SUCKER ROD PUMPING UNITS

OISD-STD-231

Prepared by
FUNCTIONAL COMMITTEE

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently flammable substances throughout its value chain – upstream, midstream and downstream – safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stakeholders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is more than 100 years old. As such a variety of practices are in vogue because of collaboration/association with different foreign companies and governments. Earlier, standardisation in design philosophies, selection, operating and maintenance practices at a national level were hardly in existence. This, coupled with feed back from some serious accidents that occurred in India and abroad, emphasised the need for the industry to review the existing state of art in designing, selecting, operating and maintaining oil and gas installations.

With this in view, the then Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a serious of self-regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safer operations. Accordingly OISD constituted a number of functional committees comprising of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present document on “Sucker Rod Pumping Units” has been prepared by the “Functional Committee”. This document, based on the accumulated knowledge and experience of industry members and the various national and international codes and practices, is meant to be used as a supplement and not as a replacement for existing codes standards and manufacture’s recommendations. It is hoped that the provision of this standard, if implemented objectively, may go a long way to improve the safety and reduce accidents in the Oil and Gas Industry. The users of this document are cautioned that no standard can be a substitute for a responsible and experienced engineer. Suggestions are invited from the users after it is put into practice to improve the standard further. Suggestions for amendment, if any, should be addressed to:

The Coordinator
Committee for Revision of Standards on Rotary Equipment
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These documents are intended to supplement rather than replace the prevailing statutory requirements & best engineering practices in vogue.
# List of Functional Committee Members

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SUCKER ROD PUMPING UNITS

1.0 INTRODUCTION

The Sucker Rod Pumping (SRP) units are used for lifting crude oil from sub-surface to the surface. SRP’s are powered by prime movers (motor/ engine) to drive a sub surface pump. A beam and crank assembly converts the rotary motion in to reciprocating motion to run the down-hole pump. The SRP units are normally operated unmanned and at times in remote areas.

A sketch of a typical SRP unit along with its different components is attached at Annexure-1.

2.0 SCOPE

This document covers minimum safety requirements for Design/ Selection, Installation, Commissioning, Operation and Maintenance of Sucker Rod Pumping units used in onshore areas. The scope of this document is limited to the surface equipment/ components of conventional units. The components below carrier bar namely polish rod, stuffing box, BOP etc. are excluded from the scope of this document.

3.0 DEFINITIONS

3.1 Shall

Indicates mandatory requirement.

3.2 Should

Indicates recommendation which is advisory but not mandatory.

4.0 DESIGN/ SELECTION CONSIDERATIONS

4.1 General Considerations

The design of Sucker Rod Pumping (SRP) Unit shall be as per API Specification 11E or equivalent standard.

The basic design/ selection considerations for a SRP unit shall include inter alia the following;

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a) Provisions for prevention of spark generation during operation by rubbing of moving parts like belt pulley/ flywheel with safety guard, from electrical fittings, dry running of bearings etc.

b) Provision for fixing of lifting tools like eye bolts, brackets etc. for safe lifting of heavy components,

c) Safety guards, railings on or around moving parts.

d) Provision of pre-assembly of heavy components before their final assembly.

e) Provision for placement of safety belt hooks while working on heights and particularly on the walking beam.

f) Sound foundations and other provisions to prevent toppling of SRP unit.

g) Provision for tripping of prime mover on overload.

4.2 Lubrication Considerations

a) Provision for accessible and convenient locations of greasing points

b) The selection of lubricants (oil and grease) for gear reducer and bearings shall be as per the original equipment manufacturer (OEM) recommendations.

c) The recommended lubricant, its quantity and periodicity shall be prominently displayed near the unit.

4.3 Protections

a) The unit shall have proper guards, walkways, rails, platforms, staircase, ladder for safe operation and maintenance. The guarding of SRP unit shall be as per the provisions of API RP 11ER or equivalent standard.

b) The SRP units shall be provided with audio and visual alerts for start up of unit. A visual alert shall indicate the readiness of unit for start up or standby/ hibernation on timer mode.

c) The multi-linguistic details of these visual & audio alerts shall be displayed on the panel.

d) In case prime mover is an engine, low lube oil pressure, high temperature indications shall be provided.

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e) Electrical protections such as grounding system, overload protection etc. shall be installed on all electrically driven units.

In case of cluster wells with multiple SRP units, the orientation of the adjacent SRPs should be such so as to have maximum separation distance for operation/ maintenance.

5.0 INSTALLATION AND COMMISSIONING

5.1 FOUNDATION

a) The foundation for SRP unit shall be designed and made in line with OEM recommendations or established standard such as API-RP-11G or equivalent.

b) Proper consideration shall be given to soil condition and its behaviour under different weather conditions.

c) In case foundation is raised one, it shall provide sufficient space around the unit for safe working.

d) The site should be graded to provide drainage away from foundation.

5.2 INSTALLATION

The installation of Pumping Unit shall be done in accordance with an approved procedure based on OEM recommendations.

In addition, the following precautions shall be taken while carrying out the installation of the SRP unit.

a) Job safety analysis shall be carried out prior to start of installation work. The dangers/ risks involved in the installation work shall be discussed with the crew members so as to create safety awareness amongst them.

b) The installation personnel should use proper personal protective equipment (PPEs), tools & tackles. All tools and tackles shall be kept free of slick so that their slippage shall not occur at any time.

c) The SRP unit components shall be inspected before assembly against any damage during transportation, storage etc.

d) The lifting, lowering and shifting of heavy equipment/ components shall be done using proper hoisting equipment. Proper supports shall be provided for suspended parts prior to working on, under or between them.

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e) Weights of all major assemblies/ components shall be known before starting the installation of the unit so as to check the adequacy of lifting tools & tackles.

f) Installation, commissioning and testing of prime mover (Motor/ Engine) shall be carried out as per OEM recommendations.

g) Installation of brake and positive locks shall be carried out as per OEM recommendations. Adequate extra care should be exercised during installation & adjustment of brake. Functional check of brake shall be done after each adjustment of counter weight.

h) Positive locking of brakes shall be ensured by engaging brake dowels while erecting the SRP unit. The crank rotating area shall be kept clear of any obstruction, before release of brake and precautionary alerts shall be issued before each disengagement.

i) The brake assembly shall be kept clean, clear of obstructions and properly lubricated. The brake adjustments shall be performed in line with the instructions provided by OEM.

j) The prime mover shall be kept under positive lockout during Installation and alignment of the SRP unit.

k) The belt and crank guards shall be installed ensuring sufficient clearance between the moving and non-moving parts.

l) Lubrication of SRP unit shall be ensured in line with recommendations of OEM.

m) Hoisting and fixing of counterweights shall be carried out with extreme care.

n) Approach to Samson post top shall be through properly secured ladder.

o) The alignment of the SRP unit with well shall be ensured in line with the guidelines of OEM.

p) The correct direction of rotation of reduction Gear shall be ensured.

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q) All railing and guards shall be designed and placed as per established standard such as API RP 11ER.

r) The well site of the SRP unit shall be properly fenced and warning signs shall be displayed.

5.3 COMMISSIONING

The pre-commissioning checks shall be carried out as per an approved checklist based on OEM recommendations.

5.3.1 No Load Running

The no load running shall be carried out in accordance with OEM recommendations and counter weight should be adjusted accordingly. The no loading running shall be for a sufficient time but not less than two hours.

The following shall be checked, after the no load running is over:

a) Reducer bearing and speed reducer mechanism for any abnormal bearing temperature rise and oil leakage.

b) Looseness of fasteners, particularly crank nuts of crank pins.

c) V-belts for proper tension.

d) Any other abnormality

The observations made during and after the no load run shall be noted and corrective actions shall be initiated, if any.

5.3.2 Load Running

The following shall be ensured before performing the load running of SRP unit:

a) Installation of polished rod into the carrier bar, tightening of the clamping plate screws and mounting the polished rod clamp.

b) Proper lubrication of bridle, bridle carrier and proper tightening of bridle clamps.

c) Proper alignment of polished rod to center of the well.

d) Adjustment of counterweights to proper positions and securely fastening them.

e) Polish rod locking clamp shall be removed after the hook up and position it properly to avoid bottom hitting.

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f) Cranking the unit by one rotation with the help of prime mover and checking the free movement of the moving parts.

After ensuring the above, the SRP unit shall be run on load and check for any abnormality and the same to be corrected. The unit shall be stopped after 1-2 hours of load run and check for temperature of bearings, alignment and tightness of all fasteners, bridle clamps & carrier bar.

The observations made during and after the load run shall be noted and corrective actions shall be initiated, if any.

The following inspection shall be done of the pumping unit after 24 hours of operation;

a) Check all bolts for tightness
b) Adjustment of counter weight for balancing, if required.
c) Check alignment of polished rod
d) Check V-belt tension.
e) Check operating parameters of prime mover

6.0 OPERATION

6.1 The SRP unit shall be operated as per an approved procedure, prepared based on OEM recommendations.

In addition, the following shall be ensured:

a) Start/ stop panel for the SRP unit shall be located at the rear end i.e. engine/ motor side.
b) Apply brake slowly several times to be sure it is functioning properly before using it to position crank. Avoid abrupt breaking.
c) SRP units, running on automatic timer/ cyclic timer, shall be positively electrical isolated before start of any inspection/ maintenance work.
d) SRP units on timer operation must have a multi-lingual display board indicating the cyclic timer mode. Before any auto start up operation, actuated by the cyclic timer, it must preceded by an audio alarm providing sufficient time for the operating/ maintenance crew to clear off from the vicinity of SRP unit moving parts.

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e) Before starting the SRP unit, it is recommended that the SRP unit including the wellhead should be inspected. The wellhead BOP, stuffing box and flow line valve shall be opened prior to starting the SRP unit.

f) After switching off the electric motor or complete stopping of the engine, the unit shall be allowed to swing due to its inertia till it comes to complete halt. The brake shall be applied to stop the unit with counter balance at 6'O clock position. The positive locking (brake pawl) for brake shall be engaged.

g) In case of air balanced SRP unit, the air pressure in the cylinder shall be so maintained that it balances the rod weights and fluid at its static position.

h) No body shall be allowed to climb the Samson Post ladder while the unit is in operation.

i) For engine driven SRP, the exhaust of the engine shall be fitted with spark arrester and thermal lagging.

j) The operational parameters and other observation shall be logged on periodic basis.

k) Nobody wearing loose clothing, ties shall be allowed to go near or work around SRP unit in operation.

l) The warning and caution signs shall be displayed at the site.

7.0 MAINTENANCE

A written and approved maintenance procedure based on OEM recommendations and best practices shall be in place for SRP unit. The preventive, predictive and breakdown maintenance records shall be maintained in soft or hard copy format. A sample preventive maintenance schedule (PMS) for SRP unit is attached at Annexure- II.

The following maintenance activities, as a minimum, shall be carried out;

a) Check lists shall be developed for periodic checks by the installation personnel to ascertain and ensure the integrity of the sucker rod unit.

b) The maintenance work shall be taken up only after proper lock out of the prime mover.

c) No maintenance work shall be undertaken while the pumping unit is in motion.

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d) Positive locking such as chains etc. shall be used to lock the moving parts before undertaking any maintenance work.

e) The maintenance checks for the prime mover shall be in line with OEM recommendations/ best practices and relevant OISD standard.

f) The quality of spare parts shall be ensured.

8.0 FAILURE AND ROOT CAUSE ANALYSIS

Any premature failure of the component shall be analyzed in line with OISD-RP-126 and the recommendation shall be documented and implemented to prevent recurrence.

9.0 DOCUMENTATION

a) Records in approved format, of all schedule maintenance, repairs carried out.

b) Records of movement of the unit (transportation) shall be properly maintained.

c) Records of reuse of components or sub assemblies shall be maintained.

d) Records of electrical checks e.g. earthing, motor inspection etc. shall be maintained in line with OISD-STD-137.
10.0 REFERENCES

a) API Specifications 11E – Specification for Pumping Units
b) API RP 11G – Recommended Practices for Installation and Lubrication of Pumping Units
c) API RP 11ER – Recommended Practices for Guarding of Pumping Units
d) O & M manuals of SRP unit manufacturers.

e) OISD STD 126 – "Specific practices for installation and maintenance of rotating equipment"
f) OISD STD 137 -" Inspection of electrical equipment"
The main components/ assemblies of SRP are:

i  Horse-head
ii  Walking Beam
iii Saddle Bearing Assembly
iv Samson Post
v  Equalizer Assembly
vi  Pitman Assembly
vii  Wrist Pin Assembly
viii Crank Assembly
ix  Gear Reducer
x  Prime Mover (Motor/ Engine)
xii  Brake system
xiii Belt Guard
xiv Polished Rod

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Annexure-II

PREVENTIVE MAINTENANCE SCHEDULE

A. Monthly Checks

i. Reducer: To check reducer oil level. If the oil level is low, add oil of grade recommended by the manufacturer to the proper level.

ii. Structural Bearing assemblies: Visually check the crank pin bearing and center bearing for seal leak.

iii. Leveling: Check leveling of the unit. In case of any deviation from the normal, corrective action like inserting shims, tightening of skid bolts etc. are recommended.

B. Quarterly Checks

i. Belts and Sheaves: Belt alignment and tension should be checked and adjusted if required. Check the sheaves for wear, chips and cracks. Replace them if any of this condition exists.

ii. Brake: Inspect the brake lining wear and clearance. There should be some notches left on the ratchet when the brake control lever is fully engaged.

iii. Brake Drum: Inspect the brake drum for cracks around the hub and key area. Inspect the brake pawl notches for any chips, cracks or broken piece. Replace the drum if any of these conditions exists.

iv. Brake Cable: Inspect the condition of the brake cable. If the rubber covering at the ends of the cable is cracked, moisture will get into the cable and possibly freeze up its movement. Make sure that the brake rods are not bent. Replace the cable if any of these conditions exists.

C. Half Yearly Checks

i. Reducer: Check the gear tooth condition for abnormal wear. Check the reducer oil for quality. If the lube oil quality has deteriorated, replace the same.

ii. Structural Bearings and Upper Pitman Pins: Lubricate all structural bearings and Upper Pitman Pins with grease recommended by the manufacturer.

iii. Wireline: Inspect the wire strands for break or fraying. A rusty wire line should be cleaned and coated with a wire line lubricant.