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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR FIELD ERECTED WATER TUBE BOILERS

FIRST EDITION

JULY, 2005

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IN THE NAME OF GOD

FOREWORD

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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1. SCOPE

This specification covers the requirements for the supply of field erected water tube boilers with accessories, design, fabrication, inspection, performance conditions, preparation for shipment, and information required with quotations.

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced/relevant IPS and the international standards, shall be made through written consent and approval of NIOEC.

2. REFERENCES

The following standards, codes, and specification, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor/Contractor.

API (AMERICAN PETROLEUM INSTITUTE)

API 613	“Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services”
API 611	“General Purpose Steam Turbine for Petroleum, Chemical, and Gas Industry Services”

BSI (BRITISH STANDARDS INSTITUTION)

BS EN 12952	“Water Tube Boilers”
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ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ASME Code Sec. I	“Boiler and Pressure Vessel Code”
ASME Code Sec. II	“Materials”
ASME Code Sect. V	“Non-Destructive Examination”
ASME Code Sec. VIII	“Rules for Construction of Pressure Vessels”
ASME Code Sec. IX	“Welding & Brazing Qualifications”
B 16.5	“Steel Pipe Flanges and Flanged Fitting”
B 31.3	“Petroleum Process Piping”

AGMA (AMERICAN GEAR MANUFACTURERS ASSOCIATION)

420.04	“Standard Practice for Helical and Herringbone Gear Speed Reducers and Increasers”
421.06	“Standard Practice for High Speed Helical and Herringbone Gear Units”

NEMA (NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION)

SM-23

“Mechanical Drive Steam Turbines”

AWS (AMERICAN WELDING SOCIETY)

D1.1

NIOEC-SP (NIOEC SPECIFICATIONS)

NIOEC-SP-00-01	“NIOEC Specification for Civil Design Criteria”
NIOEC-SP-00-11	“NIOEC Specification for Site Conditions”
NIOEC-SP-00-10	“NIOEC Specification for Units”
NIOEC-SP-00-50	“NIOEC Specification for Design Criteria for Process and Mechanic”
NIOEC-SP-20-01	“NIOEC Specification for Structural Steel Fabrication”
NIOEC-SP-41-03	“NIOEC Specification for Pressure Vessels”
NIOEC-SP-43-14	“NIOEC Specification for Centrifugal Fan”
NIOEC-SP-45-07	“NIOEC Specification for Refractory Linings”
NIOEC-SP-46-02	“NIOEC Specification for General Purpose steam Turbines”
NIOEC-SP-47-10	“NIOEC Specification for Noise Control and Vibration”
NIOEC-SP-50-04	“NIOEC Specification for Piping Material”
NIOEC-SP-50-07	“NIOEC Specification for Cleaning and Protection of Piping”
NIOEC-SP-50-08	“NIOEC Specification for Winterizing & Heat Conservation”
NIOEC-SP-60-02	“NIOEC Specification for Squirrel Cage Induction Motors”
NIOEC-SP-60-07	“NIOEC Specification for Aircraft Warning Lights”
NIOEC-SP-80-01	“NIOEC Specification for Insulation”
NIOEC-SP-80-02	“NIOEC Specification for Painting”
NIOEC-SP-70-01	“NIOEC Specification for Instrumentation”

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-G-ME-180

“Water Tube Boiler”

3. UNITS

International system of units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. SCOPE OF SUPPLY

The minimum required Components are included but not limited to the following items:

- 4.1. Complete self-supporting boiler for outdoor installation including boiler drums, tubes, drum supports, internals drum and header connections, water wall tubes, water wall headers and drum, water wall circulator tubes, stack, duct and structural steel.
- 4.2. Complete super heater assembly including inlet and outlet headers, center outlet, connecting tubes between boiler drum and saturated steam header and necessary support for headers and elements.
- 4.3. Burner assembly consisting of steam atomized burners, pilot assemblies, and air register for the combustion of liquid and gas fuels..
- 4.4. Forced draft fan requirements will be specified on the boiler Data Sheet.
- 4.5. Soot blowers with electrical accessories, pipes, valves, pipe hangers and guides and fittings. Soot blowers are not initially required for the boilers fueled with only refinery fuel gas, but space for future installation of soot blowers, water washing or steam lancing doors shall be provided.
- 4.6. All ductwork between forced draft fan and boiler and burner wind boxes.
- 4.7. Boiler valves and accessories including safety valves, blow-off valves, drum vent valve, chemical feed valve, continuous blow down valves, steam gauges, water gauge stop valves, water gauge drain valves, steam gauge line stop valves, water gauges, and super heater valves.
- 4.8. A sealing air system shall be provided from the F.D. fan discharge duct for the observation ports soot blowers etc.
On pressurized boiler, observation doors shall have a view glass and shall be furnished with:
 - a) Aspirating air of sufficient pressure to prevent flue gases from blowing out when the door is open. Each door should be fitted with inter lock.
 - b) Seal air to minimize flue gas leakage and prevent fogging of the view glass when the door is closed.
- 4.9. Outdoor setting, insulation, Refractory's and 14 gauge, or 2mm. min. ribbed outer casing shall be provided with necessary seals, expansion joints, door lining, to complete the setting.
- 4.10. Miscellaneous roof steel, buck stays and lower header supports.
- 4.11. Vendor shall furnish ladders, platforms, stairways, stack and ducting from expansion joint. After flue gas outlet damper to stack.
- 4.12. The Vendor shall furnish one (1) complete set of pneumatic tube rollers, two (2) complete sets of spare rolls for each size tube, and three (3) sets of spare gaskets.
- 4.13. Flue gas outlet damper at boiler outlet.
- 4.14. Instrumentation, including feed water regulator, flame failure devices, three element control system, alarms, recorders, instrument panels, etc. Boiler instrumentation shall be included in the specified Data Sheets.
- 4.15. Concrete foundation design information and all relevant drawings only.
- 4.16. All anchor bolts for major foundations.
- 4.17. Feed water piping's to steam drums as per flow diagram.
- 4.18. Steam piping per flow diagram.
- 4.19. Piping to all burners.
- 4.20. Chemical injection, continuous and intermittent blow down piping's.
- 4.21. Desuper heater complete with injection facility, at super heater outlet.

- 4.22. Where data presented on Data Sheets conflict with the requirement of this specification, the individual Data Sheet shall govern.
- 4.23. Field erection, Vendor must however supply erection schedule and details.
- 4.24. Economizer and static air preheated are required.
- 4.25. Maximum degree of shop fabrication commensurate with shipping limitations is preferred.
- 4.26. The Vendor shall furnish the following valves and accessories, all per ASME Codes, details of which will be specified on the Data Sheets.

Boiler Valves & Accessories

Safety Valve
Blow-Off Valve (Tandem)
Drum Vent Valve
Chemical Feed Stop Valve
Chemical Feed Check Valve
Cont. Blow down Micrometer Valve
Cont. Blow down Line Stop Valve
Steam Gauge
Water Gauge Stop Valve
Water Gauge Drain
Steam Gauge Line Stop Valve
Water Gauge
Feed Water Stop and Check Valve

Double valves in series should be used for blow down facilities, upper drum venting, sample connection (boiler water, saturated and super heater steam)

Water Wall Valves

Drain - As required

Drain connections (lower drum, water walls and super heater)

Suitable size/class Flanged openings for the installation of the thermo wells. Location:

- a: Burner air inlet
- b: Boiler outlet

Super heater Valves

Safety
Drain-Inlet Header
Drain-Outlet Header
Steam sampling connection from
Inlet header
Vent

Non-return and stop valves on super heater outlet. Non-return valve means combined stop/check valve.

Super heater outlet safety valves to be furnished and set according to ASME Sec.I.

- 4.27. Sample collector for checking of boiler TDS shall be provided with sample cooler and pressure reducing device.

4.28. Boiler Fuel Management System (BMS) shall be supplied as per Vendor and Project specifications.

5. DESIGN DATA

5.1. The maximum heat flux density at any localized "hot spots" shall not exceed 300 kW/m² (95,000 Btu/ft²h). The boiler designer shall present with his proposal the predicted furnace heat flux distribution along the length and height of the furnace at Maximum Continuous Rating (MCR) and state the maximum and average heat flux and the furnace flue-gas exit temperature.

Note:

The heat flux density is the quantity of heat passing through unit surface area in unit time and is expressed as kW/m² (Btu / ft²h). The surface area shall be that of the flat projected area of exposed tubes and exposed extended surface, integral with the tube. Refractory covered surfaces shall not be included.

5.2. The furnace width shall enable sufficient spacing of burners to ensure burner flame discrimination by individual viewing heads and also to make certain that there is no flame impingement on the side walls. The furnace depth shall be sufficient to ensure that burner flames do not impinge on the rear wall or penetrate the screen tube arrangement.

The depth of furnace shall not be so disproportionate to the width that a significant volume of furnace is not occupied by the flame, thereby making the total projected surface area not truly reckonable for the radiant heat rate calculations.

5.3. Vendor's guarantee of boiler performance shall be based on specified ambient conditions at plant site as per NIOEC-SP-00-11 "Site Conditions".

Ease of operation, inspection, maintenance, repair and cleaning are of major concern in design and arrangement of boiler.

5.4. Boiler and ancillaries shall be capable of continuous 24 hours a day operation between a 26 month statutory shut down period.

5.5. Boilers shall be designed for the following operating conditions:

5.1.1. Guaranteed net steam capacity: each boiler at super heater outlet excluding all blow down per paragraph 5.5.12 heat losses and all steam used for boiler auxiliaries such as fans, soot blowers, burners, etc. as specified on data sheet.

5.1.2. The Vendor shall guarantee that each boiler will be capable of producing the overload requirements of four hours design capacity and the minimum load for a continuous period of 24 hours. (Minimum acceptable 15%).

5.1.3. Guaranteed turn down ratio Vendor to specify.

5.1.4. Minimum thermal efficiency when firing gas Job Specification to specify.

5.1.5. The steam temperature at desuper heater outlet shall be controlled between 371°C and 397°C through the operating range 40% to 100% load. And the steam temperature at desuper heater outlet shall be guaranteed 397 ± 3°C at 100% (MCR).

5.1.6. Guaranteed operation super heater outlet pressure, and Specified on Data Sheet.

5.1.7. Feed water inlet temperature Specified on Data Sheet.

5.1.8. Steam drums shall be equipped internally with steam separators and scrubbers to ensure that the carry-over of total solids from the boiler water shall not exceed the following:

1 ppm up to 65 bar

5 ppm from 65 bar up to 135 bar

The boiler manufacturer shall state the maximum total dissolved solids (TDS) in the boiler water at which the required steam quality can be obtained.

5.1.9. Heat release per cubic foot of furnace volume when firing Specified fuels. Vendor to specify.

5.1.10. Super heater, drums and boiler tube system maximum design pressure Vendor to specify, but a minimum of 3 bar (50 psi) above operating pressure is required.

5.1.11. Steam drum and boiler tube system maximum design temperature. Super heater design temperature per code. Design temperature specified on Data Sheet.

5.1.12. Total continuous and intermitted blow downs will be no more than 5% of steam generated. Vendor to specify capacity at 100% rating.

5.1.13. Steam/Power for Fan Drivers Specified on Data sheet.

5.1.14. Exhaust Steam from Fan Drivers Specified on Data Sheet.

5.1.15. Stack temperature. Vendor to Specify.

5.1.16. Boiler feed water and chemical injection Specified on Data Sheet.

5.1.17. Boiler dynamically shall be able to maintain a constant steam pressure for any load change occurring within a 3 minute interval between 30% and 100% of maximum continuous rating (MCR) or vice versa.

6. STRUCTURAL DESIGN

6.1. Earthquake load shall be in accordance with civil design criteria NIOEC-SP-00-01.

6.2. Wind load shall be in accordance with NIOEC-SP-00-01 as following:

6.2.1. Basic wind speed and exposure coefficient as site NIOEC-SP-00-11 (Cylindrical surfaces shall be taken as 60% of the loads of the flat surfaces).

6.2.2. Design wind pressure shall be in accordance with NIOEC-SP-00-01.

6.3. Boiler setting design shall consider the possibility of oscillation at critical wind and flue gas velocities.

7. MATERIALS

Materials and construction for all pressure parts shall be as specified in the relevant ASME Codes.

Refractories shall be in accordance with the ASTM relevant codes. Other materials of construction, as a minimum, shall be equal to the following:

	ASTM
Columns, beams and other structural shapes	Carbon Steel ASTM A 36
Steel Plate Enclosure	Carbon Steel ASTM A-283 Gr.C.
Bolts and Nuts	Carbon Steel ASTM A-307

Vendor may quote on other equivalent materials, but all substitutions shall be subject to written approval by the Purchaser.

Vendor must state details of materials he proposes to use for tubes, headers, steam drum.