Engineering Procedure

SAEP-311 3 June 2008

Installation of Hot Tapped and Stopple Connections

Piping Standards Committee Members
Nasri, Nadhir Ibrahim, Chairman
Dib, Tony Georges, Vice Chairman
Balhareth, Nasser Mohammad
Bannai, Nabeel Saad
Fadley, Gary Lowell
Holland, Brad John
Khashab, Jaafar M.
Lewis, Trevor
Mahmoud, Khalid Ahmed
Phan, Howard Cong
Rao, Sanyasi
Rasheed, Mahmood A.
Sharif, Talal Mahmoud
Shihai, Saad Mohammed
Swar, Ahmad H. (ABQ PLANTS)

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1 Scope

1.1 This SAEP provides procedures for the installation of hot tap connections to piping and tanks while in service.

1.2 Also included is procedure for plugging pipes through hot tap connections (stoppling). Hot tap and stoppling are complex operations to be performed by trained technicians with the support of experienced engineers. This SAEP is not intended to detail all aspects of the operations and does not include adequate information to enable it to be used as an instruction manual. The equipment manufacturer's instruction manuals and data sheets will also need to be referenced and utilized.

1.4 The work to be performed after the hot tap and stopple operation is not within the scope of this document.

2 Conflicts and Deviations

2.1 Any conflicts between this Procedure and other applicable Saudi Aramco Engineering Procedures (SAEPs), Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
3 References

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

- **Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement**
- **Pipeline Repair and Maintenance**

Saudi Aramco Engineering Standards

- **General requirements for Pressure Testing**
- **Repairs, Alterations, and Re-rating of Pressured Equipment**
- **Repair, Alteration, and Reconstruction of Storage Tanks**
- **Regulated Vendor List for Pipes, Fittings and Gaskets**
- **Refrigeration, Compressed Air and Compressed Gas Apparatus**
- **Pressure Testing of Plant Piping and Pipelines**
- **Welding Requirements for Pressure Vessels**
- **Welding Requirements for On-Plot Piping**
- **Welding Requirements for Pipelines**

Saudi Aramco Materials System Specification

- **Hot Tap and Stopple Fittings**

Saudi Aramco Standard Drawings

- **Detail of Heavy Welding Boss for Threaded Connections to Vessels and Lines**
- **Detail of Heavy Welding Boss for Socket Weld Connections**
- **Reinforcement of Welded Branch Connections**

Saudi Aramco Forms and Data Sheets

- **Hot Tap Data and Checklist**
3.2 Industry Codes and Standards

American Petroleum Institute

- API STD 598  Valve Inspections and Test
- API RP 2201  Procedures for Welding or Hot Tapping on Equipment Containing Flammables

American Society of Mechanical Engineers/Boiler and Pressure Vessel Code

- ASME SEC VIII D1  Pressure Vessels
- PRCI PR-185-617  Criteria for Hot-Tap Welding (catalogue # L51548)
- PRCI PR-185-816  Review of procedures for Welding unto Pressurize Pipelines (catalogue # L51601)
- NG-18 Report # 175  Proof Testing of the Pre-Hot-Tap Branch Connection (catalogue # L51561e)

Commentary Note:
Referencing to PRCI reports is intended for expanding knowledge and to locate sources of many of the technical basis for the requirements of this procedure. It is not intended to be a mandatory document.

4 Definitions

**Hot Tap:** Hot tapping is technique, performed using specialized equipment for cutting a hole in a pipe or tank through a welded or bolted branch connection while they are under pressure.

**Lock-o-Ring Flange and Plug:** This is a special flange and plug assembly designed to allow the recovery of the hot tap valve while the pipeline is under pressure. The L-o-R plug has an o-ring seal on its circumference and can be lowered into the bore of the L-o-R flange, using a hot tap machine. The L-o-R flange has retractable segments that
can be advanced into a groove in the circumference of the plug above the o-ring. These segments retain the plug in position so that the valve can be depressurized and removed and replaced with a blind flange or permanent valve.

**Sandwich Valve:** This is a gate valve designed to have a short face to face dimension used as a temporary valve for stoppling. They are also used for hot tapping when the connection will only be used temporarily or when the reach of the hot tap machine is insufficient to complete a hot tap through a conventional valve. These valves cannot be operated unless the pressure is equalized across the gate.

**Stopple:** A stopple is an articulated pipe plugging device, normally inserted through a stopple split tee with a full line size hot tapped opening, while the line is pressurized. Saudi Aramco has stoppling equipment for pipe sizes from 1” to 60”.

**Stopple Split Tee:** A stopple split tee is a fitting designed with dimensional requirements to suit the stopple plugging head. These fittings shall be purchased in accordance with 02-SAMSS-006.

**Responsibilities**

5.1 The engineering group that prepares the calculations, design drawings and construction procedures is responsible for the hot tap design. The detailed hot tap installation design package shall be approved in writing by the facility Operations or Engineering Superintendents, or higher. The responsibilities and involvement of relevant organizations are detailed below.

5.2 Initiating Organization

5.2.1 The initiating organization will be either one of the following:

- The Operations Engineering Organization when the work is being undertaken by the Operations Organization.
- Project Management with the approval of the Area Operations Superintendent and Operations Engineering General Supervisor/ Superintendent in the case of tying in new installations, constructed by Project Management to existing facilities.

5.2.2 The initiating organization shall prepare a design package for each hot tap that will include fully dimensioned drawings, a materials list, Direct Charge Requisitions and welding procedures.

5.2.3 The initiating organization shall appoint a Responsible Engineer to carry out the following duties and responsibilities:
5.2.3.1 Be responsible for the overall coordination of the hot tapping activities. This is to ensure that designers, constructors, hot tap unit, facility operations and/or engineering, project management and operation/project inspection staff cooperate closely during all phases of the hot tapping operations.

5.2.3.2 Initiate form 7627-ENG, "Hot Tap/Stopple and Reinforcement Calculation Request" and complete form 7235-ENG, "Hot Tap Data & Checklist" in accordance with appendix A.2 and A.3.

5.2.3.3 Make all necessary arrangements for the preparation of the new connection. (i.e., location, excavation, scaffolding, pipe inspection, surface preparation, Installation, Welding & Testing).

5.2.3.4 Arrange for a team, consisting of himself, Operations, the responsible inspector and a representative of the Hot Tap and Stoppling Unit, to survey the general hot tap location in order to carefully and accurately mark the hot tap locations and number (obtained from Form 7627-ENG) alongside each hot tap location.

5.2.3.5 For stopple installation, make sure that the Hot Tap Unit conducts pipe roundness check to ensure that it meets the requirements stipulated in Table-1 of section 9.7 and mark the exact location of the stopple.

5.2.3.6 Make available at the site a copy of the latest version of this procedure and the installation design package during the entire installation process.

5.2.3.7 Revise existing Saudi Aramco drawings, P&IDs, or preparing new drawings, as may be required, because of the hot tap installation.

5.2.3.8 Ensure that stopple or hot tap split tees with the L-O-Ring plug to be delivered to the Hot Tap Unit shop in Dhahran to be checked prior installation.

5.3 Hot Tap and Stopple Unit/N.A. Pipelines Department

The Hot Tap and Stopple Unit is responsible for the following:

5.3.1 Review and initial the design package.
5.3.2 Review form 7235-ENG and ensure that the hot tap equipment required to perform the hot tap is available and validated.

5.3.3 Perform the hot tapping and/or stoppling operation in accordance with this procedure and an approved detailed design package.

5.3.4 Review and approve any Direct Charge Requisitions prepared as part of the design package for stopple sealing elements, hot tap tees, stopple split tees, or Lock-O-Ring flanges prior to issuing for purchase.

5.4 Inspection Organization

The responsible Inspection Unit shall be responsible for the following:

5.4.1 Review and concur with the design package prior to the start of the installation.

5.4.2 Ensure that the connection is installed in accordance with the design package.

5.4.3 Inspect and determine the minimum pipe wall thickness at the tie-in weld area as by continuous UT scan along the length of the weld and record this on the applicable form in Appendix A.1 of this procedure.

5.4.4 Review the welding procedure specification (WPS) and ensure that it has been approved by Consulting Services Department.

5.4.5 Approve the fit up of the branch connection/split tee to the pipe prior to welding.

5.4.6 Inspect the branch connection/split tee, before and during the installation, for compliance with the approved drawings and welding procedures.

5.4.7 Confirm that the hydrostatic test pressure for the branch connection is correct at the time of the test, as prescribed in Section 4 of Form SA 7627-ENG.

5.4.8 Verify that calibrated pressure gauges and relief valve are properly installed for hydrotesting.

5.4.9 Inform the Responsible Engineer if the seam weld or any other projection needs to be ground flush with the pipe surface to permit proper UT scanning or fit-up of the split tee or reinforcing sleeve.

5.4.10 Scan the weld zone and 50 mm (2 inches) each side of it.
5.4.11 Mark the inspected area permanently for future reference and identification.

5.4.12 Consult with the Responsible Engineer and the responsible Operations Engineering Organization if ultrasonic readings indicate a lamination or evidence of hydrogen induced cracking (HIC) damage in order to relocate the hot tap position. CSD and the proponent group shall be notified of this condition.

5.5 Construction or Maintenance Unit

The construction or maintenance units are responsible for ensuring that approved welding procedures and qualified welders are employed.

5.6 Consulting Services Department

Approve the welding procedure specification (WPS).

5.7 Loss Prevention Department

In the case of stoppping activities the Loss Prevention office responsible for the area where the stopple activity will commence shall be notified and provided with procedures for review and be part of the site survey team.

5.8 OSPAS

OSPAS shall ensure operation stability prior and during pipeline hot tap and stopple operation. OSPAS shall inform upstream and downstream facilities with ongoing work activities.

6 Limitations on Hot Tap and Stopple Applications

6.1 Welding and hot tapping shall not be allowed in the following cases.

6.1.1 The operating pressure of the pipeline or tank may exceed the maximum operating pressure of any of the hot tap or stopple equipment and their components while it is installed.

Commentary Note:

All hot tap and stopple equipment must be stamped with its maximum operating pressure and revalidated according to this procedure.

6.1.2 The pipe contains flammable materials below atmospheric pressure.

6.1.3 The pipe contains a combustible mixture.
6.1.4 Hot tapping on the roofs of cone or floating roof tanks in hydrocarbon service.

6.2 Welding and hot tapping shall not be performed in the following cases unless a detailed design and installation procedure has been approved by the Chairman of the Piping Standards Committee.

6.2.1 Hot taps on air lines with compressed air if there is any possibility of hydrocarbon contamination, unless the equipment being tapped is thoroughly cleaned and inerted prior to welding.

Commentary Note:

Most industrial compressed air systems will have hydrocarbon contamination from compressor lubricating oil and will therefore required being inert.

6.2.2 Any pressure vessel, heat exchanger, fired heater or boiler, manufactured in accordance with ASME Boiler and Pressure codes. This is dictated by SAES-D-008.

6.2.3 The pipe contains any of the following:

a) Liquid acids
b) Caustic

c) Elemental Sulfur
d) Oxygen
e) Chlorine
f) Ammonia
g) Potential toxic material that would be injurious to personnel by contact.

6.2.4 The material to be welded may suffer metallurgical or physical deterioration from heating or requires post weld heat treatment.

6.2.5 The pipe has a corrosion or heat resistant lining such as metal lining or cladding.

This restriction does not include internally coated piping but the damage that will result to the coating by hot tapping should be considered by the Operating Department.

6.3 Welding and hot tapping shall not be performed in the following cases unless a detailed design and installation procedure has been approved by the Piping Standard Chairman with endorsement of the Proponent.
The pipe or surface temperature is at or below zero degrees centigrade (0°C).

6.4 Hot taps shall not be made directly upstream of sensitive equipments such as pump suction piping or control valves unless facilities exist to prevent chips and shavings from entering the equipment.

7 Safety Requirements

7.1 All work shall be in strict compliance with GI-0002.100, Work Permit System.

7.2 The Operations Superintendent will assure that both Operations and the Installation Organization have the proper safety and fire protection equipment on site and in workable condition prior to the start of the job and that all relevant personnel are notified of the scheduled hot work.

7.3 Precautions against H₂S and other hydrocarbon or hazardous releases.

7.3.1 If a potential exists for a Hydrogen Sulfide release (or other toxic gas) at a work site, all personnel involved shall be provided with an appropriate breathing apparatus. (Refer to GI-1780.001, "Atmosphere-Supplying Respirators").

The responsible operation representative and work permit issuer shall make sure that a person certified as a gas tester continuously monitor the work site for the presence of hydrocarbons and hazardous gases during the work activity using calibrated instruments and established gas testing procedures.

7.3.2 When welding on hydrocarbon lines, the fire watch personnel shall be clearly instructed that should a burn-thru occur, the fire jetting from the pipe shall not be extinguished. This is particularly important if the hydrocarbon contains H₂S. If a burn-thru should occur, the Operations Superintendent should immediately be notified to advise further action.

7.3.3 The chamber of the hot tap machine and valve shall be purged with nitrogen and discharged to a safe location after cutting the coupon, retracting the cutter and closing the tapping valve when any of the following exist:

a) H₂S concentration is greater than 10 ppm.

b) Low wind conditions exist and a gas or liquid hydrocarbon release may create a hazard in the area or activate plant gas alarms.

c) The work is in a confined area.