Omaha Public Power District
1946 - 2006

Fort Calhoun Station
P.O. Box 550
Fort Calhoun, NE 68023

LIC-08-0067
May 17, 2008

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

References:
1. Docket No. 50-285
2. Letter from OPPD (R. P. Clemens) to NRC (Document Control Desk), "Fort Calhoun Station Unit No. 1 Request for Relief Pertaining to Liquid Penetrant Acceptance Criteria for Replacement Safety Injection and Refueling Water Tank (SIRWT) Outlet Header Level Control Valve (TAC No. MD 8722)," dated May 15, 2008 (LIC-08-0066)

SUBJECT: Response to Request for Additional Information re: Relief Request for Valve Replacement and Supplemental Information (TAC No. MD8722)

Based on discussions with the Nuclear Regulatory Commission (NRC) staff on May 16, 2008, the Omaha Public Power District (OPPD) provides the enclosed response to the NRC request for additional information (RAI) and supplemental information related to the relief request of Reference 2.

The flaw tolerance analysis discussed in Reference 2 is provided in Attachment 1.

In addition, this response provides a minor typographical correction to a statement made in Reference 2, Enclosure, Item 2, Applicable Code Edition and Addenda. Specifically, it states that "OPPD purchased this valve as a commercial grade item and is in the process of dedicating it from safety-related application." This statement should read, "OPPD purchased this valve as a commercial grade item and is in the process of dedicating it to a safety-related application."

There are no regulatory commitments being made in this letter.

If you should have any questions or need additional information regarding this submittal, please contact Mr. Thomas C. Matthews at 402-533-7358.

Sincerely,

R. P. Clemens
Division Manager
Nuclear Engineering

RPC/dll

Enclosure: Response to Draft Request for Additional Information

Response to Request for Additional Information (RAI)

By letter dated May 15, 2008, the Omaha Public Power District (OPPD) requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) with regard to flaw acceptance criteria. The relief request applies to the Fisher Control valve procured as a replacement for the currently installed safety injection and refueling water tank (SIRWT) outlet header level control valve (LCV-383-2). To complete its review, the NRC requested the following additional information as discussed on the telephone between OPPD staff and NRC staff on May 16, 2008:

NRC RAI # 1:

The licensee requested relief from ASME Code, Section III. It is [the] staff's understanding that relief cannot be requested from the ASME Code, Section III. Discuss rationale for requesting relief from the ASME Code, Section III. The NRC staff believes that the relief should be requested under ASME Code, Section XI. The licensee needs to include applicable requirements of ASME Code Section XI in Section 3 (page 2) of its relief request.

OPPD Response #1:

Per ASME Section XI, Division I, Subsection IWC-3112(b), the flaws indicated by the liquid penetrant (LP) examination did not meet the acceptance criteria of ASME BPVC Section III, Division I, Subsection NC-2546.3 nor Subsection NC-5352. As a result, the relief was requested from ASME BPVC Section III, Division I, Subsection NC-5350. Based on this reasoning, the relief could have been made for Subsection NC-2546, but it was determined that Subsection 5350 was more appropriate, because the ASME III 5000 sections discuss Examinations, while the ASME III 2000 sections discuss Materials.

During the dedication process, the valve (Serial No. 16988576 - identified as Wafer #2 in Reference 2, Attachment 4) was rejected due to surface discontinuities discovered during the LP examination. As such, the replacement valve could not meet the requirements of ASME BPVC Section XI, Division 1, Subsection IWC-3112(c) (1998 Edition, through 2000 Addenda), which states:

> *A component whose examination detects flaws other than the flaws of IWC-3112(b) that exceed the standards of Table IWC-3410-1 is unacceptable for service unless the component is corrected by a repair/replacement activity to the extent necessary to meet the acceptance standards prior to placement of the component in service.*

Relief, therefore, is being requested from these requirements of ASME BPVC Section XI, Division 1, Subsection IWC-3112(c) to accept the valve "As-Is" without repairing the surface discontinuities.

NRC RAI #2:

In the cover letter, the licensee requested relief from 10 CFR 50.55a(a)(3)(i). This paragraph of the regulation is not appropriate[d] provision for the subject valve because the defective new valve can be repaired but the licensee chose not to repair the valve due to certain concerns. The relief should be requested under 10 CFR 50.55a(a)(3)(ii) which states that "...Compliance with the specified requirements of this section would result in hardship or unusual difficult without a compensating increase in the level of quality and safety..." Therefore, the licensee needs to describe the hardship and discuss that compliance with the ASME requirements (installing a defective-free valve vs. a defective valve) would not provide compensating level of quality and safety.

OPPD Response #2:

OPPD requests relief pursuant to the provision stated in 10 CFR 50.55a(a)(3)(ii), "hardship or unusual difficulty without compensating increase in level of quality or safety." Relief is necessary as OPPD was unable to procure an acceptable qualified replacement valve for LCV-383-2 which is needed for installation prior to startup from the current 2008 refueling outage (RFO). Replacement of the existing valve is necessary because it exhibited excessive leakage during Technical Specification surveillance testing. Repair of the currently installed valve is not considered possible at this time because of the long lead time for obtaining replacement parts to refurbish the current valve. Therefore, a commercial grade replacement valve (s/n 16988576 - identified as Wafer #2 in Reference 2, Attachment 4), was procured. This valve was rejected due to surface discontinuities discovered during the liquid penetrant (LP) examination as part of the dedication process. Based on the results of the flaw tolerance analysis, the minimum wall thickness calculation, and radiography conducted, the replacement valve with existing surface discontinuities provides a level of quality and safety consistent with the ASME requirements.

NRC RAI # 3:

ASME Code, Section XI, Code Case N-513-2, "*Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1,*" paragraph 1.0(e) specifies frequent periodic inspections of no more than 30 day intervals be conducted to determine flaw growth. Alternatively, if a flaw growth evaluation is performed, the periodic examination of no more than 90 day intervals be conducted to verify the flaw growth analysis predictions. The flaw evaluation method describe in N-513-2 may not be applicable to the subject valve issue. However, the staff believe that the licensee needs to provide additional examination. (a) Discuss additional examinations and associated inspection methods (e.g., visual examination or ultrasonic examination) once the defective valve is installed. (b) Discuss whether the valve will be covered with insulation. If so, discuss whether insulation will be removed during augmented examination. (c) Discuss whether a daily walkdown will be performed to ensure that no leakage will occur.

OPPD Response #3:

Code Case N-513-2 is not applicable to this valve replacement issue.

(a) Since all indications are on the inner surfaces of the valve, and therefore, not accessible once the valve is installed, no additional non-destructive examinations (NDE) will be performed while the valve is in service. Additional visual observations for leakage will be performed as discussed in (c) below.

(b) The valve will not be covered with insulation or any obstruction that would prevent detecting any potential leakage through visual observation.

(c) To minimize radiological dose to Auxiliary Building Operators, operators perform tours through the general area where this valve is located twice a week (Sunday and Wednesday nights). As an enhancement during the term of this relief, guidance for conducting these rounds will require that the operators specifically observe valve LCV-383-2 for leakage. This frequency is adequate based on the minimum wall thickness calculation provided in Reference 2, Attachment 2. As an enhancement, this action is not considered a regulatory commitment.

NRC RAI #4:

The licensee needs to describe the worst case scenario of valve failure and discuss why the valve would not reach the worst-case scenario.

OPPD Response #4:

The worst case scenario is through-wall crack propagation which results in a leak from the safety injection (SI) system and SIRWT. However, the failure would be considered a leak before break scenario (due to the low system pressure ~60 psig) and would not result in a catastrophic failure. The SIRWT is equipped with two pneumatic bubblers which provide tank level indications on panel AI-30A(B) in the control room. In addition, the signal is sent to the Emergency Response Facilities (ERF) computer (the FCS plant process computer) and actuates a SIRWT low-level alarm. As such, the described leak detection capabilities would give operators time to respond to the leak and take the appropriate actions.

The SIRWT level is monitored with the automatic functions and logged every three (3) hours by the Reactor Operators in the control room. Considering the low system pressure, the leak before break scenario, the automatic level monitoring, and operator monitoring, OPPD has a high degree of confidence that the operators would be able to take action long before the through-wall leak would result in a significant loss of SIRWT level during normal and accident conditions.

NRC RAI #5:

The licensee needs to demonstrate the structural integrity (flaw tolerance) of the defective valve and the operability of the defective valve to perform its intended function (i.e., operability determination) for the upcoming operating cycle.

OPPD Response #5:

Based on the radiography results, the flaw tolerance calculation (FC07478), and the minimum wall calculation (Reference 2, Attachment 2), the valve has sufficient wall thickness to maintain its structural integrity under normal and accident operating conditions. The flaw tolerance calculation demonstrates that the flaw depth could reach as much as 75% of the wall thickness and still retain sufficient wall thickness to maintain structural integrity. The minimum wall calculation concluded that the required minimum wall thickness was 0.124" (using a Safety Factor of 4). The actual minimum wall thickness measured during the dedication process was 1.18". Thus, the valve has 9 times the required wall thickness. Radiography showed no internal discontinuities. Therefore, these three factors provide reasonable assurance that the valve will maintain its integrity during both normal and accident conditions.

NRC RAI #6:

The licensee needs to provide code of record for the current ISI interval and the specific ISI interval (4^{th} interval?) with the end date.

OPPD Response #6:

Fort Calhoun Station (FCS) is currently in its fourth (4^{th}) 120-month ISI interval (2004-2013). The FCS Inservice Inspection (ISI) Program Plan incorporates the requirements of the ASME Section XI Code (1998 Edition, through 2000 Addenda) for non-destructive examinations (NDE) and repair/replacement, and the O&M Manual (1998 Edition, through 2000 Addenda) for pump and valve testing.

NRC RAI #7:

Provide a detailed description of the flaw locations, flaw sizes, and number of indications. The indications were found by dye penetrant. Discuss why ultrasonic examination was not performed.

OPPD Response #7:

The OPPD quality control inspection report is provided in Attachment 2. A detailed description of flaw locations for the replacement valve (Serial No. 16988576 – identified as Wafer #2 in Reference 2, Attachment 4) is provided below:

Indications on LCV-383-2 were identified using liquid penetrant NDE examinations. Figure **1** below shows the location of the indications found on the valve interior surface. Figures 2 through 5 are photographs of the indications found in each quadrant. It should be noted that all indications were located on the inner surface of the valve body and are not in any flange seating surface, nor in any valve disc seating surface.

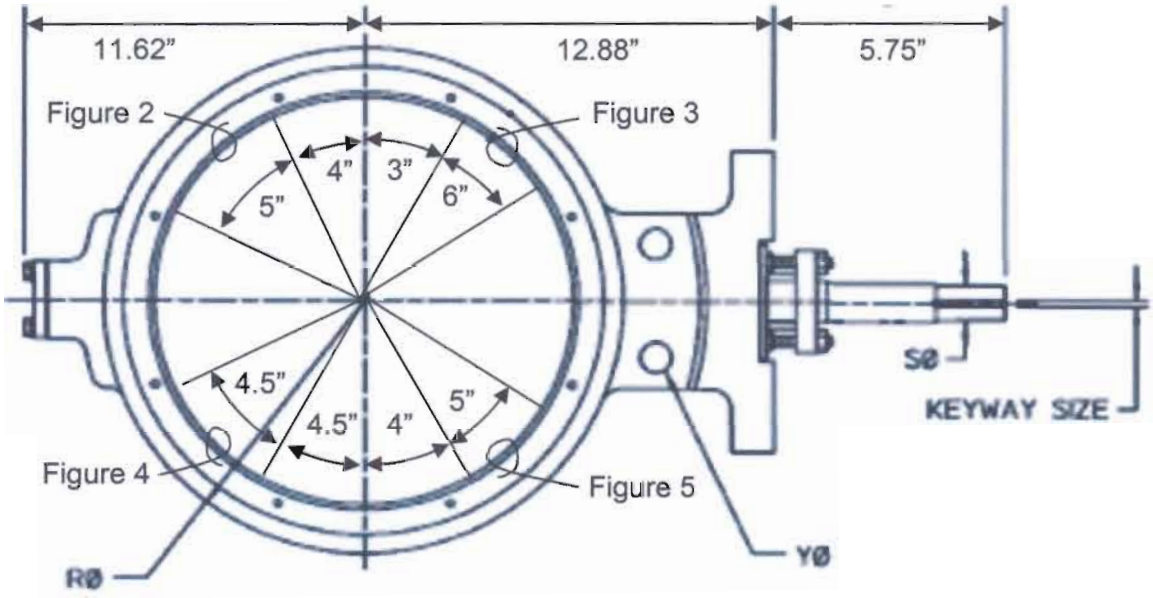

Figure 1: Location of the Indications on LCV-383-2

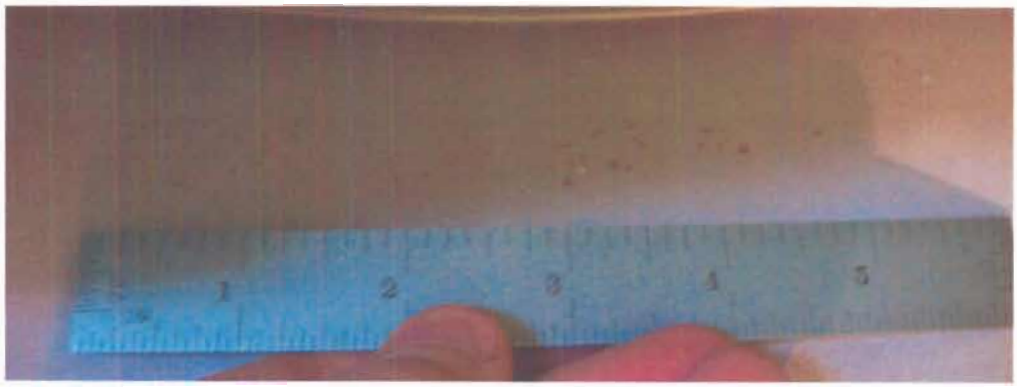

Figure 2: Indications on Top Left Quadrant

Figure 2 Notes: Scattered and cluster rounded indications. Individual sizes are 1/16", 1/32" and smaller. There is a line of 4 rounded indications that are separated by 1/16" or less.

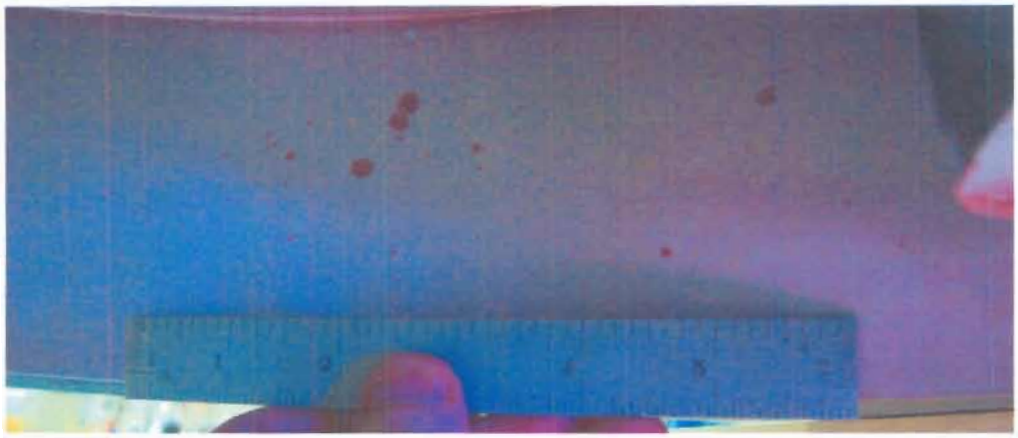

Figure 3: Indications on Top Right Quadrant

Figure 3 Notes: The indication that appears to be two indications is connected and was measured as one indication at 1/2" major dimension. The other larger round indications measured 1/4" and 3/16".

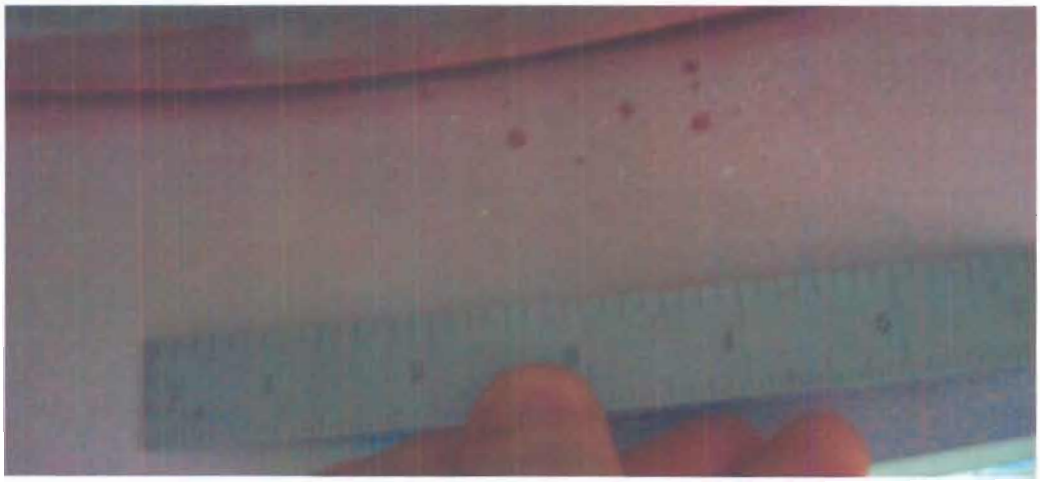

Figure 4: Indications on Lower Left Quadrant

Figure 4 Notes: The larger round indications above measured 3/32".

Figure 5: Indications on Lower Right Quadrant

Figure 5 Notes: The larger round indications above measured 3/32".

Flaw sizes: As discussed in the telephone call with the NRC on May 16, 2008, the exact sizes of the flaws are unknown at this time, but the flaws can be identified by the bleed size resulting from the LP examination. Flaw depths are unknown but are estimated to be minimal.

Number of indications: Based on the examination as shown in the photographs above, the number of indications is as follows:

Indication Size	Number of Indications
1/2"	1
1/4"	1
3/16"	1
3/32"	8
1/16" and smaller	Numerous

The original code of construction, USAS B31.1.0-1967 and ANSI B31.7 1968 Draft, does not require ultrasonic examination (UT).

NRC RAI #8:

Once the new valve is installed in the field, discuss the tests that will be performed to demonstrate its operability, the testing conditions and acceptance criteria. Discuss how the new valve will be installed (welded or bolted to the pipe?).

OPPD Response #8:

The valve will be bolted in place with 20 (twenty) 1-1/8" inch studs.

Per the guidelines outlined in FCS configuration change procedures, all applicable code testing requirements and the code references are specified.

The valve will be installed in the system and leak checked per USAS B31.1.0-1967. The valve connections will be checked during an in-service leak test, in lieu of a hydrostatic test. This is considered to be acceptable due to the inability of the system to be isolated for a hydrostatic test. The SIRWT is vented to atmosphere and no isolation valve exists between LCV-383-2 and the tank. In addition to the in-service leak check, the valve will be tested to verify the following:

- Valve operator functions properly, with no binding or hesitation or unusual noise
- No visible stem damage (i.e., bent or deformed metal filings caused by rubbing)
- Proper operation of solenoid valve
- Remote position indicator functions properly
- Proper valve stroke time and limit switch operation
- Seat leakage requirements are met

Attachments:

1. Calculation FC07478, "Flaw Tolerance Assessment for LCV-383-2, "SIRWT SI-5 Outlet Header Level Control Valve"

2. OPPD Quality Control Inspection Report

Calculation FC07478

Flaw Tolerance Assessment for LCV-383-2,

"SIRWT SI-5 Outlet Header Level Control Valve"

CALCULATION COVER SHEET

Calculation Number: FC07478	Page No.: 1
QA Category: [X] CQE [ ] Non-CQE [ ] LCQE	Total Pages: 23
Calculation Title: Flaw Tolerance Assessment For LCV-383-2 "SIRWT SI-5 Outlet Header Level Control Valve"	Short Term Calc: [ ] Yes [X] No Vendor Calc. No.: Associated Project:: EC 43180
Software Tracking No.: (from PED-MEI-23, if applicable)	Responsible NED Dept No.: 357
Owner Assignment (by Dept Head): NA (Required only if there are affected documents to be changed)	
OPPD Engineer Assignment (by Dept Head): NA (Required only for verification of vendor/contractor calculations)	
Verification of Vendor/Contractor Calc. assumptions, inputs and conclusions complete: OPPD Engineer: NA Date:	

APPROVALS - SIGNATURE AND DATE (Multiple preparers shall identify section prepared per PED-QP-3, Section 4.3.)				Supersedes Calc No.	Confirmation Required?	
Rev. No.	Preparer(s)	Reviewer(s)	Required for CQE Independent Reviewer(s)		Yes	No
A	C. Waszak Carol Waszak 5/17/08	5/17/08	5/17/08			

CALCULATION COVER SHEET

Calculation Number: FC07478	Page No.: 2

Applicable System(s) / Tag Number(s)

Safety Injection Refueling Water Tank (SIRWT) SI-5

LCV-383-2

EA's and/or Calculations Used as input in this Calculation

External Organization Distribution (Groups affected by this calculation)

Name and Location	Copy Sent (✓)	Name and Location	Copy Sent (✓)

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CALCULATION AFFECTED DOCUMENTS

The Calculation Preparer is to identify documents affected by this Calculation. Markups are to be provided in an Attachment to the Calculation except those noted with an *. Changes not involving procedures should follow the associated change process. The preparer is to indicate below how the Calculation is to be processed by Document Control.

X	Not Required, Calculation supports EC#_43180_ or is used to support EA-FC- - this form can be signed off by the Calculation Preparer. Calculation "As Built" follows direction given for modifications.
	EC, FLC, Preapproved NRC commitment change, or Condition Report need identified. Calculation is closed on receipt of the completed PED-QP-3.8 form.
	Change to a DBD, USAR, etc., without a change to plant procedures identified. Calculation is "As Built" on receipt of the completed PED-QP-3.8 form.
	Change to a DBD, USAR, etc., and plant procedures (no hardware) identified. Calculation is "As Built" on receipt of the completed PED-QP-3.8 form.
	No document changes or other changes are required. Calculation "As Built" on receipt of the completed PED-QP-3.8 form.

NOTE: Markups are to include any inputs or assumptions which define plant configuration and/or operating practices that must be implemented to make the results of the Calculation valid. The Calculation may provide the basis for a 10CFR50.59 and/or 10CFR72.48 analysis or substantiate a 10CFR50.59 and/or 10CFR72.48 analysis.

Affected Documents		
Document Type	Document Number (N/A = not applicable)	Procedure Change No., FLC No., etc.
Emergency Operating Procedure*	N/A	
Abnormal Operating Procedure*	N/A	
Annunciator Response Procedure	N/A	
Technical Data Book	N/A	
Surveillance Test Procedure	N/A	
Calibration Procedure	N/A	
Operating Procedure	N/A	
Maintenance Procedure	N/A	

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Affected Documents		
Document Type	Document Number (N/A = not applicable)	Procedure Change No., FLC No., etc.
PM Procedure	N/A	
EP/EPIP/RERP*	N/A	
Operating Instructions	N/A	
System Training Manuals	N/A	
Technical Specification*	N/A	
USAR	N/A	
Licensing Commitments	N/A	
Standing Order	N/A	
Security Procedures * (Safeguards)*	N/A	
Security Plan (Safeguards)	N/A	
CQE List	N/A	
Vendor Manual Changes	N/A	
Design Basis Documents	N/A	
Equipment Database	N/A	
Oil Spill Prevention, Control and Countermeasure (SPCC) Plan	N/A	
EEQ Manual	N/A	
ERFCS Computer Point Manual	N/A	
SE-PM-EX-0600	N/A	
Updated Fire Hazard Analysis	N/A	
EPIX	N/A	
Electrical Load Distribution Listing (ELDL)	N/A	
Station Equipment Labeling	N/A	

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Affected Documents		
Document Type	Document Number (N/A = not applicable)	Procedure Change No., FLC No., etc.
Engineering Analysis	N/A	
Calculations	N/A	
Drawing Number	N/A	
Drawing Number	N/A	
Other	none	
Completed by Owner (if Plant Procedure Changes Required or N/A): NA		Date: 5/17/08
Completed by Preparer: Carol Wasyak		Date: 5/17/08

CALCULATION PREPARER CHECKLIST		Yes	No	N/A
1.	Are all ASSUMPTIONS necessary to perform the calculation adequately described?	X		
2.	If applicable, has the use of Engineering Judgement been documented per PED-QP-14?			X
3.	Have applicable licensing commitments regarding the Calculation been met?			X
4.	Is the computer program identification number (Ref. PED-MEI-23, Section 5.3.1) on the coversheet as part of the Calculation description? **NOTE:** Only applies to DEN-Mechanical and Electrical/I&C Departments.			X
5.	Is the computer code title and version/level properly documented in the Calculation?			X
6.	Is the listing or file reference (computer file name and file location) of the final computer input and output provided?			X
7.	Does the computer run have page number and alphanumeric program number on every sheet?			X
8.	Have updates been prepared or described for any affected documents as identified on Form PED-QP-3.8? This includes assumptions that may affect plant procedures or design documents.			X
9.	Where appropriate, have the necessary 10CFR50.59 and/or 10CFR72.48 (FC-154 or FC-155) evaluations been drafted to support changes to procedures or design documents? The FC-154 forms are not to be signed by a qualified reviewer until the calculation reviews are complete.			X
10.	If the calculation determines that an existing or pre-existing condition may be outside the design basis of the plant, has a Condition Report been submitted per SO-R-2?			X
11.	If a Commitment to the NRC that is not part of the FCS Design Basis must be changed to implement this Calculation, has Licensing been notified of the proposed change? Certain Commitments require prior NRC approval before implementing the change. Has the necessary approval been obtained? See NOD-QP-34 for additional guidance.	X		
12.	Does Form PED-QP-3.8 define the Calculation As Built requirements?	X		
13.	If an existing calculation is being superseded or a vendor calculation/analysis is being assigned a calculation number, have all the references to the existing calculation/analysis been updated?			X

CALCULATION PREPARER CHECKLIST		Yes	No	N/A
14.	If the calculation is being revised, has the hard copy calculation file maintained by Document Control been reviewed for memorandum(s) sent to the file for minor changes to be incorporated into the revision?			X
15.	If the calculation is superseding a calculation of record, has the hard copy calculation file maintained by Document Control been reviewed for memorandum(s) sent to the calculation file for minor changes pertinent to the superseding calculation?			X
16.	Has a configuration change been completed per PED-QP-2 if design function/safety classification changes were required?			X

Comments: This calculation in part supports a Relief Request being submitted to the NRC for approval of the use of a commercial grade dedicated butterfly valve which has some surface flaws.

Signature: Carol Waagak Date: 5/17/08

Department/Organization: 350 / Reactor Performance Analysis

	REVIEWER'S CHECKLIST-CALCULATIONS	Yes	No	N/A
1.	Is Calculation Cover Sheet Form PED-QP-3.1 completed addressing all the blocks and included with the calculation?	✓		
2.	Is the calculation objective stated? Was this achieved?	✓		
3.	Are inputs correctly selected and incorporated into the calculation and listed on Form PED-QP-3.1?	✓		
4.	Have inputs and/or assumptions which require confirmation at a later date, been identified on the Calculation Cover Sheet Form PED-QP-3.1 and in the calculation body?			✓
5.	Are the applicable codes, standards, regulatory requirements and other references including issue and addenda identified such that they are traceable to source document?	✓		
6.	Was an appropriate calculation method used? Was the basic theory appropriate?	✓		
7.	Have assumptions been noted and justified?	✓		
8.	Are the calculations free of arithmetic errors?	✓		
9.	Is the calculation consistent with the design basis requirements?	✓		
10.	Is the conclusion stated?	✓		
11.	Is the calculation legible and suitable for microfilming?	✓		
12.	Has Form PED-QP-3.2 been used and correctly completed for calculation revision?	✓		
13.	Has Form PED-QP-3.9 been used and correctly completed?	✓		
14.	If the calculation has been prepared to supersede another calculation, has all the valid information been transferred in the new calculation? This includes content of memorandum(s) sent to the hard copy calculation file maintained by Document Control for minor changes to the calculation.			✓
15.	If the calculation is being revised, has the hard copy file maintained by Document Control been reviewed for memorandum(s) for minor changes to be incorporated into the revision?			✓
16.	If the calculation determines that an existing or preexisting condition may be outside the design basis of the plant, has a Condition Report been submitted?	✓		
17.	Have As Built requirements and affected documents been identified in Form PED-QP-3.8.	✓		
18.	Has a configuration change been completed per PED-QP-2 if design function/safety classification changes were required?			✓

Comments:

Reviewer: [signature] Date: 5/17/08

	INDEPENDENT REVIEWER'S CHECKLIST-CALCULATIONS	Yes	No	N/A
1.	Are the calculation methods accurate and appropriate?	✓		
2.	Are all inputs sufficiently detailed and listed on Form PED-QP-3.1?	✓		
3.	Are the calculation assumptions reasonable?	✓		
4.	Has the basis for engineering judgment been included in the calculation, when used?			✓
5.	Is the calculation documented sufficiently such that the analysis is understandable to someone competent in the discipline without recourse to the Preparer?	✓		
6.	Have the design interface requirements been satisfied?	✓		
7.	Are the results reasonable and do they resolve the calculation objective?	✓		
8.	If an alternate calculation was used to verify the adequacy of the calculation, is it attached to the calculation?			✓
9.	If qualification testing was used to verify the adequacy of the calculation, has it been documented using a retrievable source, or attached to the calculation?			✓
10.	Are calculations involving Technical Specification values and associated margins of safety identified?			✓
11.	If the calculation inputs, assumptions, basis or conclusions involve multiple disciplines are reviewers from applicable disciplines assigned? If No or N/A, provide justification.			✓
12.	Has a configuration change been completed per PED-QP-2 if design function/safety classification changes were required?			✓

Comments:

Reviewer: [signature]

Date: 5/17/04

CALCULATION REVISION SHEET

Calculation No.: FC07478	Page No.: 10

Rev. #	Description/Reason for Change
A	Initial Preparation

Calculation No.: FC07478

Rev.: A

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OBJECTIVE

Using the methodology presented in ASME Section XI, IWB-3642 1998 Edition with 2000 Addenda, for austenitic piping, calculate a maximum percentage depth of an axial flaw which could be present in the body of the replacement Fisher A31A butterfly valve which will still be acceptable for service.

The resulting flaw would conservatively envelope any flaws which could be expected to occur as a result of the surface indications which were found under LP examination documented in OPPD QC Inspection Report 20080803. The LP exam was performed, in conjunction with radiography as part of the dedication of the commercial grade valve for safety related service. Tag number is LCV-383-2

Calculations were made based on the formulas in ASME XI 1998 with 2000 addenda. A similar allowable axial flaw of 75% of wall thickness is calculated in attached Appendix 1 Westinghouse Letter CFTC -08-28.

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METHODS

A maximum end-of period allowable flaw size will be calculated using hand formulas and a table found in ASME XI IWB-3640.

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ASSUMPTIONS

Only inside surface flaws were considered for the flaw size calculation. Inside surface circumferential flaws are not postulated because the net valve body loading is in compression as a wafer valve between two flanges.

Outside surface flaws and embedded flaws are not postulated because they are no limiting flaw configurations. This is because the hoop stress due to internal pressure mainly acts on the inside surface and is the only significant region of the body seeing a tension loading. Also, as stated in Appendix 1, fatigue crack growth rate in a water environment is a factor of 2 higher than the growth rate in air. Therefore outside surfaces and embedded flaws are subject to a less hostile environment.

Actual fatigue crack growth rate will be negligible because the valve body will not be subject to any significant pressure / thermal cycles in its operating life.

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INPUTS/REFERENCES
1. SIGMA Inc. Power Plant Components Nonconformance Report NCR No. 48 2. Fisher Controls Valve Drawing 12B17109 Rev. E "Valve Body, ANS Class 150 Wafer Style" 3. ASME Section XI "Rules for Inservice Inspection of Nuclear Power Power Plant Components" 1998 Edition with Addenda through 2000. 4. ASME Code Section III 1986 Appendices Table I-1.2 for S_m value 5. Attached Westinghouse flaw tolerance assessment evaluation per Letter CFTC-08-28 (Appendix 1)

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CONCLUSIONS

The calculated maximum allowable maximum end-of evaluation period axial depth of a flaw 5" long is 75% of the wall thickness. The 75% is the highest flaw depth ratio found in the table. This value represents a prediction that a large flaw can exist in the body and can be tolerated without a leakage or other structural failure. The reason for this is that the valve body tensile stresses are a small percentage of the allowable for the material.

Although the surface flaws found by LP inspection of the internal surfaces of the valve did not meet the acceptance criteria, the RT exam noted no rejectable indications.

However, being conservative, it can be concluded, based on this calculation, that some very gross discontinuities internal to the body casting could be postulated and the valve will still function without failure.

Calculation Sheet	Ref.

- Find a_n, maximum allowable crack depth based on normal and upset (Level A and B) conditions:
- Find a_o, maximum allowable crack depth based on emergency and faulted (Level C and D) conditions:

To find these values, first calculate the stress ratio and the non-dimensional flaw length using the following input:

Input value	Normal / Upset	Emergency / Faulted
P = Pressure	15 psig	60 psig
Safety Factor (ASME XI IWB-3642)	3.0	1.5
Stress Intensity S_m (ASME III Appx I Table I-1.2)	20.0 KSI	20.0 KSI
End of evaluation Period flaw length l_f (assumed to be valve width between the flanges)	5.0"	5.0"

Characteristic	Value	Reference
D = Valve OD	23.0"	Ref. 2
Valve ID	18.27"	Ref. 2
Valve body width	5.0	Ref. 2
Valve body material	ASTM A-351 CF8M	Ref. 2
Normal Operating Temperature	<120F	
Valve thickness = t	2.365"	D–Valve ID / 2
Valve body radius = r	11.5"	0.5 x D

Find Stress ratio for Normal / Upset:

$$\frac{PD}{2t \times S_m} = \frac{(15)\,(23)}{2\,(2.365)\,(20{,}000)} = \mathbf{0.004}$$

Find Stress ration for Emergency / Faulted:

$$\frac{PD}{2t \times S_m} = \frac{(60)\,(23)}{2\,(2.365)\,(20{,}000)} = \mathbf{0.015}$$

Find non-dimensional flaw length:

$$= \frac{l_f}{(r \times t)^{1/2}} = \frac{(5.0)}{(11.5 \times 2.365)^{1/2}} = \mathbf{0.96}$$

Using the values of Stress ratio of 0.004 and Non-dimensional flaw length of 0.96, the allowable end of period flaw depth from Table IWB-3641-3, a_n = **0.75**

Similarly, using the values of Stress ratio of 0.015 and Non-dimensional flaw length of 0.96, the allowable end of period flaw depth from Table IWB-3641-4, a_o = **0.75**

Appendix 1

Westinghouse Letter CFTC-08-28

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Rev. A
Page 19

Westinghouse Electric Company
Nuclear Services
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

CFTC-08-28
May 16, 2008

Mr. Stephen Anderson
Omaha Public Power District
Fort Calhoun Nuclear Station
P.O. Box 550
Fort Calhoun, NE 68023-0550

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION
Preliminary Flaw Tolerance Assessment Results for Fort Calhoun Replacement Valve Body

Dear Mr. Anderson:

Please find attached the following document for your use:

- LTR-PAFM-08-87, Preliminary Flaw Tolerance Assessment Results for Fort Calhoun Replacement

If you have any questions or need any additional information, please do not hesitate to contact me at 423-752-2835 or Chris Ng at 724-722-6030.

Very truly yours,

Krish M. Rajan
Customer Projects Manager

cc:		
	Rich Clemens	OPPD
	Joe Gasper	OPPD
	Chris Burton	W
	Gregg Auld	W
	Joy Grachen	W
	Chris Ng	W
	Warren Bamford	W
	Seth Swamy	W
	A. Udyawar	W

~~Westinghouse Proprietary Class 2~~ 5/17/08

Westinghouse

To: Chris Burton
cc: Seth Swamy; Warren Bamford

Date: May 16, 2008

From: Chris Ng
Ext: 724-722-6030
Fax: 724-722-5597
Your ref:
Our ref: LTR-PAFM-08-87

Subject: Preliminary Flaw Tolerance Assessment Results for Fort Calhoun Replacement Valve Body

Please issue a project letter transmitting the attached information pertaining to the Fort Calhoun Replacement Valve Body Preliminary Flaw Tolerance Assessment Results. The information transmitted herein has been independently verified.

It should be noted that formal documentation and verification of the flaw tolerance analysis are currently in progress. Upon completion of the above effort, the information transmitted herein can be finalized.

Author* : C. K. Ng, Piping Analysis and Fracture Mechanics

Verifier*: A. Udyawar, Piping Analysis and Fracture Mechanics

* Electronically approved records are authenticated in the electronic document management system

Attachment to LTR-PAFM-08-87

Preliminary Flaw Tolerance Assessment Results for Fort Calhoun Replacement Valve Body

Introduction

Indications were discovered during PT examinations of the valve body of a 20" Fisher Posi-Seal Butterfly Valve Model A31A (Reference 1). This butterfly valve (Reference 2) will be used as the replacement valve for LCV-383-2 in the Fort Calhoun safety injection piping system.

A flaw tolerance assessment was performed to support disposition of the PT indications detected in the valve body of the replacement valve for LCV-383-2. The flaw tolerance assessment was performed in accordance with the flaw evaluation guidelines and acceptance criteria in paragraph IWB 3640 of the ASME Section XI Code for Class 1 components (Reference 3). The objective of the flaw tolerance assessment is to determine the largest allowable flaw size in the replacement valve body.

Flaw Tolerance Assessment

The following provides a summary of the assumptions and input used in the flaw tolerance assessment.

Assumptions

1. Only inside surface axial flaws were considered in the flaw tolerance assessment. Inside surface circumferential flaws were not considered in the assessment. This is because the axial loading on the valve body is compressive under all loading conditions, due to the use of flange connections at both ends of the replacement valve, which are bolted together.

2. Outside surface and embedded flaws were not considered in the assessment because these are not the limiting flaw configurations. This is because hoop stress due to pressure is highest at the inside surface and that the only tensile loading in the replacement valve body is due to the hoop stress resulting from pressure. In addition, fatigue crack growth rate under the water environment is a factor of two higher than that in the air environment (Reference 4), therefore both outside surface and embedded flaws are subjected to a less hostile environment.

3. Fatigue crack growth is negligible since the replacement valve is not subjected to any pressure/thermal transients during plant operation.

Flaw Tolerance Assessment Input

The input used in the flaw tolerance assessment is shown in Table 1 below:

Table 1: Flaw Tolerance Assessment Input

Replacement Valve Body Outside Diameter	23.00 in
Replacement Valve Body Inside Diameter	18.27 in
Replacement Valve Body Material	SA351 CF8M
Yield Strength at 200°F	25.8 ksi
Ultimate Strength at 200°F	70.0 ksi
Normal Operating Temperature	< 120°F
Normal/Upset Pressure Loading	15 psi
Emergency/Faulted Pressure Loading	60 psi

Determination of Maximum End-of-Evaluation-Period Allowable Flaw Size

The maximum end-of-evaluation-period allowable flaw size was determined using Table C-5410-1 in Appendix C of ASME Section XI. The key parameters required in the use of Table C-5410-1 are the stress ratio and non-dimensional flaw length as defined below:

$$\text{Stress Ratio} = SF_m \, \sigma_h / \sigma_f$$

$$\text{Non-dimensional flaw length} = \ell_f / (R_m t)^{1/2}$$

where

σ_h = PR_m/t
P = Pressure
R_m = Mean Pipe Radius
t = Pipe Wall Thickness
σ_f = Flow Stress = Average of Yield and Ultimate Strength
SF_m = Safety Factor for Membrane Stress
= 2.7, 2.4, 1.8 and 1.3 for Service Level A, B, C and D respectively
ℓ_f = End-of-Evaluation-Period Flaw Length

The key parameters calculated for the normal/upset and emergency/faulted conditions are shown below in Table 2 with the allowable flaw depth determined from Table C-5410-1.

Table 2: Maximum End-of-Evaluation-Period Allowable Flaw Size

	Normal/Upset	Emergency/Faulted
Pressure Loading (P)	15 psi	60 psi
SF_m (Note 1)	2.7	1.8
σ_f (Note 2)	47.9 ksi	47.9 ksi
ℓ_f (Note 3)	5.0 in	5.0 in

[1] Conservatively based on safety factor for Level A and C conditions
[2] Conservatively based on a temperature of 200°F
[3] Conservatively based on the valve body axial length of 127 mm (5 in)

Discussion and Conclusion

A flaw tolerance assessment has been performed for the replacement valve body. Based on the assessment results, the maximum allowable end-of-evaluation period allowable flaw depth is 75% of the wall thickness for a conservatively postulated axial flaw length of 5 inches under service conditions A, B, C and D. Based on Table C-5410-1, it can be demonstrated that this allowable flaw depth is applicable even for much longer axial flaw length. The high flaw tolerance of the replacement valve body is due to the fact that the replacement valve does not experience any significant mechanical loadings. Since the replacement valve is not subjected to any pressure and thermal transients, there will not be any fatigue crack growth and this allowable flaw depth is applicable for the duration of plant life. Based on the indications detected in the replacement valve body during the PT examination, it is highly unlikely that any of the indications detected would exceed this allowable flaw depth. The indications detected in the replacement valve body are acceptable for the duration of plant life. Since the replacement valve body has been demonstrated to be highly tolerant of large indications, it can be concluded that the replacement valve is acceptable for operation for the duration of plant life.

References

1. SIGAM, Inc. Power Plant Components Nonconformance Report NCR No. 48.

2. Fisher Controls Drawing 12B7109 Rev. E., "Valve Body, ANSI Class 150 Wafer Style."

3. ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 2001 Edition including 2003 Addenda.

4. Bamford, W. H., "Fatigue Crack Growth of Stainless Steel Piping in a Pressurized Water Reactor Environment," Trans ASME, Journal of Pressure Vessel Technology, February 1979.

OPPD Quality Control Inspection Report

Quality Control Inspection Report

QC Report Number **20080303**

Requested By JAMES CARLSON **Craft** SE **RWP** N/A **Inspector** STAHLY, TM

Request Date 05/15/2008 **Inspection Date** 05/15/2008

System SI-CS **Equipment** LCV-383-2

Area MAIN **Location** MACHINIST AREA

Work Document WO303184-02 **Procedure** QCP-310

Title SUPPORT RECIEPT INSPECTION FOR LCV-383-2

Instructions PT THE INSIDE SURFACE OF THE VALVE BODY PER QCP-310

TEST RESULTS

	Pass	Fail	Eng Eval Req'd	Corrective Action Req'd	Corrective Action Document	Failure Description
NDE						
PT		X	X			

DESCRIPTION

LINE OF 4 OR MORE ROUNDED INDICATIONS FOUND WITH A SEPARATION OF LESS THAN 1/16", LARGE ROUND INDICATION FOUND TO BE 1/2"

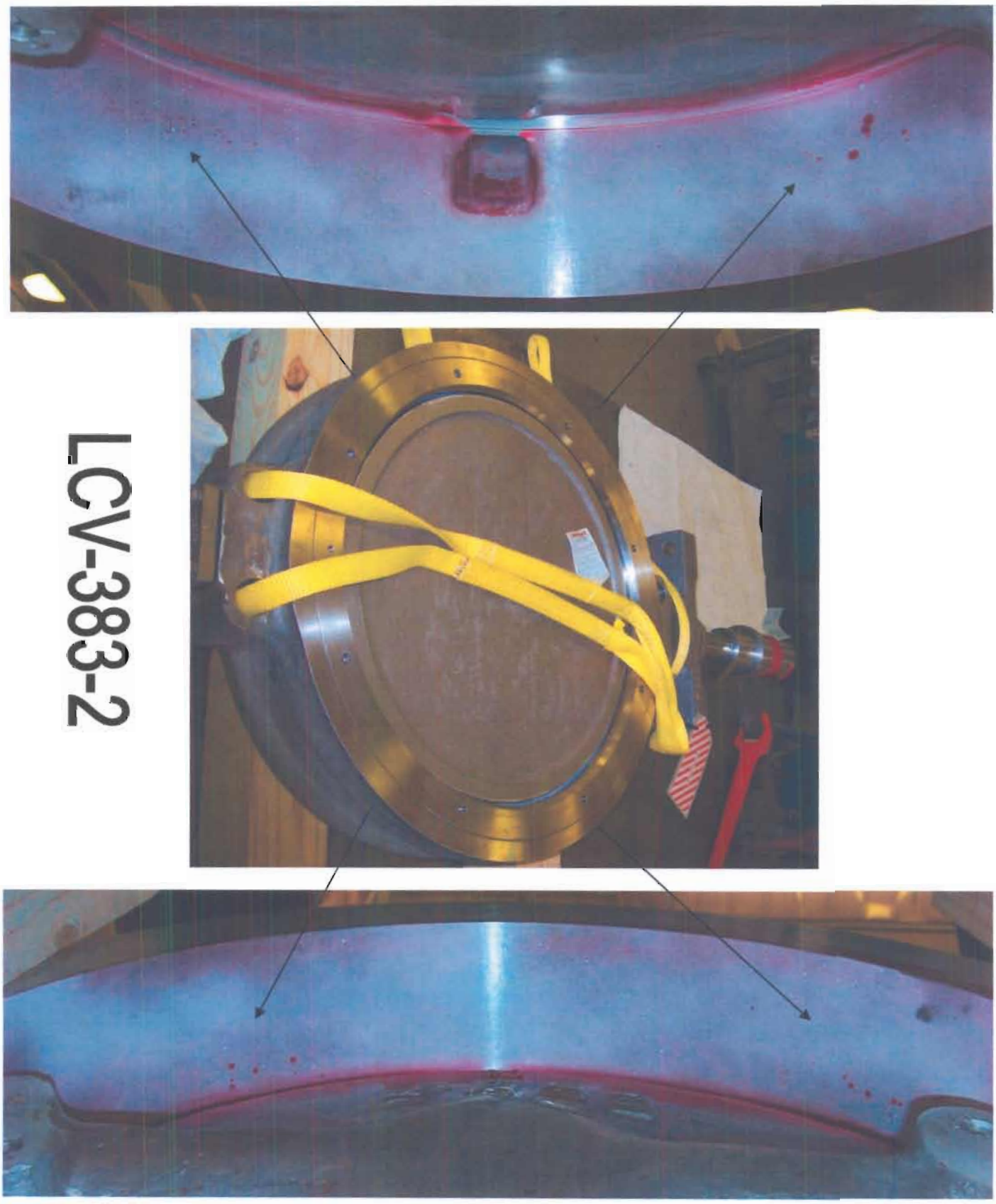
MTE USAGE

MTE Equipment ID	Description	Cal Due Date
10150	FLUKE 51 II	03/04/2009

NOTES

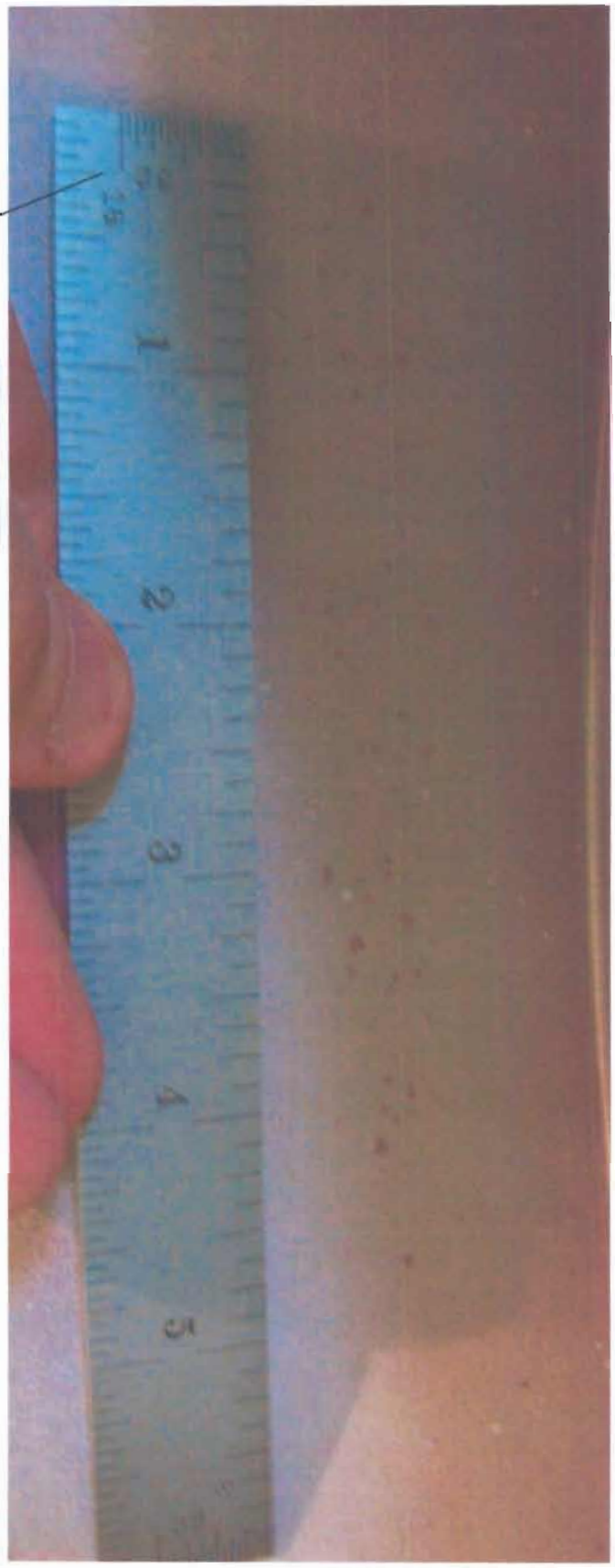
Reviewed By **Entered By** STAHLY, TM **Modified By**

Date **Date :** 05/15/2008 **Date:**



LCV-383-2

LCV-383-2



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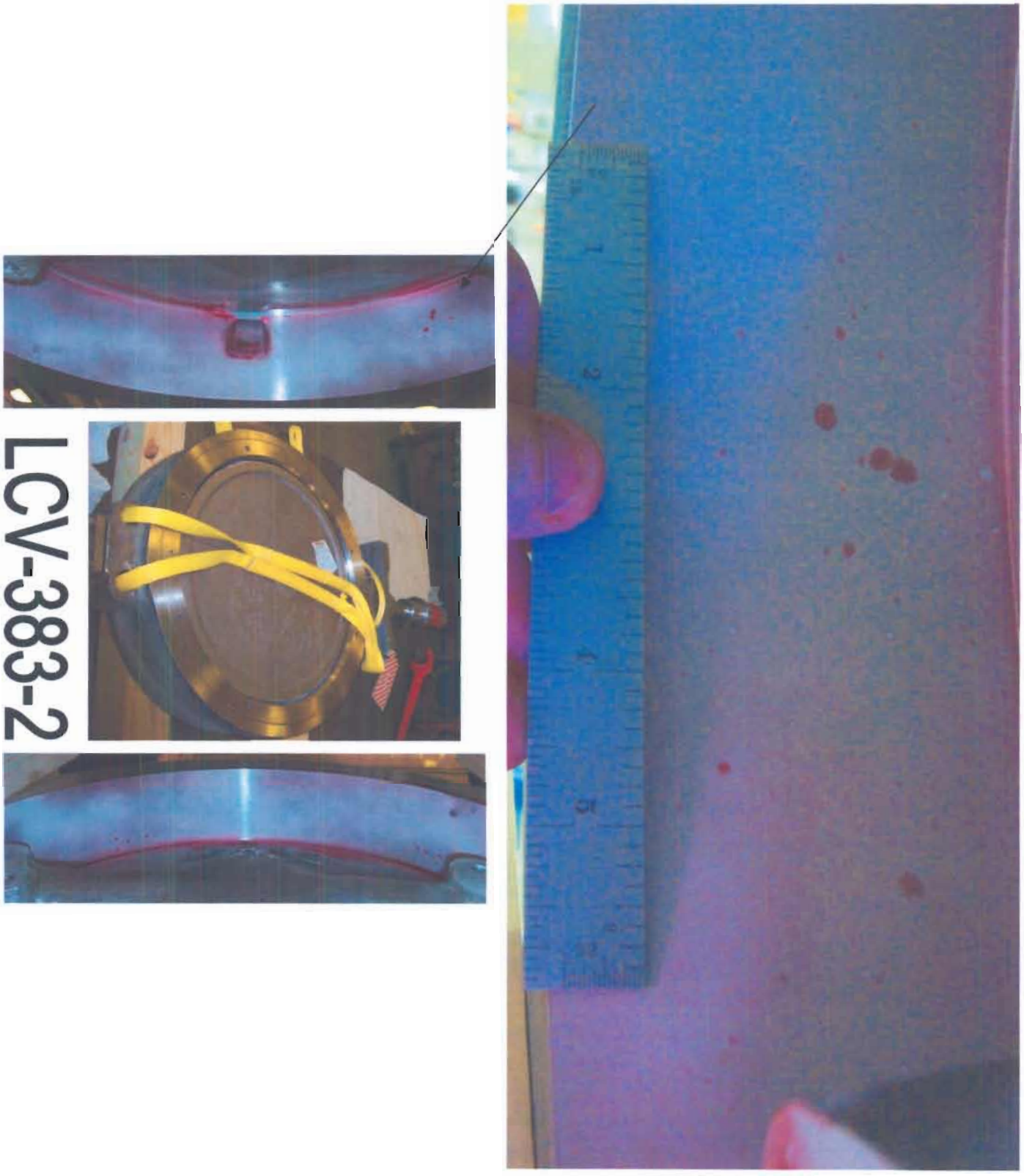

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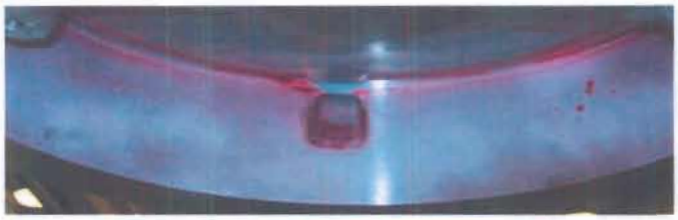

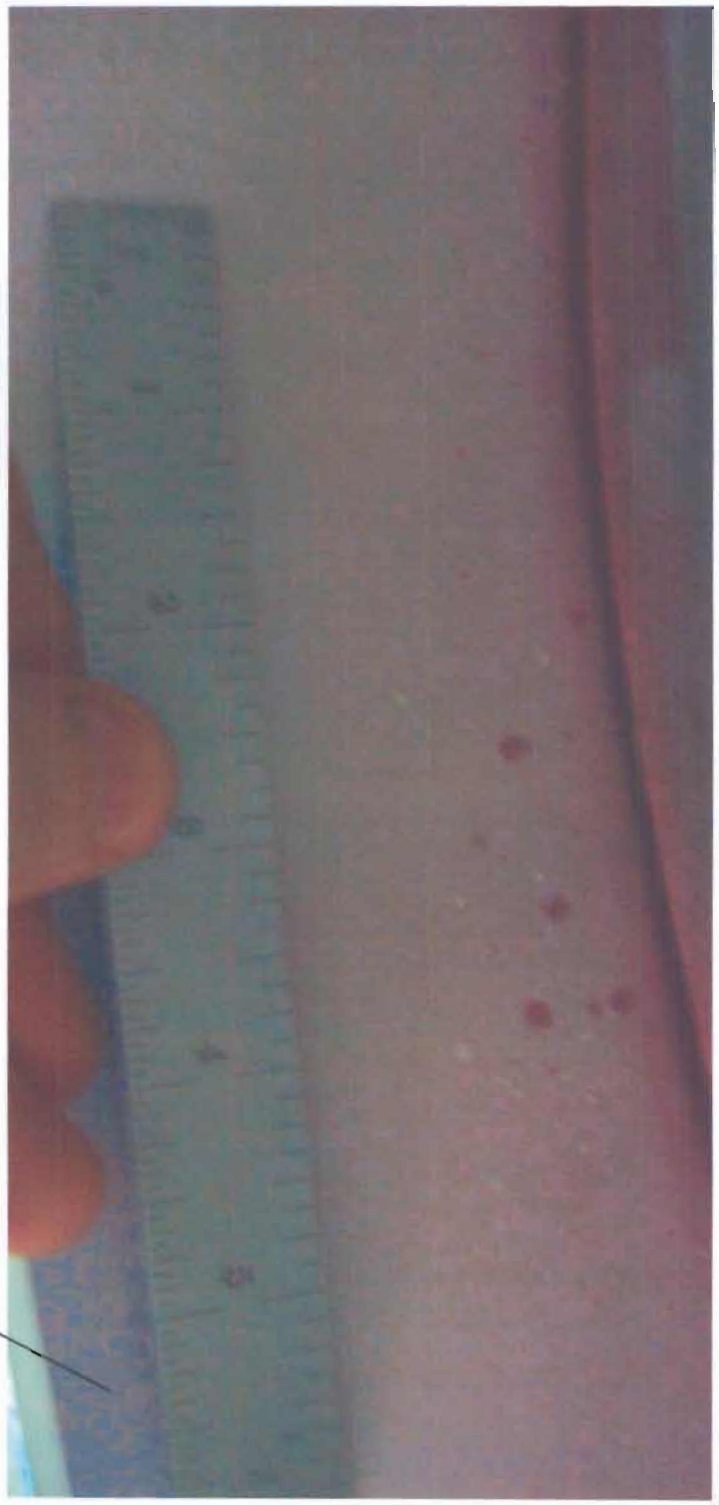

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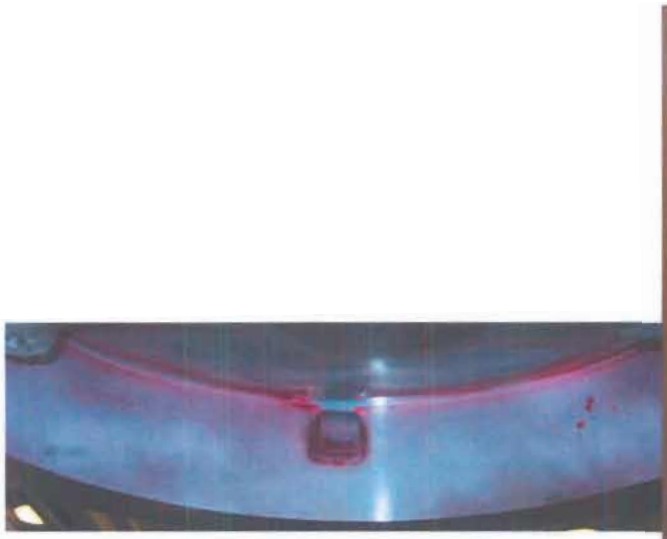
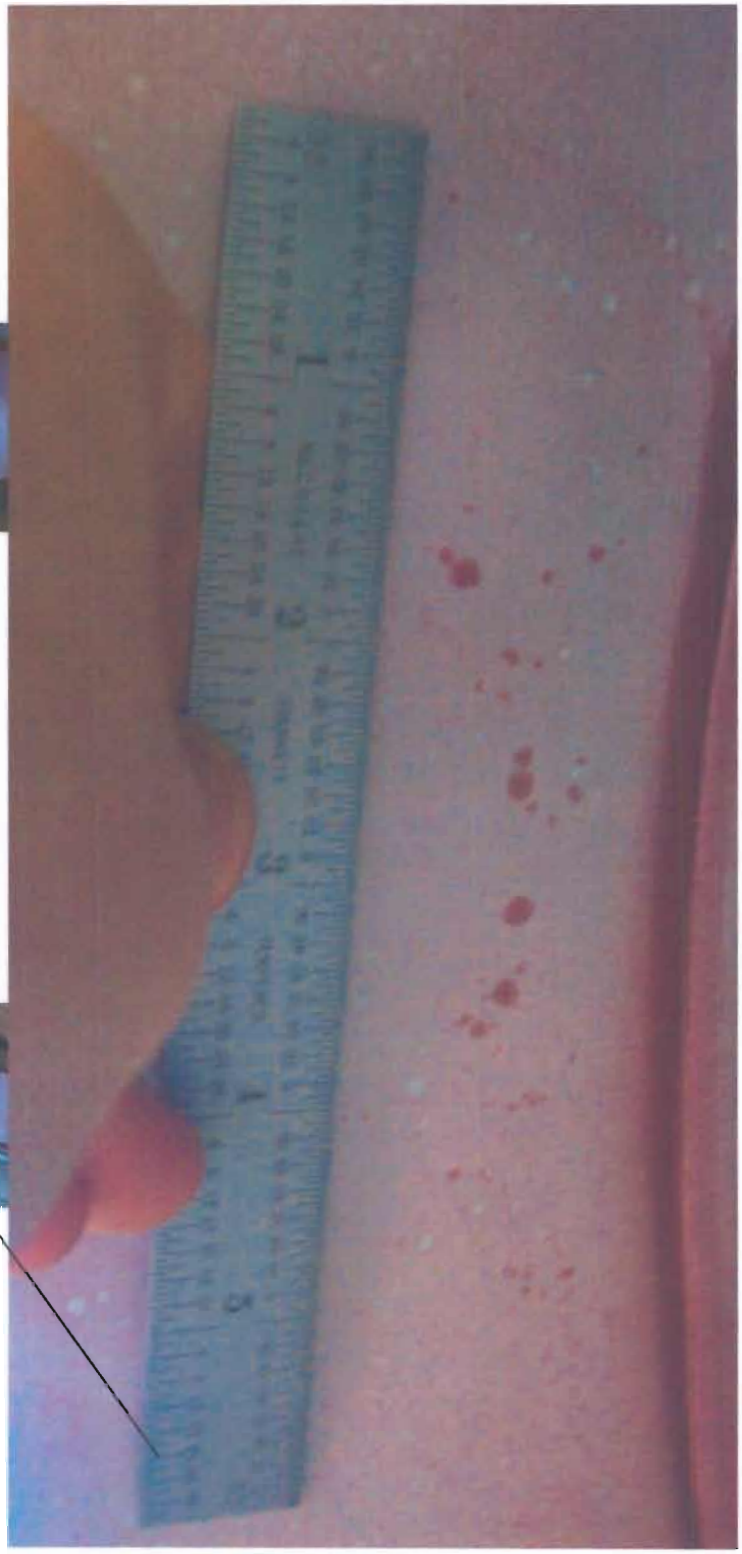
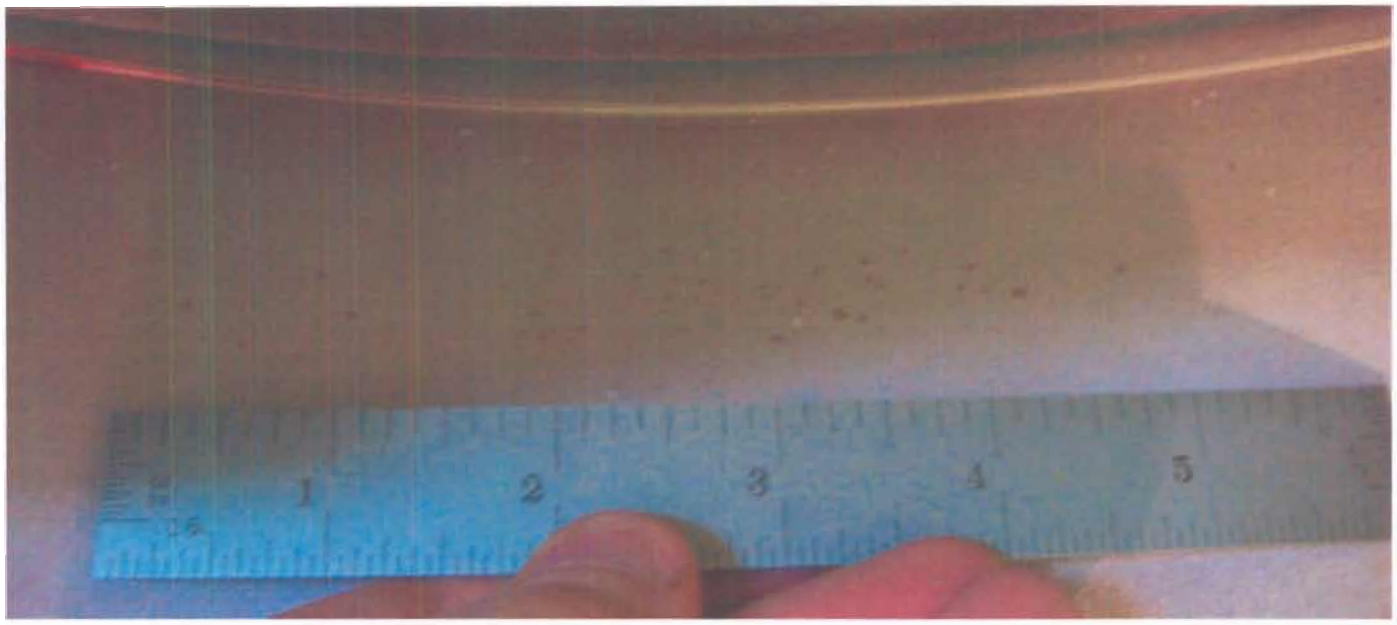
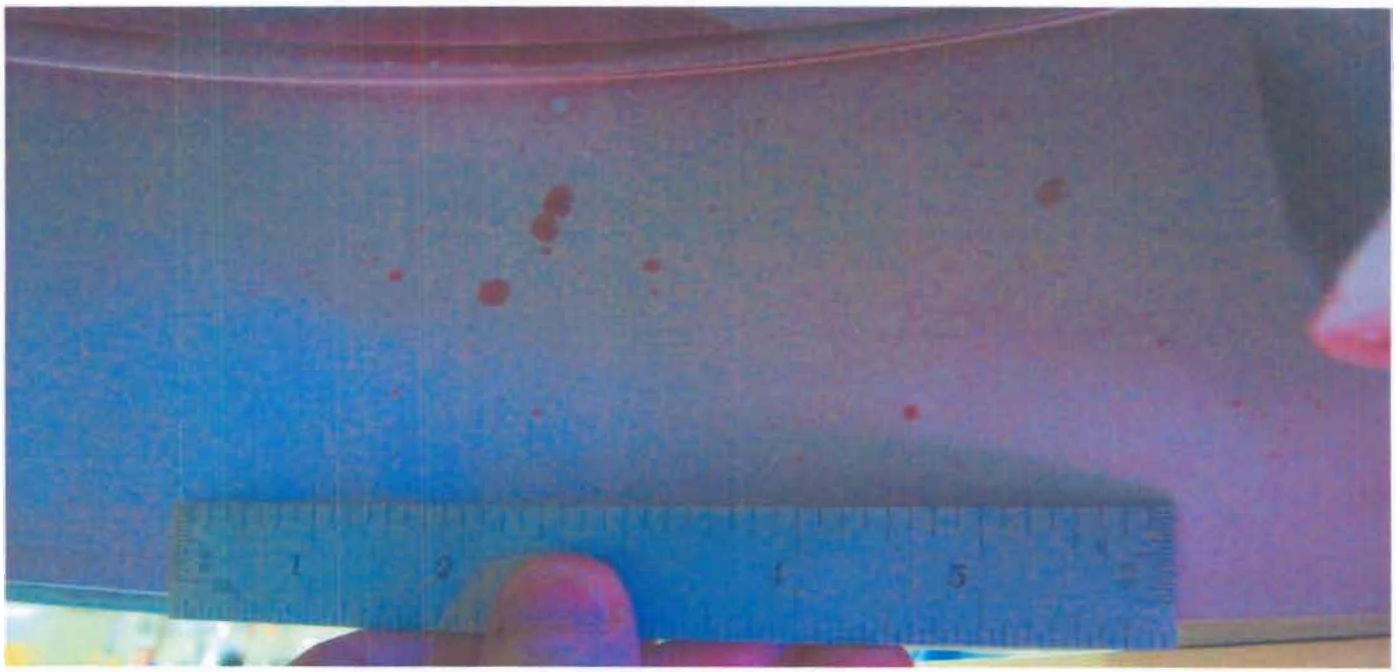


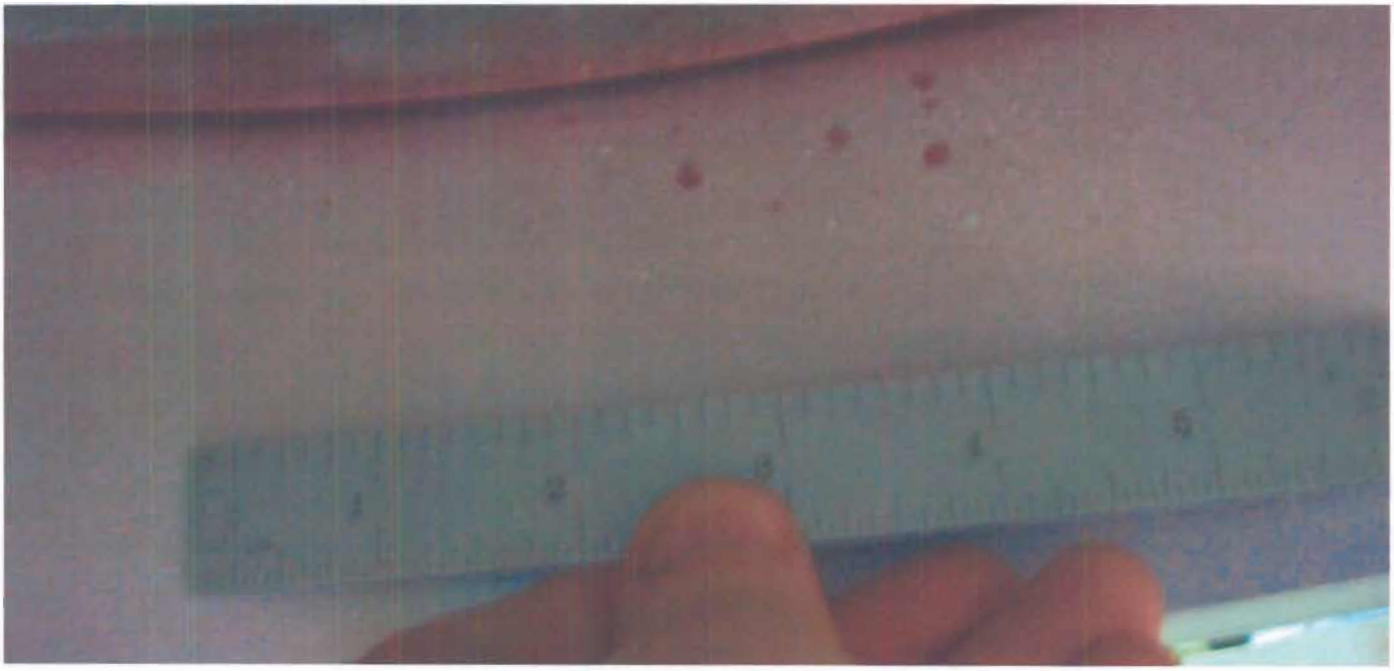




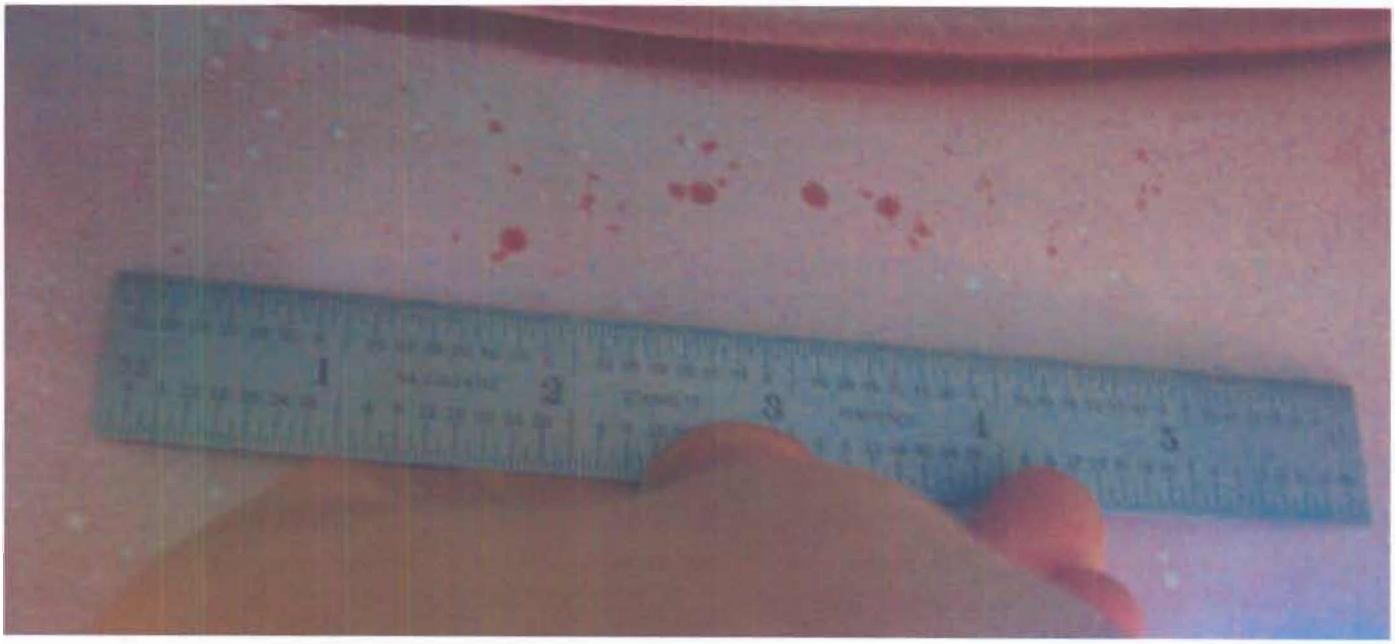
Scattered and cluster rounded indications. Individual sizes are 1/16", 1/32" and smaller. There is a line of 4 rounded indications that are not separated by 1/16" or more.



The indication that appears to be two indications is connected and was measured as one indication at 1/2" major dimension. The other larger round indications measured 1/4" and 3/16".



The larger round indications above measured to be 3/32"



The larger round indications above measured to be 3/32"