ATTACHMENT

LIST OF OPEN ITEMS/NEW ISSUES, REVIEW BRANCH AND REVIEWER

Auxiliary Systems Branch/N. Wagner
Open Item 372(10)

Containment System Branch/J. Huang
Open Item 63

Core Performance Branch/T. L. Huang
Open Item 30

Radiological Assessment Branch/S. Block
Open Item 172

Reactor Systems Branch/E. Marinos
Open Item 213

Shearon Harris Nuclear Power Plant
DSER Open Item No. 372, Part 10 (ASB Review Question 10.4.9(10)

Will the failure of the turbine impeller of the turbine driven AFW pump cause loss of the A&B trains of the motor driven AFW pumps. Provide justification.

Response

As described in Section 10.4.9.2.3, the AFW turbine is a solid wheel type steam turbine with protection by an electrical and mechanical overspeed trip.

Section 3.5.1.1.2 describes the bases for not postulating a missile from the AFW turbine. The vendor for the AFW turbine conducts an analysis of internal missile generations and its effects. Based on worst case scenarios the turbine casing may not prevent the explusion of all postulated turbine generated missiles.

An analysis of the physical plant arrangements in conjunction with AFW turbine missile trajectories supports the conclusion that in the event of an AFW turbine missile, there will be no adverse safety consequences.

Shearon Harris Nuclear Power Plant
Draft SER Open Item 63
Supplemental Information

a) How do the revised containment spray and fan cooler start times (reference M.A. McDuffie to H.R. Denton letter dated August 11, 1983 in response to Open Item 63) affect the Peak Clad Temperature (PCT) calculation dose for the ECCS analysis?

b) In the offsite available case, is credit taken in the analysis, for RCP operation during reflood?

c) Does the 75^{o}F calculated clad temperature benefit (between offsite power being available and loss of offsite power) directly correlate with the final calculated PCT?

Response

a) The fastest post-LOCA initiation of the Containment Spray System with loss of offsite power is 42.94 seconds and the fastest post-LOCA initiation of the fan coolers with loss of offsite power is 21.62 seconds. The evaluation of the effect of the revised start times on the ECCS analysis shows a 7.8^{o}F increase in predicted PCT. The FSAR states that the PCT for the limiting case break is 2181^{o}F, therefore, a 7.8^{o}F increase can be accomodated with margin remaining to the 2200^{o}F regulatory limit.

The FSAR will be revised accordingly to reflect this information.

b) During the core reflood transient the reactor coolant pumps are assumed to be in the locked-rotor configuration in the Westinghouse Evaluation Model-independent of the availability of offsite power.

c) Yes, the benefit in calculated clad temperature at end of blowdown carries forward throughout the core reflood portion of the LOCA transient through the PCT calculation time. The offsite power available case therefore exhibits a 75^{o}F benefit relative to the loss of offsite power case.

Shearon Harris Nuclear Power Plant
DSER Open Item 30 (DSER Section 4.4.8, pages 4-47 & 4-50)

Evaluate the Loose Parts Monitoring System (LPMS) to be installed at SHNPP for conformance with Regulatory Guide 1.133 and provide a commitment to supply a final design report on the LPMS.

Response:

The loose parts monitoring system used at SHNPP is the Westinghouse Digital Metal Impact Monitoring System (MIMS). This system has been used previously at other plants, such as Virgil Summer Nuclear Station.

The following information is provided as input to the format requested.

I. SYSTEM DESCRIPTION

A. There are 10 loose parts monitoring sensors (accelerometers) located in pairs to provide for sensor redundancy. Each of the 5 pairs of sensors are located on equipment (reactor vessel, steam generators) to monitor natural collection regions of the primary system where loose parts are likely to be found. Specific location details are provided in Attachment 1.

B. Detailed sensor and preamplifier specifications are provided in Attachments 3 and 4. The sensor and charge preamplifier are designed to operate in normal containment environment.

C. Sensor mounting details are provided in Attachments 1 and 2.

D. As noted in B above.

E. A complete functional and theory-of-operating description is available in the equipment instruction manuals. Pertinent portions of these descriptions are provided in Attachment 5.

The capability exists to record information from any of the 10 sensors.

II. OPERATIONAL PROCEDURES

A Loose Parts Monitoring System as recommended by Regulatory Guide 1.133 is one element of an overall effort to prevent loose parts from either entering the reactor coolant system or breaking free from the structure within the reactor coolant system. The preoperational vibration testing of the reactor internals during hot functional testing (refer to FSAR Section 3.9.2.4), as well as the post hot functional test inspections of the reactor vessel and its internals, will verify that flow induced vibration will not produce loose parts in the reactor coolant system. Subsequent to hot functional testing, maintenance procedures for work on

the reactor coolant pressure boundary and refueling will include closeout instructions. Such instructions may include steps for parts and tool inventory and reconstruction of dismantled equipment. Personnel involved in work on the reactor coolant pressure boundary and refueling and fuel-handling operations will be trained in the importance of proper steps for closeout, tool and material inventory control, and the need for reporting loose objects known or suspected to have been dropped into the reactor coolant system.

During operation of the SHNPP, the MIMS will be used to detect the presence and determine the significance of objects impacting on the reactor coolant system.

The subsections which follow decribe the preoperational and startup testing, normal operations, and surveillance for the SHNPP.

A. Preoperational and startup testing

The initial testing of the system after installation will include the following tests and checks:

1. Signal conditional calibration: each channel contains a signal conditioner which is calibrated to operate with the accelerometer installed in its channel and to accommodate the alarm levels and the typical background noise level.

2. Calibration of accelerometers: this calibration will be performed with the sensor removed from the reactor vessel or steam generator. This calibration consists of mounting the accelerometer on a vibration calibrator, vibrating the accelerometer at a predetermined frequency and acceleration, and measuring the output of the channel with a voltmeter. Such a test will also be used for an operational check of a channel subsequent to fuel load and at refueling or maintenance outages.

3. System tests: during the startup of the MIMS, the system will be tested with the accelerometer installed. The test will be performed by impacting the outside of the reactor vessel or steam generator and observing the response at the MIMS cabinet. This test will be performed under cold shutdown conditions.

4. Alarm level: An initial alarm level will be selected prior to power operation based on the recommendations of the manufacturer. During power escalation testing, the background noise level will be monitored to determine if the alarm level should be modified to avoid unnecessary alarms.

B. Normal operation

Activities anticipated during normal operation include diagnostic tests of the MIMS, channel checks of the sensor channels, response to events identified by the MIMS as impacts, and reinitialization of the MIMS should power be interrupted for a prolonged period of

time. The other activities which may be performed during normal operation include modification of the alert setpoint of each of the sensor channels, readout of data on impact events identified by the MIMS, and aural monitoring and recording of each of the sensor channels. The diagnostic tests include internal checks of the circuit and logic used to analyze sensor signals, checks of channel integrity and internal CPU power supply, and checks of the keyboard and displays.

These can be performed automatically by the MIMS or manually initiated. The channel integrity test sequentially monitors the voltage output of each channel; if the voltage of the channel is not within the proper range, the channel is assumed to be inoperable by the MIM's CPU. This channel integrity test, whether initiated manually or automatically, will be used to satisfy the channel check recommended by Regulatory Guide 1.333, Section C.3(2)(b).

In addition, the MIMS wil include a functional check of the logic circuits used to determine if the noise contains the signature of an impact. This test will be conducted on the components within the MIMS cabinet in the control room and would exclude "functional testing" of the sensor, the associated charge amplifier, and cabling. CP&L considers it to be impractical to inject a "test signal" at a sensor; this would require an impact on the reactor vessel or a steam generator. CP&L also considers it impractical to test the charge amplifier; this would require containment entry and installing a temporary accelerometer lead to the charge amplifier to insert an appropriate "test signal." The integrity cabling to the MIMS cabinet is determined from the channel check described above. Based on these considerations, CP&L believes the functional test, as described above, is adequate to determine the operability of the MIMS.

Additional surveillances which will be performed are a weekly aural monitoring of the operable channels and a quarterly measurement of the background noise level on each channel.

Appropriate procedures or qualified personnel using technical information provided by the manufacturer will be used to perform manual activities.

C. Response to alarms

As discussed in Section I, upon detection of noise which matches the signature programmed into the MIMS for a loose part, the MIMS will automatically record the channel number, date, time, and maximum amplitude for the event. An indication above the setpoint will actuate an alarm on the main control board. Data on events exceeding the alarm point are retained for up to 48 hours and the data can be obtained from the MIMS by a display or a printer. The MIMS is designed to preclude alarms during operation of the rod drive system; however, other routine events or anticipated transients may cause alarms. Operating procedures will provide instruction for the response to an alarm. The procedures will

direct the operators to review other indications for integrity of the reactor coolant pressure boundary and the integrity of the fuel record information on the status of the reactor coolant system at the time of the alarm, note other events such as pump starts or transients which were concurrent with the alarm, and provide this information in an alarm event report to the plant's Technical Support Group by the beginning of the next working day.

The Technical Support Group is responsible for diagnosis of the alarms. The purpose of the diagnosis is to correlate diverse information from sources such as process instrumentation with the MIMS alarm and determine if a loose object exists. The diagnosis of an alarm event report may include review of any additional alarms, analysis of the background noise, comparison of the background noise with earier measurements, and review of the status of the reactor coolant system concurrent with the alarm.

Additional factors which may be used to confirm the existence or absence of a loose object are the geometry of the collection area being monitored, flow conditions in the collection areas, impact acceleration, and the location and number of channels which show concurrent events. Records of alarm report reviews will be maintained for future reference.

If the diagnosis concludes that a loose object is present, the significance of the object with respect to the integrity of the reactor coolant system and the fuel will be determined.

Reports of the determination that a loose object has been identified will be made to the NRC in accordance with the reporting requirements of the Technical Specifications for the SHNPP.

III. LICENSEE EXPERIENCE WITH LPMS

Since SHNPP is not an operating plant, no prior operating experience is available with this system.

IV. EVALUATION FOR CONFORMANCE TO REG. GUIDE 1.133

The following items address each regulatory position item noted in Section C of Regulatory Guide 1.133.

<u>C.l.a Sensor location.</u> Sensors will be, as described in Attachment 1, located to monitor natural collection regions. SHNPP complies with C.l.a.

<u>C.l.b System sensitivity.</u> The Westinghouse system has been tested extensively in actual operation as well as in the laboratory. The MIMS is capable of detecting kinetic energy of less than .125 foot pounds at distances greater than 18 feet from the transducer. Tests presently are performed with .25, .5, 1.0, and 2.0 pound masses at various heights. A future test, incorporating larger masses (to 30 pounds) is presently under consideration. SHNPP meets the intent of C.l.b.

C.1.c Channel separation. Each instrumentation channel (sensor, hardline cabling, and preamplifier) within containment is electrically and physically independent. Independence is maintained through the signal conditioners to the connection panel, outside containment, which is readily accessible during full-power operation. SHNPP complies with C.1.c.

C.1.d Data acquisition system. The MIMS continuously monitors all active channels and provides for the recording of all sensor signals in digital form when an alert level is exceeded.

The processed digital (impact) data is stored in non-volatile memory and printed out every 24 hours or on operator request. The system also provides immediate audio and visual monitoring of all impact signals. SHNPP complies with C.1.d.

C.1.e Alert level. The system incorporates an adjustable alert level for each sensor. Continual monitoring provides for actuation of the alarm system if any impact above the preset alert level is detected. Criteria for establishing an alert level are discussed in Attachment 5. SHNPP complies with C.1.e.

C.1.f Capability for sensor channel operability tests. The MIMS provides for periodic (online) channel check to verify operability, as summarized below.

1. Audio: each channel may be aurally monitored to verify presence of (normal) background noise.

2. Raw signals: are available at the connection panel for frequency or time domain analysis.

3. Self-test: implemented on operator intervention.

   a. Module test: a simulated impact signal is sent to each detection network. The network must respond with the proper amplitude to pass the test.

   b. Integrity test: the voltage sent to the charge preamplifiers is measured. If the voltage is out of tolerance (due to misadjusted or defective signal conditioner, field cable, or charge preamp), that channel is displayed for appropriate action.

4. Channel functional testing consists of the tests described in Sections 3a and 3b.

5. Channel calibration is performed at the signal conditioner by using the system's internal oscillator. At convenient intervals (i.e., refueling outage) various weights should be used to verify alarm detection through the entire system. (See II.B for further discussion of the above items.)

SHNPP meets the intent of C.1.f.

C.1.g Operability for seismic and environmental conditions. The MIMS was designed for Operating Basis Earthquake (OBE) conditions. All MIMS hardware has been procured under engineering design specifications that require performance under normal, non-accident, environmental conditions. Field exeriences have confirmed the MIMS adequacy under normal operating radiation, vibration, temperature, and humidity environments at operating plants.

The sensor is hermetically sealed and employs stainless steel sheath and Rexolite radiation-resistant insulator at the connector. A NEMA-4 enclosure is employed for preamp components and connectors. SHNPP meets the intent of C.1.g.

C.1.h Quality of system components. This item recommends that a replacement program be established for those parts that are anticipated to have a limited service life. The only components of the MIMS that are inaccessible during normal operations are the sensors, the charge amplifiers, and the cable inside containment. With the exception of cabling, the balance of the system is located in the control room and is readily accessible for maintenance or part replacements. CP&L will evaluate the failure rate of the components inside containment when a suitable amount of operating experience is attained at SHNPP. Replacement schedules will then be defined such that there is a high confidence that at least one sensor channel on each collection area will be available until the end of the next fuel cycle. Replacements of items in the MIMS cabinet will be done on an as-needed basis. This approach is considered acceptable because the MIMS is not required to assure the integrity of the reactor coolant pressure boundary or the integrity of the fuel. SHNPP complies with C.1.h.

C.1.i System repair. During plant operating conditions, all system equipment that is outside of containment would be normally accessible, i.e., all equipment except sensors, preamplifiers, and containment cabling. This equipment has easy access and allows for replacement and repair of malfunctioning components. Instruction manuals provide information on troubleshooting, drawings and diagrams, and replacement parts.

All equipment outside containment will be in low radiation areas. In-containment items (sensors, preamplifier) will have capability for dismantling and installation. SHNPP complies with C.1.i.

C.2 Establishing the alert level. The alert level is established during baseline testing of the MIMS. The system uses an impact algorithm to discriminate impact signals from normal hydraulic, mechanical, and electrical noise generated by an operating plant. Potential false alert signals resulting from plant maneuvers are minimized by the following:

1. Control rod inhibit: automatically inhibits alarm actuation during rod stepping.

2. Remote inhibit: may be switched manually to inhibit alarm detection

during plant testing.

3. Test position (keylock switch): eliminates (remote) alarm signals by mechanically defeating signals sent to the remote alarm.

The MIMS alert logic provides for the alert level to be a function of normal steady-state operating conditions. In addition, the system automatically compensates for the different levels of background noise found at each sensor location. The patented floating setpoint feature is unique to the Westinghouse Digital Metal Impact Monitoring system. Procedures for responding to an alarm will require that plant transients concurrent with an alarm are noted in the report of the alarm (refer to Item II.C above). SHNPP complies with C.2.

C.3 Using the data acquisition modes. The philosophy of the system is to continuously provide online detection of loose parts. The self-test feature (actuated automatically every 24 hours and manually at operator intervention) performs channel operation checks.

Aural monitoring of all channels is possible with operator intervention. Outputs from the signal conditioners are readily available so that measurement of backgrond noise can be performed. The only calibration required by the system is at the signal conditioner. An internal oscillator is provided to adjust the amplifier to design specifications. Impact detection may be verified by impacting the external surface with specific weights from known distances.

The automatic data acquisition mode is discussed in Section II.C. The alarm points established for the MIMS during startup testing will be reported to the NRC in the startup report required by the SHNPP Technical Specifications. The surveillance performed on the MIMS will be as specified in the SHNPP Technical Specificaton; the surveillance proposed is as described in Section II.B above. The response by plant personnel to an alarm condition is discussed in Section II.C above. SHNPP meets the intent of C.3.

C.4 Content of Safety Analysis Reports.

C.4.a Refer to Attachment 1.

C.4.b Refer to Attachment 5.

C.4.c The only expected major source of extraneous noise during normal steady-state operation is the movement of the control rods.

C.4.d Acquisition of quality data is assured by the location of the sensors, proper calibration and testing of the MIMS, and the ability of the MIMS logic to discriminate noice which is not indicative of a metallic impact on the reactor coolant pressure boundary.

C.4.e Refer to Attachment 5.

C.4.f Refer to C.5 below.

C.4.g FSAR Section 7.5 illustrates process indication that will be available in the plant and recorded. This data will be used as appropriate to determine if there is a correlation with an alarm on the MIMS and other system parameters. A correlation may substantiate the validity of the alarm or confirm the integrity of the reactor coolant system and fuel. Refer to Section II.C above for additional discussion.

C.4.h Refer to Section II.A above.

C.4.i Refer to Chapter 12.0 of the FSAR for a description of the ALARA program for SHNPP. As discussed above, to the extent practical components of MIMS are located in accessible areas. The notable exceptions are those items which must be attached to, or in close proximity to, the the reactor coolant system.

C.4.j The training program for licenses operators will address the operation of the MIMS.

C.4.k Refer to C.1.g.

SHNPP meets the intent of C.4.

C.5 Technical specification for the Loose Part Detection System. The proposed Technical Specifications for SHNPP are listed in Chapter 16 of the FSAR. CP&L is currently developing a revision to the FSAR to address Rev. 4 of the NRC Standard Technical Specifications for Westinghouse Nuclear Steam Supply Systems. This revision will address the MIMS. The revision is scheduled to be submitted to the NRC staff in the second quarter of 1984. SHNPP meets the intent of C.5.

C.6 Notification of a loose part. The notification of the confirmation of a loose part will be made to the NRC in accordance with the Technical Specifications for SHNPP. SHNPP complies with C.6.

ATTACHMENT 1

Digital MIMS: Installation Instructions (Sensors)

The following is the procedure for locating the Digital Metal Impact Monitoring System sensors.

STEAM GENERATOR SENSOR LOCATION PROCEDURE

1. Locate the centerline of the tube sheet. After locating the centerline of the tube sheet, measure 30 inches up on the manway side of the hot leg of the steam generator. The secondary side transducer is to be located at this elevation no less than 10 degrees and no more than 90 degrees from the centerline of the tubeline of the steam generator.

2. The primary side transducer is to be located on the manway side no less than 10 degrees and no more than 90 degrees from the centerline of the tubeline 30 inches down from the center of the tube sheet.

3. Items one and two above must be vertically aligned with respect to each other.

4. The sensor location is to be chosen to maximize the distance to any discontinuities such as nozzles, penetrations, or weld seams. The distance to the discontinuity should be measured from the sensor loction to the outside edge of the reinforcement of the opening.

REACTOR VESSEL SENSOR LOCATION PROCEDURE

(Top)

1. Locate the three lifting lugs on the Reactor Vessel Head. Select the two most readily accessible. After selecting the two lifting lugs to be used, locate a point on the side of the lug that will allow a 1.250 inch spotface that does not interfere with the lifting rod connected to the lug. At this point the sensor will be located. Do the same on the other previously selected lifting lug.

(Bottom)

1. Locate two instrument tubes on the bottom of the vessel that are readily accessible.

2. Use the mounting hardware supplied to mount the sensors on these tubes.

TRANSDUCER MOUNTING NOTES

1. Westinghouse provides a reactor vessel bottom transducer mount for attachment of each R. V. bottom-mounted transducer. These mounts are to be attached to the instrumentation tubes by tightening the clamping

bolts of the mount to a torque of 185 ± 5 inch-pounds. The accelerometer is then attached to the mount and tightened to a torque of 100 inch-pounds.

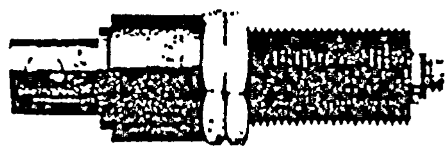
2. The customer is responsible for preparing the surface and mounting the R.V. top and steam generator mounted accelerometers. A 0.25-inch-28UNF-2B x 0.75-inch minimum, full-thread hole is required at each transducer location. Additionally, a 1.25-inch diameter spotface surface is required. Finish on the spotface surface should be 32 microinches. The threaded hole should be perpendicular to the surface within $\pm$.005 inch.

3. Care must be taken to prevent damage to the extension cable. A minimum bend radius of 3 inches is required.

UNHOLTZ-DICKIE CORPORATION

VIBRATION TEST EQUIPMENT

Model RCA-2TR Remote Charge Preamplifier



The Model RCA-2TR is a two-wire Remote Charge Preamplifier designed for use with any of the Unholtz-Dickie Series 22 Instruments. The RCA-2TR combines the advantage of a very low noise level with the convenience and simplicity of a conversion gain that is independent of normal input cable lengths. The very low output impedance of the RCA-2TR permits long cable runs of standard RG/U coaxial cable to the Series 22 Instrument without reduction in signal to noise ratio due to cable-generated-noise, cable-pickup, or cable-loading effects. The RCA-2TR is intended for operation with piezoelectric type transducers, and receives its power from the Series 22 Instrument, or other suitable constant current source.

In addition, the RCA-2TR is rated for continuous operation to 100°C with minimal degredation in performance. For operation over this wide temperature range, a constant current power supply having a voltage capability of 30 V DC nominal is required. Bias voltage readjustment is rarely necessary, even at the 100°C extreme. The RCA-2TR is also radiation-resistant and has been used successfully in nuclear power plants.

PHYSICAL DESCRIPTION

INPUT CONNECTOR:
Micro 33-01

OUTPUT CONNECTOR:
BNC with Rexolite or Halar insulator

DIMENSIONS:
.15 inches overall length
.5 inches body length
.625 inches body diameter

BODY MATERIAL:
Stainless Steel #304

BULKHEAD MOUNTING THREAD:
1/2-28 NEF (two mating HEX nuts supplied with unit).

See Performance Specifications on back page.

PERFORMANCE SPECIFICATIONS

CONVERSION GAIN:
1 mV/pC + 1, -3% (typically 0, -2%)

GAIN CHANGE:
Less than 1% for source capacitance up to 1500 pF (typically 2500 pF). Typically less than 1% from 20° C to 100° C with fixed source capacitance.

INPUT IMPEDANCE:
Typically 0.25 μF shunted by 22 megohms (decreases slightly at 100° C).

OUTPUT IMPEDANCE:
Less than 50 ohms (typically 25 ohms)

MAXIMUM OUTPUT VOLTAGE:
5V peak for the following bias voltage conditions:
- 10 - 14 V DC (obtained from standard D22 instrument 4 mA supply when RCA-2TR operating temp. is within 40°F to 100°F range)
- 10 - 23 V DC (supplied by 4 mA constant current source with 30 V DC nominal voltage capability, permitting RCA-2TR operation over entire rated temp. range).

MAXIMUM OUTPUT CURRENT:
1 mA when operated from a 4 mA source.

FREQUENCY RESPONSE:
±2% from 0.2 Hz to 50 kHz with input shunted by no less than 10 megohm at 20° C (±2% at 2 Hz at 100° C).

OPERATING TEMPERATURE:
5° C to 100° C (40° F to 212° F)

NOISE:
.005 pC rms + .001 pC rms/1000 pF source capacitance, referred to input, for 10 Hz to 20 kHz BW. Low frequency noise components increase somewhat at 100° C.

POWER SUPPLY:
Series 22 Instrument provides 4 mA constant current source with 21 V DC nominal voltage capability, allowing full 5 V peak output within preamp temperature range of 40°F to 100°F. RCA-2TR operation over entire rated temperature range requires 4 mA constant current source with 30 V DC nominal voltage capability.

UNHOLTZ-DICKIE CORPORATION
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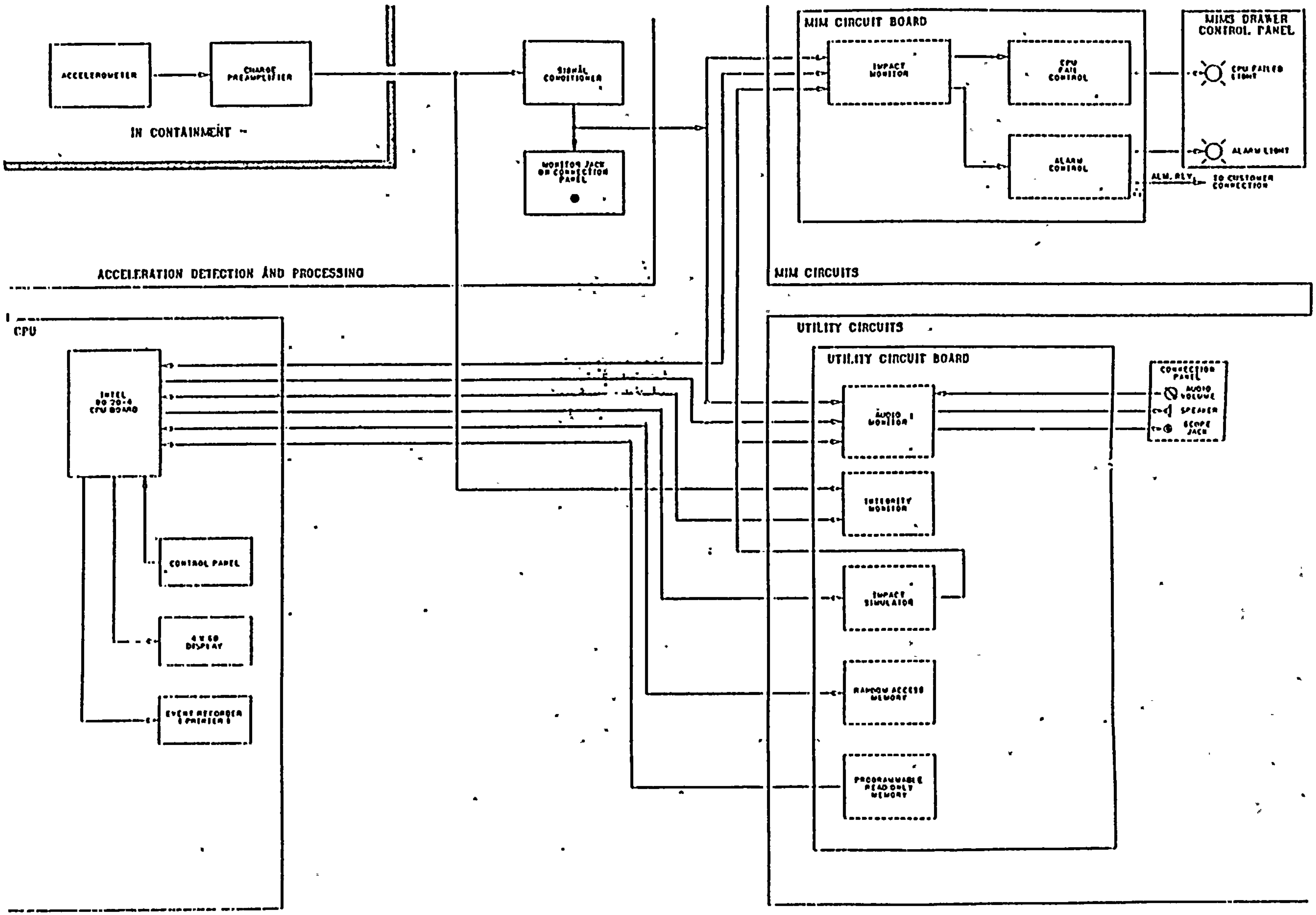

Figure 1 Block Diagram of DHIMS

ATTACHMENT 5

Equipment Description

PURPOSE

The Digital Metal Impact Monitoring System (MIMS) detects the presence of metallic debris in the Reactor Coolant System (RCS) of pressurized water reactors when the debris impacts against the internal parts of the RCS.

Metallic impacts within the RCS generate a pressure wave within the coolant. The pressure wave is detected as an acceleration by strategically placed accelerometers that are part of the MIMS. Other sources of pressure waves, such as pumps starting and control rods working, are also present in the RCS. The MIMS differentiates between pressure waves caused by metallic impacts and other pressure waves by comparing the detected acceleration to a typical signature of a metallic impact.

Pressure-wave-caused accelerations that are not caused by metallic impacts are ignored. Detected metallic impacts are recorded on the system's event recorder and initate an alarm indication.

FUNCTIONAL DESCRIPTION

The MIMS comprises three digital circuit boards housed in a common drawer with associated controls, indicators, and power supplies; 10 remotely located accelerometers and related signal processing devices; and a connection panel with a loudspeaker and thermal printer. The accelerometers and their related signal processing devices are mounted in pairs to maintain the impact monitoring function in the event that an accelerometer fails in service.

Figure 1 shows the major functional subsystems of the MIMS.

Pressure waves in the reactor coolant are detected as accelerations of the vessel external wall by strategically placed accelerometers. A charge preamplifier associated with each accelerometer provides a low-impedance representation of the detected acceleration.

A signal conditioner is provided for each charge preamplifier. The signal conditioner provides energizing current for the preamplifier, filters the preamplifier output to remove high frequency noise and signals outside the frequency range of interest (above 20 KHz), and scales the received accelerometer signal. The scaled and filtered acceleration signal from the signal conditioner is an input to the impact monitor on the Metal Impact Monitor (MIM) circuit board, to the audio monitor on the utility circuit board, and to a monitor jack on the connection panel.

The signal conditioners also supply an integrity signal, which represents the current supplied to the charge preamplifier, to the integrity monitor, or the utility board for performance monitoring purposes.

There are five impact monitors on the MIM circuit board to accommodate five pairs of accelerometers mounted on the RCS. Each impact monitor contains its own microprocessor and functions under control of the Central Processor Unit (CPU). The acceleration signal from one of the channels, or a simulated signal from the impact simulator, is selected under CPU control.

The frequencies and relative amplitude of the selected signal are made available as inputs to the impact monitor microprocessor, which continuously inspects the signal for the characteristics of a metal impact. If it is determined that the accelerometer signal represents a metal impact, the microprocessor communicates this to the CPU along with the amplitude of the detected impact. The CPU then commands the alarm control which lights an alarm lamp. The lamp remains lit until acknowledged by manual depression of the alarm reset pushbutton.

The audio monitor on the utility circuit board receives acceleration signals from all 10 channels, and a simulated acceleration signal from the impact simulator. One of these 11 signals is selected by a command from the CPU. The selected signal is available for aural monitoring at the connection panel loudspeaker, or it may be observed on an oscilloscope connected to the scope jack provided. An audio volume control on the MIMS drawer front panel gives control of the signal level on the loudspeaker.

The impact simulator on the utility circuit board operates under control of the CPU to produce simulated acceleration signals for use in testing the MIMS. On command from the CPU, the simulator creates an output signal with frequency and amplitude as required by the CPU. Thus, the impact simulator can simulate normal background accelerations as well as impacts of any desired character. The simulated acceleration signal is available as an input to the impact monitor and the audio monitor. Either or both of these monitors will select the simulated input when commanded by the CPU. The operation of the impact monitor and audio monitor with simulated accelerations is identical to operation with an accelerometer output signal.

A deadman timer is provided in each impact monitor. This timer requires updating from the CPU periodically (about every 2 minutes) as an indication to the impact monitor microprocessor that the CPU is still functioning. The CPU software requires that the deadman timer be updated by the CPU every minute. When the deadman timer times out in any impact monitor, it sends a CPU fail indication to the CPU fail control. The CPU fail control lights the CPU FAILED indicator lamp on the MIMS drawer front panel and disables the audio monitor.

The CPU is a single-board computer that controls the operation of the MIMS. A printer, display and keyboard provide input and output capability for the CPU board.

An event recorder (Data-Intersil printer) is mounted in the front of the connection panel. The printer functions under control of the CPU to provide a hard copy record of the functioning of the MIMS. An operator can request a printout of an event that resulted in an alarm indication. At the end of each day, the CPU automatically commands a printout which summarizes the day's activity. The summary lists all detected impacts and their intensity and duration. A self test is performed of the MIMS under CPU control at this time

and the results of the self test are also recorded by the printer.

The CPU has a Burroughs Self Scan II alpha-numeric display which has six lines of 40 characters and provides current data on the status of the system, and displays the parameters of the most recent event detected by the MIMS. Operator-initiated requests to the CPU can call up status and event reports stored in memory for display. Whenever an operator command is entered in the system, the CPU board controls the display to present the changed control status, which remains until cancelled or replaced with subsequent data.

The keyboard installed in the CPU provides a means of operator control over the MIMS. The keyboard provides two sets of keys: one on the left with 15 keys for inputting numerical values and one on the right with 20 keys for inputting control commands. Depressing a control key causes the CPU board to command a status display for that function to appear on the display. Modifications can be made to the display parameters by entering numerical data with the left set of keys. Depressing ENTER on the left set of keys loads the display parameters into the CPU board memory. Two print keys (PRINT DISPLAY and PRINT TIME) do not affect the CPU board operation or the display but merely cause it to command the printer to print the respective message.

Shearon Harris Nuclear Power Plant (SHNPP)
Draft Safety Evaluation Report (DSER)
Radiological Assessment Branch
Revised Response Open Item 172 (DSER Section 12.5.1, Page 12-13

CP&L has stated that the Manager, Environmental and Radiation Control will implement and enforce the SHNPP radiation protection support program. Therefore, the individual who fills the position of Manager, Environmental and Radiation Control shall have the qualifications identified in Regulatory Guide 1.8 for the Radiation Protection Manager. Provide a commitment to Regulatory Guide 1.8.

Response:

The individual filling the Manager - Environmental and Radiation Control will satisfy the qualifications given in Regulatory Guide 1.8 for the Radiation Protection Manager. The resume for the Environmental and Radiation Control Manager will be forwarded to the NRC when it is available. Carolina Power & Light Company considers this item to be confirmatory.

Shearon Harris Nuclear Power Plant
Draft SER Open Item 213

The applicant indicates that during cold shutdown one reactor makeup pump will be locked out, thus increasing the time before operator action is required to interrupt inadvertent boron dilution. The time increase from the pump lockout does not appear sufficient to meet the SRP requirement of 15 minutes.

Response:

The analysis of a boron dilution event in the cold shutdown condition is presented in FSAR section 15.4.5.2. This analysis shows that for a starting K_{eff} of .99 and maximum dilution rate of 321 gallons per minute (runout flow of two reactor water makeup pumps operating) the resultant time to criticality is 4.14 minutes (refer to section 15.4.6.3(b)).

As stated previously CP&L commits to lockout one reactor water makeup pump. Additionally CP&L commits to maintain a minimum shutdown margin of 2% delta k/k while in the cold shutdown mode. Assuming a conservatively high boron worth of -12.5 pcm/ppm, the operator will have more than 15 minutes from an alarm to initiate the necessary manual action to terminate the event before uncontrolled criticality is achieved. Thus for any initial credible boron concentration and with an initial shutdown margin of 2% delta k/k the applicant will meet the SRP requirement of 15 minutes in the cold shutdown mode.

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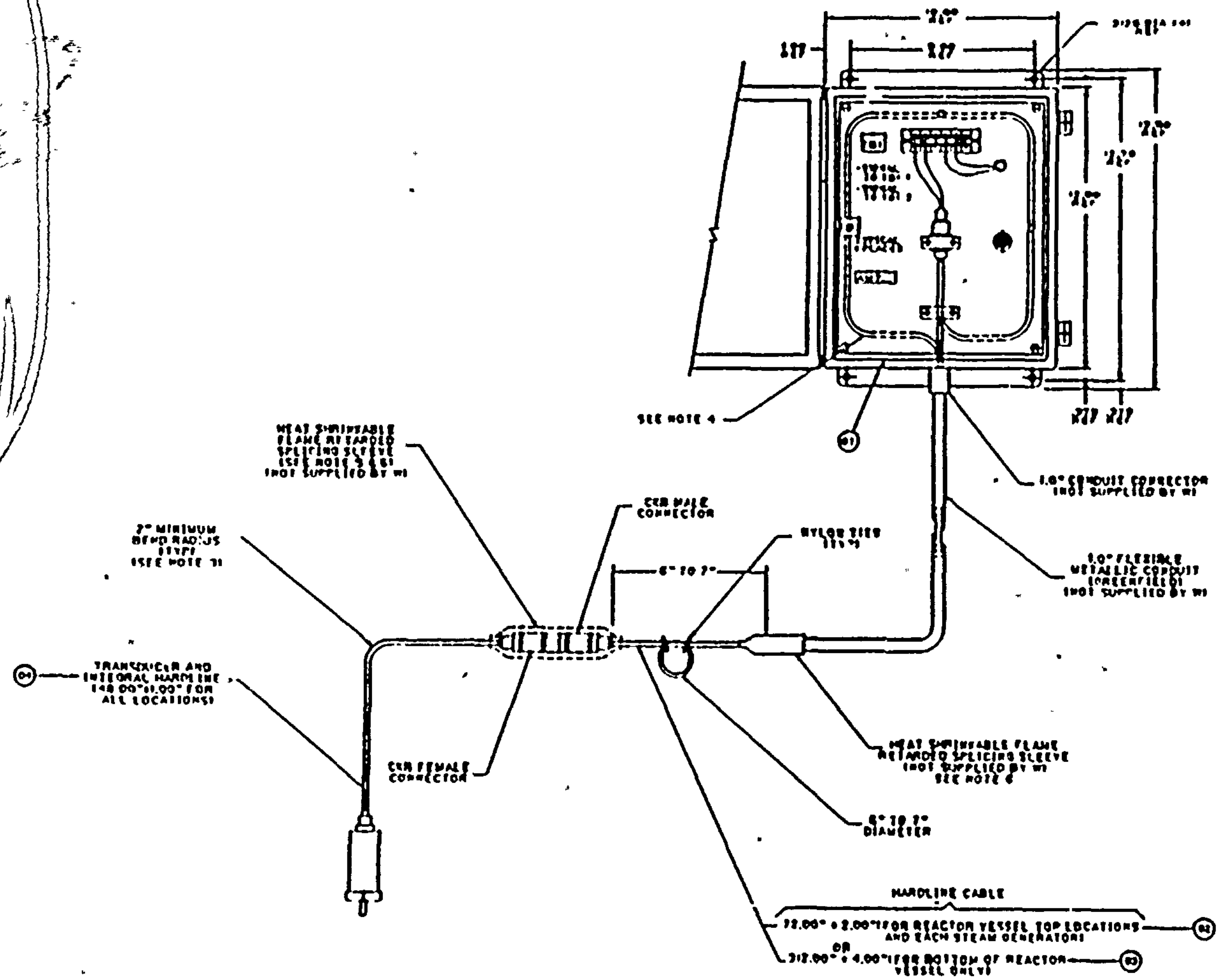
ATTACHMENT II



NOTES:

1. W PROVIDES A REACTOR VESSEL BOTTOM TRANSDUCER MOUNT FOR ATTACHMENT OF EACH R.V. BOTTOM MOUNTED TRANSDUCER. THESE MOUNTS ARE TO BE ATTACHED TO THE INSTRUMENTATION TUBES BY TIGHTENING THE CLAMPING BOLTS OF THE MOUNT TO A TORQUE OF 195 ± 5 INCH-POUNDS. THE ACCELEROMETER IS THEN ATTACHED TO THE MOUNT AND TIGHTENED TO A TORQUE OF 200 ± 5 INCH-POUNDS, USING A 1.00 INCH CROWFOOT ADAPTER.

2. THE CUSTOMER IS RESPONSIBLE FOR PREPARING THE SURFACE AND MOUNTING THE R.V. TOP AND STEAM GENERATOR MOUNTED ACCELEROMETERS. A 0.250 INCH-28UNF-2B X 0.450 INCH MINIMUM, FULL-THREAD HOLE IS REQUIRED AT EACH TRANSDUCER LOCATION. ADDITIONALLY A 1.250 INCH DIAMETER SPOT-FACE SURFACE IS REQUIRED. FINISH ON THE SPOT-FACE SURFACE SHOULD BE 32 MICROINCHES. THE THREADED HOLE SHOULD BE PERPENDICULAR TO THE SURFACE WITHIN ±.005 INCH.

3. CARE MUST BE TAKEN TO PREVENT DAMAGE TO THE HARDLINE CABLE. A MINIMUM BEND RADIUS OF 2 INCHES IS REQUIRED.

4. WHEN THERE IS EXCESSIVE HARDLINE CABLE LEFT AFTER INSTALLATION COIL HARDLINE CABLE ASSY IN THE ENCLOSURE (DETAIL SHOWN DOTTED) SECURE HARDLINE CABLE TO THE TIE WRAP BLOCKS PROVIDED USING NYLON TIE WRAPS.

5. USE HEAT SHRINKABLE FLAME RETARDED SPLICING SLEEVE OVER CONNECTOR ASSY AFTER CONNECTOR IS MATED.

6. RECOMMENDED HEAT SHRINKABLE FLAME RETARDED WIRE AND CABLE SPLICING SLEEVES (RAYCHEM CORP. TYPE WCSF UNCOATED).

7. GROUP 1 (4 LOOP PLANTS) GROUP 2 (3 LOOP PLANTS) AND GROUP 3 (2 LOOP PLANTS)

IDENTIFICATION PLATE LEGEND

WESTINGHOUSE PROPRIETARY DATA

Westinghouse Electric Corporation

DVIMS
RECOMMENDED INCONTAINMENT EQUIPMENT INSTALLATION

E 1606E41

8311040065

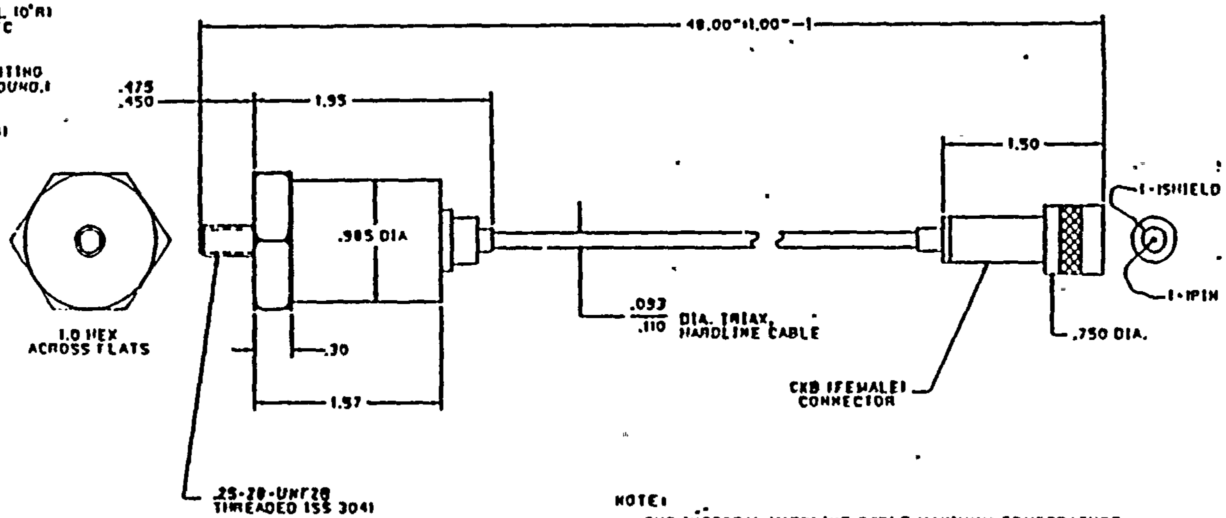
DMIMS ACCELEROMETER ASSEMBLY TECHNICAL SPECIFICATIONS

1. CHARGE SENSITIVITY	> 20 PC/g @ 70°F 100HZ
2. TRANSDUCER CAPACITANCE	< 2000 pf
3. TOTAL ASSY CAPACITANCE	< 2500 pf
4. MOUNTED RESONANCE FREQUENCY	> 30 KHZ
5 FREQUENCY RESPONSE	±5% OF REFERENCE VALUE ESTABLISHED AT 100HZ OVER THE RANGE ROOM 10HZ TO 10KHZ
6. AMPLITUDE LINEARITY	±1% OF BEST STRAIGHT LINE
7. CHARGE TEMPERATURE RESPONSE	±8% OF REFERENCE VALUE ESTABLISHED AT 70°F OVER THE RANGE FROM 0°F TO 625°F
8. TRANSVERSE SENSITIVITY	3% MAXIMUM
9. INTERNAL RESISTANCE (BETWEEN CONDUCTORS)	> 20,000 MΩ AT ROOM TEMP. > 10 MΩ AT 600°F (TESTED AT 10VDC)
10. INSULATION RESISTANCE (BETWEEN CONDUCTORS & SHIELD)	> 20,000 MΩ AT ROOM TEMP. > 10 MΩ AT 600°F (TESTED AT 10VDC)
11. ACCELERATION RANGES:	
VIBRATION	200 g(PEAK) MAXIMUM
SHOCK	TO 1000 g(PEAK)
12. TEMPERATURE RANGE	-65°F TO +625°F (NOTE 1)
13. ENVIRONMENTAL	HERMETICALLY SEALED, CASE WELDED, CONNECTOR BRAZED
14. ACOUSTIC SENSITIVITY	< 0.1 g AT 155 dB
15. NUCLEAR RADIATION	GAMMA FLUX-200 R/HR (TOTAL 10^{8}R) NEUTRON FLUX-1X10^{4} N/CM²/SEC
16. STRAIN SENSITIVITY	0.0005 g/μE
17. PYROELECTRIC SENSITIVITY	< 0.07 g/°F
18. STRAY VOLTAGE SENSITIVITY	< 0.01 g/VOLT (BETWEEN MOUNTING SURFACE AND AMPLIFIER GROUND.)
19. PRESSURE	75 PSIG
20. WEIGHT	< 150 GRAMS
21. CASE MATERIAL	STAINLESS STEEL (ASTM #304)

ACCELEROMETER TESTING REQUIREMENTS

1. FREQUENCY RESPONSE	FROM 50HZ TO 10KHZ
2. INSULATION AND INTERNAL RESISTANCES	AT 70°F AND 600°F
3 CHARGE TEMPERATURE RESPONSE	AT 70°F, 500°F AND 600°F
4. CHARGE SENSITIVITY	AT 70°F
5 RESONANCE FREQUENCY	
6 TOTAL ASSY CAPACITANCE	AT 70°F, 500°F AND 600°F

NOTE:
PROVIDE WESTINGHOUSE ELECTRIC CORPORATION WITH TEST DATA FOR EACH ACCELEROMETER. THIS DATA SHALL ALSO INCLUDE SERIAL NUMBER AND PURCHASE ORDER NUMBER.



NOTE:
THE INTEGRAL HARDLINE CABLE MAXIMUM TEMPERATURE WILL BE 500°F OVER THE FIRST FOOT OF LENGTH FROM THE ACCELEROMETER END, DECREASING TO 150°F AT THE CONNECTOR.

WESTINGHOUSE PROPRIETARY DATA

Westinghouse Electric Corporation

DMIMS ACCELEROMETER DETAILS

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