipment calibration schedule and identifying those who are responsible for control of the equipment. The CONTRACTOR shall ensure that only properly identified and calibrated measuring and testing equipment are used in the project. Equipment calibration certificates shall be made available to SA Representative upon request.

d) Document Control

The CONTRACTOR shall develop and maintain a documented control program for the review, approval, revision and distribution of document for the activities affecting quality. Responsible personnel for revision, issuance and approval of documents shall be identified. Control shall ensure that all pertinent and current issues of appropriate documents are available at locations where they are essential and obsolete or superseded documents are promptly removed. The CONTRACTOR shall list all the documents that have to be controlled and shall include Project Quality Plan/Quality Program, Quality Control Plan/Inspection and Test Plan, construction and design drawings, calculations, correspondence, inspection and test reports, field inspection checklist, etc.

*(Redacted stamp: ISSUED FOR CONSTRUCTION  
06-03-2019)*

e) Material/Equipment Handling, Storage, Identification and Control

The CONTRACTOR shall verify that material/equipment meet prescribed contractual requirements and are properly handled, identifiable, traceable, cleaned, preserved and stored.

Control of interface and interaction between the SA and the CONTRACTOR and between the CONTRACTOR and its SUB-CONTRACTOR, manufacturers / suppliers, QA/QC services CONTRACTOR's (independent inspection agency(ies)) and independent testing laboratories.

## **14.6 Field Testing/Inspection and Construction/Installation Control**

The CONTRACTOR shall establish and document all procedures and Work instructions to ensure that the construction and installation processes are

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performed in a controlled manner. The necessary qualification of personnel and procedure for activities such as Mechanical/Electrical /Instrumentation & Control/civil/concrete works, welding, non-destructive examination, heat treatment, etc. shall be defined. The CONTRACTOR's personnel shall adhere to work instructions and procedures.

The CONTRACTOR shall conduct inspection and testing activities at all phases and quality audit at appropriate stages of the project construction/installation. The CONTRACTOR's QA/QC engineers/inspectors shall develop and use field inspection checklist to facilitate checking of a process, activity, material or equipment. The field inspection checklist shall state the characteristic to be verified, inspection method, acceptance criteria and clause reference of the applicable standard or specification. The checklist shall have provision for writing the result of inspection, date of inspection and name and signature of the QA/QC engineer/inspector. Such activities where inspection checklists are required shall include but not necessarily limited to all pre-commissioning and commissioning checks and tests, material/equipment receiving inspection, concrete pre-pour inspection, asphalting, etc. All inspection and testing results shall be reviewed, safely stored and maintained by the CONTRACTOR. Typical checklist shall be provided to ~~Sup For Construction~~  
~~KER-Accredited~~ for review and comment.

The CONTRACTOR shall develop and implement the use of inspection logbook for use by the CONTRACTOR's QA/QC engineers/inspectors in recording their comments and observations as a result of their inspection. The CONTRACTOR's personnel responsible for rectifying any observed deficiency or non-conformance shall also write their reply in the logbook stating the actions taken to correct the deficiency. The CONTRACTOR's QA/QC engineers/inspectors shall ensure that all unsatisfactory observations on an item are cleared before any activity proceeds to the succeeding stage of that item.

a) Quality Control Plan / Inspection and Test Plan  
(For the Materials provided by the CONTRACTOR)

1. The CONTRACTOR shall submit to the SA the Quality Control Plan/Inspection and Test Plan for each applicable equipment/material being provided by the CONTRACTOR for this Project.

b. Manufacturers/Suppliers

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1. The CONTRACTOR shall procure all major material items for the Project from SA qualified and approved sources.
2. The CONTRACTOR shall ensure that purchase orders to manufacturers/suppliers contain all the applicable industry and SA developed standards and specifications.
3. The CONTRACTOR shall ensure that purchase order(s) to approved manufacturers/suppliers and not re-assigned or subcontracted to other manufacturers/suppliers without SA's written consent.

## 14.7 Technical Data Manuals

- A. The CONTRACTOR shall provide technical data manuals for the equipment and material installed under the scope of this Project.

## 14.8 Test Record Book

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- A. The CONTRACTOR shall provide to SA, a "Test Record Book" which shall include the following:
    - a) Description of Equipment Tested and Manufacturer's Nameplate Data.
    - b) Description of Test.
    - c) List of Apparatus with Calibration Data.
    - d) Test Results.
    - e) Conclusions and Recommendations.
    - f) Appendix, including test forms.
  - B. Each test form where applicable shall include a column quoting the acceptable maximum and minimum limits of the test in terms of voltage, current, frequency, time, etc. and include "As Found" and "As Left" values.
  - C. Four (4) copies of the "Test Record Book" are to be submitted within thirty (30) days after completion of the Project.

## 15.0 Outage Schedule/Shutdown Coordination

- a. Planned outages of existing equipment, which are required for

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CONTRACTOR's construction or installation of new equipment or movement/relocation of existing equipment, shall be minimized by the CONTRACTOR during the PROJECT execution.

- b. As a part of the CONTRACTOR's coordination activity (for the planned outage). CONTRACTOR shall provide reasons, plans, and detailed schedule for the planned outages that will be subjected to SA's review and approval.
- c. All outages shall be scheduled at least six (6) weeks in advance. Any requested outage must be approved by SA at least two (2) working weeks before actual WORK is carried out.

## 16.0 As-Built

- a) The CONTRACTOR shall maintain a complete record of all as-built information in the site office. A set of blue prints shall be marked-up on a daily basis showing changes to as-built condition. The mark-up shall be clearly made on a professional manner using green color for any deletion and red for any changes or additions and shall be signed and concurred by the COMPANY Representative.
- b) As-built engineering drawings, manuals and other documents shall be prepared and submitted in accordance with the requirements of SA. In addition the CONTRACTOR shall submit to SA three (3) copies of As-built engineering drawings (D size) and other engineering drawings, manuals, vendor drawings and other documents in soft copy one (1) month before the submittal of the final As-built package to check the adequacy of the information, legibility and completeness of the package.
- c) Final as-built package shall consist of , one (1) set of these drawings, and three (3) sets of CDs containing electronic files both PDF and native files of these drawings shall be submitted to SA.

## 17.0 ABBREVIATIONS

API	AMERICAL PETROLEUM INSTITUTE
ADIP	AMINO-DI-ISOPROPANOL
COMPANY	SAUDI ARAMCO
CONTRACTOR	LSBP CONTRACTOR
GPM	GALLONS PER MINUTE

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