VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

February 22, 2023

10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Serial No.: 23-030
NRA/GDM: R0
Docket No.: 50-280
License No.: DPR-32

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNIT 1
ASME OM CODE INSERVICE TESTING PROGRAM
ALTERNATIVE REQUEST V-01, USE OF MECHANICAL AGITATION PROCESS FOR PRESSURE ISOLATION VALVE 1-SI-241 SEAT LEAKAGE TESTING
SUPPLEMENTAL INFORMATION

By letters dated December 8 and 9, 2022 [Agencywide Document Access and Management System (ADAMS) Accession Nos. ML22342B248 and ML22343A000, respectively], Virginia Electric and Power Company (Dominion Energy Virginia) requested Nuclear Regulatory Commission (NRC) approval of inservice testing (IST) alternative request (AR) V-01 for Surry Power Station (SPS) Unit 1. The IST AR proposed using a mechanical agitation process for pressure isolation valve 1-SI-241, which is the Low Head Safety Injection to Reactor Coolant System cold leg isolation check valve, to assist in achieving acceptable seat leakage test results in lieu of meeting specific IST requirements in the ASME OM Code. The NRC provided verbal authorization of the AR on December 9, 2022.

To facilitate completion of its written safety evaluation (SE) for IST AR V-01, the NRC technical staff requested supplemental information regarding a previous engineering evaluation performed for the mechanical agitation process, specifically, Reference 4 listed in Attachment 2 of the December 8, 2022 submittal. The requested information is provided in the attachment.

Should you have any questions or require additional information, please contact Mr. Gary D. Miller at (804) 273-2771.

Respectfully,

James E. Holloway
Vice President – Nuclear Engineering and Fleet Support

Regulatory commitments contained in this correspondence: None

Attachment: Supplemental Information, Engineering Technical Evaluation ETE-SU-2021-0034, Revision 0, Engineering Evaluation for Mechanical Agitation of 1-SI-241

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Attachment

SUPPLEMENTAL INFORMATION

ENGINEERING TECHNICAL EVALUATION ETE-SU-2021-0034, REVISION 0
ENGINEERING EVALUATION FOR MECHANICAL AGITATION OF 1-SI-241

Virginia Electric and Power Company
(Dominion Energy Virginia)
Surry Power Station Unit 1

SUPPLEMENTAL INFORMATION

ENGINEERING TECHNICAL EVALUATION ETE-SU-2021-0034, REVISION 0 ENGINEERING EVALUATION OF MECHANICAL AGITATION PROCESS FOR PRESSURE ISOLATION VALVE 1-SI-241

SURRY POWER STATION UNIT 1

Purpose

The purpose of this Level 1 ETE is to provide an engineering evaluation for 1-SI-241 which initially did not pass its IST Program scheduled leak rate test during the performance of Operations Test Procedure 1-OPT-SI-014, "Cold Shutdown Test of SI Check Valves to RCS Cold Legs," (Step 7.2.1.e), and subsequently required mechanical agitation in order confirm the valve is able to perform its design safety function.

Design Inputs and Assumptions

1. The Safety Injection (SI) system provides the piping, motive force, and valves necessary to ensure delivery of a sufficient amount of water to the Reactor Coolant System (RCS) to remove latent heat and decay heat from the reactor core during and following a limiting event. (Ref. 5, Table 4.1-1, Req. 1)

2. The SI system includes check valves in the injection lines to the RCS that provide an isolation barrier for those portions of SI piping that are at a lower pressure than the RCS. (Ref. 5, Table 4.1-1, Req. 6)

3. The maintenance procedures for SI system components ensure the total SI system leakage outside containment does not exceed allowable limits. Check valves are designed and tested to ensure back leakage to the Refueling Water Storage Tank (RWST) remains within acceptable limits. (Ref. 5, Table 4.2-1, Req. 4)

4. The SI system check valves that comprise the Reactor Coolant Pressure Boundary (RCPB) isolation barrier are periodically leak tested to ensure that leakage remains below allowable values. (Ref. 5, Table 4.2-1, Req. 5)

Discussion

Background

The SI system has several equipment locations that consist of two in-series swing check valves. These valves are 6-inch, 1500 lb Velan valves that provide a flow path from the Low/High Head SI pumps to the Hot and Cold Legs of the RCS. These check valves serve the following functions:

- Provide a boundary between the higher pressure of the RCS and the lower pressure of the SI system,
- Prevent an Intersystem Loss of Coolant Accident (ISLOCA), and
- Provide a flow path from the SI pumps to the Hot and Cold Legs of the RCS.

Per Surry Power Station (SPS) Units 1 and 2 Technical Specifications (TS) Table 4.1-2A, "Minimum Frequency for Equipment Tests," these check valves are tested every refueling outage (RFO) and after each time the plant is placed in Cold Shutdown for 72 hours if testing has not been performed in the last nine months. This testing ensures the valves perform their RCS pressure boundary function satisfactorily.

Testing Conditions

During testing in accordance with 1-OPT-SI-014, RCS pressure is significantly lower than normal operating RCS pressure to prove that the check valves being tested will remain seated throughout the operating cycle. During this test, the Low Head Safety Injection (LHSI) to A Cold Leg Check Valve (1-SI-241) experiences a smaller differential pressure than during normal operation. The unsatisfactory leakage exhibited by 1-SI-241 is most likely caused by the top of the swing check valve disc contacting the top of the seat, but the bottom hanging up enough to allow leak-by. By design, when the check valve is closing, the top of the disc is intended to hit the top of the seat first and then differential pressure across the valve drives the disc until it becomes fully seated.

Impact of Mechanical Agitation

The in-series configuration of 1-SI-241 with its associated downstream check valve results in the valve being exposed to a reduced differential pressure during performance of 1-OPT-SI-014. As a result, inadequate closing pressure against the valve disc can result in the bottom of the disc not fully contacting the bottom of the seat. When unsatisfactory values for check valve leakage have been obtained in the past, mechanical agitation has been used successfully to fully seat the check valve. Mechanical agitation of the check valve body induces vibration in the hanger pin and shoulder of the disc to allow gravity and system pressure to fully seat the valve disc. The bodies of the SI check valves are 316 Stainless Steel, which is not a brittle material, and is therefore not susceptible to cracking from mechanical agitation. Additionally, discussions with the valve manufacturer (Velan) determined that it is acceptable to mechanically agitate check valves to enhance disc seating, and that Velan has never experienced problems as a result of this practice. To date, there has been no degradation or damage found on any check valves resulting from mechanical agitation.

While there have been no issues found to date as a result of mechanical agitation, due to heightened awareness at the station level to this practice, the following measures have been incorporated into station processes:

- Current procedures require Plant Manager approval to perform mechanical agitation.

- Each valve that is mechanically agitated requires a Condition Report, Engineering Evaluation, and a Work Order to open and inspect the check valve during the next refueling outage.

Failure of the as-found leak rate test reflects an IST program test failure. The mechanical agitation subsequently performed to meet TS leakage criteria could mask degradation internal to the valve. As such, it must now be considered to be degraded until proven otherwise.

Discussion of Design Functions

Design Function 1: Allow flow of borated water to the core

Forward flow capability of 1-SI-241 was verified during the performance of 1-OPT-SI-002 on May 3, 2021. Mechanical agitation will not prevent flow through the valve in the forward direction, it merely uses vibration to assist gravity and system pressure to achieve a better seating profile of the valve; therefore, the valve will continue to satisfy this design function.

Design Function 2: Provide an isolation barrier between the RCS and SI system

It has been demonstrated that mechanical agitation does not cause damage to the valve internals but rather assists in seating the valve at low system pressure test conditions. Once the valve is confirmed closed at the lower test pressure, with or without mechanical agitation, the higher system pressures to which the valve will be exposed during normal plant operation ensure the valve remains seated and thus maintains its design ISLOCA function.

Following a LOCA, 1-SI-241 would remain open in response to continued SI or recirculation cooling water system flow, or, if required to be closed during recovery, the associated upstream MOV would be closed to ensure isolation of the containment penetration.

Design Function 3: Total SI system leakage outside containment does not exceed limits

As long as the valve can be confirmed to meet its TS required leakage criteria at the lower test pressure during performance of 1-OPT-SI-014, the higher operating pressures associated with normal plant operation are sufficient to ensure the valve will

remain seated and maintain its leakage function for the planned operating cycle. If acceptable leakage can be obtained after mechanical agitation, the valve has the capability to perform its TS required function. Since the leakage measured following mechanical agitation of the valve was 0.0 gpm, the TS Surveillance for back leakage is satisfied.

Design Function 4: Leakage from each individual SI check valve below limits

Per TS Table 4.1-2A, these check valves are tested every RFO and after each time the plant is placed in Cold Shutdown for 72 hours if testing has not been performed in the past nine months. This ensures the valve can perform its RCS pressure boundary function satisfactorily. This TS Surveillance has been met as leakage past 1-SI-241 was measured to be 0.0 gpm during the performance of 1-OPT-SI-014 and will continue to be met throughout the planned operating cycle for the reasons previously stated.

1-SI-241 History

A previous occurrence of mechanical agitation of 1-SI-241 occurred in 2006. During 1-OPT-SI-014, leakage exceeded the acceptance criteria and mechanical agitation was used to obtain an as-left leakage value of 0.0159 gpm. Work Order (WO) 38075489801 was generated after mechanical agitation to open and inspect 1-SI-241 during the next refueling outage in the fall of 2007. This WO was completed on November 6, 2007, with closure comments indicating the check valve seat was lapped and the as-left blue check was satisfactory. During testing in accordance with 1-OPT-SI-014 on November 19, 2007, leakage for 1-SI-241 was measured at 0.9 gpm. The valve was mechanically agitated, and an as-left leakage rate was measured at 1.82 gpm. Another performance of 1-OPT-SI-014 occurred on November 20, 2007. During this performance, 1-SI-241 had measured leakage of 1.321 gpm. The valve was mechanically agitated, and an as-left leakage rate was measured at 1.6 gpm. WO 38079340901 was created to open and inspect the check valve. This WO was completed on November 25, 2007, with closure comments indicating the check valve internals had been rebuilt with a satisfactory as-left blue check. A Velan vendor was also brought in to provide additional direction and to improve maintenance practices and procedural guidance during the rebuild. During subsequent testing in accordance with 1-OPT-SI-014 on November 27, 2007, leakage for 1-S1-241 was measured to be 0 gpm.

Historical test results for 1-SI-241 during the performance of 1-OPT-SI-014 have consistently been approximately 0.0 gpm since the valve was rebuilt in 2007. During the most recent performance of 1-OPT-SI-014 on May 27, 2021, a leak rate of 0.0 gpm was achieved after one attempt at mechanical agitation, which demonstrates the integrity of the valve seat and disc. Based on the propensity of this valve design to exhibit leak-by under low test pressure conditions, and the consistent zero leakage valve performance exhibited since it was rebuilt in 2007, there is adequate basis to conclude the cause of the initial high leakage during the leakage test event reflects a testing anomaly and not the existence of valve internal degradation. This will be

validated by the procedural requirement to open and inspect the check valve during the next refueling outage under WO 38204242376 as initiated by Condition Report 1173987.

Conclusions

The current Unit 1 ASME OM Code of Record, paragraph ISTC-3630(f), prescribes that valves or valve combinations with leakage rates exceeding the values specified by the Owner shall be declared inoperable and either repaired or replaced. A retest demonstrating acceptable operation shall be performed following any required corrective action before the valve is returned to service.

Although 1-SI-241 did not initially pass the scheduled IST Program leakage test during the performance of 1-OPT-SI-014 on May 27, 2021, ample evidence exists following mechanical agitation to conclude the valve is capable of performing its design function throughout the next planned operating cycle. The valve remains capable of performing all stated design functions within the Updated Final Safety Analysis Report (UFSAR), TS, and Design Bases. The flow path for borated water to the core is still maintained, and the RCS pressure isolation boundary has been verified as evidenced by the measured as-left leakage of 0.0 gpm. WO 38204242376 has been created to open and inspect 1-SI-241 during the next refueling outage. Any valve degradation identified will be repaired, and a leakage rate test demonstrating acceptable operation will be performed prior to returning the valve to service. For the purpose of meeting TS leakage criteria, 1-OPT-SI-014 can be dispositioned as satisfactory with respect to leak rate testing of 1-SI-241. For the purpose of operability determination, until maintenance is performed to confirm no valve degradation exists, 1-SI-241 should be characterized as not fully qualified.

Precautions and Limitations

N/A

Recommendations

Perform WO 38204242376 - OPEN/INSPECT CHECK VALVE next RFO (1R31). Corrective Action Review Board approval required for extension.

Engineering recommends that valve 1-SI-241 be considered operable but not fully qualified, and 1-OPT-SI-014 to be dispositioned as satisfactory.

References

1. OPT-SI-014, "Cold Shutdown Test of SI Check Valves to RCS Cold Legs."
2. OPT-SI-023, "Cold Shutdown Test of SI Check Valves to RCS Hot Legs."
3. ET S-95-0455, Rev 0, "Mechanical Agitation of Check Valves, SPS Unit 1 & 2."

4. SPS Technical Specifications, Sections 3.1, 3.3, 4.1.
5. SDBD-SPS-SI, "System Design Basis Document, Safety Injection."
6. Updated Final Safety Analysis Report, Rev. 52.04, Surry Power Station.
7. CM-M-ETE-101, "Engineering Technical Evaluations (ETEs)."
8. VTM V637-00011, "Velan Check Valves 2 1/2" - 24"."
9. 1-OPT-SI-007, "Refueling Test of the High Head Safety Injection Check Valves to the Cold Legs."

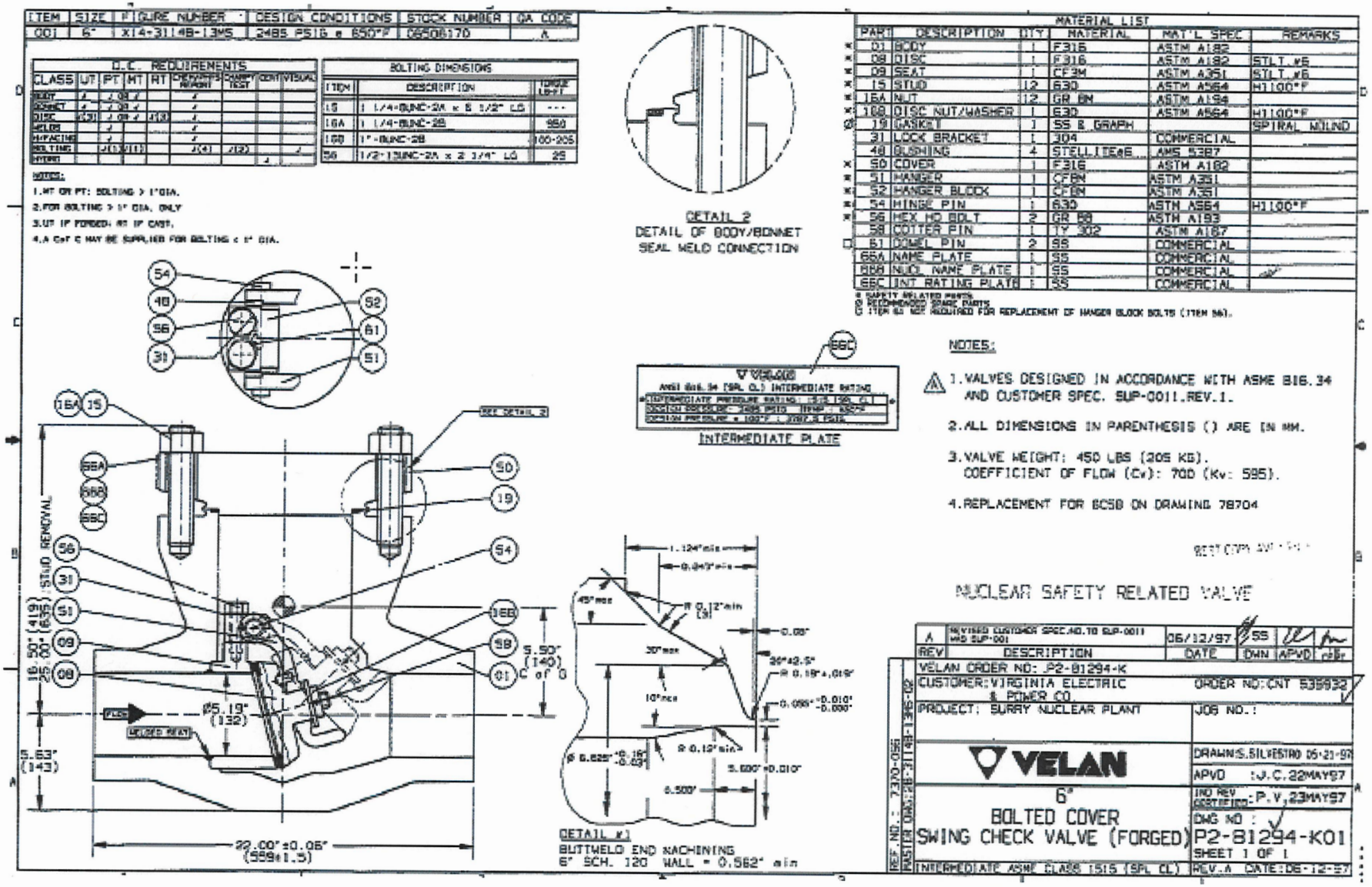
1-S1-241 Valve Information

Manufacturer: Velan

Model Number: B14-3114B-13MS

Model Number Designation:

B	Butt Welded
14	6" Size
3	1500# Class
11	Swing Check Valve
4	Vertical Orientation
B	Bolted Bonnet
13	Stainless Steel Body, Forged 316, CF3M
MS	Stellite 6 Disk and Seat Hardfacing


ITEM | SIZE | FIGURE NUMBER | DESIGN CONDITIONS | STOCK NUMBER | QA CODE
001 | 6" | X14-3114B-13MS | 2485 PSIG @ 650°F | 06506170 | A
N.D.E. REQUIREMENTS
CLASS | UT | PT | MT | RT | CHEMISTRY & WEIGHT | CHARPY TEST | CERT | VISUAL
BODY | A | ✓ 08 | ✓
BONNET | A | ✓ 08 | ✓
DISC | A(3) | ✓ 08 | ✓ | A(3) | ✓
WELDS | | ✓ | | | ✓
MACHINING | | ✓ | | | ✓
BOLTING | | A(3) | A(3) | | A(4) | A(2) | | ✓
PIPING | | | | | | | ✓
BOLTING DIMENSIONS
ITEM | DESCRIPTION | TORQUE LB-FT
15 | 1 1/4-8UNC-2A x 8 1/2" LG | ---
16A | 1 1/4-8UNC-2B | 950
100 | 1"-8UNC-2B | 600-205
56 | 1/2"-13UNC-2A x 2 3/4" LG | 25
NOTES:
1. MT OR PT: BOLTING > 1"DIA.
2. FOR BOLTING > 1" DIA. ONLY
3. UT IF FORGED: RT IF CAST.
4. A Cat C MAY BE SUPPLIED FOR BOLTING < 1" DIA.
DETAIL 2
DETAIL OF BODY/BONNET
SEAL WELD CONNECTION
MATERIAL LIST
PART | DESCRIPTION | QTY | MATERIAL | MAT'L SPEC | REMARKS
01 | BODY | 1 | F316 | ASTM A182
08 | DISC | 1 | F316 | ASTM A182 | STLT #6
09 | SEAT | 1 | CF3M | ASTM A351 | STLT #6
15 | STUD | 12 | 630 | ASTM A564 | H1100°F
16A | NUT | 12 | GR 8M | ASTM A194
100 | DISC NUT/WASHER | 1 | 630 | ASTM A564 | H1100°F
19 | GASKET | 1 | SS & GRAPH | | SPIRAL WOUND
31 | LOCK BRACKET | 1 | 304 | COMMERCIAL
48 | BUSHING | 4 | STELLITE#6 | AMS 5387
50 | COVER | 1 | F316 | ASTM A182
51 | HANGER | 1 | CFBN | ASTM A351
52 | HANGER BLOCK | 1 | CFBN | ASTM A351
54 | HINGE PIN | 1 | 630 | ASTM A564 | H1100°F
56 | HEX HD BOLT | 2 | GR B8 | ASTM A193
58 | COTTER PIN | 1 | TY 302 | ASTM A187
61 | DOWEL PIN | 2 | 98 | COMMERCIAL
66A | NAME PLATE | 1 | SS | COMMERCIAL
66B | NUCL. NAME PLATE | 1 | SS | COMMERCIAL
66C | INT RATING PLATE | 1 | SS | COMMERCIAL
* SAFETY RELATED PARTS.
@ RECOMMENDED SPARE PARTS
@ ITEM 61 NOT REQUIRED FOR REPLACEMENT OF HANGER BLOCK BOLTS (ITEM 56).
66C
VELAN
ANSI B16.34 (SPL CL.) INTERMEDIATE RATING
INTERMEDIATE PLATE
NOTES:
1. VALVES DESIGNED IN ACCORDANCE WITH ASME B16.34 AND CUSTOMER SPEC. SUP-0011,REV.1.
2. ALL DIMENSIONS IN PARENTHESIS ( ) ARE IN MM.
3. VALVE WEIGHT: 450 LBS (205 KG).
COEFFICIENT OF FLOW (Cv): 700 (Kv: 585).
4. REPLACEMENT FOR 66B ON DRAWING 78704
BEST COPY AVAILABLE
NUCLEAR SAFETY RELATED VALVE
STUD REMOVAL
50" (419)
20" (635)
16.50"
25.00"
16.63" (143)
Ø5.19" (132)
WELDED SEAT
22.00"±0.05" (559±1.5)
5.50" (140) C of G
DETAIL #1
BUTTWELD END MACHINING
6" SCH. 120 WALL = 0.562" min
A | REVISED CUSTOMER SPEC.NO.TO SUP-0011 AND SUP-001 | 06/12/97 | SS
REV | DESCRIPTION | DATE | DWN | APVD
VELAN ORDER NO: P2-81294-K
CUSTOMER: VIRGINIA ELECTRIC & POWER CO. | ORDER NO: CNT 535932
PROJECT: SURRY NUCLEAR PLANT | JOB NO.:
VELAN
DRAWN: S.SILVESTRO 05-21-97
APVD: J.C. 22MAY97
6"
BOLTED COVER
SWING CHECK VALVE (FORGED)
2ND REV CERTIFICATION: P.V. 23MAY97
DWG NO: P2-81294-K01
SHEET 1 OF 1
INTERMEDIATE ASME CLASS 1515 (SPL CL)
REV.: A DATE: 06-12-97
REF. NO.: 7370-056
PASTE IN DWG: 2B-31148-13MS-102