



KENYA ELECTRICITY GENERATING COMPANY LIMITED

KGN-GDD-062-2019

TENDER FOR DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING  
OF GEOTHERMAL WELLHEADS CONTROL CENTRE

25<sup>th</sup> April, 2019

In accordance with the TENDER FOR DESIGN, SUPPLY, INSTALLATION,  
TESTING AND COMMISSIONING OF GEOTHERMAL WELLHEADS CONTROL  
CENTRE FOR GEOTHERMAL DEVELOPMENT DIVISION, KenGen hereby issues  
Addendum No.1

ADDENDUM NO.1:

No	AS IT IS IN THE TENDER	TO BE CHANGED TO
	SECTION VI: TECHNICAL SPECIFICATIONS	
1	1.1 INTRODUCTION Some information missing in tender about Eburru power plant.	Include general information on Eburru power plant
2	Schedule A: Instrumentation technical specifications Item 4 Description	Specifications and quantity changed
3	Scope of Works	Additions in Scope of Works
4	Schedule C	Changes to Schedule C
5	Technical Evaluation Criteria	Changes to Technical Evaluation Criteria
6	Price Schedule	Changes in description and quantities
7	Warranty period	As in the technical specifications

ACKNOWLEDGEMENT OF ADDENDUM NO. 1

We, the undersigned hereby certify that the addendum is an integral part of the document and the alterations set out in the addendum has been incorporated in the tender proposal.

Signed \_\_\_\_\_

Tenderer \_\_\_\_\_



**KENYA ELECTRICITY GENERATING PLC**

**KGN-GDD-062-2019**

**TENDER FOR DESIGN, SUPPLY, INSTALLATION, TESTING  
AND COMMISSIONING OF  
GEOHERMAL WELLHEADS CONTROL CENTRE**

***(CITIZEN CONTRACTORS)***

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**April, 2019**

**SECTION VI:  
TECHNICAL SPECIFICATIONS  
GENERAL INFORMATION AND REQUIREMENTS**

**1.1 INTRODUCTION**

**1.1.6 Turbine and Turbine Governor**

- (a) Eburru plant consists of one 2.44MW turbine.
- (b) Pilot plant consists of two 2.75MW turbines
- (c) C64 Turbine consist of 3.2MW rated plants
- (d) C50 package II & III turbines consists of 5.5MW rating plants
- (e) Eburru a 2301D-ST Woodward governor for load and speed regulation. All the other units use Woodward Turbine Control 505 governor.

**1.1.7 Steam Turbine Generator**

- (a) Eburru has a 3MVA generator; voltage regulation is done using digital excitation control system (DECS 200).
- (b) Pilot plant and C64 Generators consists of 4MVA plants, voltage regulation is done by digital excitation control system (DECS 200)
- (c) The AVR modes consists of AVR and P.F/VAR
- (d) C50 package II generators consists of 6.8MVA rating with AVR model DECS250
- (e) C50 package III generators consist of 7.2MVA rating with AVR model DECS250

1.1.9 The plant control system in Eburru is realised by a Productivity 3000 PLC (Automation Direct) while in the rest of the wellhead power plants the control system is realized by use of SIEMENS S7-300 and S7-1500 series PLCs. The PLC cards arrangement encompass the following cards:

**Table 1 Eburru PLC Cards Arrangement**

	<b>Part Number</b>	<b>Description</b>	<b>Qty</b>
1		Productivity 3000 Programmable Automation Controller	1
2	P3-16TR	16 Channel Relay Output Module	2
3	P3-08TRS-1	8 Channel Isolated Relay Output module	2
4	P3-16ND3	8 Channel Analog Input module	4
5	T1F-08DA-1	8 Channel Analog Current Output Module, Sinking	2
6	T1F-16AD-1	16 Channel Analog Current Input Module, Sinking	3
7	T1F-16RTD	16 Channel RTD Input Module	7
8	T1F-08AD-1	8 Channel Analog Current Input Module, Sinking	5
9	T1K-16ND3	16 Channel 24VDC Input Module, Sinking/Sourcing	3
10	T1K-08TR	8 Channel Relay Output Module	5

11	T1K-08ND3	8 Channel 24VDC Input Module, Sinking/Sourcing	1
12	T1H-CTRIO	High Speed Counter I/O Module, Sinking/Sourcing	1
13	EA7-T15C	C-More Touch panel Screen	1

**Table 2: Instrumentation Technical Specifications**

Item	Description	General requirements	Quantity
4	Oil level Sensor/Switch with integrated temperature and moisture sensors (for cooling tower gearbox)	Capacitance actuated On/Off level control DPDT contacts relay 2NOs and 2NCs contacts Explosion proof, weather tight enclosure Operating temperatures of up to 80 degrees Celsius Power supply: 25Vdc To come with integrated temperature and moisture content sensors. NB: To be used in hazardous environment	80

**Table 3: Power Plant PLC Scope of Works**

Plant	System	Required Action
All plants	Generator capability curve	Graphics to be created to display generator capability curve with all the limits and the actual generation point within the capability curve.
	Auxiliary consumption readings	To be displayed on all HMIs.

## **SCHEDULE C: INTEGRATION, TELECOMMUNICATIONS & CONTROL CENTRE WORKS (WLCC and WRCC)**

### **SYSTEMS INTEGRATION**

#### **Introduction**

#### **Wellheads Local Control Centre (WLCC) OW914**

OW914 Local Control Centre cluster has three remote wellhead plants connecting via optical fibre ground wire (OPGW) to the WLCC. These wellheads plants are Wellhead OW915 (KWG09 & 10), Wellhead OW919 (KWG11) and Wellhead OW905 (KWG14).

Additionally, Wellhead OW914 wellhead plants (KWG04, 05, 06, 07 & 08) are connected locally via underground fibre. Currently all these plants are being controlled from OW914.

The existing configuration is that control of the plant is achieved through a touch panel at the specific plant and a remote connection at the main control centre (WLCC). The design shall have Wellheads Local Control Centre (WLCC) OW914 controlling Wellhead OW915 (KWG09 & 10), Wellhead OW919 (KWG11), Wellhead OW905 (KWG14) and OW914 (KWG04, 05, 06, 07 & 08) via a SCADA software as opposed to the current remote connection. The proposed design shall

have the virtualized servers getting information from the PLC same way as the touch panel and the workstations. A database on all the signals shall be created on the servers. Templates on all the control processes shall be clearly defined on the databases. There shall be control levels to differentiate between the touch panel control level, local control level (WLCC) and the remote control level (WRCC).

### **Wellheads Local control centre OW37 Works**

OW37 Local Control Centre cluster currently has one remote wellhead plant (OW39 (KWG15)) connecting via optical fibre ground wire (OPGW) to the LCC.

Additionally, Wellhead OW37 wellhead plants OW37 (KWG01, 12 &13) are connected locally via underground fibre. Currently all these plants are being controlled from OW37 via remote connection software.

The existing configuration is that control of the plants is achieved through a touch panel at the specific plant and a remote connection at the main control centre (WLCC). The design shall have Wellheads Local Control Centre (WLCC) OW37 controlling Wellhead OW39 (KWG15), Wellhead OW37 (KWG01, 12 &13) and Wellhead OW43 (KWG02 &03) via a SCADA software as opposed to the current remote connection.

The design shall have the virtualized servers getting information from the PLC same way as the touch panel and the workstations. A database on all the signals shall be created on the servers. Templates on all the control processes shall be clearly defined on the databases. There shall be control levels to differentiate between the touch panel control level, local control level (WLCC) and the remote control level (WRCC).

Currently Wellhead OW43 (KWG02 &03) is controlled locally and has no existing connection to OW37 Local Control Centre. However, a different tender has been floated to run an OPGW to OW37 Local Control Centre to provide point to point fibre connectivity between the two wellheads.

### **Eburru Works**

#### **Eburru Wellheads Local Control Centre**

Eburru power plant is located approximately 21 KM North West of Lake Naivasha town. It is the furthest plant from all the other plants in the Geothermal Area and hence is currently a standalone WLCC.

The existing configuration is that control of the plant is achieved through a touch panel at the plant and a workstation at the control centre. The Operator workstation accesses information on the PLC via Engineering workstation. If the Engineering workstation fails it is not possible to get information on the operator workstation.

The design shall have the local servers getting information from the PLC same way as the touch panel and operator workstations. The engineering workstation should read from either the PLC or the server. A database on all the signals shall be created on the servers. Templates on all the control

processes shall be clearly defined on the databases. There shall be control levels to differentiate between the touch panel control level, local control level and the remote control level.

### **Telecommunications Requirements (Interconnection between LOCAL Control Centres and Wellhead Central Control):**

The three WLCCs will be interconnected back to the WRCC as below:

(i) **OW37 LOCAL CONTROL CENTRE**

KenGen will avail point to point fibre pairs to connect OW37 WLCC to the new WRCC.

(ii) **OW914 LOCAL CONTROL CENTRE**

KenGen will avail point to point fibre pairs to connect OW914 WLCC to the new WRCC.

(iii) **EBURRU LOCAL CONTROL CENTRE**

The contractor will be responsible for installation, configuration and commissioning of a link between Eburru WLCC and the new WRCC. The minimum technical specifications of the installed link shall include, but will not be limited to, the below:

- Link termination on both ends will be on an Ethernet interface.
- Maximum latency of 50 milliseconds on the point to point with no traffic loaded on it.
- Minimum throughput capacity after link configuration shall be not less than 10Megabits.

### **Wellheads Remote Control Centre (WRCC) Works**

This is a new control centre integrating Wellheads Local control centres (WLCC) OW914, Wellheads Local control centre (WLCC) OW37 and Eburru wellhead. There shall be 8 high availability workstations fetching information from the controller (PLC) and historical and trends from the redundant virtual servers. The signals from the Local control centres to the remote control centre will be by communication. The same SCADA software running in the WLCC shall be installed in the servers and workstations at the WRCC. The proposed solution shall not use remote connection software to display information on the HMIs as currently configured.

### **Online Back up and disaster recovery**

There shall be an online back up and disaster recovery solution at the WRCC. The back up and disaster recovery solution shall offer back up for the devices on the SCADA network on all control centres. The solution should back up images of the individual workstations and servers and offer online restore in case of data recovery. It shall be capable of restoring system configurations of both the SCADA and windows operating system.

## **Domain Controller**

There shall be a domain controller for the Management of Windows Workstations. The Domain controller application shall be configured, tested and commissioned by the contractor for:

- Management of windows workstations.
- Authentication of users at the all the control centres in the SCADA network.
- Other active directory services necessary for optimal running and management of the virtual environment

## **SCADA Web server**

There shall be a SCADA web server. The SCADA WebServer shall enable:

Simple and clear trends and analytics visualisation. Quick display of key data and information for monitoring, regulation and control, real-time overview of current data and notifications. This information shall be read only accessed through a web browser and all security features applied.

## **Historian**

There shall be an historian archiving all the information from all the control centre (SCADA events and analogue historian). The historian system shall archive SCADA events ,user actions and analogue parameters.

The events historian shall:

- a) Be a windows-based system with an open source database platform preferably SQL and supporting ODBC.
- b) Be in such a way that events from the field will flow to the Local database stations, which interfaces to the Main SCADA server and by use of suitable interface drivers, the data from the main SCADA servers shall be off loaded and archived in weekly tables which can easily be retrievable through a reverse process from an operator station as illustrated in fig. 1 below.
- c) Contain Logs depicting the archival process and server performance. The logs shall be easily available to the system administrator.
- d) Support open data base tools and populate data in Microsoft applications like access and excel work sheets other than HMI platform to mine historized data.

The historian system for SCADA analogue parameters shall:

- a) Filter and compress field analogue data to ensure only a significant process representation is historized.
- b) Maintain high availability OPC Data Access (OPC DA) protocol between the historical and the site database servers which will also buffer the plant data in case the historian is unavailable.
- c) Archive data in a logical and easily retrievable option preferable on data slices of 100mb



- d) Have tools that can be used to mine the data from the historical server. These tools will range from Microsoft application add-ins to inbuilt tools that can either be customized or installed on standalone computers.
- e) Be capable of customizing both daily and monthly plant performance reports. The reports shall be managed in a web environment and should be shareable on a common platform.
- f) OPC Historical Data Access (OPC HDA) and OPC Alarms & Events (OPC AE) shall be supported.

### Cybersecurity Solution

There shall be a SCADA cybersecurity monitoring solution and a SCADA network forensics solution implemented at the WRCC. The cybersecurity solution shall be able to detect vulnerabilities, intrusions and deter intrusions. The cybersecurity shall conform to the latest SCADA security standards (NIST, ISA 99 (IEC 62443) etc. The cybersecurity system shall include SCADA network forensics functionality. The network forensic system shall capture and store network traffic during operations and provide data querying, events, logs and analysis functionality to support post incidence investigation, including incidence reconstruction.

### Demilitarized Zone

There shall be a DMZ to separate the SCADA LAN from the external networks.

**Table 4: Integration, Telecommunications and Control Centre Works**

	<b>Hardware Specifications</b>		<b>Bidder's Offer (Fill)</b>
	<b>Operator Station (OPS)</b>		
<b>Workstations</b>	Quantity	19	
	Model	Rack mount industrial Workstation	
	Memory (RAM)	16GB	
	CPU	Intel® Xeon® processor E5-2600 v3 3.0 GHz	
	Operating System	Pre-installed with Genuine windows 10 Pro – 64 bit/ With Recovery CDs/DVD/ISO image	
	Hard Disk Drive	500GB each.	
	<b>Interfaces</b>		
	RJ45 Ethernet Port	4	
	HDMI port	X1(One)	
	DVI Port	2(one)	
	DisplayPort	2(two)	
	VGA Port	2(two)	
	USB 3.0 Ports	X4(Four)	

	PS/2 Port	2(two) -Keyboard & Mouse	
	Parallel Port	1(one)	
	Serial Port	1(one)	
	eSATA	1(one)	
	Graphics Processor	NVIDIA Quadro P4000	
	Video Interfaces	DVI, DisplayPort, VGA, HDMI	
	Audio out Jack	1(one)	
	Line in Jack	1(one)	
	Input Voltage	110-240 V ,50 Hz	
	Power Supply Unit	Modular	
	Weight and height	1U	
	Plug Type	BF (Three pin) British standard 3 meters long	
	Specification		
<b>Monitor</b>	Quantity	33 pcs	
	LED-backlit LCD monitor -		
	Size	23 inches	
	Maximum Resolution	1920 (H) x 1080 (V) dots	
	Dimensions (w/ stand)	19.64 inches x 7.09 inches x 13.95 inches - extended / 19.64 inches x 7.09 inches x 18.81 inches - compressed	
	Power Source	100 to 240 VAC / 50 or 60 Hz $\pm$ 3Hz / 1.5 A	
	Maximum Power Consumption	42W	
	Weight (with stand)	6.8 kg	
	Interfaces	1 x DP (ver 1.2) / 1 x HDMI (ver 1.4) / 1 x VGA / 1 x USB 3.0 port - Upstream / 2 x USB 3.0 ports - Side / 2 x USB 2.0 ports - Bottom	
	Display Position Adjustments	Height-adjustable stand (130mm) / Pivot (90° clockwise) / Swivel (45° to 45°) / Tilt (-5° to 21°)	

<b>Keyboard</b>		QWERTY keyboard (English)	
	Quantity	38 pcs	
<b>Mouse</b>	Quantity	38 pcs	
<b>2.2 Engineering WorkStation (EWS) at the Remote control centre</b>	Quantity	2	
<b>Workstation</b>			
	Model	Rack mount industrial Workstation	
	Memory(RAM)	16GB	
	CPU	Intel® Xeon® processor E5-2600 v3 3.0 GHz	
	Operating System	Pre-installed with Genuine windows 10 Pro – 64 bit/ With Recovery CDs/DVD/ISO image	
	Hard Disk Drive	500 GB	
	<b>Interfaces</b>		
	RJ45 Ethernet Port	4	
	HDMI port	X1(One)	
	DVI Port	2(one)	
	DisplayPort	2(two)	
	VGA Port	2(two)	
	USB 3.0 Ports	X4(Four)	
	PS/2 Port	2(two) -Keyboard & Mouse	
	Parallel Port	1(one)	
	Serial Port	1(one)	
	eSATA	1(one)	
	Graphics Processor	NVIDIA Quadro P4000	
	Video Interfaces	DVI, DisplayPort, VGA, HDMI	
	Audio out Jack	1(one)	
	Line in Jack	1(one)	
	Input Voltage	110-240 V ,50 Hz	
	Power Supply Unit	Modular	

	Weight and height	1U	
	Plug Type	BF (Three pin) British standard 3 meters long	
<b>Engineering WorkStation (EWS) Mobile (Laptop)</b>	Quantity	2	
	Screen Size	15.6-inch	
	Operating system	Pre-installed with Genuine windows 10 Pro – 64	
		Recovery CDs/DVD	
	Processor/Chipset		
	CPU	Intel Core i7	
	Speed	2.7 Ghz	
	64-Bit Computing	Yes	
	Memory		
	RAM	16GB	
	Storage		
	Storage Capacity	1.0 TB	
	Optical Drive	Super Multi DVD burner	
	Display		
	Display Size and Type	15.6" diagonal LED-backlit (1920 x 1080)	
	Audio & Video& Graphics		
	Graphics Processor	Intel® HD Graphics 620/ AMD Radeon™ R7 M440 Graphics /NVIDIA® GeForce® GTX 960M 4GB GDDR5	
	Camera	Yes	
	Sound	Stereo speakers, stereo microphone	
	Input		
	Type	Key	
	Keyboard	QWERT	
	Mouse	High Quality branded Mouse	
	Communication		
	Modem	Yes	
	Wireless	802.11ac + Bluetooth 4.0	
	Network Interface	Integrated 10/100 BASE-T Ethernet LAN	
	Batteries (Lithium-Ion (Li-Ion))		
	Ac Adapter		

	Input	AC 120/230 V (50/60 Hz)	
	Connections & Expansions		
	Rj45 Ethernet Port	1	
	HDMI Port	X1(One)	
	USB 3.0 Ports	X1(One)	
	Mini DisplayPort Ports	X1(One)	
	USB 2.0 Ports	X2(Two)	
	Memory Card Reader	Yes (SD Card Multimedia Card)	
	Dimensions		
	Measurement	38.43x25.46x 2.43 cm: Dimensions may slightly vary by configuration	
	Weight	4.44 pounds/2.04 kg: may slightly vary by configuration	
	Environmental Standards		
	Energy Star	Yes	
	Warranty & Maintenance	2 Years	
	Good Quality Bag	Branded	
	Colour	Black	
	Brochure	Attach	
<b>2.3 Historian</b>	At Remote control Centre		
	Quantity	2	
	Processor	Intel® Xeon® processor E3- v5, 3.6GHz	
	Operating System	Windows Server 2016 x64	
	Hard Drive	4x300GB, Raid5	
	Raid 1/Raid 1		
	Raid Controller	H730 (1GB cache)	
	Memory	8GB	
	Remote Management	Provide	
	Chassis Overview	1U Rack	
	Power		
	AC Power/Max Current:	Redundant, 550W hot plug	
	Input Voltage	110-240 V ,50 Hz	
	Power Supply Unit	Modular	
	Weight	1U	
	Plug Type	BF (Three pin) British standard 3 meters long	

<b>2.4 OLE for Process Control (OPC)-Gateway</b>		(In case of OPC server use the following specifications for the server)	
	Model	Rack mount Workstation	
	Memory(RAM)	16GB	
	CPU	Intel® Xeon® processor E5-2600 v3 3.0 GHz	
	Operating System	Pre-installed with Genuine windows 10 Pro – 64 bit/ With Recovery CDs/DVD/ISO image	
	Hard Disk Drive	500GB	
	Interfaces		
	RJ45 Ethernet Port	4	
	HDMI port	X1(One)	
	DVI Port	2(one)	
	DisplayPort	2(two)	
	VGA Port	2(two)	
	USB 3.0 Ports	X4(Four)	
	PS/2 Port	2(two) -Keyboard & Mouse	
	Parallel Port	1(one)	
	Serial Port	1(one)	
	eSATA	1(one)	
	Graphics Processor	NVIDIA Quadro P4000	
	Video Interfaces	DVI, DisplayPort, VGA, HDMI	
	Audio out Jack	1(one)	
	Line in Jack	1(one)	
	Input Voltage	220-240 V ,50 Hz	
	Power Supply Unit	Modular	
	Weight	1U	
	Quantity	Depends on the interfaces	
	Plug Type	BF (Three pin) British standard 3 meters long	
<b>Servers (Virtualized environment for Well Heads Control Centre)</b>	To be installed at the Remote Control Centre (RCC) and two Local Control Centres (LCC)		
	<b>Production host A and B</b>		

	Quantity	6	
	Operating system	Windows Server 2016 x64 Microsoft Windows Server® with Hyper-V Red Hat®	
	Processor	Intel® Xeon® processor 3.0 GHz, 8 Core	
	Hard Drive	8x300GB,10K+1 Hot Spare/ Raid10 Raid 1/Raid 1	
	Raid Controller	H730 (2GB cache)	
	Memory	32GB	
	DVD	DVD-ROM,SATA	
	Supported Hypervisor	ESXi version 5.x or equivalent	
	Remote Management	AS per the model	
	Chassis Overview	1U Rack	
	Power AC Power/Max Current:	Redundant, 295W hot plug ,50-60 Hz	
	Supported Hypervisor	ESXi version 5.x or equivalent	
	Remote Management	Provide	
	Chassis Overview	1U Rack	
	Power AC Power/Max Current:	Redundant, 550W hot plug	
	Hard Drive/Raid	4X10TB, 7.2K, RAIDS hot-swap 2.5” NL-SAS or SATA drives for data and OS	
	Memory	32GB	
	Network Interface	1 x Quad Port 1Gb + 2 x Dual Port 1Gb Network Interface Cards	
<b>VM Management Host</b>	To be installed at the Remote Control Centre (RCC) and two Local Control Centres (LCC)		
	Quantity	3	

	Processor	Intel® Xeon® processor E5-2620 v3, 2.40GHz, 6 Core	
	Hard Drive	4x300GB,10K+1 Hot Spare/ Raid10 Raid 1/Raid 1	
	Raid Controller	H730 (1GB cache)	
	Memory	8GB	
	Supported Hypervisor	ESXi version 5.x or equivalent	
	Remote Management	As per the model	
	Chassis Overview	1U Rack	
	Power AC Power/Max Current:	Redundant, 550W hot plug	
	Hard Drive/Raid	4X10TB, 7.2K, RAIDS hot-swap 3.5” NL-SAS or SATA drives for data and OS	
	Memory	32GB	
<b>Vsphere Client</b>	To be installed at the Remote Control Centre (RCC) and two Local Control Centres (LCC)		
	Quantity	3	
	Model	Rack mount workstation	
	Memory	8GB	
	CPU	Intel® Xeon® processor E5-2600 v3 3.0 GHz	
	Operating System	Pre-installed with Genuine windows 10 Pro – 64 bit/ With Recovery CDs/DVD/ISO image	
	Hard Disk Drive	500 GB	
	<b>Interfaces</b>		
	RJ45 Ethernet Port	4	
	HDMI port	X1(One)	
	DVI Port	2(one)	
	DisplayPort	2(two)	
	VGA Port	2(two)	



	USB 3.0 Ports	X4(Four)	
	PS/2 Port	2(two) -Keyboard & Mouse	
	Parallel Port	1(one)	
	Serial Port	1(one)	
	eSATA	1(one)	
	Graphics Processor	NVIDIA Quadro P4000	
	Video Interfaces	DVI, DisplayPort, VGA, HDMI	
	Audio out Jack	1(one)	
	Line in Jack	1(one)	
	Input Voltage	110-240 V ,50 Hz	
	Power Supply Unit	1U	
	Plug Type	BF (Three pin) British standard 3 meters long	
<b>NAS storage</b>	To be installed at the Remote Control Centre (RCC) and two Local Control Centres (LCC)		
	Quantity	4	
	Microsoft Windows Storage Server 2016 (Standard Edition and Workgroup Edition)		
	<b>Processor</b>	Intel® Xeon® processor E3-1220 v5 3.0 GHz 4 core	
	Hard Drive	4X10TB, 7.2K, RAID 5 hot-swap 3.5” NL-SAS or SATA drives for data and OS	
	Memory	8GB	
	Chassis Overview	1U Rack	
	Data Protection, Disaster Recovery, Security	Hot-plug hard drives, hot-plug power, hot-plug cooling, ECC memory.  Should be able to back up and restore online.	
	Data Protection Features	DFS-R (Replication), VSS (Snapshots), Optional TPM	

	Power	Redundant, 350W hot plug	
	Management	All available Management Consoles	
	Data Management Features:	Data deduplication with compression, FCI (File Classification Infrastructure), FSRM (File Server Resource Manager)	
	Hard Drive	4X10TB, 7.2K, RAIDS hot-swap 3.5" NL-SAS or SATA drives for data and OS	
	Memory	8GB	
<b>Non-Virtualized Environment (Remote Well Heads)</b>	To be installed at Eburru wellhead.		
<b>DCS Servers</b>	<b>(In case of OPC server use the following specifications for the server)</b>		
	Quantity	2	
	Processor	Intel® Xeon® processor E3- v5, 3.6GHz	
	Operating System	Windows Server 2016 x64	
	Hard Drive	4x300GB, Raid5	
	Raid 1/Raid 1		
	Raid Controller	H730 (1GB cache)	
	Memory	8GB	
	Remote Management	Available supported	
	Chassis Overview	1U Rack	
	Power		
	AC Power/Max Current:	Redundant, 550W hot plug	
<b>Desktop KVM Switches</b>	<b>The quantity will be determined by the design and configuration of the</b>		

	<b>hardware.</b>		
	Where necessary		
	<ul style="list-style-type: none"> <li>• Built-in Multi-Stream Transport (MST) hub allows dual displays (DisplayPort / HDMI) from a single DisplayPort source</li> <li>• Supports superior video quality – 4K UHD (3840 x 2160 @ 60 Hz) and 4K DCI (4096 x 2160 @ 60 Hz); 2-port USB 3.1 Gen 1 hub with SuperSpeed 5 Gbps data transfer speeds</li> <li>• Computer selection via front panel pushbuttons, hotkeys, USB mouse, and RS-232 commands</li> <li>• DisplayPort Dual-Mode (DP++) technology supports HDMI and DVI signals via a DisplayPort-to-HDMI/DVI DP++ adapter</li> </ul>		
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• 1x 2-Port USB 3.0 4K DisplayPort MST KVM<sup>TM</sup> Switch</li> <li>• 2x DisplayPort 1.2 Cables (1.5m/5ft)</li> <li>• 2x USB Cables (USB 3.0-A to USB 3.0-B; 1.8m/6ft)</li> <li>• 4x Audio Cables (1.8m/6ft)</li> <li>• 1x Power Adapter</li> <li>• 1x User Instructions</li> </ul>		

<b>Firewall: Cisco Industrial Security Appliance 3000</b>	Quantity	3	
	Manufacturer	Cisco	
	Model	Cisco ISA 3000	
	Ports	Four (4) Copper 1 Gigabit Ethernet Ports	
	Visibility and control of protocols	DNP3, CIP, Modbus, IEC 61850 and applications by Omron, Rockwell, GE, Schneider, Siemens	
	Harsh Environment Operating Temperature Range	-40° to 60°C	
	Ruggedized	Hardening for vibration, shock, surge, and electrical noise immunity	
	Design	compact DIN-rail unit design with industrial LED features for easy monitoring	
	Threat Detection	over 25,000 rules for the widest range of operational technology protection	
	Throughput	Maximum 2 Gbps – Minimum 22 Mbps Varies with traffic type and security activity	
	Maximum Weight	2kg	
	Power Supply and Ranges	Dual internal DC Nominal ± 12 Vdc, 24 Vdc, or 48 Vdc Maximum range 9.6 Vdc to 60 Vdc Power consumption: 24 Watts	
	Application Control	Visibility and Control of all DMZ infrastructure Visibility and Control of Industrial applications Visibility and Control of individual protocol commands and values Example Protocols	

		Addressed for Visibility and/or Control: BACnet; CIP; COSEM; DNP3; EtherIP; GOOSE; IEC 60870-5-104; ISO-MMS; Modbus; OPC-UA;	
	Warranty	5 year warranty	
<b>Integrated Services Routers: Cisco</b>	Quantity	3	
	Manufacturer	Cisco	
	Model	C921-4P	
	Ports/Interfaces	WAN: 2 Ports (Gigabit Ethernet) LAN: 4 Ports (Gigabit Ethernet Managed Switch)	
	Integrated USB 2.0	Yes	
	Maximum crypto throughput (bit-rate policed)	150 Mbps	
	Switch Features	Auto Media Device In/Media Device Cross Over (MDI-MDX) 25 802.1Q VLANs MAC filtering Switched Port Analyzer (SPAN) Storm control Smart ports Secure MAC address Internet Group Management Protocol Version 3 (IGMPv3) snooping 802.1X	
	High Availability	Virtual Router Redundancy Protocol (VRRP) (RFC 2338) HSRP MHSRP	
	Security Features	Secure connectivity: Secure Sockets Layer (SSL) VPN for secure remote access Hardware-accelerated	

		<p>DES, 3DES, AES 128, AES 192, and AES 256  Public-Key-Infrastructure (PKI) support  50 IPsec tunnels  Cisco Easy VPN client and server  NAT transparency  Dynamic Multipoint VPN (DMVPN)  Tunnel-less Group Encrypted Transport VPN (GET VPN)  VRF-aware IPsec  IPsec over IPv6  Adaptive control technology  Session Initiation Protocol (SIP)  application-layer gateway  Cisco IOS Firewall:</p> <ul style="list-style-type: none"> <li>◦ Zone-based policy firewall</li> <li>◦ VRF-aware stateful inspection routing firewall</li> <li>◦ Stateful inspection transparent firewall</li> </ul> <p>Advanced application inspection and control  HTTPS, FTP, and Telnet Authentication Proxy  Dynamic and static port security  Firewall stateful failover  VRF-aware firewall  Cisco IOS Software black and white lists  Integrated threat control:</p> <ul style="list-style-type: none"> <li>◦ Intrusion Prevention System (IPS)</li> </ul> <p>Control plane policing  Flexible packet matching  Network foundation protection</p>	
	Default and Maximum DRAM	1GB	
	Default & Flash Memory	2GB	
	Power Supply Specifications	AC input voltage: Universal 100 to 240	

		VAC Frequency: 50 to 60 Hz Internal power supply	
	Environmental operating range	Nonoperating temperature: -40° to 158°F (-40° to 70°C) Nonoperating humidity: 5% to 95% relative humidity (noncondensing) Nonoperating altitude: 0 to 15,000 ft (0 to 4570 m) Operating temperature: 0° to 50°C (de-rate 1°C per 1000-ft increase in altitude) Operating humidity: 5% to 95% relative humidity (noncondensing) Operating altitude: 0 to 10,000 ft (0 to 3000 m)	
<b>C9200-24P-E Catalyst 9200 24-port PoE+ Switch. Network Essentials</b>	Quantity	9	
	Manufacturer	Cisco	
	Model	Cisco Catalyst 9200 Series 24-port 40 Gigabit Ethernet with QSFP+	
	Software requirements	Cisco IOS XE Software Release 16.8.1	
	Network Port	Integrated WAN Ports 2 Gigabit Ethernet (GbE) and 2 10GbE SFP+ uplink network modules  10GBASE-SR, LR, LRM, ER, ZR, DWDM SFP+ transceivers: LC fibre connectors	
	Dimensions	1.73 x 17.5 x 21.52 in 1 rack unit (1RU)	
	Power Source	90 to 264 VAC*, 50 Hz	
	Maximum Power Consumption	60W	

	Weight	Not more than 7.3 kg	
	Environment Specification (Operating)		
	Temperature	0 to 40 degrees Celsius	
	Humidity	5% to 95% (Non-condensing)	
	Plug Type	BF (Three pin) British standard	
<b>Video Wall</b>	To be installed in the Remote Control Centre		
	Quantity	1	
	Model	Specify	
	LCD Component	Minimum 84" (Inch)	
	Brand Name	Specify	
	Model	Specify	
	Backlight	Edge LED or equivalent technology	
	Detection Method	Infrared blocking detection method or equivalent technology	
	Resolution	Between 1920 x 1080 and 4K	
	On-screen display (OSD )	Default language English.	
	Minimum Brightness	500 cd / m2	
	Supported Resolutions	Between 640x480 and 1920x1080	
	Panel Life Time	At least 50,000 hours	
	Glass	Anti-Glare	
	Colours	1.07 billion colours or equivalent colour depth	
	Minimum Contrast Ratio	5000:1	
	Digital / Analog	At least 2 HDMI ports, VGA x 1 (One) ,D-Sub 15-pin x 1 (One)	
	Audio	Microphone jack x 1(one port), Line out x 1(one port)	
	Device control	1(One) port	
	USB	USB B-type connector (for external touch screen) x 1	
	Output Terminals	Must be provided	



	External speakers	Compatible ports should be installed	
	Screen Freeze	Should be a feature	
	Speakers	As per the product specifications	
	Driver	For Win 10 64bits OS & for touch screen calibration	
	Power Requirement	240V AC, 50Hz	
	Power Consumption Operating/Standby	High Power efficiency	
	Colour	Black	
	Wall Mount Kit	Should be provided	
	Driver DVD/equivalent	Should be provided	
	Remote Control	Should be provided with batteries	
<b>Printers</b>	Quantity	4	
	Supported Printing Sizes	A4 (210 x 297 mm)	
	Features	Duplex	
	Memory	512 MB	
	Technology	Laser	
	Connectivity	Ethernet (RJ-45), USB 2.0, Parallel (IEEE 1284), Bluetooth, HP Jet direct, Wireless, Cable	
	Product Line	To be specified	
	Max. Resolution	1200 x 1200 DPI	
	Output Type	Colour	
	Printer Type	Workgroup Printer	
	Weight	Not more than 35 kg	
<b>Time server</b>	<b>NTP Time Server with integrated GPS radio clock</b>		
<b>Quantity</b>	4		
<b>Key Features:</b>	<ul style="list-style-type: none"> <li>• Web based status and configuration</li> </ul>		

	<p>interface (Demo) and console based graphical configuration utility</p> <ul style="list-style-type: none"> <li>• Synchronization of NTP and SNTP compatible clients</li> <li>• Supported networking protocols: IPv4, IPv6, HTTP, HTTPS, SSH, TELNET, FTP, SCP, SFTP, SYSLOG, SNMP</li> <li>• Fibre-Optic Network Interfaces</li> <li>• USB port in the front panel to perform updates, to authenticate, save configuration and log files.</li> <li>• 6(six) independent RJ-45 Ethernet interfaces 10/100 MBit</li> <li>• Alert-Notification system of status change by Email, WinMail, SNMP or an external connected display</li> <li>• Antenna connected with up to 300m of standard coaxial cable RG58</li> </ul>		
<p><b>Other Features</b></p>	<p><b>Fibre Optic Interface</b> Additional option Network time servers to connect directly - without the need for an external media converter.</p> <p><b>Ethernet ports and an integrated reference clock</b> Should offer six 10/100baseT Ethernet ports and an integrated reference</p>		

<p>clock and a TCXO precision internal oscillator.</p> <p><b>Front panel LCD</b> The front panel LCD should provide a keypad to conveniently set the basic network parameters such as IP address, gateway, and netmask.</p> <p>The LCD menu should allow configuration of many features and provide detailed status information for the reference signal (synchronization, lock, etc.) or NTP related information (current stratum, offset, and source of synchronization).</p> <p><b>Modular system architecture</b> Should be modular system architecture which is possible to equip the Time Server with many different reference time sources.</p> <p><b>Reference Clock</b> It should include a Reference Clock that should synchronize to either GPS, DCF77(PZF), MSF, WWVB, available IRIG B/AFNOR Time Codes, or an MRS version which can synchronize to a combination of these with user-selectable priority and switchover time.</p> <p>The oscillator should provide higher accuracy and stability requirements (drift stability) when the Reference Clock signal is disturbed or temporarily unavailable.</p>		
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	<b>Other Output options</b> Other Output options should include DC power input, additional network and serial ports, different serial string configurations, and frequency and pulse outputs.		
<b>GPS Antenna</b>	Quantity	4	
<b>Digital Clock Displays</b>	Quantity	4	
	Specifications		
<b>Connection Accessories</b>	Specify		
<b>SPECIFICATIONS FOR FREE STANDING INDOOR 42 U CABINETS</b>			
Quantity	4		
	Height	42 U	
	Width	24 inch (600mm) outside measurement 19 inch inside with rails for equipment mounting	
	Depth	42 inch (1050mm) depth	
	Front Door	Glass Front door is locking, reversible and removable	
	Front & Rear Doors	Locking, removable & reversible  Split rear door design reduces clearance requirements for service entry allowing the enclosure to be placed closer to a wall	
	Side Panels	Locking, removable, keyed alike with doors  Locking removable 'half size' to make them smaller and lighter improving ease of installation and servicing	
	Mobility	Pre-installed casters and	

		levelling feet; Rolls through standard 7-foot doorway	
	Doors	perforated doors to promote efficient airflow	
	Coat Finish	Tough textured powder coat finish	
	Cooling	Top Mounted Extractor Fans	
	Levelling Feet	Levelling feet extend to allow enclosure to be positioned on uneven floors. Levellers are removable	
	Grounding Lugs	Front & Back Door Frames	
	Colour	White	
<b>PDU</b>	Quantity	10	
	<b>Output</b>		
	Nominal Output Voltage	230V	
	Maximum Total Current Draw	16	
	<b>Input</b>		
	Nominal Input Voltage	200V, 208V, 230V	
	Input frequency	50/60 Hz	
	Cord Length	3.05 meters	
	Number of Power Cords	1	
	Load Capacity	3680 VA	
	Maximum Input Current	16 A	
	<b>Physical</b>		
	Rack mount (on 19" (inch) cabinet)		
<b>Spares</b>			
<b>Planet Industrial L2+ 8Port 10/100/1000T + 2 100/1000X SFP Managed</b>	Quantity	5	

<b>Switch Model IGS-10020MT</b>			
	<p>Redundant Power – AC/DC (- 12 to 48V DC, redundant power with polarity reverse protect function  - AC 24V power adapter acceptable)  •IP30 Aluminium case protection  DIN-rail or wall-mount design  •Supports 6000 VDC Ethernet ESD protection  • -40 to 75 degrees C operating temperature  Copper Ports - 8 10/100/1000BASE-T RJ-45 Auto-MDI/MDI-X ports  SFP/mini-GBIC Slots - 2 1000BASE-SX/LX/BX SFP interfaces (Port-9 and Port-10) Compatible with 100BASE-FX SFP</p>		
<b>Planet SFPs single mode (connector type LC)</b>			
<b>Type 1</b>	<p>Planet Mini GBIC 1000Base LX Gigabit Ethernet Transceivers <b>(Two ports)</b>  Tx 1310nm 1.25Gbps 3.3V Class 1 Laser product</p>	Quantity 6	
<b>Type 2</b>	<p>Planet Mini GBIC 1000Base BX Gigabit Ethernet Transceivers <b>(One port)</b>  Tx 1310nm Rx 1550nm 1.25Gbps 3.3V Class 1 Laser product</p>	Quantity 6	
<b>Software and licenses</b>	<p>All the hardware which require configuration shall have complete software and licenses to enable successful implementation</p>		

	of the project. All these shall be handed over to the client after commissioning of the project.		
<b>Open vendor hardware</b>	All the hardware supplied shall be open to the market and easily switchable with equivalent type in the market. No tweaking of BIOS, processors, graphic cards etc. is allowed which will interfere with interoperability of equivalent type of hardware in the open market.  This shall be demonstrated during commissioning and shall form the part of the acceptance criteria.		

## **DCS/SCADA Software and Plant information system Training**

### **i. Training Knowledge transfer of the SCADA and Historian system**

The bidder shall provide detailed training on the installed SCADA to the KenGen maintenance staff.

The training shall cover but not limited to:

- i. PLC system hardware and software configuration in reference to the existing running plant configurations. This shall include control and HMI configurations. The training shall also cover possible modifications of the existing configurations (additions and removals)
- ii. Server administration (SCADA server)
- iii. Communications gateways configuration
- iv. Training on back up and restorations
- v. Installations and configurations of all relevant SCADA software which includes but not limited to Control and HMI software.
- vi. Integration of third party systems into SCADA system (OPC and SCADA interfacing)
- vii. Training on Alarm and Event management in servers
- viii. Cybersecurity on the SCADA system
- ix. System modelling and trend analysis
- x. Data warehousing archival information retrieval
- xi. Client/Server concept and features
- xii. Data historian back end systems

- xiii. Data security recovery and back up options
- xiv. Intranet Systems Configurations and applications
- xv. Data representation format
- xvi. System Modelling and Trend Analysis
- xvii. Database Maintenance and fine tuning
- xviii. Customizing plant report templates

**ii. Training Knowledge transfer of the Cybersecurity and Virtualization of Servers**

The bidder shall provide detailed training on the installed Cybersecurity solution and Virtualization of Servers to the KenGen maintenance staff.

The training on virtualization shall cover but not limited to:

- i. Virtualization Concept
- ii. Conventional -Virtualized Architecture
- iii. System Architecture: VM Internal Networks
- iv. Hardware Qualified Machines and configuration
- v. VM's specification requirement
- vi. Global Virtualization tools
- vii. VM licensing
- viii. Windows 2016 server license calculations
- ix. Virtualization Terms (Hypervisor, ESXi etc., vDR, vMOTION, Virtual Machine, vCPU, Virtual Management Services, Thin Client, CPU Reservation, Op manager, Host management)

The training on cybersecurity shall cover but not limited to:

- i. Fundamentals of ICS and SCADA cyber security
- ii. Differences between IT and OT security
- iii. Standards and best practices for industrial security
- iv. ICS and SCADA vulnerabilities
- v. Risk management basics
- vi. Selecting and implementing controls for ICS security
- vii. ICS/SCADA network and device security
- viii. Enforcement zone devices e.g. firewalls
- ix. SCADA security program development
  - x. Wireless attacks and defences (Risks like sniffing, DoS, masquerading, rogue AP)
  - xi. Real Time Integrated Threat Monitoring
  - xii. Deep forensic analysis (Event logging and analysis)
- xiii. Integrated logging events
- xiv. Full visibility and control across your Network
- xv. Workstations and server security (Patching ICS systems and defending windows systems)
- xvi. Endpoint security software (Antivirus, whitelisting, sandboxing etc)
- xvii. Governance and compliance:
  - Building an ICS Cybersecurity program
  - Creating ICs Cybersecurity policy
  - Disaster recovery



- ~ Measuring cybersecurity risks
- ~ Incident response

### **iii. Training Knowledge transfer on Configuration of Firewalls, Routers and Switches**

Firewall training guide.

This will include but will not be limited to:

- i. The basics of a firewall and a basic firewall configuration
- ii. How to permit traffic between different security levels.
- iii. How to configure NAT/PAT,IPsec VPN,SSL VPN
- iv. Practice password recovery techniques for the security appliance
- v. Gain an understanding of logging configurations
- vi. Practice backing up and restoring device's configurations
- vii. Practice backing up and restoring device's software image (operating system)
- viii. Practice configuring and using remote management
- ix. Gain an understanding of Network Address Translation and Port Address Translation on the ASA Security Appliance and practice using them in your configurations
- x. Gain an understanding of Cisco privilege levels and practice configuring local usernames and privilege levels
- xi. Practice configuring your security appliance to authenticate via Windows Active Directory using RADIUS
- xii. Practice building and troubleshooting a DHCP server
- xiii. Practice building VPNs
- xiv. Gain an understanding of DMZs and practice building one with a Web server
- xv. Practice testing security configurations with a port scanner
- xvi. Gain an understanding of filtering techniques and practice blocking Java applets
- xvii. Practice building a transparent (layer 2) firewall

### **Switch and Router training guide**

This will include but will not be limited to:

- i. Introduction to Routing
- ii. The process of routing
- iii. Dynamic Routing
- iv. Statically Learned Routes
- v. Routing Basics
- vi. Failover Configuration
- vii. Access List Configuration
- viii. Open Shortest Path First
- ix. Switched Networks
- x. Converged Networks
- xi. The switched Environment
- xii. Configuring a switch from scratch
- xiii. Switch LED Indicators Preparing for Basic Switch Management
- xiv. Configuring Basic Switch Management

- xv. Verifying switchport configurations
- xvi. Network Access Layer Issues
- xvii. Troubleshooting Network Access Layer
- xviii. Switch Security (Secure Remote Access, SSH)
- xix. Securing unused ports
- xx. VLAN Implementation & Segmentation
- xxi. Inter-VLAN Routing using Routers
- xxii. Access Control Lists
- xxiii. Understanding IPv4 and IPv6

The bidder shall submit a comprehensive training program and content for client's review and approval. The training offered shall lead to competency certification and should be tailor made to address the SCADA configuration. The bidder shall indicate the training hours per person. All the above shall form part of the evaluation requirement. The client reserves the right to vary the training quantities during award.

KenGen shall meet the cost of the round trip air tickets, accommodation and allowances of the trainees. Local transport costs and any other associated costs shall be borne by the bidder.

At the end of the training the client should be able to:

- i. Carry out SCADA configurations on both the controller and HMI
- ii. Configure/build SCADA hardware and software from scratch.
- iii. Carry out modifications as follows:
  - Change/modify PLC logics
  - Change/Modify HMI graphics
  - Modify SCADA database
  - Link graphics and logics to database
- iv. Carry out SCADA back ups
- v. Carry out SCADA preventive maintenance
- vi. Carry out SCADA audit
- vii. Configure the switches, routers and cybersecurity devices
- viii. Carry out system administration of the servers both in virtualized and non-virtualized environment.
- ix. Carry out backup and restore of the HMIs and servers from the storage (NAS)

#### **Attendance of Client's Personnel at Factory Tests and Training**

- 1.1 The Contractor shall arrange for Client's engineers or staff members to witness tests of major items of equipment at the Contractor manufacturing plant/s.
- 1.2 Tests for all Workstations, servers, firewalls, ethernet switches, routers, cybersecurity appliances and SCADA network forensics devices shall be carried out at the factory where these devices are manufactured. These tests shall include but not limited to redundancy checks, network throughput, cooling functionality, optimal performance of the equipment, system power, equipment functional tests, Third party interfacing tests etc.

- 1.3 The Contractor shall submit factory training and factory acceptance tests schedule for approval. After approval by the Client, the Contractor shall invite the Client's engineers for training and factory acceptance tests. A period of at least one month shall be provided from date of invitation to the date of departure to the contractor's country of manufacture to allow enough time for travelling preparations.
- 1.4 Training at manufacturer's plant or a reputable training centre preferably one run by manufacturer in the country of manufacture shall be provided, in order to enable client engineers, understand the equipment design, operate and maintain the equipment successfully. Factory acceptance testing shall proceed after the training.
- 1.5 The above two tasks shall be arranged to follow each other; training to precede the factory acceptance tests.
- 1.6 Contractor shall be responsible for all travel within country of manufacture and all other associated costs of stay by client engineers other than accommodation and out of pocket expenses which will be catered by the procuring entity. The procuring entity will be responsible for the round-trip airfares between Kenya and the Contractor's main factory country, accommodation and out of pocket expenses.
- 1.7 Contractor shall facilitate visa application for the client engineers by providing necessary support documents required by the contractors' /manufacturer's country government

#### **FAT**

Prior to commencement of the tests, the equipment shall be inspected to ensure:

- (i) Correct standards of workmanship and quality
- (ii) Correct identification labels, cabling, tagging, housing and mounting etc.
- (iii) Adequate accessibility
- (iv) Compliance with the Specification and reviewed drawings (including compliance with fire safety and materials requirements)
- (v) Verification of model numbers, quantities of items etc.
- (vi) All factory tests and training requirements detailed in the approved factory acceptance test plan/program and factory training program shall be carried out.
- (vii) Valid calibration certificates from a third-party accredited laboratory for test equipment to be used during FAT shall be presented to the client engineers prior to the beginning of the FAT. Only test equipment with valid calibration certificates from a third-party laboratory credited by NSTA shall be used.
- (viii) Conduct of the Tests
  - The Contractor shall conduct the tests in accordance with the approved test procedures and shall enter the results in the approved result sheets.
  - For each test, the Employer will determine whether the test has passed or failed. In general, the test will be considered to have failed if either:
    - ✓ The result of the test is not in accordance with the expected result described in the test procedure, or
    - ✓ The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the Employer considers to be a fault

- (ix) Full use shall be made during the tests of operator manuals and other documentation provided by the Contractor to determine the accuracy of the tests.
- (x) Failures
- (xi) The Contractor shall correct all faults found during testing and shall arrange for the test to be repeated. The test shall only be repeated when the fault has been remedied and the equipment demonstrated to function correctly.
- (xii) Where remedial measures involve significant modifications that might, in the Employer's opinion, affect the validity of earlier tests then the Contractor shall repeat the earlier tests and obtain satisfactory results before repeating the test in which the fault was first identified.
- (xiii) The Employer shall have the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract requirements, without in any way prejudicing his rights under the contract.
- (xiv) The Employer shall have the right to suspend any test in the event that errors or failures have become unacceptable. The Employer shall also have the right to suspend any test in the event of a fault being detected by the Contractor but not reported to the Employer within 24 hours. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the Employer
- (xv) The Contractor shall correct and re-test every fault detected during the tests. Time spent by the Employer witnessing re-tests or waiting at the Contractor's premises or the test site while corrections are made prior to re-test, shall be charged to the Contractor at the standard hourly rate for the personnel concerned.

All other costs incurred by the Employer as a result of such re-tests, including accommodation, subsistence and travel charges, will be charged to the Contractor at cost. If the Employer is required to return to the Contractor's premises or the test site to witness such re-tests then time spent by the personnel concerned in travelling to the site of and witnessing such re-tests, and all charges incurred by them in so doing, including travel and accommodation shall be charged to the Contractor.

- (xvi) After the tests detailed test report and client inspection report shall be signed by the client engineers and contractor. These documents shall then become part of the contract.
- (xvii) FAT meeting minutes duly signed by the contractor and the client representative shall form part of official project documentation and shall be required by the client to approve payment processing by the bank. As part of the terms of letter of credit.
- (xviii) Client will give consent for shipping ONLY after ALL the issues discussed in the minutes and noted in the client inspection report have been rectified and evidence given to the client.

## **Packing, Transportation and Storage**

- a) The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit and temporary storage up to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling and exposure to extreme temperatures, salt and precipitation. Packing case size and weights shall take into consideration, the Goods' final destination and the absence of heavy handling facilities at all points in transit. Indoor electrical equipment must be enclosed in welded polythene envelopes inside packing cases and the envelopes shall be evacuated or have a desiccant inside.
- b) The following information must be clearly stencilled or printed on each packing case, crate, cask, drum, bundle or loose piece, care being taken that the number and other particulars on each package agree with those entered in the packing list accompanying the Invoice:
  - (i). Employer's Identity
  - (ii). Supplier's Identity
  - (iii). Destination
  - (iv). Project name
  - (v). Contract No.
  - (vi). Package No.
  - (vii). Item Code
  - (viii). Weight, dimensions
- c) The marking above shall be durable and upon the body of the package. Marking upon a batten fastened on the case, etc. shall not be used. In the case of bags, bundles and loose pieces, the shapes of which do not permit the marks to be put on the actual package, each bag, bundle or loose piece shall have two metal labels each with two holes securely fastened by independent wires. Each label shall be die-stamped with the above particulars.
- d) The Contractor shall be responsible for all transportation from manufacturing site to the power stations
- e) Goods shall only be shipped from factory to site after approval by the procuring entity.
- f) Procuring entity shall give clearance for shipment of the equipment only after: all the finalised and approved Drawings, Instruction and maintenance manuals and software have been handed over to the client; any problems noted during FAT have been rectified and upon receipt of Authentic certified copies of the factory Test Reports
- g) Contractor will be responsible for equipment offloading and placement at the power station control room or store as detailed in the scope of supply

## **WARRANTY**

### **Suppliers Warranty**

- i. The Contractor shall warrant that ALL goods supplied under the Contract are brand new, unused, of the most recent or current models, and that they

incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

- ii. The Contractor further shall warrant that all Goods supplied under this Contract shall have no defect arising from design, materials, or workmanship or from any act or omission of the Contractor, or that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.
- iii. This warranty shall remain valid for **Sixty (60) months** after arrival of equipment at site for ALL goods in scope of supply
- iv. The bidder guarantees supplying maintenance spares and services as well as repairing of the supplied systems where called upon to do so after expiry of the warranty period at procuring entity's cost for a period of five (5) years.
- v. Bidder shall provide a signed letter in their letterhead committing to offer a Sixty (60) months warranty meeting the above conditions if awarded the tender.

#### **Manufacturer warranty**

- i. Manufacturer's warranty shall be provided for all key equipment in scope of supply as detailed in technical specifications. Manufacturer warranty shall cover all defects arising from design, materials, or workmanship or from any act or omission of the Manufacturer.
- ii. All equipment shall have a manufacturer warranty of at least five years from the date of supply.
- iii. Manufacturer's warranty shall be clearly spelt out in submitted data sheets, catalogues or manufacturer authorisations

#### **Local Warranty**

The supplied equipment shall have a local Warranty. The warranty period shall be Five (5) years.

#### **Software**

All software and software configurations shall be in English and shall have full functionality. The software support shall be done in English.

#### **As-Built documentation**

All documentation shall be in English and shall be handed over to the client's not later than the delivery date.

This documentation shall include but not limited to: -

- i. Operation/User manuals
- ii. Configuration/data sheets
- iii. License certificates
- iv. Warranty certificates

## **TECHNICAL EVALUATION CRITERIA**

- (a) As a minimum, the equipment must meet descriptive technical specifications as tabulated in the Technical Specifications section.
- (b) Proof that equipment manufacturer is globally re-known, is established, has been supplying similar equipment and services for the past twenty (20) years and is committed to offer at least 3 years technical support and spares for a period of at least 2 years from the time of commissioning.
- (c) All items shall have a warranty of at least twelve (12) months from the time of commissioning or longer as specified under each technical schedule.
- (d) Items supplied shall not have reached end-of-life or be obsolete at the time of commissioning.
- (e) Tenderers must attach a catalogue indicating the instrumentation and/or control cards/modules they intend to supply and highlight the relevant pictures and tabulate a clause by clause description of the items against the specified requirements.
- (f) Tenderers are advised to strictly adhere to the outlined format in the technical schedule when making an offer; deviations will be deemed to be non-responsive.
- (g) Indicate the relevant technical characteristics of your offer in an itemized manner as tabulated in the technical schedule.
- (h) The winning tenderer must supply the brand that is highlighted in the submitted bid, failure to which will lead to rejection during inspection of the delivery.
- (i) All items will be subjected to functional and performance test on delivery prior to acceptance and hand over to KenGen.
- (j) The winning tenderer will be required to train ten (10) KenGen staff for a period of at least 3 weeks. The training shall cover, at a bare minimum, the contents listed in the technical specifications table.
- (k) The experience of the firm:  
The Tenderer (or in the case of a Joint Venture the lead Partner) shall meet the following minimum criteria:
  - i. Performance as prime contractor in the execution of at least five projects of similar nature, complexity and volume comparable to the proposed contract over the last eight years. Tenderer MUST attach at least five duly signed award and completion certificates of similar

projects in value & complexity. Documents attached must show the value and scope of the project.

- ii. The tenderer MUST have designed, supplied, installed and commissioned during the last 8 years at least 5 control and automation projects. The tenderer shall provide the names and addresses of the clients who have purchased these systems, and the names, telephone and telefax numbers of a senior manager employed by each client from whom references can be obtained in English language.

(l) Deviations from specifications

- i. All deviations from specifications shall be stated in the deviations from specifications form. No deviations from employer specification shall be acceptable unless specifically indicated in the offer in the relevant schedule. All deviations shall be clearly spelt out by the Tenderer and the price implications thereof.
- ii. Employer shall choose to accept or reject the bid offer if the deviations are beyond what is acceptable by the client.

(m) Project preliminary designs

The tenderer shall present in the tender document and submit drawings to show;-

- i. How the various components are integrated in the proposal
- ii. That software is user-friendly and easily upgradable (especially if it differs from the installed infrastructure).
- iii. Modular design.

(n) Spare parts and after sales service facilities

- i. Tenderers must offer serviceable items and spare parts. Documentary evidence and locations of such spares must be given. Where a tenderer offers items without such spares in the country, documentary evidence must be given and assurance that adequate spares for items supplied will be provided.
- ii. The tenderer shall also guarantee supply of maintenance spares and services.

(o) Software and other necessary licenses

- i. Tenderer shall demonstrate that all software, licenses and application programs used by the supplied equipment, required to interrogate supplied equipment or required for testing, maintenance and commissioning of supplied equipment meet the minimum specifications and shall be handed over to the client.
- ii. Tenderer shall demonstrate that all programs/applications developed specifically for the project or required for the working of the products supplied and the intellectual property associated meet the minimum specifications and shall be handed over to the client after commissioning.

(p) Financial Capacity



- i. Minimum average annual turnover of USD 1 million, calculated as total certified payments received for contracts in progress or completed, within the last three (3) years.
- ii. Tenderers are advised to strictly adhere to the format indicated in Section VIII (Price Schedule of Goods and Services); i.e. itemized unit cost of each goods and services, plus applicable charges, freight, tax, duties and total cost DDP to Olkaria II Power Station.

1.1. Bidder MUST fully meet ALL the clauses below in order to qualify for further evaluation.

Clause	Requirements	Criteria	Bidder Reference document
Experience of the firm	Performance as prime contractor in the execution of at least five projects of similar nature, complexity and volume comparable to the proposed contract over the last eight years. Tenderer MUST attach at least five duly signed award and completion certificates of similar projects in value & complexity. Documents attached must show the value and scope of the project.	Must meet requirement	
	The tenderer MUST have designed, supplied, installed and commissioned during the last 8 years at least 5 control and automation projects. The tenderer shall provide the names and addresses of the clients who have purchased these systems, and the names, telephone and telefax numbers of a senior manager employed by each client from whom references can be obtained in English language.	Must meet requirement	
Litigation History	No consistent history of cases/claims against the bidder	Must meet requirement	
	Bidder shall not have a Non-performing contract within the last Five (5) years	Must meet requirement	
Project preliminary designs	Bidder has submitted preliminary designs showing how all components are integrated.	Must meet requirement	
	Openness of all components and that all software is user-friendly and easily upgradable.	Must meet requirement	

	Modular design	Must meet requirement	
Implementation plan	Bidder has submitted a clear implementation	Must meet requirement	
Compliance to technical specifications	Bidder has submitted a duly filled technical schedule	Must meet requirement	
	Submit all type test certificates specified in the specifications	Must meet requirement	
Delivery time	Must be less than one year	Must meet requirement	
Spare parts and after sales service facilities	Documentary evidence and locations of service and spares	Must meet requirement	
Software and other necessary licenses	Delivery of all required software and licenses as per specifications and intellectual property/s related to all applications/programs designed specifically for the project	Must meet requirement	
Warranty	Bidder must offer a warranty of at least one year for the systems supplied.	Must meet requirement	
Financial Position	Authentic and certified documents showing bidders compliance	Must meet requirement	
	Bidders' capability to carry out the project. Bidder must have the financial ability to complete the project.	Must meet requirement	

- 1.1. Bidder's technical offer shall be evaluated and graded as per table below.
- 1.2. Pass mark will be 80% before price comparison.

**Graded criteria**

Clause	Requirements	Criteria	Max score	Overall Score	Bidder Reference document
Project preliminary designs	How the various components are integrated in the proposal	Judged for completeness and applicability	20	30	
	Automation philosophy	Judged for completeness, applicability and ease of troubleshooting and maintenance	30		
	Preliminary design schematic diagrams	Judged for completeness, applicability, ease of maintenance and effectiveness of the overall system to the particular situation	50		
Implementation plan	Detailed implementation plan	Judged on practicability and overall good management of resources including outage duration	100	10	

Compliance to technical specifications	<p>Adherence to employer technical specifications:</p> <p>Documentation including illustrative drawings/sketches, schematics catalogues etc. showing specification of products to be used/ installed inclusive of functions offered clearly referenced to the technical schedules and employer technical specification document shall be used to determine bidder's adherence. Each and every employer specific technical specification clause should be clearly illustrated by the bidders documentation</p>	<p>Judged on completeness and adherence to technical specifications.</p> <p>Consistent deviation from specification will lead to disqualification of bidder.</p> <p>Missing documentation to show compliance with specification clauses will lead to zero score.</p>	100	40	
Delivery schedule	Offered delivery time	Judged on practicability and duration. Bidder with the shortest practical time will get maximum score	60	20	
	Implementation period	Judged on practicability and duration. Bidder with the shortest practical time will get maximum score	40		
<b>TOTAL SCORE</b>				<b>100</b>	

### 3. Financial Evaluation Criteria

Award shall be for all schedules to the lowest technically compliant bidder.

NOTE: Technical responsiveness shall be determined using the grading criteria as shown in the table above. Bidders must attain a total score of 80% to be considered as technically compliant and proceed for price/financial evaluation.

KenGen **will** conduct due diligence on the eligible bidders to establish their ability to perform the contract.

#### SECTION VIII: PRICE SCHEDULES/BILL OF QUANTITIES

No	Item Description	UoM	Country Of Origin	Qty	Unit Price	Total Price EXW Per Item (Cols. 4x5)	Unit price of other incidental services payable
<b>SCHEDULE A: INSTRUMENTATION</b>							
1.	Valve complete with compatible actuator (Turbine drain valve)	PCs		52			
2.	Valve complete with compatible actuator (Ejector On/Off Valve)	PCs		2			
3.	pH monitoring system comprising pH transmitter with dual pH/ORP sensors	PCs		15			
4.	Oil level Sensor/Switch with integrated temperature and moisture sensors (for cooling tower gearbox)	PCs		80			
5.	Vibration Switch (for cooling tower gearbox)	PCs		30			
6.	Vibration sensor complete with transducer (X and Y axis vibration for main cooling water pump motor)	PCs		40			
7.	Solenoid Valve	PCs		21			
8.	Digital Pressure Calibrator	PCs		1			
9.	Engineering services, installation, testing and	AU		1			

	commissioning						
<b>Sub-Total</b>							
<b>SCHEDULE B: PLC, I/O MODULES &amp; CONTROL WORKS PRICE SCHEDULE</b>							
10.	HMI touch-panel	PC		1			
11.	I/O modules	PCs		Lot			
12.	Engineering services	PCs		AU			
13.	Software	PCs		Lot			
14.	Maintenance tool	PCs		1			
15.	Training	PCs		Lot			
16.	Documentation	PCs		Lot			
<b>Sub-Total</b>							
<b>SCHEDULE C: INTEGRATION AND CONTROL CENTRE WORKS</b>							
17.	DCS Workstations	PCs		19			
18.	Monitors	PCs		33			
19.	Keyboard	PCs		38			
20.	Mouse	PCs		38			
21.	Engineering WorkStation (EWS)	PCs		1			
22.	Engineering WorkStation (EWS) Mobile (Laptop)	PCs		2			
23.	Historian	PCs		2			
24.	Servers (Virtualized environment)	PCs		6			
25.	VM Management Host	PCs		3			
26.	Vsphere Client	PCs		3			
27.	NAS storage	PCs		4			
28.	DCS Servers	PCs		2			
29.	Firewall: Cisco Industrial Security Appliance 3000	PCs		3			
30.	Integrated Services Routers: Cisco	PCs		3			
31.	C9200-24P-E Catalyst 9200 24-port PoE+ Switch. Network Essentials	PCs		7			
32.	Video Wall	PCs		1			
33.	Printers	PCs		4			
34.	Time server	PCs		4			
35.	GPS Antenna	PCs		4			
36.	Digital Clock Displays	PCs		4			
37.	Connection Accessories	PCs					
38.	Cabinets (42 U)	PCs		5			
39.	PDU	PCs		10			
40.	Other items necessary for the completion of the works	Lot		Itemize			
<b>Sub-Total</b>							
Sub-Total (A+B+C)							
Discount (%) if any							
Other Charges e.g. transport, handling							
<b>Total Cost DDP to Olkaria II Power Station (Wellhead stores)</b>							

<b>Country of Origin</b>	
<b>Currency of Tender</b>	
<b>Delivery Period</b>	