

# THE PRESSURE SAFETY VALVE (PSV) MANAGEMENT IN AN OIL AND GAS FACILITY AS A SAFTY DEVICE FOR QUALITY CONTROL

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## ABSTRACT

This work is divided into three sections. First section summarises the Pressure Safety Valve management policy in an Oil and Gas process facility, in this case TEPNG. It describes the meaning of Process safety/relief valve, the maintenance and inspection strategies, the Material Replenishment Plan (MRP) and re-integration. The Maintenance organisation, the standard exchange and change – out philosophy, SAP (system Flow) process, Flow decision and PSV recertification responsibility matrix. Second section summarises the Pressure Safety Valve Procedure. It describes the methodology involved right from the removal to prepop test, overhaul and final test up till the re-installation or standard exchange as the case maybe. Third section describes a case study of a faulty PSV- XXPSV3401 where an online testing would have been used if not for the particular type of valve installed. Finally, this paper gives an insight on the management of Process Safety valve in an oil and gas facility where PSVs are one of the most important safety devices.

**KEYWORDS:** Pressure Safety Valve, process facility, Material Replenishment Plan, Servicing, Certification

## INTRODUCTION

### DESCRIPTION:

A pressure safety valve is an automatic system that actuates the increment time of the inlet side pressure of the equipment increase to a predetermined set point. This will open the valve disc and discharge the fluid; and when there is a reduction in the pressure to the prescribed value, to close the valve disc again. Safety valve is one of the so-called final safety devices which controls the pressure and discharges certain amount of fluid by itself[1].

It specifically opens almost straight to full lift after a pop sound. TEPNG has around 1927 process PSVs on its facilities.

Table 1: quantities of process PSV per site:

| Site         | Number of PSV |
|--------------|---------------|
| OMLXX1       | 700           |
| OMLXX2       | 340           |
| OMLXX3       | 570           |
| OMLXX4       | 317           |
| OMLXX5       | 100           |
| <b>TOTAL</b> | <b>2027</b>   |

Note: Package PSVs are excluded from the above counting so also few Process ones which status are being confirmed.

## PSV INSPECTIONS AND RECERTIFICATION STRATEGY:

The following Recommendations are being adopted:

- Baseline inspections of all PSV before installation (Commissioning),
- First In-Service Inspection after 2 years,
- Inspection done every 30 monthly (as per Nigerian legislation)
- Shorter intervals may be necessary to maintain PSV in satisfactory conditions for operation at the maximum allowable working pressure; these cases shall be treated on an ad-hoc and case by case basis.

As-found pop tests are conducted for each PSV to ascertain the process conditions. A successful condition is within +/- 10% of the set pressure. PSV is then maintained and recalibrated successfully at within +/-3% of the recommended set pressure.

Remarks:

- All periodic inspections has been limited to only 30 monthly as against the recommendation of GS EP EXP 311 to reduce the inspection interval by one year if a PSV fails As-found-prepop test.
- During recertification of PSV, either a standard exchange PSV is provided or the old PSV is dismantled, overhauled, serviced, calibrated/certified and then re-installed. If the Old PSV is re-certified, all consumable parts shall be replaced and non consumable parts replaced as may be necessary.
- Sometimes a by-pass test rig is provided to maintain the air pressure in some panels and allow the removal of the valve for recalibration.
- All PSV certificates must be signed by the Inspection engineer that witnessed the calibration.

Reference documents:

- GS EP EXP 311-Plant integrity-minimum inspection requirements
- API Recommended Practices 576 – Inspection of Pressure relieving devices
- Department of Petroleum Resources, DPR - Mineral Oils (Safety) Regulations 1997

#### **MAINTENANCE ORGANISATION[2]:**

##### **A – Contract and procurement:**

- The award of PSV recertification contracts is handled by the C&P dept. through CFT process where different bidders are invited to bid for the services required.
- Spare parts Procurement undergoes the Supply chain process where MRP is validated by the Maintenance methods and managed by the stock control
- Materials are procured by the purchasing team through the process of CFT and PO placement.

These are always done in accordance as stipulated in the reference document: CR EP CA 110-Procurement process for goods and Services in DGEP affiliates.

##### **B - Spare parts stock management policy**

PSV spares could either be managed as Stock items or Non stock items depending on frequency and value attached to the items.

- For Non stock spares, request for procurement are generated upon work / PR creation.
- For stock items the following MRP types exist: PD – (Supervised stock) & V1 - (mini-maxi). These are always done in accordance as stipulated in the reference document: CR EP CA 210 - Stock management- E & P Affiliates and CR EP CA 751- For Stock decision tree

##### **C - Warehouse and storage system**

PSVs are stored in the warehouse in accordance with the integrity handling system. All complete conventional PSVs must be boxed and kept in upright positions. Spares and special PSVs are kept in clean rooms into the Rack area. During transportation, PSV will be fixed in a box in order to avoid damage to the settings of the calibrated PSVs.

##### **D - Integration and re-integration system**

The mandatory use of UNISUP return document Process has been integrated into PSV management process. All material returns must be initiated through SAP and as such manages the tracking and follow-up of all PSV materials movement originating from various sites locations to ONNE and vendors locations for reasons of stock integration/Re-integrations, Material repair/refurbishment, scrapping and identification (Cf chart in section IV - C below).

**E - Operational:**

- For Non Shutdown PSV, 2 campaigns per year and per site are usually conducted to cover the periodic inspection.
- Shutdown PSVs are planned during shutdown, following planned shutdown and opportunities.

**STANDARD EXCHANGE / CHANGE-OUT PHILOSOPHY:**

Most PSVs are manufactured with replaceable parts. The following paragraph will clarify:

- Either the use of repair kits
- Either the use of ‘‘standard exchange process’’.

**A - Advantages of Standard Exchange Process**

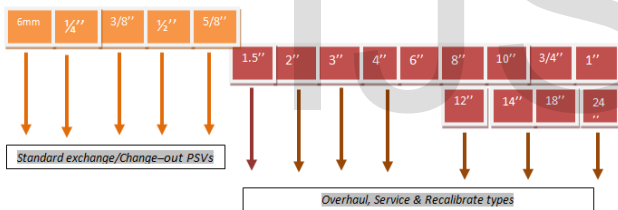
- It could save time and cost if applied appropriately especially for PSV with very sensitive parts
- It is the best approach for remotely located PSVs if handled properly during transportation
- It is the best approach for systems that is continually causing fooling

However, the standard exchange Philosophy in TEPNG is based on the sizes and then availability of spare parts.

**B - Sizes of PSVs for standard exchanges**

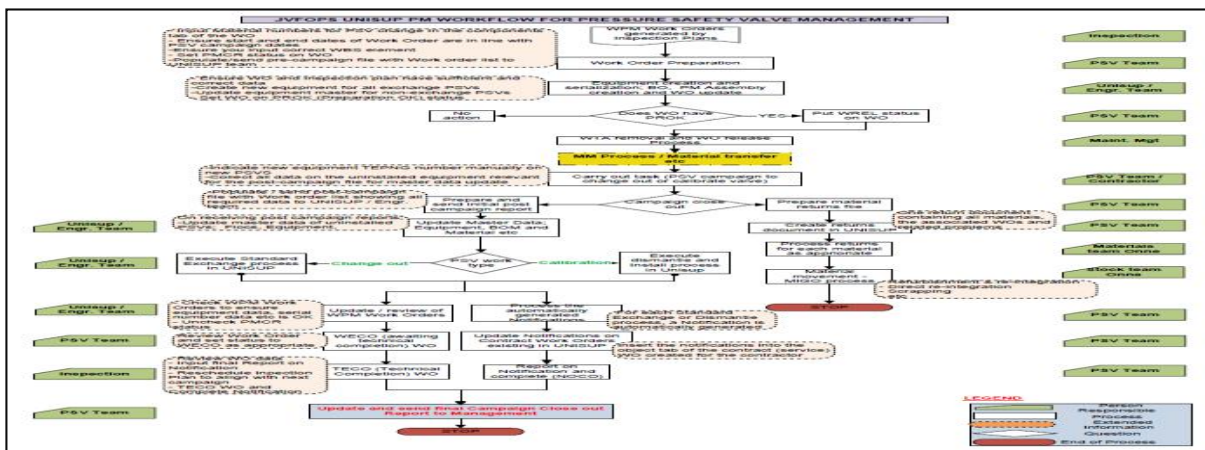
It is adopted when possible:

- To change out PSVs with inlet/outlets sizes less than or equal to 5/8’’.
- To overhaul, Service & Recalibrate PSVs above 5/8’’.



**FIG 1: C- SAP Standard Exchange Process**

- The following chart shows the decision flow for standard exchange process

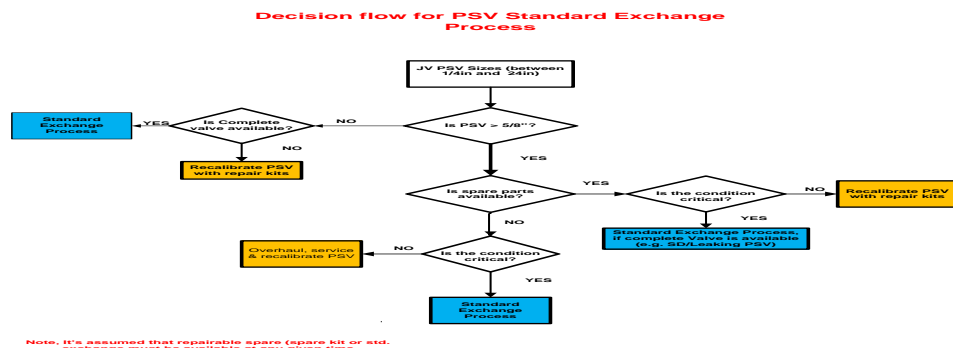


**FIG 2: D - Management of Package PSVs[3]**

Package PSVs could be regarded as all PSVs that are integral to their respective superior equipment or attached to them in a manner that makes it difficult to be isolated without shutting down the equipment completely.

Management of these PSVs is ultimately by:

- PSV removal and recertification at same time with the equipment's PM when the equipment must be shut down.
- Otherwise provision of two way connectors for some HVAC related PSVs could be implord.



**FIG 3: V - PSV Recertification campaign responsibility matrix**

**TABLE 2: PSV RECERTIFICATION PROCEDURE**

| S/n | Responsible   | PHC Insp.Mt hds | PHC Mtce. Mthds Engr. | Contractor | UNIS UP Data Engr | Site Mtc e | Site Insp. Engr | Techl og team | DPR Rep | Site Product ions | ONNE Material team |
|-----|---|-----------------|-----------------------|------------|-------------------|------------|-----------------|---------------|---------|-------------------|--------------------|
|     | Activities  |                 |                       |            |                   |            |                 |               |         |                   |                    |
| 1   | Generate WPM WOs + due and overdue list of PSVs Mid of the        | X               |                       |            |                   |            |                 |               |         |                   |                    |
| 2   | Review availability of Spares / stocks and Update MDD.            |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 3   | Plan and Schedule PSV campaign for                                |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 4   | Work order  |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 5   | Review of WOs, add Operations if necessary, Verify Scope and Cost |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 6   | Equipment Serialisation & Equipment Master                        |                 |                       |            | X                 |            |                 |               |         |                   |                    |
| 7   | Work order release  |                 |                       |            |                   | X          |                 |               |         |                   |                    |
| 8   | Site Survey + PTW Preparations                                    |                 | X                     | X          |                   |            |                 |               |         |                   |                    |
| 9   | Scaffold Erection   |                 |                       |            |                   | X          |                 |               |         |                   |                    |
| 10  | Premob Contractor's   |                 | X                     |            |                   |            |                 | X             |         |                   |                    |
| 11  | Functionality test of equipment                                   |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 12  | Eqpt. & Personnel mob-demob                                       |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 13  | Eqpt/Material & Personnel reception                               |                 |                       |            |                   | X          |                 |               |         |                   |                    |
| 14  | Eqpt. set-up on site  |                 |                       | X          |                   |            |                 |               |         |                   |                    |
| 15  | PSV Campaign Kick-off co-   |                 | X                     |            |                   |            |                 |               |         |                   |                    |
| 16  | Site PSV Campaign   |                 |                       |            |                   | X          |                 |               |         |                   |                    |
| 17  | Site PSV witnessing &   |                 |                       | X          |                   |            | X               |               | X       |                   |                    |
| 18  | Mthds & Onshore support during                                    |                 | X                     |            |                   |            |                 |               |         |                   |                    |



is noted, then cleaned and flushed with fresh water especially if on crude service. Usually, PSVs on gas services are clean internally.

- The inlet is then checked for particles or deposits and cleaned thoroughly using a jet of water and then air so that the seat on lifting will settle properly without entrapping particles, which will cause leaks.
- A simple test of the condition of the seal is then carried out by pouring fresh water into the inlet and held for 5 minutes. On sighting bubbles, it is indicative of a bad seal, which the valve will be mounted on the test stand for initial testing.

**VALVE PRE-POP TEST & CALIBRATION**

- The valve shall be mounted on the test stand and the make; cold set pressure (CSP), tag number, test date and other information on valve recorded on the test sheet. A calibration test gauge with a rating of 100% of the CSP of the PSV is then mounted to read off valve pre-pop test pressure.
- Pressure shall be applied to the valve and raised gradually so as not to damage the internals of valve. The pop pressure (pressure at which the valve seat lifts with a “pop” sound from the outlet) is recorded and for a ‘healthy’ valve. It is usually at the CSP or at most 110% of CPS. Should the valve fail to lift at more than 110% of its CSP, then no more pressure would be applied and it shall be recorded that the valve failed to lift. All personnel must stand clear of the outlet port to avoid injury from flying particles on high pressure.
- On popping, the inlet pressure is closed and the valve is left on the stand for 5 minutes to note the pressure drop and pressure retaining or holding capacity of valve. A sharp significant drop indicates a bad seal or a scoured valve seat. A maximum or 20% drop and “holding ‘indicates a healthy’ valve.
- The valve shall be calibrated to its CSP, ensuring that the adjusting bolt and lock nut is tightened after each adjustment. A seat tightness test at 90% of the CSP shall be carried out, based on API specifications.
- The Nozzle ring guide (if the valve has) shall be set to the manufacturer recommendation and then the valve body shall then be tested to ascertain the integrity of gaskets and sealing faces. For conventional valves, the test shall be done by applying pressure through the outlet flange, while valves with bellows shall be tested by applying equal pressure through the outlet flange and bonnet vent hole at the same time. Detection of leaks shall be assured by applying leak detector solution to all gaskets and sealing faces while the test medium shall be nitrogen. Test pressure shall be minimum of 30 psig.
- A final test shall be carried out; data’s recorded then fitted with an identifying tag bearing its set pressure, tag number, date of calibration and contractor’s name.
- All tests shall comply with API 527 specification and test data shall be recorded on valve certification for further reference and the procedure for re-installation shall be followed to put the valve back in service.
- Should any valve fail the test as outlined in foregoing procedure, then the following steps for overhaul and test shall be carried out.

Table 3: Leakage Rate

| Set pressure at 60°F (15.6°C)<br>(Bar) | Leakage rate (Bubbles per minute)                 |   |
|--|---|---|
|  | Effective orifice sizes 0.307<br>Inch and smaller | Effective orifice sizes larger than<br>0.307 inch |
| 1.03 – 6.896                           | 20  | 10  |
| 103                                    | 30  | 15  |
| 130                                    | 40  | 20  |
| 172                                    | 50  | 25  |
| 207                                    | 50  | 30  |
| 276                                    | 50  | 40  |
| 385 and more                           | 50  | 50  |

**VALVE DISMANTLING, SERVICING AND ASSEMBLY.**

- On test failure, the test stand be drained of all pressure and the valve lowered to the vice table for servicing. On dismantling, the set point on the adjusting bolt, after removing the cap shall be marked and the valve dismantled.
- Dismantling shall follow a strict order using the following sequence: The valve cap shall first be removed. Then the adjustment bolt lock nut marking the position of the spring load before releasing it and the adjusting and nozzle ring

set screws shall be removed. The nuts or bolts holding the bonnet to the valve body shall be loosened before lifting the bonnet up to clear the spindle and spring. The spring and washers shall then be removed and placed as a unit among the other components. All the parts are then examined for cracks, presence of corrosion, scale or scouring made from hard particles.

- The parts shall all be cleaned using the specified solvent and nozzle thread shall be lubricated with anti-rust agent and all flat gaskets, spindle ball and spring washer contact surfaces shall be lubricated with appropriate lubricant.
- Body studs and nuts, thread, washer contact surfaces and the adjusting bolt and locknut shall be lubricated with MOLYKOTE or its equivalent. On close examination, parts deemed to have been damaged beyond repair shall be replaced and the valve re-assembled, reversing the order in which it was dismantled. Lapping of seats where necessary must be done only by a trained valve technician, using the appropriate grade of past, disc and lapping blocks of various sizes.
- The assembled valve shall be mounted back on the test bench and test procedure as outlined earlier followed. Should the valve fail the test repeatedly, and then it shall be scrapped and replaced by one of same make, size, CSP and flange ANSI rating. Such replacement must be calibrated before use be it new.

#### **VALVE SEALING & STAMPING / TAGGING.**

- After calibration where the valve has been adjusted to open and close at desired set pressure, the adjusting bolt lock nut and the ring set screws shall be tightened and the cap or lifting lever and nozzle ring set screw sealed to prevent tampering. This shall be done by means of the identification tag provided for each valve showing the new test date, the set pressure, tag number and contractor name as stated earlier.
- The tag shall be fixed to the valve by stainless steel binding wire, twisted and passed through the holes provided on the valve cap and the nozzle ring set screw and sealed with a ferule at the end of the twisted wire, making it tamper proof or to show tampering if seal or twisted wire is broken.

#### **VALVE RE-INSTALLATION.**

- The tagged valve is then taken back to the location where it had been removed. The valve shall be placed on the inlet flange and new gasket-inserted. Gaskets must match flange to avoid leaks at high pressure. All corroded studs and nuts shall be replaced. For RTJ flanges.
- The ring shall be cleaned of all particles and gummy deposits as well as the groove.
- The outlet studs and nuts shall then be positioned and the gasket also inserted. All the studs and nuts on the inlet and outlet are then fitted and tightened, ensuring a proper torque to avoid leaks.
- For screwed valves, the inlet shall first be screwed on before the outlet union joint is screwed, tightened well to ensure a proper fit and torque.
- Fitting of the line to align with the flanges must be done to avoid skewed lines that will result in leaks.
- A good house keeping shall be carried out around the valve and its surrounding, cleaning them of all hydrocarbon and greasy stains. Tee-pol solvent shall be used.
- Finally, the isolation valves shall be opened in reverse order by opening the downstream first and then the up stream and the valve shall be commissioned back into services.

#### **PRELIMINARY & FINAL TECHNICAL REPORT/CERTIFICATES.**

- Based on the information obtained during the visual inspection of the valve, a preliminary technical report on the functioning status of the valve shall be made on the PSV Test Certificate. This shall give details of the valve as found.

- On completion of the re-certification exercise, a service report detailing work done on the valve. Its set pressure, behavior under pressure, tag number endorsement of test procedure by the client and Representatives and other relevant details.

**PROCEDURE FOR TESTING PRESSURE SAFETY VALVES ON-LINE**

Certain PSVS by means of their location and / or function shall require on-line or in-place testing. Should this be the case, the following steps shall be applied[4].

- ❖ All necessary permits for the exercise shall be obtained such as work permit, JSA and / or a safety By-Pass.
- ❖ A connection by means of tubing from the test bench inlet or manifold connection from Nitrogen bottle terminal, through the test pressure flange shall be made to the valve.
- ❖ The lock or seal shall be removed and inlet isolating block valve closed. This will be necessary if the valve is pilot operated (especially for Anderson Greed word valves) or the PSV is isolated by either a rapture disc or non-return valve.
- ❖ Pressure shall be applied through the test connection. The Test medium shall be Nitrogen, High-pressure gas or a Portable Hydraulic pump where necessary. The pressure at which the valve or pilot starts to lift shall be recorded in addition to the blowdown (the difference between the set pressure and the closing pressure of the PSV, expressed as percentage of the CSP (Cold set pressure) or in pressure units, psig or bars.
- ❖ Should the valve fail at its CSP or at 110% of its CSP, then no more pressure shall be applied and the fact that the valve failed to lift shall be recorded on the test sheet.
- ❖ On popping, the test connection shall be left intact until the seat settles completely and the pressure stop dropping.
- ❖ If the pop pressure is out of Tolerance range, the set point shall be re-adjusted as necessary, ensuring that pressure is released before each adjustment. For pressure up to 70psi, the tolerance range shall be +/-2psi, while for those above 70 psi, it shall be +/-3 psi.
- ❖ The valve shall be returned to service by opening the isolating block valve and lock or seal closed initially and all connections removed.
- ❖ All permits shall be closed out and test report made.

|                    |                             |                                   |                   |                     |                                       |            |
|--------------------|-----------------------------|-----------------------------------|-------------------|---------------------|---------------------------------------|------------|
| <b>TEPNG</b>       | <b>PERFORMANCE ANALYSIS</b> |                                   |                   | <b>MAINTENANCE</b>  | <b>N° 20180601</b>                    |            |
|                    | <b>PSV</b>                  |                                   |                   |                     | Date                                  | 21/06/2018 |
| <b>PRIORITY- 1</b> | Unit/site                   | <b>OML1<br/>00<br/>ODUD<br/>U</b> | Tag.<br>Equipment | <b>10-PSV-3401B</b> | PSV Methods                           |            |
|                    |                             |                                   |                   |                     | PHC                                   | MTCE       |
| PRIORITY 1 -       | Purpose of<br>intervention  | <b>Testing for XX-PSV-3401</b>    |                   |                     | MTHDS                                 |            |
| PRIORITY 2 -       |                             |                                   |                   |                     | <b>NICHOLAS</b>                       |            |
| YEARLY             |                             |                                   |                   |                     | Cc:<br><b>NOFIU SALAMI<br/>SAMUEL</b> |            |

EQUIPMENT STATUS: RESULT

EQUIPMENT- POSITIVE RESPONSE OF CDPD TEST  
BUT SUSPECTED PASSING ON LINE

Ref: GS EP EXP 311, API 576, MOSR 1997.ASME  
FOR SERVICE

**FIG 4: Performance Analysis of PSV Maintenance [5]**

**OBJECTIVE OF ONLINE TESTING:**

1. To establish the reliability of the Safety Valve while online
2. To establish true set pressure of the Safety Valve while online
3. To ensure safety and efficiency of the plant
4. To get a win-win solution between maintenance and production
5. All the above will help to reduce cost (all things being equal)



### REQUIRED FOR ONLINE TESTING:

1. Safety Valve Sizes
2. Safety Valve disc seat area
3. Safety Valve with exposed spindle
4. Safety Valve Manufacturer name
5. The line pressure
6. The Safety Valve area, EEx classification
7. Enough time for planning
8. Vessel fluid type
9. Hot test or cold test

### NECESSARY:

1. Two Personnel, at least
2. Digital/Automated Online Safety Valve Testing Equipment
3. ATEX approved Test Rig

### EQUIPMENT DETAILS:

1. TESON II Online Safety Valve Testing System or any other if deferent OEM is to be used.
2. Test Rig with Standard Pulling force of up to 20KN ( 50KN and 100KN come with a special request)
3. All the required cables of various lengths (10, 15, 20, 30, 40, 50 or 100 meter) depending on field analysis.
4. Power Supply: 115/230V @ 50-60Hz
5. EEx Area : ATEX approved Test Rig while other electronics system will have to stay outside the EEx Area.

### PROCEDURES:

1. Upon approval from OEM
2. Details of the Safety Valve to test online to be provided
3. Valve disk area is very important. This can be gotten from the manufacturer or measured physically
4. The permit to work will have to clarify either the online testing will be a cold or hot operation
5. The EEx classification of the Safety Valve area has to be indicated to determine what measure of safety protection will be required against combustion
6. The procedure is simple but requires a lot of related and necessary experience
7. The personnel will assemble the Digital Online Safety Valve Test Rig
8. Open the Safety Valve cap
9. Install the Online Safety Valve Test Rig
10. Check the result to establish the set pressure of the Safety Valve from the equipment computer.
11. The computer and the rest of the electronics have to be taken to EEx Zone 0 area.
12. If the result is not satisfactory, the Personnel can adjust the SAFETY VALVE to the required set pressure if possible with adequate care.
13. Carefully disconnect the Test Rig and put back the Safety Valve Cap.
14. After a satisfactory result, the Personnel must ensure that the SAFETY VALVE reseal properly.
15. The Digital Online Test Rig also has the capacity to ensure the SAFETY VALVE automatically reseal after the testing processes

### TYPES OF VALVE THAT CAN BE TESTED ONLINE[6]

- Conventional PSVs: Only PSVs with exposed spindle in the cap region can be tested online
  - Pilot Operated PSVs: Pilot operated PSV has no spindle and thus cannot be exposed to online testing. Pilot operated PSVs are affected by reduced and fluctuating operating pressures as this can cause back flow thereby allowing flow of fluid across to the outlet.

### ECONOMIC IMPLICATION

- Could be cheaper if only there are so many PSVs to be tested but definitely not for one valve.
- Logistics could cause delay as the company will resort to their technical partner who will bring in their experts as we have been in discussion over this in the past.



- [3] Field / Workshop Practice
- [4] GS EP EXP 311-Plant integrity-minimum inspection requirements
- [5] API Recommended Practices 576 – Inspection of Pressure relieving devices
- [6] Department of Petroleum Resources, DPR - Mineral Oils (Safety) Regulations 1997
- [7] <https://www.theprocesspiping.com/introduction-pressure-safety-valve/>
- [8] <https://blog.kimray.com/should-my-valve-fail-open-closed-or-in-place/>
- [9] <https://boilersinfo.com/psv-pressure-safety-valve-theory/>
- [10] <https://www.911metallurgist.com/blog/wp-content/uploads/2016/01/Material-Selection-for-Mechanical-Seals.pdf>
- [11] <http://ballots.api.org/cre/scprs/ballots/docs/API%205274thEdBallotDraftMarkup1.pdf>
- [12] <https://quizlet.com/61702678/power-engineering-4th-class-a2-chapter-59-flash-cards/>
- [13] [https://issuu.com/manualtrucks/docs/allison\\_transmission\\_at\\_545\\_service](https://issuu.com/manualtrucks/docs/allison_transmission_at_545_service)
- [14] [https://www.pub.gov.sg/Documents/std\\_spec.doc](https://www.pub.gov.sg/Documents/std_spec.doc)
- [15] [https://mafiadoc.com/section-vi-technical-specifications-and-drawings-for-\\_5a04aed21723dd581bd780ed.html](https://mafiadoc.com/section-vi-technical-specifications-and-drawings-for-_5a04aed21723dd581bd780ed.html)
- [16] <https://www.boltscience.com/pages/a-new-approach-to-the-tightness-checking-of-bolts.pdf>
- [17] <https://sso.agc.gov.sg/Bills-Supp/31-2008/Published/20081021?DocDate=20081021>
- [18] <https://www.inspection-for-industry.com/valve-seat-leak-test.html>
- [19] <https://itstillruns.com/problems-caused-bad-valve-adjustment-6875444.html>

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