Entergy Nuclear South
Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504 739 6660
Fax 504 739 6678
jkowale@entergy.com

Joseph A. Kowalewski
Vice President, Operations
Waterford 3

W3F1-2010-0089

January 4, 2011

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Response to Request for Additional Information Associated with Technical Specification Table 3.4-1 Isolation Valve Addition
Waterford Steam Electric Station Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:
1. W3F1-2010-0019, Technical Specification Table 3.4-1 Isolation Valve Addition, February 22, 2010.
2. NRC Letter, Request for Additional Information Re: Technical Specification Table 3.4-1 Isolation Valve Addition, June 28, 2010.
3. W3F1-2010-0065, Response to Request for Additional Information Associated with Technical Specification Table 3.4-1 Isolation Valve Addition, August 12, 2010.
4. NRC, Request for Additional Information on the LAR to Revise TS 3.4-1 Isolation Valve Addition, October 28, 2010 [ADAMS Accession Number ML103010180].

Dear Sir or Madam:

In letter W3F1-2010-0019 [Reference 1], Entergy Operations, Inc. (Entergy) proposed a change to Waterford Steam Electric Station Unit 3 (Waterford 3) Technical Specifications (TS) Table 3.4-1 Isolation Valve Addition.

During the submittal review process, the Nuclear Regulatory Commission (NRC) determined that a Request for Additional Information (RAI) was required [Reference 2]. Letter W3F1-2010-0065 [Reference 3] submitted the additional information. Letter W3F1-2010-0065 did not contain the requested Environmental Qualification (EQ) report due to the EQ report not being available at the time. The EQ report is contained

in Attachment 2 to this letter. An additional RAI [Reference 4] was received and its response is included in Attachment 1.

This letter contains no new commitments.

If you have any questions or require additional information, please contact William Steelman at 504-739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 4, 2011.

Sincerely,

JAK/WJS

Attachment 1: Response to Request for Additional Information
Attachment 2: LPL-EQA-35.1 Qualification Test Summary / Similarity Analysis / Temperature Service

cc: Mr. Elmo E. Collins, Jr.
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Waterford Steam Electric Station Unit 3
P.O. Box 822
Killona, LA 70066-0751

U. S. Nuclear Regulatory Commission
Attn: Mr. N. Kalyanam
Mail Stop O-07D1
Washington, DC 20555-0001

Attachment 1 to

W3F1-2010-0089

Response to Request for Additional Information

NRC REQUEST FOR ADDITIONAL INFORMATION

In letter W3F1-2010-0019 [Reference 1], Entergy Operations, Inc. (Entergy) proposed a change to Waterford Steam Electric Station Unit 3 (Waterford 3) Technical Specifications (TS) Table 3.4-1 Isolation Valve Addition. During the submittal review process, the Nuclear Regulatory Commission (NRC) determined that a Request for Additional Information (RAI) was required. Letter W3F1-2010-0050 [Reference 2] submitted the additional information. After NRC review of letter W3F1-2010-0050, additional information was determined to be needed and another RAI [Reference 3] was generated. Letter W3F1-2010-0065 [Reference 4] submitted the additional information but W3F1-2010-0065 did not contain the requested Environmental Qualification (EQ) report due to the EQ report not being available at the time. The EQ report is contained in Attachment 2 to this letter. An additional RAI [Reference 4] was received and its response is provided below.

The following provides the responses to the remaining Waterford 3 NRC RAIs.

RAI 1 [Reference 3]

Letter W3F1-2010-0050 RAI 6.b response – We need a summary of the licensee's EQ calculation. All design information has to be completed before we can review the application. The vendor should have these calculations ready.

RAI 1 Response

Attachment 2 contains LPL-EQA-35.1 which contains the Qualification Test Summary / Similarity Analysis / Temperature Service for solenoid valves SI-4052A (RC LOOP 2 SDC SUCTION INSIDE CONTAINMENT BYPASS ISOL) and SI-4052B (RC LOOP 1 SDC SUCTION INSIDE CONTAINMENT BYPASS ISOL) that will be installed under EC14765.

Attachment 2 LPL-EQA-35.1 page Attachment XI.8 gives the report conclusions.

RAI 2 [Reference 5]

Please provide a summary evaluation of the impact of the proposed modification for the new solenoid valves on compliance with 10 CFR 50.63 Station Blackout.

RAI 2 Response

Station Blackout (SBO) evaluation for Waterford 3 was performed in accordance with 10CFR50.63 using the guidance in NUMARC 87-00 and Regulatory Guide 1.155. The plant specific evaluation for Waterford 3 demonstrates that equipment will be functional such that Waterford 3 can safely cope with an SBO for four hours. During the 4-hour SBO event, maintaining reactor core cooling for the plant is performed via natural circulation. Shutdown cooling will only be initiated after the 4-hour SBO event.

SI-4052A(B) is required to support shutdown cooling only and is not needed for natural circulation. Battery capacity calculations verified that the Class 1E batteries have sufficient capacity to support station blackout for four hours. Offsite power or Emergency Diesel Generator is credited for restoration of AC power to the plant ending the 4 hours SBO event. Once AC power is restored, the safety related battery chargers provide DC power to the DC buses and loads.

REFERENCES:

1. W3F1-2010-0019, Technical Specification Table 3.4-1 Isolation Valve Addition, February 22, 2010.
2. W3F1-2010-0050, Response to Request for Additional Information Associated with Technical Specification Table 3.4-1 Isolation Valve Addition, June 8, 2010 [ADAMS Accession Number ML101620417].
3. NRC Letter, Request for Additional Information Re: Technical Specification Table 3.4-1 Isolation Valve Addition, June 28, 2010.
4. W3F1-2010-0065, Response to Request for Additional Information Associated with Technical Specification Table 3.4-1 Isolation Valve Addition, August 12, 2010 [ADAMS Accession Number ML102300177].
5. NRC, Request for Additional Information on the LAR to Revise TS 3.4-1 Isolation Valve Addition, October 28, 2010 [ADAMS Accession Number ML103010180].

Attachment 2 to

W3F1-2010-0089

LPL-EQA-35.1 Qualification Test Summary / Similarity Analysis / Temperature Service

Attachment 2 Contains 17 Pages

Attachment XI

Qualification Test Summary / Similarity Analysis / Temperature Service Condition
Valcor Report MR526-6040-22-3
(Model V526-6040-22, P/N 214167301 for SI ISV4052A & SI ISV4052B)

ADD
EC-14765

Qualification Test Summary / Similarity Analysis / Temperature Service Condition Valcor Report MR526-6040-22-3 (Model V526-6040-22, P/N 214167301 for SI ISV4052A & SI ISV4052B)

ADD
EC-14765

Test Sample Description

The following Valcor Solenoid Valves were submitted for qualification testing.

Model/Part No.	Tag No.	S/N	Description
V526-6180-1 P/N 356136301	0Q014-01-01-01 0Q014-01-01-02	1Q 2Q	Valcor 2", 1500# ASME III, Class 2 pilot assisted, normally open, 2-way position indicating, DC voltage solenoid operated valve. The solenoid coil assembly is a Valcor P/N V52653-6042-1 rated at 180°C (Class H), 125 VDC continuous duty.

The Model V526-6180-1 Solenoid Valve has a Class H 125 VDC coil which has an operating range of 100 - 140 VDC (no rectifier & zener diode assembly is used). Electrical power to operate the valve is applied to the solenoid through a conduit port located on the side of the solenoid assembly. The inrush and holding current is 1.5 amperes at 125 VDC & 70 °F. The valve de-energized position (fail position) is open; therefore the valve is energized to close. The disc assembly consists of a stellite which seals against an ASME SA-479 Type 316 hardface seat in the valve body. The test specimen contains 2 position indicating switches which are actuated by a magnet assembly that is attached to the plunger. The coil housing O-rings were constructed with silicone rubber. The assembly drawing for solenoid valve V526-6180-1 is shown on Dwg #356136301 (EMDRAC 5817-13985 sh1) which is included in references (h) and (i).

Solenoid Operated Valve V526-6180-1 was mounted and qualified in the stem-vertical position (QR 526-6180-1-1 section 3.6).

Acceptance Criteria

Pre- and Post Qualification Baseline Function Testing of serial numbers 1Q & 2Q valves was performed by Valcor with satisfactory results. Excessive output leakage was observed on both test valves during a Pneumatic Disc Test. The leakage was documented and monitored without increase throughout qualification testing. The Pneumatic Disc Test was revised to be performed with water, vice air and both qualification valves exhibited leakage within the required 50 cc/hr. The overall results are given below and can be found in QR 526-6180-1-1 Appendix F Sh. F1-2:

Test	Limits	Pre-Qual Test Results (1Q/2Q)	Post-Qual Test Results (1Q/2Q)
Dielectric (Solenoid)	2 mA MAX.	440 μA / 480 μA	180 μA / 200 μA
Dielectric (Switches)	2 mA MAX.	280 μA / 260 μA	100 μA / 130 μA
Insulation Resistance (IR)-Solenoid	20 MΩ MIN.	>10k MΩ / >20k MΩ	>20k MΩ / >20k MΩ

ADD
EC-14765

Insulation Resistance (IR)-Switches	20 MΩ MIN.	>6k MΩ / >10k MΩ	>20k MΩ / >20k MΩ
Position Indication (Normal)	MUST INDICATE	SAT / SAT	MISSING SWITCH
Position Indication (Energized)	MUST INDICATE	SAT / SAT	SAT / SAT
Hydrostatic Shell Test 4200 psig Water for 15 min.	NO LEAKS	SAT / SAT	SAT / SAT
Hydrostatic Disc Test 4100 psig Water for 5 min.	4 CC/HR MAX. LEAKAGE	.001 cc/min / .001 cc/min	.01 cc/min / .005 cc/min
Pull-In Voltage	57 VDC MAX.	40 VDC / 40 VDC	37 VDC / 37 VDC
Drop-Out Voltage	4 VDC MIN.	16 VDC / 11 VDC	15.8 VDC / 14 VDC
Response Time	Open/Close MAX. 2 sec	16 msec. / 25 msec. 50.2 msec / 62 msec.	N/A

Radiation Aging

Two model V526-6180-1 specimens (P/N 0Q014-01-01-01 & 0Q014-01-01-02) were sequentially radiation aged in the beginning of the qualification program based on the results of testing by the Nuclear Regulatory Commission (NRC) and reported by Sandia Laboratories in report SAND 79-0924C. Radiation exposure was performed by Steris-Isomedix Services under guidelines specified by Valcor. The test specimens were exposed for 106 hours to a Cobalt-60 gamma source and received a minimum total integrated radiation dose of 93.6 Mrads (9.36E+7) gamma with no anomalies and no degradation of non-metallics noted (QR 526-6180-1-1 section 3.13.3). The valve's performance characteristics (pull-in, drop-out, and leakage tests) were measured satisfactorily before and after the radiation exposure.

Thermal Aging

First a Heat Rise Test (Reference QR 526-6180-1-1 Appendix D) was performed in order to determine the maximum stabilized solenoid and o-ring temperatures that occur when the solenoid is continuously energized in its maximum operating ambient temperature. A total of ten thermocouples were installed as close as practical to the o-ring seals. The coil temperature was calculated based on the measurement of current changes. The fully instrumented test valves were mounted onto a steel plate to simulate actual mounting and heat transfer conditions. These assemblies were mounted in the chamber oriented with the valves in a vertical position, solenoid above the valve bodies, and on a 1-inch thick insulation board on the floor of the chamber. All thermocouples were connected to a temperature recorder and additional instrumentation to measure the applied voltage and current during the test. The test valve temperature was stabilized at 130°F with test fluid supplied to the valve at 306°F. A voltage of 125VDC was applied to the valve and the baseline current was measured. When thermal stabilization was reached, which is the point when the current did not change more than 1 mA in a 1-hour period, the current flow in the solenoid was measured. The coil winding temperature was calculated in accordance with the following equation:

ADD
EC-14765

$$T = \left(\frac{I_A}{I_F} - 1\right)\left(\frac{1}{0.00218}\right) + T_A$$

Where:

T =	Calculated Coil Temperature: 317.9°F
I_A =	Current Flow at Ambient Temperature (1.32562 Amps)
I_F =	Current Flow at Stabilized Temperature (0.94059 Amps)
T_A =	Ambient Temperature (130.6°F)
0.00218 =	Temperature Coefficient, Ohm/Ohm-°F

The thermal aging of the V526-6180-1 solenoid valves was performed to simulate the effects of a 40-year design life plus accident, except for elastomers and non-metallic items, which were qualified for a minimum of 10-year life plus accident. Following the Heat Rise Test, the measured temperatures were used to determine the thermal aging times of the various test specimen components. The final thermocouple temperatures became the Actual Part Operating Temperatures that were used to calculate qualified life. The solenoid coil shell assembly was thermally aged 690 hours @ 415°F (Reference QR 526-6180-1-1, Appendix D, Figure 1). The limiting components in the coil shell assembly are the Coil Magnet Wire, Coil Insulation, and Coil Lead Wire, which received an effective qualified life of 40.52 years. These three components had the lowest activation energy (eV) with a value of 2.096eV.

The coil materials of construction are identified in QR 526-6180-1-1 Appendix D, Figure 1 as:

PART	MATERIAL	ACTIVATION ENERGY (eV)
Coil Magnet Wire	Polyimide	2.096
Coil Insulation	Kapton	2.096
Insulating Tape	Fiberglass	2.156
Epoxy Potting	Stycast #2651	2.126
Coil Lead Wire	Kapton	2.096

The silicone o-rings, an elastomer, with activation energy of 1.150 eV were tested as part of a Coil-Shell Assembly test fixture which included an Electrical Conduit Seal Assembly (ECSA) connector manufactured by EGS attached to the solenoid housing. The o-rings received an effective qualified life of 15.64 years. The o-rings were thermally aged 855 hours @ 280°F (Reference QR 526-6180-1-1, Appendix D, Figure 2).

Cycle Aging

During Thermal Aging, Phase I of Cycle Aging was performed. Solenoid Operated Valve V526-6180-1 was cycled 8,289 times successfully (Reference QR 526-6180-1-1 section 3.13.4). The test specimens were cycled with 60 psig water at 125 VDC at a rate that did not exceed 10 cycles per minute.

Post-Thermal/Cycle Aging test results complied with test requirements and can be found in QR 526-6180-1-1 Appendix F, sheets 54 and 55. Test results are listed below:

ADD
EC-14765

Test	**Post-Thermal/Cycle Aging Test Data** 0Q014-01-01-01 / 0Q014-01-01-02
Apply Voltage to Solenoid Operator	125.418 / 125.072 VDC
Apply Pressure to Pressure Port 'A'	60.0 psig
Pull-In Voltage (Avg.)	43.340 / 54.146 VDC
Drop-Out Voltage (Avg.)	15.494 / 23.206 VDC
Leak Test	0.5 sccm / 0.4 sccm

Phase II of Cycle Aging was performed following Hot Cyclic Testing. An additional 8,250 cycles during Phase II Cycle Aging of the valve was performed at ambient temperature. The valve was cycled with 60 psig water a rate not exceeding 10 cycles per minute energizing the coil with 125 VDC. Operation of the valve was confirmed by the valve shuttling and water issuing from the outlet port when the valve is energized as well as observation of the position indication switches.

Seismic Testing

Complete successful seismic qualification testing is documented in QR 526-6180-1-1, Appendix F, Test report pages 091-189. A Resonance Search Test was performed within the range of 1-100Hz. A Vibration Aging Test was performed and tag numbers 0Q014-01-01-01 and 0Q014-01-01-02 were subjected to an amplitude of 0.75g over the frequency range of 5 Hz to 100 Hz to 5 Hz at a sweep rate of 2 octaves per minute for a minimum of 90 minutes in each orthogonal axis (see QR 526-6180-1-1, Appendix F pages 96-108). The SRV Alone Test was performed following Vibration Aging. Contact chatter was monitored throughout testing. Operability was monitored satisfactorily at 1, 5, 10 and 15 minutes during testing. An Operational Basis Earthquake (OBE) plus SRV excitations was performed in each of the X-Y and Z-Y directions using the Required Response Spectrum (RRS) method. The valve was cycled satisfactorily twice and operability was verified by a burst of flow from the outlet port. Safe Shutdown earthquake (SSE) in addition to SRV and LOCA excitations was also performed.

Post Seismic functional test results complied with test requirements and can be found in QR 526-6180-1-1 Appendix F, sheets 79 and 80. Test results are listed below:

Test	**Post Seismic Results** 0Q014-01-01-01 / 0Q014-01-01-02
Apply Voltage to Solenoid Operator	125.06 / 125.6 VDC
Pull-In Voltage (Avg.)	39.4 / 46.13 VDC
Drop-Out Voltage (Avg.)	19.87 / 19.56 VDC
Leak Test	.01 scfm / 5.2 sccm

ADD
EC-14765

LOCA Testing

Valcor model V52600-6042-1A was used to demonstrate, based on similarity, that LOCA requirements are exceeded (see MR526-6040-22-3 section 4.1.4). Two Valcor model V52600-6042-1A valves were exposed to a 30 day LOCA/MSLB test in which two initial transients were used. The first transient obtained a peak temperature/pressure of 413°F/73.7 psig in 31 seconds and the second transient obtained a peak temperature/pressure of 445°F/64 psig in 17.5 seconds. Chemical spray consisting of 3000 ppm boron pH of 11.5 adjusted with sodium hydroxide was applied during the first 24 hours of testing at a rate of 0.15 gpm/ft2 (see Attachment X). The valves were successfully operated at nominal voltage, minimum voltage and maximum voltage throughout the LOCA/MSLB test.

The valves that are installed in containment have an electrical Quick Disconnect connector manufactured by EGS (QualTech NP) attached to the solenoid housing which prevents moisture/water from penetrating into instrument housings, junction boxes or the solenoid coil. The qualified connector is a 3/4" N.P.T., quick disconnect, 10 pin bayonet style with connector field wiring consisting of 16 AWG, Rockbestos, Firewall III SIS cable.

It is assumed per calculation ECS04-013, Small Break Loss of Coolant Accident (SBLOCA) Alternative Source Term (AST) Radiological Dose Consequences for 3716 MWt Extended Power Uprate (EPU) that the plant is placed on Shutdown Cooling and secondary releases through the ADV's are stopped at a time of 7.5 hours. The SI-4052A and SI-4052B solenoid valves, normally de-energized and closed, will be required for a very short duration (approx. 7-8 minutes maximum while placing SDC into service). The function while energized is to open to equalize the SDC pressure across SI-405A and SI-405B. Once the pressure is equalized and SI-405A & SI-405B commence to open, the equalization solenoid valves can close.

It has been determined that the Valcor model V526-6040-22 is qualified for a LOCA/MSLB event at Waterford 3 based on similarity of construction and LOCA testing for qualification test sample V52600-6042-1A exceeding the plant requirements as shown with the superimposed LOCA temperature and pressure curves found in Appendix III of MR526-6040-22-3. Comparisons of the LOCA/MSLB Test Temperature and Pressure Profiles for Report QR526-6042-1A can also be found in this EQA (see Fig 4a & 4b).

Final Inspection

The test specimens were visually inspected at Trentec (testing facility) for evidence of damage, deterioration or deformation that might hinder proper valve operation. The final inspection was satisfactory and the results can be found in QR 526-6180-1-1, Appendix F on Page 011. All the lead wires were brittle, which was expected as they were effectively 40 years old (minimum).

Similarity Analysis

ADD EC-14765

Table I

Valve Similarities

Valve Model No.	Nominal Size (in)	Type	Seal Material	Body Material	Bonnet Material	Flow Capacity (Cv) (Min)	Pressure Class (Note1)	Design Temp (°F)
V526-6040-22 (Installed at WF3 SI-4052A & B)	3/4	Pilot Operated	Stellite 6B	ASME SA182 – Grade F316	ASME SA479 – Type 316	4.0	1680	650
V526-6180-1 (Test Valve)	2	Pilot Operated	Stellite 6B	ASME SA516 – Grade 70	ASME SA479 – Type XM-19	10.0	1500	576
V526-6042-1A (Test Valve – LOCA)	1	Pilot Operated	Stellite 6B	ASME SA240 – Type 316	ASME SA479 – Type 316	2.0	2500	680

Notes:

1. All valves have body nozzles that are Class 2500 capable. Only the nozzle bores and weld end preparations vary with changes in nominal size per MR526-6040-22-3 section 4.0.

Table II

Comparison of Non-Metallic Parts

Part Name	Valve V526-6040-22 Part Number	Valve V526-6180-1 Part Number	Valve V526-6042-1A Part Number
Coil-Shell Assembly	V52653-6042-1	V52653-6042-1	V52653-6042-1
Switch Assembly	S1140-6-1 & S1140-6-5	S1140-6-1	S1140-6-1
Terminal block	S1140-14-6 & S1140-14-7	S1140-14-6 & S1140-14-7	S1140-14-6 & S1140-14-7
Leadwire (QDC/ECSA)	V135-245 (Part of QDC/ECSA)	V135-227 (Part of QDC/ECSA)	S1140-36-14 (Part of QDC/ECSA)
Electrical Connection Seal	N/A	N/A	S101BD25
Leadwire (Bracket Terminal Block Assembly)	S1349-2	S1349-2	S1349-2
Leadwire (Switch Assembly)	S1517-2	S1517-2	S1517-2
O-Ring (Cover to Housing)	S101CS156	S101CS156	S101CS156 Note 1
O-Ring (Housing to Coil Shell)	S101CS156	S101CS156	N/A
Packing / O-Ring (Coil Shell to Bonnet)	S1140-49-1 & S1140-49-2	S1140-49-1 & S1140-49-2	S1140-49-1 & S1140-49-2 Note 1
Seal (Body to Bonnet)	V52618-6102-12 (K-Seal)	V52618-6102-12 (K-Seal)	Seal Weld
Seal	Metallic Disc/Seal	Metallic Disc/Seal	Metallic Disc/Seal

Part Name	Valve V526-6040-22 Part Number	Valve V526-6180-1 Part Number	Valve V526-6042-1A Part Number
Zener Diode	N/A	S1140-9-1	S1140-9-1
Rectifier	N/A	N/A	S1140-8-1
Heat Shrink Tubing (Switch Assembly)	S1318-5 & S1318-3	S1318-5 & S1318-3	S1318-5 & S1318-3
Protective Tubing (Switch Assembly)	S1325-2	S1325-2	S1325-2

ADD
EC-14765

Notes:

1. Per QR 526-6042-1A, the P/N V52600-6042-1A qualification test valves were modified to change: 1) the o-ring compounds from EPR to silicone, and 2) the o-ring seal at the solenoid/bonnet interface was replaced by a graphite seal. The o-ring material and graphite seal changes were made based upon thermal test data.

The basis for similarity is discussed below:

- The coil shell assemblies, P/N V52653-6042-1, used in the construction of the Valcor solenoid valves model V526-6040-22 installed at W3 for RC Loops 1 & 2 SDC Pressure Equalization / Containment Isolation Lines (SI ISV4052A & SI ISV4052B) are identical to the tested Valcor Solenoid Valve Model V526-6180-1 (See Ref. i - Section 4.1). As can be seen from Table II above, non metallic materials used in the solenoid construction of the above two valves including the Terminal Block, Leadwire (Bracket Terminal Block Assembly / Switch Assembly), O-Ring (Cover to Housing / Housing to Coil Shell, Heat Shrink and Protective Tubing are all identical between the two SOV valves.

- The differences in the solenoid valves include four position indicating switches in the model V526-6040-22 to two switches in the tested model V526-6180-1, however the switches are the same part number, P/N S1140-6-1. The valve installed at Waterford 3 has a P/N S1140-6-5 switch assembly, which is made of the same material as the S1140-6-1, only has a different sensitivity. The electrical connections are both made by EGS (QualTech NP) with similar materials (See Ref. i – Sections 3.1 and 4.1.1). A zener diode which is not applicable in the model V526-6040-22 was included in the Thermal Aging Testing and LOCA testing test valves. The electrical portion was tested and qualified per Ref. h and the above noted differences will have no affect on qualification.

- The metallic materials of construction are not affected by thermal aging or radiation exposure, however they can be affected by LOCA chemical spray and saturated steam environments if they are not inherently corrosion resistant. The ASME SA-516 Grade 70 Body on the model V526-6180-1 has been coated to prevent corrosion. The only other metallic item exposed to LOCA environment is the solenoid coil shell that is gray iron plated with nickel on both the tested and Waterford 3 installed valves. The materials on the model V526-6180-1 valve successfully completed LOCA test without incurring any corrosion on any metallic components (See Ref. i – Section 4.1.1.1). The electrical portion was tested and qualified per Ref. h and metallic differences will have no affect on qualification.

- The assemblies of the tested and installed Waterford 3 valves are similar except variations in size and seal disc configuration, which is due to flow, temperature and pressure ratings as shown in Table I above. The model V526-6040-22 is designed as Normally Closed while the tested model V526-6180-1

ADD
EC-14765

is Normally Open. The design and fabrication of both assemblies are in accordance with the requirements of the ASME Boiler and Pressure Vessel Code Section III. The variation in nominal size and Normally Open/Closed configurations have a negligible effect on seismic qualification since only the bore of the body nozzle varies with the change in nominal size. Both valves have body nozzle diameters that are suitable for a Pressure temperature rating of Class 2500. However, the bore is defined depending on the nominal size required (See Ref. i - Section 4.2.3).

- A detailed similarity evaluation was performed by Valcor (Ref. h & i).

Conclusion

- The material, design and construction between the Valcor V526-6040-22 and the V526-6180-1 and V526-60402-1A are similar as indicated in reports MR526-6040-22-3 and QR526-6180-1-1. The differences in valve body materials, valve size, valve rating or flow capacity are metallic differences only. This will have no affect on qualification.

- The Waterford 3 combined normal plus accident radiation environment is 3.331E+7 gamma (see Section II) and Valcor radiation aged successfully the solenoid valves to 9.36E+7 gamma with no anomalies and no degradation noted, therefore the valves have demonstrated a qualification level of 2.81 times above the requirement.
- The solenoid assembly and O-ring seals are of the same materials and method of manufacture as the solenoid assemblies and o-ring seals qualified for 40 years in QR526-6180-1-1. Other seals have identical metallic materials which are unaffected by thermal and radiation aging.
- Valcor successfully cycled the valves 8,289 times during thermal aging which significantly exceeds the 1 cycle every 18 month requirement while entering shutdown cooling (See Ref. i - Section 4.2.4).

- Based on qualification test reports QR 526-6180-1-1, QR 526-6042-1, similarities presented in MR 526-6040-22 and discussion above, the following SOV is qualified for service at Waterford 3 in SDC lines (SI-4052A & SI-4052B).

Model No.	Part No.	EMDRAC Dwg
V526-6040-22	214167301	5817-13985 sh1

- The qualified life on the valve subassembly (V52660-6040-22) is 40 years. The qualified life of the valve solenoid assembly (V105-394-21-14) is 40 years with the exception of the O-rings. The qualified life of the Solenoid Assembly O-rings is 10 years.

ADD
EC-14765

Temperature Service Condition – (SI ISV4052A & SI ISV4052B)

Normally de-energized (NCFCND) inside RCB with fluid (water) = 300°F

Comp ID	Status	Fluid	External	Internal
SI ISV4052A	DEEN	WATER	120°F / 414°F	300°F / 400°F
SI ISV4052B	DEEN	WATER	120°F / 414°F	300°F / 400°F

These two SOVs are located in the RCB and are normally closed in the de-energized position. These SOVs create a bypass around the valve SI-405A(B) to minimize the void formed during the operation cycle downstream of SI-405A(B) before SI-405A(B) is opened during shutdown cooling operation. The valves will also function as containment isolation.

The new solenoid valve, SI-4052A(B), will be opened for approximately 7 minutes before opening SI-405A(B). This sequence will allow RCS water from upstream of SI-405A(B) to compress the void between SI-405A(B) and SI-407A(B) before SI-405A(B) is opened; thus minimizing a pressure transient when SI-405A(B) is opened.

Based on a conservative energization time of 24 hours every 18 months, the following energized percentage times can be calculated:

Valve de-energized - 99.8%
Valve energized – 0.2%

Since the model V526-6040-22 is a pilot-operated SOV which uses the process fluid to assist in valve positioning, its coil generates less heat than equivalently sized direct-acting SOVs. The valve is a hard-seated solenoid valve with position indication. During normal plant operation the valve will be de-energized (no voltage applied to the solenoid) and the main seal, consisting of a disc assembly, which seals against a metal seat in the body isolates the outlet port from the inlet port. Since the valves are infrequently energized and for short periods of time, no significant self heating will occur.

Valcor has calculated a coil temperature of 318°F based on a heat rise of 12°F as indicated during a heat rise test performed (QR526-6180-1-1 Appendix 'D'). The valve was continuously energized with 125 VDC, operated in an ambient temperature of 130°F and supplied with a fluid (water) temperature of 306°F. A conservative service temperature (solenoid coil temperature) of 400°F (including 350°F SDC temperature + heat rise + additional margin) is used to calculate qualified life while the valve is energized based on shutdown cooling entry temperature of 350°F plus 12°F heat rise plus 10% margin. DC-powered solenoid valves may experience higher voltage when the station batteries are being maintained or charged. Float voltage levels are typically around 132 VDC and the equalizing voltage can be as high as 140 VDC for a 125 VDC system. Increasing the voltage increases the current drawn by the coil, which creates additional ohmic heating. This effect is considered in the margin included for the service temperature.

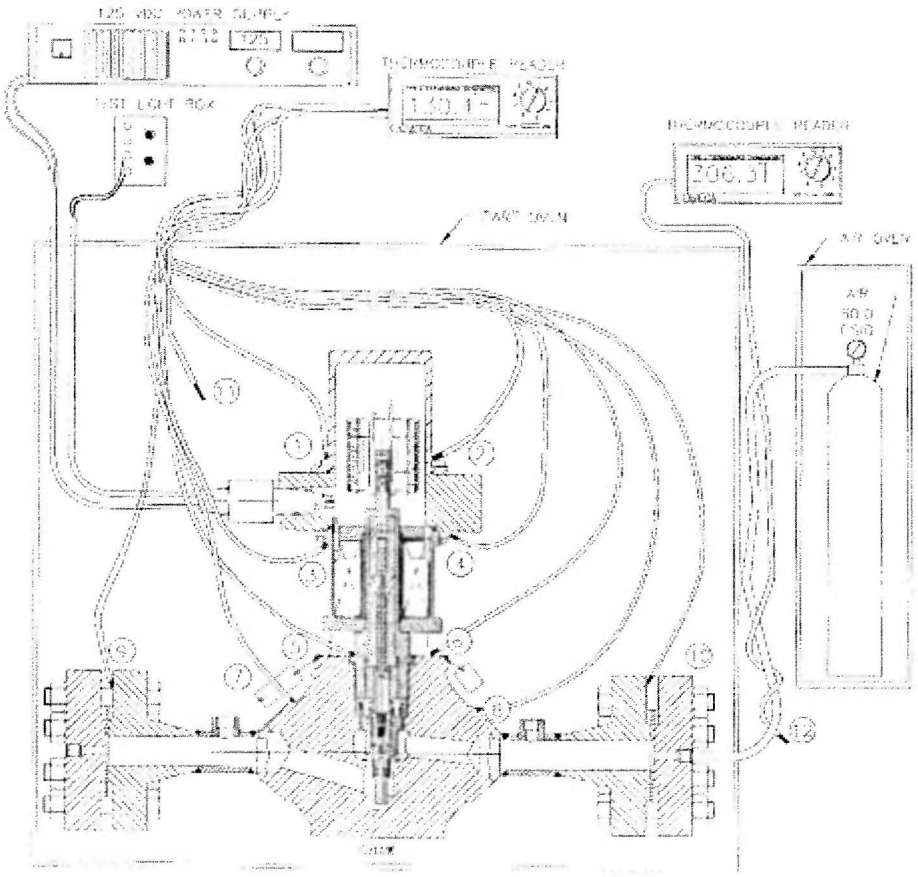
During periods while SI-4052A(B) will be closed (de-energized) and isolated from the RCS during normal plant operations, the service temperature is conservatively assumed to be 300°F. This temperature was

ADD
EC-14765

chosen based on containment ambient temperature of 120°F plus some allowance for some minor seat leakage through SI-401A(B).

The service temperature of the elastomers, O-rings being the life limiting component, (Dwg. 214167301 items 27 and 43) is calculated based on thermocouple temperatures that were recorded during the heat rise test and shown below in Figure "A". The service temperatures for the O-rings are much lower based on the elastomer location within the valve and the thermal conduction paths from the coil. The locations are depicted below as thermocouple locations 1-4. A conservative service temperature chosen for the O-rings is 240°F while the valve is open and 180°F while the valve is closed.

Figure A: Heat Rise Test Thermocouple Position and Final Temperatures



Thermocouple #	1	2	3	4	5	6	7	8	9	10	11	12
Celcius (°C)	70.6	78.2	76.3	83.3	90.1	92.6	58.4	58.2	54.6	55.0	56.5	152.39
Farenheit (°F)	159.08	172.76	169.34	181.94	194.18	198.68	137.12	136.76	130.28	131.00	133.68	306.3

QR 526 6180-1-1
Appendix D
Sheet D1-2

QUALIFIED LIFE CALCULATION

(41)

Item Description: V526-6040-22: SI-4052A(B) Solenoid Coil

CALCULATION INPUTS

Activation Energy: 2.096

SERVICE CONDITIONS

Service Temperature	Percent of Service Life
400F	0.2%
300F	99.8%

AGING CONDITIONS

Aging Temperature	Aging Time
212.78C	690 Hours

CALCULATION RESULTS: 58.6746 Years

Prepared By: Miguel Santo Date: 12/14/10

Reviewed By: John C. Chyz Date: 12/15/10

ADD
EC-14765

QUALIFIED LIFE CALCULATION

Item Description: V526-6040-22: SI-4052A(B) O-rings

42

CALCULATION INPUTS

Activation Energy: 1.15

SERVICE CONDITIONS

Service Temperature	Percent of Service Life
240F	0.2%
180F	99.8%

AGING CONDITIONS

Aging Temperature	Aging Time
280F	855 Hours

CALCULATION RESULTS: 14.9875 Years

Prepared By: Mynil Bmt Date: 12/14/0

Reviewed By: Jack Chyz Date: 12/15/10

ADD
EC-14765

REV. A

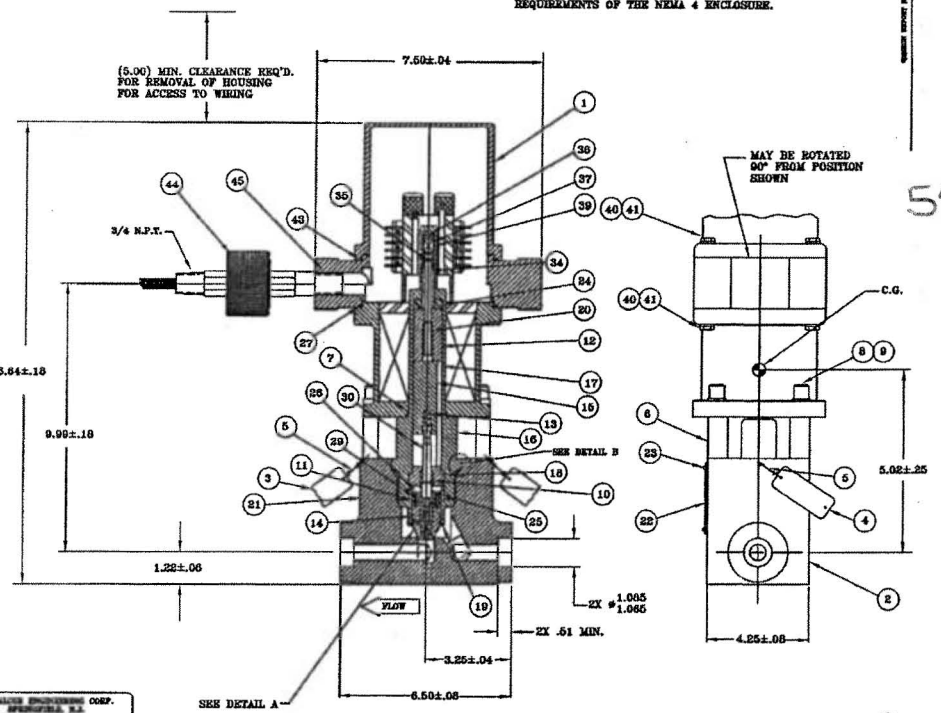
DESIGN/PERFORMANCE

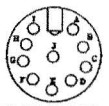
1. FLUID _____ BORATED WATER
2. DESIGN & OPERATIONAL CONDITIONS
   - PRIMARY PRESSURE RATING _____ CLASS 1680 (4032 PSIG AT 100°F)
   - PRESSURE BOUNDARY DESIGN _____ 2485 PSI AT 650°F
   - NORMAL OPERATIONAL DESIGN _____ 382 PSI AT 350°F
3. FLOW _____ Cv=4.0 MINIMUM
4. HYDROSTATIC CONDITIONS
   - SHELL LEAKAGE _____ ZERO AT 6050 PSIG AT 70°F
   - DISC LEAKAGE _____ 1.45 CC/MIN. MAX WATER AT 4436 PSIG AT 70°F
5. SOLENOID OPERATOR
   - COIL INSULATION _____ CLASS H
   - ENCLOSURE RATING _____ NEMA 4
   - VOLTAGE _____ 90-140VDC
   - CURRENT INRUSH _____ 1.5 AMP MAX. AT 125 VDC & 70°F
   - HOLDING _____ 1.5 AMP MAX. AT 125 VDC & 70°F
   - DUTY _____ CONTINUOUS AT 125 VDC MAX.
6. FAILURE POSITION _____ CLOSED
7. WEIGHT _____ 70 LBS. MAX.
8. INSTALLATION _____ HEAT TRANSFER DUE TO IN-LINE WELDING SHALL BE MINIMIZED SUCH THAT MAX. BODY TEMPERATURE WITHIN 1.0" OF WELD SHALL NOT EXCEED 400°F
9. RADIATION ENVIRONMENT:
   GAMMA INTEGRATED DOSAGE OF 5.1 X 10^7 RADS
10. CODE COMPLIANCE:
    ASME SECT. III 1977 EDITION INCLUDING SUMMER 1977 ADDENDA CLASS 1
11. POSITION INDICATION _____ MAGNETIC REED SWITCH
    - SWITCHING VOLTAGE _____ 125 VDC OR 125 VAC
    - SWITCHING CURRENT _____ 0.50 AMPS MAX.
    - SWITCHING CAPABILITY _____ 60 WATTS MAX.
12. CUSTOMER DOCUMENTS:
    a) ENTERGY NUCLEAR OPERATIONS, INC.
    WATERFORD 3 NUCLEAR
    ENTERGY P.O. NO. 10282568
    ENTERGY ENGINEERING DESIGN SPEC. NO. LOU 1664.110A
    VALCOR® J/O N133588

    b) TAG NUMBERS:
    SI ISV 4052A
    SI ISV 4052B

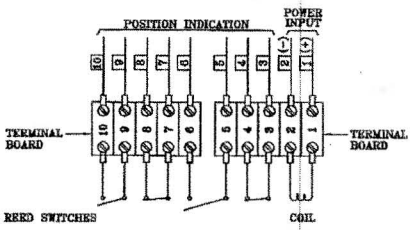
10 LEADWIRES, 360° LONG MIN. 16 AWG
ROCKBESTOS FIREWALL III SIS

OWNER IS RESPONSIBLE FOR MAINTAINING THE SEALS, ITEMS 7, 27 & 43 AND FOR SEALING THE CONDUIT CONNECTION AND PREVENTING THE ENTRANCE OF MOISTURE THRU THE CONDUIT TO MAINTAIN THE VALIDITY OF THE IEEE-323 QUALIFICATION AND THE REQUIREMENTS OF THE NEMA 4 ENCLOSURE.

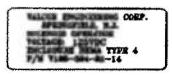




10 PIN EGS QDC

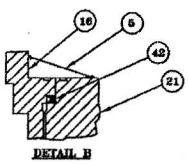


ELECTRICAL SCHEMATIC
SHOWN WITH VALVE IN THE CLOSED POSITION

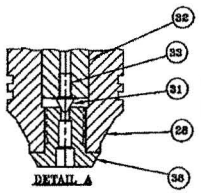


SOLENOID NAMEPLATE INFO.

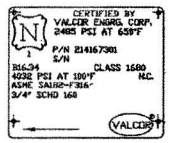
CAUTION
WELD CAUTION TAG INFORMATION



DETAIL B



DETAIL A



NAMEPLATE INFORMATION

VALVE TAG NUMBER
AS APPLICABLE PER J/O
VALVE TAG INFORMATION

ITEM	DESCRIPTION	MATERIAL
45	P-1 THREAD SEALANT	
44	CONNECTOR ASSY (QDC)	
43	O-RING	SILICONE
42	K-SEAL	INCONEL X-750
41	LOCKWASHER	300 SERIES ST. STL.
40	SCREW, SOC HD.	300 SERIES ST. STL.
39	CUP	ASTM A560 TYPE 316
38	SEAL	STELLITE #6
37	MAGNET	REMCO 15
36	PLUG	ASTM A560 TYPE 316
35	SPRING, PIN	INCONEL X-750
34	SUB	ASTM A276 TYPE 316
33	HELICOIL	300 SERIES ST. STL.
32	POPPET	ASTM A276 TYPE 316
31	SEAL	STELLITE #6
30	SEAT	ASTM A276 TYPE 316
29	HELICOIL	300 SERIES ST. STL.
* 28	DISC	ASME SA-479 TYPE 316
27	O-RING	SILICONE
26	SCREW, FLAT HD.	300 SERIES ST. STL.
25	PLATE	ASTM A276 TYPE 316
24	SPACER	ASTM A276 TYPE 316
23	SCREW, DRIVE	300 SERIES ST. STL.
22	NAMEPLATE	302 OR 304 ST. STL.
* 21	BODY	ASME SA-182 GRADE F316
20	SPRING (STOP)	ELGILOY
19	GUIDE (CYLINDER)	ASTM A479 TYPE 321000
18	SUB	ASTM A276 TYPE 316
17	PIN	ASTM A560 TYPE 316
* 16	BONNET	ASME SA-479 TYPE XM-19
15	PLUNGER	430/VALCOR STD. 8121
14	PISTON RING	410 ST. STL.
13	SPRING (PLUNGER)	ELGILOY
12	STOP	430/VALCOR STD. 8121
11	HELICOIL	300 SERIES ST. STL.
10	SPRING (DISC)	ELGILOY
9	SCREW, CAP, SOC. HD.	300 SERIES ST. STL.
8	LOCKWASHER	300 SERIES ST. STL.
7	PACKING	GRAFOIL
6	SPACER	300 SERIES ST. STL.
5	LOCKWIRE	302/304 ST. STL.
4	VALVE TAG	300 SERIES ST. STL.
2	WELD CAUTION TAG	300 SERIES ST. STL.
2	VALVE ASSY	
1	SOLENOID ASSY	

* PRESSURE RETAINING PARTS

LIST OF MATERIALS

SIGNATURES	DATE
DRAWN B. KARCH	7/21/10
CHECKED	
ENGINEER	

VALCOR ENGINEERING CORPORATION
SPRINGFIELD, NEW JERSEY

3/4" SCHD 160 CLASS 1680 D.C.
VALVE, SOLENOID, POSITION
ON, NUCLEAR SERVICE
MODEL: V526-6040-22 N.C.

DWG. NO. & PART NO.
214167301
NO. 7006-1136 SHT 1 OF 1

REVISIONS

ECO	LTR	DESCRIPTION	DATE	APPROVED
--	A	PRELIMINARY FOR APPROVAL		

FOR REFERENCE ONLY
SEP 14 2010

5817-13985 SH.1

MR526-6040-22-3
APPENDIX II
SHEET AII-1

CANDIDATE VALVE

NUCLEAR HARDWARE

V.10

ADD EC-14765

REV. A

DESIGN/PERFORMANCE DATA:

SEE SHEET 2

ECSA FIELD WIRING:
7 CONDUCTORS, 3 METERS (10 FEET) LONG
MIN. LENGTH, 14 AWG STRANDED TINNED, SR (SILICONE) ELECTRICAL WIRING (200°C RATED)

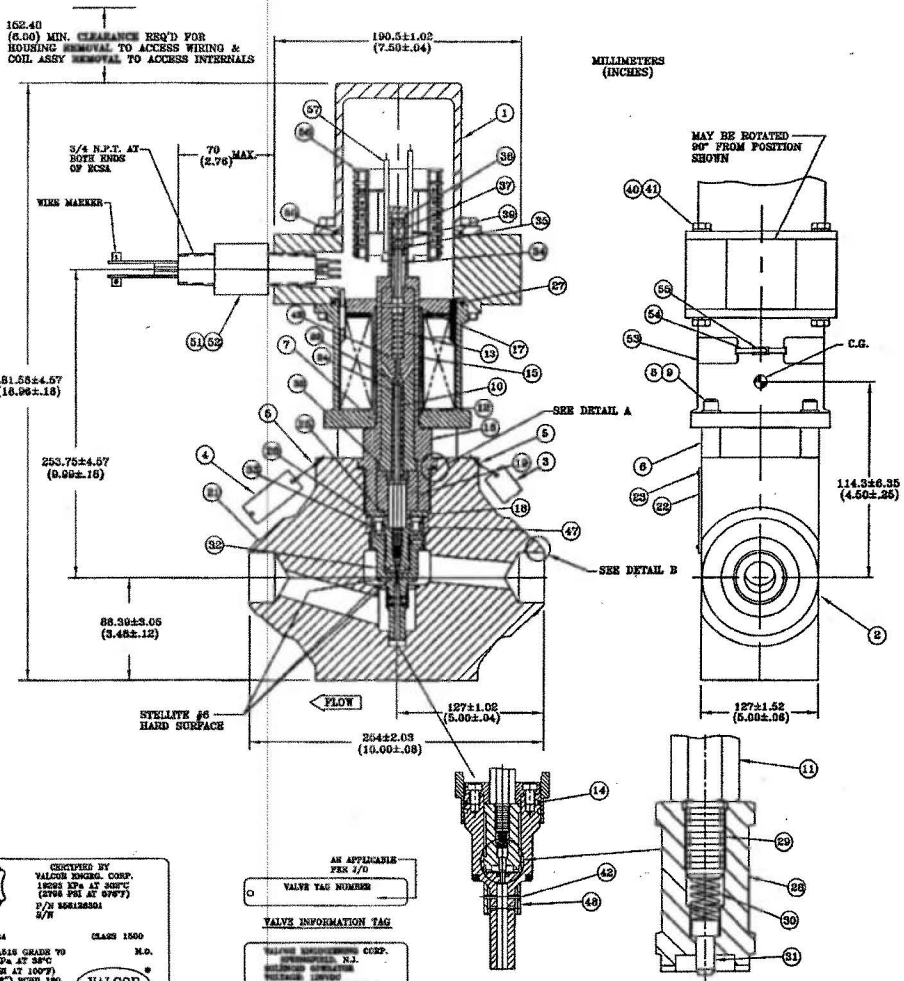
OWNER IS RESPONSIBLE FOR MAINTAINING THE SEALS, ITEMS 7, 27 & 50 AND THE ECSA TO HOUSING SEAL TO MAINTAIN THE VALIDITY OF THE IEEE-323 QUALIFICATION AND THE REQUIREMENTS OF THE NEMA 4 ENCLOSURE.

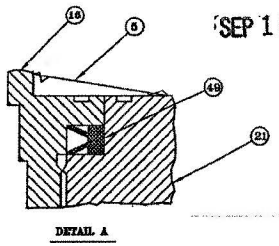
*PRESSURE RETAINING PARTS
S=SAFETY RELATED (CLASS S)
N=NON-SAFETY RELATED (CLASS G)

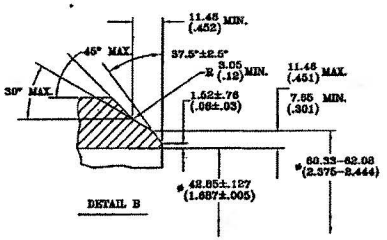
FOR REFERENCE ONLY

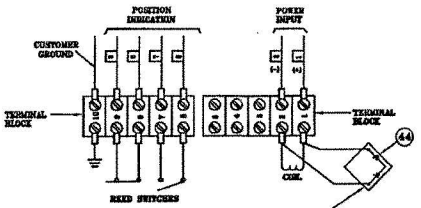
SEP 15 2010

REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
-/-	A	PRELIMINARY FOR APPROVAL		
44796	B*			
46363	D			









ELECTRICAL SCHEMATIC
SHOWN WITH VALVE IN THE OPEN POSITION

ITEM	QTY	DESCRIPTION	MATERIAL
S	57	HEAD SWITCH	ASSY, SPDT/GLASS CAPS, KOVAR, EATON
S	56	TERMINAL BLOCK	BLACK PHENOLIC, TYPE MS ST. STL.
N	55	BUCKLE	CRES ED1
N	54	BAND	CRES ED1
N	53	NAMEPLATE, SOLENOID	304/304 ST. STL. PER QQ-S-766
N	52	P-1 THREAD SEALANT	SEE TABLE 3
S	51	ELECTRICAL CONDUIT SEAL ASSY (ECSA)	SEE TABLE 2
S	50	O-RING	SILICONE (PARKER S604-70)
S	49	X-SEAL	INCONEL X-750
S	48	SLEEVE	ASTM A479 TYPE 316
S	47	SLEEVE	ASTM A479 GR. UNS21800
	46		
	45		
S	44	PENETRATION (ENDBELL) INSERT	ALUMINUM, EPOXY POTTING
S	43	BUTTON	ASTM A479/QQ-S-763 TYPE 316
S	42	SPIROL PIN	INCONEL X-750
N	41	LOCKWASHER	300 SERIES ST. STL. UNS S30300/S31600
S	40	SCREW HEX HD.	300 SERIES ST. STL.
S	39	CUP	ASTM A479 TYPE 316
S	38	SPACER	ASTM A276 TYPE 316
S	37	MAGNET	ESHETA 10
S	36	PLUG	ASTM A479 TYPE 316
S	35	SPIROL PIN	INCONEL X-750
S	34	ROD	ASTM A479 TYPE 316
N	33	HELI-COIL	300 SERIES ST. STL. AMS 7846
S*	32	DISC	ASME SA-479 TYPE 316
S	31	SEAL	STELLITE #6
S	30	SPRING	ELGILOY
N	29	HELI-COIL	300 SERIES ST. STL. AMS 7245
S	28	POPPET	ASTM A479 TYPE 316
S	27	O-RING	SILICONE (PARKER S604-70)
N	26	SCREW, CAP, SOC. HD.	300 SERIES ST. STL. ASTM F593
S	25	PLATE	ASTM A276 TYPE 316
N	24	HELI-COIL	300 SERIES ST. STL. AMS 7245
N	23	SCREW, DRIVE	300 SERIES ST. STL.
N	22	NAMEPLATE	304/304 ST. STL. PER QQ-S-766
S*	21	BODY (PAINT PER S1425)	ASME SA-515 GRADE 70
S	20	SPACER	ASTM A479/QQ-S-763 TYPE 316
S	19	GUIDE	ASTM A276/A479 TYPE 316
S	18	WASHER	ASTM A276 TYPE 316
S	17	SPIROL PIN	INCONEL X-750
S*	16	BONNET	ASME SA-479 TYPE 316
S	15	PLUNGER	430/VALCOR STD. S121/QQ-S-763
S	14	PISTON RING	410 ST. STL./AMS 5613
S	13	SPRING	ELGILOY
S	12	STOP	430/VALCOR STD. S121/QQ-S-763
S	11	BODY	ASTM A276/A479 TYPE 316
S	10	SPRING	ELGILOY
S	9	SCREW, CAP, SOC. HD.	300 SERIES ST. STL. ASTM F593
N	8	LOCKWASHER	300 SERIES ST. STL. UNS S30300/S31600
S	7	PACKING	SILICONE (PARKER S604-70)
S	6	SPACER	300 SERIES ST. STL.
N	5	LOCKWIRE	302/304 ST. STL. PER QQ-W-423
N	4	VALVE TAG	304/304 ST. STL. PER QQ-S-766
N	3	WELD CAUTION TAG	304/304 ST. STL. PER QQ-S-766
S	2	VALVE ASSY	SEE NOTE 14
S	1	SOLENOID ASSY	SEE TABLE 1

LIST OF MATERIALS

CERTIFIED BY VALCOR ENGRG. CORP.
18293 kPa AT 343°C (2795 PSI AT 676°F)
P/N 356136301
S/N
B16.34 CLASS 1500
ASME SA516 GRADE 70 N.O.
25546 kPa AT 38°C (3705 PSI AT 100°F)
60mm (2") SCHD 160
VALCOR

NAMEPLATE INFORMATION (ITEM 22)

AS APPLICABLE PER I/O
VALVE TAG NUMBER
VALVE INFORMATION TAG

VALCOR ENGINEERING CORP. SPRINGFIELD, N.J. SOLENOID OPERATED ISOLATION (NUCLEAR SERVICE) ENCLOSURE NEMA TYPE 4 P/N 356136301-01-02

SOLENOID NAMEPLATE INFO. (ITEM 55)

PURCHASER'S DRAWING NO.
52.3875.06-02023 0001

MR526-6040-22-3
APPENDIX II
SHEET AII-2

SIGNATURES	DATE
DRAWN B. KARCH	8/27/99
CHECKED B. KARCH	7/19/00
ENGINEER J. VEGA	5/25/00
PRODUCTION M. PALMER	7/20/00
APPROVED J. VEGA FOR B.W. MATHEZ	7/26/00
APPROVED B.W. J. MATHEZ	7/28/00
APPROVED	

VALCOR ENGINEERING CORPORATION
SPRINGFIELD, NEW JERSEY

60mm (2") SCHD 160 CLASS 1500 N.O.
VALVE, SOLENOID, POSITION INDICATION, NUCLEAR SERVICE

D.C. MODEL: V526-6150-1 ECSA

SIZE	CODE IDENT. NO.	DWG. NO. & PART NO.
D	96487	356136301

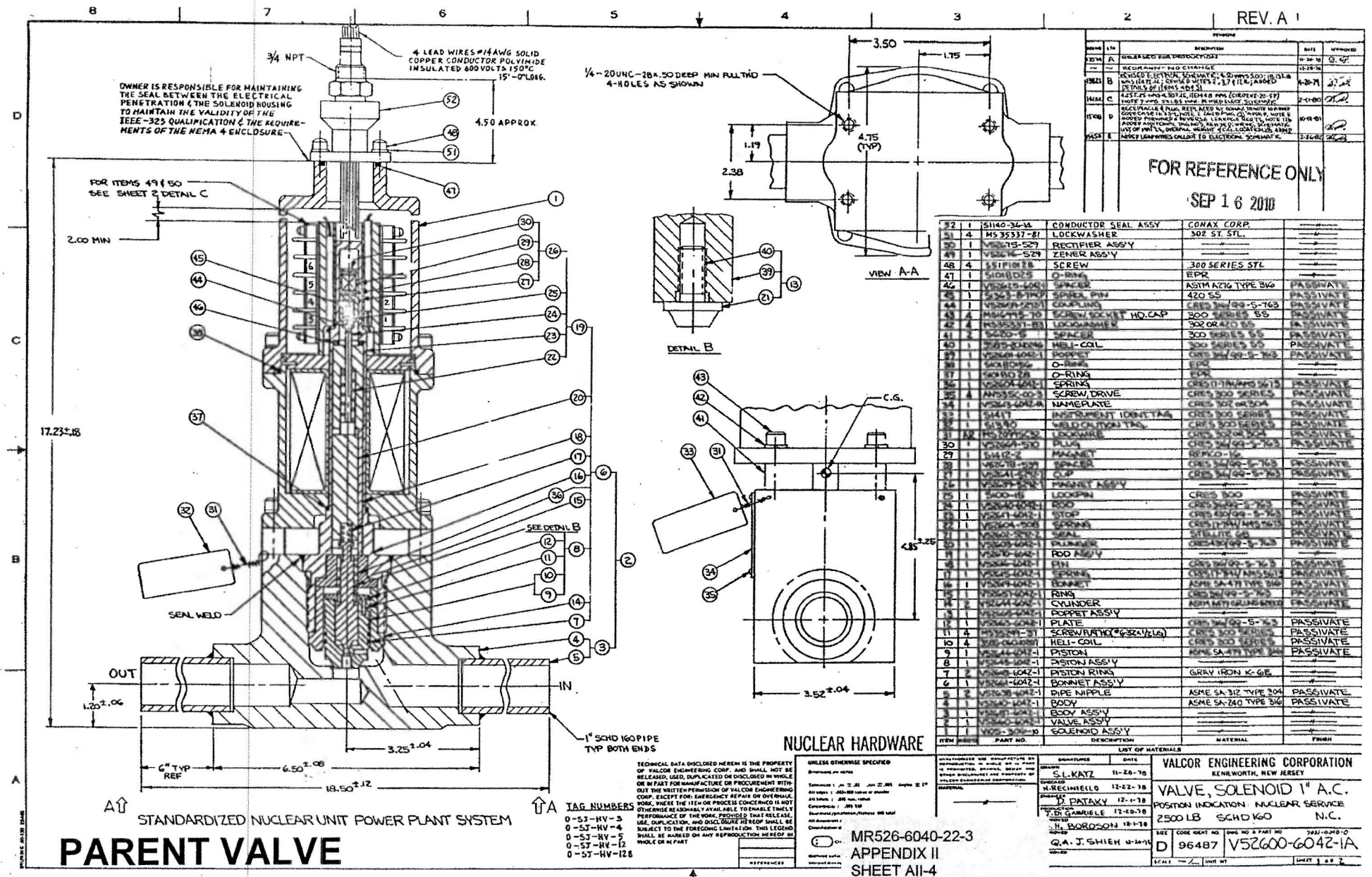
SCALE -/- | COMP. NO. 7000-0975-0 | SHT 1/2

NUCLEAR HARDWARE

PARENT VALVE

V.11

ADD EC-1475



ITEM	PART NO.	DESCRIPTION	MATERIAL	FINISH
*2	1	S1140-36-12	CONDUCTOR SEAL ASSY	CONAX CORP.	
51	4	MS 35337-81	LOCKWASHER	302 ST. STL.	
50	1	V52678-529	RECTIFIER ASS'Y		
49	1	V52611-529	ZENER ASS'Y		
48	4	S3IFI0128	SCREW	300 SERIES STL	
47	1	S1018D25	O-RING	EPR	
46	1	V52615-6041	SPACER	ASTM A276 TYPE 316	PASSIVATE
45	1	S3631-8-1PT	SPIROL PIN	420 SS	PASSIVATE
44	1	V52617-5121	COUPLING	CRES 300 SER 99-S-763	PASSIVATE
43	4	MS16995-10	SCREW SOCKET HD CAP	300 SERIES SS	PASSIVATE
42	4	MS35331-83	LOCKWASHER	302 OR 410 SS	PASSIVATE
41	2	S4420-5	SPACER	300 SERIES SS	PASSIVATE
40	1	S3619-8HN96	HELI-COIL	300 SERIES SS	PASSIVATE
39	1	V52668-6042-1	POPPET	CRES 304 99-S-763	PASSIVATE
38	1	S1018D156	O-RING	EPR	
37	1	S1018D78	O-RING	EPR	
36	1	V52604-6042-1	SPRING	CRES 17-7PH/AMS 5678	PASSIVATE
35	A	AN735C-00-3	SCREW, DRIVE	CRES 300 SERIES	PASSIVATE
34	1	V52613-6042-A	NAMEPLATE	CRES 302 OR 304	PASSIVATE
33	1	S3411	INSTRUMENT IDENT TAG	CRES 300 SERIES	PASSIVATE
32	1	S3480	WELD CAUTION TAG	CRES 300 SERIES	PASSIVATE
31	AR	MS20995C20	LOCKWIRE	CRES 302 OR 304	PASSIVATE
30	1	V52664-510	PLUG	CRES 304 99-S-763	PASSIVATE
29	1	S3412-2	MAGNET	REMCO-16	
28	1	V52678-529	SPACER	CRES 304 99-S-763	PASSIVATE
27	1	V52641-6042-1	CUP	CRES 304 99-S-763	PASSIVATE
26	1	V52679-6042	MAGNET ASSY		
25	1	S300-16	LOCKPIN	CRES 300	PASSIVATE
24	1	V52640-6042-1	ROD	CRES 304 99-S-763	PASSIVATE
23	1	V52641-6042-1	STOP	CRES 430 99-S-763	PASSIVATE
22	1	V52604-5061	SPRING	CRES 17-7PH/AMS 5678	PASSIVATE
21	1	V52602-5062	SEAL	STELLITE 6B	PASSIVATE
20	1	V52605-6042-1	PLUNGER	CRES 430 99-S-763	PASSIVATE
19	1	V52610-6042-1	ROD ASS'Y		
18	1	V52642-6042-1	PIN	CRES 304 99-S-763	PASSIVATE
17	1	V52643-6042-1	SPRING	CRES 17-7PH/AMS 5678	PASSIVATE
16	1	V52644-6042-1	BONNET	ASME SA-479 TYPE 316	PASSIVATE
15	1	V52651-6042-1	RING	CRES 304 99-S-763	PASSIVATE
14	2	V52647-6042	CYLINDER	NORMETH GRADE 630	PASSIVATE
13	1	V52648-6042-1	POPPET ASS'Y		
12	1	V52650-6042-1	PLATE	CRES 304 99-S-763	PASSIVATE
11	4	MS35206-[illegible]	SCREW, MACH (6-32 x 1/2 LG)	CRES 300 SERIES	PASSIVATE
10	4	S3619-6HN96	HELI-COIL	CRES 300 SERIES	PASSIVATE
9	1	V52644-6042-1	PISTON	ASME SA-479 TYPE 316	PASSIVATE
8	1	V52645-6042-1	PISTON ASS'Y		
7	2	V52646-6042-1	PISTON RING	GRAY IRON K-GE	
6	1	V52642-6042-1	BONNET ASS'Y		
5	2	V52638-6042-1	PIPE NIPPLE	ASME SA-312 TYPE 304	PASSIVATE
4	1	V52640-6042-1	BODY	ASME SA-240 TYPE 316	PASSIVATE
3	1	V52601-6042-1	BODY ASS'Y		
2	1	V52600-6042-1A	VALVE ASS'Y		
1	1	V52[illegible]-[illegible]-10	SOLENOID ASS'Y		

LIST OF MATERIALS

V.12

EC-14765 ADD

FIGURE 4a: LOCA/MSLB Comparision Profiles (Reference F: Report QR526-6042-1A)

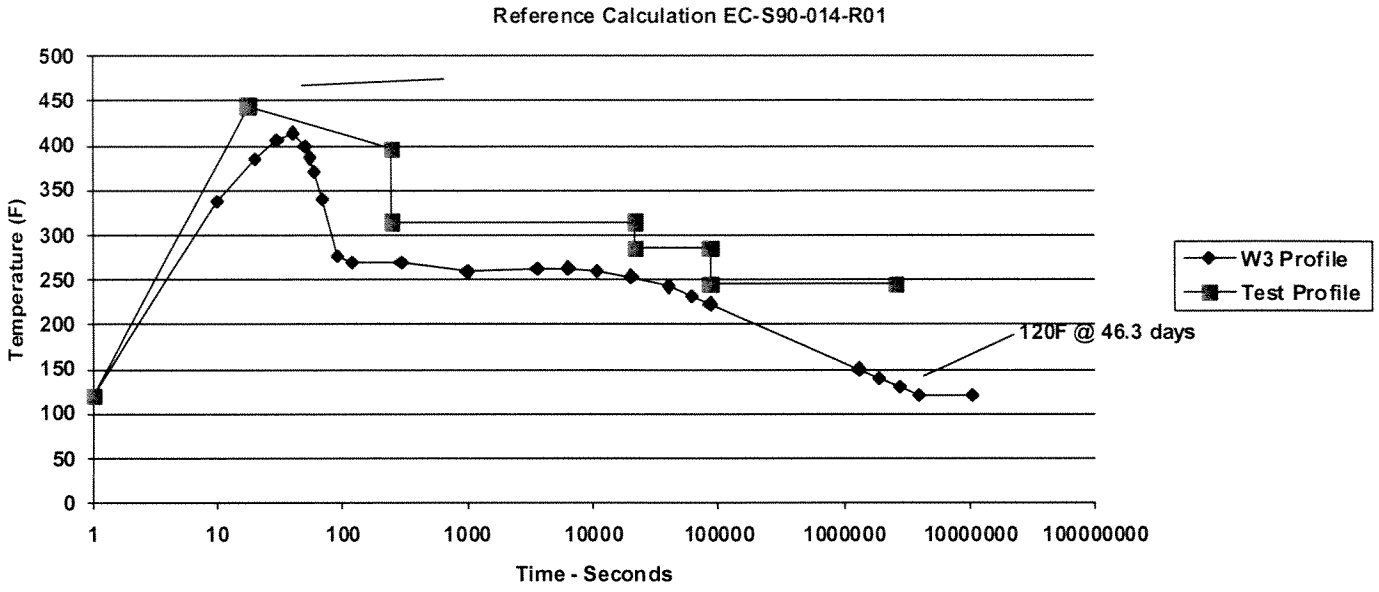


FIGURE 4b: LOCA/MSLB Comparision Profiles (Reference F: Report QR526-6042-1A)