



## Test-pack management system

Vikram Patnecha<sup>1</sup>, Dr. Manish Bhandari<sup>2</sup>, Kamlesh Purohit<sup>3</sup>

<sup>1,2</sup> Mechanical Engineering Department, MBM engineering Collage, JNV University, Jodhpur, Rajasthan, India

<sup>3</sup> Professor, Mechanical Engineering Department, MBM engineering Collage, JNV University, Jodhpur, Rajasthan, India

### Abstract

Oil and Gas industry project progress mainly depend upon respective equipment and piping system. Test-pack Management is the facility of the management as a tool to operate and maintain their project piping handover safely and efficiently. In this paper we are presenting that how Test-pack management system works for project piping progress and testing management. This system will help to track the commissioning plan and allow to test-packs for monitoring the progress in all aspects.

“Test-pack Management System” is to be used to control and monitor the mechanical completion, pre-commissioning, Commissioning and hand-over of the project piping and mechanical discipline against the components introduced (or modified) in the design phase. It will improve and maintain the quality, consistency and completeness of construction, pre-commissioning and commissioning. It will also facilitate consistent progress monitoring and reporting from construction to commissioning, and provide a tool for the communication and management of engineering queries and punch-list items.

**Keywords:** project management, project controlling, monitoring, project piping completion assurance and completion record management, test-pack management system

### 1. Introduction

Project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements. It consists of integrating processes that include initiating, planning, executing, monitoring and controlling, and closing. The principles were developed initially in engineering and construction, but are generic and can be readily applied to any discipline and project, including research in the health setting and, in particular, prospective studies such as clinical trials. Using project management principles to initiate, plan, conduct and close a study affords a structure for delivering the project successfully. Project management system dividing into four parts <sup>[5]</sup>

1. Initiation
2. Plan
3. Completion
4. Implementation

Project execution, Pre-Commissioning and Commissioning Phases are the most critical phases of the Project where a constructed Plant is made suitable for intended Operation. In these phases, the constructed Plant is being verified and certified by authorized persons to ensure that all Process requirements with respect to safety & operability of the Plant are met.

- Constructed facilities are completed as per the process requirement using Pre-defined Check sheets
- Quality of the constructed facilities meets the design, regulatory requirement and constructed as per the approved Engineering documents
- All Pre Commissioning activities like cleaning of the Piping system as per the Process requirement using Pre-

defined Check sheets

- All safety critical systems have been check and verified, verification sheets are approved.
- All these activities shall be witnessed and certified by competent personnel

Test-pack collates and review detailed information with the design team to ensure it is complete and accurate, before handing over Facilities. Test-Pack Management developed and organized work test packs and crucial function of a project throughout the construction, pre-commissioning and commissioning phases <sup>[4]</sup>

The Paper contains showing that Test-pack management system works for project management group to

- Identify and locate system boundaries for pre-commissioning activities i.e. Hydro testing, Chemical Cleaning, Pneumatic testing etc.
- Flange management systems
- Identifying system volume for individual system and sub-systems
- Tracking and managing system line numbers against isometric drawing and Piping and Instrumentation Diagram.

These are set up at the start of the project and define all of the Testing & Commissioning or Testing, Adjusting & Balancing work that has to be undertaken. Each Test-Pack requires an associated Method Statement to be agreed with the Project Management to carrying out the actual test. Progress is tracked in real time against each Test Pack, looking at state-of-sign-off for Test Pack set-up, pre-commissioning checks, actual test approvals.

Test-pack management system controls the commissioning plan and test-packs and allowing for track the progress of all aspects of the project. Commissioning and Audit Documents of Project control systems to ensure that we do not miss any important communication either incoming or outgoing that is related to the project.

- Test-pack management system allows to management team to follow the progress of piping systems and aide in the scheduling of impending piping system installations.
- Test-pack format and data base identification system can be used to develop fully integrated Work Packs inclusive of all installation activities for the mechanical completion and hand over of piping systems.
- The test pack development is based on piping systems, spec changes, piping material and mediums and shall conform to the parameters and requirements set out in the project specifications.
- Test-Packs are the identification and tracking of piping systems against P&ID and Isometric Drawings and can record information to document significant construction completion targets.
- Test-packs used to include and record other construction or commissioning activities, such as flushing, air drying, chemical cleaning or purging.
- Tracking of construction activities, testing, weld traceability, pre-commissioning, commissioning.
- Process Chemicals will work closely and integrated to identify and develop test-packs required for required packages.
- Complementing the development of test-packs is APTS' unique Test-Packer database, which records and tracks test-pack information throughout the construction, pre-commissioning and commissioning phase of a project.
- Recording and tracking of onsite activities & Ability to generate reports
- Monitor costs, scheduling, construction, testing and commissioning activities

**2. Test-pack management system**

Test-Packer Database is a management tool designed primarily for the tracking of spooling, compiled into Test-packs across the entire construction program from spool fabrication through to commissioning activities. Management individual requirements are determined prior to commencing and all required information entered by staff during the Test-pack development [4].

This Standard covers the minimum requirements and acceptance criteria for the inspection and testing of piping systems. The work shall be carried out in two stages as follows [4]

1. Inspection and verification, that all items have been supplied and installed in accordance with drawings and manufacturer's requirements.
2. The testing of piping and mechanical systems, to verify the integrity of the piping system, prior to putting into service.

**Completions /Pre-commissioning Management Systems**

For mechanical completion and pre-commissioning, handover documentation will comprise a series of certificates, generated

by the Project completion and management system. An electronic database system is normally utilized to capture and track the status of all system tags, subsystems and systems, and associated punch lists in a structured manner, enabling verification and recording completion of check-sheets and punch list items [1].

Such systems normally attach the single discipline Mechanical Completion Check-sheets (to be completed by Construction) and the single discipline Pre-commissioning Check-sheets (to be completed by Commissioning) to each tag. Some systems may also capture and record progress of dynamic commissioning procedural steps and will also maintain the system punch lists and handover documentation from Construction to Commissioning to future asset owner. Systems may also document construction tests which are areas based or cross subsystem boundaries, e.g. hydro-test packs and area handovers. Change control must be rigorously applied to ensure databases and key drawings /documents are maintained up to date and reflect ongoing design change and the impact of engineering and site queries

All documentation such as punch lists, queries, and notes will be entered / cleared through certification and commissioning system to enable an audit trail to be maintained.

The structuring of systems, tags, line numbers etc linked to check-sheets can facilitate the population of the database by electronic transfer. Major EPC/contractors may have their preferred or in-house system. Such systems will be reviewed, with reference to the project's functional specification for the system, and accepted by the project if suitable. Where the EPC/contractor has no suitable system then the project will recommend suitable commercially available systems, e.g. CCMS, PWCom, Win PCS, ICAPS, GOC and Pathmaker. That software's are used internationally. In India, Project completion certification software available is Petro IT [1].

Test-pack management system will facilitate systematic registration and tracking of all details of the project and will be used to monitor and verify the project completion status as reported by the construction contractor. Test-Pack management system for piping and mechanical discipline and will be available from the TMS coordinator / construction supervisor / commissioning engineer on completion / acceptance of all punch list items and the required check sheets.

| Construction  | Pre-Commissioning  | Commissioning   |
|---|--|---|
| <ul style="list-style-type: none"> <li>• Project Scope of Work</li> <li>• Design &amp; Engineering</li> <li>• Established Related Drawing</li> <li>• System &amp; Subsystem</li> <li>• Testing</li> <li>• Quality assurance and control</li> <li>• Construction completion</li> </ul> | <ul style="list-style-type: none"> <li>• Scope Finalization According to Scope of work</li> <li>• System, Subsystem Generation</li> <li>• Subsystem wise check-list Generation for all Discipline</li> <li>• Testing /check-list/ Procedure /document management</li> <li>• Mechanical completion</li> </ul> | <ul style="list-style-type: none"> <li>• Assurance System completion with all quality parameter</li> <li>• All Discipline start-up according Procedure</li> <li>• Line-up with operation</li> <li>• Hand-over Project to operation</li> <li>• Project completion</li> </ul> |

**Fig 1: System and Subsystem**

System is the process service, process unit, handling equipment, Chemical service, process fluid or transmission unit or device. Piping and pipeline is the device using for inter

connection of system. Different Process service or Unit (equipment) having there different unique piping line number and MOC. According to process service/unit we are making system markup for easy construction and project completion. Subsequently respective piping and connecting interrelated process equipment which are one of the parts of service, unit or equipment called subsystem. Different subsystem collection called system.

During Construction the entire piping completion job parallel moving. By system and subsystem markup we can divide the project into small subpart and do construction in fast and easiest mode. We divided subsystem to test-pack to considering of project priority, project scope, material and equipment availability etc.

**PCMS Services limitation for piping completion** <sup>[1, 2, 3, 4]</sup>

- Not having procedure or methodology to divide piping loops according to service.
- How to make system, subsystem, Test-pack/piping tags and not having relevant procedure.
- How to make test-pack markup and loop file
- How to track piping and mechanical punch-point in soft and hard copy, not having corrective method.
- Complex while tracking punch point through hard to softcopy.
- System certification complex and not user-friendly.
- Dependency upon digital things and software engineer while troubleshooting
- Need certification coordinator and for generating the certificate and checking and fulfilling the condition criteria.

**Test-pack management system advantage**

- Having simplex Procedure according to user approach
- Easy to auditable, spool and material calculator and controller
- Optimization Cost
- Data Reliability & storage
- Centralized system architecture to handle multiple projects
- Easy access to employees, Contractors from the entire corner
- Minimization of Punch Points due to the assigned work flow

**3. How to make test-pack mark-up**

**Step: 1 properly read & understand P&ID**

- Piping and Instrumentation Diagrams or simply P&IDs are the “schematics” used in the field of instrumentation and control (Automation)
- The P&ID is used to by field techs, engineers, and operators to better understand the process and how the instrumentation is interred connected.

Most industries have standardized the symbols according to the API and ISA Standard Instrumentation Symbol Specification.

- Piping & Instrumentation Drawing (original)
- Process & Instrumentation Diagram (also used)
- Process Flow Diagram – PFD (simplified version of the

P&ID)

**Step: 2 Design review (Review and mark up P&ID)**

Initial stage for making test-pack 1<sup>st</sup> need to be carried out the project design review in order of facilitates the inspection, testing and work to defining approach.

Oil and gas industry process and design engineer made P&ID according to the process service requirement Then P&ID reviewed by construction, designer & process engineer to determine extent of each Test Pack and to be define the total number of Packs. Main consideration of engineer is how to complete project in the easiest way with the fully consideration of pre-commissioning, commissioning and safety.

In P&ID project code, limit, scope, future Tie-in mentioned. Initial stage project test-pack main functioning is to extract the connecting same service P&ID and isometric. Process service identification made for easy to identifying P&ID line service. The identification terminology is very helpful for making system and subsystem markup. Table 1 showing process Service identification and description, which are commonly used in oil and gas industry <sup>[1]</sup>

| Service Identification | Service Description              | Service Identification | Service Description        |
|------------------------|----------------------------------|------------------------|----------------------------|
| BG                     | Blanket Gas                      | PF                     | Process Fluids             |
| BW                     | Boiler Feed Water                | PG                     | Process Gas                |
| CI                     | Chemical Injection               | PL                     | Process Hydrocarbon Liquid |
| CM                     | Medium Pressure Steam Condensate | PW                     | Produced Water             |
| CL                     | Low Pressure Steam Condensate    | RF                     | Refrigerant                |
| CR                     | Steam Condensate Return          | SB                     | Steam Boiler               |
| CW                     | Cooling Water                    | SH                     | High Pressure Steam        |
| DC                     | Closed Drain                     | SM                     | Medium Pressure Steam      |
| DF                     | Diesel Fuel                      | SL                     | Low Pressure Steam         |
| DO                     | Open Drain                       | SU                     | Low Pressure Utility Steam |
| EX                     | Engine Exhaust                   | SW                     | Seawater                   |
| FG                     | Fuel Gas                         | UA                     | Utility Air                |
| FH                     | Flare High Pressure              | UG                     | Utility Gas                |
| FL                     | Flare Low Pressure               | UW                     | Utility Water              |
| FM                     | Fire Protection Foam             | VA                     | Atmospheric Vent / Relief  |
| FO                     | Fuel Oil                         | VH                     | High Pressure Vent         |
| FP                     | Power Fluid (Water)              | WD                     | Distillation Water         |
| FW                     | Firewater                        | WF                     | Well Completion Fluid      |
| GL                     | Glycol                           | WG                     | Gray Water                 |
| HC                     | Hypochlorite                     | WI                     | Injection Water            |
| HF                     | Hydraulic Fluid                  | WO                     | Waste Oil                  |
| IA                     | Instrument Air                   | WR                     | Raw Water                  |
| IG                     | Instrument Gas                   | WP                     | Potable Water              |
| JW                     | Jacket Water                     | WS                     | Sewage Water (Black)       |
| LO                     | Lube Oil                         | WW                     | Waste Water                |
| NP                     | Nitrogen                         |                        |                            |

Fig 1: Process Service <sup>[1]</sup>

**1. Pressure testing consideration**

Process fluid and service handling and transferring at one to another system or location we are using piping and pipelines. Piping and pipeline MOC is Stainless Steel, carbon steel and alloy steel according to process and business requirement. In piping and Instrumentation diagram every piping spool having separate and unique number called “Line Number”. It is showing the spool pressure, temperature, process service, Insulation thickness, piping material, Electric heat tracing requirement etc. According to servicer piping testing and NDT plan. Line pressure we can find according to respective pipe and flange class rating. As per API 31.6 and ASTM standard

piping and piping Hydro-test pressure is 1.5 times of Design pressure.

## 2. Flange management

Consider flanging of piping and equipment nozzles to simplify testing work. Flange management is also important characteristic to build-up the test-pack markup. Flange is source to disconnecting or connecting the piping to one service or phase to another service or phase. For the Process point of view flange size and wall thickness made from according to line pressure, temperature, process service and

design consideration. Flange is weak joint and serves the piping at the time of sudden pressure increasing and releasing. Flange type according to inner face as below.

1. Flat Face
2. Raised Face
3. Tongue and groove
4. Ring type joint-RTJ

API B16.5 standard flange size knows in term of flange rating and Inch diameter. Table 2 Showing where different Inch pipe diameter and rating relation <sup>[4]</sup>.

| Class rating | Design Press. (Bar G) | Design Temp °C | Corrosion Allow. MM | MOC      | Valve MOC | Service                               |
|--------------|-----------------------|----------------|---------------------|----------|-----------|---------------------------------------|
| 150 RF       | 8.0                   | 120            | 3.2                 | CS       | CS        | NON HYDROCARBON & HYDROCARBON SERVICE |
| 150 RF       | 3.50                  | 113            | 6.2                 | CS       | CS        | Drain                                 |
| 150 RF       | 3.50                  | 113            | 8.0                 | CS       | Duplex    | Production Fluid                      |
| 150 RF       | 8.0                   | 120            | 3.2                 | CS       | CS        | Fuel Gas                              |
| 300 RF       | 46.5                  | 113            | 3.2                 | CS       | CS        | Injection Water                       |
| 300 RF       | 46.0                  | 113            | 8.0                 | CS       | Duplex    | Production Fluid                      |
| 300 RF       | 46.0                  | 113            | 8.0                 | CS       | Duplex    | Production Fluid                      |
| 600 RF       | 102.04                | 38             | 3.2                 | CS       | CS        | Production Fluid (MPT)                |
| 900 RTJ      | 143.5                 | 113            | 3.2                 | CS       | CS        | Injection Water                       |
| 900 RTJ      | 130.5                 | 113            | 8.0                 | CS       | Duplex    | Production Fluid                      |
| 900 RTJ      | 143.5                 | 113            | 3.2                 | CS       | Duplex    | Injection Water                       |
| 150          | 16.86                 | 38             | None                | SS316    | SS316     | Chemical Injection                    |
| 150 RF       | 13.84                 | 90             | 1.6                 | CS GALV. | CS        | Potable Water                         |
| 600 RF       | 46.5                  | 113            | None                | SS316    | SS316     | Chemical Injection                    |
| 1500 RTJ     | 143.5                 | 113            | None                | SS316    | SS316     | Chemical Injection                    |
| 150 FF       | 19.6                  | 38             | 1.6                 | CS       | CS        | Fire Water                            |

Fig 2: Flange Rating <sup>[1]</sup>

## 3. HPV and LPD Consideration

High point vent and low point drain is main consideration and important point while reviewing the P&ID for making markup. Hydro test of piping system 1<sup>st</sup> step is proper venting for removing inside air pocket and eliminating cavitations in the system. If we not vent the line properly may be chance of gauge failure, testing failure and vacuum creation inside the line. Similarly at the time of pre-commissioning and commissioning and process fluid charging proper venting required.

While doing flushing of process line, process fluid immediate draining, Hydro test water draining, roto-mall cleaning and air drying the main consideration point is Low point drain. In pre-commissioning and commissioning stage line sample collection, visual quality assurance drain line must be required LPD.

## 4. Isolation valve

Any Device for closing or modifying the passage through a pipe, outlet, inlet or likely to stop, allow or control the flow of

a media called valve.

1. Valve cost is up to 20-30% of the piping cost for a plant, depending on the process, and the cost of a given type and size of valve can vary 100%, depending on its construction.
2. Thus the selection of valves is extremely important to the economics, as well as operation, of process plant.
3. The size of a valve is mainly determined by the size of its ends, which connect to the pipe.

For connecting the one process service to another process service, controlling and isolating the service fluid isolation valve we need. According to the Process and design calculation isolation valves are provide in respective lines.

According to operating two type of valve we are using in Oil and gas industries.

1. Mechanical operating (Gate valve, globe valve, check-valve-NRV, butterfly valve, Angle valve, Knife-valve Safety-valve)
  - Isolation (Gate vane, ball valve, plug valve, piston valve,

- diaphragm valve, butterfly valve, pinch valve)
  - Regulation (Globe valve, Needle valve, Butterfly valve, diaphragm valve, piston valve, ball valve, plug valve, pinch valve)
  - NON return (Check valves, Swing check-valves, lift check-valves)
  - Special purpose(Multiport valve, flush bottom valve, float valve, foot valve, line blind valve, knife gate valve)
- 2. Instrument operation (control valve, solenoid valve, motor operated, piston operated)**

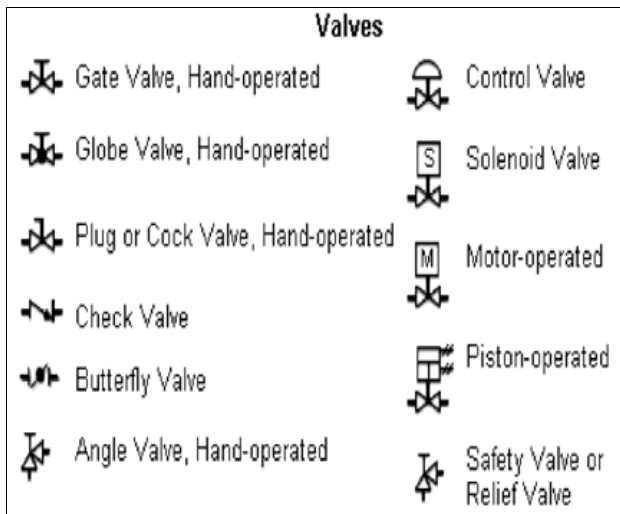


Fig 3: Different Valve symbols using in P&ID [1]

During Pre-commissioning like air blowing, steam-blowing, water flushing and Hydro-test all control valve and mechanical operated (except welded valve and knife and butterfly) valve should be dropped for passing issue due inside slug and debris. Consideration of isolation valve is also important factor. Two type of isolation use for Equipment direct isolation for 1<sup>st</sup> positive Isolation and 2<sup>nd</sup> closed isolation.

**5. Rationalize Piping system**

After construction minimum time of period maximum number of piping testing, should be complete. For minimizing testing loops 1<sup>st</sup> to be indentifying the similar testing pressure and service test-pack loop and pressures to minimize the total number of Test Packs required as a result of maximizing test limits.

**6. Prepare a master set of color coded P&ID's to identify Test-Packs and boundaries.**

Test-pack markup having different test-pack in one P&ID drawing set. To separate one test-pack to another test-pack limit, we are using different colors and red boundary flag limit for easy understanding. That boundary limit and color separation define testing scope clearly.

**7. Revise the Line List to reflect rationalized test pressures.**

Design engineer always consider four type of pressure in process service lines. According pressure rating safety device

like PSV, PRV and alarm & trip schedule in process line design.

- Working Pressure- Minimum and normal operation pressure condition in process line
- Operating pressure- Normal and Maximum pressure condition in process line
- Design Pressure- Maximum pressure of line where line having design.
- Testing Pressure- In piping system normally Design pressure 1.5 times Hydro testing pressure and in special case or service process engineer define testing pressure separately according to process condition and design basis.

All pressure having relation and must be define in process data-sheet and same as P&ID also.

As per process pressure design engineer revise the line list and rationalized the test pressure and mentioned of test-pack file also.

**8. Revise the line list to include a test pack number against every line**

P&ID all line's having their own importances. List to include a Test Pack Number against every line through we calculate number of equipments use in line, number of valve and instrument used etc.

**9. Revise isometrics to reflect rationalized test pressures where required**

Through ISO we can calculate number of welding joints, number of flange used, material requirement, NDT scope, total number of INCH DIA and INCH METER piping scope, total number of piping support requirement, spring support scope, Insulation and Painting scope etc. Isometric drawing is main attachment of test-pack file. Isometric reflect test-pressure and design pressure and suitable service of testing like as water, air, hydraulic or process fluid.

1. Calculate and tabulate a comprehensive list of carbon steel, test spade thicknesses required for the maximum non-shock flange rating for each Piping Specification Class.
2. Identify any lines that require additional temporary support during hydro testing
3. Consideration of underground and above ground piping scope.

**Step 3: Create master test-pack**

Test-pack engineer and Designer shall create a Master Test-Pack to collect all information required to make up complete test-packs. Each Master Test-Pack systems identified by the test-pack engineer during the Design Review shall include the following minimum information:

- Test-Pack lead sheet identifying Line Number, Isometric Number, P&ID Number, Test medium, Test pressure and extent of test.
- Marked up a set of P&ID's identifying Test-Pack and delineating test boundaries.

**Step 4: Completion of test-packs system**

The Test-pack engineer shall complete the Master Test-Pack

to include a marked up set of isometrics showing. Limit of test, Location, size and rating of blind flanges, Location, size and thickness of test spades, Test fill location, Test vent location(s), Test pressure gauge locations, Relief valve set pressure (for pneumatic tests), and Exclusion zone definition and location of barriers to be ensured.

#### Step 5: Test-pack final review and releasing for implementation

- The Test-pack engineer shall submit the Master copy of each Test Pack to the Superintendent for acceptance.
- If Master Test Pack is “accepted without comment” the Superintendent shall sign and return this document to the Test-pack engineer who shall prepare copies as described in the Works, or as directed by the Superintendent <sup>[4]</sup>.
- If the Superintendent makes comment, the Master will be returned to the Test-pack engineer for correction and resubmission.
- Test Pack Identification Colors For easy of identification. Test Packs shall be color coded. An example is as follows <sup>[4]</sup>:
  - Master Test Pack : Blue Folder
  - Contractor’s copy : Red Folder
  - Spare/Working Field Copies : Yellow Folder

#### Test-Pack contains for making test-pack dossier

1. Inspection and construction verification
  - Non Destructive Examination –Piping and Fitting
  - Brach weld and Reinforcing
  - Hardness Testing and PWHT (If required)
2. Testing Preparation and Readiness
3. Punch listing of piping system
  - Post Test Punch listing
  - Pre-test Punch listing
4. System Flushing
5. Witnessing of piping system pressure testing
  - Hydro Testing
  - Equipment
  - Contractor Obligations
  - Equipment Isolation
  - Valve Configuration
  - Joints
  - Loading Considerations
  - Field Installed Reinforcing Pads
  - Venting
  - Testing Medium
  - Test Pressure
  - Test Duration
  - Rectification
  - Test-pack submission
6. System Drying
7. Chemical Cleaning of piping
8. Pneumatic test procedures
9. Leak test of tested piping system Test Records
  - Test Equipment
  - Pressure Gauges
  - Flow Measurement

- Simplified Leak test Procedure

#### 10. Air blowing of process pipe

- Duration of Air Blow
- Location of Target Plates
- Location of Target Plates
- Air Flow Requirements
- Re-instatement

#### Test-pack making formula and identification symbols

##### 1-2-3-4-5-6

1. Project Code/Number
2. TP (Test-pack symbol)
3. Service & System Identification
4. System Number(3 Digit Fixed-XXX)
5. Subsystem Number(2 Digit Fixed-XX)
6. Test-Pack Number(3 Digit Fixed-XXX)

Eg- M205DCL1-TP-CI-011-01-003

Where M205DCL1 (Project Code/Number) - TP (Test-Pack Symbol) - CI (Service & System Identification) - 011 (System Number) - 01 (Subsystem Number) - 003 (Test-Pack Number). Project code/Number and location we can found from code AFC P&ID.

#### 5. Conclusion

Test-management is very useful and effective tool for oil and gas project piping completion. Through Test-pack management system the plant/section divides into system/subsystem /test pack ensuring that a group of test packs will be within the limit of subsystem and a group of subsystem will be within limit of system. In Paper we provide the method to build up test-pack for piping system. The quantum of piping job easily construct, monitor and assurance by TMS system.

- A system will be commissioned independently through TMS.
- Tracking of line numbers against isometric drawing and P&ID’s with uniquely identified ‘Test-packs’, allowing for the effective planning of all construction, testing and commissioning activities
- Identify and locate system boundaries for pre-commissioning activities Records information relating to the specific lines, such as test pressure and type, flushing, cleaning, drying and purging requirements
- All Piping tag items for each system are listed out and grouped together and each typical Tags a inspection test format for the purpose of verification is generated.
- Numbering principle of system/subsystem /tag items are such that tag items along with relevant Inspection testing report-ITR format are automatically attached to respective subsystem and then System.
- Tracking and managing system line numbers against isometric drawing and Piping and Instrumentation Diagram.
- Test-Packer Database is a management tool designed primarily for the tracking of spooling, compiled into Test-packs across the entire construction program from spool fabrication through to commissioning activities.
- Records milestone dates including punch listing,

construction completion, and test date and report numbers for each unique pack.

- Ability to track actual against estimated man hours, which can be allocated between construction and commissioning requirements
- Flange management systems record maintaining. Unique flange identification during test pack development, allowing control of gasket quantities and flange management such as bolt torquing and number of completed flanges per system.
- Full traceability to increase confidence of leak testing and other commissioning activities.

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