

**NATIONAL ELECTRICITY CORPORATION (NEC)  
SUDAN**


**4 X 125 MW KOSTI TPP**

**VOLUME IIB & III  
TECHNICAL SPECIFICATION  
FOR  
FOAM PUMP WITH DIESEL ENGINE & CONTROLLER  
FOR FIRE PROTECTION SYSTEM**

**SPECIFICATION NO.: - PE-TS-250-552-A003**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR - NORTHERN REGION  
NOIDA (U.P.)  
INDIA**

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FOAM PUMP WITH DIESEL ENGINE &  
CONTROLLER

INTENT OF SPECIFICATION

4 x 125 MW KOSTI SUDAN TPS

DOCUMENT NO.: PE-TS-250-552-A003

VOLUME- IIB


SECTION-A

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**VOLUME-IIB**


**SECTION- 'A'**

**INTENT OF SPECIFICATION**

	<b>KOSTI SUDAN TPS (4 X 125 MW) INTENT OF SPECIFICATION</b>	<b>SPECIFICATION No: PE-TS-250-552-A003</b>	
		<b>CUSTOMER</b>	<b>NEC, SUDAN</b>
		<b>VOLUME - IIB</b>	<b>SECTION A</b>
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## 1.0 INTENT OF SPECIFICATION

- 1.1 This specification covers the design, manufacturing, supply & delivery of material to the port with duly sea worthy packing & supervision of E&C for the equipment as mentioned in the different sections of this specification specified in this specification for foam protection system for 4 X 125 MW Kosti Sudan TPS.
- 1.2 The bidder shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the responsibility of providing such facilities to complete the supply.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items mentioned in Section-C, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

	<b>KOSTI SUDAN TPS (4 X 125 MW) INTENT OF SPECIFICATION</b>	<b>SPECIFICATION No: PE-TS-250-552-A003</b>	
		<b>CUSTOMER</b>	<b>NEC, SUDAN</b>
		<b>VOLUME - IIB</b>	<b>SECTION A</b>
		<b>REV</b>	<b>00</b>

- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule along with the cost of withdrawal; otherwise, it will be presumed that the bidder's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word bidder shall have same meaning as successful bidder / vendor.
- 1.11 Other requirements  
Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract along with engineering documents or along with supply of concerned equipment / component whichever is earlier.

Document approval by customer under Approval category or information category shall not absolve the bidder of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the bidder in writing and require written approval. Unless any change in specified requirement has been brought out by the bidder during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case bidder submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to bidder's account and shall not be used as a reason for extension in contract completion.



FOAM PUMP WITH DIESEL ENGINE &  
CONTROLLER

DOCUMENT NO.: PE-TS-250-552-A003

VOLUME- IIB

SECTION B

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**PROJECT INFORMATION**


**SECTION-B**  
**PROJECT INFORMATION**

	TITLE	BHEL DOCUMENTS NO.: PE-1S-250-154-A107.
	TECHNICAL SPECIFICATION FOR <del>CRUDE OIL FIRED THERMAL POWER PLANT</del>	VOLUME II-B
	NATIONAL ELECTRICITY CORPORATION LIMITED (SUDAN).	SECTION -B
	4 X 125 MW, KOSTI THERMAL POWER STATION.	REV NO 00      DATE
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**KOSTI 4 X 125 MW THERMAL POWER PLANT**  
UNIT-I COMPLETION : 29 months from Project Start Date  
UNIT-II/III/IV COMPLETION : 33/37/41 months from Project Start Date  
PROJECT START DATE: 01-09-2006

### PROJECT INFORMATION DATA

1	Owner	NATIONAL ELECTRICITY CORPORATION, SUDAN
2	Project	4 X 250 MW RATING, CRUDE OIL FIRED THERMAL POWER PLANT
3	Owner's consultant	Fichtner GmbH & Co. KG
4	Location	The Power Station site is located near Kosti ( White Nile State), 310 km south of Khartoum at latitude 13.10 North and longitude 32.6 East at an elevation of 380 meters above sea level. The northern boundary of the plot is adjacent to the Rabak-Sinnar highway
5	Nearest Airport	KHARTOUM
6	Nearest Port	PORT-SUDAN
7	Access to site	PORT-SUDAN → 850 km → KHARTOUM → 320 km → KOSTI

	TITLE	BHEL DOCUMENTS NO.: PE-1S-250-154-A107.
	TECHNICAL SPECIFICATION FOR <del>PROTECTION LOSING SYSTEM</del>	VOLUME II-B
	NATIONAL ELECTRICITY CORPORATION LIMITED (SUDAN).	SECTION -B
	1X125 MW, KOSTI THERMAL POWER STATION.	REV NO. 0.0      DATE -
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Meteorological data

A	Altitude [Observatory]	330 meters above sea level
B	Ambient Conditions:	
1.	Mean Maximum Ambient Air Temperature (in hottest month)	45 Deg.C
2.	Mean Minimum Ambient Air Temperature (in coldest month)	18 Deg.C
	Temperatures	
1	Minimum [ Annual Mean]	25 -30 deg C, 16 deg C lowest
2	Maximum [ Annual Mean ]	40-45 deg C
C	RELATIVE HUMIDITY	Low to very low in most part of the year. Rising only during rainy season.
1	Maximum Humidity	71% in Aug
2	Minimum Humidity	26% in April
D	RAINFALL	
1.	Annual Mean	300 to 400 mm spread over 150 days. Approx.50 TO 60% rainfall in July & Aug.
2.	Maximum	Max recorded is 182 mm in Aug,04
E	WIND DATA	
1.	Max Wind Speed	170Kmph
2.	Prevailing Wind Direction	Wind direction is northern from May to September and it is southern in other months
3.	Any other features	Occasional dust storms in May and June



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

DOCUMENT NO.: PE-TS-250-552-A003

VOLUME- IIB

SECTION-C

REV. 0

SHEET 1 OF 6

**VOLUME-IIB  
SECTION- 'C'  
SCOPE OF SUPPLY**



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

DOCUMENT NO.: PE-TS-250-552-A003

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SECTION-C

REV. 0

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**GENERAL**

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed at port & supervision of E&C of Foam pump, with its diesel engine control panel as specified in the specification inclusive of all prevailing taxes, duties and other levies as required for the project.

**1. SUPPLY SCOPE**

- **Foam Pump (diesel engine driven)**
  - ✓ Pl. refer cl. No. 7.0 below for technical details.
  - ✓ Quantity to be provided: One (1) no.
- **Diesel Engine**
  - ✓ Pl. refer cl. No. 7.0 below for technical details.
  - ✓ Quantity to be provided:- One (1) no.
- **Diesel Engine Local Control Panel (DECP)**
  - ✓ Pl. refer cl. No. 7.0 below for technical details.
  - ✓ Quantity to be provided:- One (1) no.

**Further, it is the responsibility of the successful bidder that the supplied equipment's fits into the existing Foam protection system and runs successfully in Auto & Manual operation as per the already fixed design parameters (Refer P&ID of foam protection system, BHEL Drg. No. PE-DG-250-552-A204-01 for further details)**

**2. PAINTING**

Bidder to note that painting shall be as per painting specification attached in Annexure-I, Section C.

**3. MAKES OF EQUIPMENTS / ITEMS**

Bidder to note that the equipment shall be sourced from the reputed make.

**4. DRAWINGS / DOCUMENTS**

Bidder to furnish the drawing / documents for all the items for approval / information within 2 weeks from date of LOI.

S.No.	Drgs. / Docs.
1	TDS & QAP FOR FOAM PUMP
2	TDS & QAP FOR DIESEL ENGINE
3	TDS, QAP & CONTROL/POWER CIRCUIT OF DIESEL ENGINE CONTROL PANEL



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

DOCUMENT NO.: PE-TS-250-552-A003

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SECTION-C

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**5. INSPECTION & TESTING**

Please note the inspection of foam pump, diesel engine and diesel engine control panel to be witnessed by bidder as per approved QAP by BHEL. However the test certificates and internal reports shall be submitted to BHEL for review / acceptance, successful bidder needs to furnish all the certificates, as per requirement of BHEL.

**6. Write-up on Foam protection system.**

Bidder to note that, the diesel engine driven foam pump required for, as per specification, needs to be fitted into the already designed Foam protection system. For this a brief description is mentioned below:

In the event of fire in any Crude oil tank (COT) / Gas oil tank (GOT), the fire sensing devices i.e. linear heat sensing cable (analogue type) in COT and probe type detectors in the GOT will detect the fire signal and will transmit these signals to Fire Alarm Panel (FAP) located in Control room. In return Local control panel (LCP-01) housed in foam pump house will receive the signal from FAP. LCP-01 will generate the signal to start the existing motor driven foam pump FP-1 (tag no. 9SGF10AP001). On receipt of 'foam pump starts signal', LCP-01 will open the motorized valve located at upstream of the foam pump. Subsequently LCP-01 will generate signal to open the deluge valve of tank under fire and water from hydrant header starts flowing to the proportioner. Further LCP-01 will generate signal to the solenoid valve located in foam concentrate line (Inlet of the foam proportioner), resulting in flow of foam concentrate from foam tank to foam proportioner. The rate of injection of foam concentrate is controlled by the pressure operated valve (Balancing valve), ensuring mixture of foam concentrate with water in the right proportion.

The foam water mixture flows to the foam makers provided in the affected tank, where it is converted into foam and discharged in to the tank. Once the foam is discharged into the tank, it spreads on the oil surface forming a blanket and extinguishes the fire.

When foam pump starts discharging foam concentrate, pressure switch in discharge line will give "Foam Pump FP-01 Running" annunciation to annunciation panel. In case the main foam pump fails to start, "Foam Pump FP-01 fails to start" annunciation will appear. After a delay of 20 seconds, LCP-01 will generate the start signal to DECP in order to start the standby foam pump automatically. As the pump starts discharging, pressure switch in discharge line energize and will give "Foam Pump FP\_02 Running" annunciation.

When pressure develops at the discharge side of deluge valve, pressure switch PSH will operate giving 'Deluge Valve Operating' annunciation. Similarly, when foam water mixture flows out of proportioner, the pressure switch provided on downstream side of proportioner will generate annunciation "Foam system Operation". When the level of foam concentrate in the foam tank is at low level, the level transmitter will give signal to LCP-01, which in turn will operate motorized valve of standby foam tank.

**Foam Pump Manual Starting Arrangement**

Foam pump controller for motor driven pump and DECP for diesel engine pump are envisaged with start/ stop buttons to facilitate start of foam pump manually. If required to start manually press the start push button on the motor driven foam pump controller or push button on diesel engine driven foam pump DECP, after that press the push button provided on the LCP-01 to operate the deluge valve and solenoid valve in foam concentrate line of the 'tank under fire' along with opening of motorized operated valve in foam pump suction line.



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

DOCUMENT NO.: PE-TS-250-552-A003

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Refer P&ID of foam protection system (BHEL Drg. No. PE-DG-250-552-A204-01) for further details.

## 7. DESIGN PARAMETERS

### A) FOAM PUMP

Make – Reputed Make

Capacity – 35LPM

Head – 12 bar

Type – PD Rotary Gear

Liquid to be handle – 3% AFFF type 3 as per IS:4989 part-2

Design Code – As per IS

Capable of dry run – Yes

Pump efficiency & Power – As per OEM

Body/End cases MOC – Brass C836 ASTM B62

Rotor / Stator Gears – SS316

Rotor / Stator Shaft – SS431

Suction / Discharge – 1 ½ x 1 ½ NPT

Inspection – As per approved QAP

### B) DIESEL ENGINE

Make – Reputed Make

Capacity – Meeting the above foam pump requirement

Cooling method – Air cooled

Lubrication system – As per OEM

Fuel system – AS per OEM

Battery & battery charger - Yes

Exhaust system & silencer – Yes

Engine meeting TAC requirements - Yes

Inspection – As per approved QAP

### C) Diesel Engine Local Control Panel (DECP)

The diesel engine local control panel is intended for starting and monitoring foam pump diesel engine. The panel monitors, displays and records foam pump system information. Diesel engine local control panel shall be provided with 1x100% lead acid batteries and 1x100% battery charger and shall be large enough to crank the engine twelve times successively, each for duration of 10 sec. without any charging in between.

#### Construction Features:

- Make – Reputed Make
- The Body shall be fabricated with 3mm thick CRCA sheet.
- Painting as per Painting schedule with Fire red shade.
- Cable entry bottom
- Protection class – IP52
- 20% control terminals shall be provided as spare.
- Cable for interconnection between the vendor supplied equipment.
- Cable lugs & glands.
- All other necessary items required to make the diesel engine pump runs automatically.



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

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Following signals to be exchanged b/w DECP & LCP-01 (LCP-01 panel in BHEL scope) (Refer GA & Schematic of Logic Control Panel (LCP-01) BHEL Drg. No. PE-DG-250-552-A307-00) for further details.

**From DECP to LCP-01**

- DE driven foam pump (FP-2) engine in trouble
- DE driven foam pump (FP-2) engine running
- DE driven foam pump (FP-2) Auto selection

**From LCP-01 to DECP**

- DE driven foam pump (FP-2) Auto start

The DECP shall be envisaged with all the protection & interlocks required as per OEM. However below listed minimum signals shall be considered while designing DECP

- AC power available indicator
- On & Off push button
- Auto-Manual selector switch
- Manual Crank Push-Button
- Minimum Run Timer/Off Delay Timer
- Engine Run Time Meter
- Engine temperature high
- Engine lube oil pressure low
- Engine over speed
- Fuel level low
- Battery charger malfunction
- Battery in trouble
- Crank Cycle Status Indication (Displays Cranking Battery, Number of Starting Attempts and Crank/Rest Time Remaining)

Diesel engine will be started with the delay of 10 seconds after getting the start command from LCP-01.

Diesel engine will be started without any delay after getting the start command from the local start push button fitted on DECP.

BHEL shall provide one no. feeder as per details below:

SL. No.	Equipment Description	Voltage rating(V)	Frequency (Hz)	No of Phases	No. of Feeders	Current/ KW rating	Type of Feeder	Location
01	Diesel Engine control panel DECP	240	50	1	1	16Amps	S	Foam pump house

Any other power requirement shall be met through ACDB board & the same shall be in bidder's scope of supply.

**D) Sea worthy packing requirement**

Mechanical items e.g. pumps, diesel engine, control panel shall be wrapped in weather proof packing & then secured in a wooden packing cases. The wood shall be Fir, Chir, Silver oak or chemically treated mango with moisture content not exceeding 50%. The wood shall be chemically treated to provide protection against deterioration due to fungi & attach by any kind of infection. The leftover spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect. Silica gel shall be used for absorbing moisture (qty shall not be 4 gms per liter volume of case subject to min 400 gms per case).



**FOAM PUMP WITH DIESEN ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

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Marking shall be provided on the boxes indicating position of the boxes for handling, storage and nature of consignment along with dispatch details.

**ANNEXURE-A**  
**PAINT SPECIFICATION**

	TITLE	DOCUMENT NO. PE-DC-250-100-A999																								
	<b>PAINTING SCHEDULE</b> 4X250 MW KOSTI TPS (SUDAN)																									
		REV.NO. 00   DATE 21/08/2006																								
		SHEET 1 OF 7																								
1.00	<b>SURFACE PREPARATION AND PAINTING</b>																									
1.01	<b>GENERAL</b>																									
1.01.01	<p>This schedule is intended to cover the requirement for surface preparation, cleaning, supply of the paint materials, and application of paints on all mechanical equipment, steel structures, piping, ducts, chutes, etc. required for the power plant.</p> <p>The term "painting" referred herein covers rust preventive and decorative coating along with surface protection. The quality of surface preparation &amp; painting shall be suitable for the plant &amp; equipment to be installed at Chennai TPP, a coastal site.</p>																									
1.02	<b>CODES AND STANDARS</b>																									
	<p>All materials and workmanship shall conform to relevant Indian/reputed International Standards. In particular the following shall be referred :</p> <p>a) SIS.05.59.00 – Pictorial Surface preparation Standards for painting Steel Surfaces.</p> <p>b) BS 4232 -- Surface Finish of Blast Cleaned Steel for painting.</p> <p>The following Indian Standards may be referred to for carrying out the painting job :</p>																									
	<table> <tr> <td>IS:5</td> <td>:</td> <td>Colours for ready mixed paints and enamels</td> </tr> <tr> <td>IS:1303</td> <td>:</td> <td>Glossary of terms relating to paints</td> </tr> <tr> <td>IS:2379</td> <td>:</td> <td>Colour code for identification of pipelines</td> </tr> <tr> <td>IS:2524</td> <td>:</td> <td>Code of practice for painting of non-ferrous metals in buildings (Parts I &amp; II)</td> </tr> <tr> <td>IS:2395</td> <td>:</td> <td>Code of practice for painting of concrete, masonry and plaster surfaces (Parts I &amp; II)</td> </tr> <tr> <td>IS:6278</td> <td>:</td> <td>Code of practice for white washing and colour Washing</td> </tr> <tr> <td>IS:3140</td> <td>:</td> <td>Code of practice for painting asbestos cement building products</td> </tr> <tr> <td>IS:158</td> <td>:</td> <td>Ready mixed paint, brushing, bituminous, black.</td> </tr> </table>	IS:5	:	Colours for ready mixed paints and enamels	IS:1303	:	Glossary of terms relating to paints	IS:2379	:	Colour code for identification of pipelines	IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)	IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)	IS:6278	:	Code of practice for white washing and colour Washing	IS:3140	:	Code of practice for painting asbestos cement building products	IS:158	:	Ready mixed paint, brushing, bituminous, black.	
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	TITLE	DOCUMENT NO. PE-DC-250-100-A999	
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leadfree, acid, alkali, water and heat resisting

- IS:2074 : Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
- IS:104 : Ready mixed paint, brushing, Zinc Chrome, priming
- IS: 2932 : Enamel , synthetic, exterior (a) undercoating (b) Finishing
- IS-1477 : Code of practice for painting of ferrous metal in buildings.  
Part – I: Pretreatment  
Part – II: Painting

**1.03 EXTENT OF PAINTING**

- 1.03.01 Structural steel work.
- 1.03.02 Various types of static and rotary equipment inclusive of electric motors, etc.
- 1.03.03 Steel tanks and vessels.
- 1.03.04 Metallic duct work such as ventilation ducts, gas ducts including supports. Hangers, etc.
- 1.03.05 Surface made of aluminum, brass, bronze, stainless steel, cast iron and other corrosion resistant alloys are not required to be painted unless specified except for aesthetic purpose or for identification bands.  
  
All machined mating surfaces (e.g. flanges) shall be properly cleaned, greased and protected before despatch.
- 1.03.06 The complete paint system for any item includes the following activities :
  - i) Proper surface preparation
  - ii) Application of primer coats
  - iii) Application of intermediate coats
  - iv) Application of finished coats

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All the above coats shall be of quality paint products and of approved make as stipulated in this painting schedule.

~~1.03.07 Manufacturer may follow his standard painting provided the same is suitable for the operating and environmental conditions where the equipment are to be installed. In such cases the manufacturer's painting procedure shall be subject to Purchaser's /Consultant's approval and superior to the requirements enlisted here.~~

1.04 **GENERAL REQUIREMENTS**

1.04.01 All materials used shall be new and of first class quality from reputed manufacturers. The application procedure, manufacturer and brand of paint to be used shall be subject to Purchaser's approval.

1.04.02 The colour scheme for the entire plant equipment and piping shall be got approved by the Contractor from the Purchaser / Consultant before application of paint.

~~1.04.03~~ The surface preparation, and type of primer/paint etc. shall be as per Annexures enclosed herewith.

1.04.04 Procedure for inside painting of vessels, heat exchangers, tanks etc, shall be developed by the equipment suppliers considering fluid properties, if the same is not indicated. This procedure and quality of paint shall be subject to Purchaser's / Consultant's approval.

1.04.05 Hot insulated pipes shall be only primer painted. All other piping shall have a base colour.

All piping, insulated shall have colour bands near valves, fittings, joints, specialties, equipment, walls, etc. for identification of conveyed fluid as per approved colour scheme.

1.04.06 Manufacturer's specific recommendation, if any, shall be followed during surface preparation of paint, if the same is more stringent than this specification.

1.04.07 Surface preparation and painting work shall not be carried out under the following weather conditions :

- a) When the surface is wet or expected to become wet before the paint/primer has dried up due to impending rain, fog or mist.



TITLE

DOCUMENT NO. PE-DC-250-100-A999

**PAINTING SCHEDULE**

4X250 MW KOSTI TPS (SUDAN)

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- b) High winds.
- c) Ambient temperature below 5 deg.C or surface temperature less than 3deg.C. above dew point.
- d) Relative Humidity is more than 85%.

1.04.08 The contractor shall provide suitable protection for adjacent plants from air borne material during cleaning and spraying to the satisfaction of Purchaser/Consultant.

1.05 **SURFACE PREPARATION**

1.05.01 Surface preparation being a pre requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint.

1.05.02  All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux, etc. irrespective of whether the same has been spelt out in the standards in order that the prime coat is rigidly anchored to the virgin metal surface. The surface preparation grade of Swedish Standards Institution SIS - 055900 or equivalent standards such as SSPC - VIS 1.67 or DIN 55928 (Part 4) or BS 4232 or IS : 1477 (Part I) shall be followed.


1.05.03 The acceptable surface preparation quality/grade are described under each painting system. The procedures are solvent cleaning, Hand tool cleaning, power tool cleaning and blast cleaning.

1.05.03.01 **Solvent cleaning**

The surface shall be cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning shall not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning shall be followed by other cleaning procedures as stated below.

1.05.03.02 **Hand tool cleaning**

The surface shall be cleaned by vigorous wire brushing done manually to St-1 quality. This method effectively removes loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent.

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	<b>PAINTING SCHEDULE</b>			
	4X250 M <sub>W</sub> KOSTI TPS (SUDAN)			REV.NO. 00    DATE 21/08/2006
				SHEET 5    OF 7

**1.05.03.03    Power tool cleaning**

The surface shall be cleaned by electric or pneumatic tools to St-3 quality. The tools shall be used carefully to prevent excessive roughing of surface and formation of ridges and burns. This method will remove loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent.

**1.05.03.04    Blast cleaning**

The surface shall be cleaned by impingement of abrasive materials, such as graded sand grit, shot etc at high velocity created by clean and dry compressed air blast. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning and excessive surface scales are removed by hand tools or power tool cleaning. The surface shall be cleaned to Sa-2 ½ quality which means that 95% of surface area is free from all rust, mill scales and visible residues, foreign materials, etc. The blast cleaning is not recommended for sheet metal work.

**1.06            PRIMER AND PAINT APPLICATION**


**1.06.01        Primer shall be applied** immediately after surface preparation has been completed.

**1.06.02        Brushing, spraying, roller coating or other suitable method shall be adopted for application of primer and paint and the work shall be carried out strictly as per the recommendation given by the paint manufacturer.**

**1.06.03        Primerized surfaces shall be faultless and shall not have mud cracking, dripping over thickness and dry sprays.**


**1.06.04        Before application of a paint / primer, the following shall be particularly checked for conformity to this schedule and recommendation of the paint manufacturer.**

- a) Surface preparation profile.
- b) Catalysis ratio for two component paints.
- c) Minimum and maximum top coating times.
- d) Type and quantity of thinners (if required)
- e) Pot life
- f) Soundness & thickness of previous coating.

	TITLE	DOCUMENT NO. PE-DC-250-100-A999
	<b>PAINING SCHEDULE</b>  <b>4X250 MW KOSTI TPS (SUDAN)</b>	
		REV.NO. 00      DATE 21/08/2006
		SHEET 6      OF 7


1.06.05	Particular care shall be taken during application to prevent painting defects, such as, dripping, fums, waviness, non uniform thickness, poor adhesion, discoloration etc.
1.06.06	Paints shall be properly stirred before and during application to make them homogenous.
1.06.07	No thinner shall be added to paints unless specifically approved. In such case, thinner recommended by the paint manufacturer shall only be used.
1.06.09	Shop painted/primed equipment shall be touched up in areas where paint has been damaged, loosened, cracked or rendered brittle. Touch-up shall be carried out by applying same number and type of coats as originally applied after carrying out surface preparation.
1.06.10	If paints are used for writing identification numbers, said paints shall be consistent with the finish coat.
1.06.14	Surfaces which cannot be painted after fabrication shall be primed and provided with suitable rust preventive oil before boxing up.
1.06.15	Paints shall be stored in well-ventilated rooms, far away from heat sources, open flames, sparks and protected from sun. Outdoor storage is not permitted. Storage life shall be clearly indicated on the container. Paints which have thickened or gelled or contained in non-original containers or in unsealed containers shall not be used.
1.06.16	Paint shall be applied in accordance with manufacturer's recommendations. The work shall generally follow IS 1477 (Part II).
1.06.18	Each coat of paint shall be dried sufficiently before application of next coat.
1.06.19	The contractor shall furnish paint manufacture's test report or technical data sheet shall indicate among other things the relevant standards, if any, composition in weight percent of pigments, drying time, viscosity, spreading rate, flash points, method of application, etc.
1.06.20	The suggestive colour code to be followed during painting are enclosed as Ann III and shall be finalized during detailing of various items/packages.
1.07	<b>PAINING SCHEME</b>

	TITLE	DOCUMENT NO. PE-DC-250-100-A999	
	<b>PAINING SCHEDULE</b>  4X250 MW KOSTI TPS (SUDAN)		
		REV.NO. 00	DATE 21/08/2006
		SHEET 7 OF 7	

1.07.01 Painting schedules for various systems/items are furnished as Annexure – I&II. Vendors of different packages/items shall furnish detail painting schedule for customer approval during detail engineering as per this guide specification/schedule.

1.08 **PAINT MAKES:**

- |                                |                          |
|--------------------------------|--------------------------|
| i) Asian Paints (I) Ltd.       | vi) Shalimar Paints Ltd. |
| ii) Berger Paints India Ltd    | vii) Bombay Paints       |
| iii) Goodlass Nerolac          |                          |
| iv) Jenson & Nicholson (I) Ltd |                          |
| v) CDC carboline (I) Ltd.      |                          |

	TITLE	DOCUMENT NO. PE-DC-250-100-A999	
	<b>PAINING SCHEDULE</b> <b>4X250 MW KOSTI TPS (SUDAN)</b>		
		REV.NO. 00	DATE 21/08/2006
	SHEET 2 OF 2		

Notes:

1. Surface preparation shown is as per Swedish Standards SIS 05-5900. Degreasing will be as per Standard SSPC-SP1.
2. Incase of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. However these items coming under Fire Fighting System shall be painted Fire Red as per TAC guidelines. Further SS/GI piping shall be given necessary colour banding for identification as per approved colour scheme/coding.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. Rust preventive coating should be given on HSFG bolt and nut threads.
8. Machined Surface are to be applied with a coating of Temporary Rust preventive oil.
9. Based on above painting schedule, detailed painting schedule will be prepared by respective package supplier and these be submitted for their approval.



TITLE

**PAINTING SCHEDULE**  
4X250 MW KOSTI TPS (SUDAN)

DOCUMENT NO. PE-DC-250-100-A999

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ANNEXURE-III

SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Fans, pumps, motors, compressors, Blowers	Light Grey	631	-	-
3.0	Tanks (without insulation and cladding)				
3.1	Outdoor, Stand pipes, vent pipes	Aluminum	-	-	-
3.2	Indoor	Aluminum	-	-	-
4.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
5.0	Switchgear	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Dark Admiralty Grey	632	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping (without insulation and cladding)				



TITLE

DOCUMENT NO. PE-DC-250-100-A999

**PAINTING SCHEDULE**

4X250 MW KOSTI TPS (SUDAN)

REV.NO. 00 DATE 21/08/2006

SHEET 2 OF 3

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
9.1	Water System				
a)	Boiler feed	Sea green	217	-	-
b)	Condensate	Sea green	217	Light brown	410
c)	D M Water	Sea Green	217	Light orange	557
d)	Soft water	Sea green	217	French blue	166
e)	Bearing cooling water	Sea green	217	French blue	166
f)	Potable & filtered water	Sea green	217	French blue	166
g)	Service & clarified water	Sea green	217	French blue	166
h)	Raw water	Sea green	217	White	-
i)	Cooling water	Sea green	217	French blue	166
9.2	Compressed Air System				
a)	Service air	Sky Blue	101	-	-
b)	Instrument air	blue	101	White	-
9.3	Oil system				
a)	Fuel oil	Light brown	410	French	166
b)	Light oil	Dark Brown	412	Brilliant green	221
c)	Lubricating oil	Light brown	410	Light grey	631
d)	Control oil	Light brown	410	Light orange	557



TITLE

DOCUMENT NO. PE-DC-250-100-A999

## PAINTING SCHEDULE

4X250 MW KOSTI TPS (SUDAN)

REV.NO. 00 DATE 21/08/2006

SHEET 3 OF 3

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
e)	Transformer oil	Light brown	410	Light orange	557
9.4	Gas system				
a)	Carbon dioxide	Canary yellow	309	Light grey	631
9.5	Fire services	Fire red	536	-	-
9.6	Ash slurry pipes	Black	-	-	-
9.7	Vacuum pipes	Sky blue	101	Black	-
9.8	Fuel pipes (lignite)	Light brown	410	-	-
9.9	Drainage	Black	-	-	-
9.10	Stand pipes and all Vent pipes	Aluminum	-	-	-
9.11	Bottom Ash system	Light Grey	631	-	-

**Notes :**

1. This colour code basically refers to IS:2379 for piping with necessary modifications.
2. Where band colour is specified, same shall be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.



TITLE

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**PAINTING SCHEDULE**

4X250 MW KOSTI TPS (SUDAN)

Annexure I

REV. NO. 00 DATE 21/08/2006

SHEET 1 of 1

Item Description	Surface Preparation Grade / Surface profile	Primer Coat		Intermediate Coat		Finish Coat		Total DFT in microns
		Primer Paint	No. of DFT in microns	Intermediate Paint	No. of Coats	Finish Paint (See Note)	No. of Coats	
Various type of equipment, valves etc. (Temp. upto 90 Deg. C)	Degreasing and surface preparation to SA 2 1/2	Epoxy based polyamide cured (2) pack HB zinc phosphate primer	50-75 per coat	Epoxy based MIO pigmented polyamide cured paint	1	Aliphatic Acrylic (2) pack glossy polyurethane paint	2	Min. 30 per coat 160-185
Piping / Structural Vessels etc. (Temp. upto 90 Deg. C)	Degreasing and surface preparation to SA 2 1/2	Epoxy based polyamide cured (2) pack HB zinc phosphate primer	50-75 per coat	Epoxy based MIO pigmented polyamide cured paint	1	Polyamide cured epoxy coating	2	Min. 30 per coat 160-185
Equipment with temp. above 90 Deg. C & upto 250 Deg C)	Degreasing and surface preparation to SA 2 1/2	(2) pack polyamide cured epoxy zinc rich primer	Min. 30 per coat	-	-	Heat resistant Al paint (only for non insulated surfaces)	2	20 per coat 110 (60 for insulated surfaces)
Elect. panels etc.	Shot blasting to SA 2 1/2 surface preparation by (7) tank process & phosphating to coating weight of 16.15 gm. Per sq. mtr	Epoxy based polyamide cured (2) pack zinc phosphate primer %V/S=58	30 per coat	Epoxy based MIO2 pigmented polyamide cured paint (shop)	1	Aliphatic Acrylic (2) pack polyurethane finish paint	2	30 per coat 140

Hot dip Galvanising to 610 gms/Sq.m shall be done as per IS 1161

Floor: grills, ladders, steps, hand rail

85



<b>TITLE</b>  <b>PAINTING SCHEDULE</b>  <b>4X250 MW KOSTI TPS (SUDAN)</b>	DOCUMENT NO. PE-DC-250-100-A999	
	REV.NO. 00	DATE 21/08/2006
	SHEET 1 OF 1	

FOR COASTAL ATMOSPHERE (OUTSIDE)

ANNEXURE -II

<b>1. Condensate/DM Water Storage Tank</b>			
	Internal	External	Underneath of Bottom Plate
Surface preparation	Blast clean to SA 2.5	Blast Clean to SA 2.5	Wire brushing/ hand tool cleaning to ST-2.
Primer	2 coats of epoxy zinc phosphate primer of 35 micron each.	1 coats of HB Epoxy based zinc phosphate primer of 50-75 microns DFT each	2 coat of high build coal tar epoxy suitably pigmented, DFT : 80-100 microns each coat.
Intermediate coat	-	1 coat of epoxy based MIO pigmented paint of DFT 50 micron	-
Finish	2 coats of solvent free epoxy paint, DFT-35 microns each.	2 coats of polyamide cured epoxy finish paint of 30 micron each.	N.A
Total DFT	140 microns	160-185 microns	160-200 microns

<b>2. CRUDE/GAS OIL STORAGE TANKS</b>			
	Internal	External	Underneath
Surface preparation	Wire brushing	Blast Clean to SA 2.5	Wire brushing/ hand tool cleaning to ST-2.
Primer	NA	1 coats of HB Epoxy zinc phosphate of 50-75 microns each coat	2 coats of high build coal tar epoxy suitably pigmented (2 pack), DFT:80-100 microns
Intermediate coat	-	1 coat of epoxy based MIO pigmented paint of DFT 50 micron	-
Finish	2 coats of double boiled linseed oil.	2 coats of polyamide cured epoxy finish paint of 30 microns each	NA
Total DFT	-	160-185 microns	160-200 microns

Note: For Crude oil tank, internal painting is same as that of Gas oil storage tank. Only primer to be applied at the outside the tank before insulation (if applicable).



**FOAM PUMP WITH DIESEL ENGINE  
& CONTROLLER  
4 x 125 MW KOSTI SUDAN TPS**

DOCUMENT NO.: PE-TS-250-552-A003

VOLUME- IIB

SECTION-D

REV. 0

## REFERENCE DOCUMENTS

SL. NO.	TECHNICAL DATA SHEET
1	P&ID OF FOAM SYSTEM: PE-DG-250-552-A204-01
2	GA & SCHEMATIC OF LOGIC CONTROL PANEL: PE-DG-250-552-A307-00



This document is for reference purpose for understanding the system control to bring the diesel engine in auto operation.

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0	04.04.09	SUBMISSION FOR APPROVAL	SKS	SBJ	BSC
REV.	DATE	DESCRIPTION	DRN.BY	CHD.BY	APPD.BY

R E V I S I O N S

CUSTOMER:



NATIONAL ELECTRICITY CORPORATION (NEC)  
THE REPUBLIC OF THE SUDAN

CUSTOMER'S CONSULTANT:

**FICHTNER**

Fichtner GmbH & Co. KG  
Stuttgart, Germany

PROJECT:

KOSTI Thermal Power Station 4x125 MW



BHARAT HEAVY ELECTRICALS LTD  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI

VENDOR:



**UNITECH MACHINES LIMITED**

'UM' HOUSE, PLOT No. 35P, SECTOR-44,  
GURGAON-122\_002, HARYANA.

PACKAGE:

FIRE PROTECTION SYSTEM

TITLE:

GA & SCHEMATIC OF LOGIC CONTROL PANEL

DRAWN	CHECKED	APPROVED	DATE	SCALE	JOB NO.
SKS	SBJ	BSC	04.04.09	NTS	*P-233
CUSTOMER DRG. NO. KTPS-MEEA-90SGA-PE250552-A307-S01DG-00			BHEL DRG. NO. PE-DC-250-552-A307	REV. 0	SHEET 1 OF 17
			UML DRG. NO. P233-E-07		



**GENERAL NOTES:-**

1. ALL TERMINALS ARE ELMEX MAKE CLIP ON TYPE, TYPE NO. CST2.5
  2. ALL WIRES ARE PVC COATED MULTISTRAND FLEXIBLE COPPER WIRE (1.1KV GRADE)
  3. 2.5 SQMM WIRE FOR POWER WIRING USED, (1.1KV GRADE)
  4. 1.5 SQMM WIRE FOR CONTROL WIRING USED, (1.1KV GRADE)
- COLOUR CODE :-**
- RED - FOR PHASE
  - BLACK - FOR NEUTRAL
  - GREEN WITH YELLOW STRIP - FOR EARTH
  - BLUE - FOR 24V DC (+)VE
  - WHITE - FOR 24V DC (-)VE
  - GREY - FOR CONTROL WIRING
- STICKER PAPER FERRULE WITH WHITE TRANSPARENT HEAT SHRINKABLE SLEEVE ARE USED FOR FERRULLING**
- CRISS CROSS FERRULLING METHOD USED IN WIRING**



**UNITECH MACHINES LIMITED**  
**PROJECT ENGINEERING MANAGEMENT**  
 (MECHANICAL DIVISION)

This approval status shall be indicated on the contract and it shall not relieve the contractor of his contractual obligations.

**APPROVAL CATEGORY AWARDED**

Approved with comments as noted  
 Not Approved  
 Reference Drawing

Name: H. Prasad  
 Signature: [Signature]  
 Date: 27/05/20

REV. NO.	DATE	DRN	SKS
0	04.04.09		

PACKAGE NAME:	FIRE PROTECTION SYSTEM
CUSTOMER:	NATIONAL ELECTRICITY CORPORATION (NEC) THE REPUBLIC OF THE SUDAN
CUSTOMER CONSULTANT:	Fichtner GmbH & Co. KG Stuttgart, Germany

PROJECT NAME:	KOSTI Thermal Power Station 4x125 MW
CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD
VENDOR NAME:	UNITECH MACHINES LIMITED
SUB VENDOR NAME:	

DRN:	SKS	TITLE:	LOGIC CONTROL PANEL LEGEND
CHD:	SBJ	CUSTOMER DRG. NO.:	K/PS-WE-FA-RSG/PE/20052-A3
APPD:	BSC	BHEL DRG. NO.:	PE-DG-250-552-A/307
		UML DRG. NO.:	P233-E-07

JOB NO.:	P233
SCALE:	N/S
SHEET:	2 OF 17
REV:	0

**LEGEND**

	SWITCH		TRANSFORMER WITH 3 WINDINGS		LIGHTNING ARRESTER		ELECTRICAL INTERLOCK		MODULE CASE CIRCUIT BREAKER WITH OVERLOAD & SHORT CIRCUIT RELEASE.
	CHANGE-OVER SWITCH		AUTO-TRANSFORMER		RESISTOR		KEY OPERATED		AMMETER
	DISCONNECTOR		CURRENT-TRANSFORMER		ADJUSTABLE RESISTOR		MANUALLY OPERATED		VOLTMETER
	DOUBLE-BREAK DISCONNECTOR		RESIDUAL CURRENT-TRANSFORMER		CAPACITOR		ELECTROMAGNETIC ACTUATOR		MOULD CASE CIRCUIT BREAKER (MCCB)
	CIRCUIT BREAKER		SHUNT		CAPACITOR VOLTAGE DIVIDER		PNEUMATIC OR HYDRAULIC ACTUATOR		MINIATURE CIRCUIT BREAKER (MCB)
	CONTACTOR		CONVERTER OR MEASURING TRANSDUC.		INDUCTOR WINDING		ELECTRICAL MOTOR OPERATED		OVERLOAD RELAY
	CONTACTOR (CONTACT CLOSED IN THE UNOPERATED POSITION)		INDICATING INSTRUMENT		BATTERY		KEY ALWAYS FREE		
	SWITCH DISCONNECTOR (ON LOAD ISOLATING SWITCH)		RECORDING INSTRUMENT		INVERTER		KEY FREE KEY LOCKED		
	LIMIT SWITCH		ENERGY METER		RECTIFIER		ISOLATED PHASE BUS DUCT		
	FUSE		IMPULSE COUNTER		SOCKET PLUG		CABLE		
	THERMAL EFFECT MAGNETIC EFFECT		MEASURING RELAY OR RELATED DEVICE		PLUG AND SOCKET		OVERHEAD LINE		
	THREE WAYS SWITCH		SIGNAL LAMP		EARTH MASS		OPTICAL FIBRE OR OPTICAL FIBRE CABLE		
	CONNECTING LINK		LIMITER		PULSE		CARRIER LINE TRAP		
	ROTATING MACHINE		SPARK GAP		MECHANICAL INTERLOCK		POWER LINE CARRIER COUPLING DEVICE		
	TRANSFORMER WITH 2 WINDINGS		ON DELAY TIMER		CONTACTOR		RELAY		
	DIODE		MOISTURE SENSOR WITH MAKE CONTACT		LEVEL SENSOR WITH MAKE CONTACT		TEMPERATURE SENSOR WITH MAKE CONTACT		
	INDICATING LAMP - RED - GREEN		PUSH BUTTON (STOP)		SELECTOR SWITCH		TERMINALS AT INST.		
	PUSH BUTTON		PUSH BUTTON (START)		TERMINALS AT FIELD				

**APPROVAL**  
 PROJECT APPROVED BY:   
 FIRE PROTECT APPROVED BY:   
 CAT I CUSTOMER APPROVED BY:   
 CAT II CUSTOMER APPROVED BY:   
 CAT III CUSTOMER APPROVED BY:   
 CAT IV CUSTOMER APPROVED BY:   
 DATE: 04.04.09



TITLE: CONTROL PANEL  
 CUSTOMER: KIPS-AMEA-905GA  
 BHFL DRG. NO.: PE-DG-250-552-A307  
 UML DRG. NO.: P233-E-07

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD  
 POWER SECTOR  
 PROJECT ENGINEERING MANAGEMENT, NEW DELHI  
 VENDOR NAME: UNITECH MACHINES LIMITED  
 "JAL" 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

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