



# MSIV Diagnostic Testing - Deciding How You Want to Test

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QUG 2014

There are two basic modes of diagnostic data acquisition

- MOV Mode
- AOV Mode

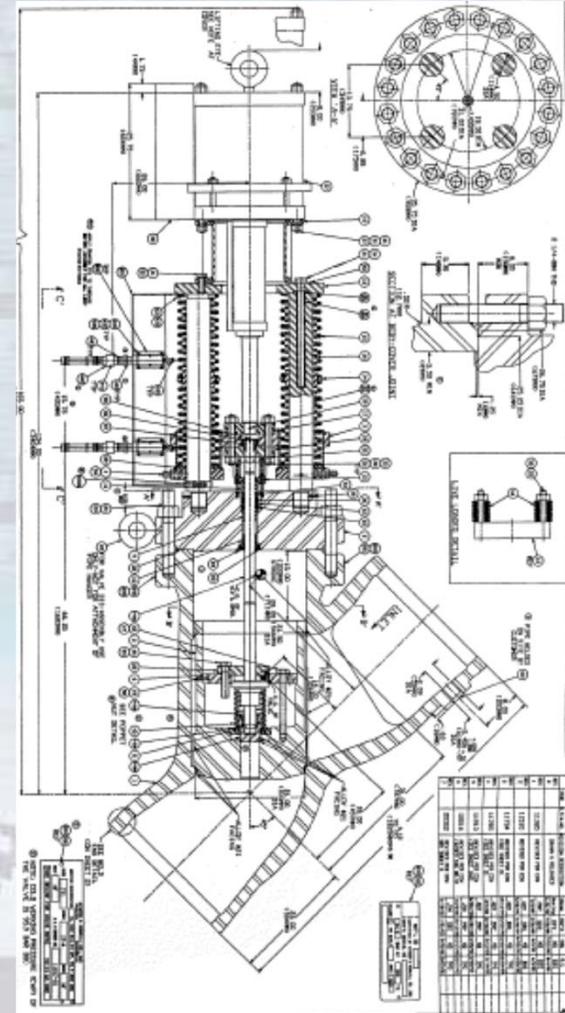
The Mode of testing utilized has a large impact on:

- The Duration of the Testing Process
- The Intrusiveness of the Testing Process
- The Value of the Diagnostic Data Obtained

# Scope of the Presentation

**This Presentation will be focused on Y pattern MSIV Globe Valves in BWR applications (A&M and Rockwell), but the results can be extended to other valve types and PWR applications**

# View of the MSIV



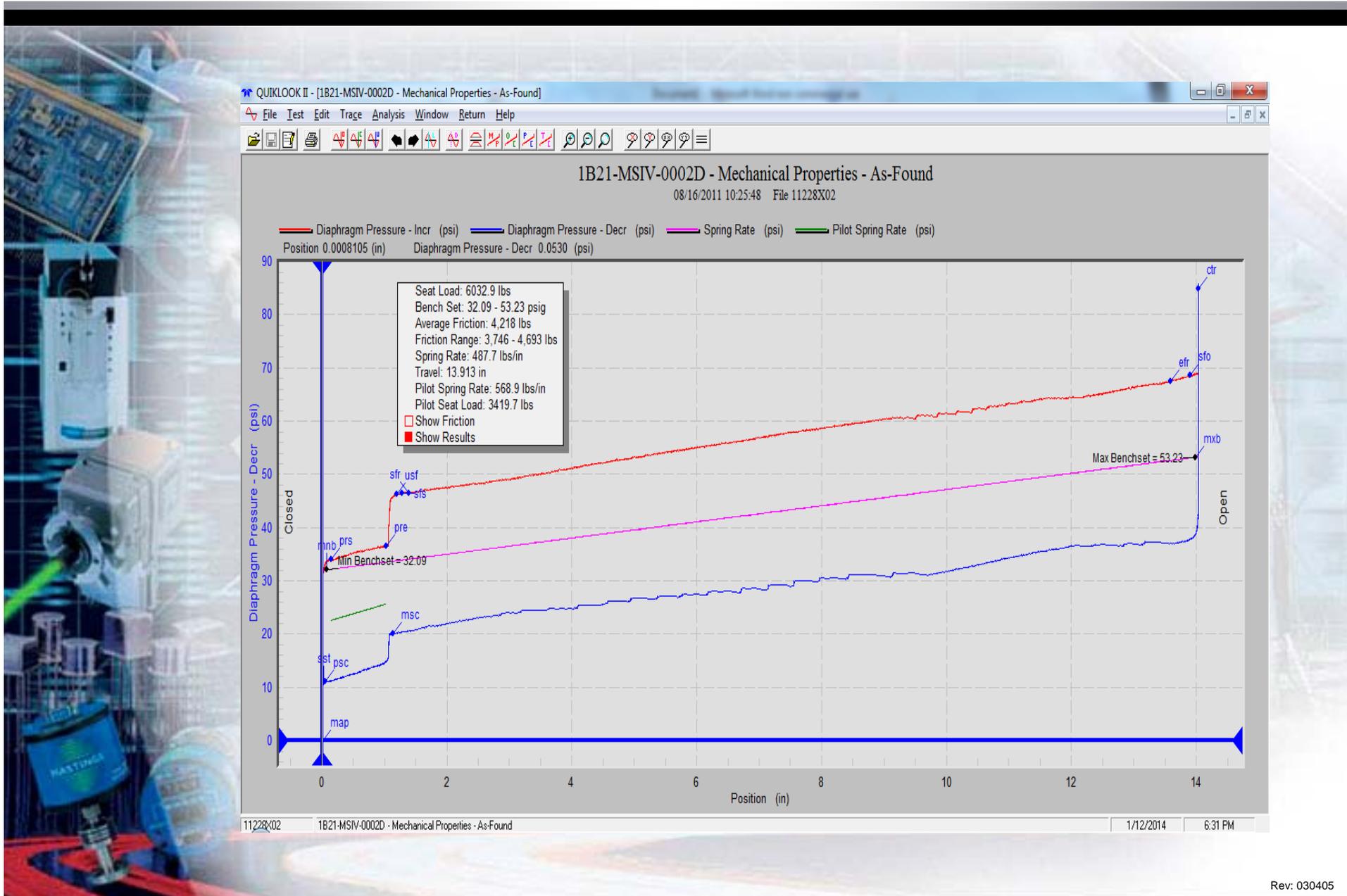
# Diagnostic Testing Considerations

- At most plants, diagnostic testing is not required for MSIVs so there must be a demonstrable benefit.
- Testing Duration is a concern:
  - Maintenance Manpower
  - Dose
  - Schedule Impact
  - Operations Impact (valve manipulation and / or clearance application)
- Impact on installed equipment is a concern:
  - Disturbing mechanical connections at the valve
  - Disturbing electrical EQ connections at the valve
- Value of the diagnostic data obtained: Is it worth it?

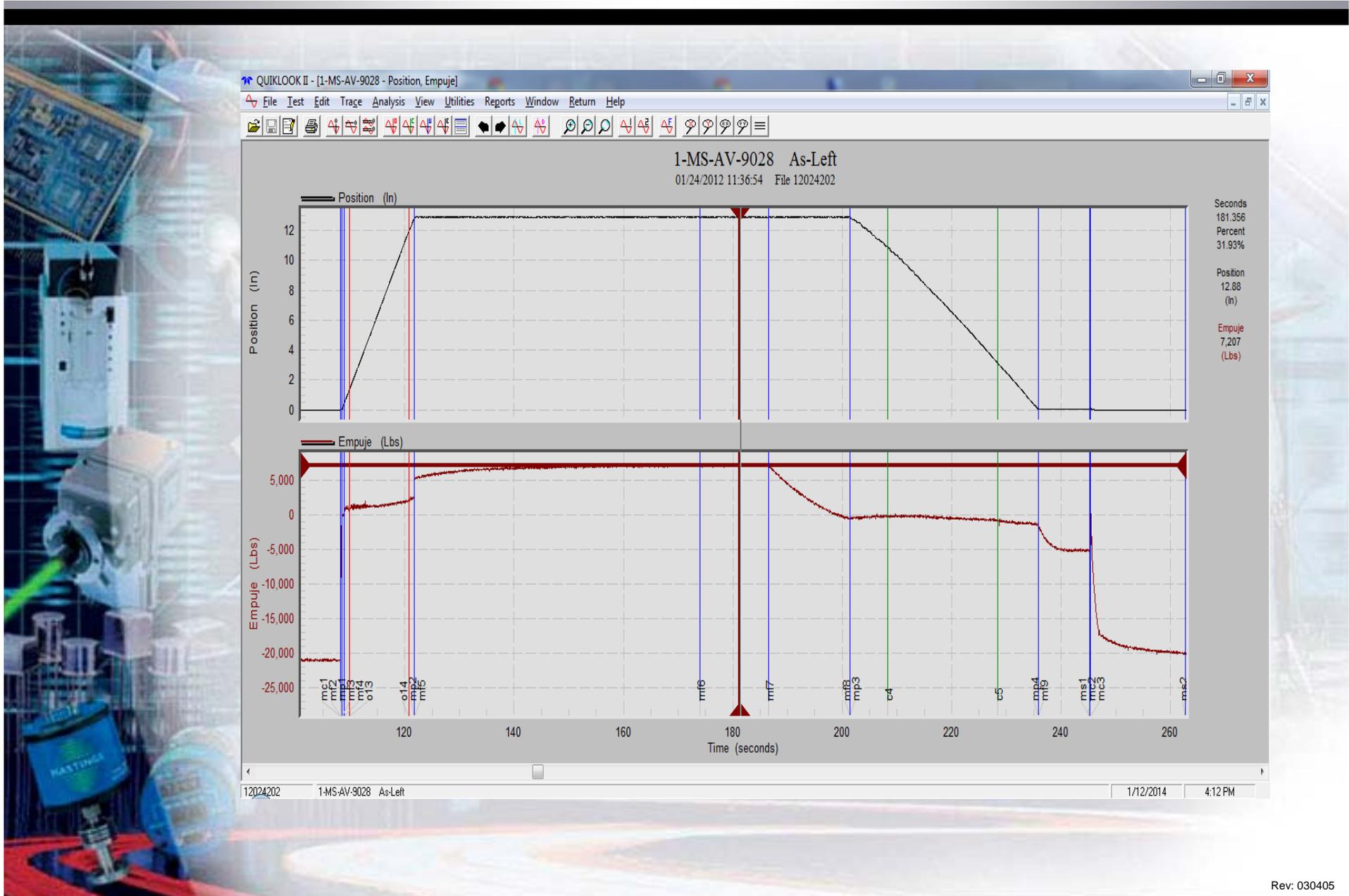
# Diagnostic Testing Considerations (cont.)

- The decision of how to test the valve usually defaults to the organization that will be performing the test and may occur at either the maintenance craft, planning or engineering level.
- Unless directed otherwise; the organization performing the testing will acquire test data in a manner that is most familiar.
  - AOV testing groups will want to drive the valve with the test equipment, the test data will be presented and analyzed in cross-plot format, use of stem mounted strain gauges are less likely.
  - MOV testing groups will want operations to stroke the valve, the test data will be presented and analyzed in a time plot format, stem mounted strain gauges will be employed.

# MSIV AOV Mode Cross Plot



# MSIV MOV Mode Time Plot



# Diagnostic Testing Results

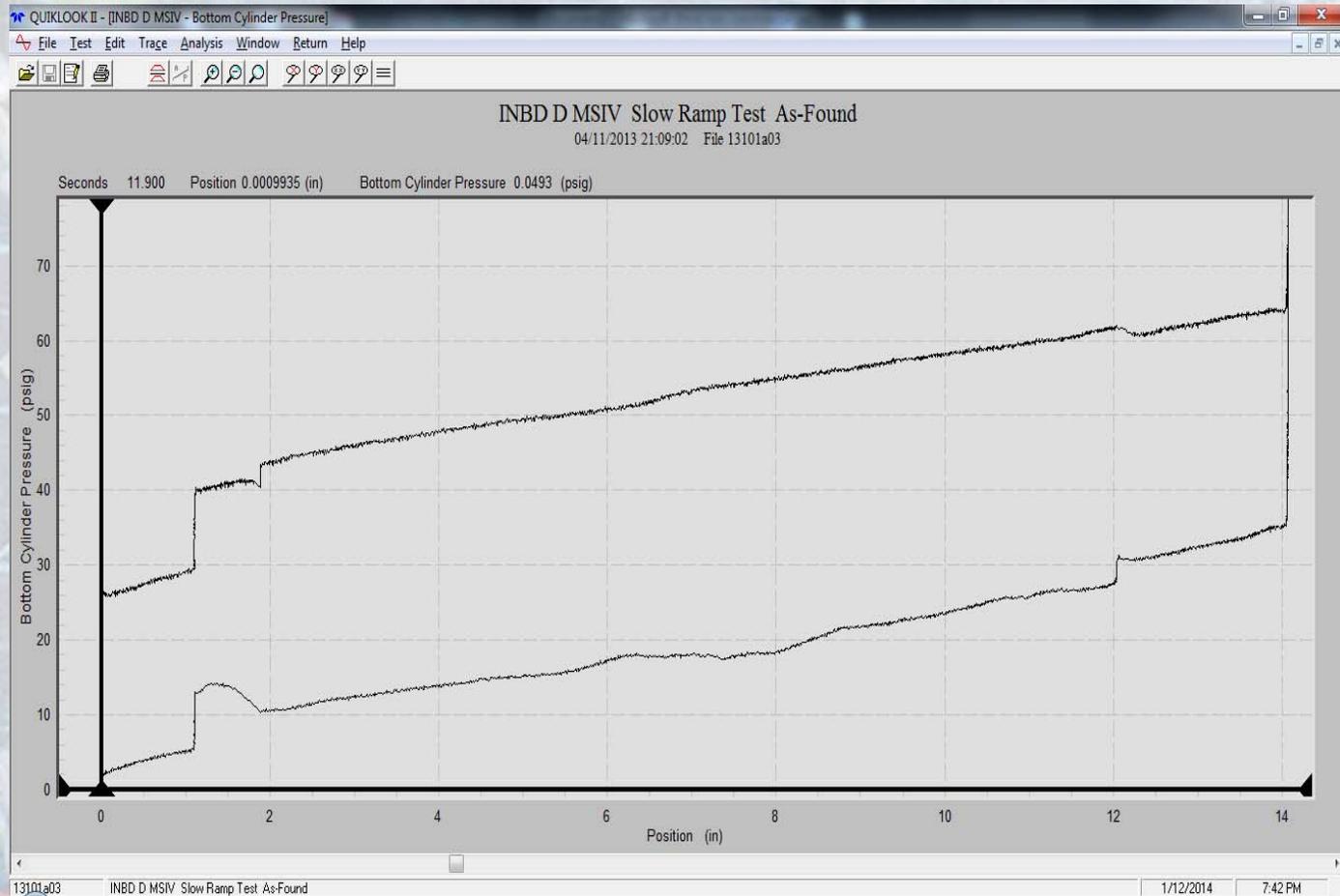
- To achieve the maximum benefit from the diagnostic testing performed, the As-Built condition of the valve to be tested should be understood to allow correct interpretation of the results. The testing method should be optimized for the configuration to be tested to detect potential degradations.
- Examples of different configurations include:
  - Main poppets with or without nose guides
  - Back seating stems or back seating main poppets
  - Single piece or multi piece stems.
  - Threaded and pinned pilot poppet spring plates
  - Articulating pilot poppets

# Diagnostic Testing Results (cont.)

- The types of degradations that have been identified through diagnostic testing include:
  - Valve guide rib wear (shelving)
  - High guide rib / disc friction and wear
  - Broken and degraded pilot spring plates
  - Improper main poppet nose guide to seat bore engagement
  - Incorrect seat load due to improper stem coupling
  - Inadequate back seating force
  - Excessive / Inadequate Packing Loads
  - Out of tolerance spring rates (main and pilot)

# Diagnostic Test Results (cont.)

Without a strain gauge it is difficult to determine the cause of the anomaly. Are we looking at Actuator or Valve issues? Both?



# Testing an MSIV in the AOV Mode

- **Overview**
  - Testing can be performed with or without a strain gauge
  - The manifold may have to be removed from the actuator or modified to allow the installation of the diagnostic equipment.
  - Valve strokes are controlled by the test personnel
  - Upon completion of testing, the manifold must be restored and appropriate Post Maintenance Testing Performed
- **Benefits**
  - The standard AOV testing process can be utilized.
  - Mechanical condition and performance of the actuator can be directly assessed
  - Test personnel can control the stroke rate of the valve
  - Once the clearance is applied on the valve, Operations personnel are not required to be involved in the testing process.

# Testing an MSIV in the AOV Mode (cont.)

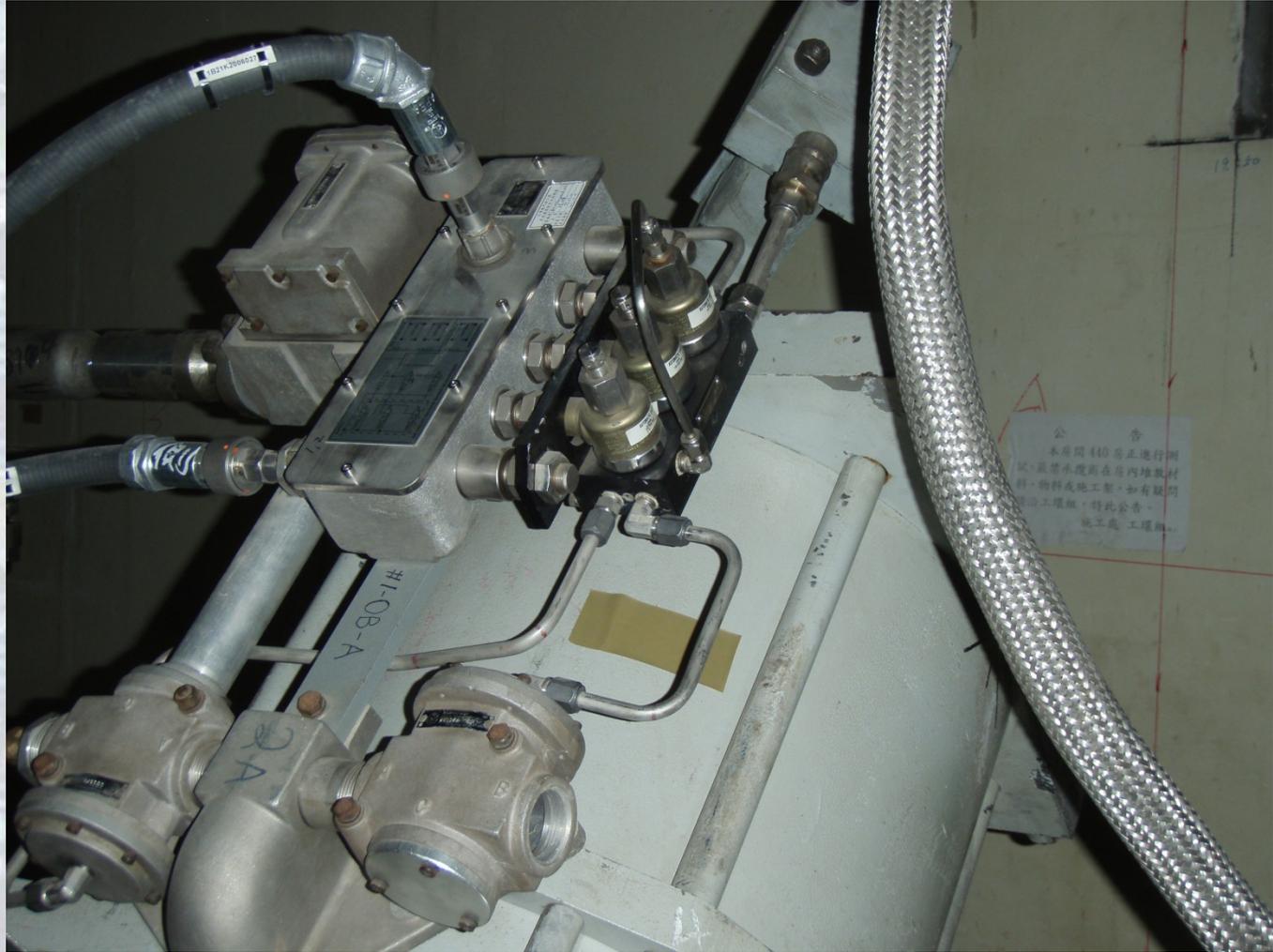
- **Limitations**
  - If strain gauges are not installed, the mechanical condition of the valve can not be directly assessed.
  - Actuator and Valve issues may be difficult to separate
  - Permanent connections at the valve must be disturbed to perform testing. Additional support personnel may be required.
  - Post Maintenance Testing is potentially more extensive

# Stroking the Valve (AOV Mode)

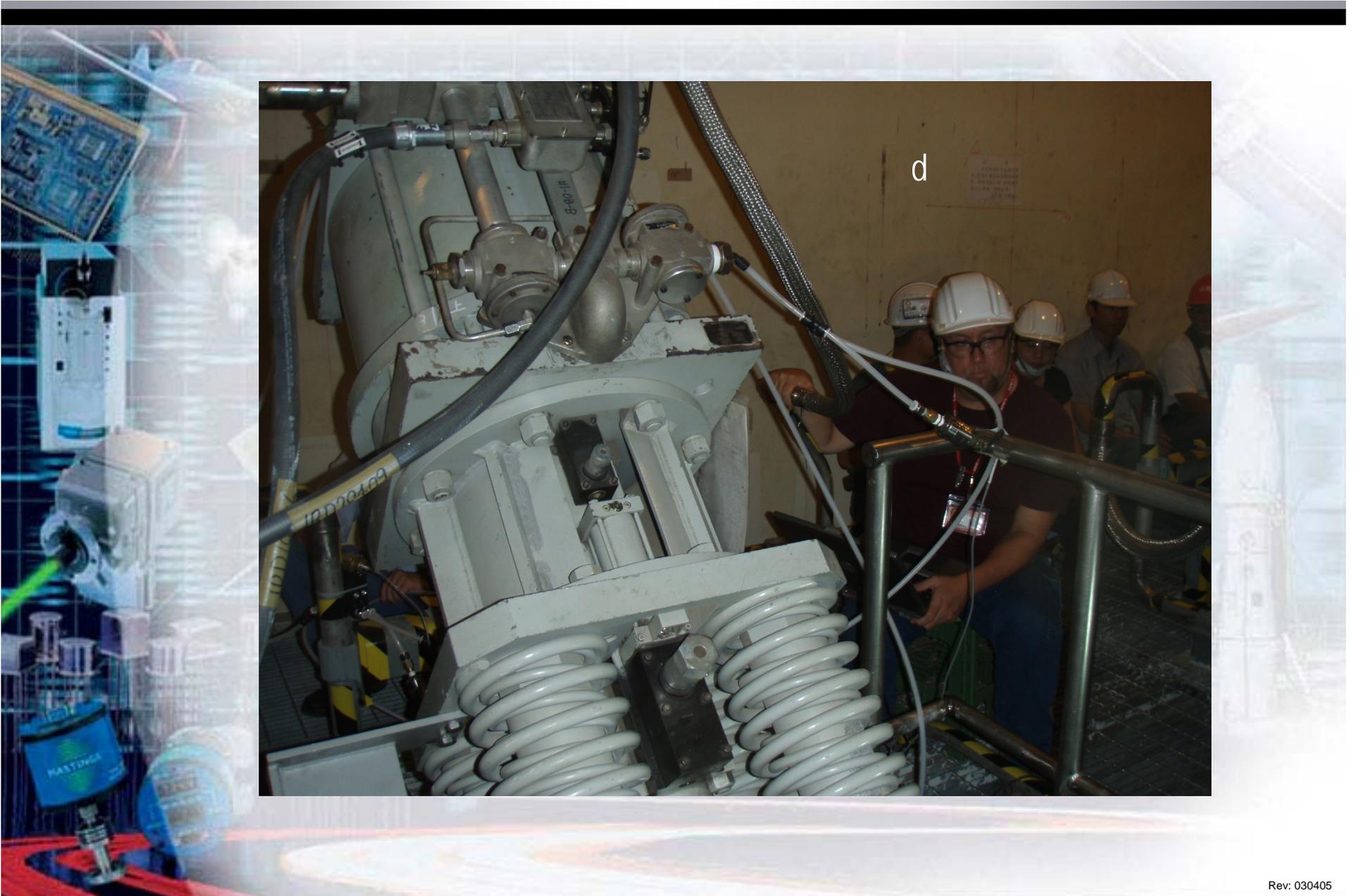
To stroke the valve in the AOV Mode the manifold must be bypassed. There are two basic ways to do this:

- Remove the manifold and connect the test equipment directly to the actuator cylinder (most intrusive)
- Use air jumpers to reposition the air relays and back feed the relays to control the valve (less intrusive)

# Air Manifold



# Air Manifold Modified



# Testing an MSIV in the MOV Mode

- **Overview**
  - A strain gauge is installed below the stem coupling (most gauges can be installed with the valve in the closed position)
  - Diagnostic equipment is installed (strain gauge and stem position are monitored)
  - Valve strokes are performed from the control room (typically one slow stroke and one fast stroke)
  - Strain gauge and equipment are removed
- **Benefits**
  - Non-intrusive. Permanent connections at the valve do not need to be disturbed
  - Mechanical condition of the valve can be directly assessed
  - Testing is relatively quick
  - Post Maintenance Testing is minimal

# Testing an MSIV in the MOV Mode (cont.)

- **Limitations**
  - Actuator parameters are not assessed such as cylinder leakage and bench set
  - The ramp rate (stroke time) of the valve can not be controlled by the diagnostic test personnel
  - Operations personnel must be involved during the stroking of the valve

# Test Data Review

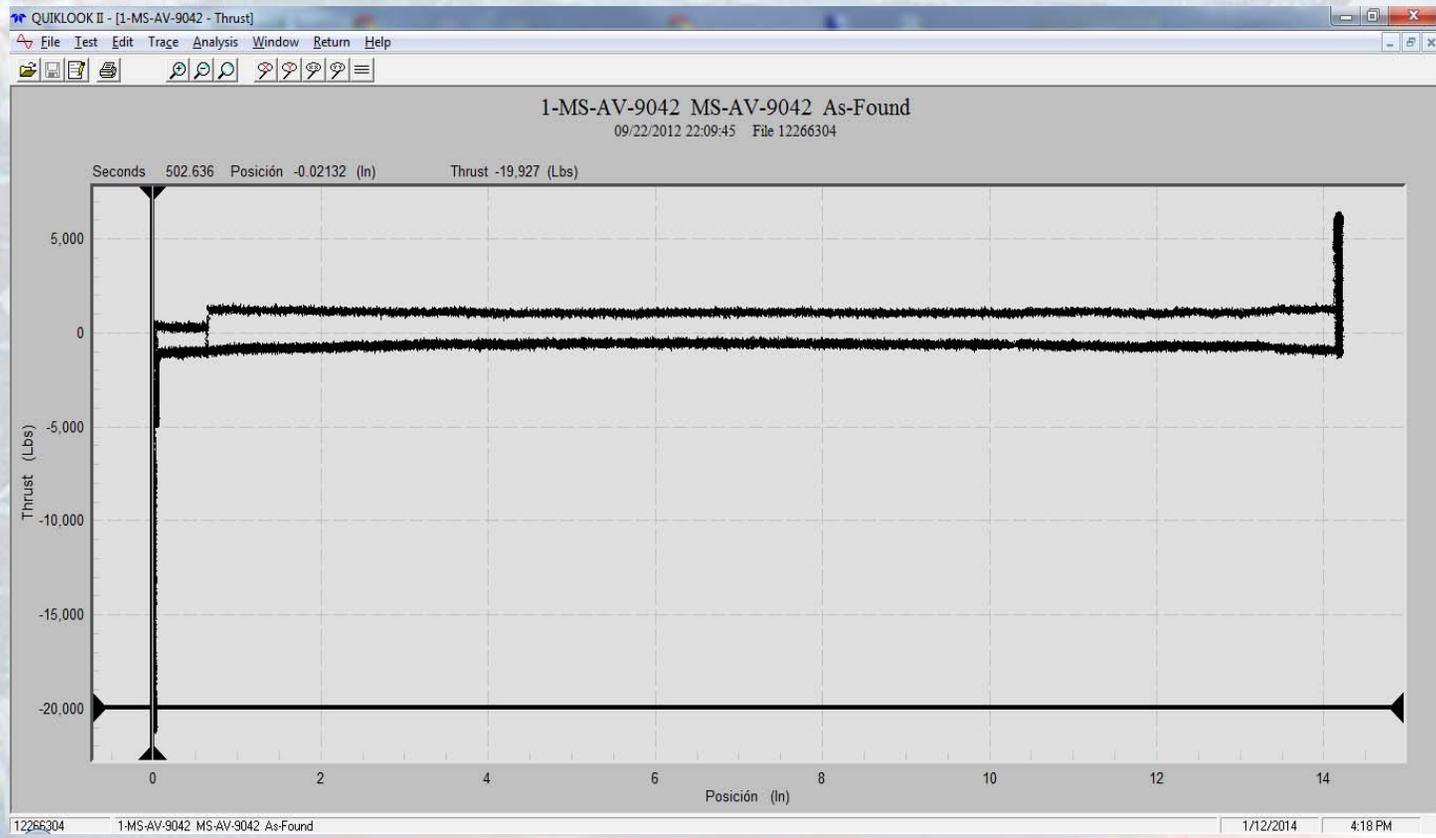
Test Data review when testing in the AOV Mode is straight forward with the standard cross plots and AOV event markers.

Test Data review when testing in the MOV Mode presents some challenges. Standard MOV markers are awkward to use and confusing, and the time plots present a challenge to AOV personnel who are not used to working with them.

- X-Y plots of Thrust and Position can assist personnel in locating a zero on the strain gauge trace
- Alternative marker system can be used to identify MSIV specific events when reviewed in the time plot mode. (a list of markers can be made available on request)

# Strain Gauge Data Viewed in Cross Plot

- Strain Gauge data taken in MOV Mode can be viewed in a Cross Plot format to assist in locating an accurate zero and in data analysis.



# Outage Scheduling Considerations

Outage schedule impact and resource availability have the potential to restrict the ability to perform desired MSIV diagnostic testing. If the diagnostic test method and sequence is adjusted, diagnostic test data acquisition can be performed during Surveillance (IST) and Post Maintenance Testing (PMT)

Surveillance testing is performed every outage to establish required stroke times. If a strain gauge is installed, diagnostic data can be obtained during stroke time testing and adjustment without any additional stroking required.

If a strain gauge is installed, diagnostic data acquisition can be performed in parallel with Post Maintenance Testing to establish new baseline performance parameters

# Conclusion

**Diagnostic Testing of MSIVs, though not required, can provide valuable information to assist in ensuring MSIV performance is reliable. Maintenance intervals can be adjusted based on Condition Monitoring rather than Time Based.**

**Planning for valve internal work can be improved if degraded conditions are identified in advance rather than discovered.**

**The diagnostic testing method should be adjusted based on the information that is desired.**

**Testing methods should be modified to minimize the impact on the plant and maximize the ability to acquire data**

**When MSIV diagnostic testing is performed, strain gauge data should be obtained to maximize the ability to evaluate all aspects of valve performance regardless of the Testing Mode.**