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WELDING ON PIPELINES FOR NATURAL GAS TRANSPORT ON LIVE DURING REPAIR AND EXECUTION OF THE NEW BRANCHES BY METHODS "HOT TAPPING" AND "STOPPLE-LINE-PLUGGING"

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ABSTRACT
Natural gas as the important energetic fuel is transporting by pipelines to consuming location. Pipe branches execution and damages repair on classical way – emptying of the pipeline part and gas flowing to the atmosphere are not economical and also is not environmentally applicable.
For this purpose, some methods for welding on live pipeline parts are developed. For damage repair and classification of pipeline damages, the most practical is to use recommendations of American standard ANSI B31.8, while for fitting welding during the execution of the new branch by methods hot tapping and stopple-line plugging, the leading world companies made own recommendations based on multi decades experience.
The experience and welding method on live pipeline in the department "Gas Pipeline Maintenance" in company JP " SRBIJAGAS " is described in this paper.
Keywords: pipelines, natural gas, welding, repair, pipe branches, hot tapping, stopple line plugging

1. INTRODUCTION

Welding pipelines in operation is necessary with aim to

1. Repair (temporary or permanent) all damages on the pipeline outside area and
2. Pipeline on live fittings welding on connected to methods "hot tapping" and "stopple-line - plugging".

Very complex welding operations require perfectly trained and qualified team of welders and welding engineers. Their duty is, in each case, to take account all relevant parameters and in formations concerning human life, health and safety and environment. It is not allowed to improvise in preparation operations, because it is the key to success. All these operations are conducted on pipelines that are few decades in operation.

2. DAMAGE REPAIR ON THE PIPELINE OUTSIDE AREA

The choice of repair method depends on type, size and frequency of damages on the steel pipes of a pipeline for natural gas transport and should be able to produce safe exploitation of pipeline. Repair of damage may be temporary or permanent characteristic. The choice of repair method is analyzed according to two aspects: pipeline integrity and economy.

2.1 Temporary repairs

This type of repair is conducted when is necessary to change damaged part of the pipe and replace it with the new part. But, often the conditions for this operation are not possible. In this case, the solution is temporary damage repair by suitable patch (steel sheet with edges) welding. The other repair methods exist, but they are not subject of this paper.

2.2 Permanent repair

One of the methods is welding of two part ring on the pipeline outside diameter while in operation. These are made of pipes that are same or better quality than pipes on pipeline which is welded. The inner diameter of ring has to be the same as outside diameter of pipeline – with the thickness greater than pipeline pipe wall thickness /50 up to 100%/.

3. WELDING OF PARTS ON GAS PIPELINE BY METHODS HOT TAPPING AND STOPLLE-LINE-PLUGGING

For conducting operations "hot tapping" and "stopple-line - plugging" is necessary to first weld fittings on gas pipeline. Drilling tool or seal head of stopper is conducted throw T-piece fitting.
T-piece - reinforcement can be made like:

3.1 fabricated two parts T - piece - fitting with flange for methods "hot tapping" and "Stopple-line - plugging"
3.2 forged, welded piece - weldoled (for "hot tapping»)
3.3 partly reinforcing like roll neck (for "hot tapping»)
3.4 reinforcing of the whole pipe diameter – two part ring with pipe branch like T -pieces (for "hot tapping")

When choosing branch form-reinforcing standard ANSI B31.8 should be consulted.

4. PREPARATION TECHNOLOGY

During the welding process on gas pipelines in live exists two essential problems which are necessary to solve:

- Burn through of the gas pipeline wall and uncontrolled gas flow to the atmosphere and
- Possibility of forming hard places on pipeline connected to accelerate cooling due to gas flowing, which can produce cracks in welded joint.

The burn through avoidance is realized with correct choice of the welding parameters - heat input control, electrode diameter, welding current and technique for root run, hot pass and other filling passes. One of the main factors for avoiding these problems is required preparing work.

- The choice of the reinforcing-fitting form and material which is required to be, as minimum, the same with pipe material quality.
- The choice of the fitting position –should always be "solid" area of base material of the gas pipeline. Minimal distance between the circular weld on the original gas pipeline and fitting edges is 1,5x diameter of the basic gas pipeline.
- The position of T - piece/ fitting should be so to avoid longitudinal or spiral weld on the basic gas pipeline during grinding.
- Removal of isolation and cleaning of the pipe is necessary on whole area for fitting positioning and conduct welding.
- Before positing of reinforcement - fitting should control pipe ovality on the montage location, visual control of the surfaces of the gas pipeline. If any defect exits, it is necessary to choice the new location for connection.
- Ultrasonic control is required for the whole area concerned fitting area plus 100 mm from each
- edge (thickness pipe wall measuring, corrosion damages or laminations)
- Removal of moisture from the pipe surface before fitting installation. /with oxyacetylene flame/.
- In each new fitting positing, it should be taken into account preheat requirement concerning fitting location, gas pressure, gas flow quantity, velocity of gas flow, wall pipe thickness etc.

Our experience is (with minor exceptions) that preheating was not necessary when ambient temperature is min.10°C, for gas pipeline up to 12 3/4″ and material quality X42 - API 5L.

- * Preheating is necessary for greater diameters and higher quality materials and fabricated T-pieces. Electro resistance heating is conducting on: *the basic pipeline on both sides of fitting, * edges of fitting from both sides /for joint 4/ ,* edges of ring from both sides (For joint 3), * internal part of branch for connection with flanges.
- Preheat temperature is 150°C and during welding process it is controlled by recorded data.
- After welding, welded joints are heated on the preheat temperature for another 1 hour, and than heaters stop and welded assembly is collied in natural way.
- For whole time of welding it is necessary to supply current power 60kW
- Welding was not conducted when ambient temperature is under 10°C,or when relative air humidity is high.
- It is necessary to decrease gas pressure only when damage repair is conducting. Gas pressure at moment when damage is found, should to decrees on 2/3 value.
- Up to today, we did not have need for pressure decreasing on the main gas pipelines during the fitting welding, because the value was about 33 bars.
- The pipe wall as the essential factor for burn thorough, on the main gas pipelines was min. 7,11mm, while on the middle pressure gas pipeline it was min. 4,77mm.
- Fitting-gas pipeline alignment should be done well, with the smallest possible gap between them. For joint 4, this gap is maximum 3mm, because it assures good alignment between edges of fitting for joint 3.

- The problem of greater gap between fitting edges and pipe surface of gas pipeline for joint 4, is
- possible to solve by depositing metal layer, applying "buttering technique", with aim to produce
- correct configuration of the whole welded joint 4.
- In order to avoid stresses in the welded assembly it is necessary to put temporary reinforcement
- under the tap of the side connector.

Figure 2. Welding conducting- place Beska

5. JOINT TYPES AND WELDING POSITIONS

According to reinforcement-fitting type, exists these joints types:

Joint 1. Is circular 1/2 V weld with full penetration (it is connection between pipe and basic gas pipeline).Welding position PB

Joint 2. Is circular V weld with partial penetration (together with joint 1 makes unit). Its role is to joint reinforcement for base pipe of gas pipeline and connection pipe. Welding position PB

Joint 3. Butt longitudinal V weld with penetration (present in half ring and fabricated T- Pieces). Whole executing of penetration in T – pieces it is not allowed to weld reinforcement and pipe of gas pipeline. As backing, use mild steel sheets thickness of 1,5mm, width 30mm and length about 150-200mm longer by each side of reinforcing -fitting. Welding position PC.

Joint 4. Circular fillet- overlap weld with partial penetration (it connects outside edge of reinforcement - fitting with base gas pipeline. Welding position PG

6. WELDING SEQUENCES

Welding sequences for producing reinforcement-fitting or two parted ring for damage repair is proposed to make residual stress in welded assembly as smaller as possible, also to prevent distortion or crack initiation in the weld.

For welding assembly 2.3 and 2.4 welding sequences are:

Figure1. Final visual control– place Arkanj

- First weld joint 1 – connecting pipe with flange on base pipe of gas pipeline
- Montage of roll neck or two part ring that are kept in place by vices
- If reinforcement is in form of roll neck, welding is finished with joint 4. if welding two parted ring, first weld longitudinal joint 3, then circular joint 4.
- Welding of weldolets (3.2) is conducted by one welder. For reinforcement type 3.3 and 3.4 executing, two welders are welded depending on length of two part ring.

7. FABRICATED TWO PART T-PIECES / FITTING WELDING

Fabricated two parted T -pieces / fittings for methods "hot tapping" and "stopple-line-plugging" are with greater dimensions (length, wall thickness, height). As mentioned above, preheat temperature for these assemblies are up to 150°C. During fitting montage, backing sheet, made of mild steel, is putt along whole longitudinal weld, on each side with the aim to prevent welding of fitting edges for base pipe. Tuck welding is conducting on classical way.

8. WELDED JOINTS CONTROL

Covers : - **preparation works control**

- Everything covered by preparation works
- Welder has duty to control completeness of welding equipment, accessories and consumables

- Control during welding covers:

- Way and quality of tuck welding,
- Welding procedure specification control,
- Heath and safety requirements ,
- Weld cleaning

-Final control :

- Visual –dimensional control of welded joints,
- Dye penetrant and ultrasonic method control
- Visual control of welded assembly area (roughness and laps should be removed because they can damage later assembled isolation layer)

9. CONCLUSION

Presented welding procedure is applicable for materials from II group (API 1104) which are used on present gas pipelines which we maintained. Next step in welded joints quality improvement is using of electrodes with low hydrogen level and modification of welding procedure for higher strength steels for gas pipelines.

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