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## 1.0 PURPOSE AND SCOPE

(5.1.1)

This standard establishes the post maintenance testing process and specific testing requirements for:

- Verifying the affected equipment (including interfaces, controls, interlocks, and instrumentation) perform their intended functions following corrective maintenance, preventive maintenance, and troubleshooting
- Ensuring that the original deficiency was corrected
- Ensuring no additional deficiencies were created.

This standard applies to post maintenance tests performed on all structures, systems, and components (SSC) associated with the Tank Operations Contractor (TOC) facilities, their mission, and the facilities personnel responsibilities applied through a consistent, graded approach strategy.

This procedure does not apply to post-modification testing or new construction testing. See [TFC-ENG-DESIGN-C-18](#) and [TFC-PRJ-CM-C-16](#), respectively for those testing activities.

## 2.0 IMPLEMENTATION

This standard is effective on the date shown in the header.

## 3.0 STANDARD

1. The engineer shall review corrective, preventive, and troubleshooting work for post maintenance testing applicability. This includes work packages, preventive maintenance tasks (periodic procedures), and troubleshooting packages. (5.1.5)
2. The engineer shall establish the specification and requirements of post maintenance testing in detail commensurate with the level of work planning as detailed in TFC-OPS-MAINT-C-01; TFC-PLN-02, Part 1, Chapter 11; and applicable environmental regulations. Refer to Table 1 and Attachment A to establish additional post maintenance requirements. (5.1.4)
  - Level 1
  - Level 2
  - Level 3
  - Level 4 (verbal).

The definitions of the levels are included in [TFC-OPS-MAINT-C-01](#). (5.1.2, 5.1.3)

3. The Design Authority shall describe what temporary modifications to SSCs that may be made to facilitate post maintenance testing in accordance with [TFC-ENG-DESIGN-C-06](#) and [TFC-OPS-OPER-C-11](#). (5.1.2, 5.1.3, 5.1.4)

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4. Only Level 1 or Level 2 post maintenance testing work packages shall be used for post maintenance testing of safety class or safety significant SSCs. (5.1.2, 5.1.3)
  - The engineer shall ensure that post maintenance testing provides assurance that safety class or safety significant SSCs can perform the safety function as described in facility Documented Safety Analysis. (5.1.3)
  - The engineer shall ensure that post maintenance testing of safety class or safety significant SSCs meets the facility Technical Safety Requirements. (5.1.2)
5. Only Level 1 or Level 2 work packages shall be used for post maintenance testing of general service SSCs which affect safety significant or safety class SSCs. (5.1.3)
6. Upon successful completion of post maintenance testing, the engineer shall update the Safety Equipment Compliance Database for approval by the applicable Design Authority. (5.1.3)
7. The Design Authority for the relevant discipline shall be responsible for any post maintenance testing required for maintenance on general purpose facilities in accordance with [TFC-BSM-FPM\\_PR-C-03](#). (5.1.5)

#### 4.0 DEFINITIONS

Post maintenance test. A test that is performed on structures, systems, and components to determine whether corrective maintenance, preventive maintenance, or troubleshooting activities have affected the ability of the equipment and its associated interfaces/equipment to perform their intended function. In the case of corrective maintenance, a post maintenance test also verifies that the maintenance action has properly corrected the identified deficiency.

#### 5.0 SOURCES

##### 5.1 Requirements

1. DOE O 252.1A, "Technical Standards Program."
2. HNF-SD-WM-TSR-006, "Tank Farms Technical Safety Requirements."
3. RPP-13033, "Tank Farms Documented Safety Analysis."
4. TFC-PLN-02, "Quality Assurance Program Description."
5. [TFC-PLN-29](#), "Nuclear Maintenance Management Program."

##### 5.2 References

1. [TFC-BSM-FPM\\_PR-C-03](#), "Work Control – General Purpose Facilities."
2. [TFC-ENG-DESIGN-C-06](#), "Engineering Change Control."
3. [TFC-ENG-DESIGN-C-18](#), "Testing Practices."
4. [TFC-ENG-DESIGN-P-17](#), "Design Verification."

5. [TFC-OPS-MAINT-C-01](#), “Tank Operations Contractor Work Control.”
6. [TFC-OPS-MAINT-STD-02](#), “Work Planning and Work Instruction Development.”
7. [TFC-OPS-MAINT-STD-03](#), “Tank Operations Contractor Skill of the Craft.”
8. [TFC-OPS-OPER-C-11](#), “Equipment Temporary Modifications and Bypasses.”
9. [TFC-PRJ-CM-C-16](#), “Construction Acceptance Testing.”

**Table 1. Selected Maintenance Activities and Post Maintenance Tests.**

(This list is only a guide and is not meant to be all-inclusive)	
Maintenance Activity	Recommended Test
Repair electric motor	<ol style="list-style-type: none"> <li>1. Perform the following checks: insulation resistance, winding resistance, polarization index, and high voltage potential test.</li> <li>2. Turn by hand to ensure no binding prior to energizing.</li> <li>3. Verify proper direction of rotation and proper phase relationships.</li> <li>4. Operate the equipment and verify absence of abnormal noises.</li> <li>5. Obtain vibration-analysis data.</li> <li>6. Obtain motor current signature data.</li> <li>7. Obtain infrared data.</li> <li>8. Measure the bearing temperatures and stabilization</li> <li>9. Measure the starting and the running current for each phase.</li> <li>10. Check oil levels.</li> <li>11. Check air-filter cleanliness.</li> </ol>
Repair (or replace) pumps	<ol style="list-style-type: none"> <li>1. Test in accordance with ASME code, as required.</li> <li>2. Attempt to turn by hand to ensure no binding prior to energizing.</li> <li>3. Perform appropriate surveillance test.</li> <li>4. Check direction of rotation if motor leads were disconnected.</li> <li>5. Inspect suction filters, oil level, cooling flows, suction and discharge pressures, bearing temperatures, packing or seal leakage.</li> <li>6. Obtain vibration-analysis data.</li> <li>7. Measure applicable pump and motor performance data.</li> <li>8. Perform automatic function tests.</li> <li>9. Inspect base plate/foundation.</li> </ol>
Adjust packing of or repack air-operated or motor-operated valve	<ol style="list-style-type: none"> <li>1. Using air or motor operator, verify full stroke of valve to ensure freedom of movement. (NOTE: Valve stroke required may be different from operative capability.)</li> <li>2. Perform stroke-timing test.</li> <li>3. Obtain motor current signature data.</li> </ol>

**Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)**

Maintenance Activity	Recommended Test
Adjust packing of or repack air-operated or motor-operated valve (cont.)	<ol style="list-style-type: none"> <li>4. Check running current on motor. (If running current has increased by more than 8 percent of the baseline value, evaluate the need to perform diagnostic testing of the valve.)</li> <li>5. Check for leakage at normal operating pressure.</li> <li>6. Perform packing leak rate test if required.</li> <li>7. Verify position indications (remote and local), if installed.</li> </ol>
Repair internals of air-operated or motor-operated valve	<ol style="list-style-type: none"> <li>1. Leak-test valve if required by technical safety specifications or surveillance procedures.</li> <li>2. Perform retesting required for adjusting packing.</li> <li>3. Verify position indications (remote and local).</li> </ol>
Repack manual valve or adjust packing	<ol style="list-style-type: none"> <li>1. Verify that valve stem moves freely without binding.</li> <li>2. Check for packing leakage at operating pressure, adjusting as necessary.</li> </ol>
Repair (or replace) motor-operated valve	<ol style="list-style-type: none"> <li>1. Verify bridge wall marking against drawing to ensure valve orientation is correct, if body of valve replaced.</li> <li>2. Perform full-stroke exercising checks (two motor-operator strokes) done at normal system flow, pressure, and temperature.</li> <li>3. Test seat leakage.</li> <li>4. Perform stroke-timing test.</li> <li>5. Obtain motor current signature data.</li> <li>6. Measure the running and the starting current of motor.</li> <li>7. Verify torque and limit switch settings.</li> <li>8. Test automatic functions.</li> <li>9. Check local and remote position indications.</li> <li>10. Check packing leakage, at operating pressure, adjust as necessary.</li> <li>11. Grease/lubricate motor-operated valve.</li> <li>12. Perform appropriate diagnostic tests to establish a new baseline.</li> </ol>

**Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)**

Maintenance Activity	Recommended Test
Repair (or replace) air-operated valve	<ol style="list-style-type: none"> <li>1. Verify bridge wall marking against drawing to ensure valve orientation is correct, if valve body is replaced.</li> <li>2. Perform full-stroke exercise checks at normal system parameters.</li> <li>3. Test seat leakage.</li> <li>4. Perform stroke-timing test.</li> <li>5. Test automatic functions.</li> <li>6. Check local and remote position indication.</li> <li>7. Verify control-valve loop alignment.</li> <li>8. Check packing leakage at operating pressure, adjust as necessary.</li> <li>9. Check positioner and E/P or S/P converter calibration.</li> </ol>
Repair solenoid valve	<ol style="list-style-type: none"> <li>1. Perform full-stroke exercise checks.</li> <li>2. Test seat leakage.</li> <li>3. Test automatic functions.</li> <li>4. Check local and remote position indication.</li> </ol>
Repair (or replacement) seat-tightness testing	<ol style="list-style-type: none"> <li>1. Perform any code-required strength or leakage test.</li> <li>2. Perform technical-specification-required leak-rate and operability testing.</li> <li>3. Verify position indication.</li> </ol>
Repair pressure-regulating valve	<ol style="list-style-type: none"> <li>1. Check set point calibration.</li> <li>2. Test valve-seat leakage.</li> </ol>
Repair safety valve/relief valve	<ol style="list-style-type: none"> <li>1. Ensure any mechanical “gagging devices” are removed.</li> <li>2. Ensure the relief path is not blocked or otherwise restricted.</li> <li>3. Ensure any vent or bleed ports required for gas or liquid service are open or closed as required by component manufacturer’s technical information.</li> <li>4. Test relief valve lift (and accumulation and blowdown, if applicable) set points (bench test or in-place test).</li> <li>5. Test valve seat leakage.</li> <li>6. Check position indications; check for chatter and packing leakage.</li> </ol>

**Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)**

Maintenance Activity	Recommended Test
Perform maintenance on ventilation system fan/filter unit	<ol style="list-style-type: none"> <li>1. Perform function tests and manual start.</li> <li>2. Check dynamic balance.</li> <li>3. Obtain motor current signature data.</li> <li>4. Obtain vibration-analysis data.</li> <li>5. Check bearing temperatures, vibration levels, abnormal noise, and air flows.</li> <li>6. Perform filter inspections and tests.</li> </ol>
Repair (or replace) manual, motor-, and air-operated dampers	<ol style="list-style-type: none"> <li>1. Check full stroke.</li> <li>2. Check damper leakage.</li> <li>3. Check automatic function and interlocks.</li> <li>4. Check stroke timing.</li> <li>5. Check position indication.</li> </ol>
Rebuild (or repair) air compressor	<ol style="list-style-type: none"> <li>1. Open or check open any unloader valves or discharge valves prior to initial startup.</li> <li>2. Check for leakage at operating pressures.</li> <li>3. Measure bearing temperatures.</li> <li>4. Measure baseline-vibration levels.</li> <li>5. Check for unusual noise.</li> <li>6. Check parameters (discharge pressure, cooling flow, oil level, air temperatures).</li> </ol>
Perform heat-exchanger maintenance	<ol style="list-style-type: none"> <li>1. Check heat-exchanger parameters (temperature, flow, external leakage, etc.).</li> <li>2. Test heat-exchanger performance (heat balance).</li> <li>3. Check hydrostatic or operational test for tube and tube-sheet leakage.</li> </ol>
Perform maintenance of generator and related components	<ol style="list-style-type: none"> <li>1. Ensure speed control devices are at lowest settings prior to manual startup.</li> <li>2. Test manual start. Perform manual startup and stop prior to automatic startup test.</li> <li>3. Test automatic start function.</li> <li>4. Test automatic protective features (over-speed, generator differential, low lube-oil pressure, high crankcase pressure, etc.)</li> <li>5. Test synchronization and load</li> <li>6. Check diagnostic baseline parameters (e.g., vibration, cylinder compression).</li> <li>7. Obtain vibration-analysis data.</li> <li>8. Check voltage regulation and frequency.</li> </ol>

Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)

Maintenance Activity	Recommended Test
Perform piping-system maintenance	<ol style="list-style-type: none"> <li>1. Check ASME code requirements.</li> <li>2. Check cleanliness and verify system filled and vented.</li> <li>3. Perform pressure/hydrostatic test.</li> <li>4. Verify correct fluid-chemical parameters.</li> <li>5. Verify that piping supports, heat tracing, and insulation are restored.</li> <li>6. Review for unusual pipe displacement.</li> <li>7. Ensure that instrumentation lines are attached to pipe and properly refilled.</li> <li>8. Perform leak testing of the waste transfer primary piping connections by visual observation as required for connections that are unmade and remade (e.g., the jumper is disconnected and re-installed or repositioned).</li> </ol>
Perform HIHTL primary hose assembly system maintenance	Perform leak testing of the HIHTL primary hose assembly connections by visual observation as required for connections that are unmade and remade.
Make new (or repair) weld	Test in accordance with the ASME code (this is required for systems covered by the code). Facility guidelines are specific for applicable categories.
Replace component in instrument loop	<ol style="list-style-type: none"> <li>1. Calibrate replaced component.</li> <li>2. Ensure that component is installed properly.</li> <li>3. Inspect mechanical joints under normal operating or hydrostatic test pressure to verify no leakage.</li> <li>4. Verify proper operation of instrument loop by comparing with: <ul style="list-style-type: none"> <li>• Other readings of the same parameter on different instrument channels</li> <li>• Readings between channels that monitor the same variables and bear a known relationship to each other</li> <li>• Readings between channels that monitor different variables and bear a known relationship to one another.</li> </ul> </li> <li>5. Measure loop-response time if a time constant is associated with instrument response.</li> <li>6. Perform loop functional test.</li> </ol>

**Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)**

Maintenance Activity	Recommended Test
Perform maintenance of radiation monitors	<ol style="list-style-type: none"> <li>1. Perform channel checks.</li> <li>2. Perform source checks.</li> <li>3. Test automatic functions.</li> <li>4. Calibrate channel.</li> <li>5. Functional test.</li> </ol>
Repair circuit breaker	<ol style="list-style-type: none"> <li>1. Verify adjustment of circuit breaker trips.</li> <li>2. Perform trip-shaft torque measurements.</li> <li>3. Measure phase-to-phase and phase-to-ground insulation resistances.</li> <li>4. Measure micro-ohms across each main contact.</li> <li>5. Perform automatic function test on the breaker (opens and closes on required signals).</li> <li>6. Measure breaker response time.</li> <li>7. Verify operation of auxiliary trip devices and relays.</li> <li>8. Perform manual operational checks on the breaker.</li> <li>9. Check breaker parameters (e.g., breaker operating voltage, current, control power, status lights).</li> </ol>
Perform transformer maintenance	<ol style="list-style-type: none"> <li>1. Check transformer parameters (oil temperature, oil level, oil pressure, tap settings, cooling-fan status).</li> <li>2. Test transformer operability (primary/secondary voltage and current).</li> <li>3. Check insulation resistance high potential, polarization index.</li> <li>4. Obtain infrared thermography data.</li> </ol>
Fuses	<ol style="list-style-type: none"> <li>1. Visually inspect for fuse tightness.</li> <li>2. Check resistance across terminals with fuse in place.</li> <li>3. Inspect blades for pitting, corrosion, charring.</li> </ol>
Repair (or replace) static inverters	<ol style="list-style-type: none"> <li>1. Verify voltage and currents.</li> <li>2. Check inverter load.</li> <li>3. Perform transfer test, if applicable.</li> </ol>
Perform electrical maintenance on load center and distribution panel	<ol style="list-style-type: none"> <li>1. Verify voltage and load current.</li> <li>2. Visually check for fastener tightness, cleanliness.</li> </ol>

**Table 1. Selected Maintenance Activities and Post Maintenance Tests. (cont.)**

Maintenance Activity	Recommended Test
Perform battery maintenance	<ol style="list-style-type: none"> <li>1. Check battery parameters (specific gravity, electrolyte level, cell voltage, electrolyte temperature, battery-terminal voltage).</li> <li>2. Verify that battery cells, cell plates, terminals, and connectors are free of corrosion.</li> <li>3. Perform battery service discharge test.</li> <li>4. Perform battery performance discharge test.</li> </ol>
Repair (or replace tank/pressure-vessels)	<ol style="list-style-type: none"> <li>1. Check tank/vessel integrity for leakage.</li> <li>2. Check tank parameters (proper level, pressure, temperature).</li> <li>3. Check tank-content parameters (e.g., boron concentration, radiation level, viscosity, particulate contamination, other).</li> <li>4. Check tank cleanliness.</li> <li>5. Check ASME code requirements, as appropriate.</li> <li>6. Check condition of internal coatings.</li> </ol>
Process Software	<ol style="list-style-type: none"> <li>1. Prepare functional test instructions.</li> <li>2. Test automatic functions.</li> <li>3. Check range(s) for correct readings.</li> <li>4. Check alarm outputs.</li> <li>5. Check interlock functions.</li> <li>6. Evaluate impact on associated components and test accordingly.</li> <li>7. If new software version tests are unsuccessful, follow the guidance of systems Software Management Plan (SMP) or equivalent software quality program.</li> </ol>

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## ATTACHMENT A - POST MAINTENANCE GENERAL GUIDANCE

### Key Indicators of Acceptance Performance

**The post maintenance testing should measure performance versus criteria of key parameters and allow for documentation and review of test data for the structures, systems, and components.**

Various classifications of equipment will require different levels of procedure support for post maintenance testing.

**Use of pre-existing surveillance procedures.** If an applicable surveillance test procedure exists, then that procedure may be used to verify operability of the equipment. A surveillance test may be used for post maintenance testing if it not only proves system operability, but also verifies operability of all components and features either directly or potentially affected by the maintenance activity, verifies that maintenance was performed properly, and ensures that the initial deficiency was corrected. An engineering or system acceptance test procedure, alignments check procedure, generic test procedure, or special test procedure may also be used to provide test instructions.

If only part of the procedure is to be performed, the applicable sections, including prerequisites and precautions, should be identified. Caution should be used to ensure that previous sections are reviewed for system status, lineups, or prerequisites. Applicable sections with supplemental precautions or prerequisites should be specifically referenced on the procedure modification request or supplemental document as appropriate.

**Multiple equipment.** Post maintenance testing procedures used for a range of generic equipment, such as manual valves or flow controllers, should include data sheets for specific equipment when acceptance specifications or performance data are required. The various classifications of equipment required to ensure safe and reliable facility operation should require different levels of instruction/ procedural support for post maintenance testing activities.

**Use of special test procedures.** If a surveillance test, calibration, or special procedure does not exist to test particular equipment following maintenance, a special test procedure may be written or the test may be performed in accordance with instructions written for the work package. With any of these procedure methods, the required and actual testing performed should be described, data recorded, acceptance criteria specified, and appropriate reviews and approvals performed and documented.

**Test details.** Test instructions should include details such as initial conditions and prerequisites; hold points, cautions, personnel qualification requirements, personnel safety requirements, clear acceptance criteria, and post test restoration, as applicable. Test instructions should be as specific as possible and should avoid using vague criteria such as “verify proper operation” or “check for excessive temperature.” Test equipment should be specified and provision made for recording the equipment identification and calibration due date.

**Troubleshooting.** For troubleshooting work packages, it may not be feasible to fully determine the post maintenance testing requirements until the troubleshooting is complete. The Cognizant System Engineer and/or Design Authority should add instructions to the troubleshooting work document stating that post maintenance testing instructions will be specified after problem identification and resolution is determined. Once the work is completed, the appropriate post maintenance testing should be specified and performed. The results should be documented and filed with the work package or cross referenced by the work package to the applicable document.

**ATTACHMENT A- POST MAINTENANCE GENERAL GUIDANCE (cont.)**

**Other affected equipment.** Testing should be identified for other equipment affected directly or indirectly by the activity, such as equipment disassembly for accessibility or equipment for which the repaired/replaced SSC provides control or indication input, to provide a complete testing profile for returning the component to service.