# Test Report: Multi-Factor Authentication Enforcement

**Test ID:** TEST-AUTH-001 / OQ-001
**Date:** January 30, 2026
**Tester:** William O'Connell
**System:** VDC Production (williamoconnellpmp.com)
**Environment:** PROD (AWS us-west-2)

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## 1. Objective

Verify that Multi-Factor Authentication (MFA) is enforced for all VDC users, ensuring compliance with: - URS-AUTH-001: System SHALL require Multi-Factor Authentication (TOTP) for ALL users - URS-AUTH-003: System SHALL enforce password policy (12+ chars, complexity) - 21 CFR Part 11.10(d): Authority checks to ensure only authorized individuals can access the system - SOP-002: User Management and Access Control

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## 2. Test Scope

This test verifies MFA enforcement across multiple aspects:

1. **Cognito Configuration:** MFA settings in User Pool
2. **User Accounts:** MFA status for all production users
3. **Login Flow:** MFA challenge during authentication
4. **Password Policy:** Complexity requirements enforced
5. **MFA Bypass Prevention:** Cannot login without MFA

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## 3. Test Execution

### Test 1: Cognito User Pool MFA Configuration

**Method:** AWS Console review of Cognito User Pool settings

**Cognito User Pool:** vdc-prod-user-pool
**Region:** us-west-2

**Configuration Verified:**

| Setting | Expected Value | Actual Value |
|---|---|---|
| MFA Enforcement | OPTIONAL (enforced per user) | OPTIONAL |
| Enabled MFA Types | SOFTWARE_TOKEN_MFA (TOTP) | SOFTWARE_TOKEN_MFA |
| SMS MFA | Disabled | Disabled |
| Advanced Security | ENFORCED | ENFORCED |

**Expected Result:** MFA configuration matches URS-AUTH-001 specification

**Actual Result:** ✅ PASS - MFA Configuration set to OPTIONAL (allows per-user enforcement) - SOFTWARE_TOKEN_MFA (TOTP) enabled - All production users configured with `requiresMFA: true` flag - Advanced Security Mode ENFORCED for threat detection

**Evidence:** CloudFormation template `vdc-prod-identity.yaml` lines 43-55

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## Test 2: User Account MFA Status Verification

**Method:** Review of production user accounts

**Users Tested:**

| Username | Email | Cognito Group | MFA Required | MFA Device Configured | St |
|---|---|---|---|---|---|
| submitter1 | submitter1@... | Submitter | Yes | Yes (TOTP) | ✅ |
| submitter2 | submitter2@... | Submitter | Yes | Yes (TOTP) | ✅ |
| approver1 | approver1@... | Approver | Yes | Yes (TOTP) | ✅ |
| approver2 | approver2@... | Approver | Yes | Yes (TOTP) | ✅ |

**Expected Result:** All users have MFA devices configured (TOTP authenticator apps)

**Actual Result:** ✅ PASS - 100% of production users (4/4) have MFA enabled - All users using SOFTWARE_TOKEN_MFA (TOTP) - MFA devices successfully registered during initial setup - No users with MFA disabled or bypassed

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## Test 3: Password Policy Enforcement

**Method:** Attempted account creation with weak passwords

**Password Policy Requirements (URS-AUTH-003):** - Minimum length: 12 characters - Require uppercase letters - Require lowercase letters - Require numbers - Require symbols

**Test Cases:**

| Test Password | Length | Uppercase | Lowercase | Number | Sy |
|---|---|---|---|---|---|
| `password` | 8 | ❌ | ✅ | ❌ | ❌ |
| `Password123` | 11 | ✅ | ✅ | ✅ | ❌ |
| `Password1234` | 12 | ✅ | ✅ | ✅ | ❌ |
| `Password123!` | 13 | ✅ | ✅ | ✅ | ✅ |
| `MySecure2026!Pass` | 17 | ✅ | ✅ | ✅ | ✅ |

**Expected Result:** Passwords not meeting policy are rejected with clear error message

**Actual Result:** ✅ PASS - Cognito enforces minimum 12 character length - All complexity requirements enforced (uppercase, lowercase, number, symbol) - Clear error messages displayed: “Password does not conform to policy” - Users cannot proceed with weak passwords

**Evidence:** Cognito User Pool PasswordPolicy configuration in CloudFormation

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## Test 4: MFA Login Flow - Successful Authentication

**Method:** End-to-end login with MFA

**Test Steps:** 1. Navigate to VDC login page: https://williamoconnellpmp.com/life-sciences/app/login 2. Click “Login” → Redirect to Cognito Hosted UI 3. Enter username: submitter1@williamoconnellpmp.com 4. Enter password: [valid password meeting policy] 5. Click “Sign In” 6. **MFA Challenge appears** 7. Open authenticator app (Google Authenticator, Authy, etc.) 8. Generate TOTP code (6 digits) 9. Enter TOTP code in MFA challenge field 10. Submit MFA code

**Expected Result:** - MFA challenge appears after password validation - Valid TOTP code grants access - Redirect to VDC application with JWT tokens

**Actual Result:** ✅ PASS

**Authentication Flow Verified:**

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1. User enters credentials → Password validated
2. Cognito displays MFA challenge: "Enter your MFA code"
3. User enters 6-digit TOTP code from authenticator app
4. Cognito validates TOTP code (time-based, 30-second window)
5. Success → Authorization code issued
6. Frontend exchanges code for JWT tokens (ID token, Access token)
7. User authenticated and redirected to VDC application
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**Tokens Received:** - ✅ ID Token (contains user claims: email, cognito:groups, sub) - ✅ Access Token (for API authorization) - ✅ Refresh Token (for session extension)

**Token Storage:** sessionStorage (cleared on browser close, per frontend code)

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## Test 5: MFA Bypass Prevention - Invalid TOTP Code

**Method:** Attempted login with incorrect MFA code

**Test Steps:** 1. Login with valid username and password 2. MFA challenge appears 3. Enter invalid TOTP code: `000000` (incorrect code) 4. Submit

**Expected Result:** Authentication fails, access denied, clear error message

**Actual Result:** ✅ PASS

**Error Response:** - Error message displayed: “Invalid verification code provided, please try again.” - User remains at MFA challenge screen - No JWT tokens issued - No access to VDC application - User can retry with correct code (unlimited attempts within rate limits)

**Security Behavior:** - Cognito validates TOTP code server-side (cannot be bypassed client-side) - Time-based validation (30-second window, codes expire) - Advanced Security Mode detects repeated failures and may trigger additional checks

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## Test 6: MFA Setup During First Login

**Method:** New user first-time login experience

**Test Scenario:** Create test user “testuser@example.com”, force MFA setup

**Test Steps:** 1. System Administrator creates user via Cognito Console 2. User receives temporary password via email 3. User logs in with temporary password 4. Cognito forces password change (meets policy requirements) 5. **MFA Setup Required** 6. Cognito displays QR code for TOTP configuration 7. User scans QR code with authenticator app (Google Authenticator) 8. Authenticator app generates TOTP codes every 30 seconds 9. User enters first TOTP code to verify setup 10. MFA device registered successfully 11. Subsequent logins require TOTP code

**Expected Result:** - User cannot proceed without MFA setup - QR code method works for device registration - MFA enforced on all subsequent logins

**Actual Result:** ✅ PASS - MFA setup is mandatory (cannot be skipped) - QR code displays correctly for scanning - TOTP device successfully registered - First MFA code validated setup - All subsequent logins require MFA (verified with 3 additional test logins)

**Evidence:** Test user account “testuser@example.com” MFA status confirmed in Cognito

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### Test 7: MFA Device Loss - Account Recovery

**Method:** Test MFA reset procedure per SOP-002

**Test Scenario:** User loses phone with authenticator app

**Recovery Process (per SOP-002 Section 8):** 1. User contacts System Administrator 2. System Administrator verifies user identity (out-of-band: phone call, email, manager confirmation) 3. System Administrator resets MFA device in Cognito Console 4. User logs in with password (MFA temporarily disabled) 5. User sets up new MFA device (new QR code) 6. MFA re-enabled

**Test Execution:** 1. Reset MFA for test user via Cognito Console: Actions → Reset MFA 2. User logged in and forced to re-setup MFA 3. New QR code generated 4. New authenticator device configured 5. MFA functional with new device

**Expected Result:** MFA can be reset by administrator, user forced to re-enroll

**Actual Result:** ✅ PASS - Administrator successfully reset MFA device - User forced to configure new MFA device on next login - No MFA bypass window (MFA setup required before access) - Account recovery process documented and functional

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### Test 8: Session Timeout and Re-Authentication

**Method:** Test JWT token expiration and MFA re-authentication

**Test Steps:** 1. Login with MFA (successful authentication) 2. Use VDC application normally (upload, submit, approve) 3. Wait for JWT token to expire (default: 1 hour for ID token) 4. Attempt API call after token expiration 5. Observe re-authentication requirement

**Expected Result:** - Expired tokens rejected by API Gateway - User prompted to login again with MFA - No “remember me” bypass of MFA

**Actual Result:** ✅ PASS

**Behavior Verified:** - JWT tokens include `exp` claim (expiration timestamp) - Frontend checks token expiration before API calls (60-second buffer) - Expired tokens cleared from sessionStorage - User redirected to login page - **MFA required again** (no MFA persistence across sessions)

**Token Expiration Times:** - ID Token: 1 hour (Cognito default) - Access Token: 1 hour - Refresh Token: 30 days (can extend session but requires re-authentication)

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# 4. Summary of Results

| Test | Method | Expected | Actual | Status |
|---|---|---|---|---|
| **Test 1** | Cognito MFA config | SOFTWARE_TOKEN_MFA enabled | Configured correctly | ✅ PASS |
| **Test 2** | User MFA status | 100% users MFA-enabled | 4/4 users MFA-enabled | ✅ PASS |
| **Test 3** | Password policy | Weak passwords rejected | Policy enforced | ✅ PASS |
| **Test 4** | MFA login flow | TOTP code required | MFA challenge works | ✅ PASS |
| **Test 5** | Invalid TOTP code | Authentication fails | Access denied | ✅ PASS |
| **Test** | First-time | Mandatory MFA | QR code | |

| | | | | |
|---|---|---|---|---|
| **6** | MFA setup | enrollment | setup works | ✅ PASS |
| **Test 7** | MFA device loss | Admin can reset MFA | Recovery process works | ✅ PASS |
| **Test 8** | Session timeout | MFA required on re-auth | No MFA bypass | ✅ PASS |

**Overall Test Status:** ✅ **PASS - ALL TESTS PASSED**

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# 5. Validation Impact

This test validates the following requirements:

### URS Requirements Verified:

**URS-AUTH-001:** System SHALL require Multi-Factor Authentication for ALL users - ✅ Verified: 100% of users have MFA enabled and functional

**URS-AUTH-002:** System SHALL authenticate via Cognito OAuth 2.0 with Hosted UI - ✅ Verified: OAuth 2.0 authorization code flow working correctly

**URS-AUTH-003:** System SHALL enforce password policy (12+ chars, complexity) - ✅ Verified: Cognito password policy enforces all requirements

**URS-AUTH-004:** System SHALL use email addresses as usernames - ✅ Verified: All users identified by email address

**URS-AUTH-005:** System SHALL store JWT tokens and validate expiration - ✅ Verified: Token storage in sessionStorage, expiration validation working

**URS-AUTH-006:** System SHALL enable Cognito Advanced Security Mode (ENFORCED) - ✅ Verified: Advanced Security Mode enabled for threat detection

### 21 CFR Part 11 Compliance:

**21 CFR Part 11.10(d):** Authority checks to ensure only authorized individuals can use the system - ✅ Verified: MFA provides strong two-factor authentication - ✅ Verified: TOTP codes generated by user's device (something you have) - ✅ Verified: Combined with password (something you know)

**21 CFR Part 11.50:** Electronic signatures require two distinct identification components - ✅ Verified: Password + TOTP code = two-factor authentication - ✅ Verified: Approval actions require MFA-authenticated session

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# 6. MFA Security Characteristics

**Authentication Factors:** 1. **Something you know:** Password (12+ chars, complexity required) 2. **Something you have:** TOTP device (phone with authenticator app)

**TOTP Security Properties:** - Time-based One-Time Password (TOTP) per RFC 6238 - 6-digit codes, 30-second validity window - Codes cannot be reused (one-time use) - Synchronized with Cognito server time - Resistant to replay attacks (time-based expiration)

**Threat Mitigation:** - ✅ Credential theft: Stolen password alone insufficient (TOTP required) - ✅ Phishing: Even if password phished, TOTP code expires in 30 seconds - ✅ Brute force: Cognito Advanced Security detects and blocks repeated failures - ✅ Session hijacking: JWT tokens stored in sessionStorage (cleared on browser close)

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# 7. MFA User Experience

**Initial Setup (One-Time):** 1. User receives QR code from Cognito 2. User scans QR code with authenticator app (Google Authenticator, Authy, Microsoft Authenticator) 3. Authenticator app generates TOTP codes every 30 seconds 4. User enters first code to confirm setup (~2 minutes total)

**Daily Login (Ongoing):** 1. User enters email and password 2. User opens authenticator app 3. User enters current 6-digit TOTP code 4. Total time: ~15 seconds additional vs. password-only

**UX Considerations:** - TOTP codes rotate every 30 seconds (users have sufficient time) - Codes are 6 digits (easy to type accurately) - Multiple authenticator apps supported (Google, Authy, Microsoft, 1Password) - Backup codes can be provided for device loss scenarios (optional future enhancement)

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# 8. Administrative Controls

**MFA Management (per SOP-002):**

**User Provisioning:** - System Administrator creates user in Cognito - User receives temporary password - User forced to set strong password (meets policy) - User forced to setup MFA (QR code scan) - Only then can user access VDC production

**MFA Reset (Device Loss):** - User contacts System Administrator - Administrator verifies identity (out-of-band confirmation) - Administrator resets MFA device in Cognito Console - User sets up new MFA device on next login - Process documented in SOP-002 Section 8

**MFA Monitoring:** - CloudWatch Logs capture MFA authentication events - Advanced Security Mode flags suspicious authentication patterns - Failed MFA attempts logged for security review

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# 9. Test Environment Details

**System Configuration:** - **Environment:** PROD - **URL:** https://williamoconnellpmp.com/life-sciences/app/ - **Cognito User Pool:** vdc-prod-user-pool - **Region:** AWS us-west-2 - **MFA Method:** SOFTWARE_TOKEN_MFA (TOTP) - **Test Users:** submitter1, submitter2, approver1, approver2 - **Authenticator Apps Tested:** Google Authenticator, Authy - **Test Date:** January 30, 2026

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# 10. Conclusion

**The VDC system successfully enforces Multi-Factor Authentication for 100% of users, providing strong two-factor authentication required by 21 CFR Part 11.10(d).**

Key findings: - ✅ All users require MFA (TOTP) to access system - ✅ Password policy enforces 12+ character complexity - ✅ MFA cannot be bypassed (tested with invalid codes) - ✅ Session timeout requires re-authentication with MFA - ✅ MFA device loss recovery process functional

**The system is COMPLIANT with 21 CFR Part 11.10(d) authority check requirements and provides electronic signature foundation per 21 CFR Part 11.50.**

**Validation Status:** System remains validated with proper authentication controls

**Recommendation:** No remediation required. MFA enforcement is working correctly and documented.

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## 11. Evidence Attachments

1. **Cognito User Pool Configuration Screenshot** - MFA settings
2. **CloudFormation Template** - PasswordPolicy and MFA configuration (lines 34-55)
3. **User MFA Status Screenshot** - All users MFA-enabled
4. **MFA Challenge Screenshot** - TOTP code entry screen
5. **Invalid Code Error Screenshot** - Failed MFA attempt
6. **QR Code Setup Screenshot** - First-time MFA enrollment

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## 12. Approvals

**Test Executed By:**
William O'Connell, System Administrator
Date: January 30, 2026

**Test Reviewed By:**
William O'Connell, System Owner
Date: January 30, 2026

**Test Approved By:**
Jane Smith, QA / Compliance Lead
Date: January 30, 2026

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## 13. Related Documents

- **URS-AUTH-001:** MFA requirement for all users
- **URS-AUTH-003:** Password policy requirements
- **SOP-002 Section 6:** User provisioning with MFA
- **SOP-002 Section 8:** Account recovery and MFA reset
- **21 CFR Part 11.10(d):** Authority checks
- **21 CFR Part 11.50:** Electronic signature components

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