



Entergy Operations, Inc.
1448 S R. 333
Russellville, AR 72802
Tel 501 858 5000

June 23, 2000

2CAN060012

U. S. Nuclear Regulatory Commission
Document Control Desk
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Washington, DC 20555

Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Additional Information on Proposed Risk-informed License Change Regarding
Steam Generator Tubing (TAC NO. MA8418)

Gentlemen:

On March 9, 2000 (2CAN030003), Entergy Operations submitted a proposed license change to allow risk-informed operation for the remainder of the 14th operational cycle for Arkansas Nuclear One, Unit 2 (ANO-2). Supplemental information in support of the proposed change was submitted on April 11, 2000 (2CAN040005) April 28, 2000 (2CAN040006), May 30, 2000 (2CAN050011), June 20, 2000 (2CAN060015), and June 22, 2000 (2CAN060017). The proposed license change was also discussed with the Staff during a meeting on June 8, 2000. By letter dated June 12, 2000 (2CNA060001), the Staff requested additional information necessary to continue the review of Entergy Operations' request. The requested information is attached.

Should you have questions concerning the information provided, please contact me.

Very truly yours,

A handwritten signature in cursive script that reads "Jimmy D. Vandergriff".

Jimmy D. Vandergriff
Director, Nuclear Safety Assurance

JDV/jjd
attachments

A001

cc: Mr. Ellis W. Merschoff
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P.O. Box 310
London, AR 72847

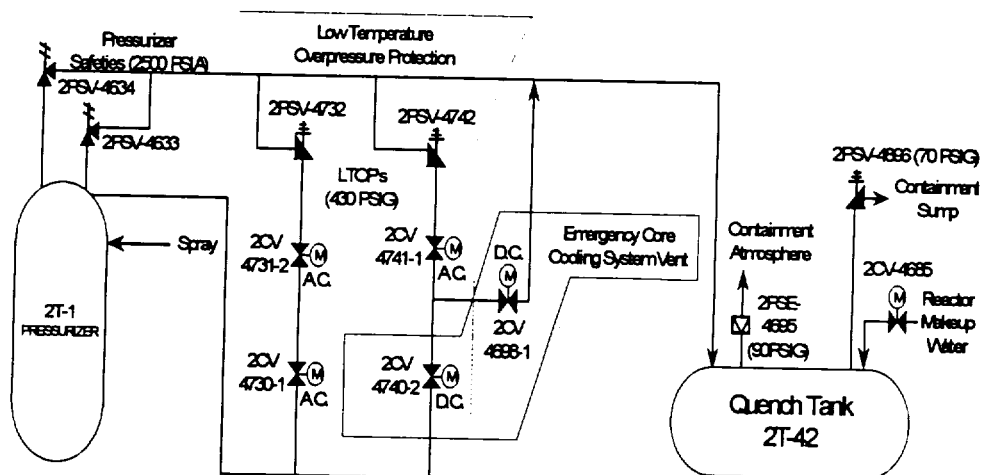
Mr. Thomas W. Alexion
NRR Project Manager Region IV/ANO-2
U. S. Nuclear Regulatory Commission
NRR Mail Stop 04-D-03
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Additional Information in Support of Risk-informed License Change

1. Provide a description of the plant changes required to support the new depressurization procedure.

The Emergency Core Cooling System (ECCS) vent valves are used to depressurize the Reactor Coolant System (RCS) in the event that the RCS heat sink is lost. This would occur during a loss of all feedwater to the steam generators. Under these conditions, the RCS would continue to heat up and increase pressure until the pressurizer safeties lifted. The RCS pressure would be greater than the shutoff head for the Safety Injection System pumps and no makeup would be available to replenish the water going out the safeties. Eventually the core would boil dry.

The ECCS vent valves are used to reduce the RCS pressure below the shutoff head of the Safety Injection pumps. With the RCS depressurized, water from the Safety Injection Pumps can then enter the RCS to provide core cooling. The water heated by the core will exit out the ECCS vent valve providing once through cooling for the core.

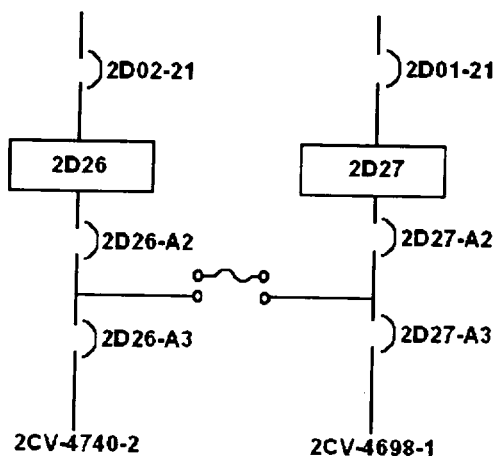


The ECCS vent valves consist of 2CV-4740-2 and 2CV-4698-1. Both valves are controlled from 2C-09 and are powered from opposite train 125 volt vital DC, making them available during a Station Blackout. The cabinets with breakers for these valves are both located in the 2B53 room (room 2091).

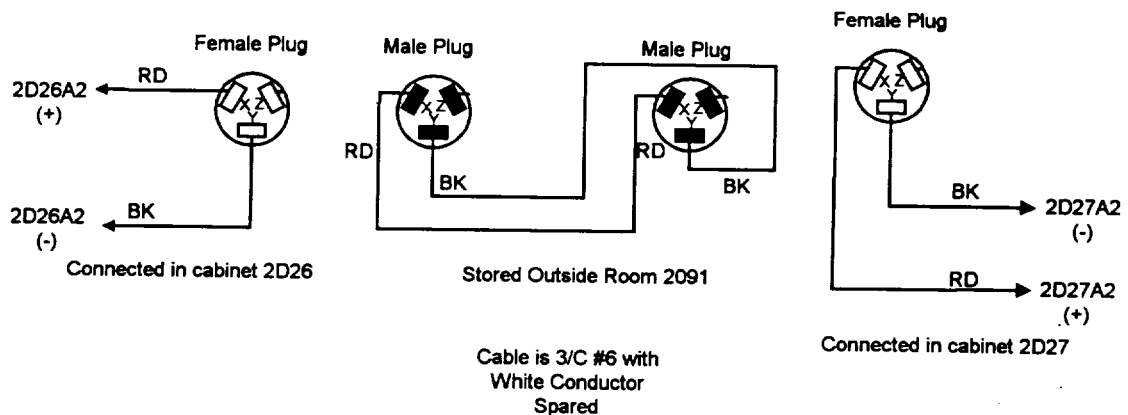
When actuated, the ECCS vent path provides a 2.624 inch diameter vent path to the quench tank.

During accident scenarios with a loss of one emergency train (both AC and DC), the RCS cannot be depressurized using either ECCS vent or LTOP valves. The modification provides for the installation of equipment to facilitate temporary power to the ECCS vent valves.

The modification provides a simple means for both ECCS vent valves to be energized from the opposite DC bus using a temporary connection to permanently mounted twist-lock plugs. The permanently mounted twist lock plugs will be connected to the load sides of 2D26 breaker 2D26-A2 and 2D27 breaker 2D27-A2.



When loss of a DC bus occurs, the procedures direct the control room to dispatch the Emergency DC Crossconnect Watch to the 2B53 room to STANDBY for further instruction. When the need to depressurize the RCS is identified, procedure guide the control room operator to open the ECCS vent valve on the still energized bus. The Crossconnect Watch then opens the DC bus supply breaker to the de-energized MCC as directed by the control room operator (2D26 or 2D27). Next, the Crossconnect Watch will open the upstream feeder breakers to both ECCS vent valves. The Crossconnect Watch will then connect the extension cable. Once the cable connectors are locked in place, the feeder breaker to the ECCS vent valve on the energized bus is closed sending DC power to the opposite train vent valve. The second ECCS vent valve is then opened from the control room commencing depressurization of the RCS.



The connection cable will be stored in a cabinet located outside the 2B53 room and labeled as follows:

“FOR EMERGENCY USE ONLY”
“USE PER SAMG Developed Strategy (SDS-02)”

The cables connected to each breaker will be identified with the same label. These cables will be found in the raceway between the Row “A” and “B” breakers in each cabinet.

Additional information on the use of this modification is included in the response to Questions 3 through 6.

2. **Based on a description of each of the dominant scenarios that contribute to the high/dry portion of your core damage frequency, provide a description of the timing, and in particular timing of cues relative to plant state. Similarly, provide a description of the cues and what instrumentation is needed to provide those cues.**

The primary cues to the operator to identify when to depressurize the RCS are as follows:

- Level in either SG is less than 70” Wide Range. Monitoring of this parameter is initiated by Annunciator Corrective Action 2K04 F(G)1 “EFAS A(B) S/G ACT” in which EFAS actuates at 23% Narrow Range which is around 300” Wide Range.
- No Main Feedwater (MFW) as alarmed on Annunciator Corrective Action Windows 2K03 A8/11 – “FEED PUMP TRIP”
- Emergency Feedwater (EFW) as alarmed on Annunciator Corrective Action Windows 2K05-A9 “2P-7A TURB OVERSPEED TRIP” and 2K07-A9 ‘2P-7B FAILURE ON EFAS”

- No Auxiliary Feedwater (AFW) available as alarmed on Annunciator Corrective Action Window 2K03-J10 "2P75 TRIP"
- At least five (5) Core Exit Thermocouples (CETs) are reading above 800°F. Monitoring of this parameter is initiated by Annunciator Corrective Action 2K01 A10/11 "CONT CENTER 2D01(2) UNDERVOLT" OR 2K06 D8 "CET TEMP HI" (driven from 2TI-4793)

All cues are alarmed in the Control Room directly or indirectly.

Estimates for the time of CET high temperature cue, the mean hot leg failure, and the mean SG tube failure after time of core uncover were calculated by MAAP and PROBFAIL. These estimates are provided in the table, below.

Accident Scenario	Time After Core Uncovery (sec)		
	Hottest CETs ≥ 800°F	Median Hot Leg Failure	Mean SG Tube Failure
High/Dry/Low: both SGs depressurized (<i>base</i>)	263	3163	2902
High/Dry/High: both SGs pressurized (<i>pbase</i>)	219	3227	3233
Medium/Dry/Low: both SGs depressurized (<i>midbase</i>)	312	3622	3989
High/Dry/Medium: both SGs at medium pressure (<i>base3</i>)	245	3170	3201
High/Dry/High: both SGs pressurized with one RCP loop seal cleared (<i>pclr</i>)	243	5124	6034
High/Dry/High, Low: one SG pressurized and other depressurized, RCP loop seal cleared in the pressurized SG loop (<i>clru</i>)	231	4825	5238
High/Dry/High, Low: one SG pressurized and other depressurized, RCP loop seal cleared in the depressurized SG loop (<i>clr</i>)	236	4598	3290

A list of the instrumentation associated with each of the RCS depressurization cues follows.

- (a) SG level cue: 2LIS 1079 and 2LIS-1179 (SG WR level),
- (b) Main Feedwater (MFW), Emergency Feedwater (EFW), Auxiliary Feedwater (AFW) (alarms listed previously)
- (c) CETs, Safety Parameter Display System (SPDS), Reactor Vessel Level Monitoring System (RVLMS), 2D01/02 undervoltage (u/v).

Entry conditions warranting RCS depressurization are:

- (a) loss of all feedwater,
- (b) level on either SG < 70" WR, and
- (c) five or more CETs > 800°F

Two scenarios and their respective response follow:

- (a) If undervoltage (u/v) relays on either DC bus 2D01 or 2D02 indicate an undervoltage condition, annunciator 2K01 will activate and ACA 2203.012A (2K01 annunciator corrective action) will direct the dedicated cross-tie operator (DXO) to proceed to 2B53 room access to obtain SDS-02 and then proceed to corridor 340 to prepare to open the ECCS vent valves by either powering 2CV-4698-1 from vital bus 2D26 or 2CV-4740-2 from vital bus 2D27. In addition, operators are instructed to monitor steam generator feed to identify whether a sustained loss of all feedwater has occurred, to monitor steam generator level to determine if SG is less than 70" WR, and to monitor the CETs to determine if the five highest CET indications are above 800°F. If all of these conditions are satisfied, then the ECCS vent valves will be opened.
- (b) If either of two core exit thermocouples (CETs) indicate a temperature greater than variable alarm setpoint (2TI-4793), i.e., greater than 700°F, annunciator 2K07 will activate Window D-8 and ACA 2203.012G (2K07 annunciator corrective action) will direct operator action. Specifically, operators are instructed to monitor steam generator feed to identify whether a sustained loss of all feedwater has occurred, to monitor steam generator level to determine if SG is less than 70" WR, and to monitor the CETs to determine if the five highest CET indications are above 800°F. If all of these conditions are satisfied, then the ECCS vent valves will be opened. An Alert Emergency Class is declared using Emergency Action Level 9.2 (which mans the Emergency Response Organization) and the operator is directed to implement Functional Recovery EOP.

- 3. Provide a copy of the procedures leading to and including the depressurization action, indicating the entry conditions.**

The associated portions of draft procedures 2203.012A, 2203.012G and SDS-02 are attached. These draft procedures may be modified prior to implementation to reflect additional lessons learned.

- 4. Provide a discussion of the training on the new depressurization procedure.**

Attached are drafts of the Emergency DC Crossconnect Watch Study Guide and qual card used to train personnel on performing SDS-02. These drafts may be modified prior to implementation to reflect additional lessons learned.

- 5. Provide a description of the actions necessary to perform the task, including an identification of who performs the actions, and where.**

The associated portions of draft procedures SDS-02, 1015.001, 1015.016 and 2202.006 are attached. These draft procedures may be modified prior to implementation to reflect additional lessons learned.

- 6. Provide a rough estimate of the time required to perform the task.**

The tasks discussed in SDS-02 can be performed in less than 15 minutes. An actual walk down of these actions was completed in less than 10 minutes. With both 2D01 and 2D02 available, the ECCS vent valves can be opened in two minutes.

- 7. Provide an estimate of the interval of time required after occurrence of the depressurization procedure initiation cues in order to achieve a probability of 0.25 or less that the human actions needed for depressurization are not yet completed.**

The time interval available for successful initiation of RCS depressurization following the last cue calling for depressurization which results in a failure probability of 0.25 or less is estimated to be about 23 minutes. This estimate is based on the use of Human Reliability Analysis quantification methods documented in the ANO-2 Individual Plant Examination and in updates to this risk analysis. It assumes that the time interval between when the highest five CETs read 800°F and the mean time for a steam generator tube failure prior to hot leg failure is about 43 minutes. This time interval is based on PROBFAIL calculations.

- 8. Provide the correlation for the Larson-Miller creep damage parameter used for the stainless steel surge line in your thermal-hydraulic analyses with the Modular Accident Analysis Program (MAAP) computer code.**

The majority of the ANO-2 surge line is composed of Stainless Steel SA-351 Gr. CF8M. However, the surge line nozzle, which connects the surge line with the hot leg, is composed of carbon steel SA-105 Gr 2.

Entergy does not have a correlation for the Larson-Miller creep damage parameter for SA-351 Gr CF8M since the surge line was not modeled as a contributor to RCS failure in the ANO-2 PROBFIL calculations. Rather, the ANO-2 Steam Generator Tube Rupture (SGTR) risk analysis conservatively assumed that the hot leg was the only RCS piping subject to creep failure as a means of reducing RCS pressure prior to SG tube creep.

Since the hottest region of the surge line is expected to be in the vicinity of its nozzle, since the nozzle base metal is SA-105 Gr. 2 (carbon steel), and since the nozzle wall thickness near its safe end is about the same as that as the rest of the surge line, the surge line nozzle is expected to be the point of its creep failure.

The Larson-Miller Parameter (LMP) for carbon steel was previously provided. If desired, the LMP for stainless steel 304 can also be provided.

9. **Provide the fraction of tubes currently plugged in each steam generator. If sleeves are currently installed, include their effect on net flow rate as its equivalent in number of plugged tubes.**

After completion of 2P99, the repairs to the ANO-2 SGs are as follows:

	SGA	SGB
REPAIRED TO DATE PLUGS	1487	1460
REPAIRED TO DATE SLEEVES		
B&W	285	48
ABB-CE	376	146
TOTAL	661	194
EQUIVALENT PLUGGED *	1511.379	1465.985
EQUIVALENT PERCENT PLUGGED	17.97%	17.430%
AVERAGE	17.70%	

* Based on 18 sleeves per plug for B&W and 44 sleeves per plug for ABB-CE

10. **Provide any other parameter changes from the conditions specified in your previously submitted document titled Calc No. 99-E-0019-02, "ANO-2 MAAP and PROBFAIL Calculations."**

No changes to the subject calculation have been made. The revised SGTR risk analysis presented at ANO's June 8, 2000, meeting with the NRC Staff continues to use the results of the MAAP calculations as input. However, the revised SGTR risk analysis no longer uses the results of the PROBFAIL calculations in 99-E-0019-02. Instead, the PROBFAIL analysis has been revised to utilize defect m and m_p distributions rather than SG "fragility distributions" and these new PROBFAIL calculations are documented in the revised SGTR risk calculation. The m and m_p distributions were calculated for and applied at the same burnup conditions as were the SG fragility distributions, i.e., at the Beginning of Period (BOP), just after 2P99, at Middle of Period on 6/15/00, assuming no SG inspection/repair (MOP-NR), and at End of Period on 9/15/00, assuming no SG inspection/repair (EOP-NR). Ninety-three (93) defects were assumed to be present in each SG after each inspection and repair.

11. Using the most recently provided estimates of flaw growth rates and the probability of detection as a function of flaw size during your most recent inspection (2P99), provide the probability distributions for the stress magnification factors for partial through-wall cracks (m_p) and through-wall cracks (m) for each of these 3 points in time during your current operating interval: 1) start-up the fall of 1999, 2) June 15, 2000 without inspection, and 3) September 15, 2000, without inspection.

The following four tables of data are the M_p and/or M values for the following predicted conditions:

- (TABLE 1) M_p for beginning of period following 2P99 (Case 1')
- (TABLE 2) M_p for conditions at the middle of period 2P00 (Case 2') which is June 15, 2000
- (TABLE 3) M_p for conditions at the end of period 2R14 (Case 3') which is September 15, 2000
- (TABLE 4) M for all three conditions. There is not a separate M table for each condition since M is based on lengths and the lengths are kept constant through out the intervals

This data was generated using the most recent model that was submitted based on use of the following:

- Bi-variant probability of detection (POD) using peak depth and bobbin volts
- Five independent POD curves used probabilistically
- Probabilistic growth based on ANO specific data
- Sizing uncertainty of 12.7%
- Depth based on profiled data

Also attached are the probability distribution graphs for the data listed above.

TABLE 1
 Mp Values for Case 1'
 Beginning of Cycle Conditions

<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>
1.1	0.06777		4.1	0.99920		7.1	0.99985
1.2	0.47099		4.2	0.99932		7.2	0.99985
1.3	0.71055		4.3	0.99935		7.3	0.99985
1.4	0.82756		4.4	0.99942		7.4	0.99985
1.5	0.89105		4.5	0.99948		7.5	0.99986
1.6	0.92681		4.6	0.99953		7.6	0.99986
1.7	0.94922		4.7	0.99954		7.7	0.99987
1.8	0.96363		4.8	0.99959		7.8	0.99988
1.9	0.97313		4.9	0.99961		7.9	0.99988
2.0	0.97940		5.0	0.99964		8.0	0.99988
2.1	0.98441		5.1	0.99968		8.1	0.99988
2.2	0.98805		5.2	0.99970		8.2	0.99988
2.3	0.99067		5.3	0.99973		8.3	0.99988
2.4	0.99240		5.4	0.99973		8.4	0.99988
2.5	0.99382		5.5	0.99973		8.5	0.99988
2.6	0.99489		5.6	0.99974		8.6	0.99988
2.7	0.99566		5.7	0.99975		8.7	0.99988
2.8	0.99634		5.8	0.99976		8.8	0.99988
2.9	0.99690		5.9	0.99976		8.9	0.99988
3.0	0.99727		6.0	0.99976		9.0	0.99988
3.1	0.99759		6.1	0.99977		9.1	0.99991
3.2	0.99791		6.2	0.99980		9.2	0.99991
3.3	0.99815		6.3	0.99980		9.3	0.99991
3.4	0.99835		6.4	0.99982		9.4	0.99991
3.5	0.99851		6.5	0.99983		9.5	0.99991
3.6	0.99866		6.6	0.99983		9.6	0.99991
3.7	0.99881		6.7	0.99983		9.7	0.99991
3.8	0.99889		6.8	0.99983		9.8	0.99991
3.9	0.99902		6.9	0.99984		9.9	0.99991
4.0	0.99914		7.0	0.99985		10.0	0.99991

TABLE 2
 Mp Values for Case 2'
 Conditions at 2P00

<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>
1.1	0.03814		4.1	0.99820		7.1	0.99960
1.2	0.37440		4.2	0.99830		7.2	0.99960
1.3	0.64070		4.3	0.99840		7.3	0.99960
1.4	0.78230		4.4	0.99860		7.4	0.99960
1.5	0.86100		4.5	0.99860		7.5	0.99960
1.6	0.90720		4.6	0.99880		7.6	0.99960
1.7	0.93490		4.7	0.99880		7.7	0.99960
1.8	0.95270		4.8	0.99890		7.8	0.99960
1.9	0.96470		4.9	0.99900		7.9	0.99960
2.0	0.97260		5.0	0.99910		8.0	0.99970
2.1	0.97850		5.1	0.99910		8.1	0.99970
2.2	0.98270		5.2	0.99920		8.2	0.99970
2.3	0.98590		5.3	0.99920		8.3	0.99970
2.4	0.98840		5.4	0.99920		8.4	0.99970
2.5	0.99020		5.5	0.99930		8.5	0.99970
2.6	0.99180		5.6	0.99930		8.6	0.99970
2.7	0.99310		5.7	0.99930		8.7	0.99970
2.8	0.99390		5.8	0.99940		8.8	0.99970
2.9	0.99470		5.9	0.99940		8.9	0.99970
3.0	0.99510		6.0	0.99940		9.0	0.99970
3.1	0.99580		6.1	0.99940		9.1	0.99970
3.2	0.99620		6.2	0.99940		9.2	0.99980
3.3	0.99650		6.3	0.99950		9.3	0.99980
3.4	0.99680		6.4	0.99950		9.4	0.99980
3.5	0.99720		6.5	0.99950		9.5	0.99980
3.6	0.99750		6.6	0.99950		9.6	0.99980
3.7	0.99770		6.7	0.99950		9.7	0.99980
3.8	0.99780		6.8	0.99950		9.8	0.99980
3.9	0.99790		6.9	0.99950		9.9	0.99980
4.0	0.99810		7.0	0.99960		10.0	0.99980

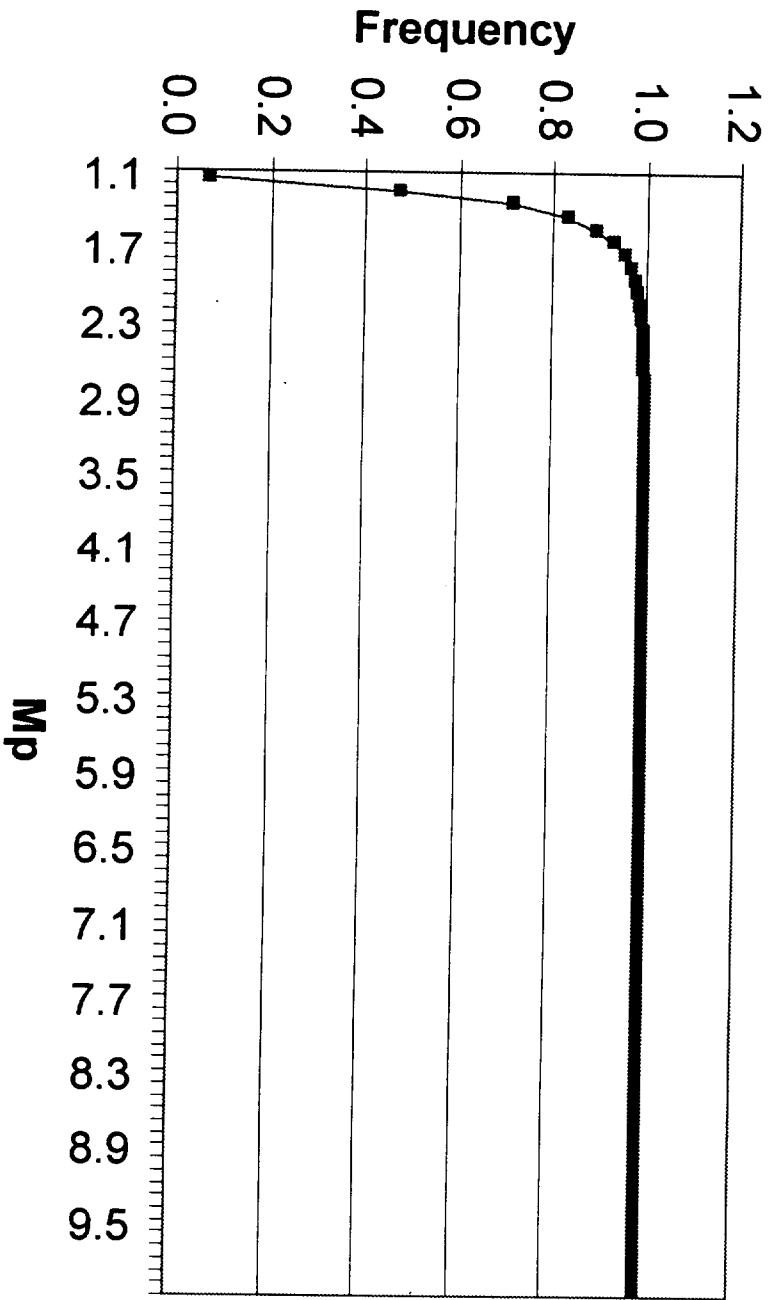
TABLE 3
 Mp Values for Case 3'
 Conditions at 2R14

<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>		<u>MP</u>	<u>CDF</u>
1.1	0.03414		4.1	0.99754		7.1	0.99917
1.2	0.33176		4.2	0.99768		7.2	0.99917
1.3	0.60255		4.3	0.99783		7.3	0.99917
1.4	0.75443		4.4	0.99798		7.4	0.99920
1.5	0.83988		4.5	0.99808		7.5	0.99921
1.6	0.89146		4.6	0.99815		7.6	0.99921
1.7	0.92253		4.7	0.99820		7.7	0.99924
1.8	0.94238		4.8	0.99830		7.8	0.99925
1.9	0.95614		4.9	0.99838		7.9	0.99927
2.0	0.96561		5.0	0.99849		8.0	0.99927
2.1	0.97261		5.1	0.99850		8.1	0.99929
2.2	0.97792		5.2	0.99856		8.2	0.99930
2.3	0.98169		5.3	0.99861		8.3	0.99931
2.4	0.98432		5.4	0.99863		8.4	0.99931
2.5	0.98676		5.5	0.99868		8.5	0.99932
2.6	0.98882		5.6	0.99874		8.6	0.99933
2.7	0.99033		5.7	0.99875		8.7	0.99933
2.8	0.99148		5.8	0.99880		8.8	0.99935
2.9	0.99257		5.9	0.99882		8.9	0.99936
3.0	0.99351		6.0	0.99885		9.0	0.99936
3.1	0.99419		6.1	0.99888		9.1	0.99936
3.2	0.99470		6.2	0.99892		9.2	0.99937
3.3	0.99518		6.3	0.99895		9.3	0.99937
3.4	0.99566		6.4	0.99901		9.4	0.99938
3.5	0.99602		6.5	0.99904		9.5	0.99940
3.6	0.99643		6.6	0.99909		9.6	0.99940
3.7	0.99679		6.7	0.99911		9.7	0.99941
3.8	0.99699		6.8	0.99914		9.8	0.99941
3.9	0.99720		6.9	0.99916		9.9	0.99941
4.0	0.99743		7.0	0.99916		10.0	0.99941

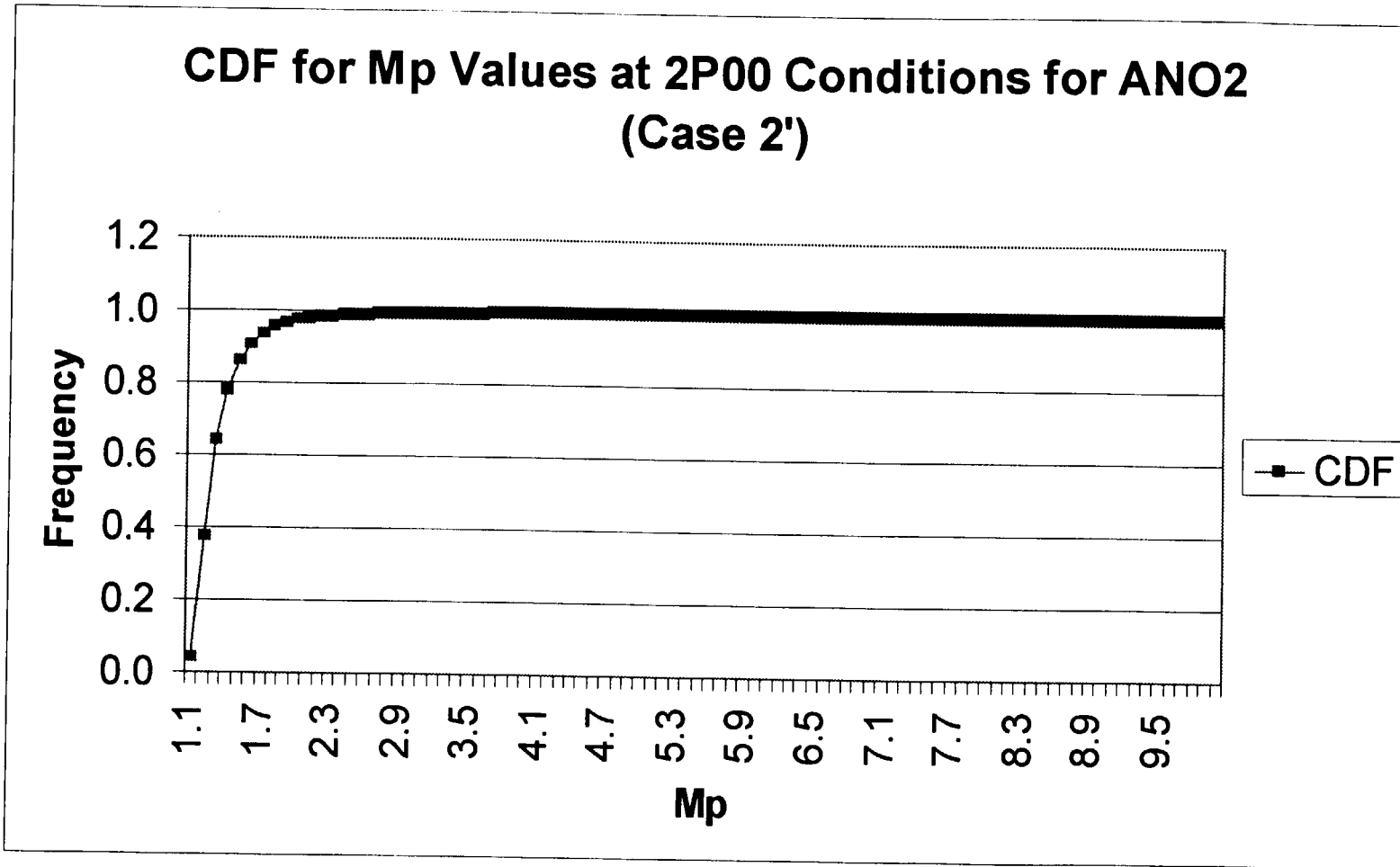
TABLE 4
M Values for All Operating
Intervals

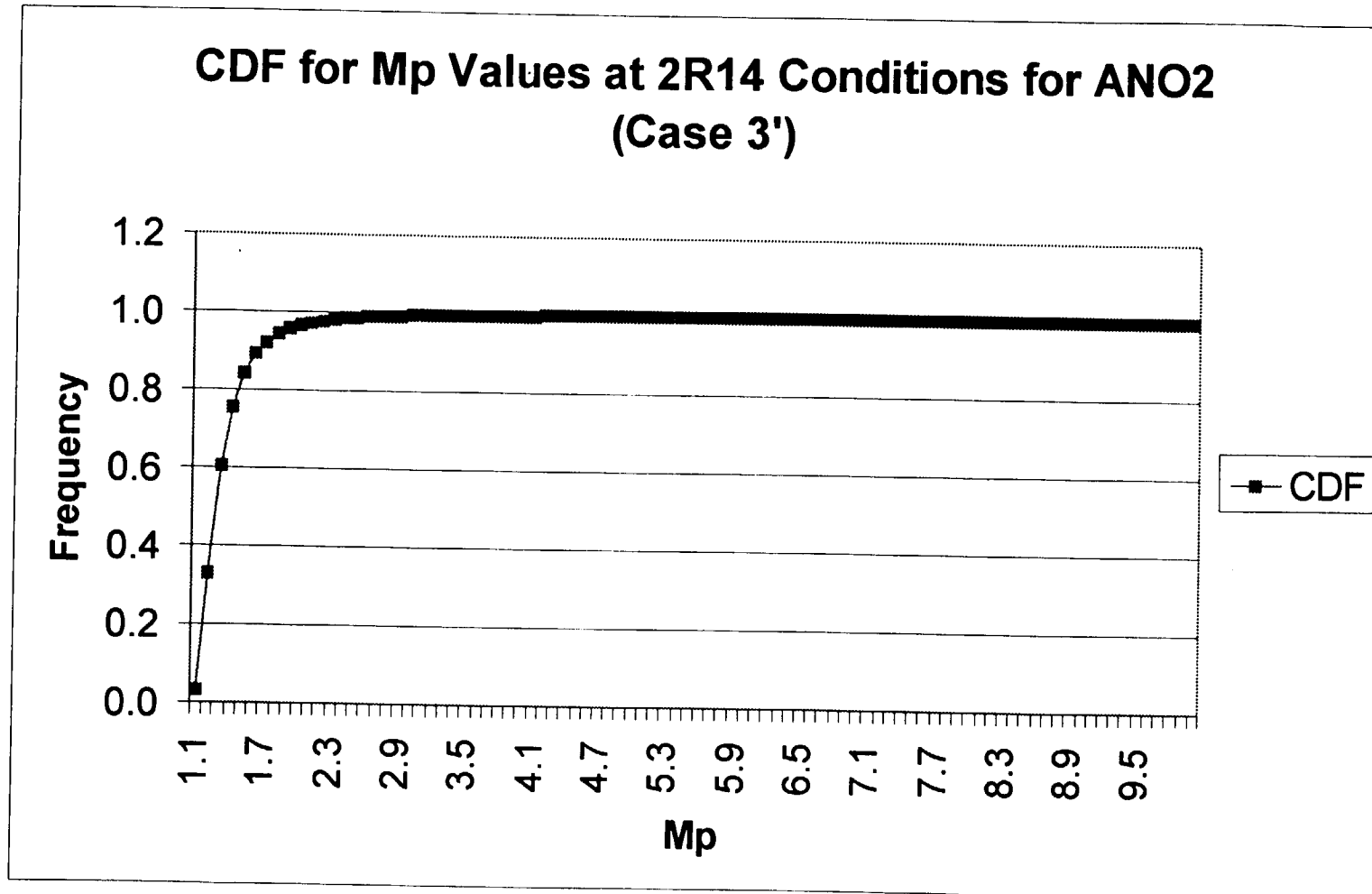
<u>M</u>	<u>CDF</u>		<u>M</u>	<u>CDF</u>		<u>M</u>	<u>CDF</u>
1.0	0.00002		4.1	0.97530		7.2	1.00000
1.1	0.00002		4.2	0.97530		7.3	1.00000
1.2	0.00002		4.3	0.98160		7.4	1.00000
1.3	0.00486		4.4	0.98160		7.5	1.00000
1.4	0.01795		4.5	0.98568		7.6	1.00000
1.5	0.02815		4.6	0.98568		7.7	1.00000
1.6	0.07344		4.7	0.98568		7.8	1.00000
1.7	0.12220		4.8	0.98568		7.9	1.00000
1.8	0.16248		4.9	0.98568		8.0	1.00000
1.9	0.22495		5.0	0.98568		8.1	1.00000
2.0	0.29096		5.1	0.98568		8.2	1.00000
2.1	0.35963		5.2	0.98568		8.3	1.00000
2.2	0.43818		5.3	0.98568		8.4	1.00000
2.3	0.46410		5.4	0.99795		8.5	1.00000
2.4	0.48550		5.5	0.99795		8.6	1.00000
2.5	0.52196		5.6	0.99795		8.7	1.00000
2.6	0.56015		5.7	0.99795		8.8	1.00000
2.7	0.65145		5.8	0.99795		8.9	1.00000
2.8	0.68932		5.9	0.99979		9.0	1.00000
2.9	0.73285		6.0	1.00000		9.1	1.00000
3.0	0.74418		6.1	1.00000		9.2	1.00000
3.1	0.75898		6.2	1.00000		9.3	1.00000
3.2	0.80621		6.3	1.00000		9.4	1.00000
3.3	0.83554		6.4	1.00000		9.5	1.00000
3.4	0.87185		6.5	1.00000		9.6	1.00000
3.5	0.89144		6.6	1.00000		9.7	1.00000
3.6	0.89308		6.7	1.00000		9.8	1.00000
3.7	0.91485		6.8	1.00000		9.9	1.00000
3.8	0.93504		6.9	1.00000		10.0	1.00000
3.9	0.95144		7.0	1.00000			
4.0	0.97302		7.1	1.00000			

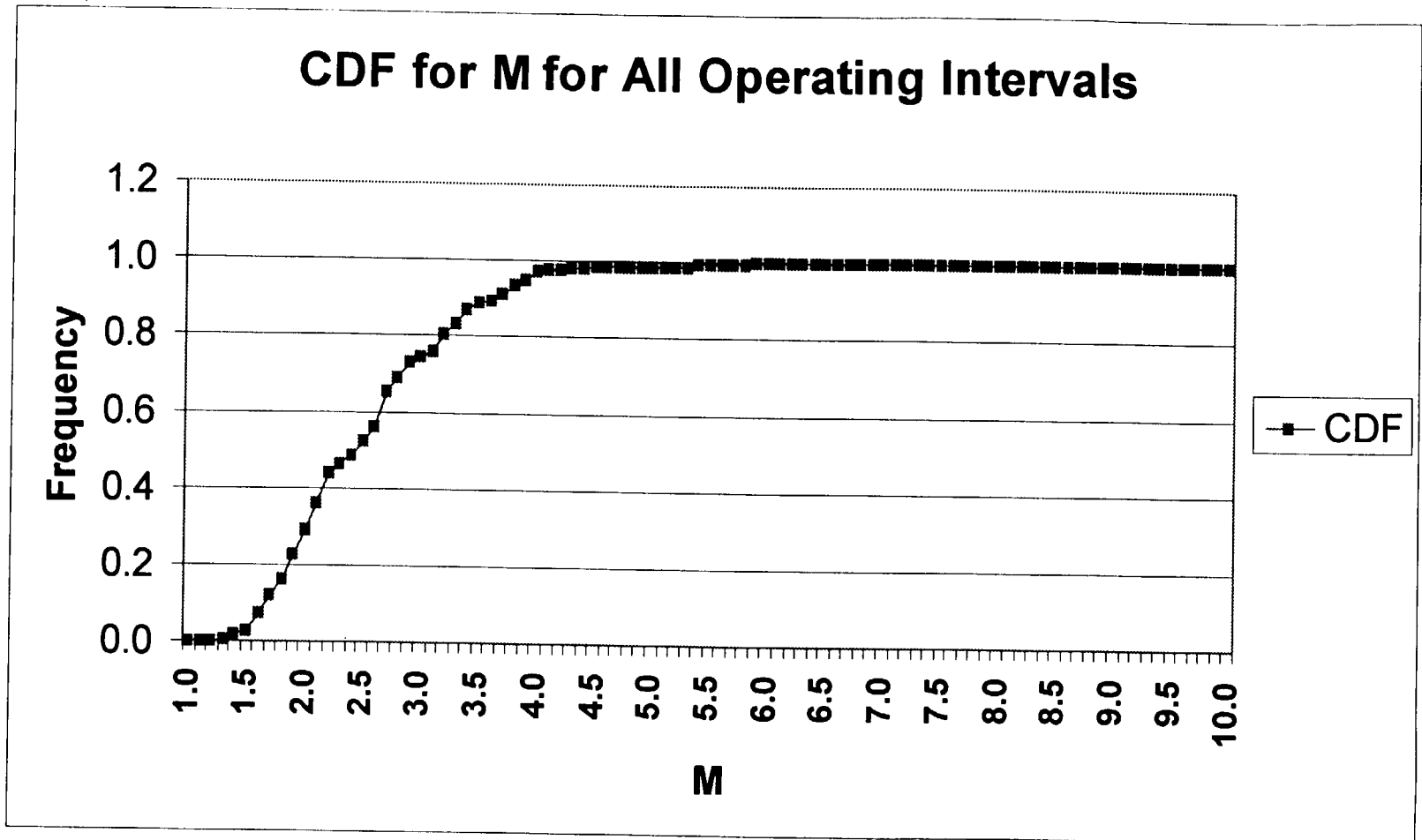
CDF of Mp Values at Beginning of Cycle Conditions for ANO2 (Case 1')



—■— CDF







12. **During the meeting between Entergy and NRC on June 8, 2000, Entergy staff stated that an improved eddy current testing calibration standard had been used for inspections conducted during the 2P99 outage. They also indicated that they had performed a study in which the eddy current testing data taken with the new and improved calibration standard was compared to data taken with the previously used calibration standard for 30 some indications. Please provide the referenced eddy current data for review by the staff. Also, provide bobbin probe eddy current data for a random sample of 12 tubes covering the full length of the tubes and the rotating pancake coil eddy current data for a random sample of 12 tube/tube support plate intersections. These latter data should be those taken with the calibration standard of record, i.e., the new and improved standard, for the examinations.**

During the latter part of the most recent mid-cycle outage (2P99) it was noticed that most distorted support indications (DSI) were being called at a consistent higher voltage than in the previous outages. Many possibilities were discussed and one identified change in equipment setup from previous outages was the use of toolhead calibration standards that had been borrowed from another plant. These calibration standards were used to improve inspection efficiency due to changes in the robotic manipulators used during the mid-cycle outage.

To determine the impact of the calibration standards, a test was conducted. Due to the inspection/plugging schedule of the two steam generators it was determined that a complete acquisition station with an "outage" eddy current bobbin probe was still available on the "A Cold Leg" platform. A "clean" calibration standard from the lot that had been used the previous two outages was taken to the "A Cold Leg" platform and a number of calibration standard "pulls" were accomplished using bobbin probe S/N 296917. These calibration standard "pulls" were then setup according to the current Examination Technique Specification Sheet #1 (ETSS #1) and used to compare the voltages using the 2P99 calibration standard setup. Note: voltage normalization was set at 4.00 volts on the 4 – 20% holes on each calibration standard.

Eddy current data for twelve tubes was collected and compared using the two calibration setups from the "A" SG. Data for these twelve tubes was collected previously with the same bobbin probe, s/n 296917, as the ANO calibration standard. An increased reported voltage on all DSIs were found when using the 2P99 standard versus the ANO calibration standard setup.

Approximately thirty DSIs were analyzed using both calibration standard setups and again the reported voltage was consistently greater when using the 2P99 setup compared to the ANO calibration standard setup.


ANO personnel have compared an additional forty two DSIs from the "B" SG and all of the reported voltages are greater when using the 2P99 standards compared to the ANO standard.

The following data is being provided to the NRC on an optical disk:

Side A

- The previous calibration standard from 2R13 along with 2R13 setups
- 32 tubes of 2P99 confirmed bobbin DSIs from the "B" SG
- ANO calibration standard from 2P99 along with 2P99 setups
- 12 random confirmed bobbin DSIs with corresponding RPC data from the "B" SG
- 12 random confirmed RPC SAIs with corresponding bobbin data from the "B" SG

In addition, drawings of the calibration standards and ANO-2 ETSS#1 and ETSS#2 for both 2R13 and 2P99 have been provided to support the data on the optical disk.

 ENTERGY	ARKANSAS NUCLEAR ONE ENGINEERING STANDARD	No.: HES-28 Rev. No.: 11 SCN No.: 1 Page: 55
	ANO-2 STEAM GENERATOR EDDY CURRENT EXAMINATION GUIDELINES	

10.4.1 ATTACHMENT I - ETSS #1 Bobbin Examination

Examination Technique Specification Sheet						
ETSS # 1 - BOBBIN PROBE				Page: 1 of 4		
Site: Entergy Operation Inc. Arkansas Nuclear One Unit #2						
Examination Scope						
Applicability: Standard ASME Code Examination. Use for detection of IGA/ODSCC at non-dented drilled and eggcrate support structures, in freespan tubing and within sludge pile region. This technique includes the detection and sizing of wear at diagonal and vertical straps using differential 400/100-amplitude mix.						
Instrument			Tubing			
Manufacturer/Model: Zetec MIZ-30A or Equiv.			Material Type: Inconel 600			
Data Recording Equipment			OD/Wall (inch): 0.750" OD X 0.048" Wall			
Manuf./Media: HP HD 2.6 Gb Optical or Equiv.			Calibration Standard			
Software			Type: ASME with Fan Bar Wear and EDM			
Manufacturer: Zetec			Analog Signal Path			
Version/Revision: EN 98, 1.30			Probe Extension Manuf.: Zetec			
Examination Procedure			Extension Type & Length: Universal 945-1760, 75 ft.			
Number/Revision: HES-28 Rev. 11			Slip Ring Model Number: 508-2052			
Scan Parameters						
Scan Direction: Pull						
Digitization Rate, Samples Per Inch (minimum):		Axial Direction		≥30	Circ. Direction	N/A
Probe Speed	Sample Rate	RPM Set	RPM Min	RPM Max		
≤48 IPS	1777	N/A	N/A	N/A		
≤24 IPS	1100	N/A	N/A	N/A		
Probe						
Description (Model/Diameter/Coil Dimensions)		Manufacturer/Part Number			Length	
A-600-M/ULC		Zetec 700-1192-061			110 ft.	
A-540-SF/RM / A-560 SF/RM / A-580-SF/RM		Zetec 754-0402-001/D#2121-10-B/700-0402-051/D#2121-9-B			110 ft.	
A-600-M/ULC (500 nose)		Zetec D# 2120-5-G			110 ft.	
600-M/ULC Replaceable Foot Bobbin Probe		760-2112-001			110 ft.	
Data Acquisition						
Calibration Differential Channels						
Channel & Frequency	Ch. 1 & 3 400 kHz	Ch. 5 & 7 200 kHz	Ch. 9 & 12 100 kHz	Ch. 15 & 17 20 kHz		
Phase Rotation	100% TWH 40 degrees	100% TWH 40 degrees	100% TWH 40 degrees	Tube Support Ring 90 Degrees		
Span Setting	100% TWH 6 divisions	100% TWH 6 divisions	100% TWH 6 divisions	Tube Support Ring 5 divisions		
Calibration Absolute Channels						
Channel & Frequency	Ch. 2 & 4 400 kHz	Ch. 6 & 8 200 kHz	Ch. 10 & 13 100 kHz	Ch. 16 & 18 20 kHz	Ch. 11 & 14 100 kHz Encoder	
Phase Rotation	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Tube Support Ring 90 Degrees	Encoder Pulse @ 90 Degrees	
Span Setting	60% TWH 5 divisions	60% TWH 5 divisions	60% TWH 2 divisions	Tube Support Ring 4 divisions	Encoder Pulse @ 4 divisions	



ENTERGY

ARKANSAS NUCLEAR ONE
ENGINEERING STANDARD

ANO-2 STEAM GENERATOR EDDY CURRENT
EXAMINATION GUIDELINES

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Examination Technique Specification Sheet

ETSS # 1 - BOBBIN PROBE

Page: 2 of 4


Configuration Board Settings

trig off	down	Configuration #		Name Bobbin								samples/sec See Pg 1 of 4	rec media =									
tester =		board # 1	board # 2	board # 3	board # 4	board # 5	board # 6	board # 7	boa													
# of channels =	18	probe # 1	probe # 1	probe # 2	probe # 2	probe # 1	probe # 1	probe # 1	prot													
		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE										
		A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A
Drive Polarity		N	N			N	N	N			N											
Group Number		1	1			1	2	2			1											
Coil Number		1	5			8	1	5			8											
FREQ #1	Time Slot # 1																					
400 kHz	G x 2 12.0 V	D	A			D	A															
FREQ #2	Time Slot # 2																					
200 kHz	G x 2 12.0 V	D	A			D	A															
FREQ #3	Time Slot # 3																					
100 kHz	G x 2 12.0 V	D	A			D	D	A			D											
FREQ #4	Time Slot # 4																					
20 kHz	G x 4 12.0 V	D	A			D	A															
FREQ #5	Time Slot # 5																					
FREQ #6	Time Slot # 6																					
FREQ #7	Time Slot # 7																					
FREQ #8	Time Slot # 8																					
END LOC CH	1 1	DRIVE A : D = A1-A2, P = dr:A1 pu:A2, DP = dr : D1&D2 pu : A1&A2																				
THRESHOLD	off off	DRIVE B : D = B1-B2, A = A1-B2																				
(P) GAIN	x6	P = dr : B1 pu:B2, DP = dr : C1&C2 pu : B1&B2																				
ACTIVE PROBES	2	DRIVE C : D = C1-C2, A = D1-C2																				
		DRIVE D : D = D1-D2																				


Default	Print
Gain/PD	Screen

Special Instructions

- The A-600-M/ULC probe is the primary use probe for the bobbin examination. The A-580SF/RM and A-560SF/RM are used to test low row tubes.
- The A-580-SFRM probe can be used in tubes reported as RRT with the .600" probe as directed by the FTI Level III and Entergy approval. If needed, a 0.560 SF/RM probe, or a 0.540 SF/RM can be used as directed by the FTI Level III and Entergy approval.
- Enter a message at the beginning of each calibration group indicating that the data is being acquired with either single or dual probes. If dual probes are being used state which calibration group is the primary probe and which is the secondary probe.
- When acquiring data with a single probe Coil 1 (differential) channels will be Ch1=400 kHz, Ch3=200 kHz, Ch5=100 kHz, Ch8=20kHz and the Coil 5 (absolute) channels will be Ch2=400 kHz, Ch4=200 kHz, Ch6=100 kHz, Ch9=20 kHz.
- Slower speeds (24 IPS) are recommended in the smaller radius U-bend tubes (row 5 and below) due to probe snapping through the U-bend.
- Three recordings of the calibration standard should be performed at the beginning and end of each calibration group.
- As a minimum, a position verification and a message will be entered once per calibration group.
- Tubes, which have been mis-encoded, should be corrected by entering a message to void that entry and re-examining the tube with the proper encode. This is required to maintain an accurate DSR database.

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	ANO-2 STEAM GENERATOR EDDY CURRENT EXAMINATION GUIDELINES	

Examination Technique Specification Sheet						
ETSS # 1 - BOBBIN PROBE					Page: 3 of 4	
Data Analysis						
Calibration Differential Channels						
Channel & Frequency	Ch 1 400 kHz	Ch 3 200 kHz	Ch 5 100 kHz	Ch 8 20 kHz		
Phase Rotation	100% TWH @ 40 degrees	100% TWH @ 40 degrees	100% TWH @ 40 degrees	Tube Support Ring @ 90 Degrees		
Span Setting Minimum	100% TWH @ 75% FSH	100% TWH @ 75% FSH	100% TWH @ 75% FSH	Tube Support Ring @ 50% FSH		
Calibration Absolute Channels						
Channel & Frequency	Ch 2 400 kHz	Ch 4 200 kHz	Ch 6 100 kHz	Ch 9 20 kHz		
Phase Rotation	100% TWH @ 32 Degrees	100% TWH @ 32 Degrees	100% TWH @ 40 Degrees	Tube Support Ring @ 270 degrees		
Span Setting Minimum	60% TWH @ 50% FSH	60% TWH @ 50% FSH	60% TWH @ 20% FSH	Tube Support Ring @ 40% FSH		
Calibration Process and Other Channels						
Channel & Frequency	P1 (Ch 1/5) 400/100 kHz Diff	P2 (Ch 1/3/5 turbo) 400/200/100 kHz Diff		Ch 7 100 kHz		
Configure & Adjust Parameters	Suppress Support Ring	Save 100, 60, 20 Suppress TSP & TSH		N/A		
Phase Rotation	Probe Motion Horiz. Flaws start down	Probe Motion Horiz. Flaws start down		Encoder Pulse @ 90 Degrees		
Span Setting Minimum	100% TWH @ 75% FSH	100% TWH @ 50% FSH		Encoder Pulse @ 4 Divisions		
Voltage Normalization			Calibration Curves			
CH	Signal	Set	Normalize	Type	CH	Set Points
1	4X20% FBH	4 Vp-p	All	Phase	1, 3, 5, P1	100, 60, 20 FBH
Data Screening						
Left Strip Chart		Right Strip Chart			Lissajous	
P1		Ch 6			Ch P1	
Reporting Requirements						
Condition/Region	Report	Ch.	Comment			
Absolute Drift	ADI	6	Vert-Max (Low Row U-bend)			
Freespan	DFI	→	Use "Free Span Bobbin Coil Indication Flow Chart"			
Eggerates	DSI	P1	See Note 6			
Tubesheet	DTI	P2	See Note 4			
Dents	DNT	P1	All Dent Indications \geq 3 volts located anywhere.			
Indication Not Reportable	INR		Indications detected are not reportable by guidelines			
Indication Not Found	INF		Resolution is require to research and resolve per guidelines			
Possible Loose Part	PLP	9	Any Indication of Secondary Side Foreign Parts, See Note 9			
Sludge Pile	NQI	P1	In the Sludge Pile			

 ENTERGY	ARKANSAS NUCLEAR ONE ENGINEERING STANDARD	No.: HES-28 Rev. No.: 11 SCN No.: 1 Page: 58
	ANO-2 STEAM GENERATOR EDDY CURRENT EXAMINATION GUIDELINES	

Examination Technique Specification Sheet

ETSS # 1 - BOBBIN PROBE

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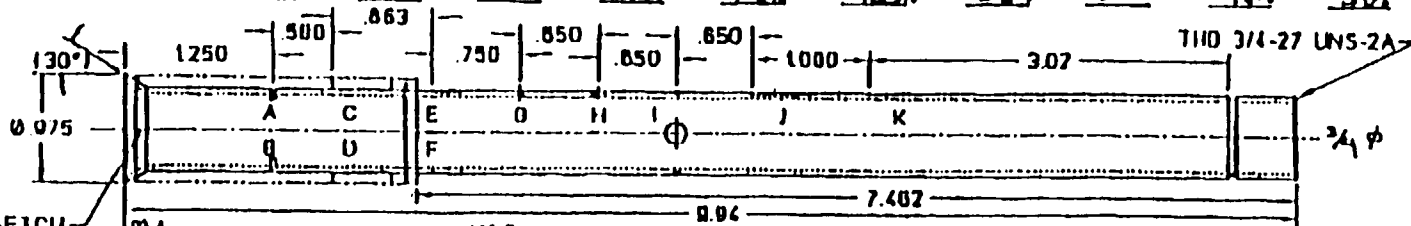
Special Instructions

1. Refer to Appendix I additional instructions regarding the data screening and evaluation of Bobbin Probe data. (The required extent to be analyzed for all bobbin examination is to be TEH-07H +1.0"; data acquired outside this extent does not require analysis.)
2. Zoom the strip chart to a maximum value of 8 to increase visibility of small amplitude indications.
3. All areas of the tubing should be examined with both P1 and Ch6 for indications and/ or drifts that may be indicative of cracking.
4. Review tubesheet data for indications of degradation, distortion and drifts indicative of axial or circumferential cracking. Indications may be confirmed by using Ch5, Ch6 or P2. Evaluation is typical in P1 or Ch1. Based upon experience at ANO-2, take care to examine the entire tubesheet entry signal at the setup span on Ch1 and Ch3 for distorted signals indicative of cracking. Also observe the response of P2. The requirement to screen the entire tubesheet entry signal is critically important in both the hot leg and cold leg. Distorted signals, which may be indicative of a flaw on the bobbin, shall be flagged for RPC examination by reporting as DTI in the % column. If the indication is not in the expansion transition, the indication should be evaluated and reported from P1.
5. In the presence of deposits at the top of the tubesheet, if the signal has the characteristics of a flaw on P1, report these indications as an "NQI" code and test with an RPC examination.
6. Evaluate each support on the P1 process channel. Eggrates typically have three signals representing the two edges and the center of the eggrate. Indications can be confirmed with Ch1, 3, or 5 when deposit influence is not present. Indications that are phased in the ID plane on P1 should confirm on Ch3 and/or Ch5. Indications may not always display an expected counter-clockwise rotation.
7. When using Auto Calibration features, make sure that you are using the file that matches the Standard being used.
8. Monitor the configuration widget for proper data sampling. Set the warning dialog to trigger at 30 axial samples.
9. Observe the stripchart and Lissajous presentations for indications occurring anywhere along the tube but especially on top of the tubesheet and supports. Possible loose parts shall be screened and reported as a Possible Loose Part (PLP) on 20 kHz absolute. This will signify the need for further characterization with a rotating probe technique.

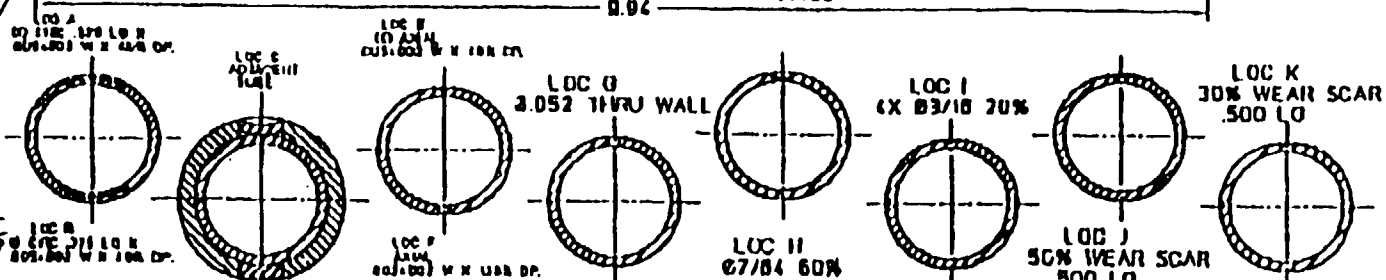
2P99

				REVISIONS				APVD	CHK	DR
REV	NO	DATE	DESCRIPTION	APVD	CHK	DR				
E	1	4/21/94	ADDED WIDTH CALL-OUT LOC. A-B-E-F						KZ	

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0205	.0205	—	—	.0205	1.000	1.000	.0205	.0195	.0195	.0160
DEPTH IN % OF WALL	40%	40%	—	—	40%	100%	100%	5%	10%	9%	31%



ALIGN ELECTRO-ETCH AND GROOVES



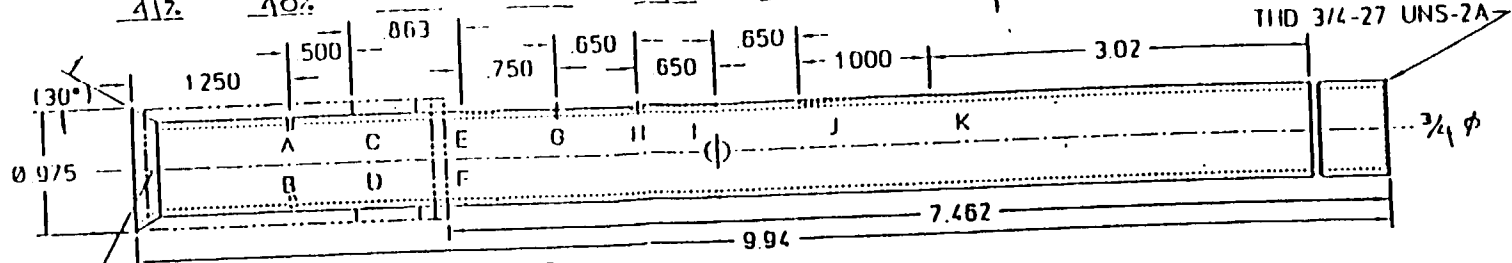
MATERIAL INCOEL 600
 AVERAGE MEAS WALL THK. 0.015
 NOMINAL WALL THK. .049
 HEAT LOT NO. 752493
 TEST FREQ USED NA
 SERIAL NO. E-13323
 P.O. NO. 679
 REL. NO. MR5524
 QUALITY REL. NO. NA
 DATE INFO. 2-1-95
 O.A. INSP. Handwritten
 CUSTOMER CONRAD NUCLEAR
 RECORDED NA
 PROBE USED Handwritten
 REVIEWED BY. Handwritten

NOTE:

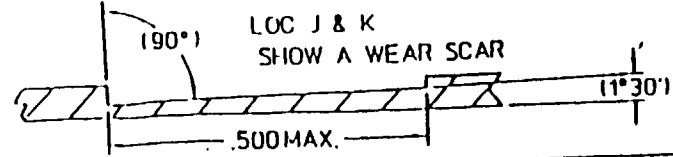
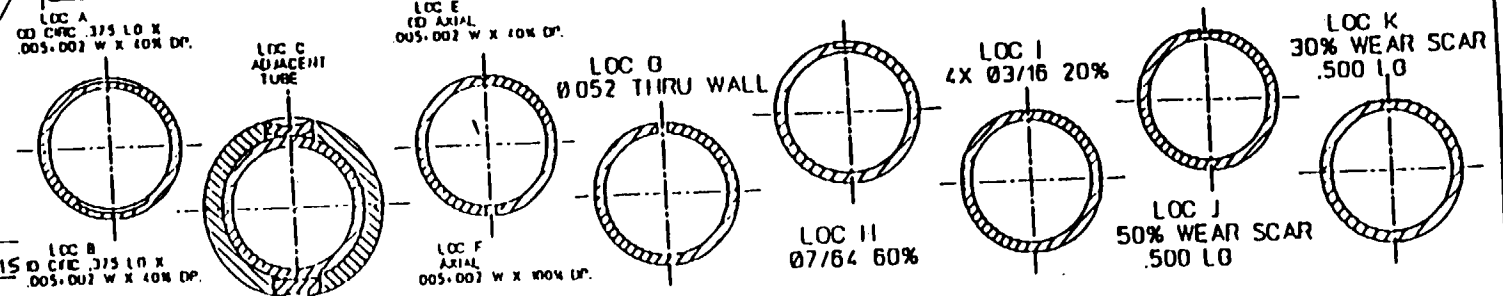
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C	REVISIONS	REV. STATUS OF SHEETS	LIN		DESCRIPTION	APVD	CK	DR
			E	DATE				
2	SHEET		E	11/24/94	ADDED WIDTH CALL-OUT LOC. A-B-E-F	LR	BT	KZ

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0210	.0205	---	---	.0215	.1110	.1110	.0300	.0100	.0210	.0140
DEPTH IN % OF WALL	.41%	.40%	---	---	.42%	100%	100%	58%	19%	47%	27%



ALIGN ELECTRO-ETCH AND GROOVES



MATERIAL INCONEL 600
 AVERAGE MEAS. WALL THK. .0515
 NOMINAL WALL THK. .049
 HEAT LOT NO. 752493
 TEST FREQ. USED NA
 SERIAL NO. Z-13325
 P.O. NO. 679
 REL. NO. MR5524
 QUALITY REL. NO. NA
 DATE MFG. 2-1-95
 O.A. INSP. [Signature]
 CUSTOMER CONNA NUCLEAR
 RECORDED NA
 PROBE USED [Signature]
 REVIEWED BY [Signature]

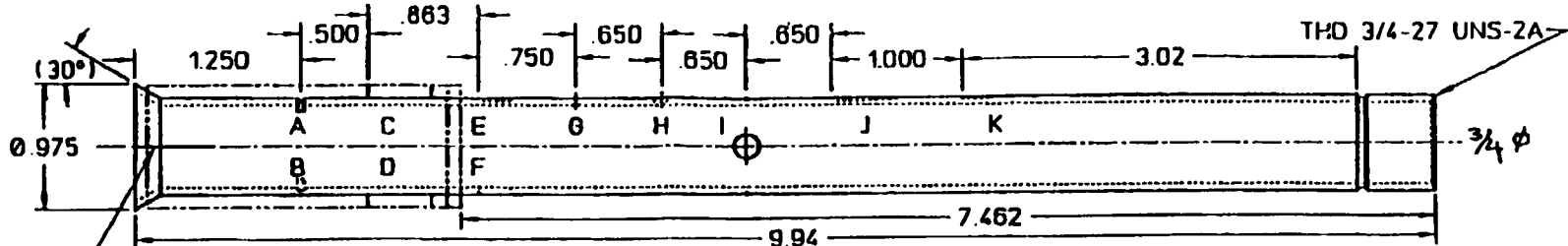
NOTE:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMAL FRACT. .1/16 XXXX .003 XXX .015 XX .050 X .001 ANGULAR .3° FINISH	DRAWN	DATE	ZETEC <small>POST OFFICE BOX 408 BROADWAY WASHINGTON MASS 01004 USA TELEPHONE (617) 251-3100</small>
	0 MATELICH	08/24/94	
	CHECK		TITLE
	B JONES	08/30/94	DUAL GUIDE TUBE STD. W/ MISC. DEFECTS
DESIGN		SHEET NO.	DWG NO.
APVD. DA			2-415-1015
0 ATKINS	08/31/94	SCALE NTS	REVISION 2-415-0004
			SHEET 1 OF 2

				REVISIONS				
REV. NO.	REASONS	REV. STATUS OF SHEETS	LTR	DATE	DESCRIPTION	APVD	CK	DR
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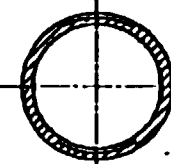
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DEPTH IN % OF WALL	40%	41%	—	—	41%	100%	100%	58%	20%	49%	28%

DIA OF DEFECT ±.003

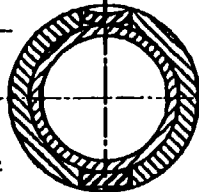


ALIGN ELECTRO-ETCH AND GROOVES

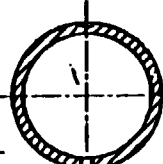
LOC A
OD CIRC .375 LG X
.005±.002 W X 40% DP.



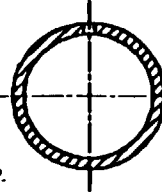
LOC C
ADJACENT
TUBE



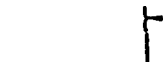
LOC E
OD AXIAL
.005±.002 W X 40% DP.



LOC G
Ø.052 THRU WALL



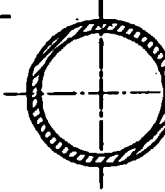
LOC F
AXIAL
.005±.002 W X 120% DP.



LOC H
Ø7/8± 60%



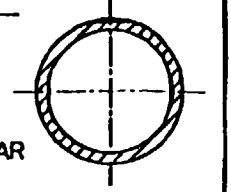
LOC I
4X Ø3/16 20%



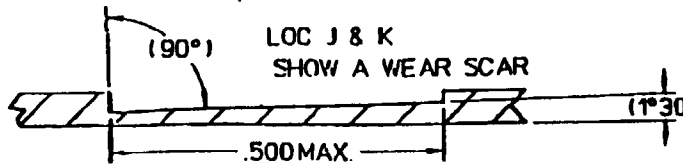
LOC J
50% WEAR SCAR
.500 LG



LOC K
30% WEAR SCAR
.500 LG



LOC D
BAT WING



MATERIAL INCONEL 600
 AVERAGE MEAS. WALL THK. .0515
 NOMINAL WALL THK. .049
 HEAT LOT NO 752493
 TEST FREQ. USED NA
 SERIAL NO. Z-13327
 P.O. NO. 679
 REL. NO. MR5524
 QUALITY REL. NO. NA
 DATE MFG. 2-1-95
 C.A. INSP. Aug 08/95
 CUSTOMER CONRAD NUCLEAR
 RECORDED NA
 PROBE USED ANA
 REVIEWED BY [Signature]

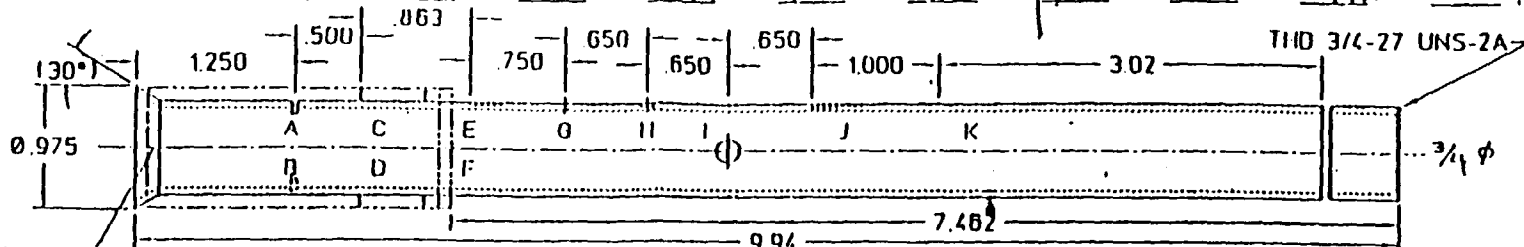
NOTE:

DIM. OTHERWISE SPECIFIED DIM ARE IN INCHES TOLERANCES DECIMAL FRACT. ± 1/16 .XXXX ± .003 .XXX ± .015 .XX ± .050 ± .003 ANGULAR ± 3° FINISH	DRAWN G. MATELICH	DATE 08/24/94	ZETEC <small>POST OFFICE BOX 118 ISSAQUAH WA 98280-0118 509-27-0072 U.S.A. TELEPHONE (206) 782-2318</small>	
	CHECK B. JONES	DATE 08/30/94		TITLE DUAL GUIDE TUBE STD. W/ MISC. DEFECTS
	DESIGN	APVD. QA G. ATKINS	DATE 08/31/94	SCALE NTS USED ON 2-415-0004
	DWG NO 2-415-1015		SHT 1 OF 2	

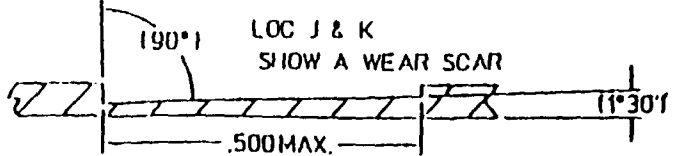
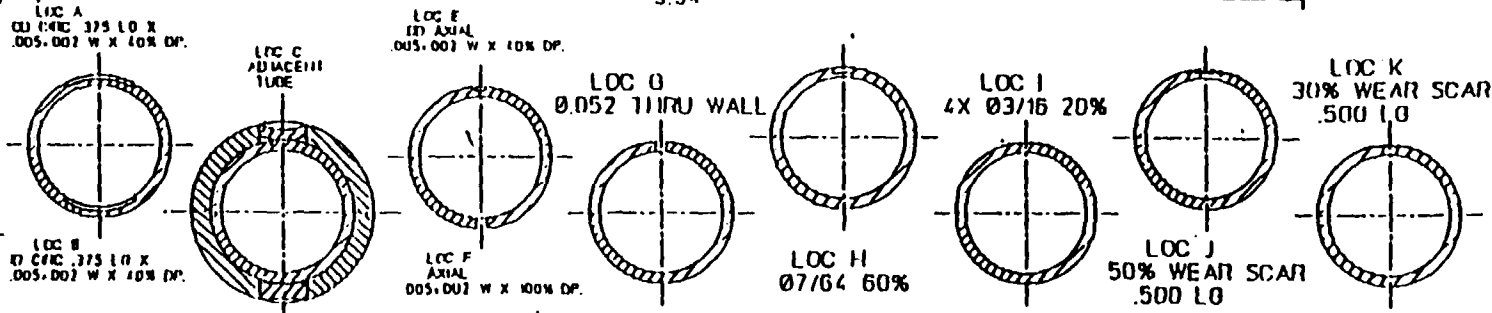
REVISIONS		APVD	CK	DN
LTR	DATE	DESCRIPTION		
E	11/21/91	UA	KZ	K2
		ADDED WIDTH CALL-OUT LOC. A-B-E-F		

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS. DEPTH	.0205	.0210	---	---	.0210	THRU	THRU	.0200	.0105	.0210	.0150
DEPTH IN % OF WALL	40%	4.1%	---	---	4.1%	100%	100%	58%	20%	4.7%	2.9%

DIA OF DEFECT .003



ALIGN ELECTRO-ETCH AND GROOVES



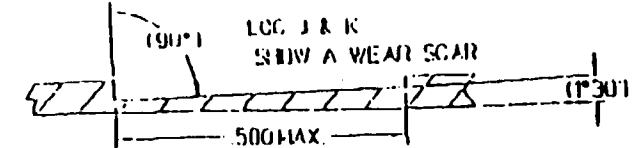
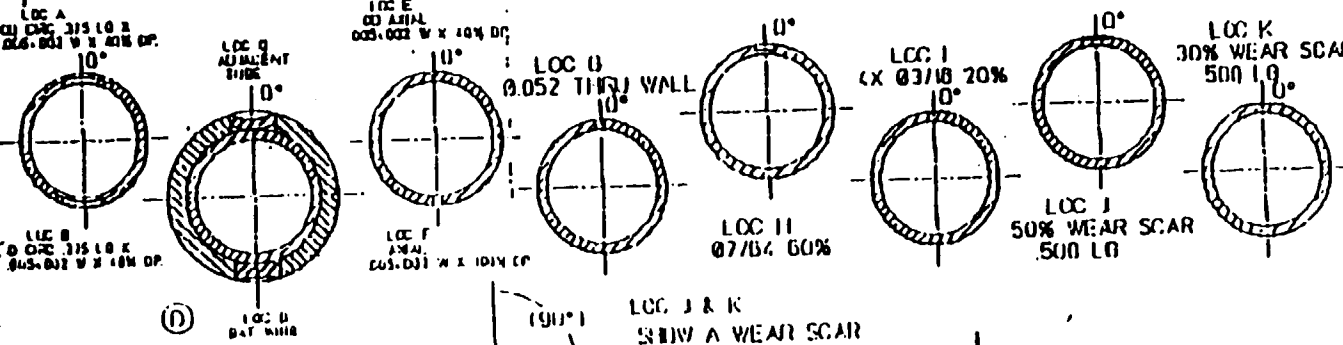
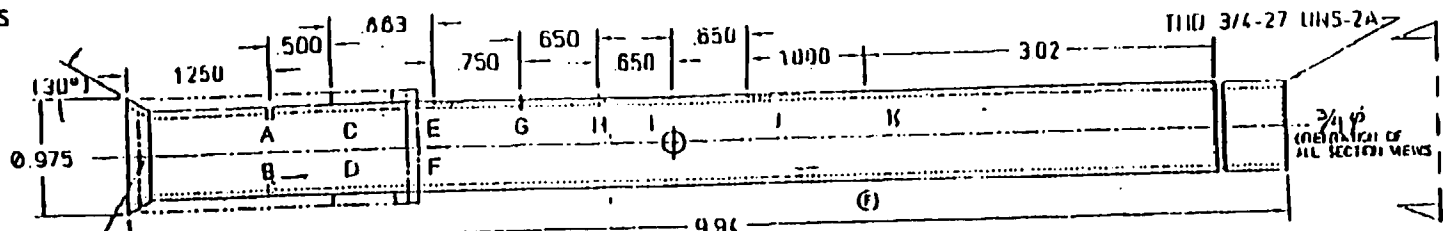
MATERIAL INCONEL 600
 AVERAGE MEAS. WALL THK. .0515
 NOMINAL WALL THK. .049
 HEAT LOT NO. 752193
 TEST FREQ. USED NA
 SERIAL NO. Z-13329
 P.O. NO. 679
 REL. NO. MR5524
 QUALITY REL. NO. NA
 DATE MFG. 2-1-95
 Q.A. INSP. None
 CUSTOMER CONNS NUCLEAR
 RECORDED NA
 PHOTODUPLICATION USED NA
 REVIEWED BY [Signature]

NOTE:

ALL DIMENSIONS SPECIFIED UNLESS TOLERANCES INDICATED DECIMAL FRACT. 1/16 XXXX .003 XXX .015 XX .050 X .003 UNUSUAL .1 FRACTION	DRAWN G. HATELICH	DATE 08/24/94	ZETEC <small>POST OFFICE BOX 100000 WASHINGTON MISSOURI 64110 USA TELEPHONE (314) 301-1100</small> TITLE DUAL GUIDE TUBE STD. W/ MISC. DEFECTS
	CHECK B. JONES	DATE 08/30/94	
	DESIGN		
	APVD. DA U. ATKINS	DATE 08/31/94	
	SCALE NTS	TWD NO 2-415-1015	ISED 2-415-0004

NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

LOCATION	REVISED										
	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	0.215	0.0725	---	---	0.215	100%	183%	0.360	100%	0.260	10155
DEPTH IN % OF WALL	43%	41%	---	---	41%	100%	100%	59%	19%	51%	31%
E.T. PHASE ANGLE MEAS							40°	112°	152°		



MATERIAL INCONEL 600
 AVERAGE MEAS WALL THK. 0.0505
 NOMINAL WALL THK. 0.049
 HEAT LOT NO. 152493
 TEST FREQ USED 100%
 SERIAL NO. 7-15041
 PO NO. 9710
 REL. NO. NA
 QUALITY REL. NO. NA
 DATE MFG. 6-17-96
 O.A. INSP. [Signature]
 CUSTOMER Rockridge Technologies
 RECORDED 10
 PROBE USED K2112 #1116
 REVIEWED BY [Signature]

NOTE

UNLESS OTHERWISE SPECIFIED	DATE
ALL DIMENSIONS IN INCHES	10/24/94
TOLERANCES	
NOMINAL DIMENSIONS ± 0.10	
XXX ± 0.03	
XX ± 0.05	
X ± 0.10	
SMALLER ± 0.01	
FRACTIONS	
DRAMA	
G. MATERIAL	
CHECK	08/30/04
D. DIMS	
DESIGN	
APVD BY	
Q. APPROV	08/31/94

ZETEC INC.
 TITLE **DUAL GUIDE TUBE STD. W/ MISC. DEFECTS**
 SCALE **1:1**
 DWG NO. **2-415-1015**
 SHEET **1 OF 2**

NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

REVISES		REV. STATUS OF SHEETS	LTR	DATE	DESCRIPTION	APPROV	CHK	DR
NO	BY							
1		2	II	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS			K7

LOCATION

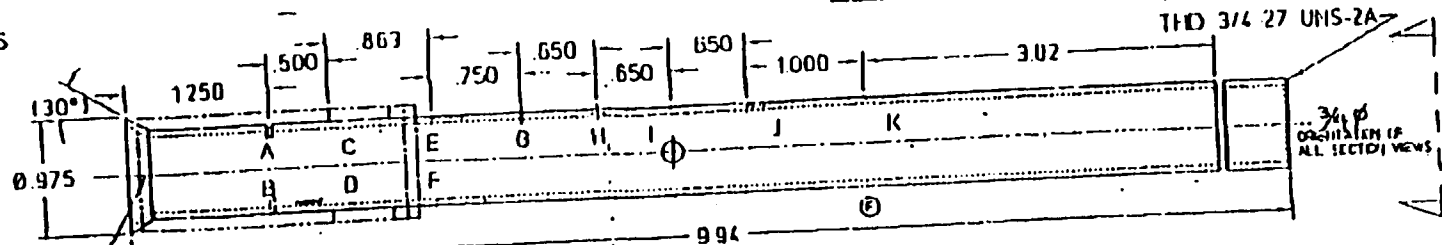
PHYSICALLY MEAS. DEPTH

DEPTH IN % OF WALL

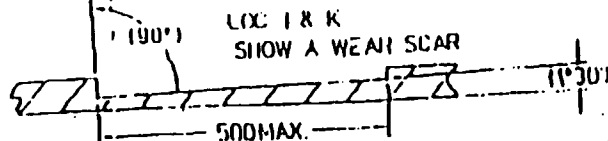
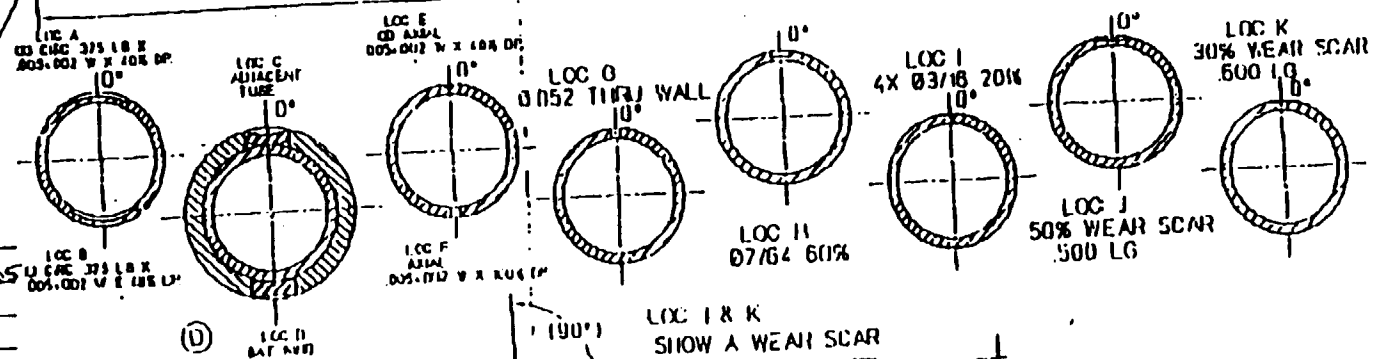
E.T. PHASE ANGLE MEAS

DIA OF DEFECT .003

A	B	C	D	E	F	G	H	I	J	K
0.015	0.015	---	---	0.015	100%	100%	0.030	0.100	0.160	0.165
39%	41%	---	---	43%	100%	100%	59%	20%	51%	31%
						90°	110°	151°		



ALKIN ELECTRO-ETCH AND GROOVES



MATERIAL INCONEL 600
 AVERAGE MEAS WALL THK. 0.045
 NOMINAL WALL THK. 0.049
 HEAT LOT NO. 752A72
 TEST FREQ. USED 400 kHz
 SERIAL NO. Z-15045
 P.O. NO. 9710
 REL. NO. NR
 QUALITY REL. NO. NR
 DATE MFD. 5-17-96
 O.A. INSP. None
 CUSTOMER Rockledge Technologies
 RECORDED AO
 PROC. USED 107745 11186
 REVIEWED BY [Signature]

NOTE:

FILE: ORIENTISE SPECTRIF	DRAWN	DATE
MIN ARE III INCHES	O. HATELICH	08/24/94
TOLERANCES	CHECK	
DECIMAL FRACT. 1/10	D. JONES	08/30/94
MAXI .001	DESIGN	
MAX .015		
XX .050		
X .001	APPROV	
MINI .003	D. ATKINS	08/31/94
FITNESS		

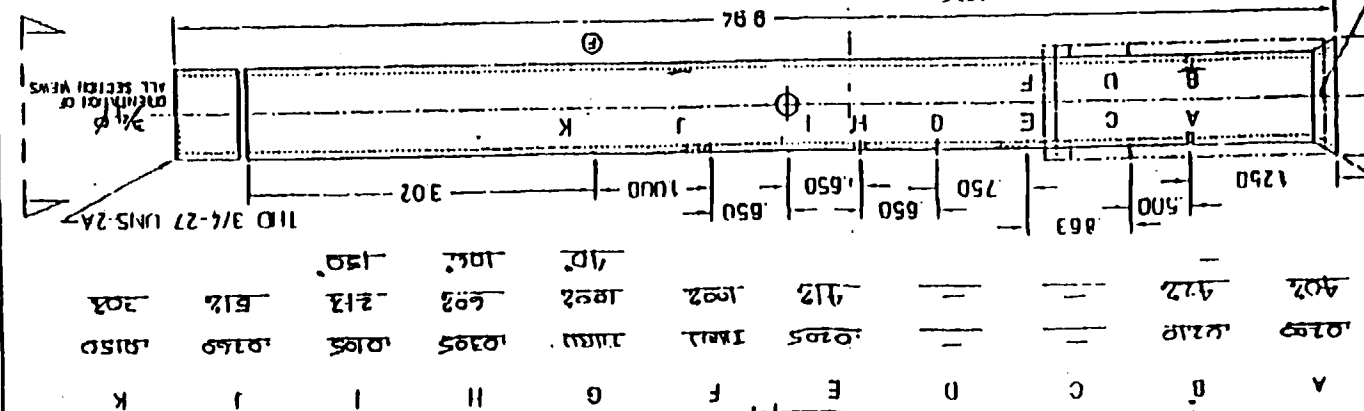
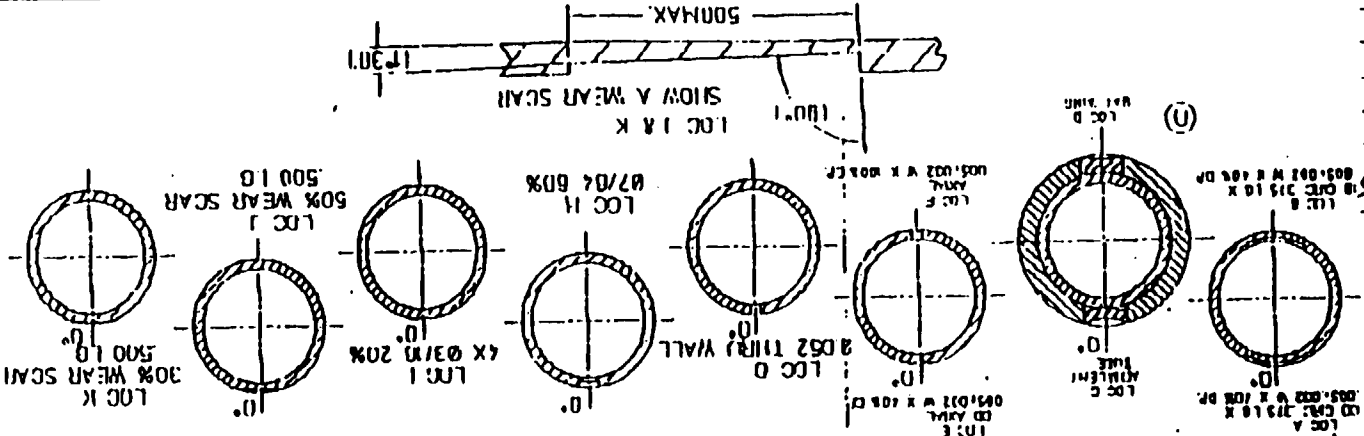
ZETEC INC. TEST CENTER FOR NON-DESTRUCTIVE TESTING
 TITLE **DUAL GUIDE TUBE STD. W/ MISC. DEFECTS**
 SERIAL DRAWING NO. 2-415-1015
 SCALE NTS SHEET 1 OF 2

DATE	08/24/94	DATE	08/24/94
TIME	08/24/94	TIME	08/24/94
DESIGN	08/30/94	DESIGN	08/30/94
APPROV. DA		APPROV. DA	
0 AIRKIS		0 AIRKIS	
DUAL GUIDE TUBE STD. W/ MISC. DEFECTS		ZETEC	
DND NO. 2-415-1015		DND NO. 2-415-1015	
REVISED BY: [Signature]		REVISED BY: [Signature]	

NOTE: ALL DIMENSIONS SPECIFIED IN DRAWING SHALL BE IN INCHES UNLESS OTHERWISE SPECIFIED.

RECORDED
PROCEED USED
CUSTOMER SERVICE Technology

DATE NO. 5-17-94
QUALITY REL. NO. 415
REL. NO. 415
P. D. NO. 8710
SCAN NO. 2-15046
TEST FILE USED 400 KHZ
HEAT LUT NO. 757793
MINIMAL WALL THK. 0.17
AVERAGE MEAS WALL THK. 0.25
MATERIAL W/SCAR 600



ALON ELECTRO-FETCH AND GROOVES

LOCATION	PHYSICALLY MEAS DEPTH	DEPTH IN % OF WALL	E.T. PHASE ANGLE MEAS	DIA OF DEFECT (Ø)
A	0.299	4.22	-	1.250
B	0.218	4.22	-	1.250
C	0.218	4.22	-	1.250
D	0.205	4.12	-	1.650
E	0.205	4.12	-	1.650
F	0.205	4.12	-	1.650
G	0.205	4.12	-	1.650
H	0.205	4.12	-	1.650
I	0.205	4.12	-	1.650
J	0.205	4.12	-	1.650
K	0.205	4.12	-	1.650

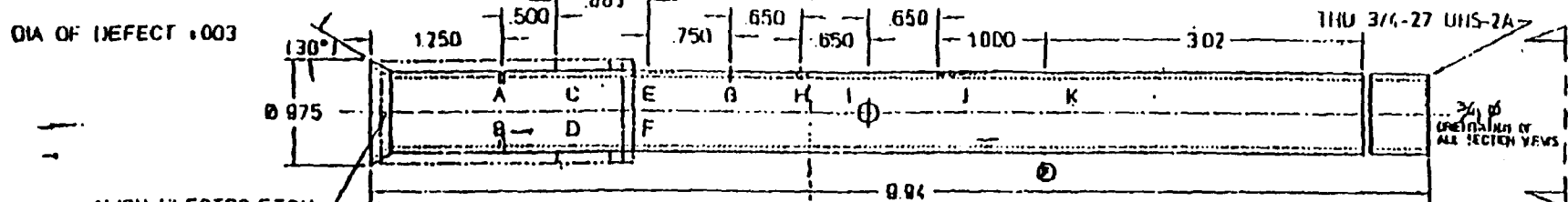
REV. NO.	DATE	DESCRIPTION
11	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
10	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
9	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
8	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
7	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
6	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
5	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
4	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
3	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
2	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS
1	4/5/94	ADDED ORIENTATION FOR SEC. VIEWS

NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

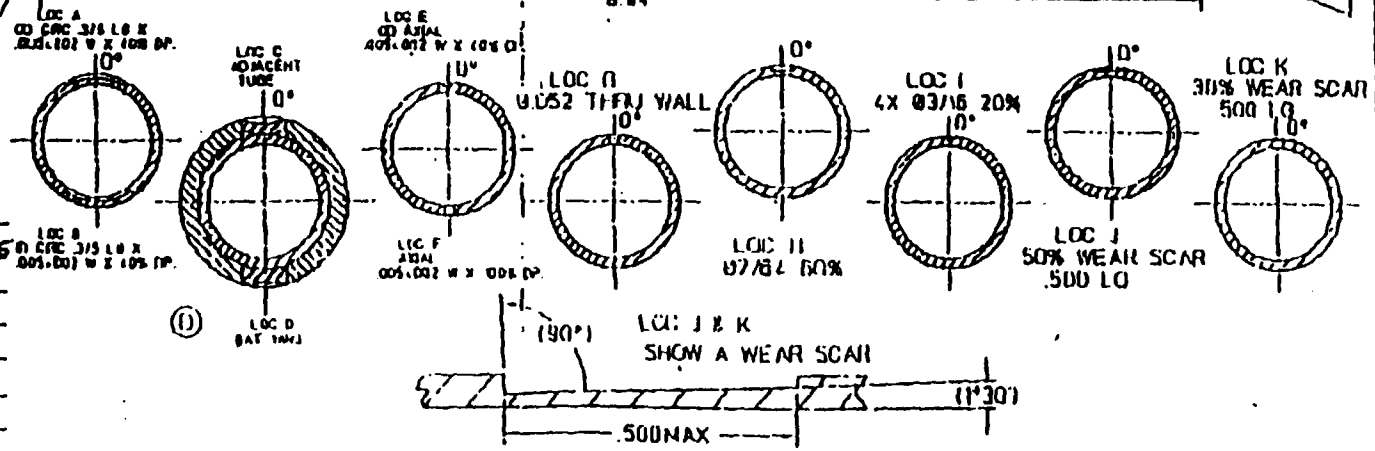
NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

REV. NO.				REV. STATUS OF SHEET		REVISIONS						AP'D	CHK	DR
LTR	DATE	DESCRIPTION				AP'D	CHK	DR						
11	11/2/96	ADDED ORIENTATION FOR SEC. VIEWS				AP	CK	K2						

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0225	.0205	--	--	.0215	100%	100%	.0305	.0095	.0150	.0150
DEPTH IN % OF WALL	45%	41%	--	--	43%	100%	100%	60%	19%	50%	30%
E.T. PHASE ANGLE MEAS							90°	111°	154°		



ALUMN ELECTRO-ETCH AND GROOVES



MATERIAL INCONEL 600
 AVERAGE MFAS WALL THIK .0505
 NOMINAL WALL THIK .049
 HEAT LOT NO 752493
 TEST FREQ. USED 40 kHz
 SERIAL NO. Z-15047
 P.O. NO. 8710
 TEL. NO. NA
 QUALITY REL. NO. NA
 DATE MFG. 2-17-96
 O.A. INSP. APR 1996
 CUSTOMER Rockwell Technologies
 RECORDED 10
 FRAME USED ACQUA 4.11MG
 REVIEWED BY [Signature]

NOTE:

DIM. ORIENTED SPECIFIED DIM ARE IN INCHES TOLERANCES DECIMAL FRACT. 1/16 XXXX (.001) XX (.015) X (.050) S (.003) MINUS AS SHOWN FINISH	DRAWN U DATE 08/24/94 CHECKED R XINES 08/30/94 DESIGN AP'D DA II ACTIONS 01/31/96	DATE 08/24/94 08/30/94 01/31/96
---	---	--

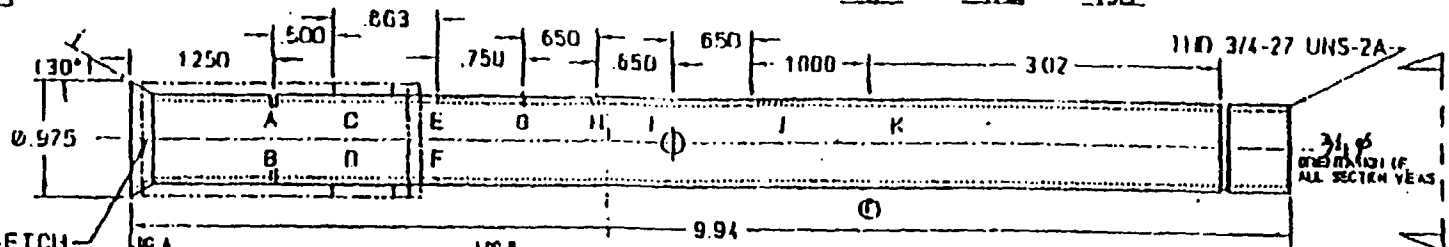
ZETEC
 TITLE: **DUAL GUIDE TUBE STD. W/ MISC. DEFECTS**
 SIMILAR: [] DWG NO: **2-415-1015**
 SCALE: **H15** SHEET NO: **2-415-0004** 1 OF 2

SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

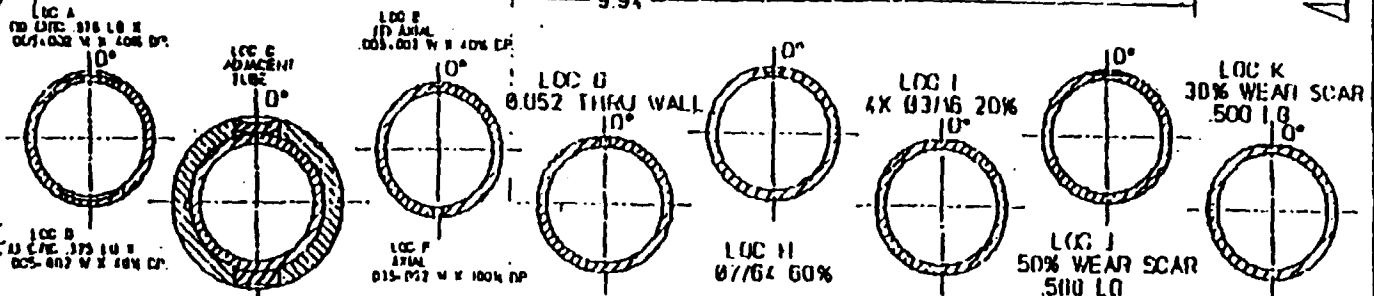
REVISIONS				DATE	DESCRIPTION	APVD	CHK	DTI
11	9/5/94	ADDED ORIENTATION FOR SEC. VIEWS						

CATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0210	.0180	—	—	.0210	100%	.1180	.0385	.0210	.0250	.0125
DEPTH IN % OF WALL	44%	40%	—	—	42%	100%	100%	60%	22%	80%	31%
1. PHASE ANGLE MEAS							40°	112°	153°		

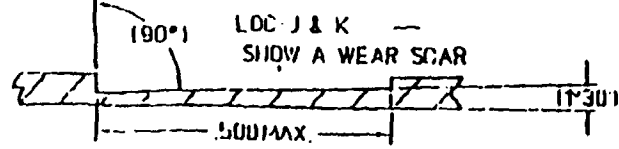
AREA OF DEFECT 1.003



ALYON ELECTRO-ETCH AND GROOVES



MATERIAL INCONEL 600
 VERADE MEAS WALL THK. DEOS
 NOMINAL WALL THK. 0.49
 HEAT LOT NO. 752413
 TEST FREQ. USED 40 YR
 SERIAL NO. 2-1501B
 P.O. NO. 4110
 EL. NO. NA
 QUALITY REL NO. NA
 DATE MFG. 6-17-94
 O.A. NSP. Raymond
 CUSTOMER Rockledge Technologies
 RECORDED 40
 PROBE USED MODEL 71186
 REVIEWED BY [Signature]



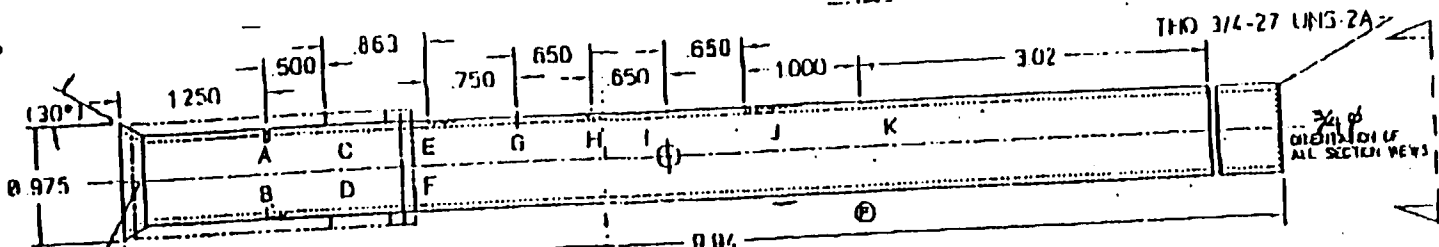
NOTE:

INT. DIMENSIONS SPECIFIED IN INCHES DIMENSIONS IN MILLIMETERS DECIMAL FRACT. = 1/16 XXX = .03 XXXX = .015 XXXX = .005 XXXX = .003 XXXX = .0015 XXXX = .001	DATE 08/24/94	ZETEC ZETEC INC. 10000 W. 150TH AVE. #1100 BENTON HARBOR, MI 48024
	0 MATERIAL ESTX 9 FRES DESIGN	
TITLE DUAL GUIDE TUBE STD. W/ MISC. DEFECTS		SCALE NTS
APVD. QA D ATKINS		DRAW NO. 2-415-1015
DATE 08/31/94		PART NO. 2-415-0004

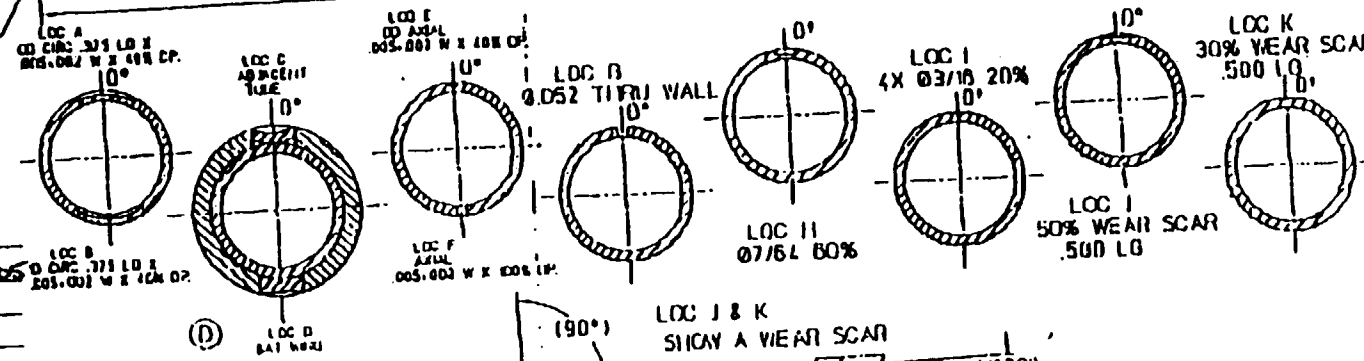
NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

REV. NO.	REV. STATUS	DATE	DESCRIPTION	APVD	CHK	DIT
2	9/21/94	11/15/96	ADDED ORIENTATION FOR SEC. VIEWS			

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0170	.0200	---	---	.0205	TREAS.	TREAS.	.0200	.0150	.0155	.0135
DEPTH IN % OF WALL	44%	40%	---	---	41%	100%	100%	57%	20%	51%	31%
E.T. FLARE ANGLE MEAS							10°	10°	15°		



ALION ELECTRO-ETCH AND GROOVES



MATERIAL INCONEL 600
 AVERAGE MEAS WALL THK 0.049
 NOMINAL WALL THK 0.049
 HEAT LOT NO. 702493
 TEST FREQ. USED 400 KHZ
 SERIAL NO 2-15099
 P.O. NO. 9710
 REL. NO. 116
 QUALITY REL. NO. 116
 DATE MFD. 5-11-96
 U.A. NSP. Raytheon
 CUSTOMER Rockridge Technologies
 RECORDED 10
 PROBE USED Model # 7116
 REVIEWED BY [Signature]

NOTE:

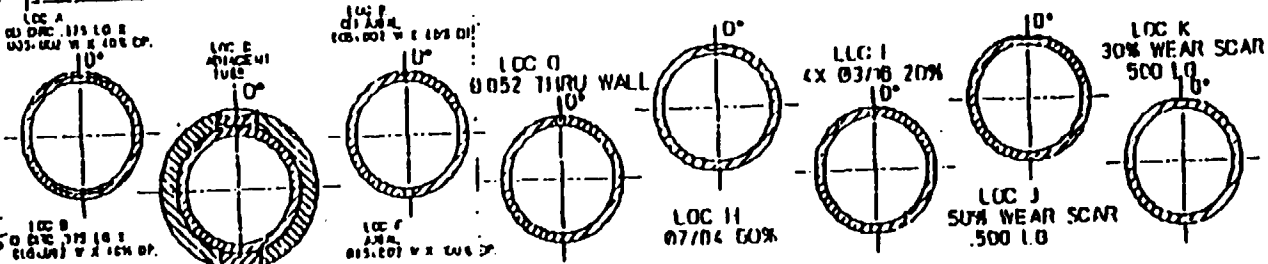
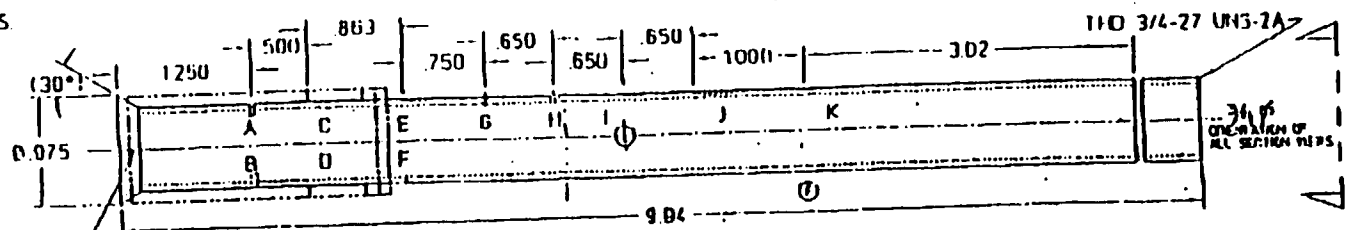
1. DIMENSIONS SPECIFIED	DATE
2. MATERIAL	00/24/94
3. CHECK	08/30/94
4. DESIGN	
5. APPROVAL	08/31/94

ZETEC INC.
 TITLE: **DUAL GUIDE TUBE STD. W/ MISC. DEFECTS**
 SERIAL NO: **2-415-1015**
 PART NO: **2-415-0004** 1 OF 2

NOTE: SEE 2-415-0004 FOR PLACEMENT OF NYLON SLEEVE

REVISED		DESCRIPTION		APVD	CK	DR
REV	DATE	BY	DESCRIPTION			
2	11/3/96		ALIGNED ORIENTATION FOR SEC. VIEWS			

LOCATION	A	B	C	II	E	F	B	II	I	J	K
PHYSICALLY MEAS DEPTH	0.0125	0.0225	---	---	0.0210	INBL.	0.0115	0.305	0.1100	0.235	0.180
DEPTH IN % OF WALL	41%	41%	---	---	12%	100%	100%	60%	20%	81%	39%
E.T. PHASE ANGLE MEAS							40°	108°	151°		




MATERIAL INCOEL 600
 AVERAGE MEAS. WALL THK. 0.025
 NOMINAL WALL THK. 0.017
 HEAT LOT NO. 702493
 TEST FREQ USED 4000
 SERIAL NO. 2-15051
 P.O. NO. 9110
 REL. NO. 116
 QUALITY REL. NO. 116
 DATE MFG. 5-11-46
 O.A. INSP. ...
 CUSTOMER Rockledge Technology
 RECORDED 10
 PHOTO USED ...
 REVIEWED BY ...

NOTE:

TITLE	DATE
DESIGN SPECIFICATION	08/21/94
CHECKED	08/30/94
DESIGNED	
APPROVED	08/30/94

ZETEC INC.
 TITLE: **DUAL GUIDE TUBE STD. W/ MISC. DEFECTS**
 SERIAL: **643 110**
 SCALE: **NTS**
 FILE NO: **2-415-0004**
 SHEET: **1 OF 2**

 ENTERGY	ARKANSAS NUCLEAR ONE ENGINEERING STANDARD	No.: HES-28 Rev. No.: 11 SCN No.: 1 Page: 59
	ANO-2 STEAM GENERATOR EDDY CURRENT EXAMINATION GUIDELINES	

10.4.2 ATTACHMENT II - ETSS #2 RPC Examination (Pancake, Ax, and Circ)

Examination Technique Specification Sheet				
ETSS # 2 - PANCAKE COIL (axial and circ. Directed coils)			Page: 1 of 5	
Site: Entergy Operation Inc. Arkansas Nuclear One Unit #2				
Examination Scope				
Applicability: Tubesheet examinations. Diagnostic testing and/or to confirm bobbin indications. Detection of IGA/ODSCC or PWSCC.				
Instrument		Tubing		
Manufacturer/Model: Zetec MIZ-30A/30-8		Material Type: Inconel 600		
Data Recording Equipment		OD/Wall (inch): 0.750" OD X 0.048" Wall		
Manuf./Media: HP HD 2.6GbOptical or Equiv.		Calibration Standard		
Software		Type: RPC EDM Notch Standard		
Manufacturer: Zetec		Analog Signal Path		
Version/Revision: EN98 1.30		Probe Extension Manuf.: Zetec		
Examination Procedure		Extension Type & Length: Universal 945-1760, 75 ft.		
Number/Revision: HES-28 Rev. 11		Slip Ring Model Number: 508-2052		
Scan Parameters				
Scan Direction: Push or Pull				
Digitization Rate, Samples Per Inch (minimum):		Axial Direction	≥25	Circ. Direction
				≥30
Probe Speed	Sample Rate	RPM Set	RPM Min	RPM Max
0.45 in/sec.	1280	900	810	1086
Probe/Motor Unit				
Description (Model/Diameter/Coil Dimensions)		Length	Motor Units	
810-4090-000 - .610 (.115) MRPC 3C-52PH		50' or 83'	700-4055-071 - .610 9D-MRPC-52MU	
D# 2651-2-A - .580 (.115) MPRC 3C-52PH		50' or 83'	810-4050-001 - .560 9D-MRPC-52MU	
			D#3414-13-A - .600 TTS extension shaft (+2'/-2") 48"	
Data Acquisition				
Calibration 0.115 Coil Channels (Dual Probes)				
Channel & Frequency	Ch. 1 & 4 300 kHz	Ch. 7 & 10 200 kHz	Ch. 13 & 17 100 kHz	Ch. 23 & 24 20 kHz
Phase Rotation	20% ID AX Notch @ 12 degrees	20% ID AX Notch @ 12 degrees	20% ID AX Notch @ 12 degrees	Tube Support Ring Up @ 90 degrees
Span Setting	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	Tube Support Ring @ 3 Divisions
Calibration Axial Sensitive Coil and Trigger Channels (Dual Probes)				
Channel & Frequency	Ch. 2 & 5 300 kHz	Ch. 8 & 11 200 kHz	Ch. 15 & 19 100 kHz	Ch. 14 & 18 100 kHz
Phase Rotation	20% ID AX Notch @ 12 degrees	20% ID AX Notch @ 12 degrees	20% ID AX Notch @ 12 degrees	Large pulse up, small pulse horizontal
Span Setting	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	Large Pulse @ 4 divisions
Calibration Circumferential Sensitive Coil (Dual Probes)				
Channel & Frequency	Ch. 3 & 6 300 kHz	Ch. 9 & 12 200 kHz	Ch. 16 & 20 100 kHz	Ch. 21 & 22 100 kHz (optional)
Phase Rotation	20% ID Circ. Notch 12 degrees	20% ID Circ. Notch 12 degrees	20% ID Circ. Notch 12 degrees	Pulse @ 90 degree
Span Setting	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	Pulse @ 4 divisions



ENTERGY

ARKANSAS NUCLEAR ONE
ENGINEERING STANDARD

ANO-2 STEAM GENERATOR EDDY CURRENT
EXAMINATION GUIDELINES

No.: HES-28
Rev. No.: 11
SCN No.: 1
Page: 60

Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

Page: 2 of 5

Configuration Board Settings

trig: off		down	Configuration #:				Name: 3-Coil				samples / sec: 1280				rec. media = Hard																										
tester =		board # 1				board # 2				board # 3				board # 4				board # 5				board # 6				board # 7				board # 8											
# of channels = 24		probe # 1				probe # 1				probe # 2				probe # 2				probe # 1				probe # 1				probe # 1				probe # 1											
		DRIVE				DRIVE				DRIVE				DRIVE				DRIVE				DRIVE				DRIVE															
		A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C				
Drive Polarity		N				N				N				N				N				N				N				N				N							
Group Number		1				1	1			1	1			2				2	2			2	2																		
Coil Number		1				4	5			7	8			1				4	5			7	8																		
FREQ #1	Time Slot # 1	D				D				D				D				D																							
300 kHz	G: x 2 12.0 V																																								
FREQ #2	Time Slot # 2	D				D				D				D																											
200 kHz	G: x 2 12.0 V																																								
FREQ #3	Time Slot # 3	D				D				D				D																											
100 kHz	G: x 2 12.0 V																																								
FREQ #4	Time Slot # 4									D								D																							
100 kHz	G: x 2 12.0 V																																								
FREQ #5	Time Slot # 5	D								D																															
20 kHz	G: x 4 12.0 V																																								
FREQ #6	Time Slot # 6																																								
FREQ #7	Time Slot # 7																																								
FREQ #8	Time Slot # 8																																								
END LOC CH:		1				1				DRIVE A : D = A1-A2, P = dr:A1 pu:A2, DP = dr : D1&D2 pu : A1&A2																															
THRESHOLD:		off				off				DRIVE B : D = B1-B2, A = A1-B2																															
(P) GAIN:		x8								P = dr : B1 pu:B2, DP = dr : C1&C2 pu : B1&B2																															
ACTIVE PROBES:		2								DRIVE C : D = C1-C2, A = D1-C2																															
										DRIVE D : D = D1-D2																															

Default	Print
Gain/PD	Screen

Special Instructions

1. Enter a message at the beginning of each calibration group indicating that the data is being acquired with either single or dual probes. If dual probes are being used state which calibration group is the primary probe and which is the secondary probe. The message shall include whether the data is acquired on the push or pull.
2. When acquiring data with a single probe delete boards 3 & 4. The Coil 1 (.115" Panc) channels will then be Ch 1=300 kHz, Ch 4=200 kHz, Ch 7=100 kHz, Ch 12=20 kHz. The Coil 4 (Trigger) channel will be Ch8=100 kHz. The Coil 5 (Axial) channels will be Ch 2=300 kHz, Ch 5=200 kHz, Ch 9=100 kHz. The Coil 7 (Circ) channels will be Ch 3=300 kHz, Ch 6=200 kHz, Ch 10=100 kHz. Coil #8 will be Ch 11 100 kHz.
3. Examine each location and record a run-out. Run-out record not required for tubesheet intersection scans.
4. The TSH expansion transition shall be acquired by pushing the probe through transition and shall be adequate to cover the target location. The scan shall normally be from 2.0" below the transition to 2.0" above the top of the tubesheet. In the event that the probe stalls on the push, the data may be acquired by pulling the probe through the transition. This will require the operator to message the event prior to acquiring the data.
5. Other locations may be scanned on the PULL or PUSH and shall be adequate to cover the target location. For special interest indications located within a structure, the data shall be acquired ±2" from the center of the structure. All other locations shall be acquired from structure to structure unless encoders are used, in which case the scan may include one structure. In these instances, care should be taken to insure that the proper location is scanned with adequate data past the target location (recommend 5 inches) to account for any variations in probe speed or axial scaling.
6. One calibration standard may be recorded at the beginning and end of each cal group provided it is a successful scan of the standards complete length.
7. Tubes which have been mis-encoded should be corrected by entering a message to void that entry and re-examining the tube with the proper encode. This is required to maintain an accurate DSR database.
8. Axial Encoder is to be used for all special interest examinations. When not used, activate timeslot as usual, and no setup is required.



ENTERGY

ARKANSAS NUCLEAR ONE
ENGINEERING STANDARD

ANO-2 STEAM GENERATOR EDDY CURRENT
EXAMINATION GUIDELINES

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Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

Page: 3 of 5

Data Analysis

Pancake Channels

Channel & Frequency	Ch 1 300 kHz	Ch 4 200 kHz	Ch 7 100 kHz	Ch 12 (Locator) 20 kHz
Phase Rotation	20% ID Ax. Notch @ 12 degrees	20% ID Ax. Notch @ 12 degrees	20% ID Ax. Notch @ 12 degrees	Tube Support Ring Up @ 90 degrees
Span Setting Minimum	40% OD Ax. Notch @ 2 divisions	40% OD Ax. Notch @ 2 divisions	40% OD Ax. Notch @ 2 divisions	Tube Support Ring @ 3 Divisions

Axial Sensitive Coil & Trigger Channels

Channel & Frequency	Ch 2 300 kHz	Ch 5 200 kHz	Ch 9 100 kHz	Ch 8 (Trigger) 100 kHz
Phase Rotation	20% ID Ax. Notch @ 12 degrees	20% ID Ax. Notch @ 12 degrees	20% ID Ax. Notch @ 12 degrees	Large Pulse Up, Small Pulse Horiz.
Span Setting Minimum	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	Large Pulse @ 4 divisions

Circumferential Sensitive Channels & Encoder Channel

Channel & Frequency	Ch 3 300 kHz	Ch 6 200 kHz	Ch 10 100 kHz	Ch 11 100 kHz (encoder)
Phase Rotation	20% ID Circ. Notch @ 12 degrees	20% ID Circ. Notch @ 12 degrees	20% ID Circ. Notch @ 12 degrees	Pulse @ 90 degrees
Span Setting Minimum	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	Pulse @ 4 divisions

Process Channels

Channel & Frequency (See Note 5)	Ch P1 300/100 kHz Panc	Ch P2 300/100 kHz Axial	Ch P3 300/100 kHz Circ	N/A
Phase Rotation	20% ID Ax. Notch @ 12 degrees	20% ID Ax. Notch @ 12 degrees	20% ID Circ. Notch @ 12 degrees	
Span Setting Minimum	40% OD Ax. Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	

Voltage Normalization

Calibration Curves

CH	Signal (Note 13)	Set	Normalize	Type	CH	Set Points
1	100% Ax notch	20 Vp-p	Ch. 4, 7 & P1	(Reso) Phase Curve (Note 12)	1	40, 60, 100 Ax. OD notch
2	100% Ax notch	20 Vp-p	Ch. 5, 9 & P2			
3	100% Circ. notch	20 Vp-p	Ch. 6, 10 & P3	(Reso) Phase Curve (Note 12)	1	40, 60, 100 Circ OD notch

Data Screening

Left Strip Chart	Right Strip Chart	Lissajous
P1	Ch 6	Ch P1

Reporting Requirements

Condition/Region	Report	Ch.(Note 16)	Comment
Single Axial Indication	SAI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Multiple Axial Indication	MAI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Single Circumferential Indication	SCI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Multiple Circumferential Indication	MCI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Single Volumetric Indication	SVI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Mixed Mode Indication	MMI	1 or P1	Any amplitude - Report on volts peak - peak (TBR in Util 2)
Possible Loose Part	PLP	12	Any Indication of Secondary Side Foreign Parts
Volumetric	VOL	1 or P1	Any amplitude - Report on volts peak - peak
Loose Part Indication	LPI	P1	Any Indication of tube degradation associated w/ PLP (see Note15) (TBR in Util 2)
Multiple Volumetric Ind.	MVI	1 or P1	Any amplitude - Report on volts peak-peak (TBR in Util 2)



ENTERGY

**ARKANSAS NUCLEAR ONE
ENGINEERING STANDARD**

**ANO-2 STEAM GENERATOR EDDY CURRENT
EXAMINATION GUIDELINES**

**No.: HES-28
Rev. No.: 11
SCN No.: 1
Page: 62**

Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

Page: 4 of 5

Special Instructions

1. Refer to Appendix II additional instructions regarding the data screening and evaluation of RPC Probe data.
2. All phase rotation settings are set with indications going up
3. Rotate data using "Data Slew Menu" so coils 5 and 7 are aligned with coil 1.
4. Span, Phase, and Volts are to be set using the center of the notch.
5. Process Channel P1, P2 and P3 shall be created to aid in the evaluation of indications that may be masked by deposits. Suppress the tube support ring on the calibration standard using the signal response from one complete revolution of the support ring. After suppression check the standard to make sure all flaws are not distorted by the suppression process.
6. Evaluate the full length of the recorded data.
7. Plot tubesheet interfaces with Channels 1, 2 and 3 as a minimum.
8. Volumetric (MBM) calls at the top of the tubesheet may represent mixed mode cracking. Indications should be investigated to determine that cracking is not present prior to accepting a MBM call.
9. Monitor the configuration widget for proper data sampling. Set the warning dialog to trigger at 25 axial samples and 30 circumferential samples. When these requirements are not met in the area of interest, reject the data and notify the Lead.
10. When the c-scan plot area is set to $\pm 1.0"$ there should be a minimum of 50 scan lines and 72 data points per scan line.
11. Label channels 1, 4, 7 and P1 "Panc". Label channels 2, 5, 9 and P2 as "Axial". Label channels 3, 6, 10 and P3 as "Circ". Label channel 8 as "Trigg". Label channel 11 as "AxEn". Label channel 12 as "Loc".
12. Resolution as required will size, on best effort basis, each reported indication. Two phase angle calibration curves will be required. One for axial indications and one for circumferential indications. These calibration curves will be developed inside the RPC c-scan window.
13. When the 100% EDM notch saturates on specific channels, use the 60% ID notch and set to 7.0 volts for these channels.
14. This configuration can be used with a single pancake coil.
15. Any bobbin PLP call shall be rotated and compared to the previous outage inspection. If the PLP was called last outage, the bobbin signal shall be compared and any change >10 degrees phase angle on P1 shall be reported as an LPI and repaired.
16. Reporting from the directed coils (axial, circ) is allowable when the pancake coil does not produce a good signal.

Examination Technique Specification Sheet ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)	Page: 5 of 5
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Resolution Sizing Methodology of Indications for Engineering Evaluation

SG ROW COL VOLTS DEG PCT CHAN LOCATION FROM TO EXTENT UTIL1 UTIL2

Circumferential Indication (SCI, MCI)

10	114	82	0.18	33	ARC	1 or P1	TSH	+0.15		TSHTSH		
10	114	82	0.34	21	SCI	1 or P1	TSH	+0.15		TSHTSH		TBR
10	114	82	0.34	21	78	1 or P1	TSH	+0.15		TSHTSH		

Axial Indication (SAI, MAI)

10	112	4	0.95	0	LEN	1 or P1	01H	+0.25		01H01H		
10	112	4	0.67	90	SAI	1 or P1	01H	+0.25		01H01H		TBR
10	112	4	0.67	90	71	1 or P1	01H	+0.25		01H01H		

Volumetric Indication (SVI, MVI, MMI, LPI)

CIRC AXIAL

10	88	4		0	CLP	1 or P1	04H	+10.25	0.76	05H04H	0.56	0.56
10	88	4	1.01	123	SVI	1 or P1	04H	+10.25		05H04H		TBR
10	88	4	1.01	123	43	1 or P1	04H	+10.25		05H04H		

The voltage shall be the maximum voltage response of the indication.

The Depth shall be the deepest or most representative estimate.

The Location shall be recorded as the distance from the center of the nearest structure to the first Hit of the indications. All Line Entries shall have the same Locations.

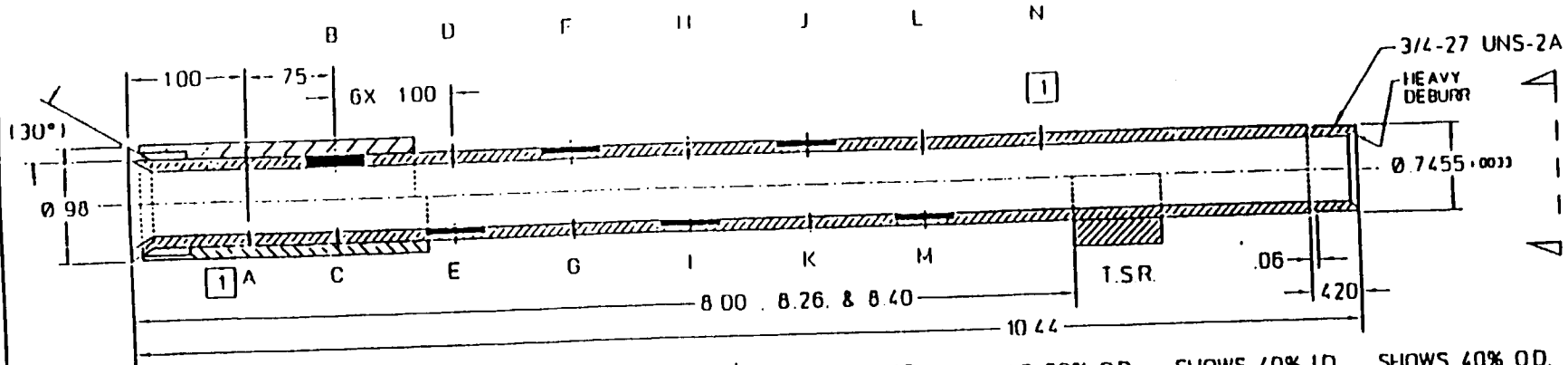
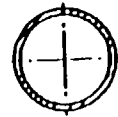
- 1 Indications will be measured using the 300 kHz pancake coil. If other frequencies or coils give a better representation of the indication it may be used. Depth measurements will be estimated from the phase angle calibration curve using the deepest hit or the most representative estimate. The most representative estimate is that derived from multiple hits, which display close correlation, and only one hit is greatly different.
- 2 Linear (crack-like) indications require a length measurement. The measurement will be taken from the C-SCAN strip chart using the To/From measurement feature. Multiple scan lines shall be reviewed to insure a conservative measure.
- 3 Volumetric indications require length and width measurement. Set the threshold just above baseline and adjust the box to the size of the positive image. Set the OD (.750") for tube diameter in C-SCAN "users select".
- 4 In the Circ and Axial Liss windows of the C-SCAN "set volts units" to "use main eddy voltage".
- 5 Report SVI, MVI, VOL, SAI, MAI from Circ Liss. Report SCI, MCI from Axial Liss.

AXIAL AND CIRC FLAWS
 FROM EDM .005 .002 WIDE X 500 LONG

3	2	STEEL	REV. STATUS OF SHEETS	0	01/00/97	REV SHEET #2	NO CHANGES SHEET #1	DRAFT	ERROR	K2
---	---	-------	-----------------------	---	----------	--------------	---------------------	-------	-------	-----	-----	----

LOCATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
PHYSICALLY MEAS DEPTH	THRU	THRU	THRU	.0310	.0320	.0300	.0300	.0195	.0205	.0195	.0210	.0110	.0100	THRU	
DEPTH IN % OF WALL	100%	100%	100%	61%	59%	59%	59%	31%	40%	38%	41%	22%	20%	100%	

SHOWS 100% THRU HOLE LOC N



ORIENTATION OF ALL FLAWS

1 Ø.052 ± .003 IN STD ≤ 75 DIA.
 Ø.067 ± .003 IN STD > 75 DIA.

MATERIAL INCONEL 600
 AVERAGE MEAS WALL THK .051
 NOMINAL WALL THK .049
 HEAT LOT NO 752493
 TEST FREQ USED NA
 SERIAL NO 7-15727
 PO NO 54414
 REL NO NA

QUALITY REL NO NA
 DATE MFG 3-13-97
 QA INSP Hugh Allen
 CUSTOMER ERAMETEC TECHNOLOGIES
 RECORDED NA
 PROBE USED NA
 REVIEWED BY Charlotte Better

	SHOWS 100% AXIAL FLAW LOC B	SHOWS 60% ID CIRC. FLAW LOC D	SHOWS 60% OD. AXIAL FLAW LOC F	SHOWS 40% ID CIRC. FLAW LOC H	SHOWS 40% OD. AXIAL FLAW LOC J	SHOWS 20% ID CIRC. FLAW LOC L
LOC A SHOWS 100% THRU HOLE	LOC C SHOWS 100% CIRC FLAW	LOC E SHOWS 60% ID AXIAL FLAW	LOC G SHOWS 60% OD. CIRC FLAW	LOC I SHOWS 40% ID. AXIAL FLAW	LOC K SHOWS 40% OD. CIRC. FLAW	LOC M SHOWS 20% ID AXIAL FLAW

NOTE

UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES TOLERANCES DECIMAL FRACT .1/16 XXXX ± .003 XX ± .015 X ± .030 ANGULAR 13° FINISH 0-ST 000	DRAWN K ZEGKE	DATE 12/03/96	ZETEC INC POST OFFICE BOX 48 3500 JAM PAS-10104 98017-446 USA TELEPHONE (509) 761-3338
	CHECK TO DELL	DATE 12/10/96	
	DESIGN B J	DATE 12/10/96	
	APVD QA G A	DATE 12/10/96	
TITLE G.T. CALIBRATION STANDARD		Dwg NO 2-415-1059	
SIMILAR		SCALE NTS	USED BY 2-415-0016 SHI 1 OF 3

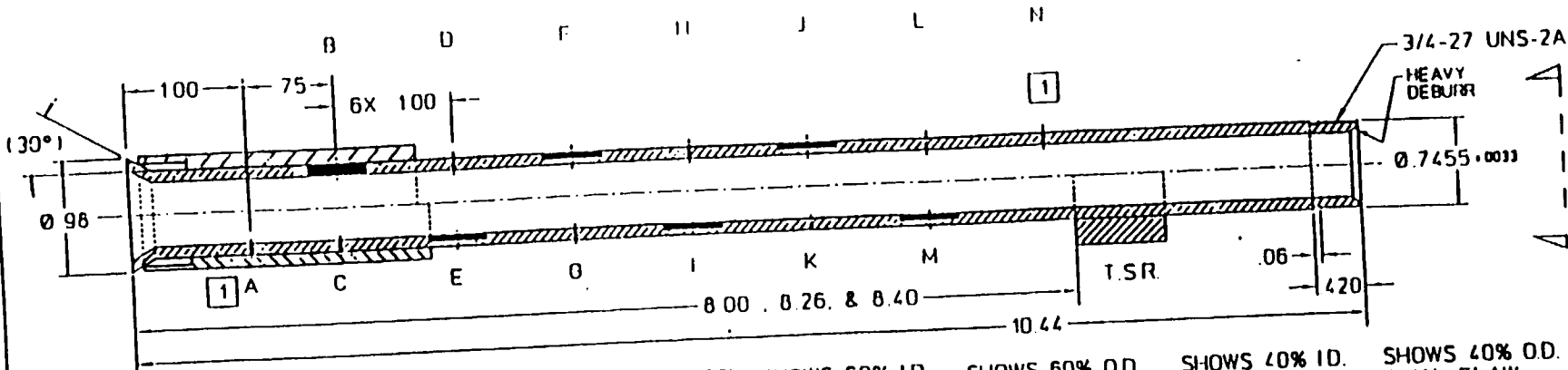
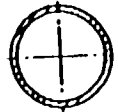
ALL AXIAL AND CIRC FLAWS
ARE EDM .005 .002 WIDE X 500 LONG

A	D	REVISIONS	REV STATUS
3	2	SHEET	OF SHEETS

REVISIONS		APVD	CK	DR
LTR	DATE	DESCRIPTION
B	01/08/97	REV. SHI #2 . NO CHANGES SHI #1, DRAFT ERROR	...	K2

LOCATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
PHYSICALLY MEAS DEPTH	THRU	THRU	THRU	.0210	.0315	.0215	.0300	.0105	.0205	.0200	.0215	.0100	.0110	THRU
DEPTH IN % OF WALL	100%	100%	100%	57%	62%	56%	59%	40%	40%	39%	41%	10%	22%	100%

SHOWS 100%
THRU HOLE
LOC N

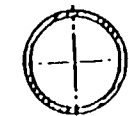


ORIENTATION
OF ALL FLAWS

1 Ø .052+.003 IN STD. ≤ .75 DIA.
Ø .067+.003 IN STD. > .75 DIA.

MATERIAL INCONEL 600
AVERAGE MEAS WALL THK .051
NOMINAL WALL THK .049
HEAT LOT NO 752493
TEST FREQ USED NA
SERIAL NO Z-15788
PO NO 54414

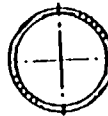
REL NO NA
QUALITY REL NO NA
DATE MFG 3-13-97
O.A. INSP Harry Allison
CUSTOMER ERLANGER TECHNOLOGIES
RECORDED NA
PROCESS USED NA
REVIEWED BY Charlotte Patten



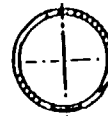
LOC A
SHOWS 100%
THRU HOLE



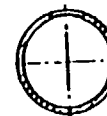
LOC C
SHOWS 100%
CIRC. FLAW



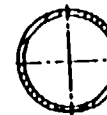
LOC E
SHOWS 60% ID
AXIAL FLAW



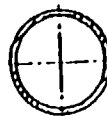
LOC G
SHOWS 60% OD
CIRC. FLAW



LOC I
SHOWS 40% ID
AXIAL FLAW



LOC K
SHOWS 40% OD
CIRC. FLAW



LOC M
SHOWS 20% ID
AXIAL FLAW

SHOWS 100%
AXIAL FLAW
LOC B

SHOWS 60% ID.
CIRC. FLAW
LOC D

SHOWS 60% OD.
AXIAL FLAW
LOC F

SHOWS 40% ID.
CIRC. FLAW
LOC H

SHOWS 40% OD.
AXIAL FLAW
LOC J

SHOWS 20% ID
CIRC. FLAW
LOC L

NOTE

ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ±.0016
XXX ± .003
XX ± .015
X ± .050
: ± .003
REGULAR ±.003
FINISH ±.001

DRAWN
K ZEOKE
CHECK
T O DELL
DESIGN
B J
APVD OA
O A

DATE
12/03/96
12/10/96
12/10/96
12/10/96

ZETEC INC

POST OFFICE BOX 48 DESHAW PASADENA
90114 USA TELEPHONE 626 302 510

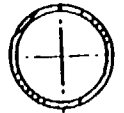
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D=4040-1-A P=343
SIMILAR
SCALE NTS
DWC NO
2-415-1059
USED BY
2-415-0016 SHI 1 OF 3

ALL AXIAL AND CIRC FLAWS
ARE EDM 005 .002 WIDE X 500 LONG

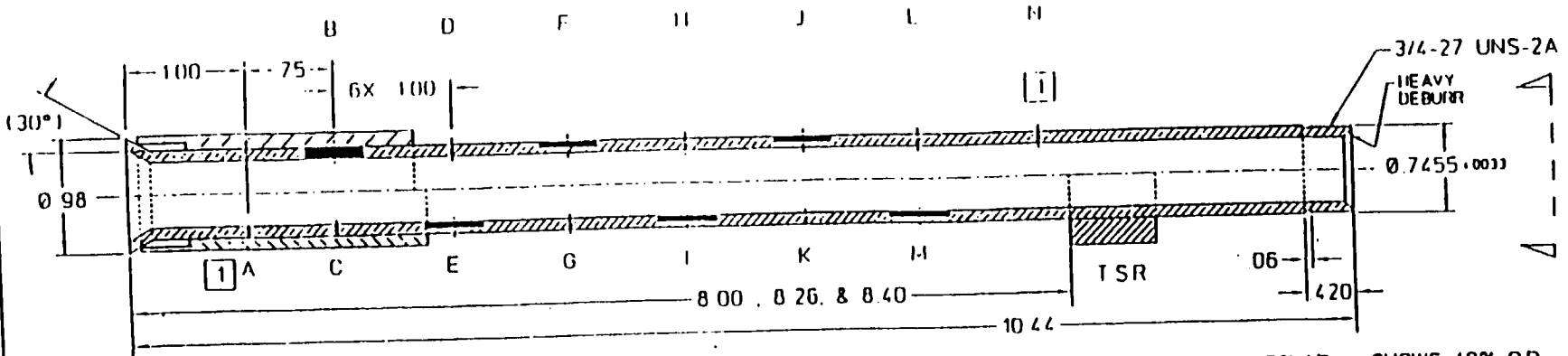
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A	B	REVISES	REV. STATUS OF SHEETS	LTR	DATE	DESCRIPTION		---	---	KZ
3	2	SHEET		B	01/00/97	REV. SHEET #2, NO CHANGES SHEET #1, DRAFT ERROR				

LOCATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
PHYSICALLY MEAS DEPTH	THRU	THRU	THRU	.0310	.0290	.0310	.0310	.0185	.0700	.0205	.0205	.0100	.0105	THRU
DEPTH IN % OF WALL	100%	100%	100%	61%	57%	61%	61%	36%	39%	40%	40%	20%	21%	100%

SHOWS 100%
THRU HOLE
LOC N



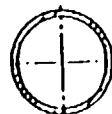
ORIENTATION
OF ALL FLAWS



[1] 0.052 ± .003 IN STD ≤ 75 DIA
0.067 ± .003 IN STD > 75 DIA

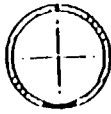
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AVERAGE MEAS WALL THK .051
NOMINAL WALL THK .049
HEAT LOT NO 752493
TEST FREQ USED NA
SERIAL NO Z-15806
PO NO 544111
REL NO NA
QUALITY REL NO NA
DATE MFG 3-13-97
QA INSP Bruce Allison
CUSTOMER FRANKLIN TECHNOLOGIES
RECORDED NA
PROBE USED NA
REVIEWED BY Charlotte Ketter

SHOWS 100%
AXIAL FLAW
LOC D



LOC A
SHOWS 100%
THRU HOLE

SHOWS 60% ID
CIRC FLAW
LOC D



LOC C
SHOWS 100%
CIRC FLAW

SHOWS 60% ID
CIRC FLAW
LOC E



LOC E
SHOWS 60% ID
AXIAL FLAW

SHOWS 60% OD
AXIAL FLAW
LOC F



LOC G
SHOWS 60% OD
CIRC FLAW

SHOWS 40% ID
CIRC FLAW
LOC H



LOC I
SHOWS 40% ID
AXIAL FLAW

SHOWS 40% OD
AXIAL FLAW
LOC J



LOC K
SHOWS 40% OD
CIRC FLAW

SHOWS 20% ID
CIRC FLAW
LOC L



LOC M
SHOWS 20% ID
AXIAL FLAW

NOTE

UNLESS OTHERWISE SPECIFIED:
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT 1/16
XXXX ± .003
XXX ± .015
XX ± .050
X ± .003
ANGULAR 1/2°
FINISH DIST 000

DRAWN	DATE
K ZEOKE	12/03/96
CHECK	DATE
T O DELL	12/10/96
DESIGN	DATE
B J	12/10/96
APVD QA	DATE
G.A.	12/10/96

ZETEC INC
POST OFFICE BOX 400000 WASHINGTON
90017-0100 USA TELEPHONE 1202 382 3300

TITLE
G.T. CALIBRATION STANDARD
D=4040-1-A P=343

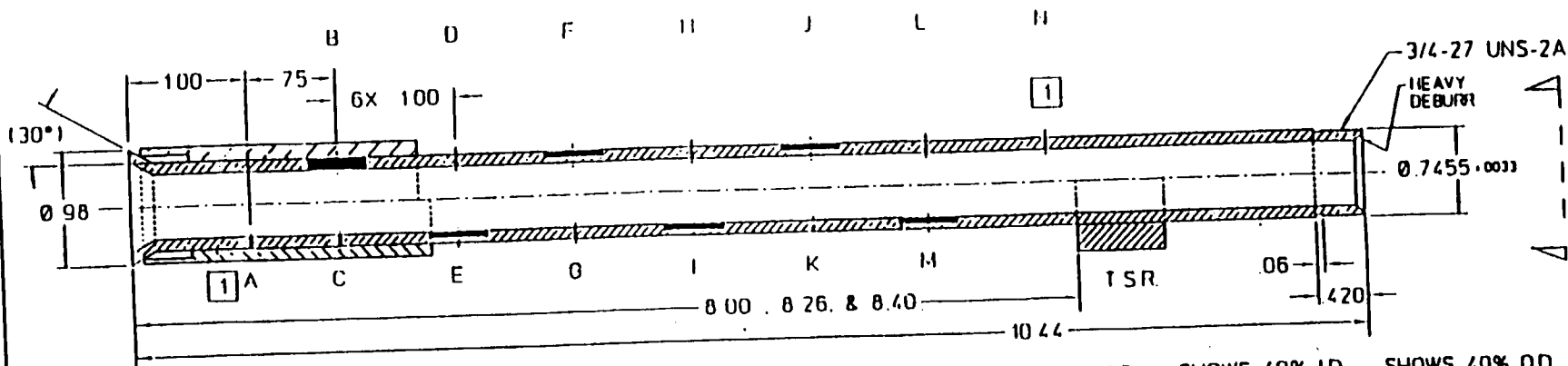
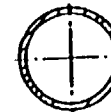
SIMILAR	OWN NO
	2-415-1059
SCALE NTS	USED BY
	2-415-001E S-1 1 OF 3

ALL AXIAL AND CIRC FLAWS
ARE EDM .005 .002 WIDE X 500 LONG

REV		DATE	DESCRIPTION	APVD	CK	DR
3	2	01/08/97	REV. SHIT #2 . NO CHANGES SHIT #1. DRAFT. ERROR	---	---	KZ

LOCATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
PHYSICALLY MEAS DEPTH	THRU	THRU	THRU	.0310	.0290	.0305	.0295	.0200	.0205	.0195	.0190	.0105	.0105	THRU
DEPTH IN % OF WALL	100%	100%	100%	61%	57%	60%	58%	39%	40%	39%	39%	20%	21%	100%

SHOWS 100%
THRU HOLE
LOC N



ORIENTATION
OF ALL FLAWS

1 Ø.052+.003 IN SID ≤ 75 DIA
Ø.067+.003 IN SID > 75 DIA

MATERIAL INCOEL 600
AVERAGE MEAS WALL THK .051
NOMINAL WALL THK .049
HEAT LOT NO 752493
TEST FREQ USED NA
SERIAL NO Z-15807
PO NO 54414

LOC A	LOC B	LOC C	LOC D	LOC E	LOC F	LOC G	LOC H	LOC I	LOC J	LOC K	LOC L	LOC M
SHOWS 100% THRU HOLE	SHOWS 100% AXIAL FLAW	SHOWS 100% CIRC FLAW	SHOWS 60% ID AXIAL FLAW	SHOWS 60% ID CIRC FLAW	SHOWS 60% OD AXIAL FLAW	SHOWS 60% OD CIRC FLAW	SHOWS 40% ID CIRC FLAW	SHOWS 40% ID AXIAL FLAW	SHOWS 40% OD AXIAL FLAW	SHOWS 40% OD CIRC FLAW	SHOWS 20% ID CIRC FLAW	SHOWS 20% ID AXIAL FLAW

REL NO NA
QUALITY REL NO NA
DATE MFG 3-13-97
QA INSP Bruce Allison
CUSTOMER ERANISIDE TECHNOLOGIES
RECORDED NA
PROBE USED NA
REVIEWED BY Charlotte Bettes

NOTE

UNLESS OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT 1/16
XXX .003
XX .015
X .050
: .003
ANGULAR .3°
FIRST 000

DRAWN
K ZEGKE
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12/10/96

ZETEC INC
1051 OFFICE BLDG 400 45100W WASHINGTON
94027-0100 USA TELEPHONE (415) 301-3100


TITLE
G.T. CALIBRATION STANDARD
Da4040-1-A P43435

SIMILAR
SCALE NTS

DWG NO
2-415-1059

REVISION
2-415-0016

SHEET 1 OF 3

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	ANO-2 STEAM GENERATOR EDDY CURRENT EXAMINATION GUIDELINES	

10.2 ATTACHMENTS

10.4.1 ATTACHMENT I - ETSS #1 Bobbin Examination

Examination Technique Specification Sheet					
ETSS # 1 - BOBBIN PROBE				Page: 1 of 4	
Site: Entergy Operation Inc. Arkansas Nuclear One Unit #2					
Examination Scope					
Applicability: Standard ASME Code Examination. Use for detection of IGA/ODSCC at non-dented drilled and eggcrate support structures, in freespan tubing and within sludge pile region. This technique includes the detection and sizing of wear diagonal and vertical straps using differential 400/100-amplitude mix.					
Instrument			Tubing		
Manufacturer/Model: Zetec MIZ-30A or Equiv.			Material Type: Inconel 600		
Data Recording Equipment			OD/Wall (inch): 0.750" OD X 0.048" Wall		
Manuf./Media: HP HD 1.3Gb Optical or Equiv.			Calibration Standard		
Software			Type: ASME with Fan Bar Wear and EDM		
Manufacturer: Zetec			Analog Signal Path		
Version/Revision: EN 98, Latest Approved Version			Probe Extension Manuf.: Zetec		
Examination Procedure			Extension Type & Length: Universal 945-1760, 75 ft.		
Number/Revision: HES-28 Rev. 9			Slip Ring Model Number: 508-2052		
Scan Parameters					
Scan Direction: Pull					
Digitization Rate, Samples Per Inch (minimum):		Axial Direction		≥33	Circ. Direction
					N/A
Probe Speed	Sample Rate	RPM Set	RPM Min	RPM Max	
≤48 IPS	1777	N/A	N/A	N/A	
≤24 IPS	1100	N/A	N/A	N/A	
Probe					
Description (Model/Diameter/Coil Dimensions)			Manufacturer/Part Number		Length
A-600-M/ULC			Zetec 700-1192-061		110 ft.
A-540-SF/RM / A-560 SF/RM / A-580-SF/RM			Zetec 754-0402-001/D#2121-10-B/700-0402-051		110 ft.
A-600-M/ULC (500 nose)			Zetec D# 2120-5-G		110 ft.
Data Acquisition					
Calibration Differential Channels					
Channel & Frequency	Ch. 1 & 3 400 kHz	Ch. 5 & 7 200 kHz	Ch. 9 & 11 100 kHz	Ch. 13 & 15 20 kHz	
Phase Rotation	100% TWH 40 degrees	100% TWH 40 degrees	100% TWH 40 degrees	Tube Support Ring 90 Degrees	
Span Setting	100% TWH 6 divisions	100% TWH 6 divisions	100% TWH 6 divisions	Tube Support Ring 5 divisions	
Calibration Absolute Channels					
Channel & Frequency	Ch. 2 & 4 400 kHz	Ch. 6 & 8 200 kHz	Ch. 10 & 12 100 kHz	Ch. 14 & 16 20 kHz	
Phase Rotation	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Tube Support Ring 90 Degrees	
Span Setting	60% TWH 5 divisions	60% TWH 5 divisions	60% TWH 2 divisions	Tube Support Ring 4 divisions	



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ETSS # 1 - BOBBIN PROBE

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Configuration Board Settings

tng: off	down	Configuration # 0								Name								samples / sec								rec. media =											
tester =		board # 1		board # 2		board # 3		board # 4		board # 5		board # 6		board # 7		board # 8		board # 1		board # 2		board # 3		board # 4		board # 5		board # 6		board # 7		board # 8					
# of channels = 16		probe # 1		probe # 1		probe # 2		probe # 2		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1		probe # 1							
		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE		DRIVE							
		A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C
Drive Polarity		N	N							N	N																										
Group Number		1	1							2	2																										
Coil Number		1	5							1	5																										
FREQ #1	Time Slot # 1	D		A						D		A																									
	G: x 2 12.0 V																																				
FREQ #2	Time Slot # 2	D		A						D		A																									
	G: x 2 12.0 V																																				
FREQ #3	Time Slot # 3	D		A						D		A																									
	G: x 2 12.0 V																																				
FREQ #4	Time Slot # 4	D		A						D		A																									
	G: x 4 12.0 V																																				
FREQ #5	Time Slot # 5																																				
FREQ #6	Time Slot # 6																																				
FREQ #7	Time Slot # 7																																				
FREQ #8	Time Slot # 8																																				
END LOC CH:	1 1	DRIVE A: D = A1-A2, P = dr: A1 pu: A2. DP = dr: D1&D2 pu: A1&A2																																			
THRESHOLD:	off off	DRIVE B: D = B1-B2, A = A1-B2																																			
(P) GAIN:	x6	P = dr: B1 pu: B2. DP = dr: C1&C2 pu: B1&B2																																			
ACTIVE PROBES:	2	DRIVE C: D = C1-C2, A = D1-C2																																			
		DRIVE D: D = D1-D2																																			

Default	Print	OK
Gain/PD	Screen	EXIT

Special Instructions

- The A-600-M/ULC probe is the primary use probe for the bobbin examination. The A-580SF/RM and A-560SF/RM are used to test low row tubes.
- The A-580-SFRM probe can be used in tubes reported as RRT with the .600" probe as directed by the FTI Level III and Entergy approval. If needed, a 0.560 SF/RM probe, or a 0.540 SF/RM can be used as directed by the FTI Level III and Entergy approval.
- Examine each tube full length or to the extent possible.
- Enter a message at the beginning of each calibration group indicating that the data is being acquired with either single or dual probes. If dual probes are being used state which calibration group is the primary probe and which is the secondary probe.
- When acquiring data with a single probe Coil 1 (differential) channels will be Ch1=400 kHz, Ch3=200 kHz, Ch5=100 kHz, Ch7=20kHz and the Coil 5 (absolute) channels will be Ch2=400 kHz, Ch4=200 kHz, Ch6=100 kHz, Ch8=20 kHz.
- Slower speeds (24 IPS) are recommended in the smaller radius U-bend tubes (row 5 and below) due to probe snapping through the U-bend.
- Three recordings of the calibration standard should be performed at the beginning and end of each calibration group.
- As a minimum, a position verification and a message will be entered once per calibration group.
- Tubes, which have been mis-encoded, should be corrected by entering a message to void that entry and re-examining the tube with the proper encode. This is required to maintain an accurate DSR database.

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Data Analysis

Calibration Differential Channels

Channel & Frequency	Ch 1 400 kHz	Ch 3 200 kHz	Ch 5 100 kHz	Ch 7 20 kHz
Phase Rotation	100% TWH @ 40 degrees	100% TWH @ 40 degrees	100% TWH @ 40 degrees	Tube Support Ring @ 90 Degrees
Span Setting Minimum	100% TWH @ 75% FSH	100% TWH @ 75% FSH	100% TWH @ 75% FSH	Tube Support Ring @ 50% FSH

Calibration Absolute Channels

Channel & Frequency	Ch 2 400 kHz	Ch 4 200 kHz	Ch 6 100 kHz	Ch 8 20 kHz
Phase Rotation	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	100% TWH @ 40 Degrees	Tube Support Ring 270 Degrees
Span Setting Minimum	60% TWH @ 50% FSH	60% TWH @ 50% FSH	60% TWH @ 20% FSH	Tube Support Ring @ 40% FSH

Calibration Process and Other Channels

Channel & Frequency	P1 (Ch 1/5) 400/100 kHz Diff	P2 (Ch 1/5) 400/100 kHz Diff	P3 (Ch 1/3/5 turbo) 400/200/100 kHz Diff	N/A
Configure & Adjust Parameters	Suppress Support Ring	Suppress Support Ring	Save 100, 60, 20 Suppress TSP TSH & TSC	
Phase Rotation	Probe Motion Horiz. Flaws start down	Probe Motion Horiz. Flaws start down	Probe Motion Horiz. Flaws start down	
Span Setting Minimum	100% TWH @ 75% FSH	50% Wear @ 50% FSH	100% TWH @ 50% FSH	

Voltage Normalization

Calibration Curves

CH	Signal	Set	Normalize	Type	CH	Set Points
1	4X20% FBH	4 Vp-p	All	Phase	1, 3, 5, P1,	100, 60, 20 FBH
				Magnitude (Vmax)	P2	0, 30, 50 Wear


Data Screening

Left Strip Chart	Right Strip Chart	Lissajous
P1	Ch 6	Ch P1

Reporting Requirements

Condition/Region	Report	Ch.	Comment
Absolute Drift	ADI	6	Vert-Max (Low Row U-bend)
Freespan	DFI	→	Use "Free Span Bobbin Coil Indication Flow Chart"
Eggcrates	DSI	P1	See Note 6
Drilled Support Plates	DSI	P1	See Note 7
Batwings	DSI	P1	See Note 9
Tubesheet	DTI	P3	See Note 4
Dents	DNT	P1	All Dent Indications > 3 volts located anywhere.
Indication Not Reportable	INR		Indications detected are not reportable by guidelines
Indication Not Found	INF		Resolution is require to research and resolve per guidelines
Wear	DSI	P2	Indications with no history. See Note 9.
Wear	%	P2	Vert-Max Differential At the Batwing edges only. Check contact. See Note 9.
Possible Loose Part	PLP	8	Any Indication of Secondary Side Foreign Parts, See Note 12
Loose Part Indication	LPI	P1	See Note 12

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ETSS # 1 - BOBBIN PROBE

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Special Instructions

1. Refer to Appendix I additional instructions regarding the data screening and evaluation of Bobbin Probe data.
2. Zoom the strip chart to a maximum value of 8 to increase visibility of small amplitude indications.
3. All areas of the tubing should be examined with both P1 and Ch6 for distortion at structure and/ or drifts that may be indicative of cracking.
4. Review tubesheet data for indications of degradation, distortion and drifts indicative of axial or circumferential cracking. Indications may be confirmed by using Ch5, Ch6 or P3. Evaluation is typical in P1 or Ch1. Based upon experience at ANO-2, take care to examine the entire tubesheet entry signal at the setup span on Ch1 and Ch3 for distorted signals indicative of cracking. Also observe the response of P3. The requirement to screen the entire tubesheet entry signal is critically important in both the hot leg and cold leg. Distorted signals, which may be indicative of a flaw on the bobbin, shall be flagged for RPC examination by reporting as DTI in the % column. If the indication is not in the expansion transition, the indication should be evaluated and reported from P1.
5. In the presence of deposits at the top of the tubesheet, if the signal has the characteristics of a flaw on P1, report these indications as an "NQI" code and test with an RPC examination.
6. Evaluate each support on the P1 process channel. Eggcrates typically have three signals representing the two edges and the center of the eggcrate. Indications can be confirmed with Ch1, 3, or 5 when deposit influence is not present. Indications that are phased in the ID plane on P1 should confirm on Ch3 and/or Ch5. Indications may not always display an expected counter-clockwise rotation.
7. Dented drilled supports should be screened with P1 and P3. P3 indications must confirm as an indication on either Ch1, Ch3, or Ch5.
8. Using P1 and Ch5 to scroll through the upper hot leg area from 07H through the u-bend region. Also evaluate this using the Ch6 strip chart for drift indications. Evaluation is typically on P1, Ch5 and Ch6. Monitor the 100 kHz absolute strip chart for positive drift (special attention to the low row u-bends).
9. Wear or fretting indications at the Batwings should be evaluated and called using P2. If the indication does not have history record as a DSI. If the indication has history record %TW. Confirmation of a contact point is made by using Ch8. If the indications are not on a contact point or are sharp and not typical of wear, evaluation should be made using P1 and report as DSI.
10. When using Auto Calibration features, make sure that you are using the file that matches the Standard being used.
11. Monitor the configuration widget for proper data sampling. Set the warning dialog to trigger at 33 axial samples.
12. Observe the stripchart and Lissajous presentations for indications occurring anywhere along the tube but especially on top of the tubesheet and supports. Possible loose parts shall be screened and reported as a Possible Loose Part (PLP) on 20 kHz absolute. This will signify the need for further characterization with a rotating probe technique.

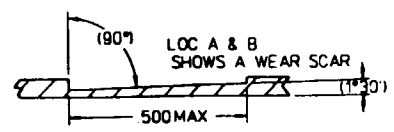
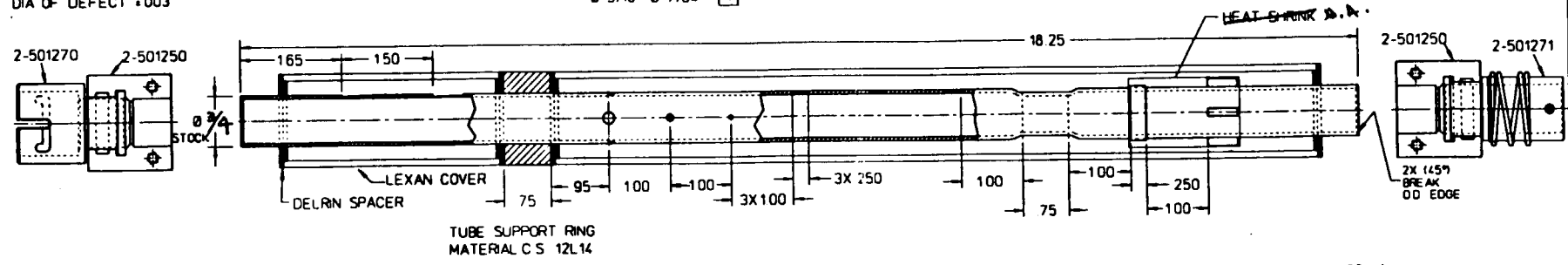
SCN
-1

2 R13

REV. SCS			
LTR	DATE	DESCRIPTION	APV: CK DR

1 0.052 IN STD ≤ 0.75
0.067 IN STD > 0.75

LOCATION	A	B	C	D	E	F	G	H	I	J	K
PHYSICALLY MEAS DEPTH	.0135	.0245	.0100	.0215	THRU	.0095	.0285	THRU	.0060		
DEPTH IN % OF WALL	28%	51%	21%	57%	100%	20%	61%	100%	13%		
ET PHASE ANGLE MEAS			150°	107°	40°						
DIA OF DEFECT *003			0.316	0.764	1						



- LOC C SHOWS 4-FLAWS EQUALLY SPACED AROUND TUBE
- LOC F THRU H SHOWS OD AXIAL EDM NOTCH 250 LONG X 006 MAX WIDE
- LOC I SHOWS 360° DENT 75 WIDE X 007±002 DP
- LOC J SHOWS 360° COPPER RING 250 WIDE X 003 THK
- LOC K SHOWS 4X EO SPACED (90°) APART EGG CRATE SIMULATION 2-416-1016 MATERIAL C S 12L14

MATERIAL INCONEL 600
 AVERAGE MEAS WALL THK .048
 NOMINAL WALL THK .048
 HEAT LOT NO 152671 ENTIRELY OPS. MTRL.
 TEST FREQ USED 430 KHZ
 SERIAL NO 2-15380
 PO NO 910519
 REL NO NA
 QUALITY REL NO NA
 DATE MFG 4-9-91
 O.A. INSP Am @llm
 CUSTOMER ENTIRELY OPERATIONS
 RECORDED 92
 PROBE USED MOSEK #71186
 REVIEWED BY Charlotte Miller

NOTE

DIM UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES TOLERANCES DECIMAL FRACT. ±.1/16 XXXX ± .003 XX ± .015 X ± .050 S ± .003 ANGULAR ±.3° FINISH	DRAWN K ZECKE	DATE 02/08/97	ZETEC INC TITLE INLINE MISC. FLAWS W/COPPER DEPOSIT AND EGG CRATE SIMULATION D=4105-1-A P=3510
	CHECK ZOR	DATE 2/1/97	
APPROVED M. Allen	DATE 2/17/97	SCALE NTS	DWG NO 2-416-1017
0051 000		USED BY 2-416-0007	SHEET 1 OF 2



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10.4.2 ATTACHMENT II - ETSS #2 RPC Examination (Pancake, Ax, and Circ)

Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. Directed coils)

Page: 1 of 5

Site: Entergy Operation Inc. Arkansas Nuclear One Unit #2

Examination Scope

Applicability: Tubesheet examinations. Diagnostic testing and/or to confirm bobbin indications. Detection of IGA/ODSCC or PWSCC.

Instrument	Tubing
Manufacturer/Model: Zetec MIZ-30A/30-8	Material Type: Inconel 600
Data Recording Equipment	OD/Wall (inch): 0.750" OD X 0.048" Wall
Manuf./Media: HP HD 1.3GbOptical or Equiv.	Calibration Standard
Software	Type: RPC EDM Notch Standard
Manufacturer: Zetec	Analog Signal Path
Version/Revision: EN98 Latest Approved Version	Probe Extension Manuf.: Zetec
Examination Procedure	Extension Type & Length: Universal 945-1760, 75 ft.
Number/Revision: HES-28 Rev. 9	Slip Ring Model Number: 508-2052

Scan Parameters

Scan Direction: Push or Pull

Digitization Rate, Samples Per Inch (minimum): Axial Direction ≥25 Circ. Direction ≥30

Probe Speed	Sample Rate	RPM Set	RPM Min	RPM Max
0.45 in/sec.	1280	850	700	1000

Probe/Motor Unit

Description (Model/Diameter/Coil Dimensions)	Length	Motor Units
810-4090-000 - .610 (.115) MRPC 3C-52PH	50' or 83'	700-4055-071 - .610 9D-MRPC-52MU
D# 2651-2-A - .580 (.115) MPRC 3C-52PH	50' or 83'	810-4050-001 - .560 9D-MRPC-52MU
		D#3414-13-A - .600 TTS extension shaft (+2'/-2") 48"

Data Acquisition

Calibration 0.115 Coil Channels (Dual Probes)

Channel & Frequency	Ch. 1 & 4 300 kHz	Ch. 7 & 10 200 kHz	Ch. 13 & 17 100 kHz	Ch. 23 & 24 20 kHz
Phase Rotation	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Tube Support Ring Up @ 90 degrees
Span Setting	40% OD Axial Notch @ 3 divisions	40% OD Axial Notch @ 3 divisions	40% OD Axial Notch @ 3 divisions	Tube Support Ring @ 3 Divisions

Calibration Axial Sensitive Coil and Trigger Channels (Dual Probes)

Channel & Frequency	Ch. 2 & 5 300 kHz	Ch. 8 & 11 200 kHz	Ch. 15 & 19 100 kHz	Ch. 14 & 18 100 kHz
Phase Rotation	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Large pulse up, small pulse horizontal
Span Setting	40% OD Axial Notch @ 3 divisions	40% OD Axial Notch @ 3 divisions	40% OD Axial Notch @ 3 divisions	Large Pulse @ 4 divisions

Calibration Circumferential Sensitive Coil (Dual Probes)

Channel & Frequency	Ch. 3 & 6 300 kHz	Ch. 9 & 12 200 kHz	Ch. 16 & 20 100 kHz	Ch. 21 & 22 100 kHz (optional)
Phase Rotation	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Probe Motion Horiz. Flaws up first	Pulse @ 90 degrees
Span Setting	20% ID Circ. Notch @ 2 divisions	20% ID Circ. Notch @ 2 divisions	20% ID Circ. Notch @ 2 divisions	Pulse @ 4 divisions

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ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

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Configuration Board Settings

trig: off	down	Configuration # 0				Name: Dual 3-Coil				samples / sec: 1280	rec. media =	Har										
tester =		board # 1	board # 2	board # 3	board # 4	board # 5	board # 6	board # 7	boa													
# of channels = 24		probe # 1	probe # 1	probe # 2	probe # 2	probe # 1	probe # 1	probe # 1	probe # 1	probe # 1	probe # 1	prol										
		DRIVE				DRIVE				DRIVE				DRIVE								
		A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A	D	B	C	A
Drive Polarity		N			N	N			N	N			N	N			N	N			N	
Group Number		1			1	1			1	2			2	2			2	2			2	
Coil Number		1			4	5			7	8			4	5			7	8				
FREQ #1	Time Slot # 1	D				D			D				D	D								
300 kHz	G: x 2 12.0 V																					
FREQ #2	Time Slot # 2	D				D			D				D	D								
200 kHz	G: x 2 12.0 V																					
FREQ #3	Time Slot # 3	D			D	D			D				D	D								
100 kHz	G: x 2 12.0 V																					
FREQ #4	Time Slot # 4								D								D					
100 kHz	G: x 2 12.0 V																					
FREQ #5	Time Slot # 5	D							D													
20 kHz	G: x 4 12.0 V																					
FREQ #6	Time Slot # 6																					
FREQ #7	Time Slot # 7																					
FREQ #8	Time Slot # 8																					
END LOC CH :	1 1	DRIVE A : D = A1-A2, P = dr:A1 pu:A2, DP = dr : D1&D2 pu : A1&A2										Default	Print									
THRESHOLD :	off off	DRIVE B : D = B1-B2, A = A1-B2																				
(P) GAIN	x6	P = dr : B1 pu:B2, DP = dr : C1&C2 pu : B1&B2																				
ACTIVE PROBES :	2	DRIVE C : D = C1-C2, A = D1-C2																				
		DRIVE D : D = D1-D2										Gain/PD	Screen									

Special Instructions

1. Enter a message at the beginning of each calibration group indicating that the data is being acquired with either single or dual probes. If dual probes are being used state which calibration group is the primary probe and which is the secondary probe. The message shall include whether the data is acquired on the push or pull.
2. When acquiring data with a single probe delete boards 3 & 4. The Coil 1 (.115" Panc) channels will then be Ch 1=300 kHz, Ch 4=200 kHz, Ch 7=100 kHz, Ch 12=20 kHz. The Coil 4 (Trigger) channel will be Ch8=100 kHz. The Coil 5 (Axial) channels will be Ch 2=300 kHz, Ch 5=200 kHz, Ch 9=100 kHz. The Coil 7 (Circ) channels will be Ch 3=300 kHz, Ch 6=200 kHz, Ch 10=100 kHz. Coil #8 will be Ch 11 100 kHz.
3. Examine each location and record a run-out. Run-out record not required for tubesheet intersection scans.
4. The TSH expansion transition shall be acquired by pushing the probe through transition and shall be adequate to cover the target location. The scan shall normally be from 2.0" below the transition to 2.0" above the top of the tubesheet. In the event that the probe stalls on the push, the data may be acquired by pulling the probe through the transition. This will require the operator to message the event prior to acquiring the data.
5. Other locations may be scanned on the PULL or PUSH and shall be adequate to cover the target location. For special interest indications located within a structure, the data shall be acquired ±2" from the center of the structure. All other locations shall be acquired to include a minimum of one structure. Care should be taken to insure that the proper location is scanned with adequate data past the target location to account for any variations in probe speed or axial scaling.
6. One calibration standard may be recorded at the beginning and end of each cal group provided it is a successful scan of the standards complete length.
7. Tubes which have been mis-encoded should be corrected by entering a message to void that entry and re-examining the tube with the proper encode. This is required to maintain an accurate DSR database.
8. Axial Encoder is used at the operator's discretion. When not used, activate timeslot as usual, and no setup is required.



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ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

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Data Analysis

Pancake Channels

Channel & Frequency	Ch 1 300 kHz	Ch 4 200 kHz	Ch 7 100 kHz	Ch 12 (Locator) 20 kHz
Phase Rotation	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	Tube Support Ring Up @ 90 degrees
Span Setting Minimum	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	Tube Support Ring @ 3 Divisions

Axial Sensitive Coil & Trigger Channels

Channel & Frequency	Ch 2 300 kHz	Ch 5 200 kHz	Ch 9 100 kHz	Ch 8 (Trigger) 100 kHz
Phase Rotation	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	Large Pulse Up, Small Pulse Horiz.
Span Setting Minimum	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	Large Pulse @ 4 divisions

Circumferential Sensitive Channels

Channel & Frequency	Ch 3 300 kHz	Ch 6 200 kHz	Ch 10 100 kHz	Ch 11 100 kHz (optional)
Phase Rotation	20% ID Circ. Notch @ 10 degrees	20% ID Circ. Notch @ 10 degrees	20% ID Circ. Notch @ 10 degrees	Pulse @ 90 degrees
Span Setting Minimum	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions	Pulse @ 4 divisions

Process Channels

Channel & Frequency	Ch P1 300/100 kHz Panc	Ch P2 300/100 kHz Axial	Ch P3 300/100 kHz Circ
Phase Rotation	Probe Motion Horiz. Flaws Up	Probe Motion Horiz. Flaws Up	20% ID Circ. Notch @ 10 degrees
Span Setting Minimum	40% OD Circ. Notch @ 2 divisions	40% OD Axial Notch @ 2 divisions	40% OD Circ. Notch @ 2 divisions

Voltage Normalization

Calibration Curves


CH	Signal	Set	Normalize	Type	CH	Set Points
1	100% Ax notch	20 Vp-p	Ch. 4, 7 & P1	(Reso) Phase Curve (Note 12)	1	40, 60, 100 Ax. OD notch
2	100% Ax notch	20 Vp-p	Ch. 5, 9 & P2			
3	100% Circ. notch	20 Vp-p	Ch. 6, 10 & P3	(Reso) Phase Curve (Note 12)	1	40, 60, 100 Circ OD notch

Data Screening

Left Strip Chart	Right Strip Chart	Lissajous
P1	Ch 6	Ch P1

Reporting Requirements

Condition/Region	Report	Ch.	Comment
Single Axial Indication	SAI	1 or P1	Any amplitude - Report on volts peak - peak
Multiple Axial Indication	MAI	1 or P1	Any amplitude - Report on volts peak - peak
Single Circumferential Indication	SCI	1 or P1	Any amplitude - Report on volts peak - peak
Multiple Circumferential Indication	MCI	1 or P1	Any amplitude - Report on volts peak - peak
Single Volumetric Indication	SVI	1 or P1	Any amplitude - Report on volts peak - peak
Mixed Mode Indication	MMI	1 or P1	Any amplitude - Report on volts peak - peak
Possible Loose Part	PLP	12	Any Indication of Secondary Side Foreign Parts
Volumetric	VOL	1 or P1	Any amplitude - Report on volts peak - peak
Loose Part Indication	LPI	P1	Any Indication of tube degradation associated w/ PLP (see note 16)
Wear	WAR	P1	Any amplitude at Batwings only
Multiple Volumetric Ind.	MVI	1 or P1	Any amplitude - Report on volts peak-peak

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Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

Page: 4 of 5

Special Instructions

1. Refer to Appendix II additional instructions regarding the data screening and evaluation of RPC Probe data.
2. All phase rotation settings are set with indications going up
3. Rotate data using "Data Slew Menu" so coils 5 and 7 are aligned with coil 1.
4. Span, Phase, and Volts are to be set using the center of the notch.
5. Process Channel P1, P2 and P3 shall be created to aid in the evaluation of indications that may be masked by deposits. Suppress the tube support ring on the calibration standard. Care should be taken when choosing the area that will be suppressed to develop these process channels. After suppression check the standard to make sure all flaws are not distorted by the suppression process.
6. Evaluate the full length of the data taken.
7. Plot tubesheet interfaces with Channels 1 and 3 as a minimum.
8. Volumetric (MBM) calls at the top of the tubesheet may represent mixed mode cracking. Indications should be investigated to determine that cracking is not present prior to accepting a MBM call.
9. Monitor the configuration widget for proper data sampling. Set the warning dialog to trigger at 25 axial samples and 30 circumferential samples. When these requirements are not met in the area of interest, reject the data and notify the Lead.
10. When the c-scan plot area is set to ± 1.0 " there should be a minimum of 50 scan lines and 72 data points per scan line.
11. Label channels 1, 4, 7 and P1 "Panc". Label channels 2, 5, 9 and P2 as "Axial". Label channels 3, 6, 10 and P3 as "Circ". Label channel 8 as "Trigg". Label channel 11 as "AxEn". Label channel 12 as "Loc".
12. Resolution as required will size, on best effort basis, each reported indication. Two phase angle calibration curves will be required. One for axial indications and one for circumferential indications. These calibration curves will be developed inside the RPC c-scan window.
13. For alternate voltage normalization, use the 60% ID notch and set to 7.0 volts.
14. For data acquired without the axial encoder configuration, no setup is required.
15. This configuration can be used with a single pancake coil.
16. Any bobbin PLP call shall be rotated and compared to the previous outage inspection. If the PLP was called last outage, the bobbin signal shall be compared and any change >10 degrees phase angle on P1 shall be reported as an LPI and repaired.

SCN-

SCN-



**ARKANSAS NUCLEAR ONE
ENGINEERING STANDARD**

**ANO-2 STEAM GENERATOR EDDY CURRENT
EXAMINATION GUIDELINES**

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Examination Technique Specification Sheet

ETSS # 2 - PANCAKE COIL (axial and circ. directed coils)

Page: 5 of 5

Resolution Sizing Methodology of Indications for Engineering Evaluation

SG ROW COL VOLTS DEG PCT CHAN LOCATION FROM TO EXTENT UTIL1 UTIL2

Circumferential Indication (SCI, MCI)

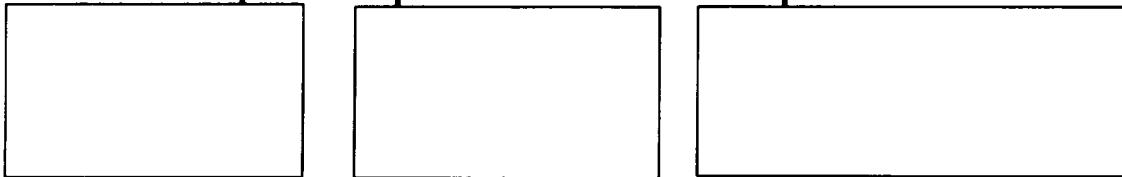
10	114	82	0.18	33	ARC	1 or Pl	TSH	+0.15		TSHTSH		
10	114	82	0.34	21	SCI	1 or Pl	TSH	+0.15		TSHTSH		
10	114	82	0.34	21	78	1 or Pl	TSH	+0.15		TSHTSH		

Axial Indication (SAI, MAI)

10	112	4	0.95	0	LEN	1 or Pl	01H	+0.25		01H01H		
10	112	4	0.67	90	SAI	1 or Pl	01H	+0.25		01H01H		
10	112	4	0.67	90	71	1 or Pl	01H	+0.25		01H01H		

Volumetric Indication (SVI, MVI)

10	88	4	0.56	0	CLP	1 or Pl	04H	+10.25	0.76	05H04H	0.56	0.76
10	88	4	1.01	123	SVI	1 or Pl	04H	+10.25		05H04H		
10	88	4	1.01	123	43	1 or Pl	04H	+10.25		05H04H		



1. Indications will be measured using the 400 kHz pancake coil. If other frequencies give a better representation of the indication it may be used. Depth measurements will be estimated from the phase angle calibration curve using the deepest hit or the most representative estimate. The most representative estimate is that derived from multiple hits, which display close correlation, and only one hit is greatly different.
2. Linear (crack-like) indications require a length measurement. The measurement will be taken from the C-SCAN strip chart using the To/From measurement feature. Multiple scan lines shall be reviewed to insure a conservative measure.
3. Volumetric indications require length and width measurement. Set the threshold just above baseline and adjust the box to the size of the positive image. Set the OD (.750") for tube diameter in C-SCAN "users select".
4. In the Circ and Axial Liss windows of the C-SCAN "set volts units" to "use main eddy voltage".
5. Report SVI, MVI, SAI, MAI from Circ Liss. Report SCI, MCI from Axial Liss.

		125 VDC/120 VAC				
		RED	GREEN	BLACK		
A	CONT CENTER 2D01 UNDERVOLT Page 68	CONT CENTER 2D02 UNDERVOLT Page 86	CONT CENTER 2D03 UNDERVOLT Page 104	A		
B	ESF PANEL 2RA1 BUS UNDERVOLT Page 69	ESF PANEL 2RA2 BUS UNDERVOLT Page 87	SPARE	B		
C	INST PANEL 2Y1 UNDERVOLT Page 70	INST PANEL 2Y2 UNDERVOLT Page 88	SPARE	C		
D	BATTERY 2D11 NOT AVAIL Page 71	BATTERY 2D12 NOT AVAIL Page 89	BATTERY 2D13 NOT AVAIL Page 105	D		
E	BUS 2D01 CHARGER TROUBLE Page 72	BUS 2D02 CHARGER TROUBLE Page 90	BUS 2D03 CHARGER TROUBLE Page 106	E		
F	2RS1 INVERTER TROUBLE Page 74	2RS2 INVERTER TROUBLE Page 92	INVERTER 2Y25 TROUBLE Page 107	F		
G	2RS3 INVERTER TROUBLE Page 79	2RS4 INVERTER TROUBLE Page 97	INVERTER 2Y26 TROUBLE Page 109	G		
H	BATTERY 2D11 GROUND Page 84	BATTERY 2D12 GROUND Page 102	BATTERY 2D13 GROUND Page 112	H		
J	DIST PNLs 2RS1/2RS3 GROUND Page 85	DIST PNLs 2RS2/2RS4 GROUND Page 103	SPARE	J		
K	SPARE	SPARE	ANNUNCIATOR POWER FAILURE Page 113	K		
	10	11	12			

• denotes reflash capability

ANNUNCIATOR 2K01

A-10

CONT CENTER 2D01 UNDERVOLT

1.0 CAUSES

1.1 2D01 bus voltage ≤ 110 VDC (relay 27-2D01).

2.0 ACTION REQUIRED

2.1 Check 2D01 voltage on Computer Point (E2D01).

2.2 Check Battery Bank (2D-11) amps and voltage.

2.3 Check 2D11 Battery Charger (2D-31A or 2D-31B) amps and voltage.

2.4 IF battery charger amps are high
AND 2D11 is discharging,
THEN secure unnecessary 2D01 loads.

2.5 Refer to Loss of 125 VDC (2203.037).

2.6 Check for overloads or multiple grounds (both positive and negative).

2.7 Refer to Tech Specs 3.8.2.3 and 3.8.2.4.

2.8 IF BOTH of the following occur:

- 2D01 Bus Undervoltage alarm valid
- Original Steam Generators (OSGs) installed

THEN direct the Dedicated Cross-tie Operator (DXO) to obtain SDS02, EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES AND proceed to Corridor 340.

2.9 IF ALL of the following occur:

- 2D01 Bus Undervoltage alarm valid
- Original Steam Generators (OSGs) installed
- EITHER SG less than 70" WR
- At least 5 available CETs above 800°F
- A sustained Loss of ALL Feedwater has occurred

THEN Control Room Staff implement SDS02, Section 2 - " Powering 2CV-4698-1 from Vital Bus 2D26".

3.0 TO CLEAR ALARM

3.1 Raise bus 2D01 voltage above setpoint.

4.0 REFERENCES

4.1 E-2451-2A

ANNUNCIATOR 2K01

A-11

CONT CENTER 2D02 UNDERVOLT

1.0 CAUSES

1.1 2D02 bus voltage ≤ 110 VDC (relay 27-2D02).

2.0 ACTION REQUIRED

2.1 Check 2D02 voltage on Computer Point (E2D02).

2.2 Check Battery Bank (2D-12) amps and voltage.

2.3 Check 2D12 Battery Charger (2D-32A or 2D-32B) amps and voltage.

2.4 IF battery charger amps are high
AND 2D-12 is discharging,
THEN secure unnecessary 2D02 loads.

2.5 Refer to Loss of 125 VDC (2203.037).

2.6 Check for overloads or multiple grounds (both positive and negative).

2.7 Refer to Tech Specs 3.8.2.3 and 3.8.2.4.

2.8 IF BOTH of the following occur:

- 2D02 Bus Undervoltage alarm valid
- Original Steam Generators (OSGs) installed

THEN direct the Dedicated Cross-tie Operator (DXO) to obtain SDS02, EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES AND proceed to Corridor 340.

2.9 IF ALL of the following occur:

- 2D02 Bus Undervoltage alarm valid
- Original Steam Generators (OSGs) installed
- EITHER SG less than 70" WR
- At least 5 available CETs above 800°F
- A sustained Loss of ALL Feedwater has occurred

THEN Control Room Staff implement SDS02, Section 1 - " Powering 2CV-4740-2 from Vital Bus 2D27".

3.0 TO CLEAR ALARM

3.1 Raise bus 2D02 voltage above setpoint.

4.0 REFERENCES

4.1 E-2451-2A

SHUTDOWN COOLING		EMERGENCY FEEDWATER		
A	LOSS OF SDC SUCTION Page 41	RCS LEVEL HI/LO Page 45	2P7B FAILURE ON EFAS Page 49	A
B	LPSI PUMP SUCT PRESS HI/LO Page 42	LPSI DISCH HEADER PRESS HI/LO Page 46	2P7B BREAKER TRIP Page 50	B
C	LPSI PUMP MOTOR AMPS HI/LO Page 43	SDC FLOW HI/LO Page 47	2P7B MOTOR OVERLOAD Page 51	C
D	SDC SUCTION PRESS HI Page 44	CET TEMP HI Page 48	EFW TRAIN A/B MISALIGNED PAGE 52	D
E	SPARE	SPARE	2P7B SUCTION PRESS HI/LO Page 53	E
F	SPARE	SPARE	2P7B DISCH PRESS HI/LO Page 54	F
G	SPARE	SPARE	2P7B TO A S/G FLOW HI/LO Page 55	G
H	SPARE	SPARE	2P7B TO B S/G FLOW HI/LO Page 56	H
J	SPARE	SPARE	SW TO 2P7B PRESS LO Page 57	J
K	SPARE	SPARE	2P7B RM CLR 2VUC-6B TROUBLE Page 58	K
	7	8	9	

ANNUNCIATOR 2K07

D-8

CET TEMP HI

NOTE

This alarm set at 700°F with Original Steam Generators (OSGs) installed.

1.0 CAUSES

1.1 CET temperature greater than variable alarm setpoint (2TI-4793).

2.0 ACTION REQUIRED

2.1 Verify temperature being controlled within desired band.

2.2 Use SPDS CET Display to verify temperature.

2.3 IF ALL of the following conditions exist:

- Original Steam Generators (OSGs) installed
- At least 5 available CETs above 800°F
- A sustained Loss of ALL Feedwater has occurred

THEN perform the following

2.3.1 Open ECCS Vent Valves

- 2CV-4698-1
- 2CV-4740-2

2.3.2 Declare Alert based on EAL 9.2 using 1903.011M, Alert Emergency Direction and Control Checklist - Shift Superintendent.

2.3.3 GO TO 2202.009, Functional Recovery

2.4 IF due to SDC failure,
THEN GO TO Loss of Shutdown Cooling (2203.029).

2.5 Adjust variable alarm setpoints as necessary.

3.0 TO CLEAR ALARM

3.1 Lower CET temperature below variable alarm setpoint (2TI-4793).

4.0 REFERENCES

4.1 E-2455-4

SAMG DEVELOPED STRATEGY SDS-02	SAMG DEVELOPED STRATEGY TITLE: SAMG DEVELOPED STRATEGY 02 EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES	PAGE: 1 of 3
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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1. Powering 2CV-4740-2 from Vital Bus 2D27	2
2. Powering 2CV-4698-1 from Vital Bus 2D26	3
Reference ER002624N201	

SAMG DEVELOPED STRATEGY SDS-02	SAMG DEVELOPED STRATEGY TITLE: SAMG DEVELOPED STRATEGY 02 EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES	PAGE: 2 of 3
--	---	---------------------

SECTION 1

Powering 2CV-4740-2 from Vital Bus 2D27

Page 1 of 1

NOTES

- Operator actions should NOT be delayed for Health Physics, Security, or any other concerns.
- Elevators should NOT be used when performing this procedure.
- Prompt completion of these actions overrides all other procedures, technical specifications, or verbal directions other than those from Operations Management.
- Communications to DXO should use radio or telephone (extension 6091 for Corridor 340 and 6093 for 2B53 Room).

1.0 Entry

- Performance of this attachment is directed by TSC or Control Room

2.0 ACTIONS

- 2.1 Open Valve 2CV-4698-1 (ECCS Vent Valve) from Control Room.
- 2.2 Open Breaker 2D02-21 (2D26 MCC Supply).
- 2.3 Retrieve DC Bus connection cable from cabinet/job box outside 2B53 Room and proceed to 2B53 Room (Door 257).
- 2.3 Open Breaker 2D27-A2 (Upstream Feeder Breaker to 2CV-4698-1).

CAUTION

Breaker 2D26-A2 (Upstream Feeder Breaker to 2CV-4740-2) MUST be opened to prevent energizing the entire 2D26 Bus.

- 2.4 Open Breaker 2D26-A2.
- 2.5 Open raceway between rows 1 and 2 of the following MCCs:
 - MCC cabinet 2D26
 - MCC cabinet 2D27.
- 2.6 Connect DC Bus connection cable to plugs in each raceway.
- 2.7 Close Breaker 2D27-A2.
- 2.8 Inform Control Room power restored to 2CV-4740-2.
- 2.9 Open valve 2CV-4740-2 from Control Room.

SAMG DEVELOPED STRATEGY SDS-02	SAMG DEVELOPED STRATEGY TITLE: SAMG DEVELOPED STRATEGY 02 EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES	PAGE: 3 of 3
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SECTION 2

Powering 2CV-4698-1 from Vital Bus 2D26

Page 1 of 1

NOTES

- Operator actions should NOT be delayed for Health Physics, Security, or any other concerns.
- Elevators should NOT be used when performing this procedure.
- Prompt completion of these actions overrides all other procedures, technical specifications, or verbal directions other than those from Operations Management.
- Communications to DXO should use radio or telephone (extension 6091 for Corridor 340 and 6093 for 2B53 Room).

1.0 Entry

- Performance of this attachment is directed by TSC or Control Room

2.0 ACTIONS

- 2.1 Open Valve 2CV-4740-2 (ECCS Vent Valve) from Control Room.
- 2.2 Open Breaker 2D01-21 (2D27 MCC Supply)
- 2.3 Retrieve DC Bus connection cable from cabinet/job box outside 2B53 Room and proceed to 2B53 Room (Door 257).
- 2.3 Open Breaker 2D26-A2 (Upstream Feeder Breaker to 2CV-4740-2).

CAUTION

Breaker 2D27-A2 (Upstream Feeder Breaker to 2CV-4698-1) MUST be opened to prevent energizing the entire 2D27 Bus.

- 2.4 Open Breaker 2D27-A2.
- 2.5 Open raceway between rows 1 and 2 of the following MCCs:
 - MCC cabinet 2D26
 - MCC cabinet 2D27.
- 2.6 Connect DC Bus connection cable to plugs in each raceway.
- 2.7 Close Breaker 2D26-A2.
- 2.8 Inform Control Room power restored to 2CV-4740-2.
- 2.9 Open valve 2CV-4698-1 from Control Room.

Emergency DC Crossconnect Watch Study Guide

In the event of a total loss of feedwater, it may become necessary to depressurize the RCS to initiate feed and bleed cooling. Additionally, if high pressure safety injection and low pressure safety injection are unavailable in conjunction with a total loss of feedwater, it is critical that the RCS be depressurized to avoid the potential of steam generator tube failure due to the severe accident conditions. The ECCS vent valves can be used to depressurize the RCS. These valves relieve steam from the pressurizer to the quench tank. The ECCS vent path has two DC powered valves in series, so they may be operated with a complete loss of AC power. The ECCS vent valves are powered from opposite 125 volt vital DC power. A problem exists, looking at single failure criteria, if one train of DC power is lost.

A contingency action has been developed to deal with the loss of one train of vital 125 volt DC. Pigtails with female connectors will be connected to the 2D26 and 2D27 buses and hung in the raceway next to the affected valves. Outside the 2B-53 room will be a locked JOBOX with a procedure and a 30' connecting wire with male connectors on each end.

When a loss of a DC bus occurs, the annunciator corrective action procedure will direct the control room to dispatch the Emergency DC Crossconnect Watch to the access to 2B-53 room to obtain instructions sheet and then to STANDBY in the ESF Switchgear corridor (corridor 340) for further instruction. When the control room gives the order, the Crossconnect Watch will verify he is using the correct section of the procedure and proceed to completion.

To accomplish this task the procedure guides the control room operator to open the ECCS vent valve on the still energized bus prior to electrically isolating the pigtails. The Crossconnect Watch will then open the DC bus supply breaker to the deenergized MCC as directed by the control room operator (2D26 or 2D27) and proceed to the 2B53 room.. The Crossconnect Watch will then open the upstream feeder breakers to both ECCS vent valves. The Crossconnect Watch will then connect the extension cable. Once the cable connectors are locked in place, the feeder breaker to the ECCS vent valve on the energized bus is closed sending DC power to the opposite train vent valve. The second ECCS vent valve is then opened from the control room commencing depressurization of the RCS.

**THE OPERATOR MUST REMAIN ON STATION AND IN CONSTANT
COMMUNICATION WITH THE CONTROL ROOM.**

The evolution is expected to take less than 15 minutes (and has been time-validated at less than 10 minutes), but the need for proper self-checking can not be ignored. This evolution is considered vital for plant operation. DO NOT STOP for anyone (including HP and security) unless the operator's life or health is at immediate risk.

Since the response needs to be timely, the Emergency DC Crossconnect Watch shall carry a radio, flashlight, and set of spare AO keys with them at all times. The AO keys will be tracked using the key log in the shifty's office. Proper turnover needs to include the updating of the key log. The qual card for this watch will be given to RO's, NLO's, and trainees. It is the shift manager's responsibility to ensure that he has a qualified person available each shift. The person manning the Emergency DC Crossconnect Watch (DXO) is entered on the Shift Turnover Checklist.

Attached are sections of resources that may be helpful.

PROC./WORK PLAN NO. 1015.001	PROCEDURE/WORK PLAN TITLE: CONDUCT OF OPERATIONS	PAGE: 21 of 60 CHANGE: 052-03-0
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6.7 Auxiliary Operator

- 6.7.1 The Auxiliary Operator reports to the CRS of their respective Unit and is responsible for all operational activities executed outside the Control Room associated with secondary auxiliary components and systems.
- 6.7.2 Specific responsibilities and authorities assigned to the Auxiliary Operator are the same as those stated in Section 6.6.2 and 6.6.3 for the Waste Control Operator.

CAUTION

Dedicated Cross-tie Operator (DXO) is a Unit 2 specific watchstation and SHALL be manned when Unit 2 Original Steam Generators (OSGs) are installed.

6.8 Dedicated Cross-tie Operator (DXO)

- 6.8.1 The Dedicated Cross-tie Operator (when manned) reports to the CRS of Unit 2 and is responsible for implementation of Severe Accident Management Guideline (SAMG) Developed Strategy 02 (SDS02), "EMERGENCY POWER FOR UNIT 2 ECCS VENT VALVES".
- 6.8.2 Specific responsibilities and authority assigned to the Dedicated Cross-tie Operator include the following:
- Maintain manned status when Original Steam Generators (OSGs) are installed on Unit 2.
 - Maintain response capability with appropriate equipment
 - Radio
 - Flashlight
 - Key to Door 257 (Room 2091 AKA 2B53 Room)
 - Implement SDS02 when directed by the CRS or the Technical Support Center (TSC). A copy of SDS02 is housed with the DC Bus connection cable at cabinet/job box outside Door 257.

6.9 Shift Engineer (SE)/Shift Technical Advisor (STA)

- 6.9.1 The SE/STA is responsible to be within operable communication range and available to the Control Room within ten minutes of call by the Control Room personnel.
- 6.9.2 **The SE/STA is responsible to maintain respirator qualifications, and if corrective eyewear is normally needed, maintain appropriate SCBA eyewear (spectacles or contact lenses) readily available.**

(3.3.13)

SHIFT TURNOVER CHECKLIST MODES 1 - 4

PAGE 1 OF 12

INSTRUCTIONS:

- 1.0 Circle YES, NO or N/A for each item in any desired order.
- 2.0 N/A items not applicable due to mode or being aligned to other train.
- 3.0 If NO is circled, then explain in the Remarks section.
- 4.0 If NO is circled on a Tech Spec (TS) required component, then refer to associated Tech Spec Action Statement and notify opposite unit, as applicable..

Mode: _____ Date: _____ Time: _____

A. SDBCS ALIGNMENT (2C02)

- | | | | |
|----|--|-----|----|
| 1. | 2CV-1002 (A S/G Upstream ADV Isol) closed | YES | NO |
| 2. | 2CV-1052 (B S/G Upstream ADV Isol) closed | YES | NO |
| 3. | 2CV-1001 (Upstream ADV) closed, HIC in Manual, permissive in Off | YES | NO |
| 4. | 2CV-1051 (Upstream ADV) closed, HIC in Manual, permissive in Off | YES | NO |
| 5. | 2CV-0301 (DDV) closed, HIC in Auto and permissive HS in Auto | YES | NO |
| 6. | 2CV-0305 (DDV) closed, HIC in Auto and permissive HS in Auto | YES | NO |
| 7. | 2CV-0302 (Bypass Vlv) closed, HIC in Auto, permissive HS in Auto | YES | NO |
| 8. | 2CV-0303 (Bypass Vlv) closed, HIC in Auto, permissive HS in Auto | YES | NO |
| 9. | 2CV-0306 (Bypass Vlv) closed, HIC in Auto, permissive HS in Auto | YES | NO |

B. SHUTDOWN COOLING (2C04)

Two independent ECCS subsystems required operable in Mode 1, 2 & 3 with PZR pressure ≥ 1700 psia. (TS 3.5.2)

- | | | | | |
|----|--|-----|----|-----|
| 1. | 2CV-5091 (LPSI Disch Header) open. | YES | NO | N/A |
| 2. | 2HS-5091 in ESF with the key removed. | YES | NO | N/A |
| 3. | 2FIC-5091 (LPSI Disch Hdr Flow) in Auto & set at ~2500 gpm. | YES | NO | N/A |
| 4. | <u>IF</u> 2TI-4793 NOT in use for SDC,
<u>THEN</u> 2TI-4793 energized AND CET alarms set at 700°F | YES | NO | N/A |

SHIFT TURNOVER CHECKLIST MODES 1 - 4

W. MSIS

- 1. IF a MSIS actuation channel becomes inoperable in 2C39 or 2C40, THEN restore the actuation channel within one hour or be in Hot Standby within 6 hours.
- 2. IF a component required for MFW isolation becomes inoperable (i.e., a Condensate, MFW, or Heater Drain pump will not trip on MSIS), THEN restore the component within 48 hours or place it in its MSIS actuated state. Otherwise be in Hot Standby in 6 hours.

COMMENTS:

If position manned, then list on shift personnel:

S/S _____	CRS _____
CRSA _____	TRO _____
CBOR _____	CBOT _____
WCO _____	AO _____
EOP _____	SE _____
DXO* _____	

*IF Original Steam Generators (OSGs) installed, THEN Dedicated Cross-tie Operator (DXO) manned.

PERFORMED BY: _____

REVIEWED BY: _____

INSTRUCTIONS

CONTINGENCY ACTIONS

■ 19. IF EITHER of the following conditions exist:

- A. EITHER SG with level less than 70 inches.
- B. RCS T_C rising in an uncontrolled manner.

THEN establish Heat Removal via Once Through Cooling as follows:

- A. Close MSIVs from Control Room.
- B. Manually actuate SIAS and CCAS.
- C. Verify ALL HPSI Cold Leg Injection MOVs open.
- D. Verify ALL available Charging pumps running.
- E. Check 4160v Vital buses 2A3 and 2A4 energized from offsite power.

E. Perform the following:

- 1) IF EITHER 4160v Vital bus energized from offsite power, THEN perform the following:
 - a) Commence aligning third HPSI pump to associated bus.
 - b) WHEN third HPSI pump alignment complete, THEN verify third HPSI pump running.
- 2) IF ANY 4160v Vital bus energized from DG, THEN perform the following:
 - a) Verify ONE HPSI pump running on train supplied by DG.
 - b) **GO TO** Step 19.G.

(Step 19 continued on next page)

PROC NO	TITLE	REV	DATE	PAGE
2202.006	LOSS OF FEEDWATER	004-02-0	6/13/00	16 of 33

INSTRUCTIONS

CONTINGENCY ACTIONS

19. (continued)

F. Verify three HPSI pumps running.

*G. Verify at least ONE HPSI pump running.

H. Open ECCS PZR Vent valve (2CV-4698-1).

I. Open LTOP/ECCS Relief Isolation valve (2CV-4740-2).

J. Maintain BOTH SG pressures 950-1050 psia using upstream ADVs or upstream ADV isolation MOVs.

K. GO TO 2202.009, Functional Recovery.

*20. Check FW flow restored to at least ONE SG by ANY of the following:

- EFW
- AFW
- MFW
- Condensate

*21. Maintain SG pressure less than 1050 psia:

A. Control SG pressure using SDBCS Bypass valves or ADVs.

B. Check at least ONE Condensate pump running.

*G. IF NO HPSI pumps running, THEN perform the following:

- 1) Verify MSIVs closed
- 2) GO TO step 19.J.

H. Open LTOP Relief Isolation valve (2CV-4741-1).

I. Perform the following:

- 1) Open LTOP Relief Isolation valve (2CV-4731-2).
- 2) Open LTOP Relief Isolation valve (2CV-4730-1).

*20. IF FW flow NOT restored, THEN RETURN TO Step 11.

B. Start ONE Condensate pump using 2106.016, Condensate and Feedwater Operations.

(Step 21 continued on next page)

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Maxoptix

12 Random
DSI w/
RPC data

12 Random
RPC w/
DSI data

Y09100121

Maxoptix

ANO Cal
std.
cal 0052

-Raw
-2pp9 DSI
calls

Resolution
Setup for
2pp9